



Minutes of the **Forty Second (42nd)** meeting of the Senate held on **16.11.2012 (Friday)** at **3.30 p.m.** and the adjourned meeting held on **19.11.2012 [Monday]** at **11:00 AM** in the Conference Room of the Institute.

Following members of the Senate attended the meeting:

1.	Prof. P. Chakrabarti	-	Director / Chairman
2.	Prof. S. K. Agrawal	-	Member
3.	Prof. R. K. Srivastava, CED	-	Member
4.	Prof. P. R Agrawal	-	Member
5.	Prof. S.C Prasad	-	Member
6.	Prof. P.K. Mishra	-	Member
7.	Prof. Nirjhar Roy	-	Member
8.	Prof. S.K. Duggal	-	Member
9.	Prof. Dinesh Chandra	-	Member
10.	Prof. Vineeta Agarwal	-	Member
11.	Prof. R.K. Srivastava, MED	-	Member
12.	Prof. Rajeev Tripathi	-	Member
13.	Prof. M.M. Gore	-	Member
14.	Prof. K.K. Shukla	-	Member
15.	Prof. Anuj Jain	-	Member
16.	Prof. N.D. Pandey	-	Member
17.	Prof. R.P.Tiwari	-	Member
18.	Prof. R. K. Singh	-	Member
19.	Prof. H.N. Kar	-	Member
20.	Prof. Vinod Yadav	-	Member
21.	Prof. P.K.Dutta	-	Member
22.	Prof. P.P. Sahay	-	Member
23.	Prof. R. D. Gupta	-	Member
24.	Prof. A.D. Bhatt	-	Member
25.	Prof. Sanjay Chaubey	-	Member
26.	Prof. Mahendra Kumar	-	Member
27.	Prof. Ramesh Kumar Tripathi	-	Member
28.	Prof. R. C. Vaishya	-	Member
29.	Prof. R.S. Yadav	-	Member
30.	Prof. V.K.Srivastava	-	Member
31.	Prof. R.P. Singh	-	Member
32.	Dr. Sarvesh K. Tiwari	-	Registrar / Secretary
33.	Dr. Shivesh Sharma, Head, Deptt. of Biotechnology	-	Special Invitee
34.	Dr. Shiv Datt Kumar, Head, Deptt. of Mathematics	-	Special Invitee

The Chairman, Senate extended warm welcome to the members and thanked them for taking their time out to attend the meeting.

Agenda wise proceedings are as follows :

Item No. 42.01 : To confirm the minutes of the Forty First [41st] Meeting of the Senate held on 13.07.2012.

Resolution : The Senate confirmed the minutes of its Forty First [41st] meeting held on 13.07.2012, as circulated.

Item No. 42.02 : To consider the action taken on decisions taken in the 41st meeting of the Senate held on 13.07.2012.

Resolution : The Senate noted the action taken on the decisions taken in its 41st meeting held on 13.07.2012, as circulated.

Item No. 42.03 : To consider the list of degree recipients for B.Tech., M.Tech., MCA, MBA, M.Sc., MSW, and Ph.D. in the Ninth Annual Convocation of the Institute.

Resolution : The Senate considered the list of degree recipients for B.Tech., M.Tech., MCA, MBA, M.Sc., MSW and Ph.D. programmes in the Ninth Annual Convocation of the Institute, and resolved to recommend the same to the Board of Governors for approval. The Senate also resolved that those Ph.D. candidates whose Oral Board examination will be completed by 13.12.2012 would be considered for award of the degree in the Ninth Annual Convocation, subject to the approval of the Chairman, Senate.

The Senate also considered the request made by the following students for name correction [Hindi / English] in the degree awarded in previous convocations and resolved that these students may be given degrees under the signature of the present Chairman, Senate and the Chairman, Board of Governors in lieu of the degrees already awarded.

Sl. No.	Name [in English]	Name [in Hindi]	Enrollment No.	Date of Convocation	Error
1.	Gajendra Singh Rathore	गजेन्द्र सिंह राठौर	20065064	08.12.2010	Spelling Mistake in हिन्दी
2.	Mayanka Saket	मयंका साकेत	2009EL05	29.10.2011	Spelling Mistake in हिन्दी
3.	Sudeep Chaturvedi	सुदीप चतुर्वेदी	20075020	29.10.2011	Spelling Mistake in हिन्दी
4.	MD. Abdullah Ansari	मु० अब्दुल्लाह अन्सारी	2009IS15	29.10.2011	Spelling Mistake in हिन्दी
5.	Prashant Kumar Kashyap	प्रशांत कुमार कश्यप	2008GT09	08.12.2010	Spelling Mistake in English
6.	Bhupender Singh	भूपेन्द्र सिंह	2001SW06	19.07.2004	Spelling Mistake in English

Item No. 42.04 : To consider the revised Ordinances for Under Graduates Programmes, Master Programmes and Doctoral Program.

Resolution : The Senate considered the recommendations of the Committees constituted for the revision of ordinances for Under Graduate Programmes, Masters' Programme and Doctoral Programmes, and after detailed deliberations it was resolved that the same may be put up in the next meeting after incorporating the suggestions given by the Senate.

Item No. 42.05 : To consider the proposal for conducting a Special Supplementary Examination of 1st year subjects for the students admitted before the session 2012-13, during the winter vacation.

Resolution : The Senate considered the proposal for conducting a Special Supplementary Examination of 1st year subjects for the students admitted before the academic session 2012-13, during the winter vacation, and approved the same.

Item No. 42.06 : To consider the proposal for the award of grades in the Practical Courses to the students admitted in the B.Tech. 1st year in the session 2012-13.

Resolution : The Senate considered the proposal for the award of grades in the Practical Courses to the students admitted in the B.Tech. 1st year in the session 2012-13, and resolved that the grades in the Practical Courses may be awarded to such students on the basis of distribution of marks as 50% of total marks for Sessional Assessment and the rest 50% for the End Semester Assessment.

Item No. 42.07 : To consider the revised Course Curriculum of B.Tech. 2nd, 3rd and 4th year.

Resolution : The Senate considered the revised Course Curriculum of B. Tech. 2nd, 3rd and 4th years for all branches and approved the same.
The revised Course Curriculum of B.Tech. 2nd, 3rd and 4th years for all branches as approved by the Senate is enclosed as **ANNEXURE – I**.

Item No. 42.08 : To note and ratify the approval accorded by the Chairman, Senate on the following matters:

- [i] Recommendations of the Ph.D. Oral Boards of different departments.
- [ii] Recommendations made by the SPGC in its meeting held on 20.07.2012.

[Signature]

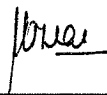
- [iii] Recommendations made by the SUGC in its meeting held on 07.08.2012.
- [iv] Recommendations of the DPGC of Department of Applied Mechanics regarding grant of extension beyond six years to Mr. Akshay Ranjan Paul [Reg. No. 2006RAM03] for completion of his Ph.D. Programme.
- [v] Appointment of Chairperson, SPGC and Chairperson, SUGC.
- [vi] Senate Nominees to SUGC.
- [vii] List of medal recipients of B.Tech., M.Tech., MBA, MCA, M.Sc. and MSW programmes in the Ninth Annual Convocation of the Institute.

Resolution : The Senate noted and ratified the approval accorded by the Chairman, Senate on the following matters :

- [i] The Senate noted and ratified the approval accorded by the Chairman, Senate on the recommendations of the Ph.D. Oral Boards of the following students as per details given below :

Sl. No.	Name of students	Registration No.	Department
1.	Jeeoot Singh	2008RAM02	Applied Mechanics
2.	Dinesh Kumar Gupta	2007RCH03	Chemistry
3.	Rajendra Kumar Srivastava	2006RCE03	Civil Engineering
4.	Mayank Pandey	2007RCS03	Computer Science and Engineering
5.	Girish Kumar Patnaik	2004RCS03	Computer Science and Engineering
6.	Raghav Yadav	2005RCS02	Computer Science and Engineering
7.	Manas Kumar Mishra	2007RCS01	Computer Science and Engineering
8.	Rozita Jamili Oskouei	2007RCS02	Computer Science and Engineering
9.	Prakash Kumar Ray	2008REE03	Electrical Engineering
10.	Vijaya Bhadauria	2005REL04	Electronics & Communication Engineering
11.	Vidyakant Dwivedi	2005REL03	Electronics & Communication Engineering
12.	Ajay Singh Raghuvanshi	2007REL09	Electronics & Communication Engineering
13.	Manish Tiwari	2008REL01	Electronics & Communication Engineering
14.	Rakesh Kumar Singh	2007REL05	Electronics & Communication Engineering
15.	Raj Laxmi Srivastava	2005RHU01	Humanities & Social Science
16.	Yogesh Gupta	2006RMA02	Mathematics
17.	Navaneet Kumar Ojha	2008RMA03	Mathematics
18.	Amit Sharma	2008RME05	Mechanical Engineering
19.	Audhesh Narayan	2005RME01	Mechanical Engineering
20.	Rajesh Tripathi	2005RMS02	School of Management Studies
21.	Ashish Mohan Dubey	2007RMS02	School of Management Studies

[Signature]

- [ii] The Senate noted and ratified the approval accorded by the Chairman, Senate on the recommendations made by the SPGC in its meeting held 20.07.2012 with the following observations:
- (a) The Senate agreed to grant extension of one year beyond the period of six years to Mr. Sanjay Kumar Maurya [2005REE08], a Part-time Ph.D. student of the Department of Electrical Engineering, to submit his Ph.D. thesis, as per the recommendations of the DPGC of the Department of Electrical Engineering, as a special case, with the condition that no further extension will be granted for thesis submission.
- (b) The Senate agreed to grant extension of one year beyond the period of six years to Mr. Surya Prakash Singh [2005REE08], a Part-time Ph.D. student of the Department of Electrical Engineering to submit his Ph.D. thesis, as per the recommendations of the DPGC of the Department of Electrical Engineering, as a special case with the condition that no further extension will be granted to him for thesis submission.
- [iii] The Senate noted and ratified the approval accorded by the Chairman, Senate on the recommendations made by the SUGC in its meeting held on 07.08.2012.
- [iv] The Senate noted and ratified the approval accorded by the Chairman, Senate on the recommendations of the DPGC of the Department of Applied Mechanics and the Chairman, SPGC for grant of extension of one year beyond the period of six years to Mr. Akshoy Ranjan Paul [2006RAM03] for Ph.D. thesis submission.
- [v] The Senate noted and ratified the approval accorded by the Chairman, Senate for appointment of Prof. V.K. Srivastava, ECED as Chairman, SUGC for a period of one year w.e.f. 24.07.2012, and Prof. Vinod Yadava, MED as Chairman, SPGC for a period of one year w.e.f. 01.09.2012.
- [vi] The Senate noted and ratified the approval accorded by the Chairman, Senate for the following Senate nominees to SPGC and SUGC :
- [A] Senate Nominees to SPGC :**
- (a) Prof. M.M. Gore, CSED
- (b) Prof. R.C. Vaishya, CED
- [B] Senate Nominees to SUGC :**
- (a) Prof. R.S. Yadava, CSED
- (b) Prof. R.C. Vaishya, CED
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- [vii] The Senate noted and ratified the approval accorded by the Chairman, Senate on the list of medal recipients of B.Tech., M.Tech., MBA, MCA, M.Sc., and MSW programmes. The list of medal recipients as approved by the Chairman, Senate is enclosed at **ANNEXURE-II**.

Item No. 42.09 : **To consider the proposal for credits for NCC/ NSS in the B.Tech. 1st year.**

Resolution : The Senate considered the proposal of assigning credits for NCC and NSS programmes in the B.Tech 1st year, and resolved that NCC and NSS be made as compulsory audit course from the academic session 2013-14. Students admitted to B. Tech. 1st year from the academic session 2013-14 will be required to opt for either NCC or NSS programme as audit course.

Item No. 42.10 : **To consider the proposal for revision of course credits for students admitted in Ph.D. [Full-time / Part-time] programmes.**

Resolution : The Senate resolved to defer the discussion on the proposal for revision of course credits for students admitted in Ph.D. [Full-time / Part-time] programmes, as the same has been incorporated in the revised ordinances.


Item No. 42.11 : **To consider the proposal for registration in the Institute of newly appointed faculty members on contract basis under Ph.D. programme.**

Resolution : The Senate considered the proposal for registration of newly appointed faculty members on contract basis under Ph.D. programme in the Institute, and approved the same. The Senate further resolved that such faculty members may be exempted from appearing in the counseling /interview process.

Item No. 42.12 : **Any other matter with the permission of the Chairman, Senate.**

Resolution : The Senate considered the following matters with the permission of the Chairman, Senate.

[i]. The Senate considered the recommendations of the DPGC of the Department of Electronics and Communication Engineering and the Chairman, SPGC for grant of extension of one year to Mr. Arvind Kumar [Reg. No. 2006REL08] a Part-time Ph.D. student of the Department, beyond the period of six years for his thesis submission, and resolved to grant him extension of one year for thesis submission. The Senate also resolved that no further extension will be permitted after the period.



[ii]. The Senate considered the recommendations of the Committee constituted to propose guidelines and norms for institution of new medals, scholarships and awards/prizes etc., and resolved to adopt the same with some modifications. The guidelines as adopted by the Senate is placed at **ANNEXURE-III**.

[iii]. The Senate considered the request made by Prof. P.P. Sahay, Department of Physics for institution of a new Gold Medal sponsored by him to be instituted in the memory of his father Late Dr. Ramji Sahai and his mother Late Smt. Vijay Prabha Devi and resolved to approve the same. This newly instituted sponsored medal named as "*Late Dr. Ramji Sahai & Late Smt. Vijay Prabha Devi Memorial Medal*" will be awarded to a student who will secure highest marks in Physics [1st and IInd Semester combined together] in the 1st year amongst the students of all branches of the B.Tech. programme.

[iv]. The Senate considered the recommendations made by the SPGC in its meeting held on 12.11.2012 and resolved the following on its recommendations :

[a]. The Senate considered the recommendations of the SPGC on the request made by Ms. Sarika Kalra [2008REE01] to permit her for appearing in the Comprehensive Examination after waiving off the Course Work, as she has already done two courses in her previous registration as Ph.D. student, and resolved to approve the same.

[b]. The Senate considered the recommendations of the SPGC to grant one year extension to Mr. Nitin Singh [2006REE10] to complete his Ph.D. programme and resolved to reject the recommendations of the SPGC in the matter.

[c]. The Senate considered the recommendations made by SPGC in the matter of Mr. Asit Mohan*ti [2008REE08], whose Ph.D. programme was terminated because of accumulation of 8X and resolved to reject the recommendations of the SPGC in the matter.

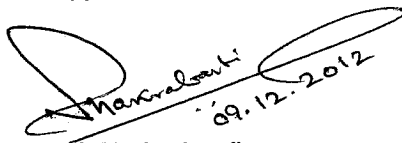
[d]. The Senate considered the cases of masters' degree students having ACD because of not acquiring of CPI of 6.0 in the 1st semester of their programme and requesting therein to clear their ACD by repeating it or substituting it by another course in the subject(s) having 'C' grade, and resolved that these students may be allowed to continue in their programme in accordance with provisions mentioned in the Institute P.G. Manual. These students will be required to complete the CPI requirement of 6.0 at the time of passing out, and have no course with E or F grades.



[e]. The Senate considered the cases of masters' degree students having ACD because of acquiring of CPI between 5.5–6.0 in both the semesters [1st and 2nd] and having no subjects with 'D' grade but were permitted to clear their ACD and resolved that only such permitted students may be allowed to clear their ACD after repeating or substituting in the subjects having 'C' grade but the number of such courses will be limited to two (2), to enable them to clear their ACD.

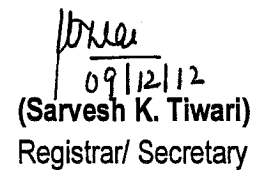
The meeting concluded with the vote of thanks to the Chair.

Approved



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(P. Chakrabarti)
Director/Chairman

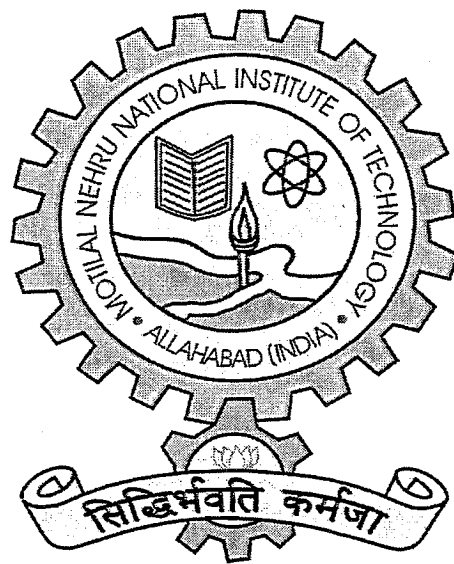


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(Sarvesh K. Tiwari)
Registrar/ Secretary

For
B. Tech. Programme

In
BIOTECHNOLOGY



Department of Applied Mechanics (Biotechnology)
Motilal Nehru National Institute of Technology
Allahabad

Mona

3rd Semester (Biotechnology)

Course Code	Course name	L	T	P	Credit
BT-1301	Biochemistry	3	1	-	4
BT-1302	Microbiology	3	1	-	4
BT-1303	Cell and System Biology	3	-	-	3
BT-1304	Genetics	3	1	-	4
AM-1305	Biomaterial Science and Engineering	3	1	-	4
BT-1305	Thermodynamics of Biological system	3	1	-	4
BT-1351	Microbiology (Lab)	-	-	3	2
BT-1352	Genetics (Lab)	-	-	3	2
AM-1355	Biomaterial Science and Engineering (Lab)	-	-	3	2
Total		18	5	9	29

4th Semester (Biotechnology)

Course Code	Course name	L	T	P	Credit
BT-1401	Biophysics and Structural Biology	3	1	-	4
AM-1406	Applied Computational Methods	3	1	-	4
BT-1402	Instrumentation in Biotechnology	3	1	-	4
BT-1403	Bioprocess Engineering	3	1	-	4
BT-1404	Molecular Biology	3	-	-	3
BT-1451	Biochemistry and Molecular Structural Analysis (Lab)	-	-	3	2
AM-1453	Applied Computational Methods (Lab)	-	-	3	2
BT-1452	Techniques in Biotechnology (Lab)	-	-	3	2
BT-1453	Bioprocess Engineering (Lab)	-	-	3	2
Total		15	4	12	27

5th Semester (Biotechnology)

Course Code	Course name	L	T	P	Credit
BT-1501	Genetic Engineering	3	1	-	4
BT-1502	Microbial Biotechnology	3	1	-	4
BT-1503	Immunology	3	-	-	3
BT-1504	Molecular and Cellular diagnostics	3	1	-	4
HS-1501	Principles of Management	3	-	-	3
MA-1501	Biostatistics	3	1	-	4
BT-1551	Genetic Engineering (Lab)	-	-	3	2
BT-1552	Microbial Biotechnology (Lab)	-	-	3	2
BT-1553	Immunology (Lab)	-	-	3	2
Total		18	4	9	28

6th Semester (Biotechnology)

Course Code	Course name	L	T	P	Credit
BT-1601	Bioinformatics	3	1	-	4
BT-1602	Enzyme Technology and Engineering	3	1	-	4
BT-1603	Animal Biotechnology	3	-	-	3
BT-1604	Plant Biotechnology	3	1	-	4
BT-1605	IPR and Biotechnology	3	-	-	3
HS-1601	Communication Skill Workshop	-	2	-	0
BT-1606	Bioreactor and Plant Design	3	1	-	4
BT-1651	Bioinformatics (Lab)	-	-	3	2
BT-1652	Enzyme Technology and Engineering (Lab)	-	-	3	2
BT-1653	Animal Biotechnology (Lab)	-	-	3	2
Total		18	6	9	28

7th Semester (Biotechnology)

Course Code	Course name	L	T	P	Credit
OE-1781	Open Elective I	3	-	-	3
BT-1731 to BT-1740	Professional Elective I	3	-	-	3
BT-1741 to BT-1750	Professional Elective II	3	-	-	3
BT-1791	Major Project (Interim Evaluation)	-	6	-	6
BT-1751	Medical Biotechnology and Diagnostic (Lab)	-	-	3	2
BT-1752	Plant Biotech (Lab)	-	-	3	2
Total		9	6	6	19

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Course Code	Course name	L	T	P	Credit
BT-1801	Bioprocess Control and Economics	3	1	-	4
OE-1881	Open Elective II	3	-	-	3
BT-1831 to BT-1840	Professional Elective III	3		-	3
BT-1841 to BT-1850	Professional Elective IV	3		-	3
BT-1891	Major Project (Final Evaluation)	-	6	-	6
	Total	12	7	-	19

1st digit; 1: UG, 2nd digit; 2, 3, etc.: Semester

Code	Description
01-30	Theory Courses
31-40	Professional Elective -I
41-50	Professional Elective -II
51-70	Practical Courses
81-90	Open Elective
91-99	Project

DM

UNIT 1: Introduction to Biochemistry-Introduction to biochemistry, water, carbohydrates, amino acids, fatty acids, lipids and nucleic acids. 2(L)

UNIT 2: Biochemistry of carbohydrates-Carbohydrate metabolism and regulation: glycolysis, citric acid cycle (TCA Cycle) and oxidative phosphorylation, biosynthesis of glucose, glycogen and starch. Pentose phosphate pathway. Regulation of carbohydrate metabolism and disease associated. 8(L)

UNIT 3: Biochemistry of lipids-Lipid Metabolism: catabolism of fatty acids, metabolism of triglycerol and cholesterol, biosynthesis of saturated and unsaturated fatty acids, phospholipids and sphingolipids. Regulation of lipid metabolism. Cofactors, vitamins and disease associated. 8(L)

UNIT 4: Metabolism of amino acids-Biosynthesis of amino acids, catabolism of carbon skeletons of amino Acids - oxidative de-amination and oxidative de-carboxylation, nitrogen excretion and urea cycle. Regulation of amino acids metabolism and disease associated. Cofactors, vitamins and disease associated. 8(L)

UNIT 5: Biochemistry of Nucleic acids-Metabolic pathways - biosynthesis of purines, pyrimidines, nucleotides and nucleic Acids (DNA and RNA), nucleic acid metabolism - degradation of nucleotides and nucleic acids and genetic disorders. Cofactors, vitamins and disease associated. 8(L)

UNIT 6: Biochemistry of Photosynthesis- Light reaction, dark reaction cyclic in C3 and C4 plants 6(L)

Text/Reference Books:

- Principles of Biochemistry (Lehninger) by David. L. Nelson and Michael. M. Cox
- Outlines of Biochemistry by Conn, E.E and Stumpf P.K.
- Biochemistry by Stryer/Lubert.
- Harper's review of Biochemistry by Martin D. W, Mayes. P. A and Rodwell. V. M
- Practical of Biochemistry by Wilson and Walker.
- Biochemistry by Champe P.C., Harvey R.A., Ferrier D.R.

MICROBIOLOGY (BT-1302)

UNIT 1: Introduction to Microbiology-Discovery of microorganisms, theory of spontaneous generation, germ theory of diseases, major contribution and events in the field of microbiology, scope and relevance of microbiology. 4(L)

UNIT 2: Classification and Identification of microorganisms-Study of classification systems, numerical taxonomy, polyphasic taxonomy, major characteristics used in taxonomy, identification of microorganisms - a general account, staining techniques. pure culture, preservation methods. 6(L)

UNIT 3: Morphology and Major Groups of Microorganisms-Morphology and fine structure of bacteria: cell wall, structure external and internal to cell wall, spore and cysts, characteristics of archeobacteria and eubacteria, characteristics of important groups of microorganisms. 7(L)

UNIT 4: Microbial Metabolism, Nutrition and Genetics-An overview of microbial metabolism, nutritional Types, uptake of nutrients by cells, simple diffusion, facilitated diffusion, group translocation, active transport, chemiosmotic theory. Microbial genetics: transformation, conjugation, transduction. 8(L)

UNIT 5: Growth and Cultivation of Microorganisms-Growth of microorganisms: growth curve, measurement of microbial growth, continuous growth, chemostat, turbidostat, balanced and unbalanced growth, methods of culturing microorganisms (aerobes and anaerobes), culture media, factors influencing growth, control of microorganisms by physical and chemical agents, evaluation of antimicrobial chemical agents. 9(L)

UNIT 6: Principles of Disease and Epidemiology-Mechanism of bacterial pathogenicity, general characteristics of antimicrobial drugs, antibiotics: classification, mode of action and resistance. 6(L)

Text/ Reference Books:

- Microbiology by Prescott L.M., Harley, J.P and Klein, D.A. McGraw Hill.
- Microbiology by Pelczar, M.J. Chan ECS and Krieg NR, Tala McGraw Hill.
- General Microbiology by Roger Y. Stanier, Macmillan.
- Bergeys Manual of Systematic Bacteriology.
- General Microbiology by Prescott and Dunn.
- Microbiology by T. D. Brocks.

CELL AND SYSTEM BIOLOGY (BT-1303)

UNIT 1: The Cell and Organelles-Introduction, definition and type of cell, cellular compartmentalization and different cell organelles (structure and functions), the nucleus: global structure of chromosomes, chromosomal DNA and its packaging, organization and evolution of the nuclear genome. 5(L)

UNIT 2: Bio-membranes and cytoskeleton-Introduction to bio-membranes, plasma membrane: organization and transport across the plasma membrane and epithelia, nature of the cytoskeleton, intermediate filaments, extracellular matrix (ECM), cell-cell junctions 5(L)

UNIT 3: Cell Cycle-General strategy of the cell cycle, mechanics of cell division, cell-cycle control, programmed cell death (apoptosis), signals that trigger cell death, growth and proliferation 5(L)

UNIT 4: Signal Transduction-Mechanisms of cell signalling, Intracellular receptor and cell surface receptors, signalling via G-protein linked receptors and enzyme linked receptor signalling pathways. 5(L)

UNIT 5: Systems Biology-Structure and function of epithelial system, muscular system, circulatory system, endocrine system and nervous system 9(L)

UNIT 6: Cancer, Stem Cells and AIDS-Cancer as a microevolutionary process, tumour cells, proto-oncogenes and viral oncogenes, tumour suppressor genes, various types of cancer, stem cells and their application in research, physiology, causes and prevention of AIDS. 5(L)

- Essential Cell Biology by Alberts.
- The Cell: A molecular Approach by Cooper.
- Developmental Biology by Gilbert Sinauer.
- Cell Biology by Pollard and Earnshaw.
- The Cell: A Problems Approach by Wilson and Hunt.
- Asking about Cells by Tobin and Morcel.

GENETICS (BT-1304)

UNIT 1: Physical Basis of Heredity-Basic law of inheritance, deviations of Mendel's ratios due of gene interaction, concept of alleles, complementation test, multiple factors of inheritance. genes and environment interaction. probability and statistical testing. 6(L)

UNIT 2: Cell division, Linkage, Recombination and Gene Mapping Methods-Mitosis, meiosis, chromosomal inheritance, concept of linkage, crossing over and mapping to genes by recombination frequency, three point test cross, tetrad analysis, mitotic crossing over, sexuality and recombination in bacteria and viruses, molecular mechanism of genetic recombination. 8(L)

UNIT 3: Sex Determination and sex linkage-Mechanism of sex determination in animals and plants, sex linked, sex influence and sex limited traits, sex linked disorders in human beings. 5(L)

UNIT 4: Cytogenetic, Mutation and Extra Chromosomal Inheritance- Chromosome aberrations, polyploidy. Mutation: type, cause and detections, application of mutants. Maternal inheritance: inheritance of mitochondrial and chloroplast genes, Transposable elements, transpositions of transposons in genome. 6(L)

UNIT 5: Molecular and Human Genetics-Identification of genetic materials, the genetic code, gene regulation and gene expression. Pedigree analysis, genetic disorders, inborn errors of metabolism (Phenylketonuria and Galactosemia), neurogenetic disorders (Alzheimer's and Parkinson's), muscle genetic disorders (Muscular Dystrophy), cancer genetics and genetic counselling 9(L)

UNIT 6: Population and Developmental Genetics-The Hardy- Weinberg equilibrium, change in gene frequencies and mating system. Genetics of the evolutionary process and development, genetic basis of evolution and speciation, genetics of development. 6(L)

Text/Reference Books:

- Genetics by Goodenough U, Hold Saunders International.
- Principles of Genetics by Gardner EJ, Simmons M.J., Snustad D.P.
- Principal of Genetics by Tamarin, Macgrahill.
- Genetics by Strickberger, Phi Learning.
- Genetics by B.D.Singh, Kalyani publication.
- Genetics by P.K.Gupta, Rastogi publication.

BIOMATERIAL SCIENCE AND ENGINEERING (AM-1305)

UNIT 1: Introduction-Introduction and overview of biomaterials, structure and property relation in materials and characterization and testing of biomaterials. 4(L)

UNIT 2: Interactions of materials-Interactions of materials with human body, bio-compatibility of materials, metals, alloys, ceramics, polymers and composites as biomaterials. 5(L)

UNIT 3: Biopolymers-Biopolymers, natural materials, material for drug delivery: biodegradable polymers. 4(L)

UNIT 4: Implants-Materials for hard tissue replacement: orthopaedic implants, dental implants. 4(L)

UNIT 5: Materials for soft tissue replacement- dermal and facial prosthesis, cardiovascular implants, ophthalmology, materials for artificial organs transplant and extracorporeal device. 6(L)

UNIT 6: Legal Issues-Recent developments in biomaterials, legal issues related to development of biomaterials. 4(L)

Text/Reference Books:

- Biomaterials: An Introduction by Park J.B. and Lakes R.S., Plenum Press, New York.
- Biomaterials, Medical Devices & Tissue Engineering: An Integrated Approach by Silver F.H., Chapman and Hall publication.
- Biomaterials by BhatSujata V., Narosa Publishing House.
- Biomaterials science: an introduction to materials in medicine by Buddy D. Ratner., Elsevier Academic Press.
- Biomaterials: A Tantalus Experience by Jozef A. Helsen., YannisMissirlis Springer.
Biomaterials by TemenoffJohnna S., Dorling Kindersley India Pvt Ltd.

THERMODYNAMICS OF BIOLOGICAL SYSTEM (BT-1305)

UNIT 1: Fundamentals and Law of Thermodynamics-Terminologies of thermodynamics, variables and quantities of thermodynamics, Point and path properties, heat and work, reversible and irreversible processes, phase rule, First law and internal energy, statements of first law for the non flow and flow systems, enthalpy and heat capacity limitations of the first law, Statements of the second law of thermodynamics, available and unavailable energies, entropy function, applications of the second law. Zeroth law of thermodynamics. 8(L)

UNIT 2: Thermodynamic Properties of Real Gases-The PVT behavior of fluids, laws of corresponding states and equation of states approaches to the PVT relationships of non ideal gas problems, compressibility factors, generalized equations of state, property estimation via generalized equation of state, fugacity and fugacity coefficients of real gas. 8(L)

UNIT 3: Thermodynamics of Solutions-Ideal and non-ideal solution, Concept of Fugacity and Fugacity coefficient, Fugacity and Activity Coefficient Modes, Solid-liquid equilibrium, solubility of gases in liquids, Liquid-liquid equilibrium. 6(L)

UNIT 4: Chemical Reaction Equilibrium-Heat effects, industrial reactions (NH₃ synthesis etc), free energy calculations, Homogeneous and heterogeneous reaction systems, multiple reactions, Work of separation, Evaluation of Properties. Phase Equilibrium, Pure component and mixtures, Latent Heat correlation Van Laar, Margules' equation, Gibbs'-Duhem

of oxidation-reduction reactions, Degree of reduction concepts, available electron balances; yield coefficients, Oxygen consumption and heat evolution in aerobic cultures, Effect of temperature on U, H and entropy (S), Energetic of Metabolic Pathways; Energy Coupling (ATP & NADH), Structure and properties of ATP and other energy currencies. 9(L)

UNIT 6: Compression and Refrigeration Cycle-Thermodynamic aspects of compression process, classification of compression processes, basic equation for change of state of gases, the work expression for different situations, the effect of clearance volume, multistage compression, convergent divergent flow, Ejectors. Definitions of refrigeration, Reverse Carnot cycle, Vapor compression and vapor absorption cycle, Gas refrigeration. 5(L)

Text/Reference Books:

- J. M. Smith and Van Ness, "Introduction to Chemical Engineering Thermodynamics", McGraw Hill, New York.
- Rao. Y.V.C. "Chemical Engineering Thermodynamics", Universities Press.
- S. Sundaram, "Chemical Engineering Thermodynamics", Ahuja Publishers, Delhi.
- B.F. Dodge, "Chemical Engineering Thermodynamics", McGraw Hill, New York.
- S.I. Sandler, "Chemical and Engineering Thermodynamics, Wiley.
- Bioprocess Engineering Principles, . Doaran, P.M, Academic Press.
- Biochemical Engg. Fundamentals, Bailey & Olis, MGH.
- Kinetics and Energetic in Biotechnology, Roels J.A, Elsevier.
- Biological Thermodynamics, Donald T Haynie.

MICROBIOLOGY (LAB) (BT-1351)

Experiment 1: Introduction to the rules, tools and equipments used in microbiology.

Experiment 2: Examination of microorganisms by staining techniques.

Experiment 3: Preparation of media for cultivation of microorganisms.

Experiment 4: Isolation and Enumeration of microorganisms by serial dilution agar plating method.

Experiment 5: To obtain pure culture of microorganisms by pour, spread and streak plate method.

Experiment 6: To measure bacterial growth and determine the effect of various factors on bacterial growth.

Experiment 7: To assess biochemical activities viz., catalase, IMViC of given culture of bacteria.

Experiment 8: Assay of an antibiotic by zone-inhibition method using antibiotic impregnated discs.

Experiment 9: Determination of bacterial transformation and conjugation.

GENETICS (LAB) (BT-1352)

Experiment 1: Chi Square Test for Monohybrid and dihybrid crosses

Experiment 2: Probability and Pedigrees analysis.

Experiment 3: Study of chromosome morphology at different stages of cell division.

Experiment 4: Study of multiple alleles inheritance by ABO blood genotyping.

Experiment 5: Study genetic material transfer in two different strain bacteria by conjugation method

Experiment 6: Study of genetic markers in bacteria.

Experiment 7: Study of genetic polymorphism from diverse populations.

Experiment 8: Study Allele Frequency Distributions in Pooled DNA Samples.

Experiment 9: Identification dominant hybrid by DNA based markers

BIOMATERIAL SCIENCE AND ENGINEERING (LAB) (AM-1355)

Experiment 1: Antimicrobial testing of bio-polymers by agar well diffusion methods.

Experiment 2: Mechanical testing of bio-materials by tenso-meter.

Experiment 3: Preparation of scaffolds by lyophilisation techniques.

Experiment 4: Coating on biomaterials by dip-coating.

Experiment 5: Preparation of hydro-gel.

Experiment 6: Preparation of biopolymer films.

Experiment 7: Quantification of biofilm and biomaterials.

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BIOPHYSICS AND STRUCTURAL BIOLOGY (BT-1403)

UNIT 1: Different interactions among proteins-Hydrogen bonding, hydrophobic interactions, ionic interactions, disulphide bonds and their role in protein structure. 2(L)

UNIT 2: Different structures of proteins-Proteins: Primary, secondary, super-secondary (motifs, folds) and tertiary structural elements and their conformational study. Protein folding kinetics: helix-coil transition, molten globule and zipper model etc. Three dimensional conformations of proteins, Ramachandran plot, fibrous proteins, membrane proteins and their structures. 12(L)

UNIT 3: Structures of nucleic acids and compositions-Nucleic acid structure and composition: A, B, and Z: forms of DNA, Topology of DNA: supercoiling of DNA. Nucleic acid and protein denaturation and renaturation kinetics. 7(L)

UNIT 4: Methods of structural determination of bio-molecular-Macromolecular structure determination by X-ray diffraction, crystallography, NMR and circular dichroism. 7(L)

UNIT 5: Biomolecular interactions-Protein-Protein interactions, protein-carbohydrate interactions, Protein-DNA interactions. 6(L)

UNIT 6: Biomechanics and Neurobiophysics-Cell contractility and motility, cytoskeletal Motility, neurobiophysics. 6(L)

Textbook/ Reference books:

- Principles of Biochemistry by Lehninger
- Principles of Physical Biochemistry by Kensal E van Holde,
- Essentials of Biophysics by R. Narayanan
- Introduction to Bioinformatics by Arther M. Lesk.
- Proteins: structures and Molecular Properties by Thomas E. Creighton.
- Practical Biochemistry Principles and techniques by Wilson and Walker., Cambridge University Press.

APPLIED COMPUTATIONAL METHODS (AM-1406)

UNIT 1: Introduction-Motivation, mathematical modeling, errors in numerical computation, convergence, conditioning and stability. 2(L)

UNIT 2: Interpolation and Curve Fitting-Motivation, polynomial forms, linear interpolation, Lagrangean interpolation, Newton interpolation, Spline interpolation, Chebyshev interpolation, regression analysis, fitting linear equations, least-square method, fitting transcendental equations, polynomial functions, multiple linear regression. 8(L)

UNIT 3: Simultaneous Linear Equations-Motivation, gauss elimination, pivoting, factoring, solution accuracy, iterative methods, Jacobi method, Gauss-Siedel method, relaxation method. 6(L)

UNIT 4: Nonlinear Equations-Motivation, open and bracketing method, bisection, fixed point, Newton's method, secant and false position method, rate of convergence, method for complex root, Muller's method, quotient Difference method, Newton-Raphson method. 8(L)

UNIT 5: Numerical Integration-Motivation, Newton-Kotes method, Trapezoidal rule, Simpson's rule, Rhomberg integration, Gauss Quadrature, singular integrals. 8(L)

UNIT 6: Initial Value Problem-Motivation, Euler's method, Modified Euler method, Runge-Kutta methods, Adaptive integrations and multistep methods. 6(L)

Text/Reference Books:

- Applied Numerical Analysis by C.F. Gerald and P.O. Wheatley., Addison-Wesley.
- Numerical Mathematics and Computing by W. Cheney and D. Kincaid.
- Applied Numerical Methods by B. Carnahan (John Wiley and Sons).
- Numerical methods by E. Balaguruswamy (TMH).
- Introductory methods of numerical analysis by S.S. Sastry (PHI).
- Introduction to Numerical Methods by V. Rajaraman (TMH).

INSTRUMENTATION IN BIOTECHNOLOGY (BT-1402)

UNIT 1: Microscopy-Principle, working, sample preparation and biological applications of different microscopes – light microscope (bright field and dark field, phase contrast, polarization, differential interference contrast), electron microscope (TEM, SEM), fluorescence microscope (simple and confocal) and Atomic force microscope. 8(L)

UNIT 2: Centrifugation-Principle, construction, working of centrifugation and concept of RCF, types of instruments and rotors used in centrifugation, types of centrifugations- preparative, differential density gradient centrifugation and analytical ultracentrifuge. 5(L)

UNIT 3: Electrophoresis-Principle & Working of zonal and continuous electrophoresis, types of electrophoresis- paper, cellulose acetate, gel and capillary electrophoresis, native and denaturing gels, isoelectric focusing, two dimensional gel electrophoresis, pulse-field gel electrophoresis. 7(L)

UNIT 4: Chromatography-Principle, instrumentation and biological applications of paper and thin layer (TLC) chromatography, gel permeation (GPC), ion exchange chromatography, affinity chromatography, gas liquid (GC) and high pressure liquid chromatography. 7(L)

UNIT 5: Spectroscopy-Part I-Basic concepts of spectroscopy, beer lamberts law, principles, instrumentation and applications of UV-Visible spectroscopy, nephelometry, turbidometry, fluorescence spectroscopy, atomic absorption spectrophotometry. 6(L)

UNIT 6: Spectroscopy-Part II-Basic concepts, instrumentation and biological applications of infra red spectroscopy and mass spectroscopy. 7(L)

Text/Reference Books:

- Practical Biochemistry by Wilson and Walker.
- Biophysics by VasanthaPattabhi and N. Gautham.
- Handbook of analytical techniques by Helmut gunzler and Alex Williams
- Bioanalytical chemistry by Susan R Mikkeleson and E. Corton.
- Biophysical chemistry by Alan Cooper.
- Fundamentals of Analytical Biochemistry by Skoog and West.

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UNIT 2: Sterilization-Sterilization methods, del factor, thermal death kinetics of cells and spores: survival curve-decimal reduction factor, extinction probability-sterilization of culture medium- batch and continuous sterilization- design aspects- air sterilization- design of fibrous type filters. 5(L)

UNIT 3: Microbial Growth Kinetics-Kinetic modelling of cell growth: model structure, structured and un-structured models, Monod chemostat model, models with growth inhibitors, growth models for filamentous organisms-structured kinetic models. Elemental balances- respiratory quotient, degree of reduction-Yield and maintenance coefficients. 9(L)

UNIT 4: Fermentation Process and Product Formation-Type of fermentation: solid state and submerged state, batch, fed-batch and continuous fermentation, kinetic of batch and continuous reactor. Growth associated and non - growth associated product formation kinetics. Leudeking-Piret models, substrate and product inhibition on cell growth. 9(L)

UNIT 5: Introduction To Transport Phenomena: Mass Transfer -Mechanisms of mass transport, molecular and diffusion theory, role of diffusion in mass transfer, film theory, types of mass transfer, mass transfer in bioprocessing systems: gas liquid mass transfer- volumetric oxygen transfer coefficient-correlations. 5(L)

UNIT 6: Aeration and Agitation in Fermentations- Introduction, the oxygen requirement for industrial bioreactors, volumetric oxygen transfer, oxygen transfer mechanism- assessment of KLa and its determination methods, factors affecting KLa, fluid rheology, effect of medium rheology on KLa, fluid flow and mixing in fermentation broths, newtonian and non newtonian fluids, factors affecting agitation in bioreactor. 7(L)

Text/Reference Book:

- Bioprocess engineering by M.L. Shuler and F. Kargi., Prentice Hall of India.
- Biochemical process principles by P.M. Doran., Academic Press.
- Introduction to Biochemical Engineering by D.G. Rao,
- Bioprocess Engineering Fundamentals by G.E Bailey and D.F Ollis, McGraw Hill
- Biochemical engineering by Aiba, Humphrey and Mells, academic press.

MOLECULAR BIOLOGY (BT-1404)

UNIT 1: DNA Structure Replication and Repair-Nucleic acids and their structure, nucleic acid as genetic material, types of DNA, DNA replication in prokaryotes and eukaryotes, model of DNA replication, DNA repair: types and mechanism DNA repair in prokaryotes and eukaryotes 6(L)

UNIT 2: Organization of genetic material- Packaging of DNA as nucleosides in chromosome, repetitive and unique DNA sequences, split genes, overlapping genes and pseudo genes 6(L)

UNIT 3: Transcription in prokaryotes and eukaryotes: Central dogma concept, transcription in prokaryotes: initiation, elongation and termination. Transcription in eukaryotes: RNA polymerase, transcription factors and initiation RNA synthesis, elongation and termination of RNA synthesis. Transcription in mitochondria and chloroplast. 6(L)

UNIT 4: RNA processing-Ribosome- Structural features of prokaryotic and eukaryotic ribosome. Types of RNA, processing of RNA and RNA Splicing, mRNA transport, mRNA synthesis in prokaryotes and eukaryotes. 6(L)

UNIT 5: Translation in prokaryotes and eukaryotes-Initiation and elongation of polypeptide, formation of peptide bond, termination of polypeptide, modification, folding and transport of released polypeptide, protein sorting or protein trafficking, protein folding. 8(L)

UNIT 6: Regulation of Gene Expression-Regulation of gene expression in bacteria- operon concept, inducible and repressible operons (lac and trp), catabolite repression of lac operon in *E.coli*. Control of gene expression in eukaryotes.enhancers, silencers and other upstream controlling elements. DNA methylation.Chromatin remodelling. 8(L)

Text/Reference Books:

- Essential Cell Biology by Alberts, Garland
- Molecular Biology of the Cell by Alberts et al, Garland
- Cell and Molecular Biology by Karp., John Wiley
- Genes IX by Lewin, Pearson
- Molecular Cell Biology by Lodish., Freeman
- Principle of Genetics by Gardner., John Wiley
- Essential Molecular Biology VII by T.A. Brown., AP

BIOCHEMISTRY AND MOLECULAR STRUCTURAL ANALYSIS (LAB) (BT-1451)

Experiment 1: Buffer preparations with the help of pH meter.

Experiment 2: Estimation of carbohydrates: DNS Methods etc.

Experiment 3: Estimation of proteins: Lowry's method, Burette method.

Experiment 4: Extraction of Lipids.

Experiment 5: To study Heat Capacity, Enthalpy and Entropy of biomolecules by DSC/ITC.

Experiment 6: Measurement of thermodynamic parameters of heat denaturation of proteins by micro-DSC.

Experiment 7: Study of re-naturation kinetics of DNA by micro-DSC.

Experiment 8: Measurement of the conformational stability of a protein.

Experiment 9: Calculation of number of particles /unit cells of a cubic crystal system.

WNA

- Experiment 2:** Interpolation with finite divided differences, Lagrange interpolation.
Experiment 3: Poisson distribution random number generator, χ^2 test for goodness of fit, Polynomial regression with plotting.
Experiment 4: Power method and Jacobi method, Gauss –Seidel and Gauss elimination method.
Experiment 5: Bisection and Newton – Raphson method.
Experiment 6: Simpson's rule, Romberg integration, Velocity distribution using Gauss quadrature.
Experiment 7: Euler's method and Fourth order Runge-Kutta method.

TECHNIQUES IN BIOTECHNOLOGY (LAB) (BT-1452)

- Experiment 1:** Preparation of a slide of given plant or bacterial sample and visualize it under dark field, bright field, and phase contrast microscopy.
Experiment 2: Isolation of chloroplast using differential centrifugation and quantitative estimation of different plant pigments using spectrophotometer.
Experiment 3: Quantitation of given nucleic acid solution and determination of its purity and molarity spectrometrically.
Experiment 4: Separation of biomolecules using paper chromatography.
Experiment 5: Separation of biomolecules using Thin Layer Chromatography.
Experiment 6: Purification and isolation of biomolecules using affinity chromatography/ ion-exchange chromatography.
Experiment 7: To purify a given protein or lipid sample by GPC/HPLC.
Experiment 8: To separate nucleic acid fragments using agarose gel electrophoresis.
Experiment 9: To separate and resolve a given protein mixture using SDS-PAGE electrophoresis.

BIOPROCESS ENGINEERING (LAB) (BT-1453)

- Experiment 1:** To get familiarized with the Conventional Stirred tank reactor (CSTR).
Experiment 2: To plot Microbial growth curve for shake flask culturing using turbidity method.
Experiment 3: Prepare a standard curve for substrate determination.
Experiment 4: To Estimate the Monod Parameters for microbial growth kinetics.
Experiment 5: Preparation of standard curve of Ethanol.
Experiment 6: Quantitative estimation of ethanol produced during Yeast fermentation.
Experiment 7: To determine the residence time distribution (RTD) in Biochemical reactor.
Experiment 8: To determine Chemical oxygen demand (COD)
Experiment 9: To determine Biological oxygen demand (BOD)
Experiment 10: To Determine the Oxygen transfer coefficient (KLa) in CSTR.
Experiment 11: Advanced Molecular Biology by Twyman., Viva

John

development of high capacity vectors. Plasmiids, types of plasmids. Construction of genomic and cDNA libraries, their strategies and advantages. 7(L)

UNIT 2: Restriction Enzymes , DNA finger printing and DNA labeling-Enzymes used in cloning – polymerases, ligases, restriction endonuclease. Types and nomenclature of restriction enzymes. Different blotting techniques: southern, northern, western and hybridization. 7(L)

UNIT 3: Gene amplification through Polymerase Chain Reaction-Principle of PCR, design of primers, PCR methodology: RT-PCR, multiplex PCR, anchored PCR, inverse PCR, site directed mutagenesis, gene sequencing. 6(L)

UNIT 4: Molecular Markers, Micro array and gene silencing-Type of molecular markers, use of RFLP, RAPD, AFLP, STMS, DNA chips, SNPs and micro array, 16s r-ANA typing, gene chip and micro array; applications in disease profiling, RNA silencing. 10(L)

UNIT 5: Expression and purification of recombinant proteins-Strategies of protein expression in bacteria, insects, transgenic plant and animal, purification of recombinant proteins. 5(L)

UNIT 6: Applications of Genetic Engineering-Gene cloning in medicine, agriculture, transgenic animals and plants, molecular farming. Trait modification by genetic engineering – over expression or under expression of heterologous genes. 5(L)

Text/Reference Books

- Genes to clone by T. A. Brown, Blackwill publication.
- Biotechnology and Genetic engineering by S. Mitra
- Principles of Gene Manipulation: An Introduction to Genetic Engineering Old RW and Primrose SB. Blackwell Science Publications.
- Molecular cloning: a laboratory manual: Volume II by Joseph Sambrook and David William Russell.

MICROBIAL BIOTECHNOLOGY (BT-1502)

UNIT 1:Introduction to Industrial Bioprocess-An overview of industrial fermentation process and products. process flow sheeting - a brief survey of microorganisms, processes, products and market economics relating to modern industrial biotechnology, screening, and fermentation media for industrial fermentation. 5(L)

UNIT 2: Production of Primary & Secondary Metabolites- A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid), amino acids (glutamic acid, lysin); alcohols, steroids, vitamin B12. 8(L)

UNIT 3: Study of production process for various classes of low molecular weight secondary metabolites-Antibiotics-beta-lactams (Penicillins), aminoglycosides (streptomycin), macrolids (erythromycin),quinines. 4(L)

UNIT 4:Production of commercially important enzymes-Proteases, amylases lipases, cellulases, pectinases, isomerases and other commercially important enzymes for the food, pharmaceutical and detergent industries. 8(L)

UNIT 5: Production of recombinant proteins, & vaccines-Insulin,interleukin, interferons and their therapeutic and diagnostic applications, production of vaccines. 6(L)

UNIT 6: Production of other commercially important products and strain improvement-Production of natural biopreservatives (nisin), and biopolymers (xanthan gum and PHB), single cell protein, high – fructose com syrup; bioconversion of vegetable oils. strain improvement through physical and chemical mutation and molecular tools. 7(L)

Text/ References Books:

- Biotechnology by John E.Smith., Cambridge Low Price Edition.
- Industrial Microbiology by J.E.Casida.
- Industrial Microbiology by A.H.Patel.
- Microbiology by Prescott and Dunn.
- Microbial biotechnology by Glazer, A.N. and Nikaido H., NewYork.

IMMUNOLOGY (BT-1503)

UNIT 1: The Immune system-History and evolution of immune system, Innate and acquired immunity, humoral and cell-mediated immunity, hematopoiesis, cells and organs of immune system, concept of immunogenicity, antigens, epitopes, and haptens, antibodies-structure, classes, functions, monoclonal and polyclonal antibodies, primary and secondary immune response. 9(L)

UNIT 2: Diversity in B and T cell receptors-Molecular basis of antibody diversity: DNA rearrangements, variations arising out of V,D,J joining, somatic hypermutation, class switching, B and T cell generation, maturation, and their receptors;. 7(L)

UNIT 3: MHC and its role in transplantation- MHC: gene organization, types of MHC molecules and their structure, basis and significance of MHC polymorphism, antigen processing and presentation, transplantation immunology- immunologic basis of graft rejection 6(L)

UNIT 4:Cytokines, complement system and hypersensitivity-Cytokines and their role in immune response, Complement system-different complement pathways, action of complement proteins. Hypersensitivity-types and their mechanism of action, inflammatory response. 6(L)

UNIT 5: Techniques in immunology-Antigen-antibody interactions- agglutination, precipitation, immunodiffusion, rocket immunoelectrophoresis, immunoassay (competitive, sandwich and indirect) ELISA, RIA. vaccines: active and passive immunization, types of vaccines. 4(L)

UNIT 6: Immune response and tolerance-Tolerance-mechanism of developing immune tolerance for T and B lymphocytes; autoimmunity-organ specific and systemic and its various causes. Immunodeficiency- with AIDS as example. 7(L)

- Immunology by Kuby J., Freeman, W.H., Oxford, UK
- Immunology by Weir W.B. Saunders and Co.
- Immunology by K.A. Abbas., W.B. Saunders and Co.

MOLECULAR AND CELLULAR DIAGNOSTIC (BT-1504)

UNIT 1: Introduction-Specimen collection (blood, urine, spinal fluid, saliva, synovial fluid and amniotic fluid), preservation, transportation. Biomarkers, markers used in cell and molecule diagnosis such as antibody markers, CD markers, secreted proteins/enzymes, cell specific antigens etc. single cell diagnostics. 5(L)

UNIT 2: General Function Tests-Principle of diagnostic enzymology: liver, cardiac, skeletal enzyme and digestive enzyme. Liver function test, cardiac function test, renal function test, thyroid function test, reproductive endocrine function test. 6(L)

Unit 3: Techniques used in cell diagnosticsCytodiagnosis - detection of disease in cells using specialized staining methods and microscopically examining their morphology and internal architecture, flow cytometry, immunohistochemistry, tissue in-situ hybridization, tissue microarrays. 8(L)

UNIT 4: DNA based diagnostics-DNA based diagnostic approaches-PCR and RT-PCR based diagnosis of diseases, fluorescent in-situ hybridization, DNA microarrays, spectral karyotype imaging, aptamers in diagnosis, DNA methylation based diagnosis. 8(L)

UNIT 5: Diagnosis of important disorders/diseases-Cellular and molecular diagnosis of some important diseases caused by bacteria and viruses, Molecular diagnostics in the evaluation of cancer. 6(L)

UNIT 6: Discovery of new biomarkers and their evaluation-Role of genomic, proteomics and bioinformatics tools in biomarker discovery and evaluation. 5(L)

Text/Recommended Books:

- Advanced techniques in diagnostics cellular pathology by Marry Hennon-Fletcher and Perry Maxwell, Wiley-Blackwell.
- Molecular diagnostics: for the clinical laboratorian by William B. Coleman and Gregory J. Tsongalis
- Molecular diagnostics by George P. Patrinos and Wilhelm Ansoerge
- Commercial Biosensors by Graham Ramsay., John Wiley and Son, INC.
- Diagnostic microbiology by W. R. Bailey, E. G. Scott and C. V. Mosby.
- Fundamentals of clinical chemistry by W.B. Saunders and Carl A. Burtis.

PRINCIPLES OF MANAGEMENT (HS-1501)

UNIT 1: Concept of business environment-Significance and nature, the interaction matrix of different environment factors, environmental scanning, basic philosophies of capitalism and socialism with their variants. 5(L)

UNIT 2: Politico-legal environment: Relationship between business and Government of India, introduction to some important business laws: competition act, FEMA, SEBI, RBI, consumer protection act, changing dimensions of these laws and their impact on business, Economic environment: philosophy and strategy of planning in India, concept of mixed economy, their changing role, policy with regard to small scale industries. 5(L)

UNIT 3: Technological and socio-cultural environment-Policy for research and development in India, multinationals as source of technology; foreign collaborations and joint ventures, liberalization in India: the new economic Policy; globalisation; FDI policy, reforms in financial Sector. 7(L)

UNIT 4: General Management-Management concepts, theories and practices, functions of management – Planning, Organizing, directing-leadership, motivation, communication and controlling, decision making. 10(L)

UNIT 5: Organisational Behavior-Organisational change, conflict management and stress management 5(L)

UNIT 6: Functional management-Human resource management, financial management, marketing management 5(L)

Text/ Reference Books:

- Principles & Practices of Management by L.M. Prasad., Sultan Chand and Sons
- Management by Harold, Koontz and CyriloDonell., Mc.Graw Hill.
- Business and society by Khan Farocq., S Chand, Delhi .
- Indian Economy Dutt R and Sundharam K.P.M., S .Chand ,Delhi .
- Business Environment by Francis Cherunilam, Himalaya Publishing House, Bombay.

BIostatistics (MA-1501)

UNIT 1: Presentation of Data-Data type, classification and summarization of data, diagrams and graphs, measures of dispersion, skewness and kurtosis. 4(L)

UNIT 2: Probability and Distribution-Introduction to probability, laws of probability, bayes theorem, binomial distribution, poisson distribution, normal distribution and gaussian distribution, mean and variance, expectation and moments, moment generating functions of these distributions. 8(L)

UNIT 3: Correlation and Regression-Positive and negative correlation, pearson and mathew correlation coefficient, non parametric tests, receiver operating characteristics (ROC) curve, linear and non linear regression, multiple regression. 6(L)

UNIT 4: Sampling-Concept of population and sample, random sample, methods of taking a random sample. 3(L)

UNIT 5: Tests of Significance-Sampling distribution of mean and standard error, large sample tests (test for an assumed means and equality of two population means with known S.D.), small sample tests (t-test for an assumed mean and equality of means of two populations when sample observations are independent, paired and unpaired), t-test for correlation and regression coefficients, t-test for comparison of variances of two populations, chi-square test for independence of attributes, goodness of fit and homogeneity of samples. 8(L)

UNIT 6: Experimental Designs-Principles of experimental designs, completely randomized, randomized block and latin square designs, simple factorial experiments of 2², 2³, 2⁴ and 3² types. Confounding in factorial experiments (mathematical derivations not required, analysis of variance (ANOVA) and its use in the analysis of RBD. 6(L)

Prasad

- Statistical methods by George W. and William G., IRI Publication.
- Introduction to Biostatistics by Ipsen J., Harper and Row Publication.
- Statistical methods in Biology by N.T.J. Bailey., English University Press.
- A Text Book of Agricultural Statistics by R. Rangaswami, New Age Intl. Pub.

GENETIC ENGINEERING (LAB) (BT-1551)

Experiment 1: Isolation & purification of Genomic DNA

Experiment 2: Isolation, purification and visualization of plasmid DNA.

Experiment 3: Isolation and quantification of RNA

Experiment 4: Restriction digestion of plasmid DNA

Experiment 5: Preparation of competent cells and cloning.

Experiment 6: Screening of transform colony by X gal – IPTG

Experiment 7: Blotting techniques – southern blotting.

Experiment 8: Amplification of DNA fragments by Polymerase chain reaction (PCR) using RAPD primers

Experiment 9: Separation of proteins molecules by SDS-PAGE method

MICROBIAL TECHNOLOGY (LAB) (BT-1552)

Experiment 1: Check the production of antibiotic in Synthetic media.

Experiment 2: Determination of the minimum inhibitory concentration (MIC) antibiotic.

Experiment 3: Demonstration of wine production by using fruit juice and determination of alcohol content.

Experiment 4: Microbial enzyme (lipase/proteinase/pectinase/cellulase) production.

Experiment 5: Production of citric acid in lab.

Experiment 6: Analysis of critical parameters for metabolite production in a fermentor.

Experiment 7: Study of product recovery process using chromatography columns and precipitation techniques.

IMMUNOLOGY (LAB) (BT-1553)

Experiment 1: Purification of lymphocytes from peripheral blood.

Experiment 2: Blood typing and count.

Experiment 3: Haemmagglutination test.

Experiment 4: Isolation of antibody from blood and their quantification using spectrophotometer.

Experiment 5: Purification of antibodies using ammonium sulphate and size exclusion chromatography.

Experiment 6: Immunodiffusion test.

Experiment 7: Rocket electrophoresis.

Experiment 8: Enzyme linked immunosorbent assay (ELISA)-competitive and sandwich.

Experiment 9: Immunoblotting and immunodetection.

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- UNIT 1: Introduction**-Introduction to strings, edit distance strings, string similarity, elementary combinatorics and protocols, Scope of Bioinformatics. 3(L)
- UNIT 2: Sequence Databases and Their Use**-Introduction to databases, database search, algorithms issues in database search, sequence database search, parametric sequence alignments, sub optimal alignments, dynamic programming global and local alignment gaps, multiple alignment, common multiple alignment methods. FASTA and BLAST. Amino acid substitution matrices PAM and BLOSSOM. 8(L)
- Unit 3: Evolutionary Trees and Phylogeny**-Ultrasonic trees, parsimony, ultrametric problem, perfect phylogeny, phylogenetic alignment, connection between multiple alignment and tree constructions. 6(L)
- UNIT 4: Protein Classification and Structure Visualization**-Overview of the protein structure, protein structure visualization, visualization tools and databases, protein structure alignment, protein classification approaches, tools for plotting protein-ligand interaction. 7(L)
- UNIT 5: Protein Structure Prediction**-Protein identification and characterization, primary structure analysis and prediction, secondary structure analysis and prediction, *Ab initio* method for protein prediction, protein function prediction 7(L)
- UNIT 6: Applications of Bioinformatics**- DNA mapping and sequencing, gene predictions, molecular predictions with DNA strings, role of bioinformatics in drug design. 4(L)

Text/ Reference Books:

- Bioinformatics basics, applications in biological science and medicine by Hooman H.
- Bioinformatics: A machine learning approach P. Baladi, S. Brunak
- Algorithms on strings trees and sequences by Dan Gusfield.

ENZYME TECHNOLOGY AND ENGINEERING (BT-1602)

- UNIT 1: Introduction to Enzymes**-Historical aspects, nomenclature and their classification. cost effective production, purification and characterization of enzymes. 8(L)
- UNIT 2: Applications of Enzymes**-Commercial applications of enzymes in food, pharmaceutical and other industries, enzymes for analytical and diagnostic applications. 6(L)
- UNIT 3: Mechanisms and Kinetics of Enzyme Action**-Mechanisms of enzyme action, concept of active site and energetics of enzyme substrate complex formation, specificity of enzyme action, kinetics of single substrate reactions, turn over number, estimation of Michaelis-Menten parameters. 8(L)
- UNIT 4: Enzymes inhibition and multi-substrate enzyme kinetics**-Multi substrate reaction mechanisms and kinetics, types of inhibition, allosteric regulation of enzymes, deactivation kinetics. 4(L)
- Unit 5: Enzyme Immobilisation**-Physical and chemical techniques for enzyme immobilization, adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., examples advantages and disadvantages of different immobilization techniques. 6(L)
- UNIT 6: Enzyme based bio sensors**- Overview of applications of immobilized enzyme systems. Applications of enzymes in analysis, design of enzyme electrodes and their application as biosensors in industry health care and environment. 5(L)

Texts/Reference Books:

- Enzymes: Biochemistry Biotechnology by Trevor Palmer and Philip Bonner, Clinical chemistry.
- Enzyme Chemistry: Impact and Application by Colin J. Suckling & Colin L. Gibson., Blackie Academic & Professional.
- Biochemical Engineering by James M. Lee., Prentice Hall.
- Biochemistry by Lubert Stryer.
- Fundamentals of Enzymology by Nicholas C. Price and Lewis Stevens.
- Enzymes in Food Processing by Gerald Reed, Academic presses.

ANIMAL BIOTECHNOLOGY (BT-1603)

- UNIT1: Introduction of animal cell culture**- Basic principles of animal cell culture, biology of cells in culture and their characteristics, basic requirements for setting up of a animal cell laboratory- space, equipments, aseptic techniques. Safety, ethical issues, norms and guidelines for handling animal cells. 4(L)
- UNIT2: Cell culture media, nutrition and types**-Media for culturing cells and tissues; natural and defined media, effect of their physicochemical characteristics such as pH, temperature, gases, osmolality, etc on cell culture, balanced salt solutions, serum free and serum based media, advantages and disadvantages of serum free media, primary and secondary cell cultures, steps in establishing primary cell culture, characteristics of continuous cell lines, development and their maintenance of cell lines, scaling-up of cell cultures. 7(L)
- UNIT3: Cryopreservation, Quantitation and cytotoxicity**-Need of cryopreservation, cell banks, transporting cells, steps involved in cryopreservation of cell culture, thawing of frozen cell culture. Various methods of cell quantitation- hemocytometer, electronic cell counting, quantitation by measuring total DNA and protein content, cytotoxicity assessment in cell cultures- viability assessment by dye exclusion and dye uptake test, MTT based cytotoxicity assay, clonogenic survival assay. 8(L)
- UNIT4: Micromanipulation of embryos**-Introduction, basics and methodology of micromanipulations. Composition of IVF media, steps involved in IVF, fertilization by micro-insemination. 8(L)
- UNIT5: Transgenic animals**-Concept of transgene and transgenic animals, gene transfer approaches for producing transgenic animals- pronuclear microinjection method, embryonic stem cell method, retroviral vector method, homologous recombination for producing knock-in and knockout mice, sperm mediated DNA transfer. Importance and applications of transgenic animals, study of model transgenic animals. 7(L)
- UNIT6: Industrial application of animal cell culture**:Market existing cell culture product, different medical applications for cell culture including expression system, therapeutics etc. 6(L)

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- Animal Cell Culture by John R. W., Masters Oxford University Press.
- Introduction to Cell and Tissue Culture by Jennie P. Matcher and Penelope E. Roberts., Plenum Press, New York and London.
- Molecular Biotechnology by Primrose.
- Animal Cell Biotechnology by R.E. Spier and J.B. Griffiths, Academic press.
- Animal Biotechnology by Ranga M.M, Agrobios India Limited.

PLANT BIOTECHNOLOGY (BT-1604)

UNIT 1: Plant tissue culture laboratory and media-Introduction to plant cell and tissue culture, historical perspectives, laboratory organization, tissue culture media- composition and preparation. 4(L)

UNIT 2: Cell culture, organogenesis, embryogenesis and production of haploid - Callus formation, organogenesis, protoplast isolation, culture and fusion; selection of hybrid cells and production of somatic hybrid, somatic embryogenesis; somaclonal variation, and application in crop improvement. Production of haploid and homozygous diploid lines through embryo culture, anther and pollen culture. 8(L)

UNIT 3: Regeneration, production, preservation and selection of plant cells-Plant regeneration, production of "synthetic seeds. Cryopreservation for germplasm conservation, clonal and micropropagation. Production of pathogen free plant. Production of plant cell line and its applications. 6(L)

UNIT 4: Genetic engineering in plant-Gene constructs and vector for the production of transgenic plant. Techniques for plant transformation: *Agrobacterium* mediated transformation, physical methods of gene transfer, production of human protein in plant cell (plant bodies) and pharmaceutically useful proteins in plants. Biosafety regulations relating to transgenic plants. 9(L)

UNIT 5: Production of transgenic plant-The genetic manipulation of herbicide tolerance, insect resistance, weedicide resistance plant Genetic modification of plant for biotic and abiotic resistance. Improvement, yield and quality in crop plant. 8(L)

UNIT 6: Chloroplast transformation and production of useful product-Chloroplast transformation: metabolic engineering and industrial products; production of plant secondary metabolites. Production of edible vaccine, molecular farming and its application. 5(L)

Text/Reference Books:

- Experiments in Plant Tissue Culture by John H. Dodds and Lorin W. Robert.
- Plant tissue Culture: Theory and Practice by S.S. Bhojwani and M.K. Razdan Elsevier, Amsterdam.
- An Introduction to Plant Biotechnology by H C Chawla Oxford and IBH.
- Elements of Biotechnology by P.K. Gupta Rastogi Publications.
- Text Book of Biotechnology by B.D. Singh Kalyani Publishers
- Plant Genomics and Proteomics by C.A. Cullis. John Wiley and Sons, New York.
- Plant Functional Genomics by E. Grotewold. Humana Press, Totowa.

IPR AND BIOTECHNOLOGY (BT-1605)

UNIT 1: Why there is a need to commercialize Biotechnology-Discovery, market needs development process, success rates and costs, current need in different sectors of biotechnology in India. 5(L)

UNIT 2: Technology transfer and R&D-Role of Research & development University-industry technology transfer arrangements, how and why a biotech company can benefit, status of R&D in India, different GLPs, GMPs and other practices. 7(L)

UNIT 3: Intellectual properties and application-Intellectual properties in biotechnology, definitions. Trademarks, copyright and related rights, industrial design, traditional knowledge, patent laws, procedures, precautions, patent infringement. WIPO, international conventions. 10(L)

UNIT 4: Bioethics and related legal issues-Bioethics and current legal issues. Ethics of new technology. Marketing and public perceptions in product development. 8(L)

UNIT 5: Bio-business and finance-Art of negotiation & effective communication. Role of venture capitalism, business plan, financing biotech businesses and project finance. 6(L)

UNIT 6: Indian and international scenario of biotechnology based products and future prospects: Indian and foreign prospective of biotechnology and current challenges for the biotechnology based products. 4(L)

Text/Reference Books:

- Positioning by All Rise and Jack Trout, Warner Books.
- Biotechnology: The science and the business by V. Moser and R.E. Cape, Harwood.
- Latest review articles and papers on the subject.

COMMUNICATION SKILL WORKSHOP (HS-1601)

Experiment 1: Art of communication: What is communication, good communication and effective communication, barriers and filters, activity on barriers and filters.

Experiment 2: Body language: verbal and non-verbal behavior interpretation, activity on non-verbal communication.

Experiment 3: Active listening. Active listening quiz.

Experiment 4: Feedback: How to give and receive feedback, Activity on feedback.

Experiment 5: Hidden date of communication: Feelings. Activity on how to handle feelings.

Experiment 6: Practical skills: assertiveness, activity on assertiveness, self-confidence, activity.

Experiment 7: In the world of teams: the team concept, element of teamwork. Team formation, effective team, exercise on team, Team players, activity.

Experiment 8: Discussions, decisions and presentations: Structured and un-structured group discussions. Activity on each.

Experiment 9: Adapting to Corporate life: exercise on grooming and dressing, getting ready for interview.

Experiment 10: Business Etiquette/Dining etiquette.

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UNIT 1: Bioreactor types and operation-Introduction, types of bioreactors, stirred tank reactor, bubble column reactor, fluidized bed reactor, trickle bed reactor, packed bed, trickle bed etc. parallel and series bioreactor. Impellers, stirrer, glands and bearings, packed gland seal, mechanical seal, magnetic drives, baffles, different types of spargers. 7(L)

UNIT 2: Bioreactor Design-Introduction, general design information, design of bioreactors, basic function of a bioreactor design, mass and energy balance, materials of construction for bioprocess plant, mechanical design of process equipment, utilities for biotechnology production plants. 5(L)

UNIT 3: Reactor engineering-Ideal reactors, concept of holding and space time, performance equations for single reactors; multiple reactor systems, design of multiple reactors: kinetics of series and parallel reaction, residence time distributions (RTD), exit age distribution, recycle reactors, recycle ratio for auto catalytic reactions. 6(L)

UNIT 4: Scale Up process-- operation, analysis and scale-up criterion: dimensional analysis, scale-up of stirred tank bioreactors. 4(L)

UNIT 5: Instrumentation and Control-Introduction, measurement of physical and chemical parameters in bioreactors, on-line, in-line and off-line sensors, temperature- pressure measurement and control, foam sensing and control, inlet and exit gas analysis, pH and dissolve oxygen probes. Computer Interfaces and peripheral devices, data logging, data analysis, process control. 9(L)

UNIT 6: Down Stream processing-Overview of bio-separations, strategies to recover and purify products, filtration, centrifugation, cell disruption, liquid-liquid extractions, flocculation, adsorption, precipitation, membrane separation, chromatographic techniques, final steps in purification – crystallization and drying. 9(L)
Perquisite- Knowledge of Bioprocess Engineering.

Text/Reference Books:

- Biochemical engineering by Aiba, Humphrey and Mells, Academic press.
- Bioprocess engineering principles by Pauline M. Doran, Academic Press.
- Biochemical Engineering by H.W. Blanch and D.S. Clark, Marcel Dekker.
- Bioseparations Science and Engineering by Roger. H. Harrison., Oxford University press.
- Applied instrumentation in the Process Industries, Vols I,II,III Andrew W G., Gulf Publishing Company.
- Bioseparations-Downstream processing for Biotechnology by Paul. A. Belter, E.L.Cussler and Wei-Shou Hu., John Wiley and sons.

BIOINFORMATICS (LAB) (BT-1651)

Experiment 1: Retrieval and analysis of sequences (nucleotides/amino acids) from biological databases using BLAST and FASTA.

Experiment 1: Implementation of a selected sequence alignment algorithm.

Experiment 2: Prediction of secondary and tertiary structure of protein from primary structure using homologymodelling.

Experiment 3 : Multiple sequence alignment using ClustalW

Experiment 4 : Calculation of physio-chemical properties of proteins

Experiment 5: Transmembrane prediction

Experiment 6: Protein targeting prediction

Experiment 7: Coiled coil prediction

Experiment 8: Primer designing

ENZYME TECHNOLOGY AND ENGINEERING (LAB) (BT-1652)

Experiment 1: Determination of enzyme activity: Enzyme assay.

Experiment 2: Production of an enzyme under solid state fermentation.

Experiment 3: Production of an enzyme in submerged fermentation.

Experiment 4: Extraction of an enzyme by salting out.

Experiment 5: Purification of an enzyme by size exclusion chromatography.

Experiment 6: Analysis of the isolated microbes for enzymes i.e., protease/cellulase production.

Experiment 7: Enzyme immobilisation either by alginate, agar-agar or cellulose strips.

Experiment 8: Determination of K_m of an enzyme Amylase/Protease/Lipase

Experiment 9: Determination of V_{max} of an enzyme Amylase/Protease/Lipase.

Experiment 10: Determination of K_i for metal inhibitors of amylase Amylase/Protease/Lipase.

ANIMAL BIOTECHNOLOGY (LAB) (BT-1653)

Experiment 1: To study laboratory requirements for animal cell culture.

Experiment 2: To determine the percentage of the viable cells in a suspension by trypan blue exclusion test.

Experiment 3: To study apoptosis by microscopic analysis.

Experiment 4: To establish primary cell culture using fine dissection for disaggregation of tissue & collagenase..

Experiment 5: To perform assay for metabolic activity of cell lines using MTT/XTT dyes.

Experiment 6: Cell proliferation study: measurement of cell growth rate and study of growth kinetics.

Experiment 7: Fluorescence staining and microscopy for cell quantification visualization

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Unit 1: Introduction-Important genera of food borne microorganisms, factors affecting the growth and survival of microorganisms in food. 5(L)

Unit 2: Microbiological examination of food-Direct examination, culture techniques, MPN count, dye reduction assay, immunological methods and advance techniques. 4(L)

Unit 3: Food preservation-Principles of food preservation, asepsis, anaerobic conditions, removal of microorganisms, low temperature, high temperature, radiation, drying, chemical preservatives and miscellaneous methods, canning. 8(L)

Unit 4: Food spoilage-Microbial spoilage of food, common food borne diseases, bacterial agents of food borne illness, non-bacterial agents of food borne illness. 8(L)

Unit 5: Fermented foods-Fermented milk, cheese, sauerkraut, fermented meat, beer, vinegar, fish products, products of baking, oriental foods. Role of enzymes in different food products (bakery, cheese, beverage production and cereal products) and industries, utilization of food waste for production of valuables 9(L)

Unit 6: Quality Control using Microbiological Criteria-Cleaning and disinfection code for good manufacturing practices, microbial and chemical safety of food products, indicator organisms, ISO, hazard analysis and critical control points, sterility testing. 6(L)

Text /Reference Books:

- Modern Food Microbiology by James M. J., CBS Publishers and Publishers.
- Food Microbiology by Freiser.
- Willis Biotechnology, Challenges for the flavour and food industries by Lidsay, Elsevier Applied Science.
- Food Biotechnology by Roger A., Gordan B., and John T.
- Basic Food Microbiology by George J. B., CBS Publishers and Distributors.

PHARMACEUTICAL BIOTECHNOLOGY (BT-1731 to BT-1740)

Unit 1: Introduction-Development of drug and pharmaceutical Industry, therapeutic agents, their use and economics, regulatory aspects. 4(L)

Unit 2: Drug Metabolism and Pharmacokinetics-Drug metabolism-physico chemical principles, radio activity-pharmacokinetic action of drugs on human bodies. 4(L)

Unit 3: Manufacturing Principles-Compressed table, wet granulation, dry granulation or slugging, direct compression, tablet presses, coating of tablets, capsules, sustained action dosage forms, parental solution, oral liquids, injections, ointment-topical applications. 4(L)

Unit 4: Preservation-Preservation, analytical methods and test for various drug and pharmaceuticals, quality management, GMP. 4(L)

Unit 5: Pharmaceutical Product and their Control- Therapeutic categories such as vitamins, laxatives, analgesics, non-steroidal contraceptives, antibiotics, hormones. 8(L)

Unit 6: Application-Pharmacological screening models for therapeutic areas such as hypertension, cerebral ischaemia, pain, epilepsy, depression, parkinson's disease, alzheimer's disease, diabetic, leishmania 5(L)

Text / References Books:

- Theory and Practice of Industrial Pharmacy by Leon Lachman, Lea and Febiger.
- Remington's Pharmaceutical Science, Mark Publishing and Co.

DRUG DESIGN AND DELIVERY (BT-1731 to BT-1740)

Unit 1: Introduction-Introduction to the drug discovery and development, structural effects on drug action, physico-chemical properties that are related to drug action, role and types of chemical bonding involved in drug-target interactions. 3(L)

Unit 2: Approaches and Principles to Drug Design-Enzyme Inhibition, molecular recognition, receptor based molecular modelling, molecular docking, QSAR, agonist and antagonist. Computer-aided drug Design: lead optimization and computer-aided drug design, overview of ligand-based and structure-based design, viewing tools and graphics tools. 7(L)

Unit 3: Preclinical development-Clinical trials, patenting and clearance for application. 5(L)

Unit 4: Designed Drug in Application-Antihypertensive, antiviral, anticancer and antibiotic, combinatorial library and highthroughput Screening 5(L)

Unit 5: Drug Delivery Approaches-Pharmacokinetics and its role in drug discovery, vehicles used for drug delivery, drug development and process development, drug absorption, distribution and excretion 5(L)

Unit 6: Drug Metabolism-Different routes of drug administration, drug absorption, drug transport in biological systems, drug permeation through biological barriers, drug distribution, transcapillary exchange of drugs, perfusion limited and permeability limited distribution of drugs, drug excretion. 8(L)

Text/Reference Books

- Comprehensive Medicinal Chemistry (Vols. I-VI) by C. Hansch
- Design of Enzyme Inhibitors as Drugs by M. Sandler and H. J. Smith.
- Computer Aided Drug Design by T. J. Perun and C. L. Propst., Dekker.
- Molecular Modelling Principles and Applications, Longman by A.R Leach
- Molecular Dynamics Simulation Elementary methods by J.M. Haile, John Wiley.

Professional Elective-II

ENVIRONMENTAL BIOTECHNOLOGY (BT-1740 to BT-1750)

Unit 1: Introduction to Environment-Ecology and ecosystem, environmental pollution (water, soil and air) noise and thermal pollution, their sources and effects. 4(L)

Unit 2: Sewage and waste treatments-Anaerobic and aerobic treatment, conventional and advanced treatment technology, methanogenesis, methanogenic, acetogenic, and fermentative bacteria, waste water treatment. Landfills, composting, vermicomposting, recycling and processing of organic residues. 7(L)

Unit 3: Microbial Interactions and biogeochemical cycles-Microbial interactions, carbon, sulphur and nitrogen cycles, microbial leaching. 4(L)

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surfactants, bioresources, treatment of oil pollution.

Unit 5: Emerging technologies-Use of biomarkers, bioreporters, bioprobes and biosensors for environmental monitoring. 7(L)
8(L)

Unit 6: Bioresource Technology, Development and Issues-Microbial leaching and mining, microbial polymer production and bio-plastic technology biofertilizers and microbial inoculants, biofuel, environmental laws and policies. 10(L)

Text/Reference Books:

- Environmental Microbiology by W.D. Grant and P.E. Long., Blakie, Glasgow and London.
- Manual of Environmental Microbiology by Cristian J.Hurst and Ronald L.Crawford., ASM press.
- Wastewater Engineering, Treatment, Disposal and Reuse by Metcalf and Eddy, Tata Mc Graw Hill.
- Environmental Biotechnology by Foster C.F., John Ware D.A., Ellis Horwood Ltd.
- Environmental Biotechnology by Bruce Rittmann and Perry McCarty
- Biotechnology and Biodegradation, Advances in applied biotechnology series, by Kamely.D., Chakrabarty K and Omen G.S, Gulf publishing company.
- Standard Methods for the Examination of Water and Waste Water. American Public health Association

BIO-NANOTECHNOLOGY (BT-1740 to BT-1750)

Unit 1: Introduction-Concept and definition of bionanotechnology, the nanoscale dimension and paradigm, definitions, history and current practice, overview of current industry application, structural and functional principles of bionanotechnology. 5(L)

Unit 2: Self assembled biological nanostructures-Artificial transmembrane ion channels such as gated and non gated ion channels, nanostructures based on coiled coil peptides, nanostructures synthesized using bio-derived templates. 6(L)

Unit 3: DNA based nanostructures-DNA as a polymer and DNA based motors basics of DNA structure, hairpin loops and helices: reciprocal exchange and stability of DNA structure, Base pairing, motifs used in DNA nanotechnology. RNA polymerase and DNA helicase as motors, single molecule mechanics and DNA dynamics. 6(L)

Unit 4: Biologically inspired nanomaterials for new generation of medicine-Structurally inspired materials like liposomes, virosomes. Polymersomes, peptoids, functionally inspired biomaterials such as mussel-adhesive proteins. 5(L)

Unit 5: Nanostructures in biological detection-Use of quantum dots and gold nanoparticles in electrochemical detection, surface plasmon resonance based detection, fluorescence detection. 5(L)

Unit 6: Techniques used for characterization of nanostructures-Particle size determination, zeta potential, electron microscopy, atomic force microscopy. 5(L)

Text/ Reference Books:

- Nanobiotechnology: Concepts, Applications and Perspectives by Christof M. Niemeyer and Chad A. Mirkin, Wiley-VCH.
- Nanotechnology: A gentle introduction to the next big idea by Ratner, M.Ratener, D.
- Bionanotechnology: Lessons from Nature by David S. Goodsell, John Wiley and Sons.
- Introduction to Nanotechnology by Charles P. Poole, Frank J. Owens, John Wiley and Sons, Inc.

STEM CELLS IN HEALTH CARE (BT-1740 to BT-1750)

Unit 1: Introduction- Stem cell biology, fate mapping of stem cells. 4(L)

Unit 2: Stem Cell Pattern-Differentiated parental DNA chain causes stem cell pattern of cell-type switching in *Schizosaccharomyces pombe* on equivalence groups and the Notch/LIN-12 communication System. 6(L)

Unit 3: Cell Cycle Control-Checkpoints, and stem cell biology, senescence of dividing somatic cells. 4(L)

Unit 4: The Drosophila Ovary-An in vivo stem cell System. 4(L)

Unit 5: Male Germ-line Stem Cells-Primordial germ cells as stem cells, embryonic stem cells, embryonal carcinoma cells as embryonic stem cells, trophoblast stem cells. 7(L)

Unit 6: Hematopoietic Stem Cells-Repopulating patterns of primitive hematopoietic stem cells, molecular diversification and developmental interrelationships, lymphopoiesis and the problem of commitment versus plasticity, hemangioblast, mesenchymal stem cells of human adult bone marrow, stem cells and neurogenesis. 10(L)

Unit 7: Epidermal Stem Cells-Liver stem cells, pancreatic stem cells, stem cells in the epithelium of the small intestine and colon. 5(L)

Text/Reference Books:

- Developmental Biology by Scott F. Gilbert.
- Hematology by William J. Williams, Ernest Beutler, Allan JU. Erslev and Marshall A. Lichtman.
- Molecular Biology of the Cell by Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts and James D. Watson.
- Stem Cell Biology by Marshak, Cold Spring Harbour Symposium Publication.

MAJOR PROJECT (INTERIM EVALUATION) (BT-1791)

Major project provides students an opportunity to demonstrate their ability to independently consider defined problems in detail. A major requirement is that the students should demonstrate knowledge of theoretical concepts and investigative skills and apply them to practical situations relating to their work. Students are required to show that they understand the need for a methodical approach to problems, and that they have the ability for reflection and scientific consideration. On completing of the project, students should be able to learn about:

Exprtiment 1: Plan and complete a significant problem

Exprtiment 2: Find and document, together with their advantages and disadvantages, possible solutions to the problem

Exprtiment 3: Select their preferred solution, and document the arguments for their selection

Exprtiment 4: Understand the advantages and disadvantages of working in a group

Exprtiment 5: Consider alternative working methods, including method-based and problem-based forms.

Exprtiment 6: Present their work using different techniques

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- Experiment 2:** Identification of various cell subsets from human blood.
- Experiment 3:** Counting of CD4+ cells in human blood by immune-fluorescence.
- Experiment 4:** Determination of blood group
- Experiment 5:** Demonstration of tumor agglutination test
- Experiment 6:** Attenuation of bacteria and/or parasite
- Experiment 7:** Demonstration of in vitro infection of macrophages with bacteria and/ or parasite
- Experiment 8:** Demonstration of one way/ two way mixed lymphocyte reaction
- Experiment 9:** Demonstration of Liver function test and Kidney function test.
- Experiment 10:** Estimation of urea in urine samples
- Experiment 11:** Determination of cholesterol in blood samples
- Experiment 12:** Determination of Erythrocyte Sedimentation Rate (ESR)

PLANT BIOTECHNOLOGY (LAB) (BT-1752)

- Experiment 1:** Selection, preparation and sterilization of explant and laboratory wares.
- Experiment 2:** Aseptic culture techniques for establishment and maintenance of cultures.
- Experiment 3:** Preparation of stock solutions of MS (Murashige and Skoog) basal medium and plant growth regulator stocks.
- Experiment 4:** Production Callus from different tissues of plant.
- Experiment 5:** Isolation and culture of protoplasts.
- Experiment 6:** Plant regeneration by embryo/ anther /pollen culture.
- Experiment 7:** Performance of Agrobacterium mediated gene transformation in plant.
- Experiment 8:** Performance of gene transfer by physical delivery method.
- Experiment 9:** Isolation of plant genomic DNA by modified CTAB method.
- Experiment 10:** Screening of putative transformed plants cell by PCR/ Fluorescent dye test

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- UNIT 1: Introduction**-Introduction, process design development. General design considerations, procedure, feasibility survey, flow diagrams. 4(L)
- Unit 2: Process Plants**-Batch versus continuous operation, bioprocess plant and equipment start up and shut downs, operations at steady state. Factors effecting investment and production cost, capital investments, estimation of capital investments. 7(L)
- UNIT3: Direct Expenses**-Manufacturing costs general expenses, estimation of total product of cost direction, direct production cost, fixed charges, plant overhead costs, financing, administration expenses, distribution and marketing expenses. 7(L)
- UNIT4: Legal policies**- Environmental protection, health and safety factors, materials of construction, plant location, government polices and company polices. 6(L)
- UNIT5: Plant Operation and Control**-Instrumentation, maintenance, utilities;supply of power,abundance of good water supplies, storage, materials handling 6(L)
- UNIT6: Financial statements**-Basic relationships in accounting, balance sheet and profit and loss account, factors affecting investment and production costs, price fluctuations, operating time and rate of production, capital investments, fixed-capital Investment, working capital. 8(L)

Text/Reference Book list:

- Plant Design and Economics for Chemical Engineering by M.S. Peters and K.D.Timmerhaus., McGraw Hill.
- Process Engineering Economics by Schweyer.
- Biochemical Engineering by Aiba, Humphry and Millis, Academic press.

Professional Elective-III

BIOSENSOR TECHNOLOGY (BT-1831 to BT-1840)

- Unit 1: Introduction**-Introduction to biosensors: concepts and applications, biosensing and biosensor technology. Review of important analytes and biomolecules. 3(L)
- Unit 2: Study of biological sensors**-Sensors / receptors in the human body, basic organization of nervous system-neural mechanism and circuit processing. Chemoreceptor: hot and cold receptors, barro receptors, sensors for smell, sound, vision, osmolality and taste. Sensor models in the time and frequency domains. 6(L)
- Unit 3: Transduction principles**-Classification of transducers, selecting of transducers, circuit based on transduction. Temperature transducers: thermo-resistive transducers, thermoelectric, p-n junction, chemical thermometry. Pressure transducer, photoelectric transducers, flow transducers, displacement transducers. 7(L)
- Unit 4. Analytical Techniques**-Chemical sensing methods, optical sensing mechanisms and tools, eletrochemical sensing mechanisms and tools, mass spectroscopy. 7(L)
- Unit 5: Biochemical Transducers**-Biopotential electrodes: microelectrodes, body surface electrodes, needle electrodes. Reference electrodes: hydrogen electrodes, silver-silver chloride electrodes, calomel electrodes. Recording electrodes for ECG, EEG, and EMG. Transducers for the measurement of ions and dissolved gases, pH electrode, specific ion electrodes. 8(L)
- Unit 6: Application**-Applications of biosensor-based instruments to the bioprocess industry, application of biosensors to environmental samples, introduction to biochips and their application in modern sciences. 5(L)

Text /Reference Books:

- Handbook of Biomedical Instrumentation by R. S. Khandpur, Tata McGraw Hill.
- Transducers for Biomedical Instruments by S.C. Cobbold, Prentice Hall.
- Engineering Principles in Physiology Vol. I by Brown & Gann, Academic Press.
- Introduction to Biomedical Equipment Technology by Carr and Brown Pearson Education, Asia.
- Principles of Medical Electronics & Biomedical Instrumentation by Rao and Guha, University Press, India.

CELL AND TISSUE ENGINEERING (BT-1831 to BT-1840)

- Unit 1: Introduction**-Basic definition, structural and organization of tissues: epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing. Cells and cell injury, extracellular matrix and cell biomaterial interactions. 7(L)
- Unit 2: Cell culture**-Different cell types, progenitor cells and cell differentiations, aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization, bioreactors. 6(L)
- Unit 3: Biocompatibility and Testing**-Bioresorbable materials, introduction to testing of biomaterials, tissue compatibility and prosthetic devices. Biocompatibility and toxicological test for screening of biomaterials. Role of molecular biology in tissue engineering. 9(L)
- Unit 4: Scaffold and transplant**-Engineering biomaterials for tissue engineering, degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Prosthesis, transplantation biology. 9(L)
- Unit 5: Gene Therapy**-Virus, liposome, receptor, CaPO₄, electroporation and gene gun-mediated gene transfer into mammalian cells. Computer aided tissue engineering. 4(L)
- Unit 6: Ethical and Legal Issues**-Ethical issues in biomaterial science, legal aspects of biomaterials. 4(L)

Text / Reference Books:

- Frontiers in Tissue Engineering by Patrick, Mikos and McIntire, Pergamon Press.
- Principles of Tissue Engineering by Lanza, Labnger and Vacanti, Academic Press.
- Tissue Engineering Methods and Protocols by Morgan and Yarmush, Humana Press.
- Biomaterials Science by Buddy D. Ratner, AS Hoffman, FJ Schoen and Jack E Lemons. Academic Press.
- Principles of tissue engineering by Robert. P.Lanza, Robert Langer and William L. Chick, Academic press.
- The Biomedical Engineering -Handbook by Joseph D. Bronzino., CRC press.
- Introduction to Biomedical Engg. by Enderle, Blanchard and Bronzino., Academic press.
- Tissue Engineering by B. Palsson, J.A. Hubbell, R.Plonsey and J.D. Bronzino, CRC- Taylor and Francis.

- Mass cultivation of microbial inoculants, plant growth promoting rhizobacteria, diazotrophic microorganisms, free living and symbiotic nitrogen fixing microbes, Molecular basis of legume *rhizobium* symbiosis. 8(L)
- Unit 2: Molecular Farming**-Molecular farming, use of plants and animals for production of nutraceuticals, organic farming and sustainable use of natural and bioresources, integrated pest management, world food security. 8(L)
- Unit 3: Soil Microbiology**-Soil as a habitat for microorganisms, rhizosphere: concept, rhizospheric effect and microorganisms, factors affecting microbial community in soil, organic matter decomposition, carbon assimilation and immobilization. 6(L)
- Unit 4: Agriculture Biotechnology and Laws**-Plant variety protection act, TRIPS and WTO, patenting of life forms-plant and products, Plant breeders rights. 6(L)
- Unit 5: Agricultural Biotechnology and Society**-Commercial status and public acceptance, bio-safety guidelines for research involving GMO's, benefits and risks, socio-economic impact and ecological considerations of GMO's. 6(L)
- Unit 6: Agribusiness and Entrepreneurship**-Types of business organizations, characteristics of small and medium agribusinesses. Setting up of an agribusiness unit and development of a business plan. Marketing strategies for an agribusiness. Entrepreneurship: generation of business ideas and innovation. Clustering. Incubators. 6(L)

Text /Reference Books:

- Agricultural Biotechnology by Arie Altman. Marcel Dekker, Inc.
- Plants, Genes and Crop Biotechnology by Chrispeels, M.J. and Sadava D.E. American Society of Plant Biologists, Jones and Bartlett Publishers, USA.
- Biochemistry and Molecular Biology of Plants by Buchanan B.B., Grissem W and Jones RL, American Society of Plant Biologists, USA.
- Soil Microorganisms and Plant Growth by Rao Subba S.M.
- Biotechnology and integrated pest management by Persely, CAB, Wallingford.
- Plant Biotechnology: The genetic manipulation of plants by A. Slater, N. Scott, M. Fowler; Published by Oxford University press, New York.
- Food and Vegetable Biotechnology by V. Valpuseta., CRC Press, New Delhi.

Professional Elective-IV

MICROBES, HEALTH AND VACCINES (BT-1841 to BT-1850)

- Unit 1: Introduction to microflora, disease and clinical handling**-Normal flora of human body, principles of disease and epidemiology, collection and transport of clinical specimens for microbiological examinations. 4(L)
- Unit 2: Disease Cycle and Pathogenesis**-Disease cycle, mechanism of pathogenesis: entry, adhesion, colonization, invasion, avoidance of host defense mechanisms, role of aggresins, host parasite interactions. 7(L)
- Unit 3: Important Diseases**-Important food-borne, water-borne, blood-borne, vector-borne, nosocomial, zoonotic, and STD infections prevalent in the human population. Morphology, culture, biochemical, pathogenicity, lab diagnosis and prevention of these important diseases, nosocomial infections. 13(L)
- Unit 4: Emerging Diseases**-Emerging infectious diseases, factors leading to disease emergence, monitoring and intervention strategies. 6(L)
- Unit 5: Bioterrorism**-Bioterrorism and bio-weapons: historical perspective, current situation, future threats. 4(L)
- Unit 6: Vaccines and Antibiotics**-Vaccines, disease eradication programs, antibiotics and the genetics of antibiotics resistance. 6(L)

Text /Reference Books:

- The Short Text books of Medical Microbiology by Satish Gupte. Jaypee Brothers, Medical Publishers (P) Ltd., New Delhi.
- Text Book of Microbiology by Ananthanarayan R and CK Jayaram Paniker. Orient Longman Private Limited.
- Essentials of Medical Microbiology by Rajesh Bhatia and Rattan Lal Ichhpujani. Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.
- Text book of Medical Parasitology, Protozoology and Helminthology by Subhash Chandra Parija., All India Publishers & Distributors, Medical Books Publishers, New Delhi.
- Bailey and Scott's - Diagnostic Microbiology by Baron EJ, Peterson LR and Finegold SM Mosby Publications.
- Principles of Bacteriology, Virology and Immunology by Topley and Wilsons., Edward Arnold, London.

BIOENERGY (BT-1841 to BT-1850)

- Unit 1: Introduction**-Bioenergy, classification and sources of energy, problems relating demand and supply of various energy sources. 3(L)
- Unit 2: Coal**-Origin and formation, composition and classification, resources and production, exploration and mining, analysis and testing storage and handling; coal carbonisation, briquette, coal hydrogenation. Wood and wood products. 4(L)
- Unit 3: Petroleum**-Origin, occurrence, chemical composition, world reserve, production, refining operations, storage and conveying, testing and analysis different products from petroleum. Combusting methods; and systems, pulverised coal furnaces; cyclone furnaces, oil fired systems, gas fired systems, waste heat boilers 6(L)
- Unit 4: Biogas plant and its design**-KVIC plants, process kinetics, digester design, sludge treatment, energy from wastes. Development in energy routes. 5(L)
- Unit 5: Conversion of heat to power**-Thermoelectric converters, thermo-electric refrigerators, magneto-hydrodynamics, fuel cells, conversion of chemical energy into electricity, fuel cell performance, co-generation, efficiency improvement, energy conversion in petrochemical industries, polymer industries, natural organic industries, fertilizer industries etc. 6(L)
- Unit 6: Energy conservation**-Process modifications, preventing energy loss, waste utilisation, energy audit. 4(L)

Text/Reference Books:

- Conventional Energy Technology - Fuels and chemical Energy by S.B Pandya., TMH.
- Fuels and Combustion by S.P. Sharma and Chander Mohan., TMH.
- Energy resources, demand and conservation with special reference to India by Kash Kori, C., TMH.
- Principles of Energy Conservation by Gulp Jr., MGK.

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- Non Conventional energy resources by Pryde P.K., J.W.
- Tidel Power by Gray T.J. and Gashos G.K., Plenum Press.
- Fuels and Combustion by Sarkar S, Orient Longmans.

BIODIVERSITY AND BIOPROSPECTING (BT-1841 to BT-1850)

Unit 1: Ecosystems-Major ecosystems and their flora and fauna. Co-evolution, symbiosis and interaction among organisms. 6(L)

Unit 2: Taxonomy-Nomenclature and classification of flora and fauna. 6(L)

Unit 3: Biodiversity-Analysis of biodiversity, on farm, *ex situ*, *in situ* and gene bank conservation, geological and human activities endangering biodiversity, domestication and utilization of biodiversity. 8(L)

Unit 4: Organic Farming-Organic farming and sustainable use of natural and bioresources, organic standards and certification of organic produce and products, biological control, global initiatives on future prospects. 8(L)

Unit 5: Bioprospecting-Bioprospecting biodiversity for food, feed, health care and other products. Ethnobiology. 8(L)

Unit 6: Bioprospecting of Extremophiles-Bioprospecting and conservation of extremophile microorganisms. 5(L)

Text/Reference Books:

- Biodiversity: New leads for the pharmaceutical and agrochemical industries by S.K., Hayes M.A., Thomas R, Chrystal E.J.T. and Nicholson L. Royal Society of Chemists., Wrigley.
- Biological and Biotechnological Resources by G Tripathi and Y.C. Tripathi., Campus Books International.

MAJOR PROJECT (FINAL EVALUATION) (BT-1891)

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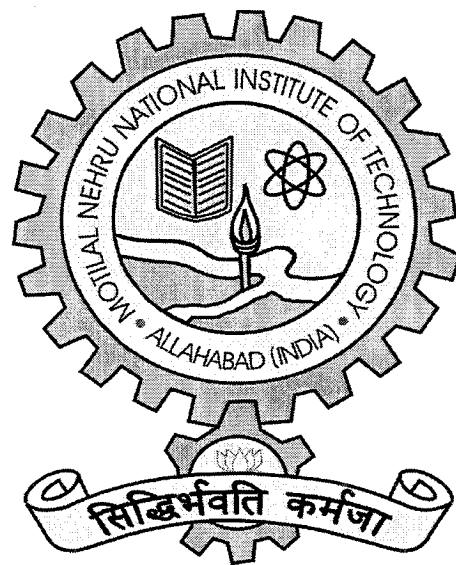
Course Structure & Curriculum

For

B. Tech. Programme

In

CHEMICAL ENGINEERING



Department of Chemical Engineering

Motilal Nehru National Institute of Technology

Allahabad

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Curriculum for
Bachelor of Technology in
Chemical Engineering

3rd Semester (Chemical Engineering)

Course Code	Course name	L	T	P	Credit
ME-1301	Engineering Thermodynamics	3	1		4
CL-1301	Fluid Particle Mechanics and Mechanical Operations	3	1		4
AM-1303	Material Science and Engineering	3			3
EE-1305	Basic Electrical and Electronics	3			3
MA-1301	Numerical Methods and Statistical Techniques	2	1		3
AM-1305	Fluid Flow Operations and Hydraulic Machine	3	1		4
ME-1351	Computational (Lab)			3	2
AM-1352	Material Science (Lab)			3	2
AM-1354	Fluid Flow Operations (Lab)			3	2
CL-1351	Mechanical Operation (Lab)			3	2
Total		17	4	12	29

4th Semester (Chemical Engineering)

Course Code	Course name	L	T	P	Credit
CH-1401	Organic and Physical Chemistry	2	1		3
CL-1401	Process Equipment Design – I	3	1		4
CL-1402	Heat Transfer Operations	3	1		4
CL-1403	Mass Transfer – I	3	1		4
CL-1404	Chemical Technology – I	3			3
CL-1405	Chemical Process Principles	3	1		4
CH-1451	Organic and Physical Chemistry (Lab)			3	2
CL-1451	Heat Transfer (Lab)			3	2
CL-1452	Mass Transfer (Lab- I)			3	2
Total		17	5	9	28

5th Semester (Chemical Engineering)

Course Code	Course name	L	T	P	Credit
CL-1501	Chemical Reaction Engineering - I	3	1		4
CL-1502	Mass Transfer – II	3	1		4
CL-1503	Process Dynamics and Control	3	1		4
CL-1504	Chemical Technology – II	3			3
CL-1505	Chemical Engineering Thermodynamics	3	1		4
HS-1501	Principles of Management	3			3
CL-1551	Mass Transfer (Lab – II)			3	2
CL-1552	Chemical Reaction Engineering (Lab – I)			3	2
CL-1553	Process Dynamics and Control (Lab)			3	2
Total		18	4	9	28

6th Semester (Chemical Engineering)

Course Code	Course name	L	T	P	Credit
CL-1601	Advanced Separation Processes	3	1		4
CL-1602	Transport Phenomena	3	1		4
CL-1603	Environmental Pollution, Monitoring and Control	3	1		4
CL-1604	Chemical Reaction Engineering - II	3	1		4
CL-1605	Process Equipment Design – II	3	1		4
HS-1601	Communication Skill Workshop			2	0
CL-1651	Environmental Monitoring (Lab)			3	2
CL-1652	Chemical Reaction Engineering (Lab – II)			3	2
CL-1653	Process Design and Simulation (Lab)			3	2
CL-1654	Chemical Technology (Lab)			3	2
Total		15	5	14	28

16/10

7th Semester (Chemical Engineering)

Course Code	Course name	L	T	P	Credit
HS-1701	Economics	3			3
CL-1701	Plant Design and Economics	3	1		4
OE -1781	Open Elective-I	3			3
CL-1731 to CL-1740	Professional Elective – I	3	1		4
CL-1741 to CL-1750	Professional Elective – II	3	1		4
CL-1791	Major Project – I			12	6
	Total	15	3	12	24

8th Semester (Chemical Engineering)

Course Code	Course name	L	T	P	Credit
CL-1801	Hazards and Safety in Chemical Industries	3	1		4
OE-1881	Open Elective-II	3			3
CL-1831 to CL-1840	Professional Elective – III	3	1		4
CL-1841 to CL-1850	Professional Elective – IV	3	1		4
CL-1891	Major Project – II			12	6
	Total	12	3	12	21

1st digit; 1: UG, 2nd digit; 2, 3, etc.: Semester

Code	Description
01-30	Theory Courses
31-40	Professional Elective –I
41-50	Professional Elective –II
51-70	Practical Courses
81-90	Open Elective
91-99	Project

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UNIT 1: Introduction to thermodynamics System, surroundings, boundaries, classification of systems. Unit and dimensions, conversion factors. Properties of systems, equilibrium, processes, heat and work interaction. The work interaction. Thermodynamic definition of work, characteristics of the work interaction. Evaluation of work. Adiabatic systems and processes.	9(L)
UNIT 2: Diathermic boundary, Zeroth law. Isothermal states. Empirical temperature. Principles of thermometry. Scales of temperature. Gas thermometer. The ideal gas. Ideal gas temperature scale.	4(L)
UNIT 3: The first law. Basic form. Energy of a system. The heat interaction. Sign convention. First law for open systems. Steady-flow energy equation and its applications.	4(L)
UNIT 4: Equations of state. Properties of gases. Properties of steam. Introduction to steam tables. Other equations of state. Van-der-waals gas. Critical state. Reduced equation of state.	4(L)
UNIT 5: The second law. Kelvin-Planck and Clausius statements. Equivalence of statements. Carnot theorem. Thermodynamic temperature. Kelvin scale. Carnot engine, refrigerator and heat pump.	6(L)
UNIT 6: Clausius inequality. Definition of entropy. Combined first and second law, Evaluation of entropy. Principle of increase of entropy.	4(L)
UNIT 7: Irreversibility and exergy. Lost work.	3(L)
UNIT 8: Introduction to cycles. Classifications of cycles. Gas power cycles- Otto, Diesel, Brayton. Vapour power cycle- Rankine cycle, vapour- compression refrigeration cycle.	5(L)

Text/Reference Books

- Engineering thermodynamics by P K Nag, Tata McGraw Hill
- Thermodynamics : An engineering approach by Cengel & Boles, McGraw Hill

FLUID PARTICLE MECHANICS AND MECHANICAL OPERATIONS (CL-1301)

UNIT 1: Properties of Particulate Solid- Introduction to unit operations and their role in Chemical Engineering industries. Types of Mechanical Operations, Characteristics of particulate solids: sampling techniques, specification and screen analysis, particle size distribution, particle size measurement, Surface area measurements and statistical mean diameters.	6(L)
UNIT 2: Handling of Particulate Solid- Transportation, conveying of bulk solids, classification and selection of conveyors. Storage of solids in bulk protected and unprotected piles, bins, silos, hoppers, mass flow and funnel flow Bins, Flow assisting devices, feeders. Weighing of bulk solids, batch and continuous weighing techniques.	7(L)
UNIT 3: Mechanical Separation- Classification of separation methods for mixtures of solid-solid, solid-gas and solid-liquid. Screening, Classifiers, magnetic separation, electrostatic separation. Gravity settling, sedimentation, jigging, Floatation and elutriation. Continuous thickeners, decantation, Phase separation: Centrifugal separation, Electrostatic precipitators. Gas-solid separation: Gravity settling, Impingement separators, Cyclone separators, bag filters, scrubbers.	8(L)
UNIT 4: Size reduction and enlargement- Principles of size reduction: Specific properties of solids for size reduction. Energy required for size reduction. Crushing and grinding efficiency. Laws of crushing, pulverization and ultrafine grinding. Classification of crushing and grinding equipment. Size enlargement: Scope and applications, size enlargement techniques, principle of granulation, briquetting, pelletisation, and flocculation.	8(L)
UNIT 5: Filtration- Theory of filtration, Batch and continuous filters, Flow through filter cake and filter media, compressible and incompressible filter cakes, filtration equipments - selection, operation and design of filters and optimum cycle of operation, filter aids.	6(L)
UNIT 6: Mixing of Solids & Pastes- Mixing and agitation - Mixing of liquids (with or without solids), mixing of powders, selection of suitable mixers, power requirement for mixing.	3(L)

Text/Reference Books

- Coulson and Richardson: Chemical Engineering, Vol. 2. Butterworth Heinemann Pub
- Perry R.H. & Chilton C.H., "Chemical Engineers Hand Book", McGraw hill.
- Foust A. S. & Associates, "Principles of Unit Operations" John Wiley and Sons.
- McCabe Smith, "Unit Operation in Chemical Engineering" 5th ed. McGraw Hill.

MATERIAL SCIENCE AND ENGINEERING (AM-1303)

UNIT 1: Introduction- Historical perspective of Materials Science, Structure and properties relationship of Engineering Materials, Classification of materials, Advanced Materials.	3(L)
UNIT 2: Structure of Solids and Characterization of Materials- Introduction to crystal structures and systems, Metallic structures, Ceramic crystal structures, Carbon nano-structures, Crystallographic directions and planes, Miller indices, Density computations, Crystallography, Diffraction methods, Electron microscopy, Metallography, Thermal characterization techniques.	6(L)
UNIT 3: Imperfections in Solids- Point defects, Dislocations, Interfacial Defects, Bulk defects.	4(L)
UNIT 4: Diffusion- Diffusion mechanisms, steady and non-steady state diffusion, Factors that influence diffusion, Law's of diffusion, Applications of Diffusion.	4(L)
UNIT 5: Mechanical Behaviour of Materials- Elastic and plastic properties, Creep, Fatigue, Fracture, Heat treatment of steels.	6(L)
UNIT 6: Phase Diagrams and Phase Transformations- Unary, Binary, Equilibrium phase diagrams, Eutectic, Eutectoid, Peritectic and peritectoid reactions, Transformation rate effects and TTT diagrams. Microstructure and property changes in iron-carbon system, Iron-Carbon (Fe-C or Fe-Fe ₃ C) Diagram.	6(L)
UNIT 7: Ceramic Materials- Ceramic types, Properties, Processing Application, Advanced ceramics.	2(L)
UNIT 8: Composites- Introduction, Applications, Particle reinforced composites, Fiber reinforced composites, Structural composites.	2(L)
UNIT 9: Thermal, Electrical, Magnetic, Optical Properties- Heat capacity, Thermal expansion, Thermal conductivity, Thermal stresses, Electrical conduction, Semi conductivity, Super conductivity, Electrical conduction in ionic ceramics and in polymers, Dielectric behaviour, Ferroelectricity, Piezoelectricity, Diamagnetism and paramagnetism, Ferromagnetism, Antiferromagnetism and	

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properties of non-metals, Application of optical phenomena. 5(L)
UNIT 10: Economic, Environmental and Social Issues of Material Usage-Economic considerations, Environmental and societal considerations, Recycling issues, Life cycle analysis and its use in design. 2(L)

Text/Reference Books

- Callister W. D. Jr., Materials Science and Engineering An Introduction.
- Van Vlack, Material Science.
- Raghavan V, Material Science.
- K. M. Gupta, Material Science and Engineering.

BASIC ELECTRICAL AND ELECTRONICS (EE-1305)

Electrical Engineering:

Unit 1: Introduction to Electrical Energy: Generation: Types of power Plant, Functional Block diagram of generating stations (Hydel & Thermal Stations); Transmission, Distribution and Utilization, Domestic Wiring: Materials, accessories & ratings of the wiring materials, types of wiring, earthing and electricity rules. 3(L)

Unit 2: Electric Circuits: Basic Circuit Elements, Ohm's law, KCL & KVL, Node & Loop Analysis, Superposition, Thevenin's Theorem & Norton's Theorem, Maximum Power Transfer Theorem. 4(L)

Unit 3: Steady-state analysis of AC circuits: Sinusoidal and phasor representation of Voltage & current, single phase ac circuit behaviour of R, L and C. Combination of R, L and C in series and parallel, Resonance. three-phase circuits. 4(L)

Unit 4: Transformer & Rotating Machines: Principle of operation and construction of single-phase transformer, efficiency and voltage regulation. Principle of electromagnetic energy conversion, Starting and speed control of DC and AC motors. 4(L)

Electronics Engineering:

Unit 1: Semiconductor Devices: Junction Diode, Bipolar -junction Transistor, JFET and MOSFET, Linear IC and its applications. 5(L)

Unit 2: Digital circuits: Number systems, conversion of bases, Boolean Algebra, logic gates, Concept of universal gate, Flip-Flops and counter. 5(L)

Measurement and Mechatronics Instrumentation:

Unit 1: Measuring Instruments: Types of instruments, working principles of Ammeter, Voltmeter, Wattmeter & Energy meter, Digital instruments, Oscilloscopes. 3(L)

Unit 2: Transducers and Sensors: for measurement of displacement, velocity, acceleration, force, torque, liquid level flow, temperature etc. 2(L)

Unit 3: Signal Conditioning: Operational Amplifiers and Circuits, Instrumentation amplifiers, Voltage to Current converters and Current boosters, Logarithmic amplifiers filters. 3(L)

Unit 4: Timing Circuits: VCO, Waveform Generator, 555 timer circuits. 1(L)

Unit 5: Converters: Analog to Digital and Digital to Analog Conversion, Sample and Hold circuits, Analog, multiplexers, de-multiplexers. 1(L)

Unit 6: Power Control: SCRs, Triacs and other solid state devices various power converters and power control. 2(L)

Unit 7: Actuators and Motors: Actuators, Brushed DC servo motors, Brushless PM motors and controllers, The AC induction motor as a servo drive, stepper motor. 2(L)

Unit 8: Controllers for automation: Introduction to microprocessors, Automation of systems using microcontrollers. 1(L)

Text/Reference Books

- V. Del Toro: Principle of Electrical Engineering, PHI
- W. H. Hayt & Kemmerley, Engineering Circuit Analysis, Mc Graw Hill.
- Millman & Halkias, Integrated Electronics, TMH
- Boylstad & Nashishky, Electronic Devices & circuits, PHI
- Mavino & Leach, Digital Principles and applications.
- W. D. Cooper Electronic Instrumentation & Measurement Techniques, PHI
- D. V. S. Murthy, Transducer and Instrumentation,
- Richard M. Crowder, Electric Drives and their Controls
- Douglas V. Hall, Microprocessors and interfacing programming and Hardware
- Scot Mackenzie, The 8051 Microcontrollers

NUMERICAL METHODS AND STATISTICAL TECHNIQUES (MA-1301)

UNIT 1: Errors in numerical computation, Algebraic and Transcendental Equations-Errors in numerical computation and their analysis, Bisection method, Iteration method, Newton-Raphson Method, Method of False Position, rate of convergence, Method for complex root, Muller's Method, Quotient Difference method. 8(L)

UNIT 2: Interpolation-Introduction, Errors in Polynomial interpolation, Finite differences, Decision of errors, Newton's formula for interpolation, Gauss, Sterling, Bessel's, Everett's Formula, Interpolation by unevenly spaced points, Lagrange interpolation formula, Divided Difference, Newton's General interpolation Formula. 9(L)

UNIT 3: Curve Fitting, Cubic Spline & Approximation-Introduction, Method of Least Square curve fitting procedures, Fitting a straight line, Curve fitting by sum of exponential, Data fitting with cubic splines, Approximation of functions. 7(L)

UNIT 4: Numerical Integration and Differentiation-Introduction, Numerical differentiation, Picard Iteration Method of Solution, Numerical integration, Trapezoidal rule, Simpson 1/3 rule, Simpson 3/8 rule, Booles & Weddles rule, Euler- Maclariaum formula, Gaussian Formula, Numerical evaluation of singular integrals. 5(L)

UNIT 5: Numerical Linear Algebra-Numerical techniques for finding solution of system of linear equations and eigen values: Gauss Jordan, Gauss Seidel methods, Power method for estimating eigen values: LU and LL^T factorization of matrices. 6(L)

UNIT 6: Statistical Computations- Discrete and continuous distribution, of function, Poisson and Normal Distribution, Mean & Variance. Moment Generation Function, linear statistical model, theory of least squares and analysis of variance, least squares

Text/Reference Books

- C.F.Gerald and P.O.Wheatley, Applied Numerical Analysis, Pearson Education
- M.K.Jain, S.R.K.Iyenger and R.K.Jain, Numerical Methods for Scientific and Engineering Computation, Wiley Eastern Ltd.
- S.S Sastry, Introductory Methods of Numerical Analysis, Prentice Hall
- S.Rajasekharan, Numerical Methods for Science and Engineering, S.Chand.
- James I. Buchman and Peter R.Turner, Numerical Methods and Analysis, McGraw-Hills Inc

FLUID FLOW OPERATIONS AND HYDRAULIC MACHINE (AM-1305)

UNIT 1: Introduction to Fluid Mechanics- Statics and Kinematics-Fluid and continuum, Physical properties of fluids, Types of fluid flows, Rheology of fluids. Manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, fluid masses subjected to linear acceleration and uniform rotation about an axis. Kinematics of Fluid flow: steadiness, uniformity, rotational and irrotational flows, streamline, streakline, pathline, continuity equation, stream function and velocity potential, applications of potential flow. 8(L)

UNIT 2: Dynamics of Fluid Flow and Dimensional Analysis-Euler's Equation of motion along a streamline and its integration, Bernoulli's equation and its applications, momentum equation and its application to pipe bends. Flow measurement by Pitot tube, orifice, Venturi, nozzle, and bend meter, rotameter. Dimensional Analysis, Buckingham's Pi theorem, important dimensionless numbers and their physical significance, geometric, kinematic and dynamic similarity, model studies, Hydraulic similitude. 8(L)

UNIT 3: Laminar and Turbulent Flows-Equation of motion for laminar flow through pipes, Stokes law, transition from laminar to turbulent flow, types of turbulent flow, isotropic and homogenous turbulence, scale and intensity of turbulence, eddy viscosity, Prandtl's mixing length theory, velocity distribution in turbulent flow over smooth and rough surfaces, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, three reservoir problems and pipe network. 8(L)

UNIT 4: Hydrodynamic Boundary Layer-Introduction with a historical background, boundary layer, displacement and momentum thickness, boundary layer over a flat plate, Prandtl boundary layer equation, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub-layer, separation and its control, drag and lift, drag on a sphere, 2D cylinder and airfoil, Magnus effect. 8(L)

UNIT 5: Introduction to Compressible Flow-Thermodynamic processes, continuity equation, work done in an isothermal process and adiabatic process, sonic velocity, Mach number, Mach line, Mach angle and Mach cone, properties a stagnation point, flow through a convergent-divergent nozzle and De Laval nozzle, Normal and oblique shocks, Rayleigh and Fanno flows. 3(L)

UNIT 6: Introduction to Pumps & Compressors-Pumps: Classifications & applications, losses and efficiencies, work and power input, cavitations and maximum suction lift, specific ad minimum speed, comparison between centrifugal and reciprocating pumps, multistage pumps, pumps in series and parallel. Compressors: Introduction to Hydroelectric power station and its components, Classification of turbines and pumps, similarity laws and specific speed, efficiency, cavitations. 5(L)

Text/Reference Books

- Fox, R.W., McDonald, A.T., Introduction to Fluid Mechanics, 7th edition, Wiley India.
- Ojha, C.S.P., Berndtsson, R., Chandramouli, P.N., Fluid Mechanics and Machinery, Oxford University Press, New Delhi.
- Majumdar, B., Fluid Mechanics with Laboratory Manual, PHI Learning, New Delhi.
- Som, S.K. and Biswas G, Introduction of Fluid Mechanics & Fluid Machines, TMH, New Delhi.
- Mohanty, A.K., Fluid Mechanics, PHI Learning, New Delhi.
- Shames, I.H., Mechanics of Fluids, McGraw Hill, International Students Edition.
- Agarwal, S.K., Fluid Mechanics and Machinery, TMH, New Delhi.
- Rathakrishnan E., Instrumentation, Measurements and Experiments in Fluids, CRC Press, New York.
- Garde, R.J., Fluid Mechanics through Problems, New Age International Pvt. Ltd, New Delhi.
- Lal, J., Hydraulic Machines, Metropolitan Book Co. Pvt. Ltd., Delhi.
- Yahya, S.M., Fans, Blowers & Compressors, New Age International Pvt. Ltd., New Delhi.

COMPUTATIONAL LAB (ME-1351)

Experiment 1: Make a program to evaluate a given polynomial $f(x)$ for a given value of x using Horner's Rule.

Experiment 2: Make a program to find the derivative of a given polynomial $f(x)$ for a given value of x .

Experiment 3: Make a program to find the roots of a given polynomial $f(x)$ using following methods:

- Bisection method.
- Method of False Position.
- Iteration method.
- Newton-Raphson method.
- Secant method.
- Muller's method.
- Lin-Bairstow's method.
- Quotient-Difference method.

Experiment 4: Make a program to solve the given set of equations using Gauss-Seidel Iterative method.

Experiment 5: Make a program to determine the following difference tables for given data points:

- Forward Difference table.
- Backward Difference table.
- Central Difference table.
- Divided Difference table.

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data points using the following methods:

- a) Newton's Forward and Backward Difference methods.
- b) Gauss, Stirling, Bessel's and Everett's methods.

Experiment 7: Make a program to find the interpolation polynomial / interpolation value of $f(x)$ at a specified value for unevenly spaced data points using the following methods:

- a) Lagrange Interpolation method
- b) Newton's General Interpolation method.

Experiment 8: Make a program to fit a given polynomial to the given set of data points and to evaluate it at a specified value of x .

Experiment 9: Make a program to find the n^{th} ($n = 1, 2$ and 3) derivative of $f(x)$ at a specified value of x for the given set of data points.

Experiment 10: make a program to find the numerical integration of $f(x)$ at a specified value of x for the given set of data points using the following rules:

- a) Trapezoidal rule.
- b) Simpson 1/3 & Simpson 3/8 rules.
- c) Boole's and Weddle's rules.
- d) Gaussian formula.

MATERIAL SCIENCE (LAB) (AM-1352)

Experiment 1: Study of various dislocation models, drawing burgers circuit and finding Burgers vector.

Experiment 2: Study of various unit cells and crystals for,

- a) Their geometry and symmetry,
- b) Total number of atoms and their arrangement,
- c) Effective number of atoms per unit cell,
- d) Co-ordination number,
- e) Atomic packing efficiency,
- f) Determining density,
- g) Concept of Miller indices and Inter-planer spacing.

Experiment 3: To study the effect of a surface treatment (Etching) on the strength of glass.

Experiment 4: Heat treatment processes (Annealing, Normalizing, Quenching) and comparison of hardness before & after heat treatment.

Experiment 5: To predict creep characteristic of materials by plotting strain vs. time curves for different loadings.

Experiment 6: Comparative study of microstructures of different given specimens (mild steel, grey C.I., brass, and copper).

Experiment 7: Specimen preparation for micro structural examination by cutting, grinding, polishing and etching of aluminium specimen.

Experiment 8: Fabrication of composite by hand-lay up technique.

Experiment 9: Mechanical testing of composite made by hand-lay up technique in experiment no. 8.

Experiment 10: To study the fatigue behaviour of a given sample.

FLUID FLOW OPERATIONS (LAB) (AM-1354)

Pre-requisite: Fluid Mechanics/ Fluid Flow Operations

Experiment 1: To verify the momentum equation using the experimental set-up on diffusion of submerged air jet.

Experiment 2: To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.

Experiment 3: To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.

Experiment 4: To study the variation of friction factor ' f ' for turbulent flow in commercial pipes.

Experiment 5: To calibrate an orifice meter, venturimeter, and bend meter and study the variation of the co-efficient of discharge with the Reynolds number.

Experiment 6: To study the impact of jets in a flat plate.

Experiment 7: To study performance of two Centrifugal pumps connected in series and parallel.

Experiment 8: To study performance of a Reciprocating pump.

Text/Reference Books

- Singh, S. Experiments in Fluid Mechanics, PHI Learning, New Delhi.
- Prakash, M.N.S., Experiments in Hydraulics and Hydraulic Machines: Theory and Procedures, PHI Learning, New Delhi.
- Majumdar, B., Fluid Mechanics with Laboratory Manual, PHI Learning, New Delhi.

MECHANICAL OPERATION LAB (CL-1351)

Experiment 1: To study the operation of filter press in the laboratory and to evaluate specific cake resistance and medium resistance.

Experiment 2: To determine the effect of initial concentration & initial suspension height on sedimentation rates.

Experiment 3: Size distribution of sand particles using sieve shaker.

Experiment 4: To study the characteristics of fluidized bed.

Experiment 5: To study the characteristics of fixed bed.

Experiment 6: To determine the efficiency of jaw crusher for crushing the material of known index.

Experiment 7: To study the operation of a hammer mill.

Experiment 8: To study effect of RPM on the power consumption of a ball mill (Variable speed).

Experiment 9: To study effect of RPM on the power consumption of a ball mill (Constant speed).

Experiment 10: To study the drying characteristics of a solid material under batch drying condition.

Experiment 11: To study the batch settling process.

UNIT 1: REACTIONS AND REAGENTS-Basic ideas relating to addition, substitutions, elimination, oxidation and reduction reactions - Electrophilic and Nucleophilic. Organometallic compounds- Grignard reagent - Synthesis of different types of compounds like alcohol, aldehyde, acid, amine and organometallic. Acetoacetic ester - tautomerism- Base hydrolysis - Acid hydrolysis - Malonic ester - cyano acetic esters- synthesis of dicarboxylic acids and Unsaturated acids. 5(L)

UNIT 2: CARBOHYDRATES-Carbohydrates - Classification - Reactions of Glucose and fructose- Inter conversion - Ascending and descending of series. Structure of glucose and fructose. Industrial uses of cellulose and starch. 4(L)

UNIT 3: ALICYCLIC COMPOUNDS, AROMATIC COMPOUNDS, FATS AND OILS-Alicyclic Compounds- Nomenclature - synthesis of alicyclic compounds using carbon - acroyloin condensation - Diels Alder reaction Freund's synthesis - Bayer's strain theory postulates, drawbacks- theory of strainless rings- conformations of cyclohexane. Coal tar distillation, separation of benzene, toluene, phenol and naphthalene- Aromaticity exhibited by these compounds. Fats and oils - Saponification- hydrogenation of oils. 5(L)

UNIT 4: AMINO ACIDS, PROTEINS AND DYES-Amino acids and proteins- classification -synthesis of amino acids - reactions of carboxyl group and amino group -peptide linkage-endgroup analysis-colour reaction of proteins- denaturation. Dyes-colors and constitution -chromophores and auxochromes- quinine theory and electron theory of dyes- preparation colour and application of azodyes-acidic, basic, mordant, direct azodyes-Triphenylmethane dyes - malachite green, crystal violet, Rosaniline, prosaniline mordant dyes- application. Vat dyes-indigo-synthesis and application. 5(L)

UNIT 5: HETEROCYCLIC COMPOUNDS AND NATURAL PRODUCTS-Heterocyclic compounds-synthesis and reaction of pyrrole, furan, thiophene, pyridine, quinoline, isoquinoline and anisole. Alkaloids-Isolation from natural products-colour reaction-structural elucidation of nicotine. Terpenoids- Isolation - Isoprene rule-structural elucidation of citral. 5(L)

UNIT 6: REACTION KINETICS-Law of Mass action. Rate order and molecularity of chemical reactions. Methods for their evaluation. Calculation of rate constants. Consecutive - Parallel and opposing reactions. Chain reactions. Energy of activation - Theories on reaction rates. Heterogeneous reactions - zero order reactions - Catalysis - Theory and applications - Inhibitors - Promoters - enzyme catalysis. 5(L)

UNIT 7: PHASE EQUILIBRIA-Phase rule: Application - to one components system (water, sulphur and carbon dioxide), Two component systems (Eutectic, Intermediate compound formation and solid solutions) and simple three component systems. Solutions: Ideal and non ideal solutions solubility of gases in liquids. Henry's law. Completely miscible liquids - Raoult's law - vapour pressure and boiling point diagrams. Partially miscible liquids - Critical solution temperature -completely immiscible liquids - Nernst: distribution law - Dilute solution and their colligative properties. Molecular weight determination using these properties. 3(L)

UNIT 8: ELECTRICAL CONDUCTANCE-Electrolytes - strong electrolytes and weak electrolytes - Arrhenius theory of electrolytic dissociation. Debye - Huckell Onsager theory; Ostwald's dilution law - solubility of electrolytes and solubility product - common ion action - acids, bases - definitions) based on proton transference, dissociation constant, amphoteric electrolyte - pH -Buffer solutions. Salts - water of crystallisation, double salts, complex ions and salts, introduction to co-ordination theory - hydrolysis. 5(L)

UNIT 9: ELECTRODE POTENTIAL-Electrode potential-Hydrogen electrode, reference electrodes, electrochemical series, Faraday's laws of electrolysis. Decomposition potential, over voltage, definitions of current density, current concentration, current efficiency, energy consumption; electrical conductance, oxidation - reduction redox couple; e.m.f. and energy relations. Conductometry, Potentiometry - Their applications. 5(L)

Text/Reference Books

- K. J. Laidler, "Chemical Kinetics", 3rd Edn., Harper & Row Publishers, 1987. I.L. Finar, "Organic Chemistry", (Vol. I & II) 5th Edn., ELBS, London.
- Morrison and Boyd, "A Text Book of Organic Chemistry", 5th and 6th Edn., Prentice Hall of India.
- B. R. Puri and S.L. R. Sharma, "Principles of Physical Chemistry", Shoban Lal Nagin Chand & Co.
- P.L. Soni, "Text Book of Physical Chemistry", S. Chand & Co., New Delhi.

PROCESS EQUIPMENT DESIGN- I (CL-1401)

UNIT 1: Stress & Strain Analysis-Stress, Strain, Hook's Law, Elastic Constants, Strain Energy, Statically Indeterminate problems, Thermal Effects, Impact Loading, Stress at a Point, Variation of Stress, Stress Transformation (2-D), Analysis of Strain, Strain displacement relations, Strain transformation, Strain Measurements, Constitutive equations, Simple Bending & Shear Stress. 8(L)

UNIT 2: General Design Considerations-Introduction to equipment design, loads, material characteristic and their basis of selection, General design considerations: - Design codes, design pressure, materials, welded joint efficiencies, corrosion allowances, design loads, equipment selection and specification. 6(L)

UNIT 3: Design of Pressure Vessels-Design of cylindrical vessels and different end closures subjected to internal pressure, Stress analysis of support and pressure vessels, Design of supports and various heads, Design of vertical pressure vessels considering the wind factors, seismic factor, etc. Design of cylindrical vessels operating under external pressure. 8(L)

UNIT 4: Bolted Flanges-Types of Flanges, and selection, Gaskets, Design of non-standard flanges, specifications of standard flanges. Fabrication of equipment major fabrication steps; welding, non destructive tests of welded joints, inspection and testing, vessel lining, materials used in fabrication of some selected chemical industries. 6(L)

UNIT 5: Tall Vertical & Horizontal Vessels-Pressure dead weight, wind, earthquake and eccentric loads and induced stresses; combined stresses, Shell design of skirt supported vessels. Vessel supports; Design of skirt, lug, and saddle supports 5(L)

Text/Reference Books

- Strength of Materials by Ryder.
- Mechanics of Materials by Gere and Timosheinko.
- J. M. Coulson, J. F. Richardson and R. K. Sinnott, Chemical Engineering Design (Vol. 6), (Indian Print), Butterworth-Heinemann.
- Joshi, M.V. - Process Equipment Design

Joshi

HEAT TRANSFER OPERATIONS (CL-1402)

UNIT 1: Introduction to Heat Transfer-Concept of the mechanism of heat flow: conduction, convection and radiation; effect of temperature on thermal conductivity of materials; introduction to combined heat transfer mechanism. 4(L)

UNIT 2: ConductionOne-dimensional general differential heat conduction equation in rectangular, cylindrical and spherical coordinate system; initial and boundary conditions. Steady state one dimensional heat conduction: Composite system in rectangular, cylindrical and spherical coordinates without energy generation; thermal resistance concept; analogy between heat and electrical flow; thermal contact resistance; critical thickness of insulation. Fins of uniform cross sectional area; error of measurement of temperature in thermometer wells, volumetric internal energy generation, solution of 2D steady state problems using relaxation method. Transient Conduction: Transient heat conduction with known temperature distribution within the system; lumped heat analysis of transient heat conduction problem, time constant of thermocouples. 10(L)

UNIT 3: Convective Heat Transfer-Newton's Law of Cooling, Types of convective heat transfer, Laminar and Turbulent flows, Hydrodynamic and thermal boundary layers, Navier-Stokes Equation, Non-dimensional numbers, Buckingham Pi Theorem. Forced Convection: Basic concept; hydrodynamic boundary layer; thermal boundary layer; flow over a flat plate; flow across a single cylinder and a sphere; flow inside tubes; empirical heat transfer relations; relation between fluid friction and heat transfer; liquid metal heat transfer. Natural Convection: Physical mechanism of natural convection; buoyant force; empirical heat transfer relations natural convection over vertical planes and a cylinder, horizontal planes and cylinders, and a sphere. 8(L)

UNIT 4: Thermal Radiation-Basic radiation concept; radiation properties of surfaces; black body radiation laws; Kirchhoff's Law, Plank Law and Wien's Displacement Law, view factor concept; view factor determination; black body radiation exchange; radiation exchange between diffuse non black bodies in an enclosure; radiation shields; solar radiations. 4(L)

UNIT 5: Heat Exchangers-Type of heat exchangers; fouling factor; overall heat transfer coefficient; logarithmic mean temperature difference (LMTD) method; effectiveness-NTU method; compact heat exchangers. 4(L)

UNIT 6: Condensation and Boiling- Introduction to condensation phenomena; heat transfer relations for laminar film condensation over vertical surfaces and a horizontal tube; pool boiling. 6(L)

Text/Reference Books

- Elements of Heat Transfer by Bayazitoglu and Ozisik, McGraw Hill Book Company.
- Heat Transfer by J.P.Holman, McGraw Hill Book Company.
- Principles of Heat Transfer by F. Kreith, and S.B. Marks, A.B.Pvt. Ltd.
- Fundamentals of Heat Transfer by F.P Incerpera and P.D.Dewitt, John Wiley and Sons, V Ed.

MASS TRANSFER – I (CL-1403)

UNIT 1: Diffusion-Fick's Law of diffusion, Molecular and Eddy diffusion, Measurement and calculation of diffusivities in gas and liquids, Diffusion in solids, Analogy between mass, momentum and heat transfer. 6(L)

UNIT 2: Inter-phase Mass Transfer-Mass transfer coefficients and their correlations, Theories of mass transfer: Film theory, two film theory, Penetration and surface removal models. Mass transfer equipments: Batch and continuous stage wise contactors- Differential contactors 6(L)

UNIT 3: Gas Absorption and Stripping-Principle of gas absorption, Choice of packing and solvent, Gas-Liquid Equilibria, Tray column: graphical and analytical method, Design of packed towers: contacts between gas and liquid, pressure drop and limiting flow rates, HTU, NTU, HETP concepts for calculation of height of packed column, diameter of packed column, Absorption with chemical reaction. 8(L)

UNIT 4: Adsorption-Principle and types of adsorption, Nature of adsorbents, Adsorption equilibria: adsorption isotherms, Stage wise and continuous contact operations, Unsteady State: Fixed-Bed absorbers, Adsorption equipments, Ion Exchange. 8(L)

UNIT 5: Humidification-Vapor – liquid equilibria, Enthalpy for pure substances, Definition and derivations related with humidity, adiabatic gas-liquid contact operation, Classification of design of cooling towers, Dehumidification operation. 7(L)

UNIT 6: Drying-Solid-gas equilibria, Different modes of drying operations, Definition of moisture, Mechanism and rate of batch and continuous drying, Batch and continuous driers. 5(L)

Text/Reference Books

- R.E.Treybal, "Mass Transfer Operations", McGraw Hill Book Co., New York.
- W.L. McCabe, J.C. Smith and P. Harriot, "Unit Operations of Chemical Engineering", McGraw Hill Book Co., New York.
- J.M. Coulson and J.F. Richardson, "Chemical Engineering", Vol. I, II, III, Pergamon Press, Newyork.

CHEMICAL TECHNOLOGY-I (CL-1404)

UNIT 1: Chlor-alkali Industries: Manufacture of Soda ash, Manufacture of caustic soda and chlorine - common salt. 6(L)

UNIT 2: Sulphur and Sulphuric acid: Mining of sulphur and manufacture of sulphuric acid. Manufacture of hydrochloric acid. 6(L)

UNIT 3: Cement: Types and Manufacture of Portland cement, Glass: Manufacture of glasses and special glasses. Ceramics: Refractories. 6(L)

UNIT 4: Industrial Gases: Carbon dioxide, Nitrogen, Hydrogen, Oxygen and Acetylene - Water Treatment: Industrial waste water treatment. 7(L)

UNIT 5: Manufacture of paints and Pigments. 5(L)

UNIT 6: Nitrogen Fertilizers: Synthetic Ammonia, Nitric Acid, Urea, Ammonium Chloride, CAN, Ammonium Sulphate - Phosphorous Fertilizers: Phosphate rock, phosphoric acid, Super phosphate and Triple Super phosphate, MAP, DAP. Potassium Fertilizers: Potassium chloride and Potassium sulphate. 8(L)

Text/Reference Books

- G.T.Austin, "Shreve's Chemical Process Industries", McGraw Hill Book Co., New York.
- R.GopalRao, "Dryden's Outlines of Chemical Technology", Affiliated East-West Publishers.

- gravity. 4(L)
- UNIT 2: Ideal Gases and Vapor Pressure**-Behaviors of Ideal gases -kinetic theory of gases - application of ideal gas law- gaseous mixtures - volume changes with change in composition. Vapor pressure- effect of Temperature on vapor pressure, vapor pressure plots vapor pressure of immiscible liquids-solutions. 7(L)
- UNIT 3: Humidity and Solubility**-Humidity, saturation, vaporization, condensation, wet and dry bulb thermometry, Solubility and Crystallization, Dissolution, solubility of gases. 6(L)
- UNIT 4: Material Balance**- Material balances for systems with and without chemical reactions, species and elemental balance, Analysis of systems with by-pass, recycle and purge 8(L)
- UNIT 5: Energy Balance**-Energy Balance, Heat capacity of gases, liquids and solutions, Heat of fusion and vaporization, Steady state energy balance for systems with and without chemical reactions, Calculations and application of heat of reaction, combustion, formation, neutralization and solution. Enthalpy-concentration charts, Combustion of solids, liquids and gaseous fuels, Calculation of theoretical and actual flame temperatures. 7(L)
- UNIT 6: Simultaneous balances**-Problems related to simultaneous steady state energy and material balance, unsteady and material balance, simultaneous material and energy balance and its application in process industries. 6(L)

Text/Reference Books

- O.A.Hougen, K. M. Watson and R. A. Ragatz, "Chemical Process Principles", Vol-I, CBS Publishers and Distributors, New Delhi.
- D. Himmelblau, "Basic Principles and Calculations in Chemical Engineering", 5th Edn., Prentice Hall of India Ltd., N.Delhi.
- B.I.Bhatt and S.M.Vora, "Stoichiometry", Tata McGraw Hill Publishers Ltd., New Delhi.
- V.Venkataramani and N.Anantharaman, "Process Calculations", Prentice Hall of India Ltd., New Delhi.

ORGANIC AND PHYSICAL CHEMISTRY LAB (CH-1451)

Experiment 1: Preparation & Physical Characterization of organic compounds.

Experiment 2: Identification of functional groups of organic molecules.

Experiment 3: Preparation of derivative of the functional groups

(a) Preparation of p- Nitro acetanilide from acetanilide (Nitration)

(b) Preparation of acetanilide from aniline (Acetylation)

Experiment 4: Microwave synthesis of Aspirin-A green chemistry experiment.

Experiment 5: Wet chemical method for the identification of organic dyes Malachite green, Rosaniline and Indigo.

Experiment 6: Preparation of buffer solution (AcOH & AcONa) of specific pH and its verification By pH- metry.

Experiment 7: Determination of distribution (partition) coefficient of I_2 between CCL_4 and water.

Experiment 8: Kinetic study of hydrolysis of ethyl acetate by volumetric titration method.

Experiment 9: Verification of Kohlrausch's 1st law for strong electrolytes using conductometric measurement.

Experiment 10: Verification of Ostwald's dilution law for weak electrolytes using conductometric measurement.

Experiment 11: Determination of the strength of a strong acid by strong base using conductometric titration.

Experiment 12: Determination of sodium & Potassium by flame photometry.

Experiment 13: To carry out the proximate analysis of a given sample of fuel.

HEAT TRANSFER LAB (CL-1451)

Experiment 1: To determine the thermal conductivity of metal bar.

Experiment 2: To determine Heat transfer through composite wall.

Experiment 3: To determine the thermal conductivity of insulating powder.

Experiment 4: To plot the radial temperature distribution and to determine the thermal conductivity of pipe insulation.

Experiment 5: To determine the variation of temperature along the length of pin fin under forced convection.

Experiment 6: To determine the convective heat transfer coefficient for heated vertical cylinder losing heat to the ambient by free or natural convection.

Experiment 7: To determine the convective heat transfer coefficient for a horizontal pipe through which air flows under forced convection.

Experiment 8: To determine the Emmissivity of a grey surface at different temperatures.

Experiment 9: To determine the value of Stefan Boltzmann constant for radiation heat transfer.

Experiment 10: To study the condensation phenomenon and to determine overall heat transfer coefficient.

Experiment 11: To conduct test on a heat pipe and compare the temperature distribution and rate of heat transfer with geometrically similar copper and stainless steel tubes.

Experiment 12: To study the Shell and Tube Heat Exchanger.

MASS TRANSFER LAB - I (CL-1452)

Experiment 1: To determine the vapor liquid equilibrium curve for CCL_4 and toluene or any other mixture.

Experiment 2: Determination of drying rate and to plot moisture lost with time under for different operating conditions.

Experiment 3: To determine overall mass transfer co-efficient based on continuous & dispersed phase.

Experiment 4: To determine individual height of transfer unit based on continuous & dispersed phase.

Experiment 5: To determine the number of transfer units, height of transfer unit and overall mass transfer co-efficient for the given system.

Experiment 6: To study the fluidized bed drying.

Experiment 7: To obtain the breakthrough curve and hence length of unused bed for the given adsorption system.

Experiment 8: Determination of the diffusion co-efficient of an organic vapor (naphthalene) in air.

Experiment 9: To study working and operation of the cooling tower operation

Experiment 10: To measure mass transfer coefficient in extraction column and its variation with flow rate of organic phase (continuous medium)

Experiment 11: To determine flooding characteristics of packed bed absorption column using Roschig Rings as packing material.

Vora

- UNIT 1: Introduction and Basics of Kinetics**-Introduction, Kinetics of homogeneous reactions: Concentration dependent & Temperature dependent term of rate equation, searching for a mechanism, 4(L)
- UNIT 2: Analysis of Batch Reactor Data**-Constant-volume batch reactor, Varying-volume batch reactor, temperature and rate equation, the search for a rate equation. 6(L)
- UNIT 3: Design of Ideal Reactor for a Single Reaction**-Introduction to ideal reactors for a single reaction, Ideal batch reactor, Ideal Steady-state mixed flow reactor, and steady-state plug flow reactor. Size comparison of single reactors, multiple reactor systems, Recycle reactor, Autocatalytic reactor. 10(L)
- UNIT 4: Design of Reactor for Multiple Reactions**-Design for multiple Reactions: Reactions in parallel, reactions in series, and series - parallel reactions. 9(L)
- UNIT 5: Heat Effects**-Temperature and pressure effects on single and multiple reactions. 4(L)
- UNIT 6: Flow Behavior of Reactors**-Non-ideal flow: Residence time distribution studies: C, E, and F curves, conversion calculations directly from tracer studies. Models for non-ideal flow: one parameter models- tank-in series and dispersion models, multi-parameter models. 9(L)

Text/Reference Books

- O. Levenspiel, "Chemical Reaction Engineering", Wiley Easter Ltd., New York.
- H. Scott Fogler, "Elements of Chemical Reaction Engineering", PHI.
- M. Davis and R. Davis, "Fundamental of Chemical Reaction Engineering", McCraw Hill, New York.
- J.M. Smith, "Chemical Engineering Kinetics", McCraw Hill, New York.

MASS TRANSFER- II (CL-1502)

- UNIT 1: Distillation**-Vapor- Liquid Equilibria: Pressure-Temperature- concentration phase diagram, Enthalpy-concentration diagrams for ideal and non-ideal solutions, Raoult's law and its applications, concept of Relative volatility, Maximum and minimum boiling mixtures. 4(L)
- UNIT 2: Single Stage Distillation** -Flash vaporization of a binary mixture, Differential or Simple Distillation of a binary mixture, Steam distillation, Principles of azeotropic and extractive distillations. 4(L)
- UNIT 3: Continuous Distillation of Binary Mixtures** -Fractionating column: Combination of rectification and stripping, Rectification on an ideal plate, Characteristics of multistage (Tray) tower; McCabe Thiele method, Ponchon Savarit method, Reflux Ratio: Condenser and top plate; total (Infinite) reflux ratio, minimum and optimum reflux ratio, Bottom plate and reboiler, Use of open steam, Tray efficiency, Determination of height and column diameter, Bubble cap tray, sieve tray, valve tray and packed columns. Introduction to multi-component distillation system, multistage batch distillation, 8(L)
- UNIT 4: Liquid - Liquid Extraction**-Principles of extraction: Ternary liquid equilibria, Triangular graphical representation concept of theoretical or ideal stage, Equipment used: Mixer settlers, plate column, spray and packed column, rotating disk contactor, sieve tray column. Single stage operation, multistage continuous operation: co-current operation and cross current operation, Stage calculation, Analytical and graphical solution of single and multistage operation, Systems with complete immiscibility. 8(L)
- UNIT 5: Solid - Liquid Extraction**-Leaching, Solid liquid equilibrium diagram, constant and variable underflow, Batch and continuous operations: Single and multistage cross current and counter current operations, number of equilibrium stages, Equipments: percolation tank, agitated vessel, thickeners, classifiers, continuous counter current decantation. 8(L)
- UNIT 6: Crystallization**-Theories of crystallization, Nucleation & crystal growth rate, Controlled growth of crystals, Equilibrium yield of crystallization, Heat and mass transfer rates in crystallization, Classification and design of Industrial crystallizers. 8(L)

Text/Reference Books

- R.E. Treybal, "Mass Transfer Operations", McGraw Hill Book Co., New York.
- W.L. McCabe, J.C. Smith and P. Harriot, "Unit Operations of Chemical Engineering", McGraw Hill Book Co., New York.
- C. J. Geankopolis, "Transport Processes in Chemical Operations", Prentice Hall of India, New Delhi.
- M. Coulson and J. F. Richardson, "Chemical Engineering", Vol - II, Pergamon Press, New York.

PROCESS INSTRUMENTATION AND CONTROL (CL-1503)

- UNIT 1: INTRODUCTION TO INSTRUMENTATION**-Introduction to process variables, static & dynamic characteristics of instruments and their general classification, Elements of measuring systems and their function, signal transmission, transmitters- electronic, pneumatic etc. 4(L)
- UNIT 2: FIRST ORDER SYSTEMS**-General Concepts, Examples of role of process dynamics and control, background, Laws and language of process control, Introduction to Laplace Transform and its application in process control. Linear open loop systems - First order and Linearized first order systems - Response to various disturbances. 9(L)
- UNIT 3: HIGHER ORDER SYSTEMS**-First order in series - Higher order systems - Response to various disturbances. 7(L)
- UNIT 4: BLOCK DIAGRAM**-Controls - Block Diagram - closed loop transfer function - Transient response- Simple alarm Modes of control and controller characteristics. 8(L)
- UNIT 5: STABILITY ANALYSIS** -Stability - Routh analysis - Frequency response - Control system design - Controller tuning. Root locus, Nyquist plot, Bode plot. 5(L)
- UNIT 6: SPECIAL CONTROLS**-Cascade - feed forward and ratio control - dead time compensation - Internal Model Control - Control valves - Process identification. 6(L)

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- S. Sundaram and T. K. Radhakrishnan, "Process Dynamics and Control", Ahuja Publishers.
- D. P. Coughnour, "Process Systems Analysis and Control", McGraw Hill, New York.
- C. A. Smith and A. B. Corripio, "Principles and Practice of Automatic Process Control", Wiley, New York.
- P. Harriot, "Process Control", Tata McGraw Hill, New Delhi.
- D.P. Eckman, "Industrial Instrumentation", Wiley Eastern Ltd., New York.
- D.P. Eckman, "Automatic Process Control", Wiley Eastern Ltd., New Delhi.

CHEMICAL TECHNOLOGY – II (CL-1504)

UNIT 1: Natural Products Processing-Production of pulp, paper and rayon. Manufacture of sugar, starch and starch derivatives, Gasification of coal and chemicals from coal. 6(L)

UNIT 2: Industrial Microbial Processes and Edible Oils-Fermentation processes for the production of ethyl alcohol, citric acid and antibiotics, Refining of edible oils and fats, fatty acids, Soaps and detergents. 5(L)

UNIT 3: Petroleum Refining and Petrochemical Precursors-Petroleum refining to produce naphtha, fuel hydrocarbons and lubricants. Processes for the production of petrochemical precursors: ethylene, propylene, butadiene, acetylene, synthetic gas, benzene, toluene and xylene, (Cracking, Catalytic reforming and separation of products) 8(L)

UNIT 4: Polymer Based Industries and Their Characteristics-Plastics: Production of thermoplastic and thermosetting resins such as polyethylene, polypropylene, phenolic resins and epoxy resins; Polymers and their applications in engineering practice. 6(L)

UNIT 5: Fiber Forming and Elastomeric Polymers-Synthetic fibers: polyamides, polyesters and acrylics from monomers, Processes for the production of natural and synthetic rubbers, electro-spinning of nano-fibres. 5(L)

UNIT 6: Sugar Technology-Sugar technology: introduction, manufacture of sugar (from sugar cane), manufacture of white sugar (sulphitation process, carbonation process), evaporation section, beet sugar. 6(L)

Text/Reference Books

- G.T. Austin, "Shreve's Chemical Process Industries", McGraw Hill Book Co., New York.
- R. Gopal Rao and M. Sittig, "Dryden's Outline of Chemical Technology", Affiliated East-West Publishers.

CHEMICAL ENGINEERING THERMODYNAMICS (CL-1505)

UNIT 1: Fundamentals and Law of Thermodynamics- Terminologies of thermodynamics, variables and quantities of thermodynamics, Point and path properties, heat and work, reversible and irreversible processes, phase rule, First law and internal energy, statements of first law for the non flow and flow systems, enthalpy and heat capacity limitations of the first law, Statements of the second law of thermodynamics, available and unavailable energies, entropy function, applications of the second law. Zeroth law of thermodynamics 8(L)

UNIT 2: Thermodynamic Properties of Real Gases-The PVT behavior of fluids, laws of corresponding states and equation of states approaches to the PVT relationships of non ideal gas problems, compressibility factors, generalized equations of state, property estimation via generalized equation of state, fugacity and fugacity coefficients of real gases. 8(L)

UNIT 3: Thermodynamics of Solutions-Ideal and non-ideal solution, Concept of Fugacity and Fugacity coefficient, Fugacity and Activity Coefficient Modes, Solid-liquid equilibrium, solubility of gases in liquids, Liquid-liquid equilibrium. 6(L)

UNIT 4: Chemical Reaction Equilibrium-Heat effects, industrial reactions (NH₃ synthesis etc), free energy calculations, Homogeneous and heterogeneous reaction systems, multiple reactions, Work of separation, Evaluation of Properties. Phase Equilibrium, Pure component and mixtures, Latent Heat correlation Van Laar, Margules' equation, Gibbs'-Duhem equation, Maxwell equation, consistency tests, multi-component phase equilibrium, partially miscible and immiscible systems, Azeotropes, retrograde condensation, thermodynamic diagram. 8(L)

UNIT 5: Thermodynamics of Chemical and living system- Gibbs free energy -properties, applications, Thermodynamics of oxidation-reduction reactions, Degree of reduction concepts, available electron balances; yield coefficients, Oxygen consumption and heat evolution in aerobic cultures, Effect of temperature on U, H and entropy (S), Energetic of Metabolic Pathways; Energy Coupling (ATP & NADH), Structure and properties of ATP and other energy currencies. 9(L)

UNIT 6: Compression and Refrigeration Cycle-Thermodynamic aspects of compression process, classification of compression processes, basic equation for change of state of gases, the work expression for different situations, the effect of clearance volume, multistage compression, convergent divergent flow, Ejectors. Definitions of refrigeration, Reverse Carnot cycle, Vapor compression and vapor absorption cycle, Gas refrigeration. 5(L)

Text/Reference Books:

- J. M. Smith and Van Ness, "Introduction to Chemical Engineering Thermodynamics", McGraw Hill, New York.
- Rao. Y.V.C. "Chemical Engineering Thermodynamics", Universities Press.
- S. Sundaram, "Chemical Engineering Thermodynamics", Ahuja Publishers, Delhi.
- B.F. Dodge, "Chemical Engineering Thermodynamics", McGraw Hill, New York.
- S.I. Sandler, "Chemical and Engineering Thermodynamics, Wiley.
- Bioprocess Engineering Principles, . Doaran, P.M, Academic Press.
- Biochemical Engg. Fundamentals, Bailey & Olis, MGH.
- Kinetics and Energetic in Biotechnology, Roels J.A, Elsevier.
- Biological Thermodynamics, Donald T Haynie.

Uma

- UNIT 1: Introduction to Management**-Definition of Management – Science or Art – Management and Administration, Functions of Management – Types of Business Organization. Levels of management and Managerial skills 5(L)
- UNIT 2: School of Management Thoughts:** Evolution of Management thoughts, classical approach, neo- classical approach, contribution of Taylor, Weber and Fayol, modern approach. 6(L)
- UNIT 3: Planning** Nature & Purpose – Steps involved in Planning ,Objectives, Setting Objectives, Process of Managing by Objectives ,Strategies, Policies & Planning Premises Forecasting Decision-making. 8(L)
- UNIT 4: Organizing** Nature and Purpose – Formal and informal organization – Organization Chart – Structure and Process – Departmentation by difference strategies – Line and Staff authority – Benefits and Limitations – De-Centralization and Delegation of Authority – Staffing – Selection Process-Techniques-HRD-Managerial-Effectiveness. **Directing:** Scope – Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment – Communication – Process of Communication – Barriers and Breakdown – Effective Communication – Electronic media in Communication. 11(L)
- UNIT 5: Controlling**-System and process of Controlling – Requirements for effective control – The Budget as Control Technique – Information Technology in Controlling – Use of computers in handling the information – Productivity – Problems and Management – Control of Overall Performance. Coordination. 5(L)
- UNIT 6: Organisational Behaviour-** Organisational change, Conflict Management and Stress Management **Functional management:** Human Resource Management, Financial management, Marketing Management. 5(L)

Text/Reference Books:

- Tripathy PC and Reddy PN, “Principles of Management”, Tata McGraw-Hill, 1999.
- Decenzo David, Robbin Stephen A, “Personnel and Human Resources Management”, Prentice Hall of India, 1996
- JAF Stomer, Freeman R. E and Daniel R Gilbert, “Management”, Pearson Education, Sixth Edition, 2004.
- Fraidoon Mazda, “Engineering Management”, Addison Wesley, 2000.
- Harold Kooritz & Heinz Weihrich “Essentials of Management”, Tata McGraw-Hill, 1998
- Joseph L Massie “Essentials of Management”, Prentice Hall of India, (Pearson) Fourth Edition, 2003

MASS TRANSFER LAB - II (CL-1551)

- Experiment 1:** To study the effect of the dispersed phase flow rate on overall volumetric mass transfer co-efficient.
- Experiment 2:** To study the effect of various system parameters like, solvent temperature, solvent rate and particle size on the %age recovery of oil from solid.
- Experiment 3:** To estimate the batch distillation curves for a binary system and verify the binary batch distillation equation for a known packed height.
- Experiment 4:** To determine overall mass transfer co-efficient based on continuous & dispersed phase.
- Experiment 5:** To study the characteristics and efficiency of steam distillation.
- Experiment 6:** To study the effect of temperature on diffusion co-efficient.
- Experiment 7:** To study the effect of the dispersed phase flow rate on overall volumetric mass transfer co-efficient.
- Experiment 8:** To study dispersed phase hold-up study.
- Experiment 9:** To study the performance of Bubble cap distillation column.
- Experiment 10:** To determine exchange capacity of ion exchange resins in softening of water in an ion exchange column.
- Experiment 11:** To find out crystal yield in batch crystallizer.

CHEMICAL REACTION ENGINEERING LAB – I (CL-1552)

- Experiment 1:** To study the kinetics and determine the reaction rate constant (k) for the given saponification reaction in a Batch Reactor at fixed temperature.
- Experiment 2:** To determine the effect of temperature on rate constant (k) of saponification in a Batch Reactor.
- Experiment 3:** To study the kinetics and determine the reaction rate constant (k) for the given esterification reaction in Batch Reactor at fixed temperature.
- Experiment 4:** To determine the effect of temperature on rate constant (k) of esterification reaction in a Batch Reactor.
- Experiment 5:** To study the kinetics and determine the reaction rate constant (k) for the given saponification reaction in a Single CSTR at fixed temperature.
- Experiment 6:** To determine the effect of temperature on rate constant (k) of saponification in a Single CSTR.
- Experiment 7:** To study the kinetics and determine the reaction rate constant (k) for the given esterification reaction in Single CSTR at fixed temperature.
- Experiment 8:** To determine the effect of temperature on rate constant (k) of esterification reaction in a Single CSTR.
- Experiment 9:** To study the kinetics and determine the reaction rate constant (k) for the given saponification reaction in a Plug Flow Reactor at fixed temperature.
- Experiment 10:** To determine the effect of temperature on rate constant (k) of saponification in a Plug Flow Reactor.
- Experiment 11:** To study the kinetics and determine the reaction rate constant (k) for the given esterification reaction in a Plug Flow Reactor at fixed temperature.
- Experiment 12:** To determine the effect of temperature on rate constant (k) of esterification reaction in a Plug Flow Reactor.
- Experiment 13:** To study the kinetics and determine the reaction rate constant (k) for the given saponification reaction in a Semi Batch Reactor at fixed temperature.
- Experiment 14:** To determine the effect of temperature on rate constant (k) of saponification in a Semi Batch Reactor.
- Experiment 15:** To study the kinetics and determine the reaction rate constant (k) for the given saponification reaction in a Coiled Type Plug Flow Reactor at fixed temperature.
- Experiment 16:** To determine the effect of temperature on rate constant (k) of saponification in a Coiled Type Plug Flow Reactor.

PROCESS DYNAMICS AND CONTROL LAB (CL-1553)

- Experiment 1:** To study the dynamic response of liquid level in two tank interacting liquid level system.
- Experiment 2:** To study the dynamic response of liquid level in two tank non-interacting liquid level system.
- Experiment 3:** To study of current to pressure (I to P) and pressure to current (P to I) converter.
- Experiment 4:** To study the dynamic behavior of a first order system.
- Experiment 5:** To study the characteristics and working principle of the RF-capacitance type level transmitter.
- Experiment 6:** To study the characteristics and working principle of the differential pressure transmitter.
- Experiment 7:** To study the characteristics and working principle of the current to pressure converter and control valve.
- Experiment 8:** To study the performance of cascade controller.
- Experiment 9:** To study the performance of on-off/P/PI/PID controllers on level process.
- Experiment 10:** To study the performance of on-off/ P/PI/PD/PID controllers on flow process.
- Experiment 11:** Study of control valve characteristics
- Experiment 12:** Study of U-tube manometer.

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UNIT 1: MEMBRANE SEPARATION PROCESSES- Principle, Classification, structure & characteristics of membranes; Membrane modules and application; Reverse osmosis, ultrafiltration, micro-filtration, nano-filtration, dialysis; Analysis and modeling of membrane separation processes gas separation and pervaporation processes; Ion selective membranes and their application in electro-dialysis, Liquid membranes; Membrane Reactors. 15(L)

UNIT 2: ADSORPTION TECHNIQUE-Adsorbents-Molecular sieves; Single component adsorption equilibrium and multi component adsorption equilibrium calculation, Langmuir, BET and Gibbs isotherms; Pressure and temperature swing adsorption techniques. Parametric Pumping: Batch, continuous and semi-continuous pumping; thermal, pH and heatless parametric pumping. 8(L)

UNIT 3: CROMATOGRAPHY SEPARATION-Principle, classification and techniques of chromatography, Chromatographic column, Development of gradient-elution separations, Equipment and commercial processes. 5(L)

UNIT 4: THERMAL SEPARATION-Thermal Diffusion: Basic rate law, Theory of thermal Diffusion Phenomena for gas and liquid mixtures. Equipments design and Applications, Zone Melting: Equilibrium diagrams. 4(L)

UNIT 5: ADDUCTIVE AND EXTRACTIVE CRYSTALLIZATION- addition compounds, Clathrate compounds and Adducts; Equipments; Applications. 4(L)

UNIT 6: FOAM AND BUBBLE SEPARATION-Principle, Classification and separation techniques, Surface Adsorption; Nature of foams; Apparatus, Applications and Controlling factors. 4(L)

Text/Reference Books:

- H. M. Schoen, "New Chemical Engineering Separation Techniques", Inter Science Publications New York.
- C. Loeb and R. E. Lacey, "Industrial Processing with Membranes", Wiley Inter Science.
- J. M. Coulson and J. F. Richardson, "Chemical Engineering", Vol.-2, Butterworth - Heinemann London.
- J. D. Seader, E. J. Henley, Separation Process Principles, John wiley & Sons Inc,
- K. Sattler, H. J. Feindt, "Thermal Separation Process", VCH
- John J. Mketta, Unit operation Handbook (vol-1, Mass Transfer), CRC Press.
- Ronald W. Rousseau, "Handbook of separation Process Technology", Wiley-India.

TRANSPORT PHENOMENA (CL-1602)

UNIT 1: Laminar Flow-Viscosity and the Mechanisms of Momentum Transport, Velocity distribution in Laminar flow - Shell momentum balances -Flow through tubes, surfaces, Flow of non-Newtonian fluids. 6(L)

UNIT 2: Equation of Motion-Vector and tensor, Equation of change for isothermal process - One dimensional equation of motion and continuity - Euler and Navier - Stokes equation, Dimensional analysis of equation of change. 10(L)

UNIT 3: Turbulent Flow-Velocity distribution in turbulent flow - Semi empirical expressions for Reynolds stress, Inter-phase transport in isothermal system - Ergun's equation. 6(L)

UNIT 4: Heat Transfer Analysis-Thermal Conductivity and Mechanisms of energy transport, Temperature distribution in solids and fluids in laminar flow - Equations of change for multi component systems. 4(L)

UNIT 5: Mass Transfer Analysis-Diffusivity and the mechanism of Mass Transport, Concentration distribution in solids and in fluids, laminar flow - Equations of change for multi component systems. 6(L)

UNIT 6: Computational Fluid Dynamics-Introduction, applications and software 4(L)

Text/Reference Books:

- J.L. Stuart., "Transport Phenomena", John Wiley, New York.
- R. B. Bird, W. Stewart and E. N. Lightfoot, "Transport Phenomena", Wiley, New York.
- C. J. Geankopolis, "Transport Processes in Chemical Operations", Prentice Hall of India, New Delhi.

ENVIRONMENTAL POLLUTION MONITORING AND CONTROL (CL-1603)

UNIT 1: INTRODUCTION-Ecology & Environment, Biodiversity, Interaction of man and environment, Overall picture of environmental pollution, Ambient air and water quality criteria, Standards and Acts-Indian, EPA& EURO, Effects and control of noise, thermal and radioactive pollution. 6(L)

UNIT 2: AIR POLLUTION-Types of pollutants - Natural and manmade air pollutants, Dispersion of pollutant in the atmosphere, Gaussian dispersion model, Meteorological factors, Stability and inversion of atmosphere, Plume behaviour, Control of air pollution from stationary and mobile sources, Methods of measuring and sampling of gaseous and particulate pollutants in ambient air and industrial waste gases, measurement of smoke density and visibility. Control of gaseous pollutants - SO_x, NO_x, H₂S, VOCs, Auto exhaust. Stack design, Classification, selection and design of equipment's like cyclones, electrostatic precipitators, bag filters, wet scrubbers, settling chambers. 10(L)

UNIT 3: WATER POLLUTION-Waste water characteristics - Physical and chemical composition, Biochemical oxygen demand (BOD), Pathogenic bacteria and chemical toxicity. Types of pollutants in waste water of chemical industries, Methods of sampling, preservation of samples and analysis. Methods for the treatment of liquid wastes to control pollution, Classification viz. physical, chemical and biological methods, Selection and design of equipment like hydrocyclone, settling tanks, filters, ion-exchange. 10(L)

UNIT 4: SOLID WASTE MANAGEMENT-Characterization of solid wastes, Problems of collection and handling, Various processing techniques used in solid waste management such as compaction, incineration, Composting, landfills and biological processing, Solid waste as resource material. 6(L)

UNIT 5: POLLUTION ABATEMENT IN CHEMICAL INDUSTRIES-Pollution abatement in important chemical industries like fertilizers, petroleum refineries and petrochemicals, Pulp and Paper, Pharmaceuticals, Tannery, Sugar, Distillery, food processing, cement and electroplating. 6(L)

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ading.
Text/Reference Books:

- Howard S. Peavy, D. R. Rowe & C. Tchobonoglous "Environmental Engineering", McGraw Hill.
- Metcalf & Eddy, "Waste Water Engineering Treatment, Disposal & Reuse", Tata McGraw Hill.
- Werner Strauss, 'Air Pollution Control: Measuring and monitoring air pollutant' Wiley.
- Werner Strauss, 'Air Pollution Control part -II' Wiley.
- Pandey G. N. and Carney G. C., "Environmental Engineering ". Tata McGraw Hill.

CHEMICAL REACTION ENGINEERING-II (CL-1604)

UNIT 1: GENERAL CONSIDERATIONS-Introduction to design for Heterogeneous Reacting Systems: Rate equation for heterogeneous reactions, contacting pattern for two-phase systems. Mixing of fluids: Self mixing of single fluids, mixing of two miscible fluids 6(L)

UNIT 2: NON-CATALYTIC FLUID-PARTICLE REACTIONS SYSTEM-Models for non-catalytic heterogeneous reactions, limitations, and selection. Fluid-particle reactors design. 7(L)

UNIT 3: NON-CATALYTIC FLUID- FLUID REACTIONS SYSTEM-Rate equations for instantaneous, fast, intermediate, slow, and infinitely slow reactions. Slurry reaction kinetics. Fluid-Fluid reactors design. 7(L)

UNIT 4: CATALYSIS AND CHARACTERISTICS OF CATALYST-Introduction to catalysis, catalyst: definition and properties, Promoters, inhibitors. Poisons, solid catalyzed reaction system, the rate equation for surface kinetics, Pore diffusion resistance, Porous catalyst particles, turn over frequency. 8(L)

UNIT 5: REACTORS AND KINETICS OF SOLID CATALYZED REACTIONS-Kinetics and Mechanism of Heterogeneous Catalytic Reactions, Various models, Evaluation and elimination of internal and external diffusion resistances, effectiveness factor, heat effects, controlling resistances, rates of chemisorptions, adsorption isotherms, rates of adsorption and desorption, Reactor for solid catalyzed Reaction systems. 10(L)

UNIT 6: CATALYST DEACTIVATION- Mechanism of catalyst deactivation, the rate and performance equations 4(L)

Text/Reference Books:

- O. Levenspiel, "Chemical Reaction Engineering", Wiley Easter Ltd., New York.
- H. Scott Fogler, "Elements of Chemical Reaction Engineering", PHI.
- M. Davis, "Fundamental of Chemical Reaction Engineering", McCraw Hill, New York.
- J.M.Smith, "Chemical Engineering Kinetics", McCraw Hill, New York.

PROCESS EQUIPMENT DESIGN- II (CL-1605)

UNIT 1: DESIGN OF PIPE FITTINGS AND JOINTS- Design and schematic of simple bolts and screws. Riveted joints. Design & Drawing of shafts and couplings. 5(L)

UNIT 2: DESIGN OF REACTION VESSEL AND STORAGE TANK-Design and schematic of storage tank, (vertical and horizontal) supports, agitating vessel. 4(L)

UNIT 3: FLOWSHEETING-Introduction, Flow sheet Presentation, Process Simulation Programs, Specification of Components and Physical Property Models, Simulation of Unit Operations, User Models, Flow sheets with Recycle, Flow sheet Optimization, Dynamic Simulation 5(L)

UNIT 4: DRAWING AND DESIGN OF PHASE SEPARATION EQUIPMENTS-Drawing of physical separation equipments such as hydro-cyclones, packed towers, plate columns, electro static precipitators. Design of physical separation equipment such as cyclones, centrifuges, thickeners filtration equipment KO drum. 7(L)

UNIT 5: DESIGN OF HEAT TRANSFER EQUIPMENTS-Design and Drawing of Heat Transfer Equipments such as heat exchangers with and without phase change, evaporators, crystallizes. 6(L)

UNIT 6: DESIGN OF MASS TRANSFER EQUIPMENTS-Design and Drawing of mass transfer equipments such as distillation columns, absorption columns, extraction columns, dryers and cooling towers. 6(L)

Text/Reference Books:

- B. C. Bhattacharyya, Introduction to Chemical Equipment Design, CBS Publishers & Distributors, New Delhi.
- Gavin Towler, R. K. Sinnott, Coulson and Richardson's Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design
- Joshi M.V. "Process Equipment Design", Macmillan India Ltd, New Delhi.
- L. E. Brownell and E.H. Young, "Process Equipment Design - Vessel Design", Wiley Eastern Edn. New York.
- Indian & American Codes used in Designing of Equipment (TEMA & IS Codes)

COMMUNICATION SKILL WORKSHOP (HS-1601)

Exprtiment 1: Art of communication: What is communication, good communication and effective communication, barriers and filters, activity on barriers and filters.

Exprtiment 2: Body language: verbal and non-verbal behavior interpretation, activity on non-verbal communication.

Exprtiment 3: Active listening. Active listening quiz.

Exprtiment 4: Feedback: How to give and receive feedback, Activity on feedback.

Exprtiment 5: Hidden date of communication: Feelings. Activity on how to handle feelings.

Exprtiment 6: Practical skills: assertiveness, activity on assertiveness, self-confidence, activity.

Exprtiment 7: In the world of teams: the team concept, element of teamwork. Team formation, effective team, exercise on team, Team players, activity.

Exprtiment 8: Discussions, decisions and presentations: Structured and un-structured group discussions. Activity on each.

Exprtiment 9: Adapting to Corporate life: exercise on grooming and dressing, getting ready for interview.

Exprtiment 10: Business Etiquette/Dining etiquette.

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- Experiment 1:** To study the increase in loss of head with respect to time in the filter bed.
- Experiment 2:** To study the effect of parameters like pH and temperature on adsorbents.
- Experiment 3:** To study change in alkalinity of wastewater by bubbling acidic gas.
- Experiment 4:** To check the acidity and alkalinity of water resources.
- Experiment 5:** To calculate the amount of solids in a suspension.
- Experiment 6:** To measure COD level in wastewater.
- Experiment 7:** To measure the conductivity of various wastewater.
- Experiment 8:** To plot the pressure drop profile through the filter bed.
- Experiment 9:** To measure the sediment removal efficiency and relating this to the hydraulic characteristics of a sedimentation tank.
- Experiment 10:** To study the characteristics of anaerobic digester.
- Experiment 11:** To determine the effect of velocity of water for separation of equal sized particles of different densities.

CHEMICAL REACTION ENGINEERING LAB – II (CL-1652)

- Experiment 1:** To study the kinetics and determine the reaction rate constant (k) for the given saponification reaction in a multiple reactor (Cascade CSTRs) at fixed temperature.
- Experiment 2:** To determine the effect of temperature on rate constant (k) of saponification in a multiple reactor (Cascade CSTRs).
- Experiment 3:** To study the kinetics and determine the reaction rate constant (k) for the given esterification reaction in a multiple reactor (Cascade CSTRs) at fixed temperature.
- Experiment 4:** To determine the effect of temperature on rate constant (k) of esterification reaction in a multiple reactor (Cascade CSTRs).
- Experiment 5:** To study the kinetics and determine the reaction rate constant (k) for the given saponification reaction in a multiple reactor (Combined CSTR & PFR) at fixed temperature.
- Experiment 6:** To determine the effect of temperature on rate constant (k) of saponification in a multiple reactor (Combined CSTR & PFR).
- Experiment 7:** To study the kinetics and determine the reaction rate constant (k) for the given esterification reaction in a multiple reactor (Combined CSTR & PFR) at fixed temperature.
- Experiment 8:** To determine the effect of temperature on rate constant (k) of esterification reaction in a multiple reactor (Combined CSTR & PFR).
- Experiment 9:** To determine the activation energy for a non catalytic homogeneous reaction in CSTR.
- Experiment 10:** To determine the activation energy for a catalytic homogeneous reaction CSTR.
- Experiment 11:** To study the effect of different kinds of packing in a packed bed reactor.
- Experiment 12:** To study the residence time distribution in a CSTR at constant flow rate. To plot the exit time distribution of the reactor and thereby obtain E-curve, F-curve and mean residence time, t.
- Experiment 13:** To study the residence time distribution in a CSTR with varying flow rates. To plot the exit time distribution of the reactor and thereby obtain E-curve, F-curve and mean residence time, t.
- Experiment 14:** To study the flooding characteristics and pressure drops in a trickle bed reactor. RTD studies in a packed bed reactor.

PROCESS DESIGN AND SIMULATION (LAB)(CL-1653)

- Experiment 1:** Modeling and Simulation of CSTR using programming language.
- Experiment 2:** Modeling and Simulation of PFR using programming language.
- Experiment 3:** Modeling and Simulation of Shell and Tube/Plate Type Heat Exchanger using programming language.
- Experiment 4:** Modeling and Simulation of Multicomponent distillation column using programming language.
- Experiment 5:** Modeling and Simulation of Reactive/Extractive/Azeotropic distillation column using programming language.
- Experiment 6:** Modeling and Simulation of Absorption unit using programming language.
- Experiment 7:** Steady State and Dynamic simulation of Heat Exchanger using ASPEN HYSYS.
- Experiment 8:** Steady State and Dynamic simulation of CSTR using ASPEN HYSYS.
- Experiment 9:** Steady State and Dynamic simulation of PFR using ASPEN HYSYS.
- Experiment 10:** Steady State and Dynamic simulation of Multicomponent distillation Column using ASPEN HYSYS.
- Experiment 11:** Steady and Dynamic simulation of Reactive/Extractive/Azeotropic distillation Column using ASPEN HYSYS.
- Experiment 12:** Steady State and Dynamic simulation of Absorption unit using ASPEN HYSYS.

CHEMICAL TECHNOLOGY (LAB) (CL-1654)

- Experiment 1:** To calculate the calorific value of a given sample by using bomb calorimeter.
- Experiment 2:** To calculate the flash point of a sample by using Pensky Martin flash point apparatus.
- Experiment 3:** To calculate the flash point and fire point of a sample by using Clereland's apparatus.
- Experiment 4:** Melting and drop melting point of Wax.
- Experiment 5:** Cloud point and Pour point.
- Experiment 6:** Drop point and Softening point of grease.
- Experiment 7:** To study the stoichiometry and kinetics of aerobic biological processes.
- Experiment 8:** To calculate the aniline point of a sample.
- Experiment 9:** To calculate the calorific value of a given sample by using Junker's gas calorimeter
- Experiment 10:** To analyze a gas sample (typically fossil fuel flue gas) for its oxygen, carbon monoxide and carbon dioxide content.
- Experiment 11:** To determine the amount of carbon residue in petroleum products left after evaporation and pyrolysis of oil and to indicate relative coke-forming propensities.

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UNIT 1: Introduction to Economics: Nature and Scope of Economics, Significance, Branches of Economics, Micro and Macro, fundamental concepts. Objectives of a firm. 6(L)

UNIT 2: Utility Analysis: cardinal and ordinal view, laws. Demand Analysis; Law of Demand, Exceptions to the law of Demand, Determinants of Demand. Elasticity of Demand- Price, Income, Cross and Advertising Elasticity; Uses of Elasticity of Demand for managerial decision making, measurement of Elasticity of Demand. Demand forecasting meaning, significance and methods. 8(L)

UNIT 3: Supply Analysis; Law of Supply, Supply Elasticity; Analysis and its uses for managerial decision making. Production concepts & analysis; Production function, single variable-law of variable proportion, two variable-Law of returns to scale. Cost concept and analysis, short-run and long-run cost curves and its managerial use. 8(L)

UNIT 4: Market Equilibrium and Average Revenue Concept. Market Structure: Perfect Competition, features, determination of price under perfect competition. Monopoly: Feature, pricing under monopoly, Price Discrimination. Monopolistic: Features, pricing under monopolistic competition, product differentiation. Oligopoly: Features, kinked demand curve, cartels, price leadership. 8(L)

UNIT 5: Pricing Strategies; Price determination, full cost pricing, product line pricing, price skimming, penetration pricing. 4(L)

UNIT 6: Indian Economy: National Income; Concepts and various methods of its measurement, Inflation, types and causes, Business Cycle. 6(L)

Text/Reference Books:

- Damodaran Suma – Managerial Economics (Oxford 2006)
- Hirschey Mark – Economics for Managers (Thomson, India Edition, 2007)
- Dominick Salvatore - Managerial Economics (Oxford, 2007)
- Mithani D.M. - Principles of Economics (Himalaya Publishing House, 2005).
- Dwivedi D.N. - Managerial Economics (Vikas Publication, 7th Edition)

PLANT DESIGN AND ECONOMICS (CL-1701)

UNIT 1: Introduction, Process Design development. General design considerations, Cost and asset accounting, The Hierarchy of Chemical Process Design, the Nature of Process Synthesis and Analysis, introduction to PERT and CPM. 4(L)

UNIT 2: Cash flow for industrial operations, factors effecting investment and production cost, estimation of capital investments, cost indices, cost factors in capital investment, production costs, fixed charges, plant overhead costs, financing. Interest and investment cost, present worth and discount annuities, cost due interest on investment, Taxes and insurances, type of taxes. 8(L)

UNIT 3: Depreciation, types of depreciation, services life, salvage value; present value, methods for determining depreciation. Profitability, alternative investments and replacements, profitability standards, discounted cash flow, capitalized cost, pay out period, alternative investments, analysis with small investments, increments and replacements. 6(L)

UNIT 4: Optimum design and design strategy, incremental cost, general procedure for determining optimum condition, comparison of graphical and analytical methods, optimum production rates, semi continuous cyclic operation, fluid dynamics, mass transfer strategy of linearization 6(L)

UNIT 5: Choice of reactor based on reactor performance, reactor conditions and reactor configuration. Reactor networks in process flow sheets. Heat exchange networks synthesis and utilities: Energy targets, Integration in distillation columns 8(L)

UNIT 6: Choice of separation of heterogeneous and homogeneous mixtures - Attainable region Separation systems in process flow sheets: multicomponent distillation for ideal and non ideal systems, distillation column sequences. Introduction to optimization approaches to optimal design, role of simulations in process design, Design under uncertainty and failure tolerance. 8(L)

Text/Reference Books:

- M.S. Peters and K.D. Timmerhaus, Plant Design and Economics for Chemical Engineering, Mc Graw Hill.
- Process Engineering Economics, Schweyer,
- W.D. Seider, J.D. Seader, D.R. Lewin, Process Design Principles Synthesis, Analysis, and Evaluation. John Wiley.
- Perry's Chemical Engineer's Handbook, McGraw-Hill Book Company, New York.

Professional Elective-I

BIOPROCESS ENGINEERING (CL-1731)

UNIT-1: MICROBIAL GROWTH KINETICS- Introduction, Types of Microorganisms: Structure and function of microbial cells. Fundamentals of microbial growth, Isolation and purification cells and enzymes from cells Methods of inoculation, Assay of Enzymes, Batch, continuous and fed batch processes, mass balance in series of vessels, recycle system, an overview of aerobic and anaerobic processes. 6(L)

UNIT-2: MEDIA STERILIZATION:-Medium preparation, Methods of media sterilization, batch and continuous sterilization, kinetics of sterilization, Methods of air sterilization, mechanism of air sterilization, filter design. 6(L)

UNIT-3: DESIGN OF FERMENTER-Construction materials, Temperature control, Mass transfer and microbial respiration, Baffles, different types of fermenter, Material and energy balance in steady and unsteady reaction systems. Stoichiometry and Kinetics of substrate utilization and Biomass and product formation: Stoichiometry of microbial growth, Substrate utilization and product formation, Recovery and purification of products. 6(L)

UNIT-4: AERATION AND AGITATION-Bubble aeration and mechanical agitation, correlation between oxygen transfer coefficient and operating variables, factors affecting volumetric oxygen transfer, the effect of degree of agitation on volumetric oxygen transfer, rheology of fermentation fluids. 6(L)

UNIT-5: SCALE UP- Scale up concepts, criteria for bioreactors scale up. 4(L)

UNIT-6: MONITORING OF BIOPROCESSES- On line data analysis for measurement and control of important physicochemical and biochemical parameters, parameter estimation techniques for biochemical processes, parameter estimation techniques for biochemical processes, computer based data acquisition, Control of physical, chemical and biological environment of the bioreactor. Advanced control strategies viz. PID controllers. 6(L)

Text & Reference Books:

- Shuler M L, Kargi F, "Bioprocess Engineering- Basic Concepts", 2nd edition, Prentice Hall of India Ltd. (2002)

Uma

- Stanbury P F and Whitaker A, "Principles of Fermentation Technology," 2nd edition, Elsevier, (1995)
- Bailey J E and Ollis D F, "Biochemical Engineering Fundamentals", McGraw Hill (1986)

INDUSTRIAL ENZYME ENGINEERING AND FERMENTATION TECHNIQUES (CL-1732)

- UNIT 1: BASIC CONCEPTS OF ENZYME**-Mechanism of Enzyme Action and kinetic of reaction: Concept of active sites, and energetic of enzyme substrate complex formation, Specificity of enzyme action, Estimation of Michaelis-Menten Parameter. 6(L)
- UNIT 2: STABILITY OF ENZYMES**-pH, Temperature, Mechanical forces, Heterogeneous system. 6(L)
- UNIT 3: PRODUCTION AND PURIFICATION OF ENZYMES**-Extract from plant, animal and microbial sources, Methods of characterization of enzymes, Development of enzymatic assays. 6(L)
- UNIT 4: ENZYME IMMOBILIZATION**-
Physical and chemical techniques for enzyme immobilization adsorption, Matrix entrapment, Encapsulation, cross linking, covalent binding, Advantages and disadvantages of different immobilization techniques. 6(L)
- UNIT 5: APPLICATIONS OF ENZYMES**-Classification of enzymes, Commercial application of enzymes in food, Pharmaceutical and other industries, Enzymes for analytical and diagnostic application. 6(L)
- UNIT 6: MASS TRANSFER EFFECTS IN IMMOBILIZED ENZYMES**-Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reaction, Formulation of dimensionless groups, Calculation of effectiveness factors. 6(L)

Text books and references:

- Price N C and Stevens L, "Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins", 3rd Edition, Oxford University Press (2003).
- Bailey and Ollis, "Biochemical Engineering Fundamentals", McGraw Hill (1996)
- Lehninger, A L "Principles of Biochemistry", Butterworth Publishers, New York (1993)
- Conn E E and Stump P K, "Outlines of Biochemistry" John Wiley and Sons, New York (1987)
- Stanbury P F and Whitaker A, "Principles of Fermentation Technology", Pergamon Press (1995)

INTRODUCTION TO BIOTECHNOLOGY (CL-1733)

- UNIT 1: INTRODUCTION TO BIOTECHNOLOGY**-Fundamentals of Biochemical Engineering, Biotechnology and Society. Principles and Processes; Application in Health, food, medicine and Agriculture, genetically modified (GM) organisms, bio-safety issues. 6(L)
- UNIT 2: BIOMOLECULES**-Building Blocks of Biomolecules-Structure and dynamics, Structure and function of Macromolecules (Carbohydrates, Proteins, Lipids), Major Cycle (Glycolysis, TCA) 6(L)
- UNIT 3: CELLS**-Cell as a basic unit of life, Introduction: Definition, Study of Microbes, Types of microbes, Classification of microbes, Origin of microbiology, Application of microbes in fermentation Biotechnology, Cellular Techniques including chromatography. 6(L)
- UNIT 4: BIOINFORMATICS**-History of Bioinformatics, Introduction and application, Biological databases (nucleotide and protein data bases, Structure databases) and their retrieval, Sequence file formats, Information Sources Analysis using Bioinformatics tools. 7(L)
- UNIT 5: GENOMICS**-Genetic engineering, Recombinant technology, Introduction Genome Sequencing Projects, Gene Prediction and counting, Genome similarity, SNP's and comparative genomics. 5(L)
- UNIT 6: ENZYMES**-Classification of Enzymes, Purification and characterization of enzymes from natural sources, Production, Comparison of chemical and enzyme catalysis. 5(L)

Text & Reference Books:

- Text book of Biotechnology by H.K.Dass (Wiley India publication)
- Biotechnology by B.D.Singh (Kalyani Publishers)
- Text book of Biotechnology by R.C.Dubey (S.Chand and company)
- Introduction to Biotechnology by William J. Thieman, Michael A. Palladino, Publisher: Benjamin ummings
- Basic Biotechnology by Colin Ratledge Publisher: Cambridge University Press

BIOENERGY ENGINEERING (CL-1734)

- Unit 1: Biomass Sources, Characteristics & Preparation:** Biomass Sources and Classification, Chemical composition and properties of different biomass materials and bio-fuels, Sugarcane molasses and other sources for fermentation ethanol-Sources and processing of oils and fats for liquid fuels, Energy plantations, Preparation of woody biomass: Size reduction, Briquetting of loose biomass, Drying, Storage and Handling of Biomass. 6(L)
- Unit 2: Biogas, Technology:** Feedstock for biogas production, Aqueous wastes containing biodegradable organic matter, animal residues, Microbial and biochemical aspects- Operating parameters for biogas production. Kinetics and mechanism, Dry and wet fermentation, Digesters for rural application, High rate digesters for industrial waste water treatment. 7(L)
- Unit 3: Bio-Ethanol and Bio-Diesel Technology:** Production of Fuel Ethanol by Fermentation of Sugars, Gasohol as a Substitute for Leaded Petrol, Trans-Esterification of Oils to Produce Bio-Diesel. 5(L)
- UNIT 3: Pyrolysis and Gasification of Biomass:** Thermo-chemical conversion of ligno-cellulose biomass - Biomass processing for liquid fuel production, Pyrolysis of biomass - Pyrolysis regime, effect of particle size, temperature, and products obtained. Thermo-chemical gasification principles: Effect of pressure, temperature and of introducing steam and oxygen, Design and operation of Fixed and Fluidized Bed Gasifiers. 9(L)
- UNIT 4: Combustion of Biomass and Cogeneration Systems:** combustion of Woody Biomass: Theory, Calculations and Design of Equipments, Cogeneration in Biomass Processing Industries. Case Studies: Combustion of Rice Husk, Use of Bagasse for Cogeneration. 5(L)

Text & Reference Books:

- Chakraverthy A, "Biotechnology and Alternative Technologies for Utilization of Biomass or Agricultural Wastes", Oxford & IBH publishing Co, 1989.
- D. Yogi Goswami, Frank Kreith, Jan. F. Kreider, "Principles of Solar Engineering", 2nd Edition, Taylor & Francis, 2000, Indian reprint, 2003

FOOD TECHNOLOGY AND ENGINEERING (CL-1735)

- UNIT 1: FOOD PROCESS ENGINEERING -FUNDAMENTALS**-Fundamentals of food process engineering, application of quantitative methods of material and energy balance in food engineering practice. 6(L)
- UNIT 2: UNIT OPERATIONS IN FOOD INDUSTRIES**-Fluid flow, thermal process calculations, refrigeration, evaporation and dehydration operations in food processing. Basic Principles of Food Preservation; Preservation of food by removal or supply of heat, dehydration, irradiation, addition of chemicals and fermentation; CA/MA storage; Water activity and food stability. 8(L)

11/11/11

UNIT 4: MECHANICAL OPERATIONS- Conversion operations, Size reduction and screening of solids, mixing and emulsification and membrane separation, centrifugation, extraction. 6(L)

UNIT 5: FOOD BIOTECHNOLOGY- Food Biotechnology, Dairy and cereal products, Beverages and food ingredients, High fructose corn syrup, Single Cell protein. 6(L)

UNIT 6: IMPROVEMENT OF NUTRITIVE QUALITY-Process such as fortification, enrichment, germination fermentation, inactivation of nutritional factors, stabilization of nutrients and increasing the availability of nutrient 6(L)

Text & Reference Books:

- Food Microbiology; WC Frazier; Tata McGraw Hill, Delhi
- Modern Food Microbiology; James M Jay; CBS Publishers, Delhi
- Essentials of Food & Nutrition by Swaminathan, Vol. 1 & 2
- Chemical changes in food during processing by Richardson
- Nutrition and Dietetics by Rose
- Technology of Food Preservation by Desrosier
- Food Science by Potter

OIL AND FAT TECHNOLOGY (CL-1736)

Unit 1: Industrial Oils And Fats- Raw material properties, Sources, composition, properties, classification, General survey of oils, and analysis of oils and fats. 6(L)

Unit 2: Recovery and Refining of Oils from Raw Materials- Extraction of oils, Mechanical and solvent extraction methods. Refining and hydrogenation of oils, Edible oil processing. 5(L)

Unit 3: Manufacture of Fatty Acids, Glycerin and Soap- Fat splitting and hydrolysis. Manufacture of glycerine and fatty acids, Soap manufacture. 4(L)

Unit 4: Technology of Oil Based Detergents- Oil based raw material for detergents, Detergents manufacturing processes, Oleo-Chemicals for other applications 6(L)

Unit 5: Modern Development in Detergents- Indian Oils, Fats and Detergents Industries, Manufacturing of Synthetic detergents and Surfactants 6(L)

Unit 6: Alpha Olefin from natural oils and conversion to sulphonate, Fatty alcohols and their sulphates form natural oils. 6(L)

Text & Reference Books:

- D.Swern, "Baileys Industrial Oils and Fat Products", 4th Edn. Vol.I &II, Wiley, 1982.
- Edgar Woollatt, "The Manufacture of Soaps, Other Detergents and Glycerine", 1stEdn, Ellis Horwood, 1985.

FUNDAMENTAL OF POLYMER SCIENCE TECHNOLOGY (CL-1737)

UNIT 1: CHARACTERISTICS AND ANALYSIS OF POLYMERS-The science of large molecules, Theory of polymer solutions, Measurement of molecular weight and size, Polymer degradation, Analyzing and testing of polymers. 7(L)

UNIT 2: POLYMER MATERIAL STRUCTURE AND PROPERTIES-Morphology in crystalline polymers, Polymer structure and physical properties, Deformation, flow and melt characteristics, Rheology and mechanical properties of polymers. 7(L)

UNIT 3: POLYMER SYNTHESIS AND REACTION ENGINEERING-Condensation and Addition polymerization, Ionic and Coordination polymerization, Co-polymerization, Ring opening polymerization. 7(L)

UNIT 4: MANUFACTURING OF THERMOPLASTICS POLYMERS- Polyethylene, polypropylene, polyvinylchloride and copolymers, polystyrene, Teflon, Fibers-polyamides (Nylon 6,6), polyesters (Dacron), Acrylics 6(L)

UNIT 5: MANUFACTURING OF THERMOPLASTICS POLYMERS-Phenol-formaldehyde, Melamine-formaldehyde, Polyurethane, Epoxides, Rubbers and elastomers. 6(L)

UNIT 6: PROCESSING OF POLYMERS- PLASTICS, FIBERS AND ELASTOMERS-Plastics-extrusion, injection molding, blow molding, compression and transfer molding; Spinning of fibers. 7(L)

Text books and references:

- F.W. Billmeyer, "Text Book of Polymer Science", 3rd Edn., Wiley Inter Science.
- F. Rodriguez, "Principles of polymer systems", 4th Edn., Taylor and Francis, Washington.
- "Encyclopedia of Polymers Science and Technology", John Wiley-Inter Science.
- Fried, J.R., "Polymer Science and Technology", Prentice Hall, Inc

DOWNSTREAM PROCESSING (CL-1738)

Unit 1: Requirement of Downstream Processing -Basic concepts of separation Technology, Overview of a bioprocess including upstream and downstream processing, Importance of downstream processing in biotechnology, characteristics of biological molecules, New Separation process in modern biotechnology; Separation characteristics of proteins and enzymes – size, stability & other biological properties; Selection of purification methodologies, Characteristics of fermentation broth & its pretreatment. 6(L)

Unit 2: Biomass Removal and Disruption-Biomass removal and disruption: Cell disruption by Mechanical and non mechanical methods, Chemical lysis, Enzymatic lysis, physical methods, Sonication, Types of Homogenizers, Centrifugation; Sedimentation; Flocculation. 8(L)

Unit 3: Product Isolation-Liquid - liquid extractions, Precipitation (salt, pH, organic solvent, high molecular weight polymer). Separation of particulate by filtration, Rotary Vacuum Filtration, Centrifugation & Ultracentrifugation (Batch, continuous, basket), settling, sedimentation, decanting; Product Purification: Electrophoresis; Different Electrophoresis technique –Isoelectric, focusing 8(L)

Unit 4: Membrane Based Separation-Membrane based purification: Microfiltration, Ultrafiltration, Reverse osmosis (UF and RO); Dialysis; Electrodialysis; Diafiltration; Pervaporation; Perstraction, Biotechnological application, Structure and characteristics of membranes; Liquid membranes; Supported liquid membrane; Membrane reactors. 6(L)

Unit 5: Separation by Adsorption and Chromatography-Types of adsorption; adsorbents types, their preparation and properties, Types of adsorption isotherms and their importance; Chromatography: general theory, partition coefficients, zone spreading, resolution and plate height concept and other chromatographic terms and parameters; chromatographic method selection; selection of matrix; separation based on size, charge, hydrophobicity and affinity: Gel filtration, Ion exchange chromatography, Affinity chromatography, IMAC chromatography; Covalent chromatography; Reverse phase chromatography (RPC) and hydrophobic interaction chromatography (HIC), HPLC, role of HPLC in protein characterization; Chromatofocussing; Polishing of Bioproducts by Crystallization of small and large molecules, drying and Formulations 8(L)

Unit 6: Product Polishing-Crystallization, Drying. A Few case studies: Citric acid, Glutamic acid, Penicillin G, Extracellular Enzymes, Intracellular enzymes, Antibodies. 4(L)

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- Biodegradation (Principles & techniques), Sivasankar, Prentice-Hall of India, 2004.
- Bioprocess Technology (Principles & techniques), B. Sivasankar, Prentice-Hall of India, 2005.
- Comprehensive biotechnology- Murray Moo-Young, Vol. II-latest ed., Pergan Publishers.
- H. J. Rehm and G. Reed, Biotechnology- Vol. 3, 4, 5, Verlag Publishers
- Stanbury & Whitteker, Principles Of Fermentation Technology, Pergamon Press
- A Biologist's Guide to Principles & Techniques of Practical Biochemistry- Wilson and Golding, Cambridge University Press
- Biochemical Engg. -Bailly & Ollis, Academic Press.
- Product Recovery in Bioprocess Technology, Heinemann, Butterworth Publication.

INTRODUCTION TO MULTIPHASE FLOW (CL-1739)

UNIT 1: Flow past immersed bodies-Drag and drag coefficients, flow through beds of solids, motion of particles through fluids, fluidization, types of fluidization and applications. 6(L)

UNIT 2: Two-phase flow-Two-phase flow through pipes, Lockhart-Martinelli parameters and their application in analysis of two-phase flows. 4(L)

UNIT 3: Interaction of fluids-Mixing of a single fluid; degree of segregation, early and late mixing of fluids, models for partial segregation, mixing of two miscible fluids, Gas-liquid flow phenomenon, Types of regimes formation – trickle, pulse, bubble, dispersed bubble, spray regime etc. 6(L)

UNIT 4: Types of Multiphase-Reactors-Various types of multiphase reactors e.g. packed bed, packed bubble column, trickle bed reactor, three phase fluidized bed reactor, slurry bubble column, stirred tank reactor. Characteristics of above mentioned reactors such as; fluid flow phenomena and flow regimes, flow charts/ correlations, pressure drop, liquid hold up etc, Reactors involving Newtonian and non-Newtonian fluids 8(L)

UNIT 5: RTD in Multiphase Flow systems-Non Ideal Flow: Residence time distribution of fluid in vessel, E, F & C Curve, Mean and variance, the Dirac delta function, residence time, linear and non-linear processes, models for non ideal flow, dispersion model, N tanks in series model, model for small deviations from plug flow and long tails, conversion in a reactor using RTD data, diagnosing ills of operating multiphase reactors, models for multiphase reactors, Two parameter model, PD model, three parameter models, PE Model. 9(L)

Text & Reference Books:

- Levenspiel O, "Chemical Reaction Engineering", 3rd Ed, John Wiley & Sons, Singapore (1999).
- Fogler H Scott, "Elements of Chemical Reaction Engineering", 3rd ed, Prentice Hall Inc. (1999).
- Shah Y.T., "Gas-Liquid-Solid Reactor Design", McGraw Hill Int. New York, 1979.
- Westerterp K.R., van Swaaij W.P.M., and Beenackers A.A.C.M., "Chemical Reactor Design and Operation", John Wiley & Sons, 1993.
- Doraiswamy L.K., and Sharma M.M., "Heterogeneous Reactions: Volume 2 Fluid- Fluid-Solid Reaction", John Wiley & Sons, 1984, Singapore.

FLUID FLOW & HEAT TRANSFER IN MICROCHANNEL (CL-1740)

Unit 1: Introduction and applications of fluid flow in microchannel; Micro-fabrication techniques; Dimensional analysis and role of dimensionless numbers in microchannel. 4(L)

Unit 2: Fundamental Transport Equations viz. Momentum balance, Mass Balance and Energy balance in microchannel. 8(L)

Unit 3: Statistical mechanics, Continuum assumption and limits of linear transport properties; multiphase flow in microsystem; pressure drop models in single and two phase flow in microchannels. Slip velocity, Continuum flow (with slip), free molecular flow; Electro-osmotic flow, electric double layer; Capillary filling, passive valves, electro-wetting; 8(L)

Unit 4: Introduction to heat transfer in micro-channels. Convective Heat transfer in microchannel with and without phase change. Boiling and Condensation in microchannels. Concepts and examples of micro heat exchange devices. 9(L)

Unit 5: Micro-mixing and its characterization; Heat transfer in multi-channel stack with chemical reactions; Viscous heating and entropy generation in channel flow; Microfluidic network for heat and mass transfer, Dispersion in micro-channel; entrance effect, Field flow fractionation. 8(L)

Text & Reference Books:

- Oliver Brand, Gary K. Fedder, Christofer Hierold, Jan G. Korvink, and Osamu Tabata; Advanced Micro & Nanosystems, Volume 5, Micro Process Engineering: Fundamentals, Devices, Fabrication, and Applications; Wiley-VCH
- Satish G. Kandlikar, Srinivas Garimella, Dongqing Li, Dongqing Li, Heat transfer and fluid flow in minichannels and microchannels; Elsevier
- By Nam-Trung Nguyen, Nam-Trung Nguyen Steven T. Wereley; Fundamentals and Applications of Microfluidics; Artech house

Professional Elective-II

TWO PHASE FLOW AND HEAT TRANSFER (CL-1741)

UNIT 1: INTRODUCTION-Introduction to two phase flow: type and applications, Flow Patterns in Adiabatic Flow, Flow Pattern Transitions in Adiabatic Flow, Flow Patterns in Diabatic Flow, Void Fraction and Slip Ratio, Methods of identifications for two-phase flow, Measurement technique in two phase flow. Introduction to two phase flow problems in process industry. 6(L)

UNIT 2: MODELING OF TWO-PHASE FLOW-Homogeneous Model/Drift Flux Model, Separate-Phase Model (Two-Fluid Model), Models for Flow Pattern Transition, Models for Bubbly Flow, Models for Slug Flow, Models for Annular Flow, Models for Stratified Flow (Horizontal Pipes), Models for Transient Two-Phase Flow. 8(L)

UNIT 3: PRESSURE DROP IN TWO-PHASE FLOW-Local Pressure Drop, Analytical Models for Pressure Drop Prediction: Bubbly Flow, Slug Flow, Annular Flow, Stratified Flow; Empirical Correlations for various flow types, Pressure Drop in Rod Bundles, Pressure Drop in Flow Restriction. 8(L)

UNIT 4: POOL BOILING HEAT TRANSFER-Introduction to two phase heat transfer, Modes of pool boiling, boiling curve, Heat transfer mechanism in pool boiling: bubble nucleation, growth and departure from a Heated Surface, Bubble emission Frequency, Waiting Period, Correlation of Nucleate Boiling Data, Pool Boiling Crisis, Film Boiling in a Pool; Forced convection boiling, Burnout. 8(L)

UNIT 5: HEAT TRANSFER IN CONDENSATION-Type of condensation, Film condensation, Drop-wise condensation, Condensation on a vertical plate, Condensation on tubes and spheres. 6(L)

UNIT 6: ENHANCED HEAT TRANSFER-Introduction to enhanced heat transfer, Techniques for enhanced heat transfer: Active Techniques, Passive techniques and compound techniques. 6(L)

10/11

- S. G. Kandlikar, "Handbook of Phase Change: Boiling and Condensation" Taylor & Francis.
- Jean J. Ginoux, Two phase flow and heat transfer.
- Bergles, Collier & Hewitt, Two phase flow and heat transfer in the power and process industries.

PETROCHEMICAL TECHNOLOGY (CL-1742)

UNIT 1: PRIMARY PROCESSING OF CRUDE OIL-Classification of crude oil, Atmospheric distillation. Vacuum distillation of residue-products and distillation practice. Production and consumption pattern of petrochemicals in India, Feedstocks for petrochemicals- Natural gas, LPG, Refinery off-gases, Hydroforming of petroleum stocks, Naphtha and fuel oils, Petroleum coke. 6(L)

UNIT 2: SECONDARY PROCESSING OF CRUDE OIL-FCCU, Hydro cracking, Visbreaking, Thermal cracking, Coking, Reforming, Alkylation, Polymerization and Isomerisation process. Ethylene and acetylene via steam cracking of hydrocarbons 6(L)

UNIT 3: TREATMENT-TECHNIQUES-Treatment techniques for removal of objectionable gases. Odors to improve performance, Storage stability. Extraction of aromatics, Olefins and recovery operations from petroleum products, Steam reforming and partial oxidation processes for syngas. 6(L)

UNIT 4: PETROCHEMICALS-Chemicals from methane and synthetic gas: Ammonia, Methanol and Hydrogen Cyanide, Chemicals from olefins; Ethylene derivatives, Propylene derivatives and Butylene derivatives, Aromatics, intermediates for synthetic fibers, Plastics and rubber. 6(L)

UNIT 5: ENVIRONMENTAL ASPECTS IN REFINERY AND PETROCHEMICALS- Waste water and effluent gases treatment from alkylation units and petrochemical units. 5(L)

UNIT 6: SAFETY-Safety and fire hazard aspects in the petroleum industries. 4(L)

Text books and references:

- W.L. Nelson, "Petroleum Refinery Engineering", 4th Edn., McGraw Hill, New York 1985.
- B. K. BhaskaraRao, "Modern Petroleum Refining Processes", 2nd Edn., Oxford and IBH Publishing Company, New Delhi, 1990. Khanna Publishers.
- G. D. Hobson and W. Pohl, "Modern Petroleum Technology", Gulf Publishers 2nd. Edn., 1990.
- R. A. Meyers, "Handbook of Petroleum Refining Processes", McGraw Hill, 1st Edn., 1980.
- F. Hatch and Sumi Malar, "From Hydrocarbons to Petrochemicals", Gulf Publishing Company, 1st Ed. 1981.

PETROLEUM REFINING ENGINEERING AND OIL WELL ENGINEERING (CL-1743)

UNIT 1: INTRODUCTION TO PETROLEUM INDUSTRY-World petroleum resources, petroleum industries in India. Scope and Purpose of Refining: Global and Indian refining scenario, Petroleum refining industry in India practice and prospects, An overview of the entire spectrum of the refinery products, refinery configuration development, Physio-chemical characteristics of Petroleum and Petroleum products 6(L)

UNIT 2: REFINERY PROCESSES-Desalting and Stabilization of crude, Process description of typical simple distillation, Fractional distillation, crude oil distillation, vacuum distillation etc, Degree of separation and degree of difficulty of separation, Packie charts, ASTM, TBP and EFV Distillation. Fuel Refining: Cracking, coking, reforming, alkylation, isomerisation, polymerization, sweetening, visbreaking. 8(L)

UNIT 3: LUBE REFINING-Solvent extraction, dewaxing, propane deasphalting. Wax Refining: Deoiling of crude wax, crystallization, catalytic, sweating microcrystalline and petroleum wax applications. 8(L)

UNIT-4: HYDRO PROCESSING-Hydro cracking, hydro treating, hydro finishing. Refinery Feedstock: Nature and effect of different types of refinery feedstock and their impurities on refinery configuration and operation. Refinery Gas Processing: Process description of typical light ends unit, acid gas removal using gas treating processes. 8(L)

UNIT 5: PHASE SEPARATION EQUIPMENTS-Two Phase oil and gas separation equipment: Types, their description, vessel sizing, theory of separation and separator design.

Three Phase Oil gas and water separators: Types of separators, their description. Various control and vessel internals, theory and sizing of three phase separator. LACT units. 8(L)

UNIT 6: SAFETY AND POLLUTION CONSIDERATIONS IN REFINERIES-Treatment methods, sweetening, hydrodesulphurization, smoke point improvement, health and environmental concerns. 4(L)

Text & Reference Books:

- Nelson W L, "Petroleum Refinery Engineering", McGraw Hill Book Co. 1985).
- Watkins R N, "Petroleum Refinery Distillation", Gulf Publishing Co.
- Gary J H and Handwork G E, "Petroleum Refining Technology and Economics", Marcel Dekker, Inc. (2001).
- Jones D S J, "Elements of Petroleum processing", John Wiley & Sons (1995)
- Waquier J P, "Petroleum Refining" Vol. I & II Editions, Technip (1995)
- Guthrie, V.B., "Petroleum Products", Hand-Book McGraw Hill.

MAJOR PROJECT – I (CL-1791)

Wise

UNIT 1: INTRODUCTION-Risk Analysis, Rapid risk analysis, Comprehensive risk analysis, Failure types and release rate calculations, Emission and dispersion, Dispersion models for dense gas, Plume dispersion, Jet dispersion, and Toxic dispersion model Evaluation of risk contours. 6(L)

UNIT 2: CONSEQUENCE ANALYSIS-Radiation, Tank on fire, Flame length, Radiation intensity calculation and its effect on plant, people & property, UCVCE, 5(L)

UNIT 3: FIRE AND EXPLOSION-Explosion due to deflagration, Detonation, TNT, TNO & DSM model, Over pressure, Effects of explosion, Risk contour, Flash fire, Jet fire, Pool fire, BLEVE, Fire ball. 6(L)

UNIT 4: RISK MANAGEMENT-Overall risk analysis, Generation of Meteorological data, Ignition data, Population data, Overall risk contours for different failure scenarios, Disaster management plan, Emergency Planning, on site & offsite emergency planning, Risk management & ISO 14000, EMS models, Case studies, Marketing terminal, gas processing complex, refinery. 7(L)

UNIT 5: PAST ACCIDENT ANALYSIS-Hazard identification, Safety Audits, Checklists, What if Analysis, Vulnerability models, Event tree and Fault tree Analysis, Past accident analysis Flixborough, Mexico, Bhopal, Vizak 3 miles, island chernobyl, feyzih disasters, seveso accident analysis. 6(L)

UNIT 6: HAZOPS- Principles, Risk ranking, Guide word, Parameter, Deviation, Consequences, Recommendations, Coarse HAZOP study, Case studies Pumping system, Reactor System, Mass transfer system. 6(L)

Text/Reference Books:

- K. V. Raghavan and A. A Khan, "Methodologies in Hazard Identification and Risk Assessment", Manual by CLRI.
- V. C. Marshal, "Major Chemical Hazards", Ellis Hawood Ltd., Chichester, United Kingdom.
- Kletz, "Risk Analysis Hazops" Institute of Engineers, U.K.
- Frank P. Less, "Loss Prevention in Process Industries", Vol. I, II & III Butterworth, London.

Professional Elective-III

SYNTHESIS OF NANOMATERIAL AND THEIR APPLICATION (CL-1831)

UNIT 1: INTRODUCTION TO THE PRACTICE AND DISCIPLINE OF NANOTECHNOLOGY-The nanoscale dimension and paradigm, Definitions, history and current practice, Overview of current industry applications, Nanoscale science and engineering principles. Different classes of nanomaterials: Metal and Semiconductor Nanomaterials, Quantum Dots, Wells and Wires, Overview of chemistry fundamentals for nanotechnology, Molecule to bulk transitions, Bucky balls and Carbon Nanotubes., Self-assembly and overview of Complex Adaptive Systems (CAS). 6(L)

UNIT 2: CARBON NANOTUBE TECHNOLOGIES (CNT)- From graphite to buckyballs to CNT, Carbon nanotube applications and MWNT, Fabricating carbon nanotubes and nano-wall structures, Key applications of CNT and MWNT. 6(L)

UNIT 3: SYNTHESIS OF NANOMATERIALS-Top-down (Nanolithography, CVD), Bottom-up (Sol-gel processing, chemical synthesis), Physical Vapor deposition, Wet deposition techniques, Self-assembly (Supramolecular approach), Molecular design and modeling. 6(L)

UNIT 4: CHARACTERIZATION-TEM, SEM and AFM technique, Fluorescence Microscopy and Imaging. 5(L)

UNIT 5: NANOFABRICATION-Nanolithography, Thin film processes, semiconductors, MEMS: Overview and history of development, Industry applications: Challenges and future development. 5(L)

UNIT 6: APPLICATIONS-Solar energy conversion and catalysis, Molecular electronics and printed electronics, Liquid crystalline systems, Linear and nonlinear optical and electro-optical properties, Applications in displays and other devices, Advanced organic materials for data storage, Photonics, Plasmonics, Chemical and biosensors, Nanomedicine and Nanobiotechnology. 5(L)

Text/Reference Books:

- Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, 2002
- A. Nabok, "Organic and Inorganic Nanostructures", Artech House, 2005
- C. Dupas, P. Houdy, M. Lahmani, Nanoscience: "Nanotechnologies and Nanophysics", Springer-Verlag Berlin Heidelberg, 2007
- Introduction to Nanotechnology by Charles Poole, Frank Owens, Wiley India Pvt Ltd 2007.
- Nanotechnology by Lynn E. Foster, Pearson Released: 2007

ELECTROCHEMICAL ENGINEERING (CL-1832)

UNIT 1: INTRODUCTION TO ELECTROCHEMICAL ENGINEERING-Introduction, Methods of measurement - Steady state techniques, Non-steady state techniques, Eliminating IR Drop. 5(L)

UNIT 2: ELECTROCHEMICAL TRANSFER PROCESS-Electrochemical Transfer Processes, Mass Transport, Charge Transport and Heat Transfer. 6(L)

UNIT 3: ELECTROCHEMICAL REACTION ENGINEERING-Electrochemical Thermodynamics and Electrode kinetics, Kinetics in Electrochemical Reactors. 6(L)

UNIT 4: DESIGN AND MODELING IN ELECTROCHEMICAL PROCESSES-Optimization and Factorial Design of Experiments, Experimental Modeling of Industrial Processes. 6(L)

UNIT-5 SEPARATION PROCESSES IN ELECTROCHEMICAL CELLS- Separation Systems in Electrochemical Cells, Materials and corrosion 6(L)

UNIT-6 THERMAL BEHAVIOR OF REACTORS-General aspects of thermal behavior in electrochemical reactor, Thermal behavior under CSTR conditions, the estimation of heat losses; the thermal behavior under PFR conditions; Thermal behavior of batch electrochemical reactors. 7(L)

Text/Reference Books:

- J.C. Kuriakose and J. Rajaram, "Chemistry in Engineering and Technology", Vol.1 & 2, Tata Mcgraw Hill Publishing Company (P) Ltd., New Delhi, 1996.
- Electrochemical Engineering Principles by Geoffrey A. Prentice, Prentice hall publications
- Electrochemical Methods: Fundamentals and Applications by Allen J. Bard, Larry R. Faulkner.
- Electrochemistry by Carl H. Hamann, Andrew Hamnett, Wolf Vielstich, Wiley publications

- UNIT 2: GEOMETRIC AND ELECTRONIC FACTORS IN CATALYSIS**-Adsorption and reaction kinetics in catalytic (heterogeneous) system. 6(L)
- UNIT 3: CATALYST PREPARATION**-Preparation and evaluation of industrial catalysts. 6(L)
- UNIT 4: KINETICS OF HETEROGENOUS REACTIONS**-Reaction engineering applied to catalytic homogeneous and heterogeneous chemical reactions. Theories of heterogeneous catalysis 8(L)
- UNIT 5: CATALYST POISONING**-Catalyst poisoning and deterioration (sintering) origination of catalyst. 6(L)
- UNIT 6: ELECTRO CATALYSIS AND FUEL CELL**-Photo catalysis for the removal of air and water pollutants and conversion of solar energy, Polyfunctional catalysts. 8(L)

Text/Reference Books:

- Fundamentals of Industrial Catalytic Processes by C. H. Bartholomew, Robert J. Farrauto, Wiley-AIChE; 2 edition
- Concepts of Modern Catalysis and Kinetics by I. Chorkendorff, J. W. Niemantsverdriet, Wiley-VCH; 2nd edition
- Handbook of Industrial Catalysts by Lloyd, Lawrie, Springer publications
- Industrial Catalysis: A Practical Approach by Jens Hagen, Wiley-VCH; 2 edition

COMPUTER-AIDED PROCESS CONTROL (CL-1834)

- Unit 1:** Introduction to Computer-Aided Process Control 4(L)
- Unit 2:** Hardware, Analog and digital interfacing, Sensors and transducers, 8(L)
- Unit 3:** System software: Real time programming, Application software: data logging, filtering. 8(L)
- Unit 4:** Z transforms discrete time dynamics systems, adaptive control, and introduction to MIMO control systems. Digital control algorithm: Conversion of analog PI, PD, PID into digital; 10(L)
- Unit 5:** Direct synthesis method; Dead beat control; Control algorithm for load changes. Introduction to DDC, DCS, supervisory, optimizing and hierarchical computer control. 10(L)

Text/Reference Books:

- Computer aided process control by S.K.Singh, Prentice Hall of India Pvt.Ltd.
- Process Control Engineering by P. Sai Krishna, I. K. International Pvt Ltd, 2010
- Industrial Instrumentation & Control by S.K.Singh, Tata McGraw-Hill Education

ADVANCES IN FLUIDIZATION ENGINEERING (CL-1835)

- Unit 1: Introduction and Applications**-Introduction to Fluidized bed systems, Fundamentals of fluidization. Industrial applications of fluidized beds - Physical operations, synthesis reaction, cracking and reforming of hydrocarbons, Gasification, Carbonization, Gas - solid reactions, calcining and clinkering. 6(L)
- Unit 2: Gross Behavior of Fluidized Bed**-Gross behavior of fluidized bed, Minimum and terminal velocities in fluidized beds, Types of fluidization. Design of distributors. Voidage in fluidized beds. TDH, variation in size distribution with height, viscosity and fluidity of fluidized beds. Power consumption. Bed expansion. 6(L)
- Unit 3: Analysis of Bubble and Emulsion Phase**-Davidson's model, Frequency measurements, Bubble behavior, bubbles in ordinary bubbling bed model for bubble phase. Emulsion phase, Experimental findings, Turnover rate of solids. Bubbling bed model for emulsion phase interchange co-efficient. 7(L)
- Unit 4: Flow Pattern of Gas and Heat & Mass Transfer in Fluidized Beds**-Flow pattern of gas through fluidized beds, Experimental findings, The bubbling bed model for Gas inter- change Interpretation of Gas mixing data, Heat and Mass Transfer between fluid and solid: Experiment findings on Heat and Mass Transfer, Heat and Mass Transfer rates from bubbling bed model. 7(L)
- Unit 5: Heat Transfer between Fluidized Beds and Surface**- Heat transfer between fluidized beds and surfaces, Experiment finding, theories of bed heat transfer, comparison of theories, Entrainment of or above TDH, model for Entrainment and application of the entrainment model to elutriation. 7(L)
- Unit 6: Semi Fluidization**-Principles, production of various bed parameters, Industrial applications, Design of fluidized bed reactors, Concept of RTD, Basic design principles for fluidized bed reactors. 6(L)

Text/Reference Books:

- D.Kunii and O.Levenspiel, Fluidization Engineering "2nd. Edn., John Wiley & Sons, 1992.
- Handbook of Fluidization and Fluid-Particle Systems (Chemical Industries) by Wen-Ching Yang, CRC Press publications.
- Fluid Bed Technology in Materials Processing by C. K. Gupta, D. Sathiyamoorthy, CRC Press; 1st edition.

PROCESS MODELING AND SIMULATION (CL-1836)

- UNIT 1:** Introduction to modeling and simulation, classification, Uses of mathematical models, Principles of model formulation, Fundamental laws- continuity equation, energy equation, equations of motion, Transport equations, equations of state, equilibrium and kinetics, Introduction to process simulators and mathematical tools. 8(L)
- UNIT 2:** Numerical solution of model equations with Linear and non linear algebraic, Equations in one and more than one variables, ordinary differential equations in one and more than one variables. 6(L)
- UNIT 3:** Numerical solution of model equations with partial differential equations using finite difference method. Model Parameters Estimation: Introduction, method of least squares, curve fitting, etc. 6(L)
- UNIT 4:** Lumped Parameter Models: Formulation and solution techniques for vapor-liquid equilibrium models, batch and continuous distillation column, mixing tank, stirred tank with heating, CSTR with multiple reactions. N- CSTRs in series, Non-isothermal CSTR, Non-ideal CSTR models. 8(L)
- UNIT 5:** Steady State Distributed Parameter Models: Formulation and solution of split boundary value problems - shooting technique, quasi-linearization techniques, counter current heat exchanger, tubular reactor with axial dispersion. 8(L)
- UNIT 6:** Unsteady State Distributed Parameter Models: convective problems, diffusive problems, combined convective and diffusive problems. 6(L)

Text/Reference Books:

- K. M. Hangos and I. T. Cameron, "Process Modeling and Model Analysis", Academic Press, 2001.
- W.L. Luyben, "Process Modelling, Simulation and Control for Chemical Engineers", 2nd Edn., McGraw Hill Book Co., New York, 1990.
- W. F. Ramirez, "Computational Methods for Process Simulation", Butterworths, 1995.
- Process Dynamics: Modeling, Analysis and Simulation, B Wayne Bequette, Prentice Hall. International Inc.
- Computational Methods for Process Simulation, 2nd ed., W F Ramirez, Butterworth-Heinemann.
- Roger E. Franks, "Modeling and Simulation in Chemical Engineering", John Wiley and Sons, 1972.

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- Singiresu S. Rao, "Applied Numerical Methods for Engineers and Scientists" Prentice Hall, Upper Saddle River, NJ, 2001
- Seinfeld and Lapidus, "Mathematical Methods in Chemical Engineering", Prentice Hall, 1974.

INDUSTRIAL CORROSION AND SURFACE COATING (CL-1837)

- UNIT 1 : INTRODUCTION**-Survey of paint industry and its scope in India. Pigments and their classification. Methods of manufacture: white, colored, metallic and luminous pigments. 8(L)
- UNIT 2: CLASSIFICATION OF PAINTS**-Oil, emulsion, and water soluble paints and their manufacturing processes; Drying oils; Natural and synthetic resins; Solvents and plasticizers. 8(L)
- UNIT 3: DEFINITION AND CLASSIFICATION OF VARNISH**-Oleoresinous and spirit varnishes; Manufacture of different types of varnishes. Ceramic coating: Glazing and enameling. 6(L)
- UNIT 4: METALLIC COATING**-Electroplating, Galvanizing, Tinning, Polymeric coating; Protective and decorative coatings, Powder Coating. 6(L)

Text/Reference Books:

- Noel, H., "Out of Paint Technology", Charles Griffin and Co., Ltd.
- Morgans, W.M., "Outlines of Paint Technology", Vol.I, Charles Griffin and Co.
- Bidlack, C. and Edgar W. P., "Paints and Varnish Production Manual", Chapman & Hall Ltd.
- Turner, G.P.A., "Introduction to Paint Chemistry Principles of Paint Technology", Oxford University Press.

ADVANCED PROCESS CONTROL (CL-1838)

- UNIT 1: FREQUENCY RESPONSE**-Review of control system design in Laplace, time, and frequency domains, controller design using Laplace, time and frequency response-Analysis of some common loops Bode diagrams for 1st & 2nd order system, Bode stability criteria, Ziegler- Nichols and Cohen-coon Tuning rules and Nyquist Plots. 6(L)
- UNIT 2: DESIGN OF CONTROLLERS FOR DIFFICULT & COMPLEX DYNAMICS**-Inverse response systems - controller design - design of inverse response compensator, Time delay systems - controller design - Smith predictor method,. 7(L)
- UNIT 3: COMPLEX DYNAMICS**-Dynamics and Control of complex processes. Theoretical analysis of complex processes like jacketed kettle, absorber and heat exchanger. 5(L)
- UNIT 4: MULTIVARIABLE SYSTEMS**-Feed forward control, cascade and ratio control - Introduction to stage space methods-Design of controllers using state-space methods - Introduction to multiloop systems- Relative gain analysis. 6(L)
- UNIT 5: CONTROLLERS DESIGN AND ART OF PROCESS CONTROL**-Degrees of freedom analysis - Introduction to distillation system - Controller design for multiloop systems. Interaction and pairing of control loops, the art of process control. 6(L)
- UNIT 6: DESIGN OF DIGITAL CONTROLLERS**-Supervisory control systems-Digital computer control - sampling & filtering of continuous measurements, Developments of discrete time models - Dynamic response of discrete time systems. Analysis of sampled data control System-Design of digital controllers. 7(L)

Text/Reference Books:

- D. R. Coughanowr, "Process System Analysis and Control", 2nd Edn. McGraw Hill, 1991.
- G Stephanopoulos, "Chemical Process Control", Prentice-Hall India, 1984.
- D. E. Seborg, T.F. Edgar and D.A. Mellichamp, "Process Dynamics Control", John Wiley, 1989.
- Ogunnauke and W.H. Ray, "Process Dynamics, Modeling and Control" Oxford Press. 1994.
- Luybin W.L.; Process modeling, simulation and control for chemical Engineers; "McGraw Hill, 1973."

SCALE-UP IN PROCESS INDUSTRIES (CL-1839)

- UNIT 1: INTRODUCTION**-Introduction to pilot plants and Models, Process Development, Process study, the principle of similarity and similarity criteria. 4(L)
- UNIT 2: PILOT PLANTS AND PLANT MODELS**-Dimensional analysis and its application in scaling-up or scaling-down the chemical process plant, Project engineering, Practical consideration; Safety considerations, successful plant operations and case studies. 6(L)
- UNIT 3: MATHEMATICAL EQUATIONS**-Mathematical Equations representing the Mechanical, Thermal, Diffusional and chemical processes and derivation of the dimensionless groups from these differential equations. Rate of chemical reaction of Homogeneous and Heterogeneous chemical reactions. 6(L)
- UNIT 4: THE REGIME CONCEPT**-The Regime Concept, Laupichleir's study of catalytic water gas reaction, chemical dynamic and mixed regime, Effect of temperature on physical and chemical reactions. Similarly criteria for the principle types of regime and scale equations. 5(L)
- UNIT 5: SCALE UP OF HEAT TRANSFER EQUIPMENTS**-Scale-up methods for Heat-Transfer equipment e.g.-Heat Exchangers, Steam or vapor Heaters, Evaporators, Condensers and Coolers. 6(L)
- UNIT 6: SCALE-UP OF MISCELLANEOUS EQUIPMENT**-Scale-up methods for mixing equipment and other miscellaneous equipment used in chemical process industries. 7(L)

Text/Reference Books:

- R.E. Johnstone and M.W. Thring, "Pilot Plants, Models and Scale-up methods in Chemical Engineering ", McGraw Hill Book Company, New York, 1957.
- Bisio&Kabel, "Scale-up in Chemical Industry".
- D.G. Jordan, "Chemical Process Development", Vol. I & II, Interscience Publishers, 1988.

SOLID WASTE MANAGEMENT (CL-1840)

- UNIT 1: Introduction**-Philosophy and organization, Status of solid waste management, Computation an integrated waste management strategy. Evolution of solid waste management, Legislation and Government agencies. 8(L)
- UNIT 2: Management**-Planning solid waste management progress, Generation of solid waste, Onsite handling, Storage and processing, Transfer and transport, Processing techniques and equipment, Hazardous waste and their management, Process management issues, Planning, Recovery of resources- Conversion, Chemical and Biological methods. 8(L)
- UNIT 3: Disposal of solid waste**-Land filling, Ocean disposing, Source reduction, Recycling, Incineration, Composting. 7(L)
- UNIT 4: Case studies on major industrial solid waste generation units**-Coal fired power plant, Textile industry, Brewery, Distillery, Oil refinery, radioactive generation units. Case studies on spills, Sludge lagooning and incineration. 7(L)

Text/Reference Books:

- Solid Wastes, Martell, 1975, John Wiley, NY.

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ENERGY ENGINEERING (CL-1841)

UNIT 1: Coal- Classification, properties, washing and storage, combustion, carbonization, liquefaction and gasification, briquetting of pulverized coal, proximate and ultimate analysis, merits and demerits of solid, liquid and gaseous fuels. 6(L)

UNIT 2: Liquid fuels- Properties, handling, storage and transportation, combustion characteristics and associated problems, fuel specification and standards, Origin of petroleum, classification and refining of crude petroleum, knocking, octane rating and cetane rating of fuels, Gaseous fuels: Manufacture, properties and characteristics of natural gas, CNG, LPG, coal gas, coke oven gas, producer gas and water gas. 8(L)

UNIT 3: Alternate energy sources- Biomass combustion and pyrolysis, bio-gas production, Solar energy- Flat plate collector, analysis and construction of solar water heater, solar pond, solar desalination and solar space heating and cooling. Geothermal energy sources and their harnessing, energy from wind and tides, energy storage and distribution. 7(L)

UNIT 4: Combustion process- Nature of combustion, mechanism of combustion reactions, chain reaction – hydrogen-oxygen reaction, velocity of flame propagation, limits of inflammability, structure of flame, kinematics of liquid and solid fuel combustion. 6(L)

UNIT 5: Energy conservation measures- Waste heat recovery, use of low grade hot streams, condensate and flue gases, improvement in heat energy, steam trap. 5(L)

UNIT 6: Energy auditing- Mapping of distribution of energy supply and demand in a chemical plant, identification of energy intensive areas, energy auditing and acts. 7(L)

Text /Reference Books:

- Fuel and Combustion – Smith N.L. & Stainson K.W.
- Principles of Solar and Energy Handbook: Kreider J.F., Frank and Kreith, F
- Unconventional energy sources: G.D. Rai, Khanna Publishers.
- Renewable Energy Resources: John Twidell and Tony Wein
- Industrial Energy Conservation: A hand book for engineers and managers - Reay D.A.
- Fuels & Combustion: Samir, Sirkar, Orient Longman Pub. 2nd ed. Mumbai.
- Solar Energy Engineering – S.P. Sukhatma, 2nd ed, TMH Pub, Ltd. New Delhi
- Fuels Combustion & Refractory- O.P.Gupta, Khanna Publishers .

ENERGY MANAGEMENT AND AUDIT (CL-1842)

UNIT 1: Energy Scenario- Commercial and Non-Commercial Energy, Primary Energy Resources, Commercial Energy Production, Energy Needs of Growing Economy, Long Term Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy and Environment: Air Pollution, Climate Change, Energy Security, Energy Conservation and its Importance, Energy Strategy for the Future, Energy Conservation Act-2001 and its Features. Kyoto Protocol, Global warming. 6(L)

UNIT 2: Energy Management & Audit- Definition, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments. 8(L)

UNIT 3: Energy Action Planning- Key elements, Force field analysis, Energy policy purpose, perspective, Contents, Formulation, Ratification, Organizing - location of energy management, Top management support, Managerial function, Roles and responsibilities of energy manager, Accountability. 6(L)

UNIT 4: Motivating-motivation of employees- Information system designing barriers, Strategies; Marketing and communicating-training and planning. 4(L)

UNIT 5: Financial Management- Investment-need, Appraisal and criteria, Financial analysis techniques- Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs. 6(L)

UNIT 6: Project Management- Definition and scope of project, Technical design, Financing, Contracting, Implementation and performance monitoring. Implementation plan for top management, Planning Budget, Procurement Procedures, Construction, Measurement & Verification. Energy Monitoring and Targeting: Defining monitoring & targeting, Elements of monitoring & Targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences (CUSUM). 8(L)

Text/Reference Books:

- Capehart, Barney L., Wayne C. Turner and William J. Kennedy, "Guide to Energy Management", Third Edition, Fairmont Press, Atlanta, GA, 2000;
- Albert Thumann and D. Paul Mehta "Handbook of Energy Engineering", 4th ed. Lilburn, GA: Fairmont Press; 1997
- Loftness, Robert L. "Energy Handbook." 2d ed. New York: Van Nostrand Reinhold Co., 1984.
- Turner W. "Energy Management Handbook", Ed., John Wiley & Sons, New York, 1982
- Lapedes, DN "Encyclopedia of Energy", McGraw-Hill, New York, (1976)

MAJOR PROJECT – II (CL-1891)

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**Course Structure & Curriculum
For
B. Tech. Programme**

**In
CIVIL ENGINEERING**



**Department of Civil Engineering
Motilal Nehru National Institute of Technology
Allahabad**

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**Curriculum for
Bachelor of Technology in
Civil Engineering**

3rd semester (Civil Engineering)

Course code	Course name	L	T	P	Credit
CE-1301	Building Planning & Construction	2	---	---	2
CE-1302	Computer Based Numerical Techniques	3	---	---	3
AM-1304	Strength of Materials	3	1	---	4
AM-1301	Fluid Mechanics – I	3	1	---	4
CE-1303	Engineering Geology	2	---	---	2
CE-1351	Building Planning & Construction (Lab.)	---	---	3	2
CE-1352	Computer Based Numerical Techniques (Lab.)	---	---	3	2
AM-1353	Strength of Materials (Lab.)	---	---	3	2
AM-1351	Fluid Mechanics – I (Lab.)	---	---	3	2
CE-1353	Engineering Geology (Lab.)	---	---	3	2
Total		13	2	15	25

4th semester (Civil Engineering)

Course code	Course name	L	T	P	Credit
CE-1401	Building Materials & Concrete Technology	3	---	---	3
CE-1402	Estimating, Costing & Valuation	3	1	---	4
CE-1403	Survey – I	3	1	---	4
HS-1401	Principles of Management	3	---	---	3
AM-1404	Structural Analysis – I	3	1	---	4
AM-1405	Fluid Mechanics – II	3	1	---	4
CE-1451	Building Materials & Concrete Technology (Lab.)	---	---	3	2
CE-1452	Survey – I (Lab.)	---	---	3	2
AM-1452	Fluid Mechanics – II (Lab.)	---	---	3	2
Total		18	4	9	28

5th semester (Civil Engineering)

Course code	Course name	L	T	P	Credit
CE-1501	Survey- II	3	1	---	4
CE-1502	Transportation Engineering - I	3	1	---	4
CE-1503	Geotechnical Engineering – I	3	1	---	4
CE-1504	Concrete Structures – I	3	1	---	4
CE-1505	Environmental Engineering - I	3	1	---	4
AM-1501	Structural Analysis – II	3	1	---	4
CE-1551	Transportation Engineering – I (Lab.)	---	---	3	2
CE-1552	Geotechnical Engineering – I (Lab.)	---	---	3	2
AM-1551	Structural Analysis – II (Lab.)	---	---	3	2
Total		18	6	9	30

6th semester (Civil Engineering)

Course code	Course name	L	T	P	Credit
CE-1601	Concrete Structures - II	3	1	---	4
CE-1602	Transportation Engineering - II	3	1	---	4
CE-1603	Environmental Engineering - II	3	1	---	4
CE-1604	Steel Structures - I	3	1	---	4
CE-1605	Geotechnical Engineering - II	3	1	---	4
CE-1671	Survey Camp	---	---	---	3
CE-1651	Concrete Structures – II (Lab.)	---	---	3	2
CE-1652	Environmental Engineering – II (Lab.)	---	---	3	2
CE-1653	Geotechnical Engineering – II (Lab.)	---	---	3	2
Total		15	5	9	29

7th semester (Civil Engineering)

Course code	Course name	L	T	P	Credit
CE-1701	Water Resources Engineering - I	3	---	---	3
CE-1702	Construction Planning & Management	3	---	---	3
CE-1703	Steel Structures – II	3	---	---	3
OE-1781to 1788	Open Elective - I	3	---	---	3
CE-1791	Project	---	4	---	4
CE-1751	Steel Structures – II (Lab.)	---	---	3	2
CE-1731 to CE-1740	Professional Elective – I	3	1	---	4
Total		15	5	3	22

Course code	Course name	L	T	P	Credit
CE-1801	Computer Aided Design (Civil)	1	---	3	3
CE-1802	Water Resources Engineering - II	3	1	---	4
CE-1803	Earthquake Resistant Design	3	1	---	4
CE-1841 to CE-1850	Professional Elective – II	3	1	---	4
OE-1881 to 1888	Open Elective – II	3	---	---	3
CE-1891	Project	---	8	---	8
CE-1851	Computer Aided Design (Civil) Lab				
	Total	13	11	3	26

1st digit; 1: UG, 2nd digit; 2, 3, etc.: Semester

Code	Description
01-30	Theory Courses
31-40	Professional Elective –I
41-50	Professional Elective –II
51-70	Practical Courses
71	Survey Camp
81-90	Open Elective
91-99	Project

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BUILDING PLANNING & CONSTRUCTION (CE-1301)

UNIT 1: Building Byelaws & Development Controls-Types of buildings, Concept of functional efficiency of buildings, Recommendations of NBC 2005 for building planning. FSI and FAR restrictions. Green rating of Buildings. Oriental principles of building planning. 3(L)

UNIT 2: Building Science-Thermal and acoustic behavior of buildings and associated design computations. Lighting in building. Active and passive means of improving functional performance of buildings. Energy Efficient Built environment. 4(L)

UNIT 3: Building Components & Construction Details-Components of building and area considerations, Damp proofing and termite treatment. Planning, design and construction of vertical circulation means. Different types of floors, and flooring materials. Different types of roofs and roof treatments for thermal insulation and water proofing. Construction details of Lintels and Chhajja and Waffle slab. Form works, Scaffolding, shoring and underpinning. 5(L)

UNIT 4: Masonry Construction-Masonry construction using stones, bricks and other building blocks: Specifications for building stone, commonly used stones in masonry construction. Testing and preservation of stones. Manufacture of burnt clay bricks, and their classification, Properties of clay bricks and their testing, Problems of efflorescence & lime bursting in bricks & tiles. Different types of mortars used in masonry construction. Factors affecting strength of masonry. Cavity wall, hollow block construction, Fal G bricks and other green construction building blocks. 5(L)

UNIT 5: Planning for Building Services-Water supply and sanitary fittings (Plumbing), Fire safety installations, electricity. Heating ventilation & air-conditioning, mechanical lifts and escalators. 4(L)

UNIT 6: Building Finishes and Maintenance: Plastering, pointing, Distempering, Color washing, and Painting. Preventive maintenance Principles & Methods. Useful life of buildings. 3(L)

Text/ Reference Books:

- S.K. Sharma: A Text Book of Building Construction, S. Chand & Company Ltd.
- B.C. Punmia : A Text Book of Building Construction, Laxmi Publications, Delhi.
- O.H. Koenisberger: "Manual of tropical housing and building", Orient Longman Ltd., Madras.
- S.P. Arora et al., "A Text Book of Building Construction (Planning Techniques and Methods of construction) - Dhanpat Rai & Sons, Delhi.
- TERI Guide to Sustainable Building Design, TERI, New Delhi

COMPUTER BASED NUMERICAL TECHNIQUES (CE-1302)

UNIT 1: General Considerations-Introduction to numerical analysis, its concepts & mathematical preliminaries 4(L)

UNIT 2: Errors and Their Analysis-Sources of Errors, Accuracy of Numbers, Type of Errors, Errors in Numerical Computations, Arithmetic Operation with Normalized Floating Point Numbers. 6(L)

UNIT 3: Algebraic & Transcendental Equation-Bisection Method, Iteration Method, Muller's Method, Method of False Position, Newton-Raphson Method. 10(L)

UNIT 4: Interpolation-Introduction of Finite Differences, Decision of Errors, Newton's formulae for Interpolation, Gauss, Interpolation by Unevenly Spaced Points, Lagrange Interpolation Formula, Newton Divided Difference Formula 6(L)

UNIT 5: Numerical Integration and Differentiation-Introduction of Numerical differentiation and Numerical Integration, Trapezoidal Rule, Simpson 1/3 rule, Simpson 3/8 Rule, Booles and Weddles rule, Gaussian formula. 8(L)

UNIT 6: Statistical Computation-Frequency Distribution & Chart, Method of Least Square, Fitting a Straight Line, Exponential curve fit, Regression analysis, Least Square fit, Polynomial fit, Linear & Non Linear Regression, Multiple Regression, Statistical Quality Control Methods. 6(L)

Text/ Reference Books:

- Manish Goyal, Computer-Based Numerical & Statistical Techniques, Laxmi Publications, New Delhi, 2008.
- Jain, Iyengar, Jain, Numerical Methods for Scientific & Engineering computation, New Age International
- Balaguruswamy, Numerical Methods, TMH
- Sastry, Introductory Method of Numerical Analysis, PHI
- Gerald & Wheatley, Applied Numerical Analysis, Addison Wesley
- Hulquit, Numerical Method for Engineers & Computer Scientist?, Addison Wesley
- Flowers, Numerical Methods In C++, Oxford University Press
- Vedamurthy, Numerical Methods, Vikas

STRENGTH OF MATERIALS (AM-1304)

UNIT 1: Analysis of Stress and Strain- Uniaxial stress and strain: Stress, Strain, Hooke's Law, Stress-strain curves, Elastic Constants, Strain Energy, Statically Indeterminate problems, Thermal Effects, Impact Loading. Biaxial stress and strain: Stress at a Point, Variation of Stress, Stress Transformation, Analysis of Strain, Strain-displacement relations, Strain transformation, Strain Measurements, Constitutive equations, Principal stresses and strain. 10(L)

UNIT 2: Bending and Shear Stresses- Introduction, Pure Bending, Normal stresses in beams, Combined Bending and Axial Stress, Composite Beams, Shear Stress, Shear Centre, Strain energy in bending. 6(L)

UNIT 3: Torsion: Introduction, Torsion of Circular Shaft, Power Transmitted by a Shaft, Compound Shaft, Tapered Shaft, Strain Energy in Torsion, Combined Bending and Twisting, Torsion of Thin Walled Tubes, Open and Closed Coiled Springs. 6(L)

UNIT 4: Thin and Thick Cylinders & Spheres- Introduction, Thin Walled Shells, Thick Shells, Compound Cylindrical Shell. 6(L)

UNIT 5: Deflections of Beams- Introduction, Equation of Elastic Curve, Methods for Determining Deflections - Double Integration, Macaulay's Method, Moment-Area Method, Conjugate-beam method, Castigliano's Theorem. 5(L)

UNIT 6: Columns and Theories of Failure- Introduction, Euler's Theory for Long Columns, Rankine-Gordon Formula, Empirical Formulae, Eccentrically Loaded Columns. 7(L)

Text/ Reference Books:

- Elements of Strength of Materials, S.P. Timoshenko and D.H. Young, East-West Press Pvt. Ltd. Publications.
- Mechanics of Materials, Pytel and Kiusalaas, Cengage Learning Publications.
- Mechanics of Materials, Gere and Timosheinko, CBS Publications.
- Mechanics of Materials, E. P. Popov, Prentics Hall Publications.
- Strength of Materials, G. H. Ryder, Macmillan India Limited.
- Strngth of Materials- Pytel and Singer, Harpercollins College division publications.
- Strength of Materials, Crandal, Dahal and Lardener, Tata Mcgraw Hill Publications.
- Mechanics of Materials- Riley, Struges and Morris, John Wiley & Sons.

FLUID MECHANICS-I (AM-1301)

UNIT 1: Introduction to Fluid Mechanics-Fluid and continuum, Physical properties of fluids, Types of fluid flows, Rheology of fluids. 2(L)

UNIT 2: Fluid Statics and Kinematics-Pressure-density-height relationship, manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis. Kinematics of Fluid flow: steadiness, uniformity, rotational and irrotational flows, streamline, streakline, pathline, continuity equation, stream function and velocity potential, circulation, applications of potential flow. 8(L)

UNIT 3: Dynamics of Fluid Flow and Dimensional Analysis-Euler's Equation of motion along a streamline and its integration, Bernoulli's equation and its applications, momentum equation and its application to pipe bends. Dimensional Analysis, Buckingham's Pi theorem, important dimensionless numbers and their physical significance, geometric, kinematic and dynamic similarity, model studies, Hydraulic similitude. 8(L)

UNIT 4: Laminar and Turbulent Flows- Equation of motion for laminar flow through pipes, Stokes law, transition from laminar to turbulent flow, types of turbulent flow, isotropic and homogenous turbulence, scale and intensity of turbulence, eddy viscosity, Prandtl's mixing length theory, velocity distribution in turbulent flow over smooth and rough surfaces, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer (rigid theory), three reservoir problems and pipe network. 10(L)

UNIT 5: Hydrodynamic Boundary Layer- Introduction with a historical background, boundary layer, displacement and momentum thickness, boundary layer over a flat plate, Prandtl boundary layer equation, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub-layer, separation and its control, drag and lift, drag on a sphere, a 2D cylinder and an aerofoil, Magnus effect. 8(L)

UNIT 6: Measurement Techniques- Flow measurement by Pitot tube, orifice, Venturi, nozzle, and bend meter, rotameter, notches and weirs, hot-wire anemometer, LDV and PIV, Turbine flowmeter, Vortex shedding flowmeter, magnetic flowmeter, Doppler Ultrasonic flowmeter, Coriolis flowmeter etc. 4(L)

Text/ Reference Books:

- Fox, R.W., McDonald, A.T., Introduction to Fluid Mechanics, 7th edition, Wiley India.
- Ojha, C.S.P., Berndtsson, R., Chandramouli, P.N., Fluid Mechanics and Machinery, Oxford University Press, New Delhi.
- Majumdar, B., Fluid Mechanics with Laboratory Manual, PHI Learning, New Delhi.
- Som, S.K. and Biswas G, Introduction of Fluid Mechanics & Fluid Machines, TMH, New Delhi.
- Mohanty, A.K., Fluid Mechanics, PHI Learning, New Delhi.
- Shames, I.H., Mechanics of Fluids, McGraw Hill, International Students Edition.
- Agarwal, S.K., Fluid Mechanics and Machinery, TMH, New Delhi.
- Rathakrishnan E., Instrumentation, Measurements and Experiments in Fluids, CRC Press, New York.
- Garde, R.J., Fluid Mechanics through Problems, New Age International Pvt. Ltd, New Delhi.

ENGINEERING GEOLOGY (CE-1303)

UNIT 1: Minerals and Rocks- Minerals: Their physical properties and study of certain rock forming minerals. Rocks: origin, structure, Texture and classification of igneous, sedimentary and metamorphic rocks and their suitability as engineering materials. 6(L)

UNIT 2: Structural Geology- Stratification, Lamination, Bedding, Outcrop-its relation to topography, dip and strike of bed, overlap, outlier and inlier, Rock deformation: Folds, Faults, joints unconformity and their classification. 6(L)

UNIT 3: Earthquake-Earthquake, its causes, classification, seismic zones of India and Geological consideration for construction of building and other projects in seismic areas. 2(L)

UNIT 4: Landslide and Ground Water Harvesting-Landslides, its causes, classification and preventive measures, Ground water and rainwater harvesting, Ground water provinces of India. 4(L)

UNIT 5: Engineering Materials-Building Stones, Engineering properties of rocks, Alkali aggregate reaction, Grouting, Pozzolonic materials. 2(L)

UNIT 6: Geological Investigation- Geological investigations for site selection of Dams and reservoirs tunnels, bridges and Highways, Principles of Geophysical explorations methods for subsurface structures. 6(L)

Text/ Reference Books:

- P.K. Mukerjee: A Text Book of Geology, Calcutta Word Publishers.
- K V G K Gokhale: Principles of Engineering Geology, B.S. Publications.
- D.S. Arora: Geology for Engineers, Mohindra Capital Publishers, Chandigarh.
- J.M. Treteth: Geology of Engineers, Princeton, Von. Nostrand.
- Prabin Singh: Engg. and General Geology, Katson Publishing House.
- F.G.M. Blyth: Geology for Engineers, Arnold, London.
- R.F. Leggot: Geology and Engineering, McGraw Hill, New York.

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Experiment 1: Preparation of Drawings by students:

- a) Details of Bonds in Brick Masonry and Stone Masonry
- b) Planning of a building with given site conditions.
- c) Details of different types of Staircase and a section through foundation and super structure.
- d) Details of commonly used Doors and Windows.
- e) Details of Single Stack and Double Stack Plumbing system.
- f) Development of drawings for Planning of a building with given site conditions on Auto Cad.
- g) Details of earthquake resistant provisions in masonry structures.

Experiment 2: Design for Noise control & acoustic for an auditorium.

Experiment 3: Computation of thermal load and associated design of building for thermal comforts and lighting.

Experiment 4: Evaluation of a Building for Green Rating.

COMPUTER BASED NUMERICAL TECHNIQUES (LAB) (CE-1352)

Experiment 1: Bisection Method

Experiment 2: Iteration Method

Experiment 3: Method of False Position

Experiment 4: Newton-Raphson Method

Experiment 5: Newton's forward difference Interpolation formula

Experiment 6: Newton's backward difference Interpolation formula

Experiment 7: Gauss's interpolation formula.

Experiment 8: Lagrange's interpolation formula.

Experiment 9: Numerical Integration using Simpson 1/3 Rule and Simpson 3/8 Rule and their applications.

STRENGTH OF MATERIALS (LAB) (AM-1353)

Experiment 1: Tension Test

Experiment 2: Compression Test

Experiment 3: Torsion Test

Experiment 4: Beam Bending

Experiment 5: Impact Tests

Experiment 6: Closed and Open coiled springs

Experiment 7: Shear Test

Experiment 8: Buckling of Struts

Experiment 9: Hardness Test (Brinell and Rockwell)

Experiment 10: Tensometer (Tension Test)

FLUID MECHANICS-I (LAB) (AM-1351)

Experiment 1: To verify the momentum equation using the experimental set-up on diffusion of submerged air jet.

Experiment 2: To determine the coefficient of discharge of an orifice of a given shape. Also to determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.

Experiment 3: To calibrate an orifice meter, venturimeter, and bend meter and study the variation of the co-efficient of discharge with the Reynolds number.

Experiment 4: To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.

Experiment 5: To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.

Experiment 6: To study the variation of friction factor 'f' for turbulent flow in commercial pipes.

Experiment 7: To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.

Text/ Reference Books:

- Singh, S. Experiments in Fluid Mechanics, PHI Learning, New Delhi.
- Prakash, M.N.S., Experiments in Hydraulics and Hydraulic Machines: Theory and Procedures, PHI Learning, New Delhi.

ENGINEERING GEOLOGY (LAB) (CE-1353)

Experiment 1: Identification of certain rock forming minerals

Experiment 2: Identification of certain igneous, sedimentary and metamorphic rocks

Experiment 3: Study of geological models

Experiment 4: Study of geological maps

Experiment 5: Study of thin sections

Text/ Reference Books:

- K V G K Gokhale: Principles of Engineering Geology, B.S. Publications.
- Prabin Singh: Engg. and General Geology, Katson Publishing House.
- D.S. Arora: Geology for Engineers, Mohindra Capital Publishers, Chandigarh.
- P.K. Mukerjee: A text Book of Geology, Calcutta Word Publishers.

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BUILDING MATERIALS AND CONSTRUCTION (CE-1401)

UNIT 1: Clay Based Building Products- Manufacture of clay bricks and their classification, Properties of clay bricks and their testing, Problems of efflorescence in bricks and tiles. 5(L)

UNIT 2: Organic Materials-Timber: Classification, Defects and properties, Seasoning and preservation of timber. Asphalt, Bitumen and Tar, Polymers, Plastic, Paints and Varnishes. Metals & Non-Metals: Ferrous metals, Mechanical & physical properties of ferrous metals, Aluminum and lead, Glass and insulating materials. 10(L)

UNIT 3: Concrete and Its Composition-Importance of its ingredients. Physical & chemical properties of OPC. Testing of OPC as per BIS Specifications. Types of cements, Pozzolona and associated PPC. Hydration of cement. Physical and mechanical properties of aggregates. Need of admixtures, IS Classification of admixtures. Super plasticizers and other air entraining agents. Desirable properties of water for concrete making and curing. 8(L)

UNIT 4: Fresh Concrete & Hardened Concrete-Workability and its measurements, Segregation, Bleeding and Laitance in concrete, Strength of concrete, micro structure of hardened concrete, Factors affecting strength of concrete, Testing of Concrete, Ready Mix concrete, Compaction & curing of concrete, Principles of Concrete Mix Design. 8(L)

UNIT 5: Durability of Concrete-Problem identification for durability of concrete, Mechanism of deterioration of concrete Different modes of transport mechanism in concrete mass, Fick's law of Diffusion, Sulphate and Chloride attack & Alkali aggregate Reactivity in concrete. Corrosion of reinforcement in concrete, causes and mitigation. High Performance concrete. 4(L)

UNIT 6: Special Concretes & Material Evaluation-Light weight concrete, High density concrete, Polymer concrete, No Fines concrete, Self compacted and Roller compacted concrete, FRC, Sulphur Impregnated concrete. Material Testing & Instrumentation: NDT & Conventional Testing of concrete & concrete Structures. UPV method, Rebound Hammer Method & Impact Echo Method of NDT. 5(L)

Text/ Reference Books:

- S.K.Duggal: Building Materials, New Age International Publishers, New Delhi
- "Civil Engineering Materials "Technical Teachers" Training Institute Chandigarh, Tata McGraw Hill Publishing Company Ltd., New Delhi.
- Rai Mohan and Jai Singh M.P. "Advances in Building Materials and Construction-CBRI Roorkee.
- Mehta, P.K. & Monterio P.J. " Concrete Microstructure , Properties and Materials", TMH New Delhi
- Spence RJS and Cook DJ-'Building Materials in Developing Countries' John Wiley and Sons.
- Neville A.M., Properties of Concrete, Pitman Publishing Company.
- Shetty M.S. "Concrete Technology, Theory and Practices." S. Chand & Company Ltd., New Delhi.
- Gambhir M.L. "Concrete Technology" - Tata McGraw Hill Publishing Company Ltd., New Delhi.

ESTIMATING, COSTING & VALUATION (CE-1402)

UNIT 1: Estimation Fundamentals-Importance of estimation, different types of estimates, general and detailed specifications. Methods of Estimation: Items of work for estimates, units and measurement of items. 7(L)

UNIT 2: Detailed Estimation of Buildings and Analysis of Rates- Detailed estimates of a single roomed and a two roomed single storey residential building. Estimates of Steel Framed Industrial Building:, Analysis of rates, material and other cost considerations. Resource planning through analysis of rates, market rates, P.W.D. Schedule rates, non scheduled items and cost indices for building material and labour. 7(L)

UNIT 3: Establishments, Organization Structures and Standard Work Procedures-Organization set up for various works departments. Duties and responsibilities of officers. Administrative, Technical and Financial approvals, System of P.W. accounts, Cash and cash book, Temporary advance, Stores, Issue of stores, Material at site account, Measurement and standard measurement book. Release of payments. Defect Liability considerations. 7(L)

UNIT 4: Valuation of Assets-Standard Terminology, Factors affecting the values of property. Methods of valuation, years purchase, capitalized value and depreciation. Standard rent, free hold and lease hold propriety, Mortgage and easement. 7(L)

UNIT 5: Estimation for Mechanized Construction and Infrastructure Projects-Estimation for mechanized construction including slip forming pumped concreting. Equipment costs and productivity analysis. Estimation of highways /irrigation/ airways projects including cross drainage structures. 7(L)

UNIT 6: Computer Aided Estimation and Costing-Application of computer software for estimation and costing. 5(L)

Text/ Reference Books:

- Chakraborty M., "Estimating costing and valuation in Civil Engg., Principle and applications (Authors Publication, Kolkata)
- Frederick E. Gould. "Managing the Construction Process Estimating, Scheduling and Project Control", Pearson Education
- B.N. Dutta "Estimating & Costing in Civil Engineering," UBS Publishers & Distributors Pvt. Ltd. New Delhi.
- CPWD Works Manual 2012.

SURVEY- I (CE-1403)

UNIT 1: Introduction-Introduction, Importance of surveying to engineers, plane and geodetic surveying, principles of surveying, classification of Surveys, Working principle, temporary adjustments and parts of prismatic compass, Dumpy & Tilting levels, EDM, Vernier Theodolite and Total Station. 7(L)

UNIT 2: Measurement of Distance, Direction & Angle, Traversing-Distance measurement by EDM, Chainage & offsets, Designation of Bearings & inter-conversion, magnetic declination, Measurement of horizontal angles: repetition method & reiteration method, Principles of traversing by compass and theodolite, computations of traverse coordinates, Traverse Adjustment, Gales Traverse Table. 6(L)

UNIT 3: Levelling, Contouring and Tacheometry- Direct levelling- basic terms and definitions, principle & type of direct levelling, reduction of field notes, level tube, curvature and refraction correction, Contours- Characteristics, methods and uses, Tacheometry: Basic terms & principles, Distance elevation formulae. 7(L)

UNIT 4: Triangulation and Plane Table Surveying-Triangulation: Principle and classification, intervisibility of stations, Triangulation field work, Plane Table Survey: Principles, plane table equipments, methods- radiation, intersection & traversing, Resection by three point problem, Lehmann's rules. 6(L)

simple circular curves by instrumental methods, compound curves, reverse curves. 6(L)
UNIT 6: Transition and Vertical Curves -Transition curves- types and their characteristics, ideal transition curve, equations of various transition curves, Shift of transition curve, setting out, vertical curves. 6(L)

Text/ Reference Books:

- Surveying (Vol- I & II): S.K. Duggal, Tata McGraw-Hill Pub. Co. Ltd., New Delhi.
- Surveying (Vol- I & II): B.C. Punmia & A.K. Jain, Laxmi Publications, New Delhi.
- Surveying (Vol- I & II): K.R. Arora, Standard Book House, New Delhi.
- Plane Surveying & Higher Surveying: A.M. Chandra, New Age Int. (P) Ltd. Publisher, New Delhi.
- Surveying: Bannister, A., Raymond S., Baker, R., Pearson Education, New Delhi.

PRINCIPLES OF MANAGEMENT (HS-1401)

- UNIT 1: Concept of business environment**-Significance and nature, the interaction matrix of different environment factors, environmental scanning, basic philosophies of capitalism and socialism with their variants. 5(L)
- UNIT 2: Politico-legal environment:** Relationship between business and Government of India, introduction to some important business laws: competition act, FEMA, SEBI, RBI, consumer protection act, changing dimensions of these laws and their impact on business, Economic environment: philosophy and strategy of planning in India, concept of mixed economy, their changing role, policy with regard to small scale industries. 5(L)
- UNIT 3: Technological and socio-cultural environment**-Policy for research and development in India, multinationals as source of technology; foreign collaborations and joint ventures, liberalization in India: the new economic Policy; globalisation; FDI policy, reforms in financial Sector. 7(L)
- UNIT 4: General Management**-Management concepts, theories and practices, functions of management – Planning, Organizing, directing-leadership, motivation, communication and controlling, decision making. 10(L)
- UNIT 5: Organisational Behavior**-Organisational change, conflict management and stress management 5(L)
- UNIT 6: Functional management**-Human resource management, financial management, marketing management 5(L)

Text/ Reference Books:

- Principles & Practices of Management by L.M. Prasad., Sultan Chand and Sons
- Management by Harold, Koontz and Cyrilo Donell., Mc.Graw Hill.
- Business and society by Khan Farocq., S Chand, Delhi .
- Indian Economy Dutt R and Sundharam K.P.M., S .Chand ,Delhi .
- Business Environment by Francis Cherunilam, Himalaya Publishing House, Bombay.

STRUCTURAL ANALYSIS- I (AM-1404)

- UNIT 1: Introduction & Analysis of Plane Structures**-Introduction and Classification of Structures, Review of AFD, SFD and BMD for Beams, Degrees of Freedoms, Static and Kinematic Indeterminacy of Structures, Analysis of Compound and Complex Trusses, Analysis of Plane Frames. 9(L)
- UNIT 2: Displacements of Plane Structures**-Introduction, Energy methods, Maxwell's Reciprocal & Betti's Theorem, Unit Load method, Deflection of trusses and plane frames. 7(L)
- UNIT 3: Rolling Loads and Influence Line Diagrams**-Introduction, Influence Line Diagrams for Beams & Trusses, Absolute Maximum Bending Moments, Muller- Breslau principle and its applications. 7(L)
- UNIT 4: Arches, Cables and Suspension Bridges**- Introduction, Linear Arch, Eddy's Theorem, Three-Hinged & Two-Hinged Arches, Spandrel Braced Arch, Influence Lines for Arches, Analysis of Cables, Suspension bridges with three and two hinged stiffening girders. 7(L)
- UNIT 5: Unsymmetrical Bending**-Introduction, Location of Neutral axis, Computation of Stresses and deflections. 4(L)
- UNIT 6: Curved Beams**-Bending of curved beams in plane of bending, stresses in bars with small and large initial curvatures, Beams Curved in plan. 6(L)

Text/ Reference Books:

- Structural Analysis, Hibbeler, Pearson Publications.
- Structural Analysis, Aslam Kassimali, Cengage Learning Publications.
- Structural Analysis in Theory and Practice, Alan Williams, Elsevier Publications.
- Elementary Structural Analysis, C. H. Norris, J. B. Wilbur and S. Utku, Tata McGraw Hill Publications.
- Structural Analysis, L.S. Negi and R. S. Jangid, Tata McGraw Hill Publications.

FLUID MECHANICS-II (AM-1405)

- UNIT 1: Introduction to Open Channel Hydraulics**-Introduction, difference between open channel flow and pipe flow, geometrical parameters of a channel, continuity equation. 4(L)
- UNIT 2: Uniform Flow in Open Channel**-Introduction, Chezy's and Manning's equations for uniform flow in open channel, velocity distribution, most efficient channel section. Energy and momentum principles, Critical depth, concepts of specific energy and specific force, application of specific energy principle for interpretation of open channel phenomena, flow through vertical and horizontal contractions. IV Non-Uniform Flow in Open Channel, Equation of gradually varied flow and its limitations, flow classification and surface profiles, integration of varied flow equation by analytical, graphical and numerical methods, flow in channels of non-linear alignment. 8(L)
- UNIT 3: Hydraulic Jumps, Surges, and Water waves**-Classical hydraulic jump, evaluation of the jump elements in rectangular and non-rectangular channels on horizontal and sloping beds, open channel surge, celerity of the gravity wave, deep and shallow water waves. 8(L)
- UNIT 4: Hydraulic Pumps**-Rotodynamic pumps, classification on different basis, basic equations, velocity triangles, manometric head, efficiencies, pumps in series and parallel, multi-stage pumps, cavitation in pumps. 8(L)
- UNIT 5: Hydraulic Turbines**-Introduction to Hydroelectric power station, penstock and surge tank, water hammer (elastic theory), Rotodynamic machines, Pelton turbine, equations for jet and rotor size, efficiency, spear valve, reaction turbines, Francis and Kaplan type, head on reaction turbine, unit quantities, similarity laws and specific speed, cavitation. 10(L)

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characteristics and operating characteristics, Muschler curves, Design point and operating point. (2)

Text/ Reference Books:

- Ranga Raju, K.G., Flow through open channels, T.M.H. 2nd edition.
- Lal, J., Hydraulic Machines, Metropolitan Book Co. Pvt. Ltd., Delhi.
- Ojha, C.S.P., Fluid Machinery and Applied Hydraulics, Oxford University Press, New Delhi.
- Vasandani, V.P., Theory of Hydraulics Machines, Khanna Publishers, New Delhi.
- Sawhney, G.S., Thermal and Hydraulics Machines, PHI Learning, New Delhi.
- Majumdar, B., Fluid Mechanics with Laboratory Manual, PHI Learning, New Delhi.
- Karassic, I.J., Pump Handbook, Tata McGraw Hill Ltd. New Delhi.
- Som, S.K. and Biswas G, Introduction of Fluid Mechanics & Fluid Machines, TMH, New Delhi.

BUILDING MATERIALS AND CONCRETE TECHNOLOGY (LAB) (CE-1451)

- Experiment 1:** (a) To determine the specific gravity of cement using lechatelier flask and the fineness by sieve analysis.
(b) To determine the normal consistency and setting times.
- Experiment 2:** (a) To assess the soundness of OPC using lechatelier appartus.
(b) To determine the compressive strength of ordinary portland cement.
- Experiment 3:** To determine the specific gravity, bulk density and water absorption of aggregates.
- Experiment 4:** To study the phenomenon of bulking of sand.
- Experiment 5:** To draw the grading curves for fine and coarse aggregates and hence to determine their fineness moduli.
- Experiment 6:** To determine the crushing value, impact value and ten percent fine value for coarse aggregates.
- Experiment 7:** To measure the workability of concrete using slump cone, compaction factor Appartus and Vee Bee Consistometer.
- Experiment 8:** (a) To determine compressive strength and water absorption of burnt clay bricks.
(b) To assess the degree of efflorescence, dimensional tolerance and warpage in burnt clay bricks.
- Experiment 9:** To determine the physical and mechanical properties of reinforcing steel.
- Experiment 10:** To design a concrete mix of given specifications and to evaluate associated trial mixes.

SURVEY- I (LAB) (CE-1452)

- Experiment 1:** Study of different types of topographical maps and to prepare conventional symbols chart.
- Experiment 2:** To measure bearings of a closed traverse by prismatic compass and to adjust the traverse.
- Experiment 3:** To find out reduced levels of given points using dumpy level.
- Experiment 4:** To perform fly levelling with a tilting level.
- Experiment 5:** To find out reduced levels with an Automatic Level.
- Experiment 6:** To measure vertical angle of given points by Vernier theodolite.
- Experiment 7:** To measure horizontal angle between two objects by repetition method with three repetitions.
- Experiment 8:** To measure horizontal angle between four objects by method of reiteration.
- Experiment 9:** To determine tacheometric constants of a Vernier Theodolite.
- Experiment 10:** To set out a simple circular curve by Rankine's method of tangential angles.
- Experiment 11:** To plot details using Survey Station.

FLUID MECHANICS-II (LAB) (AM-1452)

- Experiment 1:** To study the characteristics of hydraulic jump in an open channel.
- Experiment 2:** To study the velocity distribution on an open channel and to determine the energy and momentum correction factors.
- Experiment 3:** To study performance of two Centrifugal pumps connected in series and parallel.
- Experiment 4:** To study performance of a Reciprocating pump.
- Experiment 5:** To study the impact of jets on a flat plate.
- Experiment 6:** To study performance of a Pelton wheel.
- Experiment 7:** To study performance of a Francis turbine.
- Experiment 8:** To study performance of a Kaplan Turbine.

Text/ Reference Books:

- Singh, S. Experiments in Fluid Mechanics, PHI Learning, New Delhi.
- Prakash, M.N.S., Experiments in Hydraulics and Hydraulic Machines: Theory and Procedures, PHI Learning, New Delhi.

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SURVEY- II (CE-1501)

UNIT 1 :Theory of Errors & Adjustment Computations-Errors, accuracy and precision, Characteristics of random errors, weighting of observations, propagation of errors, observation and condition equations, Principle of least squares, most probable values & their determination, Observation equations accompanied by condition equation, method of differences. 6(L)

UNIT 2: Astronomy & Photogrammetry-Definitions of terms used in field astronomy, Astronomical coordinate systems, Napier's rules, Aerial Photographs- Basic terms & Definitions, Geometry of a truly vertical photograph, Photo scale, relief displacements, Flight Planning. 7(L)

UNIT 3: Remote Sensing-Physics of remote sensing, remote sensing system, Spectral reflectance curves, resolution and multi-concept, Sensors and orbital characteristics, Visual interpretation: FCC, Indian Remote Sensing satellites & data products. 6(L)

UNIT 4: Satellite Image Processing-Satellite Image- Characteristics and formats, Image histogram, Land use and land cover classification system, Image rectification, Image Classification: Unsupervised & Supervised, Applications of remote sensing. 6(L)

UNIT 5: Geographic Information System (GIS)-Basic concepts of geographic data, GIS and its components, Data acquisition, Raster and Vector data structures, topology, creation of integrated geographic database, Query formation, Buffering, Spatial Overlay, Data output, GIS Applications. 7(L)

UNIT 6: Global Positioning System (GPS)-Introduction, Satellite navigation System, GPS- Space segment, Control segment, User segment, GPS satellite signals, Receivers, Static, Kinematic and Differential GPS. 6(L)

Text/ Reference Books:

- Remote Sensing & Image Interpretation: Lillesand, T.M. & Kiefer, R.W, Wiley Students Edition, India.
- Surveying (Vol- II): S.K. Duggal, Tata McGraw-Hill Pub. Co. Ltd., New Delhi.
- GIS & Remote Sensing: Chandra, A.M. & Ghosh, S.K., Narosa Publications, India.
- Computer Processing of Remotely Sensed Images: Mather, P.M., John Wiley & Sons.
- Essentials of GPS by N.K. Agarwal, Spatial Networks Publishers, Hyderabad.
- Remote Sensing & GIS: M. Anji Reddy, BS Publications, Hyderabad.

TRANSPORTATION ENGINEERING –I (CE-1502)

UNIT 1: Highway Planning and Alignment-Introduction to transport systems; various modes of transportation. Highway Development in India; Institutions for Highway Development at National level; Methods of Highway Planning. Requirements of Ideal Alignment, Factors controlling highway alignment; engineering surveys for highway planning. 6(L)

UNIT 2: Geometric Design of Highways- Classification and cross section of urban and rural roads (IRC), Highway cross sectional elements. Sight distances - Cross sectional elements, camber, shoulder Factors affecting Sight Distances, PIEV theory, Stopping Sight Distance (SSD), Overtaking Sight Distance (OSD), Sight Distance at Intersections and Intermediate Sight. Design of Horizontal and Vertical Alignments. 10(L)

UNIT 3: Traffic Engineering-Traffic characteristics Volume studies; Speed study; Traffic flow characteristics; capacity, density; Traffic control devices: Signs, signals, island; intersections: at grade and grade separated intersections, rotary intersection, and design of signals at intersections. 8(L)

UNIT 4: Pavement Analysis and Design-Rigid and Flexible Pavements: Components and their functions, Design principles of Flexible and Rigid Pavements, Factors affecting the Design of Pavements: ESWL, Climate, Sub-grade Soil and Traffic, Design Practice for Flexible Pavements [CBR method, IRC Method and Recommendations- Problems], Design Practice for Rigid Pavements – [IRC Recommendations-Problems], Joints. 7(L)

UNIT 5: Highway Construction-Material Specification and Construction Practice - Water Bound Macadam Road, Bituminous Road and Cement Concrete Road [as per IRC and MORTH specifications], Highway Drainage [IRC Recommendations] 6(L)

UNIT 6: Highway Failures and Maintenance-Types of defects in Flexible and Rigid pavements, their Symptoms, Causes and Treatments, Special Repairs. Pavement Evaluation – Pavement Surface Conditions and Structural Evaluation, Evaluation of pavement Failure and strengthening -Overlay design by Benkelman Beam Method. 5(L)

Text/ Reference Books:

- Highway Engineering by S.K. Khanna and C.E.J. Justo, Nem Chand Publication.
- Transportation Engineering by Animesh Das and P. Chakravorthy, Tata McGraw Hill.
- Principle and Practices of Highway Engineering by L.R. Kadiyali and N.B. Lal, Khanna Publishers.

GEOTECHNICAL ENGINEERING - I (CE-1503)

UNIT 1: Soil formation, Properties and Classification of soils-Soil mechanics and its importance, Particle size analysis, Phase relationship, Index properties, Soil structure and Clay mineralogy, Identification and Classification of soils, Soil Classification systems. 10(L)

UNIT 2: Permeability and Capillarity-Types of soil water, effective stress principle, Permeability and seepage of soils, Coefficient of permeability and its determination in laboratory and field, Quick sand and Liquefaction phenomenon, Seepage analysis, Flow nets and its construction, Seepage through earthen embankments. 8(L)

UNIT 3: Soil Compaction-Theory of compaction, Standard and Modified Proctor test, Effect of compaction on properties of soils, Field compaction of soils, Compaction control in fields. 5(L)

UNIT 4: Consolidation of Soils-Compressibility of soils, Types of consolidation, Terzaghi's theory of consolidation, Consolidation test, Determination of coefficient of consolidation, Pre-consolidation pressure and its determination, Time rate of consolidation, Computation of settlement, Sand drains. 7(L)

UNIT 5: Shear Strength of Soils-Mechanism of shear resistance, Mohr-Coulomb theory, Shear strength and effective stress principle, Shear tests under different drainage conditions, Pore pressure parameters, Shear characteristics of cohesionless and cohesive soils, Modified failure envelop, Stress path. 6(L)

UNIT 6: Stability of Slopes-Types of slope failure, Stability of infinite and finite slopes, Taylor's stability number, Stability

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Text/ Reference Books:

- Lambe & Whitman: Soil Mechanics, Wiley-India.
- Gopal Ranjan and A.S.R. Rao: Basic and Applied Soil Mechanics, New Age International
- B. M. Das: Principles of Geotechnical Engineering, CL-Engineering.
- D.F. Mc Garthy: Essentials of soil mechanics and foundation. New Age International
- Alam Singh: Modern Geotechnical Engineering., CBS publisher
- K.R. Arora: Soil Mechanics and Foundation Engineering, Standard Publishers Distributors
- Purushotama Raj: Geotechnical Engineering, New Age International Limited

CONCRETE STRUCTURES-I (CE-1504)

UNIT 1: Working Stress Design-Introduction to Reinforced Cement Concrete, Working Stress Design Method, Assumption, Distribution of Stresses on the cross section in bending, transformed area, Analysis and Design of a rectangular singly and doubly reinforced section, T and L sections for flexure, shear and bond. 6(L)

UNIT 2: Limit State Design-Limit State Design Method, Assumptions, Distribution of stresses on the cross section in bending, Analysis and Design of a rectangular singly and doubly reinforced section, T and L sections. 8(L)

UNIT 3: Behaviour of Section in Shear & bond-Behaviour of RC beam in shear, shear strength of beam with and without shear reinforcement, Minimum and Maximum shear reinforcement, Design of beam in shear using Limit state method. Nature of bond between steel and concrete. Development of bond stress in reinforcement, Concept of development length and anchorage, Design of RC section in bond and calculation of development length using Limit state methods. 6(L)

UNIT 4: Design of Slab & Staircase-Design of one-way and two-way solid slabs, and design of staircase. 6(L)

UNIT 5: Design of Compression Members-Classification of Compression members, Effective length, Slenderness ratio and slenderness limit, Axially loaded short column's design Limit State methods, Increase in permissible load in helically reinforced columns. Eccentrically loaded columns, Minimum eccentricity, Pu & Mu interaction diagrams Design of Columns using IS-456 Design Aids with Uniaxial and biaxial bending. 8(L)

UNIT 6: Design of Footings-Structural behaviour of footings, design of footing for a wall and a single column, combined rectangular and trapezoidal footings, Design of strap footing. 8(L)

Text/ Reference Books:

- Fundamentals of Reinforced Concrete Structures, M L Gambhir, PHI
- Reinforced Concrete Design, A K Jain, Nem Chand
- Reinforced Concrete Design, P Dayratnam, Oxford IBH
- Reinforced Concrete, Pillai & Menon, TMH

ENVIRONMENTAL ENGINEERING – I (CE-1505)

UNIT 1: Water Demand and Sources-Introduction, population forecasting, variations in water demand, estimation of quantity of water. Sources of Water: determination of capacity of impounding reservoirs: Suitability of surface and subsurface sources; Rain water harvesting intake structures. 7(L)

UNIT 2: Water Quality and Conveyance-Water Quality Parameters and standards, Conveyance of Water, Appurtenances and valves; types of pumps with fittings. 7(L)

UNIT 3: Distribution Networks-Storage and Distribution of water: Analysis of distribution network, Plumbing system-Layout, plumbing equipments and operation, installation and maintenance 6(L)

UNIT 4: Sewage System & Wastewater flows-Wastewater Collection Systems, quality examination of wastewater, effluent discharge standards .Estimation of wastewater flows and storm run off to Indian catchments 7(L)

UNIT 5: Flow in Sewers-Flow in Full and partially full sewers, Design of sewers and storm water drains, laying of sewers, testing and ventilation of sewers. 6(L)

UNIT 6: Sewer Appurtenances-Sewer appurtenances: Manholes, catch pits, storm relief works etc., House drainage and Sanitary fixtures and fittings. 7(L)

Text/ Reference Books:

- McGhee: Water supply and sewerage, Tata McgrawHill, publication.
- Peavy, Rowe and Techbanoglous: Environmental Engineering, Tata McgrawHill, publication.
- MetCalf & Eddy: Wastewater Engineering: Treatment and Reuse, Tata McgrawHill, publication.
- Sawyer and McCarty: Chemistry for Environmental Engineering, Tata McgrawHill, publication.
- Garg S. K.: Environmental Engineering (I&II), Khanna publication, New Delhi.
- B.C. Punamia & Jain A.: Environmental Engineering (I&II), Laxmi publication, New Delhi.

STRUCTURAL ANALYSIS- II (AM-1501)

UNIT 1: Introduction: Introduction, Force and Displacement Methods of Analysis of Indeterminate Structures, Method of Consistent Deformation for beams and plane frames. 5(L)

UNIT 2: Strain Energy Methods: Introduction, Method of Minimum Strain Energy for indeterminate beams, Trusses and plane frames. 4(L)

UNIT 3: Moment Distribution and Slope Deflection Methods: Introduction, Moment distribution and Slope Deflection methods for continuous beams and plane frames. 7(L)

UNIT 4: Matrix Method of Analysis: Introduction, Flexibility Method- Application to Beams, Trusses, Frames and Grid Structures; Stiffness Method- Application to Beams, Trusses, Frames and Grid Structures (including plane and space structures. 12(L)

UNIT 5: Computer Oriented Direct Stiffness Method: Introduction, Application to Beams, Frames and Trusses. 8(L)

UNIT 6: Plastic Analysis of Structures: Introduction, Analysis of Plastic Structures. 4(L)

Text/ Reference Books:

- Structural Analysis, Hibbeler, Pearson Publications.
- Structural Analysis, Aslam Kassimali, Cengage Learning Publications.
- Structural Analysis in Theory and Practice, Alan Williams, Elsevier Publications.
- Elementary Structural Analysis, C. H. Norris, J. B. Wilbur and S. Utku., Tata Mcgraw Hill Publications.
- Structural Analysis, L.S. Negi and R. S. Jangid, Tata Mcgraw Hill Publications.
- Intermediate Structural Analysis, C. K. Wang, Tata Mcgraw Hill Publications.
- Matrix Analysis of Framed Structures, W. Weaver (Jr.) and J. M. Gere, CBS Publications.

TRANSPORTATION ENGINEERING – I (LAB) (CE-1551)

Experiment 1: Tests on Aggregate:

- (a) Impact Test.
- (b) Abrasion Test.
- (c) Shape Test.

Experiment 2: Tests on Bituminous materials:

- (a) Penetration Test.
- (b) Viscosity Test.
- (c) Ductility Test.
- (d) Stripping Value Test.
- (e) Softening point Test.
- (f) Flash and Fire point Test.

Experiment 3: Marshal Stability Test.

Experiment 4: Traffic studies:

- (a) Traffic Volume study.
- (b) Traffic speed studies.

GEOTECHNICAL ENGINEERING-I (LAB) (CE-1552)

Experiment 1: Visual identification and specific gravity

Experiment 2: Sieve Analysis

Experiment 3: Hydrometer Analysis

Experiment 4: Atterberg's Limits

Experiment 5: Relative Density Test

Experiment 6: Proctor Compaction Test

Experiment 7: In site Density-Core Cutter & Sand Replacement Method.

Experiment 8: Permeability Test: Constant Head

Experiment 9: Permeability Test: Variable Head

Experiment 10: CBR Test

Experiment 11: Consolidation test

Experiment 12: Direct Shear Test

Experiment 13: Unconfined Compression Test

Experiment 14: Triaxial test

STRUCTURAL ANALYSIS- II(LAB) (AM-1551)

Experiment 1: Analysis of Redundant Joint

Experiment 2: Flexural Stiffness of Beam

Experiment 3: Verification of Maxwell's Reciprocal Theorem

Experiment 4: Analysis of Curved Members

Experiment 5: Verification of Carry Over Factor

Experiment 6: Three Hinged Arch

Experiment 7: Two Hinged Arch

Experiment 8: Elastically Coupled Beam

Experiment 9: Unsymmetrical Bending

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CONCRETE STRUCTURES-II (CE-1601)

UNIT 1: Design of Flat & Circular Slabs-Design of flat slabs with and without drops. Circular slabs with various edge and loading conditions, and their usages. Design of coffer slab. 6(L)

UNIT 2: Design of Circular Water Tanks-Water tanks: Design criteria, material specifications and Permissible stresses for water retaining structures, Design of circular water tanks with fixed & flexible base situated on the ground/underground. 6(L)

UNIT 3: Design of Rectangular Water Tanks-Design of square /rectangular tanks situated on the ground/underground using approximate method and IS- code method. 6(L)

UNIT 4: Design of Beams for Flexure, Shear & Bond-Failure of beam under torsion, interaction between shear and torsion and between moment and torsion, Concept of equivalent shear and moments. Analysis and design of beam curved in plan. 4(L)

UNIT 5: Design of Retaining Walls-Structural behaviour of retaining wall, stability of retaining wall against overturning sliding and pressure developed under the base, Design of T-shaped retaining wall, Concept of counterfort retaining wall. 8(L)

UNIT 6: Prestressed Concrete Design-Advantages of prestressing, methods of prestressing, Losses in prestress, analysis of simple prestressed rectangular and T-section. Introduction to design of element, load balancing concept, profile of cable. 12(L)

Text/ Reference Books:

- Reinforced Concrete Design, Limit State Method ,Jain A.K. , NemChand
- Reinforced Concrete Structures , M L Gambhir , PHI
- Reinforced Concrete Design , Pillai & Menon , TMH
- Design of Reinforced Concrete Structures , Dayaratnam , P. , Oxford IBH
- Prestressed Concrete , Krishna Raju , N , CBS
- IS 456-2000: Code of practice for plain & reinforced concrete.
- SP-16: Design Aids of Reinforced Concrete to IS: 456-1978.
- IS 3370-1968 & IS 3370-2009: Code of practice for water retaining structures.

TRANSPORTATION ENGINEERING –II (CE-1602)

UNIT 1: Introduction-Introduction to Indian Railways, Modes of Transportation, Classification of Railway Lines in India, Undertakings under Ministry of Railways. 3(L)

UNIT 2: Components of Track and Track Alignment-Permanent way, Rail gauges, Coning of wheels, Rails, Creep of rail, Rail Fastenings, Sleepers, sleeper density, Ballast, Traction and Tractive Resistances. Alignment of Railway Lines, Engineering Surveys, Plate laying methods. 8(L)

UNIT 3: Geometric Design of Track-Gradients, Grade compensation on curves, Super elevation, Cant deficiency and Cant excess, Negative Super elevation. Curves, Extra clearance on curves, permissible speed on tracks, Widening of gauges on curves. 8(L)

UNIT 4: Points and Crossings & Signalling-Switches, Components and types of crossing, Turnouts, Design of turnouts. Signalling: Classification, Signalling systems, systems for controlling train movements, Interlocking. 8(L)

UNIT 5: Stations and Yards-Classification of railway stations and yards; platforms, sidings. 3(L)

UNIT 6: Airport Engineering-Air Transport in India, Components of Air Transportation, Air craft characteristics affecting airport design, Airport Planning, Runway Design: runway orientation; basic runway length; corrections to runway length. Airport Configuration: Runway configurations and operations, Taxiway configurations,. Runway pavement design, design of overlay, Airport Layout, Runway lighting and Marking. 12(L)

Text/ Reference Books:

- Railway Engineering by Satish Chandra and M. M. Agarwal, Oxford University Press.
- A Text Book of Railway Engineering by S. C. Saxena and S. P. Arora, Dhanpat Rai Publications.
- Airport Planning and Design by S. K Khanna, M.G. Arora and S.S Jain, Nem Chand & Bros. Roorkee.

ENVIRONMENTAL ENGINEERING – II (CE-1603)

UNIT 1: Introduction to Water Treatment-Water Treatment units, processes, flow sheets. Sedimentation: - Theory and mechanisms, Removal efficiency of discrete and flocculent particles, Design of primary and secondary settling tank. 7(L)

UNIT 2: Coagulation and Flocculation-Coagulation, Mechanisms of coagulation, optimum dose of coagulants, design of rapid mixer. Flocculation: Theory and mechanisms, design of hydraulic and mechanical flocculator. 6(L)

UNIT 3: Filtration, Disinfection and Softening: Filtration: Theory and mechanisms, hydraulics of filtration and back-washing, Design of Slow sand filter, Rapid sand filter, dual and multi-media filters. Disinfection, methods of disinfection, various forms of chlorine application and equipments, Water Softening: Methods of water softening, estimation of dose of chemicals. 7(L)

UNIT 4: Introduction to Wastewater Treatment-Wastewater Treatment: Unit operations and unit processes, primary, secondary and tertiary treatments, BOD kinetics. microbial growth kinetics and various relationships, Design of Primary treatment units. 7(L)

UNIT 5: Secondary Treatments- Aerobic-Secondary treatment: Biological treatment- its principle, Design of Activated sludge process- and modifications, trickling filter-theory and design, design of oxidation ponds and oxidation ditches and rotating biological contactor. 7(L)

UNIT 6: Anaerobic Treatment and Disposal of Effluent-Principles of Anaerobic Treatment, Introduction to sludge treatment, anaerobic digestion of sludge, design of anaerobic digester and septic tank. Disposal of wastewater on land and in water bodies, stream sanitation. 6(L)

Text/ Reference Books:

- Masters: Introduction to Environmental Engineering and Science, Prentice Hall Publication.
- McGhee: Water supply and sewerage, Tata McgrawHill, publication.

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- MetCalf & Eddy: Water Engineering: Treatment and Reuse, Tata McgrawHill, publication.
- Manual on Water Supply and Treatment, CPHEEO, Govt. of India.
- Manual on Sewerage and Sewage Disposal, CPHEEO, Govt. of India.

STEEL STRUCTURES I (CE-1604)

UNIT 1: General Considerations-Structural Steel, Stress-Strain Curve for Mild Steel, Rolled Steel Sections, Design Philosophies, Local Buckling of Plate Elements, Introduction to Plastic Analysis and Design, Introduction to Limit State Steel Design, Probabilistic Basis for Design, Design Criteria. 10(L)

UNIT 2: Simple Connections-Riveted, Bolted and Pinned Connections-Introduction to Riveted and Bolted Connections, Types of Bolted Joints, Load Transfer Mechanism, Failure of Bolted Joints, Specification for Bolted Joints, Bearing-Type Connections, Prying Action, Slip-Critical Connections, Working Load Design, Pin Connections. 6(L)

UNIT 3: Simple Welded Connections-Types of welds, Analysis and design of Welded Joints such as Groove Welds, Fillet Welds, Intermittent Fillet Welds, Plug and Slot Welds, Distortion of Welded Parts, Working Load Design. 5(L)

UNIT 4: Tension Members-Types of Tension Members, Net and effective Sectional Areas, Types of Failure, Design Strength and design of Tension Member, Lug Angles, Splices, Gusset Plate, Working Load Design. 5(L)

UNIT 5: Compression Members- Effective Length, Slenderness Ratio (λ), Classification of Cross Sections, Column Formula, Design of Axially Loaded Compression Members, Built-Up Columns (Latticed Columns), Encased Column, Splices, Working Load Design. Design of Column Bases and Caps. 10(L)

UNIT 6: Beams-Types of Sections, Behaviour of Beam in Flexure, Section Classification, Lateral Stability of Beams, Lateral-Torsional Buckling, Design of Laterally Supported Unsupported Beams Rolled Beams, Built-Up Beams (Plated Beams), Lintels, Purlins, Bearing Plates, Working Load Design. 6(L)

Text/ Reference Books:

- Design of Steel Structures by S. K. Duggal, Tata Mcgraw Hill.
- Design of Steel Structures by N. Subramanian, Oxford University Press
- Steel Structures by Robert Englekirk. Hohn Wiley & sons inc.
- Structural Steel Design by Lambert Tall, Ronald Press Comp. New York.

GEOTECHNICAL ENGINEERING – II (CE-1605)

UNIT 1: Stresses in Soils-Causes of stress in soil, Geostatic stress, Boussinesq's equation, Stress distribution diagrams, Vertical stress in soils under different types of loading, Newmark's influence chart, Westergard's equation. 6(L)

UNIT 2: Earth Pressure and Retaining Walls-Types of lateral earth pressure, Rankine's and Coulomb's earth pressure theory, Graphical methods of determination of lateral earth pressures, Types of retaining walls, Design Principles, Stability conditions, Sheet pile walls. 6(L)

UNIT 3: Bearing Capacity and Shallow Foundation-Methods of determining bearing capacity, Analytical methods of determining bearing capacity – Rankine's method, Terzaghi's theory, Meyerhof's method, Brinch-Hansen's method, Skempton's analysis, Vesic's analysis, IS code method, Settlement of foundation, Differential settlement, Settlement analysis, Bearing capacity based on tolerable settlement, Field tests, Types & design of shallow foundations. 10(L)

UNIT 4: Pile Foundation-Type of pile foundation, Types, Pile driving, Pile capacity by static and dynamic analysis, Pile load tests, Negative skin friction, Group action of piles, Settlement of pile groups, Under reamed piles – analysis and design. 6(L)

UNIT 5: Well Foundation-Types of wells, Component of wells, Depth and bearing capacity of well foundation, Forces acting on well foundation, Construction and sinking of well foundation, Measures to prevent and rectify tilts and shifts. 7(L)

UNIT 6: Machine Foundation-Types, Design criteria, Equation of motion, Natural frequency, Design of Reciprocating, Impact and Rotary type of machine foundation as per codal provisions. 5(L)

Text/ Reference Books:

- J.E. Bowels: Foundation Analysis and Design, McGraw-Hill.
- W. C. Teng : Foundation Design, Prentice-Hall.
- B. M. Das: Principles of Foundation Engineering, PWS Publishing.
- K.R. Arora : Soil Mechanics and Foundation Engineering, Standard Publishers Distributors.
- P. C. Varghese: Foundation Engineering, PHI Learning Private Limited.
- V. N. S. Murthy: Advance Foundation Engineering, CBS Publisher.
- Nainan P. Kurian: Design of Foundation Systems, Narosa Publishing House.

SURVEY CAMP (CE-1606)

Survey camp will involve triangulation and plane table surveying to prepare a topographical map of an area. Duration of survey camp will be 2 weeks.

CONCRETE STRUCTURES-II (LAB) (CE-1651)

Experiment 1: Simple Beam/Lintel

Experiment 2: T-Beam floor

Experiment 3: Rectangular Slabs

Experiment 4: Brick wall and Isolated footing

Experiment 5: Combined Rectangular and Trapezoidal Footing

Experiment 6: Water tank

Experiment 7: T. shape Retaining wall

Experiment 8: Details of Flat slab & Circular Slabs

Experiment 9: Details of Stair Case

Note - Three hour practical is for drawing work (Manual & computer Aided).

- Experiment 1:** Determination of pH, electrical conductivity & turbidity of the given water sample.
- Experiment 2:** Determination of acidity & alkalinity of given sample.
- Experiment 3:** Determination of solids (TS, TSS, TDS, VSS and Inorganic solids) in a given wastewater sample.
- Experiment 4:** Determination of optimum coagulant dosage required for treating the given water sample.
- Experiment 5:** Determination of chloride content & hardness in given water sample.
- Experiment 6:** Determination of residual chlorine in the given water sample & the chlorine demand.
- Experiment 7:** Determination of amount of iron present in the given sample.
- Experiment 8:** Determination of amount of dissolved oxygen (DO) present in the sample.
- Experiment 9:** Determination of amount of nitrate in the given water sample using PDA method.
- Experiment 10:** Determination of amount of fluoride present in the given water sample.
- Experiment 11:** Determination of chemical oxygen demand (COD) of given sample.
- Experiment 12:** Determination of biochemical oxygen demand (BOD) of given sample.

Text/ Reference Books:

- Standard Methods for the Examination of Water & Wastewater, APHA, AWWA, U.S.A.
- Sawyer and McCarty: Chemistry for Environmental Engineering
- Kotaiah: Environmental Engineering Laboratory Manual, Charotar Publishing House.

GEOTECHNICAL ENGINEERING – II (LAB) (CE-1653)

- Experiment 1:** Methods of Soil Exploration
- Experiment 2:** Free swell Index & Differential free swell Index
- Experiment 3:** Swelling pressure test
- Experiment 4:** Static cone penetration test
- Experiment 5:** Dynamic cone penetration test
- Experiment 6:** Standard penetration test
- Experiment 7:** Plate load test.
- Experiment 8:** Laboratory vane shear test
- Experiment 9:** Field vane shear test
- Experiment 10:** Pile load test
- Experiment 11:** Geophysical methods
- Experiment 12:** Planning of site investigations for a real life problem.

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UNIT 1: General Considerations and Water Requirement of Crops-Definition, Scope of subject, Advantage, Lift and flow irrigation, Development of irrigation in India, crops season, Weather in relation to crops, Important crops. Functions of water in plant growth, Soil moisture, consumptive use of water, Irrigation frequency, irrigation methods. 10(L)

UNIT 2: Canal Irrigation-Classes of irrigation canal, Parts of a canal system, Preliminary survey, Detailed survey, Commanded areas, Channel alignment, Curves, Assessment of water requirement, Channel losses, Kennedy's Theory, Lacey's Theory, Longitudinal section, Schedule of area statistics and channel dimension cross-section of irrigation channel. 6(L)

UNIT 3: Water-Logging-Definition, Effect, Causes and Anti-water logging measure, concrete lining, shotcrete lining, Asphaltic lining, Brick tile lining of earth material, Sections of lined channel. Drainage of Water logged land, Types of Drains, Open Drains, Closed Drains, Spacing of closed Drains. 5(L)

UNIT 4: Regulation and Control of Canal System-Definition, requirement and classes of outlets, Non-modular outlet, Semi-module, Rigid module, Selection of outlet. Regulation, Measurement of discharge, Assessment of canal Revenue, Efficient Management of irrigation water. 5(L)

UNIT 5: Hydrology- Definition, Hydrologic cycle, Measurement of rainfall, rain gauge, Peak flow, Flood frequency method, catchment area formulae, Rainfall analysis, Infiltration, Run off, Unit Hydrograph and its determination, Hydrologic Routing, Introduction to wells and tube wells, Specific yield, Deep and shallow wells, Comparative advantage of well and canal irrigation, Duty of well water, Determination of discharges through confined & unconfined aquifer, Types of Tube wells. 12(L)

UNIT 6: Water Resources Development-Planning, design and economics of water resources development. 4(L)

Text/ Reference Books:

- Singh, Dr. Bharat - Fundamentals of Irrigation Engineering, Nem Chand and Bros.
- Varshney, Dr. R.S., Gupta & Gupta - Theory and Design of Irrigation Structures Vol. I & II., Nem Chand and Bros.
- Punamia, Dr. B.C. and Pandey B.B. Lal, Irrigation and Water Power Engineering, Laxmi Publications(Pvt)Ltd.
- Bedient and Huber- Hydrology and Flodplain Analysis, Prentice Hall.
- Ojha,C.S.P. , Bhunya, P. and Berndtsson, R.- Engineering Hydrology, Oxford University Press Canada.
- Todd and Mays- Groundwater Hydrology, John Wiley and Sons, Inc.
- K. Subramanya - Engineering Hydrology, Tata McGraw Hill Education Pvt.Ltd.
- Modi, P.N. – Irrigation Water Resources and Water Power Engineering, Standard Book House
- Asawa, G.L. – Irrigation and Water Resources Engineering, New Age International.
- Walker, W.R. and Skogerboe, G.V. 1986. Surface irrigation theory and practice. Prentice-Hall, Inc.

CONSTRUCTION PLANNING & MANAGEMENT (CE-1702)

UNIT 1: Construction Engineering Systems: An Over View-Brief introduction to construction projects - magnitude and critical considerations. Principles and process of management, Managerial role of engineers. Project cycle. Resources involved in construction projects. Classification of projects, Modeling of construction projects for managerial controls using bar charts, milestone charts, and network diagrams. Resource quantification. 8(L)

UNIT 2: Network Techniques and LOB- Deterministic and probabilistic networks, CPM, PERT, PDM and GERT. Critical path evaluation, cost planning and resource allocation through network techniques. Project monitoring and controls, Line of balance technique. 7(L)

UNIT 3: Engineering Economics & Construction Contracts and Delivery Methods-Time value of money, Present economy studies, Equivalence concept, financing of projects including PPP, economic comparison, Depreciation and break even cost analysis. Contract management legal aspects of contracts, laws related to contracts, land acquisition, labour safety and welfare. Different types of contracts. Managing contracts and disputes. 7(L)

UNIT 4 : Construction Procedures-Tenders and tender preparation, process of tendering, pre-qualification of contracts, Evaluation of tenders, contract negotiation and award of work, monitoring of contract, extra items, settlements of disputes, arbitration and commissioning of project. 5(L)

UNIT 5 : Construction Equipment Management-Different types of construction equipments viz. Excavating, Hauling, Lifting and Concreting equipments, Scrapers. Cost of owning and operating, economic life of equipment, factors influencing performance of equipment, Rolling resistance, Coefficient of traction, Rimpull, drawbar pull. Safety during mechanized construction. Time motion studies. 6(L)

UNIT 6 : Application of Optimization Techniques in Construction Planning & Management and Software Applications- Application of Linear Programming Techniques to construction project management, Transportation and Assignment Models in construction management. Decision making under risk – Decision tree concept, MS Project and Primavera Project Planner. 8(L)

Text/ Reference Books:

- Charles, Patrick. "Construction Project Planning and Scheduling", Pearson Education.
- Peurifoy R.L., and Schexnayder, Clifford J., Construction Planning", Equipment and Methods, T.M.H., International Book Company.
- Panneerselvam, R., Engineering Economics, Prentice- Hall of India Private Limited New Delhi.
- Wiest, Jerome D., and Levy Ferdinand K., A management Guide to PERT/ CPM: with GERT/PDM/DCPM and other Networks. - Hall of India Private Limited New Delhi.
- Seetharaman, S., Construction Engineering and Management, Umesh Publications New Delhi.
- Taha, Hamdy A., Operations Research – An Introduction , Prentice- Hall of India Private Limited New Delhi (2006).

- UNIT 1: Plate Girders**-Elements of Plate Girder, General considerations, Proportioning of web, Proportioning of flanges, Design methods, End panel design, Design of Stiffeners, Curtailment of Flanges. 8(L)
- UNIT 2: Gantry Girders**-Introduction, Loads, Fatigue Effects, Specifications, Design of gantry Girders. 4(L)
- UNIT 3: Members Under Combined Axial Load and Moment**-Columns in Frame Structures, Crane Columns in Industrial Buildings, Behaviour and strength of Beam-Columns, Check for local and Overall buckling, Member Strength. 6(L)
- UNIT 4: Eccentric Connections**- Beams-Column Connections, Bracket Connections, Framed Connections, Seat Connections, Moment Resistant Connections. 10(L)
- UNIT 5: Roof Truss**-Introduction, Selection of the Type of Truss, Loads on the Roof Truss, Analysis of Roof Truss, End Bearings, Design Procedure. 4(L)
- UNIT 6: Introduction to Industrial Building**- Introduction, Planning, Structural Framing, Types, Roof and Side Coverings, Elements of an Industrial Building, Design Steps of Industrial Building. 6(L)

Text/ Reference Books:

- Design of steel structures, by S.K.Duggal, Tata McGraw Hill
- Limit State Design of steel structures, by S.K.Duggal, Tata McGraw Hill
- The Behaviour & Design of Steel Structure by M.S. Trahair & M.A. Bradford
- Cold Formed Steel Structures by Wei-Wen Yu, McGraw Hill

PROJECT (CE-1791)

STEEL STRUCTURES-II (LAB) (CE-1751)

- Experiment 1:** Detailing of column and footing connection
- Experiment 2:** Detailing of beam and column connection
- Experiment 3:** Grillage foundation detailing
- Experiment 4:** Plate girder detailing
- Experiment 5:** Gantry girder detailing
- Experiment 6:** Detailing of trusses
 - a) Using Angle sections, Tee sections, Channel sections and I-sections
 - b) Using tubular sections
- Experiment 7:** Detailing of purlins
- Experiment 8:** Over head tank detailing

UNIT 1: Introduction -Elements of Computer Aided Design and its advantages over conventional design.	1(L)
UNIT 2: Design principles -Type of Hardware required for CAD works, Principles of software design.	1(L)
UNIT3: Programming Concepts: Concept of modular programming, debugging and testing and applications in MATLAB.	1(L)
UNIT 4: Computer Applications -Computer applications in analysis and design of Civil Engineering systems.	5(L)
UNIT 5: Application using Software Packages -Use of software packages in the sub-areas of Civil Engineering	4(L)
UNIT 6: Introduction to Expert system and Soft computing -Introduction to Expert system and Soft computing	4(L)

Text/ Reference Books:

- Computer aided design: software and analytical tools by C. S. Krishnamoorthy, S. Rajeev and Arunachalam Rajaraman, Narosa Publication, Second Edition, 2009.
- Computer aided design in reinforced concrete by V. L. Shah, Structures Publishers, Third Edition, 1998.
- Artificial intelligence and expert systems for engineers by C. S. Krishnamoorthy and S. Rajeev, CRC Press, First Edition, 1996.
- Developments in computer aided design and modelling for civil engineering by B.H.V. Topping, Civil-Comp Press, First Edition, 1995.
- Developments in computer aided design and modelling for structural engineering by B.H.V. Topping, Civil-Comp Press, First Edition, 1995.

WATER RESOURCES ENGINEERING – II (CE-1802)

UNIT 1: Principles of Design of Canal Masonry Works -Types of Masonry work, Principle of design, BLIGH'S Theory, Khosla's theory for determination of pressure and exit gradient, Hydraulic jump.	7(L)
UNIT 2: Canal Regulation Works and Cross Drainage Works -Falls, Classification of falls, Design of falls, Distributory head regulator and cross-regulator, Escape, Bed bars. Necessity and types, Aquaduct, Syphon Aquaduct, Super passage, Canal syphon, Level crossing, Design of cross drainage work.	7(L)
UNIT 3: Canal Head Works -Canal Head Works-Functions, Location, Layout of Head work, Weir, Canal head regulator, Design of Weirs on permeable foundation, silt control at head work.	7(L)
UNIT 4: River Training Planning of Dams & Reservoirs - Objective, scope & classification of river & river training, stages, Methods of River Training, bank protection. Selection of Dam sites, Investigation, Estimation of storage capacity, Principle of Reservoir planning. Flood Routing, Reservoir loss, Reservoir sedimentation.	7(L)
UNIT 5: Types of Dams and Their Characteristics - Gravity Dams, Forces acting, method of analysis, Modes of failure and factors of safety, Elementary Profile of a gravity dam, Stability analysis, galleries. Earth dam, Foundation, Materials, Criteria for safe design, typical sections, compaction of Rock fill dam. Spillways, Spilway capacity, Types of spilway, Energy dissipation below spillway, Gates.	10(L)
UNIT 6: Water Power -Hydro-Electric Power: Assessment of potential, Classification of power plants, Types of turbine, Power house.	4(L)

Text/ Reference Books:

- Singh, Dr. Bharat - Fundamentals of Irrigation Engineering, Nem Chand and Bros.
- Varshney, Dr. R.S., Gupta & Gupta - Theory and Design of Irrigation Structures Vol. I & II., Nem Chand and Bros.
- Punamia, Dr. B.C. and Pandey B.B. Lal, Irrigation and Water Power Engineering, Laxmi Publications(Pvt)Ltd.
- Modi, P.N. – Irrigation Water Resources and Water Power Engineering, Standard Book House
- Bedient and Huber- Hydrlogy and Flodplain Analysis, Prentice Hall.
- Asawa, G.L. – Irrigation and Water Resources Engineering, New Age International.
- Walker, W.R. and Skogerboe, G.V. 1986. Surface irrigation theory and practice. Prentice-Hall, Inc.

EARTHQUAKE RESISTANCE DESIGN (CE-1803)

UNIT 1: Response of Single-Degree-Freedom Systems - Introduction to Seismology. Response of Structure to Earthquake motion, Modeling of structures, Dynamics of single degree of freedom system.	7(L)
UNIT 2: Response of Multi-Degree-Freedom Systems -Dynamics of multi degree of freedom system, Idealization of structures, Dynamics of soils and seismic response. Response spectra method, Time history method.	8(L)
UNIT 3: Concept of Structural Design -Conceptual design, Analysis of single and multi storey frame, Equivalent lateral force method.	7(L)
UNIT 4: Design of Reinforced Concrete Buildings -Design of Reinforced Concrete buildings.	7(L)
UNIT 5: Design of Masonry and Steel Buildings -Design of Masonry buildings, Steel Buildings and non structural element, Material Properties, Code provisions.	5(L)
UNIT 6: Design of Non-Structural Element and Structural Control -Design of non structural element. Concept of base isolation and structural control.	6(L)

Text/ Reference Books:

- Introduction to Structural Dynamics - J.M. Biggs, McGraw-Hill Companies.
- Earthquake Resistant of Design of structures, S.K.Duggal, Oxford University Press.
- Elements of Earthquake Engineering - Jai Krishna an A.R. Chandrasekaran, Sarita Prakashan.
- IS: 1893 – 2002, Criterion for Earthquake Resistant Design.
- Fundamental of Earthquake Engineering -N.M. Neumarks and E. Rosenblueth, Prentice Hall, Inc. Englewood Cliffs, N.Y., 1971
- Engineering Vibrations - L.S. Jacobsen & R.S. Ayre, McGrawHill Book Co., New York
- Structural Dynamics - Theory & computation - Mario Paz, Springer, 1997.
- Dynamics of Structures Theory and Applicaions to Earthquake Engineering - Anil K.
- Chopra, Pearson/Prentice Hall.
- Structural dynamics - R. Roy Craig Jr, Wiley, 1981.
- Dynamics of structures - R. W. Clough and J Penjien.McGraw-Hil, Inc.

COMPUTER AIDED DESIGN (CIVIL) (LAB) (CE-1851)

Experiment 1: Introduction to MATLAB to solve the problems related to analysis of Civil Engineering structures.

Experiment 2: Develop the algorithms and computer programmes to develop SFD and BMD of the following structures subjected to different kind of loading conditions:

- a) Cantilever Beam
- b) Simply Supported Beam
- c) Fixed Ended Beam
- d) Propped Cantilever Beam

Experiment 3: Write computer programmes to generate the element stiffness matrix and global stiffness matrix for the following structures:

- a) Continuous beam
- b) Plane Truss
- c) Plane Frame

Experiment 4: Write computer programmes to generate the global load vectors for the above structures and determine the unknown joint displacements, unknown joint reactions and member end forces.

Experiment 5: Write computer programmes to design the different elements of the building structure using Limit State Method.

Experiment 6: Applications of software packages to solve the problems related to analysis and design of Civil Engineering structures.

Primo

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVES (IN VII/VIII SEMESTERS)	
1. Prestressed Concrete	17. Air Pollution & Control
2. Matrix Analysis of Structures	18. Solid Waste Management
3. Structural Dynamics	19. Transportation System and Planning
4. Advanced Concrete Design	20. Traffic Engineering
5. Bridge Engineering	21. Rural Roads
6. Plastic Design of Steel Structures	22. Transport Asset Management
7. Advanced Concrete Technology	23. Finite Element and Finite Difference Methods
8. Geotechnical Processes	24. Construction Equipment and Techniques
9. Advanced Foundation Design	25. Precast and Modular Construction Practices
10. Earth and Earth Retaining Structures	26. Remote Sensing in Civil Engineering
11. Soil Dynamics	27. Engineering Hydrology
12. Rock Engineering	28. Open Channel Hydraulics
13. Design of Waste Water System	29. Water Resources Systems Management
14. Design of Water Supply and Treatment Systems	
15. Advanced Wastewater Treatment	
16. Rural Water Supply and Sanitation	
Courses offered by Applied Mechanics Department	
1. Theory of Plates and Shells	
2. Composite Materials	
3. Theory of Elasticity and Plasticity	
4. Stability of Structures	
5. Computational Fluid Dynamics.	

PROFESSIONAL ELECTIVES

PRESTRESSED CONCRETE (CE-1731/CE-1841)

UNIT 1 : Over-View-Over-view of basic concept of prestressing, materials for prestressed concrete, prestressing systems, losses of prestress, Analysis of Prestress, Pressure line or Thrust line, Concept of load balancing, stresses in tendons, Cracking moment. 6(L)

UNIT 2 : Deflection and Flexure-Importance of control deflection, Short term deflections of uncracked members, Prediction of long time deflections, deflections of cracked members, Types of flexural failure, Different methods of estimating flexural strength, Shear resistance of Prestressed concrete members. 10(L)

UNIT 3 : Anchorage Zone Stresses and Limit State Design Criterion-Stress distribution in end block of post-tensioned members, Investigations on Anchorage zone stresses and anchorage zone reinforcement, Limit state design criteria for prestressed concrete members, principles of dimensioning prestressed concrete members. 6(L)

UNIT 4 : Design of Prestressed Concrete Sections-Design of prestressed concrete sections for flexure, axial tension, compression & bending, shear & torsion, bond and bearing, Design of pretensioned, post-tensioned and partially prestressed members. 8(L)

UNIT 5 : Continuous Prestressed Concrete Beams-Analysis and Design of Continuous Prestressed Concrete Beams , Application of Prestressed Concrete in Bridges. 6(L)

UNIT 6 : Pole and Sleeper- Design of Pole and sleeper 4(L)

Text/ Reference Books:

- Theory of Prestressed Concrete, Michael Chi & frank A. Biberstein, Prentic Hall International, London
- Prestressed Concrete Theory and Practice, P.B.Morice & E.H.Cooley, Sir Isaac Pitman & Sons, Ltd. London.
- Modern Prestressed Concrete, James R. Libby, Van Nostrand Reinhold Company New York.
- Prestressed Concrete, N.Rajgopalan, Narosa Publishing House, New Delhi.
- Prestressed Concrete, N. Krishna Raju, Tata McGraw Hill, Publishing Company Limited New Delhi.

MATRIX ANALYSIS OF STRUCTURES (CE-1732/CE-1842)

UNIT 1: Analysis of Space Truss-Space Truss, General, Stiffness matrix of a member, Equilibrium of a joint, axial force in a member, illustrative example. 6(L)

UNIT 2: Analysis of Grids- Grid, general, stiffness matrix of a member, joint equilibrium conditions, member forces, torsion constant, examples. 5(L)

UNIT 3: Analysis of Space Frames-Space Frame, general, stiffness matrix of a member, Rotation matrix, joint equilibrium conditions, fixed end reactions, member forces, and examples. 6(L)

UNIT 4: Additional Topics-Stiffness method as a variational approach, strain energy, potential of loads, total potential energy, minimum potential energy theorem, loaded members, equilibrium equations and energy minimization conditions, interpolation and shape functions, member stiffness matrix using displacements, equivalent joint loads using shape functions, introduction to finite element method, triangular element for plane stress, exercises. 8(L)

UNIT 5: Nonlinear Analysis-Linear and non linear response , secant and tangent stiffness matrices , error in equilibrium , Non linear analysis, incremental load method, direct iteration method, Newton –Raphson method, modified Newton –Raphson method. 8(L)

UNIT 6: Nonlinear Analysis of Truss -Error vector , Nonlinear behaviour of a truss , nonlinear analysis of a truss. 7(L)

Text/ Reference Books:

- Matrix Methods of Structural Analysis, A. Kassimali, Cengage Learning.
- Matrix Methods of Structural Analysis, A S Meghre , Charotar Publishing.
- Matrix Methods of Structural Analysis, Wang , C. K. , International Text Book Company.
- Matrix Methods of Structural Analysis, Przemieniecki , J. S. , Courier Dover Publication.

STRUCTURAL DYNAMICS (CE-1733/CE-1843)

- UNIT 1: Response of Single Degree Freedom Systems**-Free and Forced vibrations of single degree freedom system. Response to harmonic, periodic, impulsive and general dynamic loading. 7(L)
- UNIT 2: Response of Multi Degree Freedom Systems**-Two degree and multi-degree-freedom systems. Free vibration of lumped multi degree of freedom system. 9(L)
- UNIT 3: Vibration of Distributed Systems**-Vibration of continuous Beams, Lagrange's equation and its application. 6(L)
- UNIT 4: Structural Control**-Base Isolation, Damper and Concept of structural control 6(L)
- UNIT 5: Random vibrations**-Random vibrations response. 5(L)
- UNIT 6: Soil Structure Interaction and Code Provision**-Use of IS-1893 in Earthquake Resistant Design. Dynamics of soil structure interaction. 7(L)

Text/ Reference Books:

- Introduction to Structural Dynamics - J.M. Biggs, McGraw-Hill Companies
- Engineering Vibrations - L.S. Jacobsen & R.S. Ayre, McGrawHill Book Co., New York
- Structural Dynamics - Theory & computation - Mario Paz, Springer, 1997.
- Dynamics of Structures Theory and Applications to Earthquake Engineering - Anil K. Chopra, Pearson/Prentice Hall.
- Structural dynamics - R. Roy Craig Jr, Wiley, 1981.
- Dynamics of structures - R. W. Clough and J Penjien. McGraw-Hill, Inc.

ADVANCED CONCRETE DESIGN (CE-1734/ CE-1844)

- UNIT 1: Building Frames**-Introduction to building frames, Substitute method of frame analysis, Portal frame method, Cantilever method. 8(L)
- UNIT 2: Grid Floors**-Analysis and design of grid floors. 4(L)
- UNIT 3: Bunker and Silo**-Introduction, Difference between Bunker and Silo, Design of bunker and Silo. 8(L)
- UNIT 4: Chimney**-Analysis and design of chimneys. 6(L)
- UNIT 5: Folded Plates and Shells**-Analysis and design of folded plates. 6(L)
- UNIT 6: Overhead Tanks**-Circular overhead tank, I.S. code method, Intz Tank (Membrane Analysis). 8(L)

Text/ Reference Books:

- N.Krishna Raju :Advanced Reinforced Concrete Design, CBS Publishers, New Delhi
- M.L.Gambheer: Design of Reinforced Concrete Structures, PHI Learnig Private Limited New Delhi.
- B.C.Punmia: Reinforced Concrete Design, Standard Publishers Distributers, New Delhi
- S.S.Bhavikatti, Advance R.C.C. Design, New Age International Publishers, New Delhi
- P. Dayaratnam: Design of Reinforced Concrete Structures.

BRIDGE ENGINEERING (CE-1735/CE-1845)

- UNIT 1: General Introduction**-Site selection, various types of bridges and their suitability, loads, forces, IRC bridge loading and permissible stresses. 7(L)
- UNIT 2: Culvert Design**-Theory of force calculation in bridge slabs, Design of RC & PC culverts. 7(L)
- UNIT 3: RC/PC Bridges Types**- Introduction to design of box culvert, box girder and other RC/PC bridges types. 4(L)
- UNIT 4: T-beam Bridges Design**-Theory of load distribution in girders. Detailed design of RC/PC T-beam bridge. 11(L)
- UNIT 5: Cable Stayed Bridges**-Introduction to cable stayed bridges and its analysis. 4(L)
- UNIT 6: Bearing, Substructures and Foundations**-Introduction to design of bearing, abutments, pier and pier cap and foundation. 5(L)

Text/ Reference Books:

- Design of bridges- N. Krishna Raju , Oxford & IBH Publication Co. Pvt. Ltd.
- Plain & Reinforced Concrete – O.P. Jain , Nemchand, Roorkee.
- Concrete Bridge Practice, Analysis, Design & Economics – Tata Mcgraw hill
- Essential of Bridge Engineering – D.J. Victor , Oxford & IBH publication Co.

PLASTIC DESIGN OF STEEL STRUCTURES (CE-1736/CE-1846)

- UNIT 1:** Introduction, Historical review, plastic failure, plastic moment, Behaviour of cross section, capacity of a cross-section, shape factor, concept of load factor, factors affecting Plastic Collapse. 5(L)
- UNIT 2:** Plastic Hinge, Collapse Mechanisms, Analysis and Design of beams and frames, Gable frames. 6(L)
- UNIT 3:** Semi Graphical method and Mechanism method. 5(L)
- UNIT 4:** Plastic moment distribution for multi-storey and multi-bay frames. 5(L)
- UNIT 5:** Analysis for deflections at collapse. Effect of axial force and shear, Second order effects. 6(L)
- UNIT 6:** Minimum Weight Design. 5(L)

Dno

Text/ Reference Books:

- Plastic Analysis of Structures by P G Hodge, McGraw Hill
- Plastic Analysis and Design of steel structures by M Bill Wong
- Limit State Design of Steel Structures by S.K.Duggal, Tata McGraw hill

ADVANCED CONCRETE TECHNOLOGY (CE-1737/CE-1847)

UNIT 1: Microstructure of Concrete -Microstructure of the aggregate phase, Microstructure of the hydrated cement paste, Interfacial transition zone in concrete. 6(L)

UNIT 2: High Performance Concrete- Brief history, ACI definitions, Field experiences, Applications, High performance High volume fly ash concrete. 6(L)

UNIT 3: Special Concrete-High strength concrete, Light weight concrete, Self compacting concrete, Polymer concrete, Mass concrete, Roller compacted concrete. 6(L)

UNIT 4: Durability of Concrete-Permeability, Surface wear, Crystallization of salts in pores, Frost action, Sulphate, attack, Chloride attack, Alkali aggregate reaction, corrosion of embedded reinforcement in concrete, Effect of Fire, Development of Holistic model of concrete deterioration , Concrete in marine environment. 8(L)

UNIT 5: Damage Assessment in Concrete-Non destructive test: Rebound hammer test, Pullout test, Ultrasonic pulse velocity method, Impact method, Accoustic emission, Electrical, Electro-chemical, and Electromagnetic methods, Tomography. 8(L)

UNIT 6: Fracture Mechanics and its Application in Concrete-Linear elastic fracture mechanics, Concrete fracture mechanics, Fracture process zone. 6(L)

Text/ Reference Books:

- Mehta, P.K. & Monterio P.J. “ Concrete Microstructure , Properties and Materials”, TMH New Delhi
- Lea, F.M., “The Chemistry of Cement and Concrete”, Arnold London
- Neville A.M., Properties of Concrete, Pitman Publishing Company.
- Shetty M.S. “Concrete Technology, Theory and Practices.” S. Chand & Company Ltd., New Delhi.
- Gambhir M.L. “Concrete Technology” - Tata McGraw Hill Publishing Company Ltd., New Delhi.

GEOTECHNICAL PROCESSES (CE-1738/ CE-1848)

UNIT 1: Soil Stabilization-Soil Stabilization Techniques; Mechanical, Lime, Cement, Bituminous, Chemical, Thermal, Electrical stabilization. 7(L)

UNIT 2: Compaction-Field and Laboratory compaction, Properties of soil on wet and dry of OMC, Compaction control, Precompaction, Compaction piles. 6(L)

UNIT 3: Dewatering-Dewatering Methods; Interceptor Ditches, Single and multi-stage well points, Vacuum Well points, Electro-osmosis, Vertical drains. 9(L)

UNIT 4: Grouting-Grouting materials; Suspension, Solutions and Resins, Grouting technology. 6(L)

UNIT 5: Geosynthetics-Types of Geosynthetics, Geotextile testing, Application of Geosynthetic material, Bearing Capacity improvement. 7(L)

UNIT 6: Reinforced Earth- Mechanism of reinforced earth, Soil reinforcement, Design of reinforced earth wall. 5(L)

Text/ Reference Books:

- Haussman: Engineering Principles of Ground Modification, McGraw-Hill
- Leonards: Foundation Engineering, McGraw-Hill
- Witerkorn & Fang: Foundation Engineering, Springer
- F.G. Bell: Foundation on Difficult Ground, Newnes-Butterworth
- Shroff: Grouting Technology in Tunnelling and Dam Construction, A A Balkema Publishers
- Ingles and Metcallf: Soil Stabilization, Wiley.

ADVANCED FOUNDATION DESIGN (CE-1739/CE-1849)

UNIT 1: Foundation Components-Components of foundation, Classification of foundation, Geotechnical Design Parameters. 5(L)

UNIT 2: Shallow Foundation in Clay- Footings in Clay; Bearing Capacity and Settlement, Design of Rafts in Clay, Floating raft-Design. 7(L)

UNIT 3: Shallow Foundation in Sand- Geotechnical Design of Isolated, Raft and Combined footing in Sand, 8(L)

UNIT 4: Pile Foundations- Load transfer through Piles, Piles in Clay and Sand, Test load on Piles, Pile Driving Formulae, Analysis of pile groups in sand & clay, Laterally loaded and Battered pile. 8(L)

UNIT 5: Well Foundation-Types of well foundation, Grip length, Well sinking, Measures for Rectification of Tilts and Shift, Analysis for well. 7(L)

UNIT 6: Foundations on Expansive Soils-Identification of Expansive Soils, Consequences of Swelling, Design of Foundations in Expansive soils, Modification of Expansive Soils. 7(L)

Text/ Reference Books:

- Tomilson: Foundation Design and Construction, Pitman.
- J. E. Bowles: Foundation Analysis and Design, McGraw-Hill.
- Swami Saran: Analysis and Design of Sub structure, oxford and IBH publishing company pvt. ltd.
- Kaniraj: Design Aid in Soil Mechanics and Foundation Engineering, Tata McGraw-Hill
- Kurian: Design of Foundation System, Narosa Publishing House

EARTH AND EARTH RETAINING STRUCTURES (CE-1731to CE-1740 & CE-1841to CE-1850)

UNIT 1: Earth and Rock Fill Dams -Types of Dams, Materials, Foundation.	5(L)
UNIT 2: Stability Analysis -Slope-Stability Analysis, Seepage through Earth dam with Different Sloping face, Requirement and Safety of Earth dams, Stability of Slopes under Different Conditions.	8(L)
UNIT 3: Design of Retaining Walls -Types of Retaining Walls, Design of Gravity, Cantilever and Counterfort Retaining walls.	7(L)
UNIT 4: Sheet Piles -Types of Sheet Piles, Design of Free Cantilever, Cantilever and Anchored Sheet Piles.	7(L)
UNIT 5: Braced Cuts and Cofferdams -Sheeting and Bracing System, Design of Bracing, Types of Cofferdams, Design of Cofferdams in Soil.	7(L)
UNIT 6: Shaft, Tunnels and Underground Conduits -Stresses in Soil around Shaft and Tunnels, Design of Underground Conduits; Ditch, Positive Projected, Negative Projected, Imperfect and Tunneled Conduits.	7(L)

Text/ Reference Books:

- Sherard: Earth and Rockfill Dams, J. Wiley and Sons
- Bharat Singh and Sharma: Earth and Rockfill Dams, Sarita Prakashan.
- V.N. S. Murthy: Soil Mechanics and Foundation Engineering, CBS Publishers & Distributors Pvt Ltd.
- Christian Kutzner: Earth and Rockfill Dams, Taylor & Francis
- Robert B. Jansen: Advanced dam engineering for design, construction, and rehabilitation, Springer

SOIL DYNAMICS (CE-1731to CE-1740 & CE-1841to CE-1850)

UNIT 1: Earthquake and its Effect -Introduction. Site seismicity, Seismic soil response, Design earthquake parameters.	5(L)
UNIT 2: Vibrations -Elementary vibrations, Free & Forced vibration with and without damping of single degree freedom system, Two degree freedom system.	5(L)
UNIT 3: Dynamic Soil Properties -Properties of Soil and its Evaluation, Behavior of Soil Properties due to Dynamic loads.	9(L)
UNIT 4: Liquefaction -Mechanism of Liquefaction, Liquefaction factors, Evaluation of Liquefaction, Anti-liquefaction measures.	7(L)
UNIT 5: Dynamic Earth Pressure -Nature and Magnitude of Earth Pressure, Modified Coulomb's Theory of Earth Pressure, Modified Culmann's Graphical Earth Pressure.	6(L)
UNIT 6: Dynamic Bearing Capacity -Bearing capacity, Settlement, Tilt and horizontal displacement of shallow foundations under dynamic load.	8(L)

Text/ Reference Books:

- Shamsheer Prakash: Soil Dynamics, McGraw-Hill
- Barkan: Soil Dynamics, McGraw-Hill
- S.L. Kramer: Geotechnical Earthquake Engineering, Pearson Education
- P. J. Moore: Analysis and Design of Foundation for Vibration: Taylor & Francis
- Das & Ramana: Principles of Soil Dynamics, Cengage Learning

ROCK ENGINEERING (CE-1731to CE-1740 & CE-1841to CE-1850)

UNIT 1: Rock Engineering -Rock Mechanics, Different types of Rocks, Stress and Infinitesimal strain.	4(L)
UNIT 2: Classification of Rock and Rock Masses -Engineering classification of rocks and rock masses. Strength and Modulus from Classifications.	6(L)
UNIT 3: Rock Strength and Deformability -Rock strength and failure criteria, Intact rock and rock masses properties, initial stresses in rock and their measurements, Stress-Strain models.	7(L)
UNIT 4: Rock Foundation -Estimation of Bearing Capacity in Intact and Fractured Rocks, Bearing Capacity of Pile / Pier in Rocks.	9(L)
UNIT 5: Drilling and Blasting For Underground and Open Excavations -Operational Planning, Explosive Materials, Blast Design, Controlled Blasting Techniques.	8(L)
UNIT 6: Shotcreting - Shortcrete; Purpose, Methods, Mix Design and Testing.	5(L)

Text/ Reference Books:

- B. Singh and R.K. Goel: Rock Mass Classification, Elsevier.
- Brady and E.T. Brown: Rock Mechanics for Underground Mining, George Allen & Unwin (Publishers) Limited.
- Vutukuri, Lama and Saluja: Handbook on Mechanical Properties of Rock, Trans Tech Publications.
- E. Hoek and J. Bray: Rock Slope Engineering, Taylor and Francis
- T. Ramamurthy: Engineering in Rocks, PHI Learning Private Limited
- Rock Slope Engineering: E. Hoek and J. Bray

DESIGN OF WASTE WATER SYSTEM (CE-1731to CE-1740 & CE-1841to CE-1850)

UNIT 1: Wastewater Characteristics -Wastewater characteristics, Priority pollutants in Wastewater.	5(L)
UNIT 2: Unit Operations -Unit operations and processes, Reactor Analysis, Continuity Equation, Analysis of Ideal and field reactors.	7(L)
UNIT 3: Biological Treatment Processes-I Process Flowsheets, Theory and Design of biological treatment processes like activated sludge process and its modifications	6(L)
UNIT 4: Biological Treatment Processes-II Trickling filter, Aerated lagoons and oxidation ditches,	6(L)

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Text/ Reference Books:

- Manual on Sewerage and Sewage Disposal CPHEEO, Govt. of India.
- S.R. Quasim, Design of Wastewater Treatment,, CBS Publications, U.S.A.
- Metcalf & Eddy, Wastewater Engineering, Tata-McGraw Hill.
- Fair, Geyer and Okin, Water and Wastewater Engineering Vol. II, John Wiley & Sons.
- S.J. Acreivala, Dekker & Merceel Wastewater Treatment for Pollution Control, Tata McGraw Hills..

DESIGN OF WATER SUPPLY AND TREATMENT SYSTEMS (CE-1731to CE-1740 & CE-1841to CE-1850)

UNIT 1: Water Quality -Water quality parameters and standards, quality of water in various resource pools.	5(L)
UNIT 2: Unit Operation -Unit operations and processes flow sheets for water treatment,	6(L)
UNIT 3: Settling Tanks -Design of settling basins, mixing devices and flocculation tank	6(L)
UNIT 4: Filtration -Design of Filtration and disinfection units,	5(L)
UNIT 5: Miscellaneous Treatment -Water softening, Ion exchange, Adsorption etc.	6(L)
UNIT 6: Distribution Networks -Analysis and design of water supply distribution networks.	7(L)

Text/ Reference Books:

- Manual on Water Supply and Treatment, CPHEEO, Govt. of India
- Mannual on Sewage & Sewage Distribution, CPHEEO, Govt. of India
- Peavy, Rowe & Tchobanoglous ,Environmental Engineering, McGraw Hill Publication
- Fair, Geyer and Okin, Water and Wastewater Engineering Vol. I & II, John Wiley & Sons.
- S.R. Qasim, Water Supply treatment plant design, CBS Publications, U.S.A.
- S.R. Qasim: Design of wastewater Treatment, CBS Publications, U.S.A.

ADVANCED WASTEWATER TREATMENT (CE-1731to CE-1740 & CE-1841to CE-1850)

UNIT 1: Introduction -Introduction to Advanced Wastewater Treatment: Need, Various Technologies Used, Unit Operations and Unit Processes and their combination.	5(L)
UNIT 2: Removal of Refractory and Dissolved Organics -Adsorption, Adsorption Isotherms, Design of Adsorption systems; Microfiltration and membrane bioreactor.	5(L)
UNIT 3: Removal of Dissolved Inorganic Substances -Chemical Precipitation, Ion Exchange, Reverse Osmosis. Electro dialysis, Membrane Filtration Processes, Gas stripping, Advanced oxidation processes & Distillation, Disinfection.	8(L)
UNIT 4: Nutrients Removal -Nitrogen – sources and forms, Nitrification & denitrification processes, Phosphorous –Sources, Forms, Chemical and Biological Methods of treatment for nutrients.	6(L)
UNIT 5: Kinetics - Immobilised cell technology, Comparison of different techniques, Enzymes & Microbial cell Immobilisation, Effect of Immobilisation on growth Kinetics. Immobilised cell reactors – types, design criteria & applications.	7(L)
UNIT 6: Re-Use of Water -Wastewater reclamation, wastewater reuse & recycle applications.	5(L)

Text/ Reference Books:

- Manual on Sewerage and Sewage Disposal CPHEEO, Govt. of India.
- S.R. Quasim, Design of Wastewater Treatment,, CBS Publications, U.S.A.
- Metcalf & Eddy, Wastewater Engineering, Tata-McGraw Hill.
- Fair, Geyer and Okin, Water and Wastewater Engineering Vol. II, John Wiley & Sons.
- S.J. Acreivala, Dekker & Merceel Wastewater Treatment for Pollution Control, Tata McGraw Hills.
- Davis, Introduction to Environmental Engineering, McGraw Hills International.

RURAL WATER SUPPLY AND SANITATION (CE-1731to CE-1740 & CE-1841to CE-1850)

UNIT 1: Water Supply -Water Supply, Nature of the Problem, Sources locating a well, Construction of a Dug-well and Drilled Tubewell.	6(L)
UNIT 2: Water lifting Arrangements -Water-lifting arrangements, Hilly Areas, lakes and ponds.	5(L)
UNIT 3: Treatment -Treatment in Rural Water Supplies, Sanitation, Choosing Waste Disposal Techniques,	7(L)
UNIT 4: Wastewater Disposal -Excreta Disposal and Techniques for Reusing, Waste Disposal and Reuse,	5(L)
UNIT 5: Onsite Collection & Treatment -On-Site collection and Disposal, pit latrines, Compositing privy, Septic Tanks and Aqua privy.	6(L)
UNIT 6: Offsite Collection & Treatment -Collection and off Site Treatment, Cartage, waterborne ponds, Composting, Aquatic weeds, Reuse, Irrigation, Aquaculture, Algae, Fertilization and Biogas.	6(L)

Text/ Reference Books:

- Manual on Water Supply and Treatment - CPHEEO Govt. of India.
- Excreta Disposal for Rural Areas and Small Communities. Wagner, Lanoix, WHO Publication.
- Small Community water supplies - Holkef (ed.), John Wiley & Sons.

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AIR POLLUTION AND CONTROL (CE-1731to CE-1740 & CE-1841to CE-1850)

- UNIT 1: Introduction**-History of Air Pollution, Atmosphere-its structure and composition, Major Air pollutants-their sources and effects in quality criteria and Ambient air quality standard. 6(L)
- UNIT 2: Photo- Chemistry of Atmosphere**-Photo-Chemical reactions, Monatomic oxygen and ozone formation, role of oxides of Nitrogen, Hydrocarbons and oxidants in photochemical smog; Oxidation of SO₂ in polluted atmospheres. 6(L)
- UNIT 3: Meteorology and Air Pollution**-Atmospheric stability and inversions,mixing height-plume behaviour, effluent dispersion theories, Isokinetic sampling, Modeling, Gaussian and other models, Effective stack height. 6(L)
- UNIT 4: Control of Particulate**-Particulate distribution, collection efficiency, Settling and Deposition. Particulate collection mechanisms, and control equipments. Filters, gravitational, centrifugal-multiple type cyclones, wet collectors, Electrostatic Precipitation. 7(L)
- UNIT 5: Control of Gasses and Vapors**-Adsorption and absorption processes, Carbon Monoxide emission control, Incineration or after-burning processes, control of oxides of sulphur and oxides of nitrogen, General control methods, flue gas control. 7(L)
- UNIT 6: Automobile Pollution**-Automobile emissions and their control methods. Automobile emission standards. Legislation and regulatory trends: Air pollution laws, standards, their implementation and compliance. 6(L)

Text/ Reference Books:

- Peavy, Rowe & Tchobanoglous ,Environmental Engineering, McGraw Hill Publication
- Richard w. Boubel et al , " Fundamentals of Air Pollution ", Academic Press, New York.
- Noel de Nevers, " Air Pollution control Engg. ", McGraw-Hill, New York.
- M. N. Rao et al, " Air Pollution ", Tata McGraw Hill.
- C. Stern "Fundamentals of Air Pollution" Academic Press Inc.

SOLID WASTE MANAGEMENT (CE-1731to CE-1740 & CE-1841to CE-1850)

- UNIT 1: Introduction**-Waste generation, major legislation, monitoring responsibilities, sources and types of solid waste - sampling and characterization, and properties of solid waste. Determination of composition of MSW- storage and handling of solid waste. 6(L)
- UNIT 2: Collection Systems**-Collection Systems, Alternative techniques for collection system. Separation, Processing and Transportation of Solid Waste: 6(L)
- UNIT 3: Separation & Recovery**-Unit operations used for separation and processing, Materials Recovery, Waste transformation through combustion and anerobic composting, anaerobic methods for materials recovery and treatment - Energy recovery – Incinerators, RDF, etc. 7(L)
- UNIT 4: Transfer and Transport**- Transfer and Transport: Means and methods, Types and design of transfer station. Landfills: Site selection, design and operation, drainage and leachate collection systems - requirements and technical solutions, designated waste landfill remediation - Integrated waste management facilities. 7(L)
- UNIT 5: Hazardous Wastes**-Hazardous wastes - sources and characteristics, regulations, minimization & Compatibility, handling, storage, collection and transport of hazardous waste. 6(L)
- UNIT 6: Hazardous Waste Treatment Technologies**-Hazardous waste treatment technologies - Design of operation facilities, Solidification, chemical fixation and encapsulation, incineration. Hazardous waste landfills: Site selection, design operation & remediation of hazardous waste disposal sites. 7(L)

Text/ Reference Books:

- Manual on Municipal solid waste management, CPHEEO, Govt. of India
- G. Technobanglous, H. Theisen and S. A. Vigil, Integrated Solid Waste Management. McGraw-Hill InternationalPublication
- Masataka Hanashima, Modern Landfill Technology and Management; Proceedings of the Asian Pacific Landfill Symposium, Fukuoka, Japan, Oct. 11-13, 2000.
- Integrated Solid Waste management: A Lifestyle Inventory by P. White, M. Franke and P. Hindle (Chapman & Hall)
- Iqbal H. Khan and naved Ahsan, A Text Book of Solid Waste Management,CBS Publishers.
- Manoj Datta, Waste disposal in engineered landfills, Narosa Publishing House

TRANSPORTATION SYSTEM AND PLANNING (CE-1731to CE-1740 & CE-1841to CE-1850)

- UNIT 1: Introduction** -The fields of transportation system, Transportation system engineering, Transportation organizations. Role of Transportation, Social, Economical, Political and Environmental. 4(L)
- UNIT 2: Transportation Planning Process**-Elements of Transportation Planning, Goals and objectives, Identification of needs, generation of alternatives, evaluation of alternatives, Implementation of alternatives. 6(L)
- UNIT 3: Land-Use Transportation System**-Components of transportation system, Urban Transportation System, Landuse and Transportation, land-use forecasting and land-use plans, Lowry-type transportation/Land use model. 7(L)
- UNIT 4: Transportation Survey**-Study area definition, Zoning, Home interview surveys, Road-side Interview surveys, Inventory of Transport Facilities, Inventory of Landuse and Economic Activities, Expansion of data from samples. 8(L)
- UNIT 5: Travel Forecast and Trip Distribution Models**- Overview of Forecasting Process, Urban Activity Forecast, Trip Generation Models, multiple linear regression analysis, Category analysis methods of Trip Distribution: Uniform Factor method, Average Factor method, Frator method, Furnace method, Gravity models, Intervening Opportunity model, Destination Choice models, Entropy model. 7(L)
- UNIT 6: Mode Choice and Traffic Assignment Models** -Logit models for mode choice, All or nothing assignment models, Incremental assignment models, user equilibrium models. 6(L)

Text/ Reference Books:

- Introduction to Transportation Engineering – William W Hay.
- Introduction to Transportation Engineering Planning- E.K. Mortak.
- Metropolitan Transportation Planning – J.K. Dickey
- Principles of Transportation Engineering- Partha Chakroborty and Animesh Das

TRAFFIC ENGINEERING (CE-1731to CE-1740 & CE-1841to CE-1850)

UNIT 1: Introduction To Traffic Engineering-Definition and Scope of Traffic Engineering, Functions, Organization and Importance of Traffic Engineering. Elements of Traffic Engineering: Vehicular, Driver and Road Characteristics. 4(L)

UNIT 2: Traffic Flow Parameters -Traffic flow parameters: volume, density, speed and related terms, Relationship between various parameters, Study and analysis of vehicle arrivals, headways, and gap acceptance in traffic flow. Highway Capacity and Level of Service. 8(L)

UNIT 3: Traffic Flow Theory-Fundamental diagrams of traffic flow theory, Macroscopic traffic flow models: Green Shield's model and Greenberg model, Calibration of macroscopic models. Microscopic traffic flow models: Lighthill and Whitham's Theory, Car Following theory. Shock waves, Queuing theory and its practical applications in traffic engineering problems. 10(L)

UNIT 4: Traffic Studies-Traffic survey: Speed studies, journey time and delay studies; traffic volume studies, vehicle classified count and occupancy; origin-destination studies, parking studies. 6(L)

UNIT 5: Traffic Analysis-Traffic Analysis: Statistics and its applications in analysis of traffic data: Probability, Mean, Variance, and Standard Deviation; Poisson, Binomial and Normal distributions, Significance Testing; Linear and Multiple Regression; and Correlation. 6(L)

UNIT 6: Traffic Control-Definition, functions and importance of traffic control. Methods of traffic control: Traffic signs, Road Markings, and other traffic controls aids. Traffic Regulation. Intersection control and design of traffic signals. 8(L)

Text/ Reference Books:

- Traffic Engineering by L.R. Kadiyali , Khanna Publishers.
- Highway Engg by S.K. Khanna and C.E.J. Justo, Nem Chand Publication
- Principles of Transportation Engineering by P. Chakravorty and Animesh Das, PHI Learning Private Limited.
- Transportation Engineering: An Introduction by C. Jotin Khisty, B. Kent Lall, PHI Learning.

RURAL ROADS (CE-1731to CE-1740 & CE-1841to CE-1850)

UNIT 1: Rural Road Planning-Introduction -Concept, Objective and Significance of rural roads for Developing Countries, Rural Road Planning and Investment -State of Art, Existing practices for Rural Road Planning, PMGSY Models, Accessibility Based Models. 8(L)

UNIT 2: Geometric Design Planning-Geometrics of low cost rural roads -traffic and design speed, Horizontal alignment, Vertical alignment and Cross section elements. 5(L)

UNIT 3: Pavement Design-Pavement design: CBR method of Rural Road Design as adopted in PMGSY programme, IRC method of pavement design for rural roads. 7(L)

UNIT 4: Materials and Construction Techniques-Materials for low cost roads -Stabilized techniques, various construction techniques for sub-base, base and surface courses; soil tests for construction of rural roads. 6(L)

UNIT 5: Rural Road Drainage and Cross Drainage Structures-Road Drainage -Various Low Cost Drainage Alternatives for rural roads. Types of cross drainage structures for rural roads: Hume pipe, slab culverts and cause ways, Preparation of detailed estimates for rural road. 6(L)

UNIT 6: Rural Road Maintenance-Maintenance -Various Type of Maintenance, Low Cost Maintenance Management Techniques. 8(L)

Text/ Reference Books:

- Barwell, I., Edmonds, G.A., Howe, J.D.G.F. and De Veen, J., Rural Transport in 1989. Developing Countries, Intermediate Technology Publications, U.K., 1985.
- Document of Rural Road Development in India, Vol I & II, Central Road research Institute, New Delhi, 1990.
- Manual for Rural Road design and specifications, Ministry of Rural Development, Govt. of India.

TRANSPORT ASSET MANAGEMENT (CE-1731to CE-1740 & CE-1841to CE-1850)

UNIT 1: Introduction-Transport Infrastructure: Roads, Railways and Airways 4(L)

UNIT 2: Asset Management-Asset Management Concept, Management Systems: Components, objectives, designs, role. 6(L)

UNIT 3: Measures of Performance-Defining performance, common characteristics of infrastructure, alternative approaches. 6(L)

UNIT 4: Condition Assessment Techniques-Condition assessment, alternative technologies, for assessing condition including surface and subsurface condition, and the limitations of technologies 7(L)

UNIT 5: Transport Economics-Parameters used in Transport economic analysis, Life Cycle Cost Analysis, Cost and benefit components in Transportation Systems, Economic Evaluation of Transportation Project. 7(L)

UNIT 6: GIS Based Asset Management Systems: Techniques and importance of inventories, GIS as a data integration and analytic tool, Diagnostics and data, The collection and use of data, Discussion of the use of data., example application for road and rail infrastructure management. 10(L)

Text/ Reference Books:

- "Measuring and Improving Infrastructure Performance," National Academy Press, Washington DC 1995
- Grigg, Neil, "Infrastructure engineering and management," Wiley, 1988. (On reserve in library)
- Haas, Hudson, Zaniewski, Modern Pavement Management, Krieger, Malabar, 1994.
- Hudson, Haas, Uddin, Infrastructure management : integrating design, construction, maintenance, rehabilitation, and renovation, McGraw Hill, 1997. (On reserve in library)
- Munnell, Alicia, Editor, Is There a Shortfall in Public Capital Investment? Proceedings of a Conference Held in June 1990. (On reserve in library)
- World Development Report 1994: Infrastructure for Development
- Chakroborty, P. and Das A., Principles of Transportation Engineering, Prentice Hall of India, New Delhi 2003

FINITE ELEMENT AND FINITE DIFFERENCE METHODS (CE-1731to CE-1740 & CE-1841to CE-1850)

- UNIT 1: Introduction**-Brief introduction to numerical methods. 4(L)
- UNIT 2: Different Approaches**-Direct method, Energy approach, Integral formulations and Variational methods. 6(L)
- UNIT 3: Modeling**-Interpolation functions, Numerical integration and modeling considerations. 6(L)
- UNIT 4: Applications**-Finite element analysis of 1-D and 2-D problems. 10(L)
- UNIT 5: Applications and Error Analysis**-Application of the method to the axisymmetric and 3-D bodies, Finite element error analysis. 6(L)
- UNIT 6: Dynamic Considerations**-Eigen value and time-dependent problems. 6(L)

Text/ Reference Books:

- K. J. Bathe & E. L. Wilson, Numerical Methods in Finite Element Analysis, Prentice-Hall, Englewood Cliffs, N. J., 1976.
- R. D. Cook, Concepts and Applications of Finite Element Analysis, John Wiley, New York, 2001.
- C. Zienkiewicz and R. L. Taylor, Finite Element Method, Butterworth Heinemann publication, 3rd Edition, 2005.
- Thomas J. R. Hughes, The Finite element method, Dover Publications, 2nd Edition, 2000.
- T. R. Chandupatla and A. D. Belegundu, Introduction to Finite Elements in Engineering, Prentice Hall of India Pvt. Ltd., New Delhi, 5th Reprint, 1999.
- J. N. Reddy, An Introduction to Linear Finite Element Method, Oxford University Press, Oxford, 2004.


CONSTRUCTION EQUIPMENT AND TECHNIQUES (CE-1731to CE-1740 & CE-1841to CE-1850)

- UNIT 1: Imperatives of Mechanized Construction** -General considerations, specifications, types of drives, classification of equipment, efficiency and performance evaluation criteria of equipment, terminology relating to equipment and machine. Sources of equipment cost of owning and operating of equipment, economic life of equipment, time motion study. 10(L)
- UNIT 2: Construction Equipment**-Excavating, hauling, loading and unloading equipment. Earthmovers, soil compacting equipment, and pile driving equipment. Hoists and cranes. Details and applications of composite equipment viz. power shovel, dragline, clamshell, backhoe, scraper etc. Concrete producing equipment, Ready mixed concrete plants, transit mixers and vibrators. Equipment for dredging, trenching, tunneling, drilling, blasting, dewatering and pumping equipment. Safety in construction. 6(L)
- UNIT 3: Building Construction Practices**-Building construction: Site clearance, earthwork, shallow and deep building foundations, masonry construction water and damp proofing, flooring, joints. Temporary works viz. form work centering and shuttering. Slip forms, steel trusses. 7(L)
- UNIT 4: Sub Structure Construction** -Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls, cofferdams. Piling, well and caisson sheet piles, shoring for deep cutting. 7(L)
- UNIT 5: Super Structure Construction**-Launching girders, bridge decks, off shore platforms, in-situ pre-stressing in high rise structures, aerial transporting handling, erection of transmission towers. Construction sequences in cooling towers, silos, chimney, sky scrapers, bow string bridges, cable stayed bridges -Support structure for heavy Equipment and conveyors - Erection of articulated structures, braced domes and space decks. 7(L)
- UNIT 6: Repair and Rehabilitation**-Study on causes of building damage and deterioration – Assessment of materials and methods of repair and restoration such as grouting, jacketing, use of rebar fasteners etc. 3(L)

Text/ Reference Books:

- Jha J and Sinha S.K., Construction and Foundation Engineering, Khanna Publishers, 1993.
- Sharma S.C., "Construction Equipment and Management", Khanna Publishers New Delhi.
- Deodhar, S.V., "Construction Equipment and Job Planning", Khanna Publishers, New Delhi.
- Varma, M., "Construction Equipment and its Planning and Application", Metropolitan Book Company, New Delhi..
- Stuart Wood J. R. - Heavy construction equipment and methods, Prentice Hall Englewood Cliffs, New Jersey.
- Peuritoy, R. L. - Construction Planning equipment and methods, McGraw Hills International Book Company.
- Russel, J. F. - Construction equipment, Metropolitan Book Co. Delhi.

PRECAST AND MODULAR CONSTRUCTION PRACTICES (CE-1731to CE-1740 & CE-1841to CE-1850)

- UNIT 1: Fundamentals of Industrialized Construction Systems**-Introduction and Overview of reinforced and prestressed concrete construction. 3(L)
- UNIT 2: Design Principles of Precast/Prefabricated Structure Components**-Materials for construction of precast elements, Design and detailing of precast/prefabricated building components, Structural design and detailing of joints in prefabricated structures, consideration of handling stresses. 8(L)
- UNIT 3: Precast Concrete Construction**-Production of ready mixed concrete, quality assurance, equipments in precast prefabricated structures. 7(L)
- UNIT 4: Economic Evaluation for Precast Modular Concrete Construction**-Productivity analysis, Economics of form 

and other reliable proportioning concepts. Modular construction practices in building construction. 8(L)

UNIT 6: Modular Coordination & Standardization-Modular coordination, Standardization, systems building, limitations and advantages of modular construction. Codal recommendations relating to modular construction. 8(L)

Text/ Reference Books:

- Gerwick, B. C. Jr. and Gerwick., "Construction of Prestressed Concrete Structures", Wiley Interscience.
- Smith R. E. – Prefab architecture: a Guide to modular design and construction, John Wiley and Sons.
- Staib, G., Darrhafer, A. and Rosenthal, M. "Components and Systems- Modular Construction Design, Structure, New Technologies" Birkhauser publisher
- Precast Concrete in Mixed Construction: State-of-art report, FIB Bulletin, International Federation for Structural Concrete (fib).
- NBC 2005 , Bureau of Indian Standard, New Delhi

REMOTE SENSING IN CIVIL ENGINEERING (CE-1731to CE-1740 & CE-1841to CE-1850)

UNIT 1: Introduction-Definition of terms, space and airborne imageries, characteristics of photographic images, colour, tone and texture. 4(L)

UNIT 2: Photo Interpretation-Techniques of photo-interpretation, Special equipment, photo-interpretation keys, Ground truth collection and verification, photo-interpretation for selection of Civil Engineering project sites such as for buildings, Railways and highways etc. 6(L)

UNIT 3: Introduction to Remote Sensing-Principles of Remote Sensing and platform for remote sensing, different platform, sensor combinations. Multiconcept in remote sensing through visible and other bands spectral signals 6(L)

UNIT 4: Digital Image Processing-Digital image processing- Digital image and its characteristics, satellite data formats, Image rectification and restoration, Image Enhancement- Contrast Manipulation, Spatial Feature Manipulation, Multi-image manipulation, Image Classification- Unsupervised and Supervised Classification. 10(L)

UNIT 5: Remote Sensing Image Interpretation and its application-Different methods of remotely sensed data interpretation, Application of Remote sensing in land use and land cover analysis, water resources management, flood zoning and damage estimation, pollution studies, regional planning 8(L)

UNIT 6: Engineering Survey Using Remote Sensing-Survey of natural resources and engineering works, Remote sensing satellite and their data products. 8(L)

Text/ Reference Books:

- Remote Sensing and Image Interpretation by Thomas M. Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, 6th Edition, Wiley, 2006.
- Surveying by S. K. Duggal, Volume 2, 3rd Edition, 2009.
- Remote Sensing of the Environment by John R. Jensen, Pearson Education, 2009.
- Introduction to Remote Sensing by James B. Campbell and Randolph H. Wynne, Fifth Edition, Guilford Press, 2011.
- Remote Sensing and GIS by Basudeb Bhatta, Oxford University Press, 2011.

ENGINEERING HYDROLOGY (CE-1731to CE-1740 & CE-1841to CE-1850)

UNIT 1: General Consideration-Introduction, Definition, Hydrologic cycle. 4(L)

UNIT 2:Precipitation and Abstractions-Precipitation, Infiltration and Evapotranspiration, Forms of precipitation, measurement, depth-area-duration and intensity-duration frequency relations, Evaporation - process, measurement, and estimation, Infiltration process, measurement, and estimation, Evapotranspiration measurement and estimation, Runoff and Hydrographs, Rainfall Runoff correlations, Flow duration curve, Mass curve, Stream Flow measurements, Droughts and floods. 10(L)

UNIT 3: Hydrograph- Factors affecting flow hydrograph, Unit hydrograph, its analysis, and S-curve hydrograph, Synthetic and instantaneous unit hydrographs. 6(L)

UNIT 4: Floods-Statistical analysis, Flood frequency studies, Flood forecasting, Rational method, Time Area curves, Risk, reliability, and safety factor, Flood control measures. 8(L)

UNIT 5: Flood Routing-Introduction to basic routing equations, Design flood, Channel and flood routing, Hydrologic Routing, Hydraulic routing 6(L)

UNIT 6: Groundwater Hydrology-Groundwater hydrology, Flow equations and Numerical solutions, Confined and unconfined flow, Well hydraulics Steady and unsteady flow, Well losses, Specific capacity, Groundwater recharge, Groundwater quality and Groundwater monitoring network.

Text/ Reference Books:

- Bedient and Huber- Hydrlogy and Flodplain Analysis, Prentice Hall.
- Ojha,C.S.P. , Bhunya, P. and Berndtsson, R.- Engineering Hydrology, Oxford University Press Canada.
- Todd and Mays- Groundwater Hydrology, John Wiley and Sons, Inc.
- K. Subramanya - Engineering Hydrology, Tata McGraw Hill Education Pvt.Ltd.
- Modi, P.N. – Irrigation Water Resources and Water Power Engineering, Standard Book House
- Asawa, G.L. – Irrigation and Water Resources Engineering, New Age International.

OPEN CHANNEL HYDRAULICS (CE-1731to CE-1740 & CE-1841to CE-1850)

UNIT 1: General Considerations-Classification, description, types energy and momentum equation for prismatic and non prismatic channels. 6(L)

UNIT 2: Uniform Flow-Uniform flow, critical flow, critical depth, specific energy. Channel transitions, Energy-depth relationships, uniform flow computations, Manning's coefficient, Compound Channels. 8(L)

UNIT 3: Gradually Varied Flow- Gradually varied flow, dynamic equation, flow profiles and computation, analytical and

UNIT 4: Rapidly Varied Flow-Characteristics of the flow, hydraulic jump in horizontal, and sloping channels, submerged hydraulic jump, Flow in channel of non-linear alignment and non-prismatic channel sections. 6(L)

UNIT 5: Spatially Varied Flow- Basic principles, dynamic equation, analysis of flow profile, methods of numerical integration. 6(L)

UNIT 6: Unsteady Flow and Flow in Mobile Boundary Channel-Introduction to unsteady flow, continuity and momentum equations, Finite difference techniques for open channel problems, bed forms, channel resistance, sediment loads. 8(L)

Text/ Reference Books:

- Open Channel Hydraulics - Ven Te Chow, mcgraw Hill International Edition
- Flow Through Open Channel - K.G. Ranga Raju., Tata McGraw-Hill
- Open Channel Flow – Henderson, Macmillan.
- Open Channel Hydraulics – Hanif Choudhary, Prentice Hall of India.
- Flow in Open Channels – K. Subramanya, Tata McGraw Hill
- Flow Through Open Channels- Rajesh Srivastava, Oxford University Press.

WATER RESOURCES SYSTEMS MANAGEMENT (CE-1731to CE-1740 & CE-1841to CE-1850)

UNIT 1: General Considerations-Introduction, Global and National scenario of water availability, Economics of Water Resources Systems: principles of engineering economics; Projected water needs for drinking, agriculture and other uses, National water policy. 6(L)

UNIT 2: River Basins-River basins of India and Inter Basin transfer of water, Run off and rainfall data of basins, Interstate and Inter National level sharing of water. 6(L)

UNIT 3: Water Power-Water power, its relation with irrigation and other needs, water power potential and estimation, Storage of water - Current storage scenario in India. Sedimentation, evaporation and other related problems like location of storage sites and rehabilitation problems, etc. 8(L)

UNIT 4: Irrigation and Hydraulic Structures -Broad Principles of Hydraulic structures and canal systems, Floods and draughts, drainage, water logging, soil salinity and soil conservation problems. 8(L)

UNIT 5: Introduction to Mathematical Optimization-Optimization Techniques; Application of Optimization techniques; Water Resources Planning under uncertainty; Stochastic Planning models; Application of Simulation models. 6(L)

UNIT 6: Water Related Environmental Problems-Water related environmental problems, Water pollution, ground water and river pollutions etc., Water conservation measures. 6(L)

Text/ Reference Books:

- Water Resources systems- Vedula and Mujumdar, Tata McGraw-Hill.
- Bedient and Huber- Hydrlogy and Flodplain Analysis, Prentice Hall.
- Ojha,C.S.P. , Bhunya, P. and Berndtsson, R.- Engineering Hydrology, Oxford University Press Canada.
- Todd and Mays- Groundwater Hydrology, John Wiley and Sons, Inc.
- K. Subramanya - Engineering Hydrology, Tata McGraw Hill Education Pvt.Ltd.
- Modi, P.N. – Irrigation Water Resources and Water Power Engineering, Standard Book House
- Asawa, G.L. – Irrigation and Water Resources Engineering, New Age International.

Courses offered by Applied Mechanics Department

1. Theory of Plates and Shells
2. Composite Materials
3. Theory of Elasticity and Plasticity
4. Stability of Structures
5. Computational Fluid Dynamics.

THEORY OF PLATES AND SHELLS (AM-1731to AM-1740 & AM-1841to AM-1850)

UNIT 1: Bending Theories of Plates-Plates: Cylindrical bending of plates, Pure bending of plates. 4(L)

UNIT2: Governing Differential Equation of Plate-Plate Equation. Rectangular plates: Navier's and Levy's solution 6(L)

UNIT 3: Axi-symmetrically Circular Plates-Axi-symmetrically loaded circular plates, 4(L)

UNIT 4: Plates on Elastic Foundation-Plates on elastic foundation, Anisotropic plates. 8(L)

UNIT 5: Shells-Shells: Classification of shells, Membrane theory of shells of revolution and cylindrical shells. 8(L)

UNIT 6: Bending of Shells-Bending theory of axi-symmetrically loaded shells of revolution and cylindrical shells. 8(L)

Text/ Reference Books:

- Thin Plates and Shells- Ventsel and Krauthammer, Marcel Dekker Inc.
- Theory of Plates and Shells- Timoshenko, Tata McGraw Hill.
- The Bending and Stretching of Plates- Mansfield, Cambridge university press.
- Shear Deformable Beams and Plates- Wang, Reddy and Lee, Elsevier Science Publisher.

COMPOSITE MATERIALS (AM-1731to AM-1740 & AM-1841to AM-1850)

UNIT 1: Introduction-Introduction, Historical background, Applications. Fibres and matrix types and properties. 4(L)

UNIT 2: Classification of Composites-Classification of composites. Particulate, Flaked Fibrous, Whisker and Hybrid composites. Forms of fibre reinforcement. 4(L)

UNIT 3: Properties of Composites-Comparison of composites with R.C.C. and metals. Behaviour of uni-directional, crossply, angleply and other composites-strength and stiffness. 8(L)

UNIT 4: Constitutive Equations-Anisotropy, orthotropy etc. and generalized Hooke's law. Performance and behaviour of

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Short fibre composites.

8(L)

UNIT6: Manufacturing Techniques of Composites-Manufacturing techniques, Ingredients, Joints, Performance of composites under adverse conditions. Resin treated concrete. Wear and abrasion resistant composite. Liquid crystal polymers. Optical, electrical, absorption, conductivity and other properties. 8(L)

Text/ Reference Books:

- Mechanics of Fibrous Composites- C. T. Herakovich, John Wiley & Sons.
- Composite Materials – K.K. Chawla, Springer Publisher.
- Composite Material: Design and Application, Daniel Gay and Suong V. Hoa, CRC Press.
- Principles of Composite Materials –R.F. Gibson, CRC Press.
- Mechanics of Composite Materials – R.M. Jones, Taylor & Francis.

THEORY OF ELASTICITY AND PLASTICITY (AM-1731to AM-1740 & AM-1841to AM-1850)

UNIT 1: Fundamentals of Elasticity Theory- Fundamentals of Elasticity Theory: The requirements for a solution, solution procedures, the St. Venant's principle, Stress functions. 6(L)

UNIT 2: Elasticity Theory for Beams- Beams: Some exact solutions for the bending of beams. Beams of irregular cross-section, Curved beams. 6(L)

UNIT 3: Stress Concentration and Fracture Mechanics-Concentrated Loads and Stress Concentrations, Fracture Mechanics : Stress distributions due to cracks, & Fracture. 8(L)

UNIT 4: Variational and Energy Methods-Variational-and Energy Methods. Numerical Methods. 6(L)

UNIT 5: Constitutive Stress-Strain Relations-Theory and Deformation Theory, Generalized stress-strain relations, Bending and torsion of prismatic bars, Ax symmetric problems. Metal forming processes. 8(L)

UNIT 6: Plasticity-Plasticity: Yield surfaces, Prandtl - Reuse. 4(L)

Text/ Reference Books:

- Theory of Elasticity – Timoshenko & Goodier, Tata Mcgraw Hill.
- Theory of Elasticity – L. D. Landau, A. M. Kosevich, E. M. Lifshitz, Butterworth-heinemann.
- Theoretical Elasticity – A. E. Green & W. Zerna, Dover Publications
- Elasticity – M. H. Saad, Elsevier.
- Advanced Strength and Applied Elasticity – Ugural & Fenster, Prentice Hall.
- Elasticity – J. R. Barbar, springer.
- Generalized Plasticity – Mao-hong Yu, Guo-wei Ma, Hong-fu Qiang, Springer.
- Theory of Plasticity – J. Chakrabarty, Elsevier.

STABILITY OF STRUCTURES (AM-1731to AM-1740 & AM-1841to AM-1850)

UNIT 1: Fundamentals of Stability-Concepts of Stability: Equilibrium path, Geometric Non linearity, Stability criteria. Elastic Stability of bars: Columns with various loading and boundary conditions, Uniform and varying cross-sections, Beam – columns, Inelastic Stability of bars, Tangent Modulus, Double Modulus and Shanleys theories. 6(L)

UNIT 2: Large Deformation Theory-Elastica: Large Deformation Theory: Effect of Imperfections, Initial curvature, Eccentricity of loading, Residual stress. 4(L)

UNIT 3: Solution Methodologies-Approximate Methods of Analysis: Principle of conservation of Energy, Principal of stationary Potential Energy, Rayleigh-Ritz Method, Galerkins method, Numerical methods. Energy Methods. 8(L)

UNIT 4: Torsional and Lateral Stability-Torsional Stability: Stability of Thin-walled open sections, buckling by torsion and torsion and Flexure. Lateral Stability: Lateral stability of beams with various loadings and end conditions. 6(L)

UNIT5: Stability of Plates-Elastic Stability of Plates: Differential Equations of plate, Buckling linear theory, stability of Rectangular plates under axial compression and shear, Effect of imperfections, Postbuckling behaviour of plants.

Elastic Stability of Cylindrical Shells: Stability of cylindrical shells under uniform axial pressure and torsion. Effect of imperfections. 10(L)

UNIT 6: Experimental Techniques-Experiments in Stability: South well Plot, Experimental and Design formulae. 4(L)

Text/ Reference Books:

- Theory of elastic Stability - Timoshenko & Gere, Dover Publications.
- Principle of Structural Stability Theory – Chazes, Prentice Hall.
- Stability of Theory of Structures - Ashwani Kumar, Tata Mcgraw Hill
- Background to Buckling - H.G.Allen & P.S.Bulson, MCG Publisher.
- Elastic Stability of Structural Elements - N G R Iyengar, Macmillian India Ltd.
- Fundamentals of Structural Stability – Simitsces & Hodges, Butterworth-heinemann.

COMPUTATIONAL FLUID DYNAMICS (AM-1731to AM-1740 & AM-1841to AM-1850)

UNIT 1: Introduction-Introduction to CFD, CFD as a research and design tool, Applications of CFD in Civil engineering, Problem solving ability of CFD. 2(L)

UNIT 2: Grid Generation-Introduction to grid generation, Body fitted co-ordinate grids for complex geometry, Cartesian vs. curvilinear grids, Curvilinear grid, Block structured grid, Unstructured grid, Discretisation in unstructured grid, Discretisation of diffusive and convective term, Pressure-velocity coupling in unstructured meshes, Staggered vs. co-located grid arrangement, Laboratory based work on grid generation using commercial CFD software/indigenous codes. 8(L)

UNIT 3: Basic Equations of Fluid Flow and Boundary Conditions-Governing equation of fluid flow and heat transfer: mass conservation in three dimensions, rate of change following a fluid particle and for a fluid element, momentum equation in three dimensions, energy equation in three dimensions, equation of state, Navier-Stokes equation for a Newtonian fluid, conservative form of the governing equations of fluid flow. Differential and integral form of the general transport equations, classification methods for simple PDEs, Laboratory based work using commercial CFD software/indigenous codes. 8(L)

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UNIT 4: FVM for Diffusion and Convection-Diffusion Problems -FVM for one, two and three-dimensional steady state diffusion problems. Steady one-dimensional convection and diffusion, central differencing scheme, properties of discretisation schemes, assessment of central differencing scheme for convection diffusion problems, upwind differencing scheme, hybrid differencing scheme, power law scheme, higher order differencing scheme for convection-diffusion problems, TVD schemes, Laboratory based work using commercial CFD software/indigenous codes. 10(L)

UNIT 5: Solution Scheme for Pressure-Velocity Coupling in Steady Flows -The staggered grid, momentum equation, SIMPLE, SIMPLER, SIMPLEC and PISO algorithm, Laboratory based work using commercial CFD software/indigenous codes. 6(L)

UNIT 6: FVM for Unsteady Flows-One-dimensional unsteady heat conduction (explicit, Crank-Nicolson and implicit scheme), implicit method for two and three dimensional problems, discretisation of transient convection diffusion equation. Solution procedures for unsteady flow calculations, steady state calculations using the pseudo-transient approach, Laboratory based work using commercial CFD software/indigenous codes. 6(L)

Text/ Reference Books:

- Versteeg, H.K., and Malalasekara, W., An Introduction to Computational Fluid Dynamics: the Finite Volume Method, 2nd edition, Pearson Learning, New Delhi.
- Muralidhar, and Sundararajan, T., Computational Fluid Flow and Heat Transfer, 2nd edition, Narosa Publishing, Delhi.
- Patankar, S.V., Numerical Heat Transfer and Fluid Flow, McGraw-Hill, New York.
- Ferziger, J.H., and Peric, M., Computational Methods for Fluid Dynamics, 3rd edition, Springer.
- "Fletcher, C.A.J., Computational Techniques for Fluid Dynamics (Vols. I & II), 2nd edition, Springer-Verlag.
- Sengupta, T.K., Fundamentals of Computational Fluid Dynamics, Universities Press, Hyderabad.
- Hirsch, C., Numerical Computation of Internal and External Flows (Vols. I & II), Wiley International.
- Anderson, J.D., Computational Fluid Dynamics: The Basics with Applications, McGraw-Hill.

OPEN ELECTIVES

List of Open Electives for IV Year (for other Streams) offered by Civil Engineering Department:

- 1) Waste Material Management
- 2) Environmental Impact Assessment
- 3) Elements of Remote Sensing
- 4) Fundamentals of GIS & GPS
- 5) Water Resources Management
- 6) Operations Research
- 7) Regional and Urban Planning
- 8) Elements of Civil Engineering

WASTE MATERIAL MANAGEMENT (CE-1781/CE1881)

UNIT 1: Waste Materials & their Composition-Introduction - global material and energy consumption patterns. comparison between the United States, Europe and India. Quantity and composition of wastes. Relevance of waste recycling in the modern world. 8(L)

UNIT 2: Energy Conservation-Energy conservation and fuel production by reprocessing organic/inorganic wastes. 5(L)

UNIT 3: Recovery of Materials-Recovery of materials from municipal, agricultural and industrial wastes e.g. Iron & steel, aluminium. Other non-ferrous metals. glass paper, plastics, rubber, leather, textiles, biomass and flyash etc. 8(L)

UNIT 4: Waste Disposal Techniques-Methods of waste disposal - Land fill, Incineration. composting etc. 5(L)

UNIT 5: Waste-to-Energy Conversion-Technologies of waste-to-energy conversion - Pyrolysis to liquid and gaseous fuels, anaerobic digestion to CH₄, Refuse derived solid fuels and their calorific values, heat recovery incineration etc. 8(L)

UNIT 6: Case Studies-Case studies of operating plants using waste-to-energy conversion technologies, economic analysis and implementation, techniques of waste processing plants. 6(L)

Text/ Reference Books:

- "Solid Waste Conversion to Energy" by Alter harvey & Dunn J.J., Published by Marcel Dekker. 1980.
- "Handbook of solid waste management" by Frank Kreith and George Tchobanoglous, Mc-Graw Hill ,2002.
- "Resources and references: hazardous waste and hazardous materials management" by Gayle Woodside and Dianna S. Kocurek, William Andrew Publishing,1996.

ENVIRONMENTAL IMPACT ASSESSMENT (CE-1782/CE1882)

UNIT 1: Introduction-Environment and its components, Concept of Ecological imbalances, carrying capacity and sustainable development. 5(L)

UNIT 2: EIA Procedure-Introduction to Environmental impact Analysis, EIA procedure, A step-by-step procedures for developing EIA. Notification of EIA by MoEF, Environmental impact Statement. Elements of Environmental Analysis. 5(L)

UNIT 3: Methodologies-Impact Assessment Methodologies,-Matrices, overlays, network analysis. Battle system, Geographic Information System (GIS), Cost-Benefit Analysis, etc. 8(L)

UNIT 4: Air and Water Quality Impact Analysis-Brief Introduction of Air Quality Impact analysis. General Approach for Assessment of Air Pollution Impact, Introduction of Water Quality Impact Analysis. 5(L)

UNIT 5: Noise and Human Health Quality Impact Analysis-Introduction of Noise quality impact analysis and energy impact analysis. Introduction of Socio-Economic and Human Health Impact Analysis. 6(L)

UNIT 6: Environment Laws-Brief introduction about Environment legislation and Environmental Audit. Case studies of EIA of developmental projects. 5(L)

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- Environmental Impact Assessment by C.W. Canter, Tata McGraw-Hill publication
- Environmental Impact Assessment Methodologies by Y. Anjaneyulu & V. Manickam, BS Publication
- Environmental Impact Assessment Theory and Practice by Peter Wathern, Routedge-Taylor & Francis Group.
- Environmental Impact Assessment-A guide to Best Professional Practice by Charles H. Eccleston, CRS Press
- Manual on Environmental Impact Assessment, Ministry of Environment & Forest (MoEF), Govt. of India.

ELEMENTS OF REMOTE SENSING (CE-1783/CE1883)

UNIT 1: Basic Concepts of Remote Sensing-Remote sensing- introduction, Physics of remote sensing- electromagnetic radiations and their characteristics, Thermal emissions, Multi-concept in remote sensing, 6(L)

UNIT 2: Remote Sensing System-Remote sensing satellites and their data products. Sensors and orbital characteristics, Spectral reflectance curves for earth surface features, Methods of remotely sensed data interpretation- Visual interpretation, Concept of FCC. 10(L)

UNIT 3: Introduction to Advanced Remote Sensing techniques-Basic principles and analysis techniques of thermal, hyperspectral and microwave sensing, LIDAR. 4(L)

UNIT 4: Photogrammetry-Fundamentals, vertical and tilted photographs, relief and tilt displacements; strip triangulation, Flight planning, parallax calculation. 6(L)

UNIT 5: Applications of Remote Sensing-Applications of remote sensing in Natural resources management, Environmental impact assessment and water resources management. 6(L)

UNIT 6: Digital Image Processing-Digital image and its characteristics, satellite data formats, Image rectification and restoration, Image Enhancement- Contrast Manipulation, Spatial Feature Manipulation, Multi-image manipulation, Image Classification- Unsupervised and Supervised Classification, Classification Accuracy, Details of digital image processing software packages. 10(L)

Text/ Reference Books:

- Remote Sensing and Image Interpretation by Thomas M. Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, 6th Edition, Wiley, 2006.
- Surveying by S. K. Duggal, Volume 2, 3rd Edition, 2009.
- Remote Sensing of the Environment by John R. Jensen, Pearson Education, 2009.
- Introduction to Remote Sensing by James B. Campbell and Randolph H. Wynne, Fifth Edition, Guilford Press, 2011.
- Remote Sensing and GIS by Basudeb Bhatta, Oxford University Press, 2011.

FUNDAMENTALS OF GIS & GPS (CE-1784/CE1884)

UNIT 1: Basic Concepts of GIS-Introduction, Essential components of a GIS, Data acquisition- Scanners and Digitizers, Raster and Vector formats, Data editing, Geo-referencing. 6(L)

UNIT 2: Data Modelling and Analysis in GIS-Real world problem solving and spatial Analysis, Database Query, Overlay Operations, Buffer Analysis, Digital Terrain Modelling, Data output. 7(L)

UNIT 3: GIS Software and Applications-Introduction to various GIS packages, Applications of GIS in natural resource management, land use planning, environmental management and impact analysis, disaster management, transportation planning etc. 7(L)

UNIT 4: Introduction to GPS-Introduction, Satellite navigation System, GPS satellite constellation, Space segment, Control segment, User segment. 8(L)

UNIT 5: GPS Signal Structure, Receiver and Errors-GPS signal, Receivers and their types, GPS errors. 6(L)

UNIT 6: Surveying using GPS-Position and time from GPS, Static, Kinematic and Differential GPS. 6(L)

Text/ Reference Books:

- Fundamentals of Geographic Information System by Kang-Tsung Chang, Tata McGraw-Hill (TMH), 4nd edition, 2009.
- Surveying by S. K. Duggal, Volume 2, 3rd Edition, 2009.
- GPS: Principles and Applications by A. Ganesh and R. Narayanakumar, Satish Serial Publishing House, Delhi, 2006.
- Fundamentals of GPS by PLN Raju,, URL: <http://www.wamis.org/agm/pubs/agm8/>
 - o Paper-7.pdf
- GPS Basics, Leica Geosystems, URL: www.geoplane.com/gpsbasics.pdf.
- Basics of the GPS Technique: Observation Equations by Geoffrey Blewitt,, URL: [http://www.nbmj.unr.edu/staff/pdfs/Blewitt Basics of gps.pdf](http://www.nbmj.unr.edu/staff/pdfs/Blewitt%20Basics%20of%20gps.pdf).

WATER RESOURCES MANAGEMENT (CE-1785/CE1885)

UNIT 1: General Considerations- Introduction of the subject, Global and National scenario of water availability, Projected water needs for drinking, agriculture and other uses, National water policy. 6(L)

UNIT 2: River Basins-River basins of India and Inter Basin transfer of water, Inter-state and International level sharing of water. 6(L)

UNIT 3: Water Power-Water power, its relation with irrigation and other needs, water power potential and estimation, Storage of water - Current storage scenario in India. Sedimentation, evaporation and other related problems like location of storage sites and rehabilitation problems, etc. 8(L)

UNIT 4: Irrigation And Hydraulic Structures -Broad Principles of Hydraulic structures and canal systems, Floods and draughts, drainage, water logging, soil salinity and soil conservation problems. 8(L)

UNIT 5: Groundwater-Ground Water - Its hydrology, conjunctive uses etc. and ground water rules, groundwater quality, sea water intrusion. 6(L)

UNIT 6: Water Related Environmental Problems-Water related environmental problems, Water pollution, ground water and river pollutions etc., Water conservation measures. 6(L)

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Text/ Reference Books:

- Bedient and Huber- Hydrlogy and Flodplain Analysis, Prentice Hall.
- Ojha, C.S.P. , Bhunya, P. and Berndtsson, R.- Engineering Hydrology, Oxford University Press Canada.
- Todd and Mays- Groundwater Hydrology, John Wiley and Sons, Inc.
- K. Subramanya - Engineering Hydrology, Tata McGraw Hill Education Pvt.Ltd.
- Modi, P.N. – Irrigation Water Resources and Water Power Engineering, Standard Book House
- Asawa, G.L. – Irrigation and Water Resources Engineering, New Age International.
- Walker, W.R. and Skogerboe, G.V. 1986. Surface irrigation theory and practice. Prentice-Hall, Inc.

OPERATIONS RESEARCH (CE-1786/CE1886)

UNIT 1: Introduction-History of operations research. Nature and scope of operations research. Allocation, assignment and transportation models. Construction and solution of those models. 6(L)

UNIT 2: Linear Programming-Introduction. Mathematical formulation of the problem. Graphical solution. Mathematical solution of linear programming problem. Slack and surplus variables. Matrix formulation of general linear programming problem. 8(L)

UNIT 3: Simplex Method-Fundamental properties of solution of extreme points. Computational procedures. Artificial variables. Two phase simplex method. Unrestricted variables. Problems of degeneracy. Principle of duality in Simplex method. Sensitivity analysis. 10(L)

UNIT 4: Integer Programming-Formulation and solution of Integer programming problems. 3(L)

UNIT 5: Game Theory-Introduction, Two persons zero sum games. The maximin and minimax principles. 3(L)

UNIT 6: Graphical Solution-Reduction of game problem to L.P.P. matrix form of transportation problem, Initial basic feasible solution. Transportation algorithm. Degeneracy in transportation problem. Inventory Control. 8(L)

Text/ Reference Books:

- Taha, H. A., Operations Research – An Introduction, Prentice Hall of India Private Ltd., New Delhi, 6th Edition, 1997.
- Rao S. S., Optimization Theory and Application, John Wiley & Sons., New Delhi, 1st Edition, 1996.
- Hillier F. S. and Lieberman G. J., Introduction to Operations Research, Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 1980.
- Wagner, H. M., Principles of Operations Research with Application to Managerial Decisions, Prentice Hall of India Private Ltd., New Delhi, 2nd Edition, 1975.
- Lomba N. Paul, Linear Programming, Tata Mc Graw Hill Publishing Company Ltd., New Delhi.

REGIONAL AND URBAN PLANNING (CE-1787/CE-1887)

UNIT 1: Introduction-Definition. Theories in urban and regional planning. Efficiency measures, Planners skills. Planning processes and continuity of planning process. Visual representation for planning purposes. 3(L)

UNIT 2: Regional Planning-Integrated Area planning in India. Distribution and sizes of settlements. Factors Affecting regional planning, regional surveys and preparation of regional plans. 7(L)

UNIT 3: Urban-Planning-Factors affecting urban growth, town plans and local surveys. Planning for utilities, services and civil amenities. 7(L)

UNIT 4: Transportation Planning-Urban Travel Characteristics, Goals and Objectives, planning agencies, legislation, Travel Demand Models, Transportation System Impacts and Traffic Impact Analysis, System Costs, User Costs, Environmental Costs, Urban Transit Planning. 8(L)

UNIT 5: Standards and Design-Service design and networking, settlement and habitat, Open space land use planning, Integrated rural planning schemes. 7(L)

UNIT 6: Development-Control and Planning Organisation, Development Control legislation. Master Plans, Growth of urban complexes. 6(L)

Text/ Reference Books:

- Urban and Regional Planning in India - by K.V. Sundaram. Vikash Publishing House Pvt. Ltd.
- Town and Country Planning by Lewis Kuble.
- The Urban Pattern - by A.B. Gallion.

ELEMENTS OF CIVIL ENGINEERING (CE-1788/CE-1888)

UNIT 1: Civil Engineering and Infrastructural Development-Introduction, Role of civil Engineer, Infrastructural development, Impact of Infrastructural Development, Vastu. 6(L)

UNIT 2: Materials-Properties, Principles and uses of Traditional materials, Stone, Brick, Timber, Mortar and Concrete, Alternate materials, Composite materials, Smart materials. 8(L)

UNIT 3: Surveying-Introduction to conventional methods of surveying and instruments to prepare map/plan, Introduction to modern surveying methods and instruments. 8(L)

UNIT 4: Building Construction, Design and Services-Introduction to functional and structural elements of buildings. Functional planning of building, Damp proofing, Sound proofing and Heat insulation of buildings. 8(L)

UNIT 5: Geotechnical Investigations-Geotechnical considerations for engineering projects, Sub-soil investigations. 4(L)

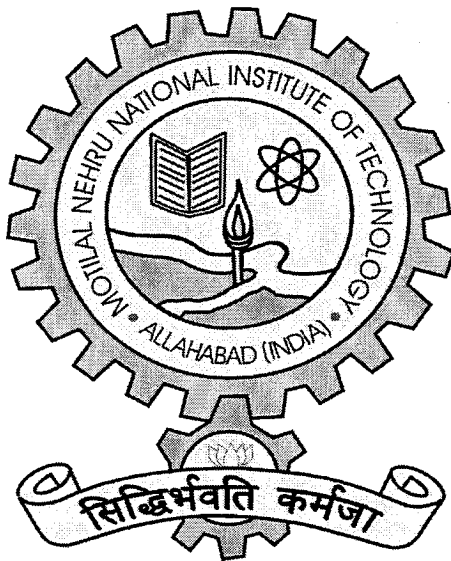
UNIT 6: Environmental Engineering-Water Demand, Waste Water, Solid waste disposal, Environment Pollution: sources, measurement and mitigation. 6(L)

Text/ Reference Books:

- Building Materials, S.K. Duggal, IVth Ed, New Age Publisher.
- Surveying Vol. 1+2 ,3rd Ed.,S.K.Duggal, Tata McGraw Hill ,New Delhi.
- Building Technology evaluation, TTI Publication, Chandigarh.
- Geotechnical Engineering, P.R.Arora, Standard Publisher , New Delhi.
- Environmental Engineering Vol.I S.K. Garg, Khanna Publisher , New Delhi.
- Environmental Engineering, Peavy, Rowe, G. Tachobanglous, McGraw Hill International Edition, New Delhi.

Course Structure & Curriculum
For
B. Tech. Programme

In
COMPUTER SCIENCE & ENGINEERING



Department of Computer Science & Engineering
Motilal Nehru National Institute of Technology
Allahabad

1/2/10

**Curriculum for
Bachelor of Technology in
Computer Science and Engineering**

3rd Semester (Computer Science & Engineering)

Course Code	Course name	L	T	P	Credit
CS-1301	Data Structures	4	-	-	4
MS-1301	Management of IT Industries	3	-	-	3
CS-1303	Analog & Digital Electronics	4	-	-	4
CS-1304	Foundations of Logical Thought	4	-	-	4
CS-1305	Technical Writing	3	-	-	3
CS-1351	Programming Tools – I (Shell)(Lab)	-	-	3	2
CS-1352	Data Structures (Lab)	-	-	3	2
CS-1353	Analog & Digital Electronics (Lab)	-	-	3	2
Total		18		9	24

4th Semester (Computer Science & Engineering)

Course Code	Course name	L	T	P	Credit
CS-1401	Analysis of Algorithms	3	-	-	3
CS-1402	Graph Theory & Combinatorics	3	-	-	3
CS-1403	Computer Organization	3	-	-	3
CS-1404	Automata Theory	4	-	-	4
EC-1405	Communication Foundations	3	-	-	3
CS-1405	Contemporary Issues in Information Technology	2	-	-	2
CS-1451	Programming Tools – II (System Call)(Lab)	-	-	3	2
CS-1452	Analysis of Algorithms (Lab)	-	-	3	2
EC-1454	Communication Foundations (Lab)	-	-	3	2
CS-1453	Automata & Compilers (Lab)	-	-	3	2
Total		18		12	26

5th semester (Computer Science and Engineering)

Course Code	Course name	L	T	P	Credit
CS-1501	Microprocessor and its Application	3	-	-	3
CS-1502	Operating Systems	4	-	-	4
CS-1503	Computer Networks	4	-	-	4
CS-1504	Object Oriented Modeling	3	-	-	3
CS-1505	Operation Research	3	-	-	3
CS-1506	Cryptography	3	-	-	3
CS-1551	Programming Tools – III (Web)(Lab)	-	-	3	2
CS-1552	Microprocessor (Lab)	-	-	3	2
CS-1553	Operating Systems (Lab)	-	-	3	2
CS-1554	Computer Networks (Lab)	-	-	3	2
Total		20		12	28

6th Semester (Computer Science & Engineering)

Course Code	Course name	L	T	P	Credit
CS-1601	Embedded Systems	3	-	-	3
CS-1602	Scientific Computing	3	-	-	3
CS-1603	Computer Architecture	3	-	-	3
CS-1604	Wireless Network Security	3	-	-	3
CS-1605	Database Management System	4	-	-	4
CS-1606	Software Engineering	3	-	-	3
CS-1652	Network Security (Lab)	-	-	3	2
CS-1653	Embedded Systems (Lab)	-	-	3	2
CS-1654	Database Management System (Lab)	-	-	3	2
CS-1651	Mini Project	-	-	3	2
Total		19		12	27

7th Semester (Computer Science & Engineering)

Course Code	Course name	L	T	P	Credit
CS-1701	Distributed System	4	-	-	4
CS-1702	Professional Ethics	2	-	-	2
OE-1781	Open Elective – I	3	-	-	3
CS-1731 to CS-1740	Professional Elective – I	3	-	-	3
CS-1741 to CS-1750	Professional Elective – II	3	-	-	3
CS-1791	Project	-	6	-	6
CS-1751	Distributed System (Lab)	-	-	3	2
Total		15	6	3	23

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8th Semester (Computer Science & Engineering)

Course Code	Course name	L	T	P	Credit
CS-1801	Formal Methods	4	-	-	4
CS-1802	Research Trends in CS	3	-	-	3
CS-1831 to CS-1840	Professional Elective – III	3	-	-	3
CS-1841 to CS-1850	Professional Elective – IV	3	-	-	3
OE-1881	Open Elective – II	3	-	-	3
CS-1891	Project	-	6	-	6
	Total	16	6	-	22

1st digit; 1: UG, 2nd digit; 2, 3, etc.: Semester

Code	Description
01-30	Theory Courses
31-40	Professional Elective –I
41-50	Professional Elective –II
51-70	Practical Courses
81-90	Open Elective
91-99	Project

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DATA STRUCTURES (CS-1301)

UNIT 1: Introduction, Elementary Data Organization, Data Structure Operations, Algorithms Complexity, Time-Space Trade off	6(L)
UNIT 2: Arrays, Linked List, stacks and Queues	10(L)
UNIT 3: Tree, Binary tree, Search tree, Heap, B+ tree	12(L)
UNIT 4: Sorting methods, External Sorting/Searching, Hashing	8(L)
UNIT 5: Graphs	6(L)

Text/Reference Books:

- The Art of Computer Programming (Volume 1 and Volume 3) - D E Knuth,
- Data Structures Using C & C++, Langsam, Augenstein&Tenenbaum,
- Data Structures – A Programming Approach with C, Kushwaha&Mishra,
- R.L. Kruse, B.P. Leary, C.L. Tondo, "Data structure and program design in C"
- Fundamentals of Data Structures in C, by Ellis Horowitz, SartajSahni, and Susan Anderson-Freed

MANAGEMENT OF IT INDUSTRIES (MS-1301)

UNIT 1: Introduction, Nature & Concept of Management; Managerial skills; Evolution of management thought; Concept of functional management; Management styles, Productivity measurement, productivity index, types of production system.	3(L)
UNIT 2: Human Resource Management: Definition and theories of Managing People for IT Industry, Human Resource Planning, responsibility assignment matrix, resource management, developing and managing the project team, Case Studies.	6(L)
UNIT 3: IT Industry Supply Chain Management: Types, Business processes, Strategic, tactical, and operational decisions in supply chains, performance measures, inventory management, bullwhip effect, e-marketplaces, e-procurement, e-logistics, e-fulfillment, customer relationship management, web services, ERP and supply chains, Case Studies	6(L)
UNIT 4: IT Project Quality Management: Tools and techniques for quality control (Pareto Analysis, Statistical sampling, testing), process control, SQC control charts, single, double and sequential sampling, TQM. Case Studies	6(L)
UNIT 5: Environmental Issues, Pollution Control Acts, Green IT Practices, Establishing a Green IT Action Plan, techniques and technologies available to enable Green IT Case Studies	
UNIT 6: Comprehensive Case studies: Any three from TCS, Cisco, Infosys, Wipro, Facebook, Accenture, Google, IBM, Microsoft etc.	3(L)

Text/Reference Books:

- Management :Global Perspectives, by Koontz and Weihrich
- Principles of Management by Prasad, L.M.,
- Environmental and Pollution Awareness by Sharma B.R.

ANALOG AND DIGITAL ELECTRONICS (CS-1303)

UNIT 1: Introduction to semiconductor physics. Diode, Zener Diode, Diode as a switch, Rectifier, Clipping and Clamping Circuits	6(L)
UNIT 2: Bipolar Junction Transistor, Biasing of Transistor, Transistor configurations, Transistor as an Amplifier, Transistor as a Switch.	8(L)
UNIT 3: Introduction to FET, MOSFET, Operational Amplifier, SCR, UJT and other devices	6(L)
UNIT 4: Introduction to Boolean Algebra and fundamental theorems, Basic Logic Gates, Realization of combinational circuits using universal gates, Gate level minimization	8(L)
UNIT 5: Important Digital Circuits Decoder, Multiplexer, PLA, ROM, RAM	4(L)
UNIT 6: Flip Flops, Design of Sequential Circuits, Registers, Counters	8(L)

Text/Reference Books:

- Digital Design by M Morris Mano, M D Ciletti
- Integrated Electronics by Millman&Halkias
- Electronic Principles by Malvino
- Foundations of Analog and Digital Electronic Circuits by AnantAgarwal and Jeffrey Lang

FOUNDATIONS OF LOGICAL THOUGHT (CS-1304)

UNIT 1: Introduction, Set theory, Notion of proofs, Linear congruence	8(L)
UNIT 2: Formal logic: Propositional Logic, Relational logic, First order logic, and related issues	8(L)
UNIT 3: Lattices and related issues	8(L)
UNIT 4: Group Theory and related issues	6(L)
UNIT 5: Finite Fields and related issues	6(L)
UNIT 6: Generating Functions and related issues	4(L)

Text/Reference Books:

- The Essence of Logic, by John Kelly, Ed.
- Logic for Applications, Anil Nerode and Richard A. Shore, Ed.
- Logic, Sets, and Recursion, by Robert L. Causey, Ed.

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- Concrete Mathematics: Foundations for Computational Mathematics, by Donald Knuth, Benjamin
- A Mathematical Introduction to Logic, Enderton, H
- Discrete Mathematical Structure with Application to Computer Science”, J.P Trembley, & R. Manohar

TECHNICAL WRITING (CS-1305)

UNIT 1: Introduction, Introduction To Latex, Introduction to Xfig and other drawing software.	8(L)
UNIT 2: English usage, when English is a foreign language.	6(L)
UNIT 3: Reading a draft, Writing a draft, revising a draft, Introduction to IEEE, ACM style files	6(L)
UNIT 4: Writing a technical talk, presenting the technical talk	4(L)
UNIT 5: Writing a project/thesis. Introduction to various styles.	4(L)
UNIT 6: Copyright issues and plagiarism	2(L)

Text/Reference Books:

- Handbook of Writing for the Mathematical Sciences By Nicholas J. Higham
- *The Elements of Style*, William Strunk, ISBN 0-205-30902-X
- LaTeX: A document preparation system, User's guide and reference manual *Leslie Lamport*, ISBN 0-201-52983-1
- Cambridge English for Engineering, Mark Ibbotson

PROGRAMMING TOOLS – I (SHELL) (LAB) (CS-1351)

This is first independent lab course in programming tools which intends to introduce shell programming skills. UNIX is popular alternative to the Windows environment, especially in high-performance PC Linux servers and other UNIX-based web servers. Topics include: Unix utilities and file structure, Links and symbolic links, Data processing and process control in the Unix shell, Shell programming, Regular expressions, Exposure to different shells like bash, csh, ksh. Introduction to the Python/Perl programming in the Unix environment.

DATA STRUCTURES (LAB) (CS-1352)

Data structures represents the logical way for organizing the stored data. The study of data structures is very necessary because it enables the student to learn, analyze and then subsequently apply, proper the efficient operations over the data items used in the programs or software applications. This lab course is in alignment with the subject's theory classes and it will strengthen the basic concepts which are mandatory prerequisites for understanding any other field related to computer science and engineering. In this lab course would learnb, use of different data structures for the same algorithms (Wherever applicable) to see its effect on time and space, comparison of different algorithms for the same problem etc. programs include: stack, queue linked list, heap, tree, binary search tree and graph using C/C++.

ANALOG & DIGITAL ELECTRONICS (LAB) (CS-1353)

This lab course introduces the students fundamentals of basic electronics and takes them forward to experiments on digital circuits.

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ANALYSIS OF ALGORITHMS (CS-1401)

UNIT 1: Introduction, Review of basic concepts, Advanced data structures like Binomial Heaps, Fibonacci Heaps etc	5(L)
UNIT 2: Divide and Conquer with examples such as Sorting, Matrix Multiplication, Convex hull etc	6(L)
UNIT 3: Dynamic programming with examples such as Knapsack, All pair shortest paths etc	4(L)
UNIT 4: Backtracking, Branch and Bound with examples such as Travelling Salesman Problem etc	6(L)
UNIT 5: Algorithms involving Computational Geometry	4(L)
UNIT 6: Selected topics such as NP-completeness, Approximation algorithms, Randomized algorithms, String Matching	5(L)

Text/Reference Books:

- Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson and Ronald L. Rivest
- Fundamentals of Computer Algorithms by E. Horowitz & S Sahni
- The Design and Analysis of Computer Algorithms by Aho, Hopcraft, Ullman,

GRAPH THEORY AND COMBINATORICS (CS-1402)

UNIT 1: Combinatorics Basic counting techniques, pigeon-hole principle, recurrence relations, Polya's counting theorem. Introduction to probabilistic method in combinatorics	6(L)
UNIT 2: Fundamental concepts of graphs and digraphs,	4(L)
UNIT 3: Spanning tree, connectivity, optimal graph traversals	5(L)
UNIT 4: Planarity of Graphs, Drawing graphs and maps, graph coloring	5(L)
UNIT 5: Special digraph models, network flow and applications	6(L)
UNIT 6: Algebraic specifications of Graphs, Non planar layouts	4(L)

Text/Reference Books:

- Introduction to Enumerate Combinatorics, M. Bona,
- Introduction to Graph Theory, D.B. West
- Graph Theory and Applications J.A. Bondy and U.S.R. Murty: (Freely downloadable from Bondy's website; Google-Bondy)
- Graph Theory: Modeling, Applications, and Algorithms, by Geir Agnarsson and Raymond Greenlaw
- Introductory Combinatorics by R A Brualdi,

COMPUTER ORGANIZATION (CS-1403)

UNIT 1: Introduction, Register Transfer Language, Bus and Memory Transfers, Bus Architecture, Arithmetic Logic Unit	6(L)
UNIT 2: Fundamental concepts of controller design.	6(L)
UNIT 3: Processor design and related issues	8(L)
UNIT 4: Input/Output Organization and related concepts	4(L)
UNIT 5: Optical, magnetic and semiconductor memory devices, Memory organization	6(L)

Text/Reference Books:

- Computer Organization and Design: The Hardware-Software Interface, by David Patterson and John Hennessy.
- Computer Organization, by Vravice, Zaky&Hamatcher
- Structured Computer Organization, by Tannenbaum
- Computer System Architecture, by M. Mano

AUTOMATA THEORY (CS-1404)

UNIT 1: Introduction, inductive Proofs Relations and Functions	4(L)
UNIT 2: Regular Languages DFA, NFA Machines and their equivalence, Regular Expressions, Equivalence of Regular Expressions and Finite State Machines, Closure Properties of Regular Languages Proving Non-Regularity	8(L)
UNIT 3: Context-free Languages Context-free Grammars, Derivations, Leftmost, Rightmost, Inherent Ambiguity, Parse Trees, Normal Forms, Proof of Containment of the Regular Languages Pushdown Automata, Equivalence of PDAs and Context-free Grammars Closure Properties of Context-free Languages	12(L)
UNIT 4: Pumping Lemma for both Regular & Context-free Languages, Proving Some Languages are not Context-free.	6(L)
UNIT 5: Recursive and Recursively Enumerable Languages, Turing Machines Definition of Recursive and Recursively Enumerable, Church's Hypothesis, Computable Functions, Methods for Turing Machine Construction	10(L)

Text/Reference Books:

- Introduction to the Theory of Computation, by Michael Sipser
- Introduction to Automata Theory, Languages, and Computation, by Hopcroft, Motwani, and Ullman (ISBN 0-321-45536-3)
- Theory of Computer Sciences Korral,
- Automata, Computability and Complexity: Theory and Applications. by E Rich

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COMMUNICATION FOUNDATIONS (EC-1405)

UNIT 1: Introduction, Elements of communication systems, review of signal	
UNIT 2: Representations in time and frequency domain, bandwidth, filters, Electromagnetic spectrum	6(L)
UNIT 3: Sky waves, ground waves and space waves, Antenna fundamentals and types of antennas	4(L)
UNIT 4: Amplitude Modulation, Frequency modulation, Radio receivers	4(L)
UNIT 5: Sampling theorem, quantization and pulse code modulation, digital modulation techniques	6(L)
UNIT 6: Fundamentals of guided waves, wave guides, coaxial cables, fiber optic cables, cable types and specifications.	6(L)
UNIT 7: Case studies: FM Broadcast, satellite communication, telephone systems, mobile telephony	

Text/Reference Books:

- Communication Systems Engineering by Proakis, John, and MasoudSalehi
- Electronic Communication Systems by Kennedy D
- Computer Networks by Tanenbaum, Andrew
- Communication Systems by Haykin, Simon.

CONTEMPORARY ISSUES IN INFORMATION TECHNOLOGY (CS-1405)

UNIT 1: Introduction, Information technology in the past, present, and in the future	4(L)
UNIT 2: Contemporary theoretical and research issues which include the digital divide, optical and quantum computing, human computer interfaces and computing limitations.	8(L)
UNIT 3: Applying information technology across disciplines	4(L)
UNIT 4: Case study of famous IT professionals	4(L)

Text/Reference Books:

- CSI Communications (latest 12 issues)
- Communications of ACM (latest 12 issues)
- IEEE Software (latest 12 issues)
- IEEE Computer (latest 12 issues)
- IEEE Spectrum (latest 12 issues)

PROGRAMMING TOOLS -II (SYSTEM CALL) (LAB) (CS-1451)

This is second independent lab course in programming tools which intends to introduce programming involving system calls. System calls are commands that are executed by the operating system. System calls are the only way to access kernel facilities. In this lab course students would learn to use these system calls as file system, multitasking mechanisms and the inter-process communication primitives.

ANALYSIS OF ALGORITHMS (LAB) (CS-1452)

Implementation of algorithms covered in class: This will involve running the algorithms under varying input size and measuring running times, use of different data structures for the same algorithms (wherever applicable) to see its effect on time and space , comparison of different algorithms for the same problem etc.

Following areas should be covered: Dynamic Programming, Divide and conquer, Branch and Bound, Backtracking.
Programming language: C/C++.

COMMUNICATION FOUNDATIONS (LAB) (EC-1454)

Automata theory is the study of abstract computational devices. They have applications in modelling hardware, lexical analysis, machine design, syntax analysis, parser generation, program verification, text editing and so on. The students would do experiments on compiler construction.

AUTOMATA & COMPILERS (LAB) (CS-1453)

Lex and Yacc- Generation of Intermediate Code for Expression Grammar – Construction of Predictive Parsing Table –LR Parsing Tables – Parsing Actions. The aim is to write a compiler for a small language. Familiarity with compiled codes (assembly language) of RISC and CISC machine, writing a scanner, writing a predictive parser for a small language, a small experiment with scanner (lex/ flex) and parser (Yacc/ byson) generator (such as translation as regular expressions to NFA or the construction of parse tree), writing scanner –parse specification for a small language, translation of language to an intermediate form (e.g. three-address code), generation of target code (in assembly language). Code improvement (optional).

Programming languages and Tools: Lex, Yacc/ byson.

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MICROPROCESSOR AND ITS APPLICATIONS (CS-1501)

UNIT 1: Introduction, Overview of microprocessors	3(L)
UNIT 2: Microprocessor Programming Concepts with case study of 8086 and other microprocessors	7(L)
UNIT 3: Memory interfacing and related issues	4(L)
UNIT 4: Interrupts and Interrupt Applications with case study of 8086 and other microprocessors	6(L)
UNIT 5: Peripheral device control and interfacing	10(L)

Text/Reference Books:

- Microprocessors and Interfacing by Douglas V. Hall
- Microprocessor Architecture, Programming and Applications by R. Gaonkar
- Microprocessors Theory and Applications: Intel and Motorola by M. Rafi Quazzaman

OPERATING SYSTEMS (CS-1502)

UNIT 1: Introduction and Overview	2(L)
UNIT 2: Process fundamentals, scheduling, synchronization	12(L)
UNIT 3: Inter-process communication, Deadlock	8(L)
UNIT 4: Memory management and virtual memory	7(L)
UNIT 5: File system and secondary storage	5(L)
UNIT 6: Protection and security issues, Case studies e.g. Linux, Solaris and Android	6(L)

Text/Reference Books:

- Operating Systems, by William Stallings
- Operating Systems Concepts by Silberschatz, Galvin, and Gagne
- The Design of the UNIX Operating System, by Maurice J. Bach
- Advanced Programming in the UNIX Environment, by W. R. Stevens & S. A. Rago
- The Design and implementation of the 4.4 BSD UNIX operating system by Marshall Kirk McKusick, Keith Bostic, Michael J. Karels, John S. Quarterman

COMPUTER GRAPHICS (CS-1501)

UNIT 1: Introduction, Input-Output devices, Line Scan algorithms, Mid-point Circle and Ellipse Generating algorithms, Polygon Filling, Clipping	7(L)
UNIT 2: Geometrical Transformations (2D & 3D), Projections, Visible-Surface Determination	9(L)
UNIT 3: Representation of Curves and Surfaces, Solid Modeling	6(L)
UNIT 4: Color models and applications	4(L)
UNIT 5: CAD/CAM and Applications of computer Graphics	4(L)

Text/Reference Books: (Not Applicable)

- Computer Graphics, by Hearn and Bakerand
- Procedural Elements of Computer Graphics by Rogers
- Principle of Interactive Computer Graphics by Newman and Sproul
- Computer Graphics, A programming Approach by Steven Harrington

COMPUTER NETWORKS (CS-1503)

UNIT 1: Introduction, Fundamental requirements of network, OSI & TCP/IP model	3(L)
UNIT 2: Physical and Link layer issues	4(L)
UNIT 3: Medium Access protocols (IEEE 802.3 ...) and related issues	8(L)
UNIT 4: Network layer: IP and other protocols, Routing protocols, and LAN design.	11(L)
UNIT 5: Transport layer Protocols and related Issues	8(L)
UNIT 6: Basic client server architecture, introduction to different application layer protocols like ftp, telnet, mail(SMTP), HTTP, DNS, DHCP and peer to peer	6(L)

Text/Reference Books:

- Computer Network – Top down approach by James. F. Kurose & Keith W. Rose,
- Computer Network – A system approach by Larry.L.Peterson&Bruce.S.Davie
- Data Communication & Networking by BehrouzForouzan
- Unix Network Programming –volume-I by W.Richard Stevens

OBJECT ORIENTED MODELING (CS-1504)

UNIT 1: Introduction, Need for formal and semi-formal modeling, UML-2 Meta-model	4(L)
UNIT 2: UML-2 Concepts and Examples: Object, Class, Relationship, Interface, Types, roles, Use Case, Interaction and Activity Diagrams, State Machine and State-chart Diagram, Events, signals, Process and threads	8(L)
UNIT 3: Software System Design, Design Patterns, Pattern Classification, Creational, Structural and Behavioral patterns, Idoms	12(L)

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Text/Reference Books:

- Object-Oriented Modeling and Design with UML - Michael Blaha, James Rumbaugh
- Pattern-Oriented Software Architecture A System of Patterns, Volume 1 - Frank Buschmann, RegineMeunier, Hans Rohnert, Peter Sommerlad, Michael Stal
- Object-Oriented Analysis and Design with Applications - Grady Booch et al
- Object-Oriented Design with UML and JAVA - K. Barclay, J. Savage
- Practical Object-Oriented Design with UML - Mark Priestley

OPERATION RESEARCH (CS-1505)

- UNIT 1:** Introduction, Linear programming (LP) models, 4(L)
- UNIT 2:** Simplex & revised simplex algorithms, Duality and sensitivity analysis in LP 4(L)
- UNIT 3:** Basics of Game theory, Transportation and assignment problems, Project scheduling (critical path method & PERT) 10(L)
- UNIT 4:** Integer programming models, Stochastic processes: Markov chains and birth/death processes, Queuing theory 6(L)
- UNIT 5:** Network Analysis and Inventory Control 4(L)

Text/Reference Books:

- Operations Research Models and Methods, by Paul A. Jensen and Jonathan F. Bardto
- Operation Research by Hamdy.ATaha
- Introduction to Operations Research, by Frederick Hillier & Gerald Lieberman
- Linear Programming by Hadely G.

CRYPTOGRAPHY (CS-1506)

- UNIT 1:** Introduction, Prime Number Generation, Shannon's Theory of Perfect Secrecy 5(L)
- UNIT 2:** Asymmetric Key Cryptosystem and related issues 5(L)
- UNIT 3:** Public Key Cryptography and related concepts/methodologies 10(L)
- UNIT 4:** Cryptographic Hash Functions design and implementation issues. 5(L)
- UNIT 5:** Digital Signatures and related issues 5(L)

Text/Reference Books:

- Modern Cryptography : Theory and Practice by W Mao
- Applied cryptography by Bruce Schiener
- "Cryptography: Theory & Practice" D R Stinson,
- Introduction to cryptography by Johannes A Buchmann
- Network Security and Cryptography by Bernard Menezes

PROGRAMMING TOOLS III (WEB) (LAB) (CS-1551)

This is third independent lab course in programming tools which intends to introduce web programming skills. The web is an integral part of society and our lives. The web browser has also grown to be a critical piece of software on many platforms: PC, Laptop, mobile devices, and video game consoles. This course will follow the course tradition of "looking under the hood," exploring ways to create web content and applications. Include search, retrieval and classifications for web. The student would learn XML, ontology language (OWL), resource description framework to development of intelligent internet agent.

MICROPROCESSOR (LAB) (CS-1552)

This lab course mainly deal with programming of microprocessor . Programming will be in assembly format for processors like 8085,8086 and else . Programming 8085 involves Student Development Kit (SDK) to work on. Assignments carried out will be as performing arithmetic operations, searching , shorting and other logical operation on sum real time operations involving interface of 8085 with ADC, DAC, CRO, PPI, PIC and other. This lab will also cover 8086 assembly programming utilizing the Turbo assembler. Programming assignments will involve all memory addressing sehemes, memory segmentation and finally real time applications with interfacing devices.

OPERATING SYSTEMS (LAB) (CS-1553)

Unix command implementation (6-10), Signal handling , Matrix and Graph operations using pthreads, Classical synchronization problems using IPC and pthreads, Thread Library implementation, CPU scheduling algorithms as part of thread library and also using IPC, Deadlock handling algorithms , Page replacement algorithms using pthreads and IPC, sample file system inside disk image file.

COMPUTER NETWORKS (LAB) (CS-1554)

In the of course computer network students will learning about hardware component like RJ-45 connector, CAT-6 Cable, configuration of router, hub switch etc, configuration of server in programming mode they will lean about socket programming , client server programming for deeply understanding TCP/ IP model and various protocols.

In simulation area they will work on Cisco networking, NS-2 or NS-3 tools for more clearly understanding about computer network

EMBEDDED SYSTEMS (CS-1601)

UNIT 1: Introduction, Different perspectives of embedded systems	4(L)
UNIT 2: Design considerations for Processors	4(L)
UNIT 3: Microcontroller programming concepts in Assembly language and C	5(L)
UNIT 4: Processors and peripherals for embedded systems	7(L)
UNIT 5: Serial port programming and interrupts	4(L)
UNIT 6: Microcontroller interfacing with a case study of 8051	6(L)

Text/Reference Books:

- Embedded System Design: A Unified Hardware/Software Introduction by Frank Vahid and Tony Givargis.
- 8051 Microcontroller and Embedded Systems by Muhammad Ali Mazidi, Janice Mazidi and Janice GillispieMazidi.
- Fundamentals of Embedded Software Where C and Assembly Meet by D W Lewis

SCIENTIFIC COMPUTING (CS-1602)

UNIT 1: Introduction, Algebraic and Transcendental Equations and related issues	8(L)
UNIT 2: Discussion on different Interpolation concepts and methods	8(L)
UNIT 3: Curve Fitting, Cubic Spline & Approximation	7(L)
UNIT 4: Numerical Integration and Differentiation.	6(L)
UNIT 5: Numerical Linear Algebra	5(L)
UNIT 6: Statistical Computations	6(L)

Text/Reference Books:

- Numerical Recipes in C The Art of Scientific Computing by W H Press, S A Teukolesky, W T Vetterling and B P Flannery
- Numerical Methods for Scientific and Engineering by M.K.Jain, S.R.K.Iyenger and R.K.Jain
- Numerical Methods and Analysis by James I. Buchman and Peter R.Turner
- Applied Numerical Analysis by C.F.Gerald and P.O.Wheatley

COMPUTER ARCHITECTURE (CS-1603)

UNIT 1: Introduction, History of Computing.	3(L)
UNIT 2: Fundamentals of computer Design, Performance related issues- Performance Parameters- Measuring Performance- Instruction Set Architecture Design – compiler related issues.	7(L)
UNIT 3: Instruction Pipelining- Pipeline hazards- Overcoming hazards- Instruction set design and pipelining- Parallelism Concepts – Dynamic Scheduling – Dynamic hardware branch prediction.	7(L)
UNIT 4: Multi-core, Super scalar, VLIW and vector processors – compiler support for ILP – extracting parallelism – speculation – performance.	6(L)
UNIT 5: Centralized shared memory architectures, Distributed shared memory architectures – synchronization – memory organisation and cache coherence issues	7(L)

Text/Reference Books:

- Advanced Computer Architecture: Parallelism, Scalability and Programmability by Kai Hwang
- Computer Organization and Design, The Hardware/Software Interface by Patterson and Hennessey,
- Advanced Computer Architecture: A System Design Approach by Richard Y. Kain
- Microprocessor Architecture: From Simple Pipelines to Chip Multiprocessors by Jean-Loup Baer

WIRELESS NETWORK SECURITY (CS-1604)

UNIT 1: Introduction, Wireless Communications	2(L)
UNIT 2: Wireless devices and Middleware, Design of Wireless Networks	2(L)
UNIT 3: Ad-hoc wireless networks, wireless sensor networks	2(L)
UNIT 4: Security threats in wireless networks. Security requirements of wireless networks	4(L)
UNIT 5: Security case studies for Wireless LAN and Ad-hoc wireless networks	6(L)
UNIT 6: Speech Cryptology	5(L)
UNIT 7: Protocols and Applications of Cellular, Personal Communications Systems, and Bluetooth. Security issues and services.	9(L)

Text/Reference Books:

- Wireless Security Models, Threats, and Solutions By: Randall K. Nichols, Panos C. Lekkas
- Wireless Communications: Principles & Practice, by Ted Rappaport,
- Wireless Network Design: Optimization Models and Solution Procedures, by J. Kennington et. al.
- Security and Cooperation in Wireless Networks, by LeventeButtyán and Jean-Pierre Hubaux [Available Online]
- The IEEE 802.11 Handbook: A designers companion by Bob O Hara, Al Petrick

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DATABASE MANAGEMENT SYSTEM (CS-1605)

UNIT 1: Database system concept and architecture, Entity Relationship and Enhanced E-R	5(L)
UNIT 2: Relational Data Model and Relational Algebra, SQL, Indexing, Query Optimization	10(L)
UNIT 3: Relational Database Design, Normalization principles and normal forms	8(L)
UNIT 4: Transaction concept and concurrency control	8(L)
UNIT 5: Web Interface to DBMS, Semi-structured databases, Object oriented databases	6(L)
UNIT 6: DBMS Case studies	3(L)

Text/Reference Books:

- Database system concepts, by Korth, Silberschatz, and Sudarshan
- Fundamentals of Database Systems by Elmasari and Nawathe
- Databases by O Neil,
- Database Systems The Complete Book by Garcia-Molina, Ullman, & Widom
- Database Management System by Ramakrishnan and Gehrke

SOFTWARE ENGINEERING (CS-1606)

UNIT 1: Introduction, Software life-cycle models	4(L)
UNIT 2: Software requirements, Requirements Specification	6(L)
UNIT 3: Software design and Software user interface design	7(L)
UNIT 4: Coding Issues, Software integration and testing.	6(L)
UNIT 5: Software support processes and Quality Assurance, IEEE Software Engineering Standards	4(L)
UNIT 6: Software maintenance, Software reuse,	3(L)

Text/Reference Books:

- Software Engineering – A Practitioner’s Approach, by Pressman R. S. and Ince D
- Software Engineering by Sommerville
- Software Engineering, Volume 1 and Volume 2, by Thayer, and Christiansen,
- Fundamentals of Software Engineering by Rajib Mall

NETWORK SECURITY (LAB) (CS-1652)

The lab work will include implementation of algorithms of cryptography (RSA, AES, and DES etc). In network security, the lab work will include firewall implementation, SSH certificates and security tools implementation, database security, program security etc. The lab work will also include configuring DNS, DHCP, NAT etc, router configuration, WAN networking, Building VPN and network security tools (Nmap, Nessus, and Wireleshark etc.)

Programming Languages and Tools: Java (Security Library, JCE, JCA)/C or C++, Nmap, wireshark, cain n able, Nessus etc.

EMBEDDED SYSTEMS (LAB) (CS-1653)

Spectrum for this is wide enough and will cover lot of the embedded technologies lying in currently in real world. Digital system design using logic elements is one part of lab. Next will be working with microcontrollers (8051, PIC, Cortex M or ARM & else). Assignments concerning design of some real time systems either with processor, controllers OR ASIC technology are added portion. Next thing covered will be FPGA with programming in HDL (VHDL or Verilog). Working with technologies will involve interfacing with real time environment through sensors and actuators. Intent of this will be to give real view of embedded technologies and applications leading to robotics and mechatronics.

DATABASE MANAGEMENT SYSTEM (LAB) (CS-1654)

Familiarization of Oracle RDBMS, SQL* Plus, Design and development of database using Oracle, implementation of application with GUI, Implementation of relational operators using C/C++, DSL, Front end development. Web interface to DBMS (using PHP/.Net/JSP)

MINI PROJECT (CS-1651)

In this mini project students will do the experiments to develop basic understanding of the software requirement specification and design issues.

UNIT 1: Introduction, System Models, Network & Inter-networking, Architectures, Challenges	6(L)
UNIT 2: Distributed Communication Paradigms	8(L)
UNIT 3: Distributed Resource Management	8(L)
UNIT 4: Distributed File Management.	8(L)
UNIT 5: Distributed system case studies (at least 5)	10(L)

Text/Reference Books:

- Distributed Operating System, by PradeepK.Sinha,
- Distributed Systems – Concepts & Design, by Coulouris, Dollimore&Kindberg
- Distributed Systems – Principles & Paradigms, by Tanenbaum& Steen,

PROFESSIONAL ETHICS (CS-1702)

UNIT 1: Introduction, Ethical theories	4(L)
UNIT 2: Ethics in IT societies, Intellectual rights and privacy	6(L)
UNIT 3: Professional Relationships, Professional Responsibilities, Professional Ethics in Computing	6(L)
UNIT 4: Online crime, hacking, Legal aspects of Professional Ethics	4(L)

Text/Reference Books:

- IEEE/ACM Software Engineering Code of Ethics and Professional Practice (online)
- Computer Ethics by Deborah Johnson
- Ethics in Engineering by Martin M.W., Schinzinger R.
- Ethics in Information Technology by George Reynolds
- Readings in Cyber Ethics, Edited by Richard Spinello and Herman Tavani.

PROJECT (CS-1791)

DISTRIBUTED SYSTEM (LAB) (CS-1751)

The lab work will include implementation of client server application, CORBA based client server application , implementation of RPC, RMI, Implementation of WSDL based implementation (web services, SOAP) Peer to peer simulation and cloud simulation and internet computing.

Programming Languages and Tools: Java/.Net, C/C++. PeerSim (P2Psimulator), JADE etc. Hadoop framework, Eucalyptus.

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Course Code	Subject
CS-1731	Artificial Intelligence
CS-1732	Data Compression
CS-1733	Data Warehousing and Mining
CS-1734	Design Pattern
CS-1735	Functional Programming
CS-1736	Genetic Algorithm
CS-1737	Network Administration
CS-1738	Neural Network
CS-1739	SOSE (Service Oriented Software Engg.)
CS-1740	XML Based Applications

ARTIFICIAL INTELLIGENCE (CS-1731)

UNIT 1: Introduction, Intelligent agents, reactive, deliberative, goal-driven, utility-driven, and learning agents, Artificial Intelligence programming 5(L)

UNIT 2: Defining problems at state space search, Production system, Problem and production system characteristics, Forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications. Issues in design of search programs 7(L)

UNIT 3: foundations of knowledge representation and reasoning, issues in knowledge representation, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, sample applications. 6(L)

UNIT 4: Planning as search, partial order planning, construction and use of planning graphs, planning and acting in the real world 3(L)

UNIT 5: Basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications. 4(L)

UNIT 6: Learning from memorization, examples, explanation, and exploration. Supervised and un-supervised learning, learning nearest neighbor, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications. Sample Applications of AI 5(L)

Text/Reference Books:

- Artificial Intelligence: A Modern Approach, by Stuart Russell and Peter Norvig,
- Artificial Intelligence by Eliane Rich, Kevin Knight and Shivashankar B Nair,
- Introduction to Artificial Intelligence by Charniak, McDermott

DATA COMPRESSION (CS-1732)

UNIT 1: Information theoretic foundations, Arithmetic coding 6(L)

UNIT 2: Dictionary techniques, Context modeling 6(L)

UNIT 3: Lossless image compression, Lossy coding preliminaries 6(L)

UNIT 4: Scalar and vector quantization 6(L)

UNIT 5: Differential encoding, Transform coding 6(L)

Text/Reference Books:

- Introduction to Data Compression by Sayood, Khalid,
- Data Compression: The Complete Reference by M. Nelson,

DATA WAREHOUSING AND MINING (CS-1733)

UNIT 1: Introduction and overview of data mining processes	3(L)
UNIT 2: Data Warehousing: Overview, Definition, Delivery Process, Multi Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept hierarchy, Process Architecture, 3 Tier Architecture, Data Marting.	5(L)
UNIT 3: Data clustering and classification techniques	9(L)
UNIT 4: Association rule mining	5(L)
UNIT 5: Tuning Data Warehouse, Testing Data Warehouse Data Mining interface, Historical information, Query Facility, OLAP function and Tools. OLAP Servers, ROLAP, MOLAP, HOLAP, Security, Backup and Recovery	5(L)
UNIT 6: Applications and case studies	3(L)

Text/Reference Books:

- Data Mining: Concepts and Techniques by J. Han and M. Kamber,
- Introduction to Data Mining by Pang-Ning Tan, Michael Steinbach and Vipin Kumar
- Data Warehousing in the Real World : A Practical Guide for Building Decision Support Systems by Sam Anahory, Dennis Murray

DESIGN PATTERNS (CS-1734)

UNIT 1: Introduction To Design Patterns, Introduction To Java, Some OO Design Principles, The Observer Pattern, The Template Method Pattern	6(L)
UNIT 2: Factory Patterns: Factory Method and Abstract Factory, The Singleton Pattern, The Iterator Pattern, The Composite Pattern, The Facade Pattern	6(L)
UNIT 3: The State and Strategy Patterns, Functors and the Command Pattern, The Proxy Pattern	5(L)
UNIT 4: RMI, The Adapter Pattern, The Decorator Pattern	4(L)
UNIT 5: Dynamic Proxies In Java, The Chain of Responsibility Pattern, Concurrency Patterns, The Visitor Pattern, Anti Patterns	5(L)
UNIT 6: Layer, Pipe and Filters, Black Board Broker, Case Studies	4(L)

Text/Reference Books:

- Design Patterns - Elements Of Reusable Object-Oriented Software, Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides,
- Head First Design Patterns, Eric Freeman and Elisabeth Freeman
- Applied Java Patterns, Stephen Stelting and Olav Maassen,
- Java Design Patterns - A Tutorial, James W. Cooper,
- Refactoring To Patterns, Joshua Kerievsky,

Functional Programming (CS-1735)

UNIT 1: Introduction, Problem Solving with Functional Language, Programming with functions, List constructors and selectors, Recursive functions, Accumulating parameters, Local definitions, Higher Order functions, Dot notation, and example simple functional programs	12(L)
UNIT 2: Un-typed and Typed Lambda Calculus and Combinators, Term structure and substitution, alpha and Beta reductions and Beta Equality, Normal Form, Combinators, Church Numerals, Reduction Rules, Y-Combinator, Bracket Abstraction, Standard Combinator Expressions, Typed Lambda Calculus and Reduction Rules	10(L)
UNIT 3: Lambda Calculus Semantics: Reduction Machines SECD Machine , Graph Reduction Machine, Lazy/delayed Evaluation,	8(L)

Text/Reference Books:

- Functional Programming : Application and Implementation by Peter Henderson
- Lambda Calculus, Combinators and Functional Programming by G. Revesz
- Lambda Calculus and Combinators : An Introduction by J. Roger Hindley and Jonathan P. Seldin

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GENETIC ALGORITHM (CS-1736)

UNIT 1: Basics of Optimization, Optimization Problems, Point to Point Algorithms, Simulated Annealing	3(L)
UNIT 2: Population Based Algorithms, Brief Overview of Evolutionary Computation, Genetic Algorithms (Theory and Advanced Operators), Genetic Representation, search operators, selection schemes and selection pressure.	7(L)
UNIT 3: Operators on Real-valued Representations, Niche and fitness sharing, Particle Swarm Optimization, Memetic Algorithms	7(L)
UNIT 4: Evolution Strategies, Genetic Programming, Evolutionary Programming, Differential Evolution	6(L)
UNIT 5: Constraint Handling in optimization problems, Real Life application of optimization Algorithms, Introduction of Multi-objective Evolutionary Algorithms	7(L)

Text/Reference Books:

- Genetic Algorithms in Search, Optimization & Machine Learning by D E Goldberg
- Multi-Objective Optimization Using Evolutionary Algorithms by K. Deb
- Handbook on Evolutionary Computation by T. Baeck, D. B. Fogel, and Z. Michalewicz (eds.)

NETWORK ADMINISTRATION (CS-1737)

UNIT 1: Introduction, Basic System Administration	3(L)
UNIT 2: Windows Installation, Linux Installation and Package Management, Backup and Security, Monitoring and Managing Processes/Daemons, Scripting basics and start-up scripts	8(L)
UNIT 3: Unix Networking, Network Protocols - TCP, IP, UDP, NetBIOS, TCP/IP Concepts and Configuration - the basics, Sub netting Implementation, Basic Network Trouble-Shooting and Monitoring Tools	8(L)
UNIT 4: Server configuration and management, DHCP, NIS, NFS, LDAP and Samba	6(L)
UNIT 5: Apache Web Server with PHP, DNS, BIND and Sendmail, Tools like Webmin, Webalizer, and Phpmyadmin; Security and firewall	5(L)

Text/Reference Books:

- TCP/IP Network Administration?, by Craig Hunt,
- Neural Networks and Learning Machines by S. Haykin
- Artificial Neural Networks by Robert J. Schalkoff
- Multi-Objective Optimization Using Evolutionary Algorithms by Deb Kalyanmoy
- Genetic Algorithms + Data Structures = Evolution Programs by Z Michalewicz

NEURAL NETWORKS (CS-1738)

UNIT 1: Introduction, Brain Physiology, Neuron Model and Network Architectures	4(L)
UNIT 2: Nonlinear dynamical system theory	6(L)
UNIT 3: The Hopfield Model, Spin Glasses, Stochastic Neural Networks, Boltzmann Machine	8(L)
UNIT 4: Multilayer Feedforward Networks For Supervised Learning	6(L)
UNIT 5: Unsupervised and Competitive Learning Algorithms, Bifurcating Neural Networks	6(L)

Text/Reference Books:

- Neural Networks: A Comprehensive Foundation by S. Haykin,
- Neural Networks and Learning Machines by S. Haykin
- Artificial Neural Networks by Robert J. Schalkoff
- Multi-Objective Optimization Using Evolutionary Algorithms by Deb Kalyanmoy
- Genetic Algorithms + Data Structures = Evolution Programs by Z Michalewicz

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SERVICE ORIENTED SOFTWARE ENGINEERING (CS-1739)

UNIT 1: Concepts of Service orientation	8(L)
UNIT 2: Service oriented Software architecture concepts	5(L)
UNIT 3: Requirements Analysis & Design Process	7(L)
UNIT 4: Service Testing and Estimation models	6(L)
UNIT 5: Cloud based services models	4(L)

Text/Reference Books:

- Service Oriented Architecture – Concept Technology & Design by Thomas Earl
- Enterprise SOA – Designing IT for Business Innovation by Woods & Mattem
- Web Service Essentials, Eiban Cerami, O'Reilly

XML AND APPLICATIONS (CS-1740)

UNIT 1: Emerging Technologies; XML Documents: Syntax, Well formed and Valid; CCS and XHTML; Document Type Definition(DTD); XML Schema : XSD, XDR, Examples; JavaScript	12(L)
UNIT 2: SAX and DOM Parser and APIs, Example of API usage; XPATH, XLink, Xpointer; XSL: XSLT	10(L)
UNIT 3: Applications: RDF and RDFS, JENA API, Case Study	8(L)

Text/Reference Books:

- XML The Microsoft Way By Peter G. Aitken
- Learning XML By Erik T. Ray and Christopher R. Maden
- XML How to Program By Harvey M. Deitel, Paul J. Deitel, Tem R. Nieto, Ted Lin and Praveen Sadhu

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FORMAL METHODS (CS-1801)

UNIT 1: Introduction, Hardware and Software verification, Model Checking, Reactive systems, Process algebras. 7(L)

UNIT 2: Modeling Systems, The language CCS, CCS process constructions, CCS formally, Introduction to Pi-calculus, Concurrency Work Bench. 9(L)

UNIT 3: Theory of fixed points and bisimulation equivalence, Posets and complete lattices, Tarski's fixed point theorem, Behavioural equivalences, Trace equivalence, Strong bisimilarity, Weak bisimilarity, Bisimulation as a fixed point. 8(L)

UNIT 4: Modalities and Capabilities, Safety Properties and Invariants, Liveness Properties, Fairness, Hennessy-Milner logic, HML with recursion, Temporal Properties and Modal Mu-Calculus. 8(L)

UNIT 5: Verifying Temporal properties, CTL Model Checking algorithms, The fixed point characterization of CTL. 8(L)

Text/Reference Books:

- Communication and Concurrency by Robin Milner,
- Pi-calculus by Robin Milner
- Logic in computer science by Michael Huth and Mark Ryan,
- Model Checking by Clarke, Grumberg, Peled,
- Modal and Temporal Properties of Processes by Colin Sterling,

RESEARCH TRENDS IN CS (CS-1802)

UNIT 1: Introduction, History of Computing, 3(L)

UNIT 2: Presentation Schedule

Text/Reference Books:

- DBLP to identify areas and TOC of Journals and Conference Proceedings
- INDEST, ACM digital Library, IEEE Digital Library etc to browse papers
- Handbook of Writing for the Mathematical Sciences By Nicholas J. Higham

PROJECT (CS-1891)

Course Code	Subject
CS-1831	Distributed & Parallel Algorithms
CS-1832	E-Commerce
CS-1833	Gaming and Animation
CS-1834	Information Retrieval
CS-1835	Pattern Recognition
CS-1836	Semantic Web (Web Ontology)
CS-1837	Software Metrics & Quality Assurance
CS-1838	Software Testing
CS-1839	Theory of Virtualization
CS-1840	Web Mining

Note : The list of Professional Electives would be enriched further.

DISTRIBUTED AND PARALLEL ALGORITHMS (CS-1831)

- UNIT 1: Introduction, architectures and languages for parallel and distributed processing. 3(L)
- UNIT 2: Abstract models of parallel computing, PRAM (Parallel Random Access Machine). Distributed and parallel algorithms and their complexity. Interaction between processes, communication, synchronization. 9(L)
- UNIT 3: Topologies, synchronous and asynchronous algorithms. Algorithms for parallel sorting. Algorithms for parallel searching. 6(L)
- UNIT 4: Parallel matrix operations. All prefix sums and their applications. Graph and list algorithms. Synchronization algorithms and tasks. 6(L)
- UNIT 5: Mechanisms and language constructs for synchronization. Recently published algorithms. 6(L)

Text/Reference Books:(Not applicable)

- Parallel Computation, Model and Methods by Akl,
- An Introduction to Parallel Algorithms
- Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes by Leighton,
- Synthesis of Parallel Algorithms by J. H. Rief,
- Introduction to Distributed Algorithms by Gerard Tel,

E-COMMERCE (CS-1832)

- UNIT 1: Introduction to e-Commerce and Network Infrastructure for e-commerce. 4(L)
- UNIT 2: E-commerce Models, e-Advertising & Marketing 6(L)
- UNIT 3: Electronic Payment Systems and Electronic Data Exchange 6(L)
- UNIT 4: E-commerce Security 4(L)
- UNIT 5: E-CRM 6(L)
- UNIT 6: Mobile Commerce 4(L)

Text/Reference Books:

- Introduction to E-commerce by Jeffrey F. Rayport & Bernard J. Jaworski
- Frontiers of E-commerce by Kalakota & Winston
- E-Commerce- Strategy technologies and Applications by David Whiteley
- E-Commerce-Concepts, Models & Strategies by C.S.V. Murthy
- E-Commerce by Perry

GAMING AND ANIMATION (CS-1833)

- UNIT 1: Introduction, Fundamental Principles of Animation and gaming 6(L)
- UNIT 2: Rigging & Posing Techniques, Fundamentals of Character Animation, Facial Animation and Lip Sync Techniques 8(L)
- UNIT 3: Fundamentals of Motion Capture, Principles of Motion Simulation 6(L)
- UNIT 4: Game design principles and processes 8(L)

Text/Reference Books:

- Fundamentals of Game Design. By E. Adams.
- The Art of Game Design by J. Schell
- Computer Animation: Algorithms and Techniques by Rick Parent

INFORMATION RETRIEVAL (CS-1834)

UNIT 1: Introduction to IR models and methods, Text analysis / Web spidering Text properties	5(L)
UNIT 2: Vector-based model, Boolean model, Probabilistic model, other IR models; IR evaluation and IR test collections; Relevance feedback, query expansion	8(L)
UNIT 3: Web search: link based and content based; Query-based and content sensitive link analysis; Search engine technologies	8(L)
UNIT 4: Text classification and clustering; Question answering on offline and online collections	5(L)
UNIT 5: Personalized IR, Cross-language IR, Web 2.0,	4(L)

Text/Reference Books:

- Introduction to Information Retrieval by Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze (available online)
- Information Retrieval: Algorithms and Heuristics. By D.A. Grossman, O. Frieder
- Readings in Information Retrieval by K. Sparck Jones and P. Willett

PATTERN RECOGNITION (CS-1835)

UNIT 1: Introduction to Pattern Recognition, Feature Detection, Classification, Decision Theory, ROC Curves, Likelihood Ratio Test, Linear and Quadratic Discriminants, Fisher Discriminant, Sufficient Statistics, Coping with Missing or Noisy Features, Template-based Recognition, Feature Extraction, Eigenvector and Multilinear Analysis	10(L)
UNIT 2: Training Methods, Maximum Likelihood and Bayesian Parameter Estimation, Linear Discriminant/Perceptron Learning, Optimization by Gradient Descent, Support Vector Machines, K-Nearest-Neighbor Classification	6(L)
UNIT 3: Non-parametric Classification, Density Estimation, Parzen Estimation, Unsupervised Learning, Clustering, Vector Quantization, K-means, Mixture Modeling, Expectation-Maximization	6(L)
UNIT 4: Hidden Markov Models, Viterbi Algorithm, Baum-Welch Algorithm, Linear Dynamical Systems, Kalman Filtering, Decision Trees, Multi-layer Perceptrons, Reinforcement Learning with Human Interaction	8(L)

Text/Reference Books:

- Pattern Classification by Richard O. Duda, Peter E. Hart and David G. Stork
- Pattern Recognition and Machine Learning by C. M. Bishop
- Pattern Recognition by S. Theodoridis and K. Koutroumbas

SEMANTIC WEB (CS-1836)

UNIT 1: Review of XML; Meta-model and Meta-data, RDF & RDFS; OWL; Ontology Engineering and tools	12(L)
UNIT 2: Description Logic(DL); Programming with DL; Example Application	12(L)
UNIT 3: Knowledge Acquisition and Management System,	6(L)

Text/Reference Books:

- A Semantic Web Primer by Antoniou, Grigoris and Frank van Harmelen
- The Description Logic Handbook: Theory, Implementation and Applications by Franz Baader, Deborah L. Guinness, Daniele Nardi, and Peter F. Patel-Schneider (Eds.)
- An Introduction to Description Logic by Daniele Nardi and Ronald J. Brachman

UNIT 1: The state of IT project management & basics of measurement	6(L)
UNIT 2: Measuring internal product attributes: size and structure	6(L)
UNIT 3: Measuring cost and effort	6(L)
UNIT 4: Measuring external product attributes: Quality & Reliability	6(L)
UNIT 5: Software test metrics	6(L)

Text/Reference Books:

- Software Metrics: A Rigorous and Practical Approach by N.E. Fenton and S.L. Pfleeger
- Metrics and Models in Software Quality Engineering by Stephen H. Kan
- Software Project Management in practice by PankajJalote
- Software Project Management by Bob Hughes and Mike Cotterell

SOFTWARE TESTING (CS-1838)

UNIT 1: Fundamentals of Testing and its current state of art	8(L)
UNIT 2: Various approaches to Testing	6(L)
UNIT 3: Test planning and Management	6(L)
UNIT 4: Test Strategies - Preventive, Reactive Approach, Analytical, Heuristic, Configuration Management	6(L)
UNIT 5: Mutation Testing &Testing Object Oriented Software	4(L)

Text/Reference Books:

- Software Testing Techniques by BorrisBeizer
- Software Testing – A Craftman’s Approach by Paul C. Jorgensen
- Software Testing by Hambling, Samaroo& Williams.
- Software Testing Practice: Test Management by Spillner, Rossner, Winter & Linz

THEORY OF VIRTUALIZATION (CS-1839)

UNIT 1: Introduction, Overview of virtualization	8(L)
UNIT 2: Hardware/Server virtualization	8(L)
UNIT 3: Network virtualization	8(L)
UNIT 4: Virtual machines	6(L)

Text/Reference Books:

- Virtual Machines: Versatile Platforms for Systems and Processes by James E. Smith, Ravi Nair,
- Virtualization: From the Desktop to the Enterprise by Chris Wolf, Erick M. Halter
- Network virtualization by Kumar Reddy, Victor Moreno,
- Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center by David Marshall, Wade A. Reynolds,

WEB MINING (CS-1840)

UNIT 1: Introduction, Practical web mining applications overview	3(L)
UNIT 2: Natural Language Processing methods used for web information retrieval	6(L)
UNIT 3: Web Content Mining	5(L)
UNIT 4: Web Structure Mining	5(L)
UNIT 5: Web Usage Mining	6(L)
UNIT 6: Specific applications and case studies	5(L)

Text/Reference Books:

- Web data mining: exploring hyperlinks, contents, and usage data by LIU, B.
- Mining the Web - Discovering knowledge from hypertext data, by SoumenChakrabarti,
- Ontology learning and population from text : algorithms, evaluation and applications by CIMIANO, P.

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Course Structure & Curriculum
For
B. Tech. Programme

In
ELECTRICAL ENGINEERING



Department of Electrical Engineering
Motilal Nehru National Institute of Technology
Allahabad

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3rd Semester (Electrical Engineering)

Course Code	Course name	L	T	P	Credit
EE-1301	Networks & Systems	3	1	-	4
EE-1302	Electrical Measurement and Measuring Instruments (EMMI)	3	1	-	4
EE-1303	Principles of Electronics	3	1	-	4
CS-1302	Data Structure and Operating Systems	3	-	-	3
MA-1302	Numerical Methods and Statistical Techniques	2	1	-	3
EE-1304	Electrical Engineering Material and Devices	3	-	2/2	3
EE-1351	Networks & Systems (Lab)	-	-	3	2
EE-1352	Electrical Measurement and Measuring Instruments (EMMI) (Lab)	-	-	3	2
EE-1353	Principles of Electronics (Lab)	-	-	3	2
CS-1354	Data Structure and Operating Systems (Lab)			3	2
Total		17	4	14	29

4th Semester (Electrical Engineering)

Course Code	Course name	L	T	P	Credit
EE-1401	Basics of Electrical Machine	3	1	-	4
EE-1402	Basic Control System	3	1	-	4
EE-1403	Power System -I	3	1	-	4
EC-1402	Digital Electronics	3	1	-	4
EC-1403	Electro-Magnetic Theory	2	1	-	3
EE-1451	Electrical Machine-I (Lab)	-	-	3	2
EE-1452	Basic Control System (Lab)	-	-	3	2
EE-1453	Power System -I (Lab)	-	-	3	2
EC-1452	Digital Electronics (Lab)	-	-	3	2
Total		14	5	12	27

5th Semester (Electrical Engineering)

Course Code	Course name	L	T	P	Credit
EE-1501	AC Electric Machine	3	1	-	4
EE-1502	Advance Control System	3	1	-	4
EE-1503	Power System - II	3	1	-	4
EC-1504	Communication System and Networking	3	1	-	4
HS-1501	Principles of Management	3	-	-	3
EE-1551	AC Electric Machine (Lab)	-	-	3	2
EE-1552	Advance Control System (Lab)	-	-	3	2
EE-1553	Power System - II (Lab)	-	-	3	2
EC-1554	Communication System and Networking (Lab)			3	2
Total		15	4	12	27

6th Semester (Electrical Engineering)

Course Code	Course name	L	T	P	Credit
EE-1601	Power Electronics	3	1	-	4
EE-1602	Microcontroller & Computer Organization	3	1	-	4
EE-1603	Instrumentation	3	1	-	4
EE-1604	Applied Control	3	1	-	4
EE-1605	Modern Electrical Machines	3	1	-	4
HS-1601	Communication Skill (Workshop)	0	0	0	0
EE-1607	Power Plant Engineering	3			3
EE-1651	Power Electronics (Lab)	-	-	3	2
EE-1652	Microcontroller & Computer Organization (Lab)	-	-	3	2
EE-1653	Instrumentation (Lab)	-	-	3	2
Total		18	5	9	29

7th Semester (Electrical Engineering)

Course Code	Course name	L	T	P	Credit
EE-1701	Electrical Drives	3	1	-	4
EE-1702	Renewable Energy Sources and Distributed Generation	3	1	-	4
EE-1731 to EE1740	PE01	3	1	0	4
OE-1781	OE1	3	1	0	4
EE-1751	Electrical Drives (Lab)	-	-	3	2
EE-1752	Project			6	6
Total		12	4	9	24

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Course Code	Course name	L	T	P	Credit
EE-1801	Advance Power Electronics	3	1	-	4
EE-1831 to EE-1840	Professional Elective02	3	1	0	4
EE-1841 to EE-1850	PE03	3	1	0	4
OE-1881	OE2	3	1	0	4
EE-1851	Advance Power Electronics (lab)			3	2
EE-1852	Project			6	6
	Total	12	4	9	24

1st digit; 1: UG, 2nd digit; 2, 3, etc.: Semester

Code	Description
01-30	Theory Courses
31-40	Professional Elective –I
41-50	Professional Elective –II
51-70	Practical Courses
81-90	Open Elective
91-99	Project

Prima

UNIT 1: Network Analysis & Classifications- Steady-state analysis of AC circuits: Sinusoidal and phasor representation of Voltage & current, single phase ac circuit behavior of R, L and C. Combination of R, L and C in series and parallel resonance. Three Phase AC circuits: Line and phase voltage/current relationship for star & delta connections. 5(L)

Network classification & Introduction to continuous time signals and systems: Unit Step, ramp and impulse signals, Example of each signal, Differential Equation formulation of linear time invariant continuous system, Responses for unit step, ramp, square pulse and impulse function. 6(L)

UNIT 2: Review of Laplace Transform- Initial value and Final Value Theorem, Properties and solution of differential equation using LT, Time domain analysis of LTI network using Laplace transform, Waveform Synthesis, LT of Complex waveforms, Concept of Transform Impedance, Voltage ratio, Transfer function, Relation between impulse response and system function. 5(L)

UNIT 3: Networks Theorems- Thevenin's and Norton's Theorem, Maximum power transfer Theorem, Superposition, Tellegen's, Milliman's. 8(L)

UNIT 4: Concepts of Poles and Zeros- Relation between locations of Poles, time response and stability, frequency response and bode plots, interrelation between frequency response and time response, convolution integral. 6(L)

UNIT 5: Two Port networks-Two port network parameters (z , y , T , T , h , g), Symmetrical & Reciprocal networks, Inter-conversion of two port network parameters, Interconnection of two port networks, Ladder networks, T-M transformation, Image & characteristic impedance. Network functions: Driving point and Transfer functions. 5(L)

UNIT 6: Positive Real function- Definition and properties and testing, Synthesis of LC, RL & RC circuits using Cauer and Foster's first and second form. 5(L)

Text/ Reference Books:

- M.E. Van Valkenberg, Network Analysis Prentice Hall
- M.E. Van Valkenberg, Network Synthesis Prentice Hall
- D. Roy Choudhary, Networks & Systems
- W. H. Hayt & J. E. Kemmerly, Engineering circuit Analysis, TMH
- A Chakrabarti & S. Bhadra, Networks & Systems Dhanpat Rai & Co.

ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENTS (EMMI) (EE-1302)

UNIT 1: Principles of Measurement and error analysis-Methods of measurement, Characteristics of instruments & measurement systems, Errors in measurement & its analysis. 5(L)

UNIT 2: Analog Instruments-Classification, Principle of operation of Permanent Magnet Moving Coil (PMMC) and Moving Iron Instruments, Voltmeters & ammeters, Errors in Voltmeter and Ammeters, Range extension, Advantages and disadvantages, Electro-dynamometer Instruments, Power & Energy measurement. 7(L)

UNIT 3: Electronic Instruments-Digital Instruments for measurement of current, voltage, resistance etc., Measurement of frequency & phase, Cathode Ray Oscilloscopes (CRO) –analog and special CRO 6(L)

UNIT 4: Potentiometers & Bridges-D.C. & A.C. Potentiometers, D.C. & A.C. Bridges, Measurement of inductance and capacitance & quality factor, Measurement of low, medium, high resistances and earth Resistances. 6(L)

UNIT 5: Instrument Transformers- Principle of operation and applications, Current transformer and its error analysis, Potential transformer and its error analysis, Misc. Measurement, Frequency & power factor, Harmonic analyser, Power analyser 6(L)

UNIT 6: Introduction to DAC & ADC System-Analog to Digital Conversion: Ramp, Voltage to Frequency Converter (Integrating type), Dual slope integration Techniques, Digital to Analog Conversion: Weighted Resistor type, R-2R Ladder type, Specification of D/A Converter -Resolution, Accuracy 7(L)

Text/ Reference Books:

- E.W.Golding & F.C.Widdis, "Electrical measurement & measuring instruments" A.H.Wheeler &Co.Pvt Ltd. India.
- A.D.Helfrick & W.D.Cooper, "Electronic Instruments & Measurement Technique" Prentice Hall of India.
- David A. Bell, "Electronic Instrumentation & Measurement" Prentice Hall of India.
- M.B.Stout, "Basic Electrical measurement" Prentice Hall of India.
- H.S.Kalsi, "Electronic Instrumentation" Tata McGrall Hill.

PRINCIPLES OF ELECTRONICS (EE-1303)

UNIT 1: Diodes-Introduction to pn diode and its applications as rectifier, rectifier as DC Power Supply, Clamper, Clipper, Voltage multiplier etc., Zener diode and its applications as regulator, Tunnel diode and Varactor diode 8(L)

UNIT 2: Transistors-Review of Transistor working, characteristics & its parameters, Transistor as an amplifier, Biasing of bipolar junction transistors, h -parameters & transistor equivalent circuits, small signal single-stage amplifier, frequency response, concept of feedback. 8(L)

UNIT 3: JFET and MOSFET-Basic construction, working, concept of pinch-off, characteristics of JFET, MOSFET (Enhancement and Depletion), FET as a voltage variable resistor 6(L)

UNIT 4: Operational amplifier-Ideal & non-ideal characteristics, concept of summing junction and virtual ground. Application of operational amplifier as: Adder, Subtractor, Differentiator, Integrator, Multiplier, Unity gain amplifier & Logarithmic amplifier 6(L)

UNIT 5: Introduction to Digital Electronics-Review of number systems, complements, codes, Boolean algebra, Logic gates, Minterm and Maxterms, Canonical and Standard forms, Logic functions & Logic circuits. Minimization of Boolean functions using K-map. 6(L)

UNIT 6: Measuring Instruments-Working of Cathode Ray Oscilloscope, Power supply, Multimeter and Function generator. 6(L)

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- Electronic devices and circuit theory by Robert Boylested and Louis Nashelsky
- Electronic principles by Albert Malvino
- Integrated Electronics by Jacob Millman, Chistos C. Halkias
- Digital design by Morris Mano
- Modern Digital Electronics by R. P. Jain
- Modern electronics Instrumentation and Measurement Techniques by A. D. Helfrick and W. D. Cooper

DATA STRUCTURE AND OPERATING SYSTEMS (CS-1302)

UNIT 1: Basic Computer Architecture, Function and structure of Hardware and Software Components, CPU, ALU, Memory, I/O devices, System Software, Application Software. 6(L)

UNIT 2: Introduction, Motivation, and Overview of an Operating System with an emphasis on its role as a Manager of Hardware Resources, History of Computer Hardware (including a review of H/W structures) and how Operating Systems Evolved in tandem with the Hardware. 7(L)

UNIT 3: Programming software (Writing software), Program and Process, Program specifications and design, Abstract data types, Basics of C, Time and space complexity of Programs. 5(L)

UNIT 4: Need of Data Structures, Linear and nonlinear Data structure, Stack, Queue, Tree, Graph, B-tree 5(L)

UNIT 5: Processor and Memory Management, Process Management, Concurrent Process, Semaphores, Fork and Join, CPU Scheduling including Preemptive, and Non-Preemptive, Application of Stack and Queue, Sequential and linked implementation, in designing program for CPU and Disk scheduling, Page Tables, Page Replacement Algorithms. 7(L)

Text/ Reference Books:

- Fundamentals of data structures by Horowitz and Sahni
- Data Structure Using C by Tanenbaum
- Operating System Concepts, Abraham Silberschatz and Peter Galvin

NUMERICAL METHODS AND STATISTICAL TECHNIQUES (MA-1302)

UNIT 1: Algebraic and Transcendental Equations-Errors in numerical computation and their analysis, Bisection method, Iteration method, Newton-Raphson Method, Method of False Position, rate of convergence, Method for complex root, Muller's Method, Quotient Difference method, 8(L)

UNIT 2: Interpolation-Introduction, Errors in Polynomial interpolation, Finite differences, Decision of errors, Newton's formula for interpolation, Gauss, Sterling, Bessel's, Everett's Formula, Interpolation by unevenly spaced points, Lagrange interpolation formula, Divided Difference, Newton's General interpolation Formula. 9(L)

UNIT 3: Curve Fitting, Cubic Spline & Approximation-Introduction, Method of Least Square curve fitting procedures, Fitting a straight line, Curve fitting by sum of exponential, Data fitting with cubic splines, Approximation of functions. 7(L)

UNIT 4: Numerical Integration and Differentiation-Introduction, Numerical differentiation, Picard Iteration Method of Solution, Numerical integration, Trapezoidal rule, Simpson 1/3 rule, Simpson 3/8 rule, Booles & Weddles rule, Euler-Maclaurin's formula, Gaussian Formula, Numerical evaluation of singular integrals. 5(L)

UNIT 5: Numerical Linear Algebra-Numerical techniques for finding solution of system of linear equations and eigen values: Gauss Jordan, Gauss Seidel methods, Power method for estimating eigen values: LU and LL* factorization of matrices. 6(L)

UNIT 6: Statistical Computations-Frequency Chart, Regression Analysis, Least Square fit, Polynomial fit, Linear and Nonlinear Regression, Multiple Regression, Statistical Quality Control Methods. 7(L)

Text/ Reference Books:

- C. F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education
- M.K.Jain, S.R.K.Iyenger and R.K.Jain, Numerical Methods for Scientific and Engineering Computation, Wiley Eastern Ltd.
- S.S Sastry, Introductory Methods of Numerical Analysis, Prentice Hall
- S.Rajasekharan, Numerical Methods for Science and Engineering, S.Chand.
- James I. Buchman and Peter R. Turner, Numerical Methods and Analysis, McGraw-Hills Inc.

ELECTRICAL ENGINEERING MATERIALS AND DEVICES (EE-1304)

UNIT 1: Introduction-Classification of materials on the basis of energy gap, conductors, semiconductors, dielectrics, superconductors, ferroelectrics, pyroelectrics, piezoelectrics, perovskites (titanates, zirconates, hafnates) etc. 2(L)

UNIT 2: Electrical Properties and Conducting Materials-Mechanism of electrical conduction, electron theories of solids, free electron theory, Factors affecting electrical conductivity, Wiedemana-Franz law, Lorentz number, thermoelectric properties, characteristics, properties and examples of high voltage conducting materials, high and low resistance materials. Contact fuse and filament materials. Conductors, cable & wire materials. Solder, sheathing, and sealing materials. Electrical properties of these materials. Related calculations. 4(L)

UNIT 3: Electronic Properties and Semiconducting Materials-Energy band theory, Brillouin zone theory, Fermi energy level, effective mass, concept of doping, energy diagrams, types of semiconductors, semiconductor compounds and alloys and their properties. structures of semiconductors, amorphous semiconductor, Junction properties, materials for different devices. Related calculations. 4(L)

UNIT 4: Superconductivity and Superconducting Materials-Concept of superconductivity, Phenomenon, properties of superconductors, Meissner effect, Critical magnetic field & critical temperature. Types of superconducting materials. Type I

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calculations. 5(L)

UNIT 5: Dielectric Properties and Insulating Materials-Dielectric constant, dielectric strength and dielectric loss. Polarizability, mechanism of polarization, factors affecting polarization, polarization curve and hysteresis loop, types of dielectric materials-solid, liquid and gaseous types; natural and synthetic types. Characteristic, properties, and applications of different types of mica, transformation oil, vacuum etc. Behavior of polarization under impulse and frequency switching. Ferroelectrics, piezoelectric, pyroelectrics, electrostriction effect. Clausius -Mosotti equation. Related calculations. 5(L)

UNIT 6: Magnetic Properties and Magnetic Materials-Origin of magnetism, basic terms and properties. Types of magnetic materials. Introduction to dia, para, ferro, antiferro and ferrimagnetic materials, Curie temperature. Laws of magnetic materials. Domain theory, Domain growth and domain wall rotation, Magnetic anisotropy. Magnetostriction & its mechanism. Ferrites, spinels & garnets. Ferromagnetic domains, magnetic hysteresis. Magnetoplumbite, hexaferrite. Magnetic hysteresis loop, hysteresis loss. Hard and soft magnetic materials. Textured magnetic materials, Oxide magnetic materials. Magnetic tape, Magnetic bubble, Magnetic glasses, Colossal magneto- resistance. High energy hard magnetic materials, Commercial magnetic materials such as Supermalloy, Alnico, Cunife, Cunico etc., Conventional and non-conventional applications, characterisation of magnetic materials, Recent developments. Related calculations. 8(L)

UNIT 7: Optical and Optoelectronic Materials-Optical properties, Solar cell, Principles of photoconductivity. simple models, effect of impurities. Principles of luminescence, types; semiconductor lasers; LED materials, binary, ternary photoelectronic materials, effect of composition on band gap, crystal structure and properties. LCD materials, photo detectors, application of photoelectronic materials, introduction to optical fibers, light propagation, electro-optic effect, Kerr effect, Pockel's effect. 5(L)

UNIT 8: Recent Advances. Developments and Researches-Spintronics: materials and devices, Diamond semiconductors, Ferromagnetic semiconductors, Giant magneto- resistance (GMR), Left handed materials, Left and right handed (LH & RH) composite materials, Diluted magnetic semiconductor etc. 3(L)

UNIT 9: Fabrication of Electronic and Opto-electronic Devices-Methods of crystal growth, zone refining 2(L)

UNIT 10: Term Paper-On application/recent advances based on literature survey and/or lab/industry visit(s) 2(L)

Text/ Reference Books:

- L. Solymar, D. Walsh, 'Electrical Properties of Materials', Oxford University Press, USA, 2004. ,
- David C. Jiles, 'Introduction to the Electronic Properties of Materials', Taylor and Francis, 200 I.
- D.C. Jiles, 'Introduction to Magnetism and Magnetic Materials', Springer, 1990.
- M.Tech. (Material Science and Engineering) 2010-11 21/21
- Manijeh Razeghi, 'Optoelectronic Materials and Device Concepts', SPIE-International Society for Optical Engine, 1991.
- Rose R.M., Shepard L.A., Wulff J., 'Structure and Properties of Materials', Volume IV, 'Electronic Properties', 4th Edition, 1984.
- K.M. Gupta, 'Electrical Engineering Materials', 3rd Edition, Umesh Publication, Delhi, 2005.
- B.D. Cullity, 'Introduction to Magnetic Materials', Addison-Wesley publishing company, California, London, 1972.
- Goldman, 'Modem Ferrite Technology', Van Nostrand, New York, 1990.
- J.P. Jakubovics, 'Magnetism and Magnetic Materials', Institute of Materials, London, 1994.
- Tareev B., 'Physics of Dielectric Materials', MIR, 1975.
- Rolf E. Hummel, 'Electronic Properties of Materials', Springer, 2004.
- Safa O. Kasap, 'Principles of Electronic Materials and Devices', McGraw-Hili, 2005.
- Irene, 'Electronic Materials Science', Wiley-Interscience, 2006.
- Jasprit Singh, 'Smart electronic materials: Fundamentals and Applications', Cambridge University Press, 2005.
- M.E. Lines, A.M. Glass, 'Principles and Applications of Ferroelectrics and Related Materials', Oxford University Press, USA, 200 I.
- Dekker A.J., 'Solid State Physics', Macmillan India, 1995.
- Robert C., O' Handley, 'Modem Magnetic Materials: Principles and Applications', Wiley-Interscience, 1999

NETWORKS & SYSTEMS (LAB) (EE-1351)

Experiments 1: To verify Thevenin's Theorem.

Experiments 2: To verify Norton's theorem.

Experiments 3: To verify maximum power transfer theorem.

Experiments 4: (a) To verify superposition theorem using D. C. Sources.

(b) To verify superposition theorem using A. C. Sources.

Experiments 5: Transient response of the RC circuit. To study the transient response of the RC circuit with step input with different values of R. To verify the calculated values of different parameters with that of measured values.

Experiments 6: Frequency response of RLC series circuits. To study the variation of current and capacitor voltage with change in frequency for RLC series circuit.

Experiments 7: To study the variation of current and capacitor voltage with change in frequency for RLC parallel circuit.

Experiments 8: To find out the frequency response of Twin - T Notch Filter.

Experiments 9: To determine z and h parameter of two port networks and compute the other parameter.

Experiments 10: Verification of parameter properties in interconnected two port networks (series, parallel & cascaded).

PD/10

Experiments 1: Range Extension of Ammeter & Voltmeter.

Experiments 2: Calibration of

(a) Ammeter for application as Voltmeter and

(b) Voltmeter for application as Ammeter.

Experiments 3: Calibration of a given Sine-Responding Voltmeter for other types of Waveforms (such as Squire & Rectangular).

Experiments 4: Measurement of Power in a 1-Phase load using 3-Voltmeter method and its Calibration using Wattmeter.

Experiments 5: Calibration of Wattmeter by Direct-load test.

Experiments 6: Calibration of 3-Phase Energymeter.

Experiments 7: Measurement of Signal Amplitude, Frequency and Phase using C.R.O.

Experiments 8: Measurement of capacitance and inductance using A.C. bridges

Experiments 9: Measurement of Earth-Resistance.

Experiments 10: Measurement of High Resistance using Insulation Tester and its Study.

PRINCIPAL OF ELECTRONICS LAB (EE-1353)

Experiments 1: Familiarization to basic test and measuring instruments like Cathode Ray Oscilloscope (CRO), Function Generator, Power supply, Bread board etc.

Experiments 2: To measure the frequency and amplitude of various waveforms using CRO.

Experiments 3: To verify the truth tables of different logic gates by using ICs and implement different logic gates using IC 7400.

Experiments 4: To study the *pn* junction diode characteristics under forward and reverse bias conditions.

Experiments 5: To study the application of a zener diode as voltage regulator.

Experiments 6: To determine the ripple factor of Half-Wave and Full-wave (Bridge) rectifiers.

Experiments 7: To observe the clipping wave forms in different clipping configurations.

Experiments 8: To observe the clamping wave forms in different clamping configurations.

Experiments 9: To determine the CE (Common Emitter) characteristics of a given BJT.

Experiments 10: To plot the drain and transfer characteristics of a given FET and to find drain resistance.

Experiments 11: To verify the addition and subtraction operation using op-amp 741.

DATA STRUCTURE AND OPERATING SYSTEMS (LAB) (CS-1354)

Experiments 1: a) Write a program to implement linear search in a single dimensional array.

b) Write a program to implement linear search in a 2- dimensional array, when array is stored in a row major order.

c) Write a program to implement linear search in a 2- dimensional array, when array is stored in a column major order.

Experiments 2: a) Write a program to implement binary search using iteration.

b) Write a program to implement binary search using recursion.

Experiments 3: a) Write a program to implement bubble sort and insertion sort.

b) Write a program to implement Merge Sort.

Experiments 4: Write a program to implement Quick Sort.

Experiments 5: a) Write a program to implement a singly link list.

b) Write a program to implement a doubly link list.

c) Write a program to reverse a doubly link list.

Experiments 6: Write a program to implement a binary search tree.

Experiments 7: Write a program to simulate preorder, inorder and postorder traversal over a binary search tree.

Operating Systems

Experiments 8: Write a program to implement

a) Creation of file

b) Read contents of a file

c) Write to a file

d) Link and unlink a file

e) Copy file

f) Read contents of a file in a reverse order

Experiments 9: Write a program to simulate the following CPU Scheduling Algorithms:

a) FCFS

b) SJF

c) Priority

d) Round Robin

Experiments 10: Write a program to simulate Bankers algorithm for Deadlock Avoidance.

Experiments 11: Write a program to simulate the following Page Replacement Algorithms:

a) FIFO

b) LRU

Page

UNIT 1: Transformer principles, Construction details, Equivalent circuits (Exact and approximate), OC & SC test, Voltage regulation, Efficiency, Losses in Transformer, Separation of hysteresis and eddy current losses, All-day efficiency, Three-phase transformers: Connections, Parallel operation (conditions, equal and unequal voltage turn ratio), Division of load between parallel transformers, Polarity test, Sumpner's test. 14(L)

UNIT 2: Electromechanical Energy Conversion-Principles of electromechanical energy conversion, Singly- and multiply-excited systems- Energy, co-energy, Determination of Torque/Forces from energy/co-energy 5(L)

UNIT 3: Basics of rotating machines-Introduction to AC machine- Stator & rotor (cylindrical and salient), DC machines- Field & Armature, Flux lines due to field and stator excitation, Windings layout, connections, Armature windings- Simplex-Lap and wave types. 4(L)

UNIT 4: DC machines-Construction details, Speed and voltage expression, Torque production in D.C. machines, Types according to excitation (with circuit representation and equations), Magnetization curve- effect of field resistance and speed, Series, shunt and compound machines: DC generator & DC motor- Characteristics, Speed control and starting methods, Efficiency, Armature reaction: reduction and compensation, Commutation action, Testing of DC machines: Hopkinson's test, Swinburne's test, Braking methods. 16(L)

Text/ Reference Books:

- E. Fitzgerald, Charles Kingsle, Jr. Stephen D. Umans, Electric Machinery, Tata McGraw Hill.
- Stephen J Chapman, Electrical Machinery and Power System Fundamentals, McGraw-Hill Higher Education.
- P.S. Bhimbhra, Generalized Theory of Electrical Machines, Khanna Publications, New Delhi
- J. Nagrath, D. P. Kothari, Electric Machines, TMH Publications, New Delhi
- G. K. Dubey, Fundamental of Electrical Drives, Narosa Publishing House, New Delhi.

BASIC CONTROL SYSTEM (EE-1402)

UNIT 1: Introduction to Control System-Introduction, Closed-loop control versus open-loop control 2(L)

UNIT 2: Mathematical Modelling of Control Systems-Control hardware and their models, various physical system modeling, Block diagram reduction, Signal flow graph, Basic characteristics of Feedback, Modes of feedback control: proportional, integral and derivative, PID, The performance of Feedback systems 10(L)

UNIT 3: Transient Response Analysis-Time response analysis, Concepts of Stability and Routh's Stability Criteria, Steady-state error analysis 6(L)

UNIT 4: Root-Locus Analysis& the Frequency-Response Method-Root-locus plots, Rules of constructing Root Loci, Root-locus analysis of control systems 4(L)

UNIT 5: Frequency Response Analysis- Bode plots, Polar plots, The Nyquist Stability Criterion and Stability Margins, Closed loop frequency response (M & N circles) 7(L)

UNIT 6: Design and Compensation Techniques-Design considerations, Lag Compensation, Lead Compensation, Lag-lead Compensation, Compensator Design Using Root-locus and Frequency Response methods 10(L)

Text/ Reference Books:

- Kuo B.C., "Automatic Control System", Prentice Hall.
- Ogata K., "Modern Control Engineering", Prentice Hall.
- Nagrath & Gopal, "Modern Control Engineering", New Ages International.
- Stephani R.T., "Design of Feedback Control Systems", Oxford University Press.

POWER SYSTEM –I (EE-1403)

Unit 1: Introduction to Power system: Single line diagram of power system, Brief Description of Power system elements such as Synchronous Machine, Transformer; Busbar, Circuit Breaker etc., Per unit system and their application to power system network, Different kinds of supply system and their comparison; Choice of transmission voltage, conductor size, Kelvin's law 2(L)

Unit 2: Transmission lines: Conductor materials, types of conductors, Parameters-Resistance, Inductance and capacitance of lines, Current distortion effects-Skin, Proximity etc., Mathematical Analysis of transmission lines., Interference with communication lines, Reduction methods; 8(L)

Mechanical Design: Main components of overhead line, line supports, sag, stringing chart, vibrations, 2(L)

Insulators: types, material, potential distribution, string efficiency, methods of improvement of string efficiency, causes of failure, testing of insulators, 3(L)

Corona: formation, critical disruptive voltage, visual disruptive voltage, power losses, factors affecting corona, reduction methods 4(L)

Unit 3:Cables: types and applications, construction, Potential distribution; Equalizing the potential, Insulation Resistance, Capacitance of single phase and three phase cables, Dielectric Loss 4(L)

Unit 4: Load flow Analysis: Complex power, Y bus and Z bus formulation, Load flow analysis-Newton Raphson and fast decoupled methods, Methods of voltage control 5(L)

Unit 5: Power System Stability: Dynamic stability, transient stability, equal-area criterion, Numerical Solution and improvement of system stability for single machine and multi machine. 4(L)

Unit 6: Neutral grounding: Necessity and methods of neutral grounding, Grounding Practice. 2(L)

Text/ Reference Books:

- Power System analysis, John.J.Grainger & W. D. Stevenson, Mc Graw Hill
- Modern Power System Analysis, D.P.Kothari, & I.J. Nagarth, Tata MCGraw-Hill Publishing Company Limited, New Delhi,2003
- Electric Power System, C.L.Wadhwa, New Age International Ltd., 2000
- Power system stability and control, Prabha Kundur, Power system Engineering Series
- Power System Stability, Paul.M.Anderson, Electrical Engineering Power system Series.
- Power System analysis, Hadi Sadat, Second edition, 2002, Mc Graw- Hill
- Stephen J. Chapman, Electric Machinery and Power System Fundamentals, McGraw Hill, New York, 2002

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UNIT 1: COMBINATIONAL LOGIC -Introduction, Design Procedure, Adders, Subtractors, Code Converters, Magnitude Comparator, BCD to Seven Segment decoder, Parity generator and Checker, Decoders, Encoders, Multiplexers, Demultiplexers, ROMs, Design of the circuits using Decoders, Multiplexers, ROMs.	7(L)
UNIT 2: PROGRAMMABLE LOGIC DEVICES -Programmable Logic Array (PLA), Programmable Array Logic (PAL), Design of the circuits using PLA and PAL, Field Programmable Gate Array (FPGA).	5(L)
UNIT 3: SEQUENTIAL LOGIC -Introduction, Flip-Flops, Flip-Flop Excitation Tables, Triggering of Flip-Flops, Analysis of Clocked Sequential Circuits, State Reduction and Assignment, Race Around Condition, Master-Slave flip-flops, Conversion design of flip-flops.	4(L)
UNIT 4: Design of synchronous & ripple counters, Mod-k or Divide-by-k counters, Decade counter, BCD Counter, UP/DOWN Counters, Lock Out problem, Design with State Equations.	6(L)
UNIT 5: Shift register, Serial to Parallel Converter, Parallel to Serial Converter, Ring counters, Twisted-ring counter, Sequence Generator.	3(L)
UNIT 6: TIMING CIRCUITS: Multivibrators (Monostable, Astable.)	2(L)
UNIT 7: LOGIC FAMILIES -Characteristics of Digital ICs, DTL, TTL, ECL, MOS Logic & CMOS Logic, Calculation of noise margins and fan-out.	8(L)
UNIT 8: INTRODUCTION to VHDL - Basics, Simulation of Multiplexers, Demultiplexers etc	3(L)

Text/ Reference Books:

- M. Morris Mano: Digital Design, Third Edition, Prentice Hall
- R. P. Jain: Modern Digital Electronics, Third Edition, TMH
- Taub and Schilling: Digital Integrated Electronics, McGRAW HILL
- Sandige: Digital concept Using standard ICs
- R. J. Tocci: Digital Systems: Principles and Applications, Fourth Edition, Prentice Hall

ELECTRO-MAGNETIC THEORY (EC-1403)

UNIT 1: INTRODUCTION - Review of scalar and vector field, Vector representation of surface, Physical interpretation of gradient, divergence and curl, Divergence theorem, Stokes theorem, Different coordinate systems.	4(L)
UNIT 2: ELECTROSTATIC FIELDS - Electric field due to point, surface and volume charges, Electrostatic potential for different charge distributions, Gauss's law, Solution of Laplace's and Poisson's equation in one dimension, Method of images applied to plane boundaries, Electric flux density, Boundary conditions, Capacitance, Electrostatic energy.	8(L)
UNIT 3: MAGNETOSTATIC FIELDS - Biot- Savart's law, Ampere's law, magnetic flux density, Boundary conditions, Faraday's law, Energy stored in magnetic field, Scalar and Vector Magnetic Potential.	8(L)
UNIT 4: TIME VARYING ELECTROMAGNETIC FIELDS -Continuity equation, Displacement current, Maxwell's equations in point form and integral form, Retarded potential, Plane wave equation and its solution in conducting and non conducting media, Phase velocity, Group velocity, Plane waves in lossy dielectrics, Propagation in good conductors: skin effect, impedance of conducting medium, Polarization, Reflection and Refraction of plane waves at plain boundaries, Poynting Vector, Poynting theorem and power considerations.	8(L)
UNIT 5: TRANSMISSION LINES -Transmission line equations, parameters- primary and secondary constants, Analogy of transmission lines with δ e.m. waves, determination of α , β , γ and v_p , characteristics impedance, Input impedance of a lossless line, open and short circuited lines, distortionless lines, reflection coefficient and standing wave ratio, matched transmission line, Impedance matching, Smith chart and its applications.	8(L)
UNIT 6: COMPUTATIONAL ELECTROMAGNETICS -Finite element method (FEM) and Finite difference time domain method (FDTD)	4(L)

Text/ Reference Books:

- Hayt William., "Engineering Electromagnetics", Tata Mc Graw Hill
- Matthew N.O. *Sadiku* 'Elements of Electromagnetics'
- Kraus J.D., "Electromagnetics" Mc Graw Hill
- Complex Electromagnetic Problems and Numerical Simulation Approaches, Levent Sevgi, IEEE Press and John Wiley, New York, 2003.
- Jordan E.C. and Balmain K.G., "Electromagnetic waves and Radiating Systems" PHI
- Plonsey R. and Collin R.E., "Principles and Applications of Electromagnetic fields", Tata Mc Graw Hill.

ELECTRICAL MACHINE-I (LAB) (EE-1451)

Experiments 1: To obtain magnetization characteristic of a DC. Shunt generator.

Experiments 2: To obtain load characteristic of a D.C. shunt generator.

Experiments 3: To obtain speed torque characteristic of a D.C. series motor.

Experiments 4: To obtain speed torque characteristic of a D.C shunt motor.

Experiments 5: Speed control of a DC shunt motor by armature and field control

Experiments 6: To perform load test on a single phase transformer

Experiments 7: To perform polarity & ratio test on a single-phase transformer and Parallel operation of two single-phase transformers.

Experiments 8: To determine efficiency & regulation of a one-phase transformer by O.C. & S.C. Tests.

Experiments 9: To study 3-phase to 2-phase conversion by Scott connection.

Experiments 10: To obtain efficiency & regulation of two single-phase transformers by Sumpner's (back to back) test.

Prusa

A-EXPERIMENT BASED LABORATORY PRACTICAL

- Experiments 1:** Determine the transfer function of a separately excited DC generator.
- Experiments 2:** Obtain the frequency response characteristics of the first and second order active LPF.
- Experiments 3:** Obtain the graph between output errors and angular position difference of a given potentiometer error detector.
- (a) When the excitation is DC.
 - (b) When the excitation is AC.
- Experiments 4:** Determine the time response of different order of system using linear system simulator.
- (a) Determine the time constant of first order system for open loop system
 - (b) Determine the time constant of type-1 system for closed loop system.

Experiments 5: Determine the frequency response of given open loop linear system and time response of closed loop system.

Experiments 6: Obtain the frequency response of LAG and LEAD Compensator.

Experiments 7: To draw the frequency response of a given L,R,C network theoretically and to capture the time response for a given square wave input at 50Hz (power supply).

Experiments 8: Use Lag and Lead compensator with the given closed loop system and show that the lead compensator improves transient performance and lag compensator improves the steady state characteristics.

B. SIMULATION BASED LABORATORY PRACTICAL (Using MATLAB)

Experiments 9: To study the performance of PID controller under closed loop with open loop transfer function

$$G(s) = \frac{1}{LCs^2 + RCs + 1}$$

Where L=1mH, C=5μF, R=5Ω.

Experiments 10: Use MATLAB to draw the bode plot and determine GM and PM for the given open loop transfer function and comment on stability.

I. $G(s) = \frac{10}{s(s+2)}$

II. $G(s) = \frac{20(0.5s+1)}{s^2(0.2s+1)}$

III. $G(s) = \frac{50}{s^2+2s+5}$

Experiments 11: Use MATLAB to draw the root locus for the unity feedback system with the following open loop transfer function.

$$G(s) = \frac{k(s+6)}{s(s+4)(s^2+4s+8)}$$

Determine k for $\xi=0.5$ using root locus. At this value of k, obtain the closed loop transfer function using function 'feedback()'. Obtain the step response of closed loop system and verify the value of ξ using measurement of peak overshoot. Also obtain the impulse and ramp response of the closed loop system.

Commands: rlocus, feedback, step, impulse, lsim.

Experiments 12: Represent the following system in the state space form using MATLAB 'ss' function.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -3 & -4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \end{bmatrix} u$$

- a) Find out the time response for unit step input for initial condition of $x_1(0)=-1, x_2(0)=2$.
- b) Test for controllability and observability.
- c) Test the stability from eigenvalue of A-matrix.

Commands: ss, step, ctrb, obsrv, eig.

POWER SYSTEM -I (LAB) (EE-1453)

- Experiments 1:** Determination of positive, negative and zero sequence impedances of a three phase transformer.
- Experiments 2:** Determination of ABCD parameters of a transmission line model.
- Experiments 3:** To calculate the voltage regulation of a transmission line.
- Experiments 4:** Calculate the string efficiency of a suspension type insulator with and without guard ring.
- Experiments 5:** To determine the dielectric strength of transformer oil.
- Experiments 6:** To study the flow of active and reactive power using an inter-connector.
- Experiments 7:** To study the effect of load power factor on power system stability.
- Experiments 8:** Determination of R, L and C parameters of a transmission line model and observing the Ferranti effect.

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- Experiments 1:** Verification of operation of Full Adder and Full Subtractor.
- Experiments 2:** Design & verification of 4-bit binary adder/subtractor using binary adder IC.
- Experiments 3:** Realization of operation of full adder and full subtractor using IC 74151/74153 MUX.
- Experiments 4:** Design & verification of full adder and full subtractor using an inverted output 3 to 8 line decoder.
- Experiments 5:** Design and verification of operation of a BCD Adder using IC 7483.
- Experiments 6:** Realization of 4 X 1 MUX using basic gates.
- Experiments 7:** Verification of operation of BCD to Seven segment code conversion using IC 7447.
- Experiments 8:** Verification of Truth Tables of SR & D Flip flops.
- Experiments 9:** Verification of Truth Tables of Master Slave JK Flip-Flop.
- Experiments 10:** Design of MOD-8 UP/Down synchronous counter.
- Experiments 11:** Design of BCD ripple counter.
- Experiments 12:** Design of Universal Shift Register.
- Experiments 13:** Design of a sequential circuit from given state diagram.
- Experiments 14:** Design and verification of Astable Multivibrator using IC 555.
- Experiments 15:** Design and verification of Monostable Multivibrator using IC 555.
- Experiments 16:** Implementation of Basic Combinational and sequential circuits using VSM (Virtual System Modelling)
- Experiments 17:** Implementation of Basic Combinational and sequential circuits using VHDL

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UNIT 1: Synchronous machine-Construction features, EMF eqn. Winding coefficients/factors, Harmonics in emf induced, Rotating magnetic field including rotating phasors of MMF, OC & SC characteristics, Short circuit ratio, Armature reaction in synchronous machine, Equivalent circuit model and analysis (Regulation), Armature reaction, Voltage regulation, Flux and MG wave of salient rotor (d-and q-axis reactance), Power-angle expression (Cylindrical and salient rotor), Operating characteristics as generator & motor, V-curves, Inverted V-curves, Starting methods of synchronous motors, Excitation systems-basic types (DC and AC) and their block diagram, Synchronization, Parallel operation- Active and reactive power control, Synchronous motor as condenser. 17(L)

UNIT 2: Polyphase induction machine-Introduction, Construction features, Generating principle, Emf expression, Equivalent circuit and its analysis (torque-slip expression), Losses and efficiency, T-s characteristics, Effect of rotor resistance on the same characteristic, No-load and block rotor test, Starting methods, Speed control, Deep bar, double cage IM motor and their T-s characteristic, Induction generator driven by Wind turbine. 16(L)

UNIT 3 Single phase induction motors: Construction details, Double revolving field theory, Equivalent circuit, starting methods along with performance characteristics. 7(L)

Text/ Reference Books:

- E. Fitzgerald, Charles Kingsle, Jr. Stephen D. Umans, Electric Machinery, Tata McGraw Hill.
- Stephen J Chapman, Electrical Machinery and Power System Fundamentals, McGraw-Hill Higher Education.
- P.S. Bhimbhra, Generalized Theory of Electrical Machines, Khanna Publications, New Delhi
- J. Nagrath, D. P. Kothari, Electric Machines, TMH Publications, New Delhi.
- G. K. Dubey, Fundamental of Electrical Drives, Narosa Publishing House, New Delhi.

ADVANCE CONTROL SYSTEM (EE-1502)

UNIT 1 Introduction-Signal Processing in Digital Control: Introduction to digital control systems, Principles of signal conversion, Sampling and reconstruction, Principles of discretization, Impulse and step invariance, Finite difference approximation, Bilinear transformation 6(L)

UNIT 2 Models of Digital Control Devices and Systems : Mathematical models discrete time signals and systems, Transfer function and system response, Stability on the z-domain, Closed loop digital control systems, System with dead time, Commonly used digital devices, Examples of industrial control systems 8(L)

UNIT 3 Design of Digital Control Algorithms: Transform design of digital controllers, Root locus methods and frequency domain method 5(L)

UNIT 4 Control System Analysis Using State Variable Methods : State variable representation of continuous and discrete time systems, Conversions state variable models to transfer function models, Conversion of transfer function to canonical models, Eigen values and eigenvectors, Solution of state equations, Sampled continuous-time systems, Controllability and Observability properties 12(L)

UNIT 5 Design of Control Systems by State Variable Methods: Pole-placement design, Observer design, Lyapunov Stability analysis 8(L)

Text/ Reference Books:

- M.Gopal, "State space and Digital Control System", Wiley Eastern Ltd.
- Ogata K., "Discrete-Time Control Systems", Prentice-Hall, 1987.
- Kuo, B.C., "Digital Control System", Oxford University Press, second edition, 1992

POWER SYSTEM - II (EE-1503)

UNIT 1: Faults in Power System: Fundamental principle of fuses, Symmetrical components, Symmetrical and Unsymmetrical fault, Fault calculation in Power System network, Switch gear and substation apparatus, Relays and circuit breakers, plug setting. 9(L)

UNIT 2: Short circuit studies: Calculation using bus impedance method, Algorithms for calculating system conditions after occurrence of fault, Comparison between symmetrical component and phase co-ordinate methods. 6(L)

UNIT 3: Protection systems: Classification of protection schemes, Transformer protection, Generator protection, Role of voltage and current transformer in power system protection, Relay co-ordination, Over current protection schemes for feeders. 8(L)

UNIT 4: Numerical Relaying: Introduction to numerical relaying, Numerical relaying algorithms for over current distance and differential protection with application to transmission system, transformer and bus bar protection. 5(L)

UNIT 5: Optimal Power Flow: Reactive power control for loss minimization, gradient method for optimal power flow, Lagrange function for optimal load flow, computational procedures, conditions for optimal load flow, implementation of optimal conditions. 6(L)

UNIT 6: High Voltage Transmission: Introduction to extra and ultra H.V.A.C., Transmission and High Voltage D.C. Transmission – Kind of D.C. Link, Merits and Demerits of HVDC transmission, Introduction to FACTS. 4(L)

UNIT 7: Advanced topics: SCADA and Computer control voltage, Expert system applications to power systems. 2(L)

Text/ Reference Books:

- Analysis of Faulted Power Systems, P.M. Anderson, Wiley.
- Power System Protection Static Relays, T.S.M. Rao, Tata McGraw Hill.
- Power System Protection and SWITCHgear, B. Ravindranath, M. Chander, New age international.
- Digital Power System Protection, R.P. Singh, PHI.
- Power System Restructuring and Deregulation, L.L. Lai, Wiley

UNIT 1: INTRODUCTION TO COMMUNICATION SYSTEMS-Elements of a General Communication System, Modulation, Need for Modulation, Fundamental Limitations of a Communication System, Analog and Digital Signals and Systems, Baseband and Bandpass Communication, Introduction to Radio Communication, Analog Modulation Techniques: Amplitude Modulation, Frequency Modulation and Phase Modulation, Model of a Digital Communication System, Elements of a Digital Communication System, Logarithmic Measure of Information, Entropy and Information Rate, Source Coding, Fixed and Variable Length Code Words, Mutual Information and Channel Capacity of a Discrete Memoryless Channel, Hartley-Shannon Law. 10(L)

UNIT 2: Pulsemodulation and waveform coding techniques-

Sampling and Reconstruction of Analog Signals, Types of Pulse Modulation System: PAM, PWM and PPM, Quantization, Encoding, Pulse Code Modulation (PCM), Bandwidth of PCM, Differential PCM, Delta Modulation (DM), Threshold of Coding and Slope Overload, Adaptive Delta Modulation (ADM), ADPCM, Comparison of PCM and DM Line Coding and its Properties, NRZ and RZ Types, Signaling Format for Unipolar, Polar, Bipolar (AMI), and Manchester Coding, Digital Multiplexing. 10(L)

UNIT 3: DIGITAL MODULATION TECHNIQUES-Types of Digital Modulation, Waveforms for Amplitude, Frequency and Phase Shift Keying, Method of Generation and Detection of Coherent and non-coherent Binary ASK, FSK and PSK, Differential Phase Shift Keying (DPSK), Quadrature Modulation Techniques: Quadrature Amplitude Modulation (QAM) and Quadrature Phase Shift Keying (QPSK), Minimum Shift Keying (MSK) – Generation and detection. 10(L)

UNIT 4: COMPUTER NETWORKS-Local Area Networks: LAN architecture, Bus/Tree LANs, Ring LANs, star LANs, wireless LANs. LAN Systems: Ethernet and Fast Ethernet, CSMA/CD, Token Ring and FDDI, 100VG-Any LAN, ATM LAN, Fiber Channel, Wireless LAN Bridges: Bridge Operation, Routing with Bridges, ATM LAN Emulation. Internetworking: Principles of Internetworking, connectionless Internetworking, The Internet Protocol, Routing Protocol, IPv6, ICMPv6. 10(L)

Transport Protocol: Transport Services, Protocol Mechanism, TCP, UDP.

TEXT BOOK: B. Sklar, "Digital Communications: Fundamentals and Applications," Pearson Education.

Behrouz A. Forouzan, "Data Commn& Networking," TMH

REFERENCES:

B.P. Lathi "Modern Digital and Analog Communication Systems," Oxford University Press.

S. Haykin, "Digital Communication," John Willey.

T. Schilling, "Principles of Communication Systems," TMH.

J.J. Proakis, "Digital Communications," McGraw Hill.

A.B. Carlson, "Communication Systems," TMH.

G. Kennedy, "Electronic Communication Systems," TMH.

PRINCIPLES OF MANAGEMENT (HS-1501)

UNIT 1: Introduction to Management-Definition of Management – Science or Art – Management and Administration, Functions of Management – Types of Business Organization. Levels of management and Managerial skills 5(L)

UNIT 2: School of Management Thoughts: Evolution of Management thoughts, classical approach, neo- classical approach, contribution of Taylor, Weber and Fayol, modern approach. 6(L)

UNIT 3: Planning Nature & Purpose – Steps involved in Planning ,Objectives, Setting Objectives, Process of Managing by Objectives ,Strategies, Policies & Planning Premises Forecasting Decision-making. 8(L)

UNIT 4: Organizing Nature and Purpose – Formal and informal organization – Organization Chart – Structure and Process – Departmentation by difference strategies – Line and Staff authority – Benefits and Limitations – De-Centralization and Delegation of Authority – Staffing – Selection Process-Techniques-HRD-Managerial-Effectiveness. **Directing:** Scope – Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment – Communication – Process of Communication – Barriers and Breakdown – Effective Communication – Electronic media in Communication. 11(L)

UNIT 5: Controlling-System and process of Controlling – Requirements for effective control – The Budget as Control Technique – Information Technology in Controlling – Use of computers in handling the information – Productivity – Problems and Management – Control of Overall Performance. Coordination. 5(L)

UNIT 6: Organisational Behaviour- Organisational change, Conflict Management and Stress Management, **Functional management:** Human Resource Management, Financial management, Marketing Management. 5(L)

Text/Reference Books:

- Tripathy PC and Reddy PN, "Principles of Management", Tata McGraw-Hill, 1999.
- Decenzo David, Robbin Stephen A, "Personnel and Human Reasons Management", Prentice Hall of India, 1996
- JAF Stomer, Freeman R. E and Daniel R Gilbert, "Management", Pearson Education, Sixth Edition, 2004.
- Fraidoon Mazda, "Engineering Management", Addison Wesley, 2000.
- Harold Kooritz & Heinz Wehrich "Essentials of Management", Tata McGraw-Hill, 1998
- Joseph L Massie "Essentials of Management", Prentice Hall of India, (Pearson) Fourth Edition, 2003

AC ELECTRIC MACHINE (LAB) (EE-1551)

Experiments 1: Determination of equivalent circuit of a three phase induction motor from light running and blocked rotor test.

Experiments 2: Determination of equivalent circuit of a single phase induction motor from light running and blocked rotor test.

Experiments 3: Speed control of induction motor by voltage and frequency control

Experiments 4: Determination of voltage regulation of an alternator by synchronous impedance method and Potier triangle method

Experiments 5: Determination of losses and efficiency of an alternator.

Experiments 6: Determination of V-curves of a Synchronous motor

Experiments 7: Determination of direct axis and quadrature axis reactance of a salient pole alternator

Prima

ADVANCE CONTROL SYSTEM (LAB) (EE-1552)
MATLAB BASED LABORATORY EXERCISE

Experiment 1: Obtain the state space model of a given RLC series circuit and plot unit step response of the system with following data. $V_{in}=5$ V, $L = 5$ mH, $R = 3$ Kohm, $C = 1$ microF

Experiment 2: For a given state space model

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \\ \dot{x}_4 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & -0.1618 & 2.6727 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & -0.4545 & 3.11818 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} + \begin{bmatrix} 0 \\ 1.6182 \\ 0 \\ -4.5455 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \end{bmatrix} u$$

- a) Find the Transfer function of the system
- b) Check the controllability, Observability and stability of the system.

Experiment 3: Consider the following MIMO transfer function matrix:

$$G(s) = \begin{bmatrix} 1/(s+1) & 0 & (s-1)/[(s+1)(s+2)] \\ -1/(s-1) & 1/(s+2) & 1/(s+2) \end{bmatrix}$$

Using MATLAB convert this to state space and find

- a) Unit step, impulse, ramp response for the above system.
- b) Check the controllability and observability.
- c) Comment on the stability of the system

Experiment 4: Consider the continuous-time linearised model of twin rotor MIMO system given:

$$A = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 \\ -4.7059 & -0.0882 & 0 & 0 & 1.3588 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & -5 & 1.617 & 4.5 \\ 0 & 0 & 0 & 0 & -0.9091 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 \end{bmatrix}, B = \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 1 & 0 \\ 0 & 0.8 \end{bmatrix} \text{ and } C = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \end{bmatrix}$$

- a) Discretize the system for $T=0.5$ sec. and represent the system in discrete-time state space form.
- b) Design a state feedback controller which will place the close loop poles at $-1/2 \pm j/4$, $1/2 \pm j/4$, $1/2$ and $-1/2$.

Experiments 5: Consider the coupled mass system shown below under the influence of applied force $u(t)$. The system has equation of motion

$$My'' + B(y' - d') + K(y - d) = u$$

$$Md'' + B(d' - y') + K(d - y) = 0$$

If we assume the measurable outputs are the displacements d & y the state and output equations are:

$$A = \begin{bmatrix} 0 & 1 & 0 & 0 \\ -K/m & -b/m & K/M & b/M \\ 0 & 0 & 0 & 1 \\ K/M & b/M & K/M & b/M \end{bmatrix}; B = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1/M \end{bmatrix}; C = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

Where, $x = \begin{bmatrix} d \\ d' \\ y \\ y' \end{bmatrix}$; $M=1$; $m=0.1$; $K=0.091$; $b=0.0036$.

- a) Discretize the system for $T_s = 0.4$ sec.
- b) Design a deadbeat controller.

Experiments 6: Consider the inverted pendulum system given:

$$\dot{x} = Ax + Bu$$

$$y = Cx$$

$$\text{with, } A = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 4.4537 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ -0.5809 & 0 & 0 & 0 \end{bmatrix}; B = \begin{bmatrix} 0 \\ -0.3947 \\ 0 \\ 0.9211 \end{bmatrix}; C = [0 \ 0 \ 1 \ 0]$$

Determine:

- a) Controllability and Observability properties of the given system.
- b) Unit step, impulse & ramp response of the system.
- c) Plot the response for the initial conditions given by $-X_0 = [1 \ 1 \ 1 \ 1]^T$.
- d) Find the characteristic equation of the system and its roots.
- e) Convert this system to the unity feedback system and find its response to unit step input also comment on its stability.
- f) For the above system find all the forms of the state space representation.

Experiments 7: Consider the linearised model of twin rotor MIMO system given:

$$A = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 \\ -4.7059 & -0.0882 & 0 & 0 & 1.3588 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & -5 & 1.617 & 4.5 \\ 0 & 0 & 0 & 0 & -0.9091 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 \end{bmatrix}$$

$$B = \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 1 & 0 \\ 0 & 0.8 \end{bmatrix} \text{ and } C = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \end{bmatrix}$$

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Determine:

- Controllability and Observability properties of the given system.
- Unit step, impulse & ramp response of the system.
- Plot the response for the initial conditions given by $-X_0 = [1 \ 1 \ 1 \ 1]^T$.
- Find the characteristic equation of the system and its roots.
- Convert this system to the unity feedback system and find its response to unit step input also comment on its stability.
- For the above system find all the forms of the state space representation.

Experiments 8: Consider dynamics the following state-space representation of the linearized longitudinal aircraft

$$\begin{bmatrix} \dot{v}(t) \\ \dot{\theta}(t) \\ \dot{\mu}(t) \\ \dot{q}(t) \end{bmatrix} = \begin{bmatrix} -0.045 & 0.036 & -32 & -2 \\ -0.4 & -3 & -0.3 & 250 \\ 0 & 0 & 0 & 1 \\ 0.002 & -0.04 & 0.001 & -3.2 \end{bmatrix} \begin{bmatrix} v(t) \\ \theta(t) \\ \mu(t) \\ q(t) \end{bmatrix} \\ + \begin{bmatrix} 0 & 0.1 \\ -30 & 0 \\ 0 & 0 \\ -10 & 0 \end{bmatrix} \begin{bmatrix} \delta(t) \\ \mu(t) \end{bmatrix} \\ \begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} v(t) \\ \theta(t) \\ \mu(t) \\ q(t) \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} \delta(t) \\ \mu(t) \end{bmatrix}$$

Find the following for the above problem?

- Convert this to a transfer function model ?
- Find unit step, ramp, and impulse response for the system?
- Find the response of the system for $u(t) = 9 \exp(5t)$?
- Comment on the stability of the system?
- Comment on the controllability and observability of the system?
- Find the response for the initial conditions $x_0 = [1 \ 1 \ 1 \ 1]^T$.

POWER SYSTEM – II (LAB) (EE-1553)

Experiment 1: Obtaining line parameters of a 345 kV transmission line and its modeling in MATLAB.

Experiment 2: Study of load flow analysis of a power system using (a) Gauss-Seidel and (b) Newton-Raphson methods.

Experiment 3: Study the effect of transformer in a power system while load flow analysis using MATLAB.

Experiment 4: To Study the effects of sudden short-circuit on a synchronous generator output using MATLAB.

Experiment 5: To obtain the current harmonics drawn by power electronics interface.

(a) To study the effect of real and reactive powers on bus voltages.

(b) Modeling of thyristor Controlled Reactors (TCR).

(c) Modeling of thyristor Controlled Series Capacitors (TCSC).

Experiment 6: To calculate transient stability limit of a 3-bus power system.

Experiment 7: To study the effect of symmetrical and unsymmetrical short-circuit faults of transmission lines.

Experiment 8: To study over voltages resulting from switching of transmission lines and limiting them by using ZnO arresters.

COMMUNICATION SYSTEM AND NETWORKING (LAB) (EE-1554)

Experiment 1: To design and implement a Band Pass Filter for the range (400Hz-1KHz).

Experiment 2: To implement Amplitude Modulation (AM), demodulation and calculate the modulation index.

Experiment 3: To implement Frequency Modulation (FM) using IC 2206 and demodulation using IC 565.

Experiment 4: To implement Pulse Amplitude Modulation (PAM) and Demodulation.

Experiment 5: To implement Pulse Position Modulation (PPM).

Experiment 6: To implement Pulse Width Modulation (PWM).

Experiment 7: To implement Phase Locked Loop (PLL) and find out the lock range and capture range.

Experiment 8: To determine the performance of PCM.

Experiment 9: Study of LAN transmission media's, topologies, interconnection devices & LAN standards.

Experiment 10: Study of TCP/IP & Internet.

Experiment 11: To generate a random wireless scenario.

Experiment 12: To generate wireless MANETs scenario.

Experiment 13: To compare AODV and DSR routing protocols for wireless MANETs.

Experiment 14: To use Voice over IP application in wireless scenario.

Experiment 15: To compare reactive and Hybrid routing protocols for MANETs.

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UNIT 1: Introduction to Power Electronics, Power Electronics Systems, Role of Power Electronics in the field of electric power control. 2(L)

UNIT 2: Power Electronic Devices-A Brief Survey of Power Semiconductor Devices: Power Diodes, Thyristor, Diac, Triac, UJT, GTO etc. Construction characteristics and their applications, methods of triggering a SCR. Different firing (R, RC and UJT) circuits, commutation of SCR, converter grade and inverter grade SCRs, series parallel operation of SCRs, Protection of SCR and GTO thyristor and triggering of GTO thyristor 10(L)

UNIT 3: Other Power Electronics Devices-Characteristics, operation, constructional details and application of Power Transistor (BJT), MOSFET, IGBT and MCT. 4(L)

UNIT 4: Controlled Rectifiers-Phase controlled Rectifiers operation on resistive and inductive loads, use of free-wheeling diode, Single -Phase and Three phase controlled and Fully controlled bridge rectifiers, Semi-converters, Dual converters, Effect of source impedance on converter, Line commuted inverters 9(L)

UNIT 5: Choppers-Principle of operation and control technique of chopper, classification of Choppers, current and voltage waveforms for resistive, inductive and motor loads, Power Transistor and MOSFET based chopper circuits, step up chopper and its application. 5(L)

UNIT 6: Inverters-Single-phase and Three-phase (six-step) inverters, voltage and current waveforms, Bridge Inverter, voltage control & PWM strategies of VSI, Series and parallel inverters, Methods of voltage control, and various techniques of phase width modulation. Comparisons of voltage source, current source inverters and their applications. 6(L)

UNIT 7: Cycloconverters-Single-phase and three-phase Step-up and Step down cycloconverter, full bridge and half bridge configurations. 2(L)

UNIT 8: Applications-Static circuit breakers, UPS, Static frequency converter, Power factor control. 2(L)

Text/ Reference Books:

- Power Electronics – M. H. Rashid
- Thyristorised Power Controllers - G. K. Dubey, S. R. Doradla, A. Joshi & V. P. Sinha
- Power Electronics - P. C. Sen
- Power Electronics – P. S. Bimbhra
- Power Electronics- Cyril W. Lander
- Power Electronics (Converter, Applications & Design) – Ned Mohan, T. M. Undeland & W. P. Robbins
- Power Electronics - R. S. Ramstrand.
- Power Electronics- Vineeta Agrawal & Krishna Kant

MICROCONTROLLER & COMPUTER ORGANIZATION (EE-1602)

UNIT 1: Introduction-Introduction to COA, Basic Computer Model, Working Principle, and Main Memory Organization, Microprocessor 3(L)

UNIT 2: ALU-Operation and Hardware Implementation, Implementation issues of some of the instructions 2(L)

UNIT 3: Memory-Concept of Memory, Cache Memory, Memory management, Virtual memory 4(L)

UNIT 4: Instruction set and addressing 3(L)

UNIT 5: Processor Organization, Control Unit, Micro programmed Control 4(L)

UNIT 6: I/O operation 4(L)

UNIT 7: Organization of Intel 8085 Micro-Processor 2(L)

UNIT 8: Instruction set of Intel 8085 Micro-Processor & Assembly programming 4(L)

UNIT 9: Introduction to Peripherals 2(L)

UNIT 10: Micro-controller Architecture 4(L)

UNIT 11: Addressing Mode, Digital and Analog I/O, timing and delay, Interrupts 6(L)

UNIT 12: Application of micro controller. 2(L)

Text/ Reference Books:

- Computer Organization and Architecture: Designing for Performance, : William Stallings, Publisher: Prentice-Hall India
- Computer Organization : Carl Hamacher, Zvonko Vranesic and Safwat Zaky Publisher: McGraw Hill
- 8051 Microcontroller An Applications Based Introduction D. M. Calcutt, Frederick J. Cowan, G. Hassan Parchizadeh. Publisher: Elsevier Publication
- Microcontrollers : Rajkamal Publisher: Pearson Education
- The 8051 Microcontroller and Embedded Systems: Muhammad Ali Mazidi, Janice Gillispie Mazidi
- The 8051 Microcontroller: Scott Mackenzie

INSTRUMENTATION (EE-1603)

UNIT 1: Instrumentation Systems: Role of instrumentation; Elements of instrumentation system; Use of monitored information; Classification of data acquisition systems; Standards of instrumentation; Calibration; Recent developments. 4(L)

UNIT 2: Transducer Instrumentation: Sensors and transducers; Primary sensing elements; Electrical Transducers-characteristics, classification, desirable properties. 3(L)

UNIT 3: Passive transducers: Resistive, inductive, capacitive, frequency generating or modulating type; opto-electronic transducers; ultrasonic transducers; Hall-effect transducers- types, principle, modeling, analysis, industrial applications. 6(L)

UNIT 4: Active and digital transducers: Thermo-electric type, piezoelectric type, electromagnetic type; photo-electric type; digital transducers- types, principle, modeling, analysis, industrial applications. Applications with transducers for common industrial variables- temperature, pressure, flow, level, weight/ load/force, position, speed, acceleration, vibration. 7(L)

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resistive, reactive converters; Precision rectifiers and applications; Active filters- low-pass first, second order types, features and design; Linearization of transducer characteristics for common transducers. 10(L)

UNIT 6: Data converters and digital signal conditioning- Sampling and Hold operations; Digital to analog converters (DACs)-R/2R, Binary weighted, BCD to analog types; Analog to digital converters (ADCs)- classifications; Capacitor charging type- VFC, PWM type, dual slope integrator types; Discrete voltage comparison type- counter ramp, successive approx, flash types, Properties and specifications. 6(L)

UNIT 7: Telemetry and Networked Systems: Types of data telemetry systems- land line, wireless, analog and digital, current, voltage, position, frequency telemetry; Network requirements; Communication interface- types of buses, IEEE 1451 standards; Data acquisition systems- configurations, comparative; Sensor networks and smart transducers. 4(L)

Text/ Reference Books:

- Patranabis, D. – Principles of industrial instrumentation (TMH)
- Seippel, R.G. – Transducers, sensors and detectors (Reston pub)
- Rangan, Sarma, Mani – Instrumentation systems and devices (TMH)
- Hoeschele - Analog-to-Digital and digital –to-analog converters (MGH)
- Shiengold- Transducer interfacing handbook (Analog devices)
- Roychaudhary, D. and S.Jain – Linear integrated circuits (Wiley eastern)

APPLIED CONTROL (EE-1604)

UNIT 1: Optimal Control: Performance Indices, Euler-Lagrange Equation, Linear Quadratic Regulator, Dynamic programming, Pontryagin's minimum principle 6(L)

UNIT 2: Nonlinear systems: Phase-plane, Describing function methods, advanced stability theory, nonlinear control system design. 6(L)

UNIT 3: Sliding mode control: Variable structure, definition of sliding mode, a simple sliding mode controller, sliding in multi input systems, sliding mode and system zeroes, non-ideal sliding mode, sliding surface design, state estimation of uncertain systems. 8(L)

UNIT 4: Adaptive Control: Model reference adaptive control and self-tuning regulators, MIT rule, Design of MRAS using Lyapunov theory, stochastic adaptive control. 5(L)

UNIT 5: Fuzzy Logic: Fuzzy arithmetic and Fuzzy relations, Fuzzy logic control, stabilization using Fuzzy models, adaptive Fuzzy control. 6(L)

UNIT 6: Micro-controller and DSP control, Distributed digital control system, PLCs, Embedded and FPGA controllers, Hardware-in-loop control. 6(L)

Text/ Reference Books:

- Stanislaw H. Zak, Systems and Control.
- Wolovich William A., "Automatic Control Systems", Oxford University Press, 1st Indian ed., 2010.
- Chidambaram, M., "Computer Control of Processes", Narosa Publishing House, 3rd reprint, New Delhi, India
- Kuo, B.C., "Digital Control System", Oxford University Press, second edition, 1992.
- Nagrath & Gopal, "Modern Control Engineering", New Ages International.
- V. I. Utkin, "Sliding Modes in control and optimization", Springer-Verlog, 1992.
- W. Pedrycz, "Fuzzy control and Fuzzy systems", Research Studies Press, Taunton, Somerset, England, 1993.
- H. K. Khalil, "Nonlinear control Systems", Prentice Hall, NJ, 1996.
- D. E. Kirk, "Optimal Control Theory: an introduction", Prentice Hall, NJ, 1970.

MODERN ELECTRICAL MACHINE (EE-1605)

UNIT 1: Precision Motors: Servo & Stepper Motor: stepper motors: construction, operation and characteristics of stepper motors; electronic as well as microprocessor based controllers for stepper motors; stepper motor applications in control, instrumentation, computer peripheral devices, CNC systems, robotics, etc.; and stepper motor analysis and design 7(L)

UNIT 2: Reluctance Motor: Synchronous and Switched reluctance Motors, Variable reluctance stepping motor: principle of operation of the switch reluctance motor (SRM): Introduction, Background, Elementary Operation of the Switch Reluctance Motor, Principle of Operation of the Switched Reluctance, Motor, Derivation of the Relationship Between Inductance and Rotor Position, Equivalent Circuit, SRM Configurations, Linear Switched Reluctance Machines 7(L)

UNIT 3: Wound rotor Induction Generator: Steady State, Transient and Control, Self Excited Induction Generators 6(L)

UNIT 4: Permanent Magnet Synchronous Motor / Generators (PMSM/ PMSG): Steady State and dynamic modeling 6(L)

UNIT 5: Brushless DC Machines: Steady State and dynamic modeling 4(L)

UNIT 6: Linear motors & its application MEGLEV 4(L)

UNIT 7: Electrostatic motor and its application in MEMS, Nanotube nanomotor, piezoelectric motors. 4(L)

Text/ Reference Books:

- Stepper Motors: Fundamentals, Applications and Design by V.V. Athani, New Age International Publisher
- Handbook of Small Electric Motors by William H. Yeadon and Alan W. Yeadon, eds. McGraw-Hill, 2001
- Stepping motors: a guide to modern theory and practice by Acarnley, Peregrinus on behalf of the IEE, 1984
- Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications by R. Krishnan, CRC Press
- Switched Reluctance Motor Drives: Fundamentals of Magnetic Design and Control by Babak Fahimi, CRC Press
- Special Electric Machines edited by K. Venkataratnam, CRC Press
- Permanent Magnet Synchronous and Brushless DC motor Drive by R. Krishnan, CRC Press
- Electric Motors and Drives Fundamentals, Types and Applications by Austin Hughes, Elsevier
- Variable Speed Generators by I. Boldea CRC Press 2005

pbua

Experiment 1: Art of communication: What is communication, good communication and effective communication, barriers and filters, activity on barriers and filters.

Experiment 2: Body language: verbal and non-verbal behavior interpretation, activity on non-verbal communication.

Experiment 3: Active listening. Active listening quiz.

Experiment 4: Feedback: How to give and receive feedback, Activity on feedback.

Experiment 5: Hidden date of communication: Feelings. Activity on how to handle feelings.

Experiment 6: Practical skills: assertiveness, activity on assertiveness, self-confidence, activity.

Experiment 7: In the world of teams: the team concept, element of teamwork. Team formation, effective team, exercise on team, Team players, activity.

Experiment 8: Discussions, decisions and presentations: Structured and un-structured group discussions. Activity on each.

Experiment 9: Adapting to Corporate life: exercise on grooming and dressing, getting ready for interview.

Experiment 10: Business Etiquette/Dining etiquette.

POWER PLANT ENGINEERING (EE-1607)

UNIT 1: Introduction to Power plants-Conventional power plant- Thermal, Hydro, Nuclear, Combined cycle, etc, Non-conventional power plant-Small hydro, wind (on shore/off-shore), fuel cell, PV etc, their layout, Load duration curves, Switchyard. 6(L)

UNIT 2: Thermal power plant (steam based)-Study on different sections- fuel and ash handling, Furnace and mechanical stokers, Pulverizers, Steam boiler types and cycles (including fluidized bed), Turbo-generators, Excitation system, Draught, Electrostatic precipitator, Cooling towers 8(L)

UNIT 3: Nuclear power plant-Nuclear energy-Fission and fusion reaction, Types of reactors, pressurized water reactor, waste disposal. 4(L)

UNIT 4: Hydro power plant: Different layout- Dam and run-of-river, Main sections- Intake, Tunnel, Surge tank, Penstock, Tail race, Turbine types, Hydro generators, Governors. 8(L)

UNIT 5: Diesel and Gas turbine power plant-Types of diesel power plant, components, Selection of engine type, Gas turbines, Open and closed cycles, reheating, Regeneration, Inter-cooling. 6(L)

UNIT 6: Economics of power plants-Cost of electrical energy- Fixed and operating cost, Tariff rates, Economics of load sharing, Comparison of cost from different power plants, Power plant instrumentation and major Electrical Equipment, Pollution and its control. 6(L)

Text/ Reference Books:

- Power plant engine- P.K. Nag
- Tata McGraw- Hill Publishing company Ltd., New Delhi
- Power plant Technology- M.M.El-Wakil, McGraw Hill.
- Power plant engg.-Mahesh verma.
- Power plant engg. F.T. Morse & D.Van Nostianopl.
- British Electricity international London [CEGB], Modern power station practice, Third Ed. Voil1-8, Pergamon press.
- Modern power plant engineering- J.Weisman and Eckert, prentice- Hall of India New Delhi.
- A Text Book of power plant engineering R.K. Raajpoot, Luxmi publication (P) Ltd, New Delhi.

POWER ELECTRONICS (LAB) (EE-1651)

Experiment 1: Obtain the V-I Characteristics of the following devices

- a) SCR
- b) Triac

Experiment 2: To test the characteristics of single phase diode-bridge module under varying load condition.

Experiment 3: Implement the UJT as an Oscillator.

Experiment 4: Implement R and RC firing circuits for SCR.

Experiment 5: To program the given microprocessor (8085) for varying the firing angle of SCR triggering.

Experiment 6: Operation of Semi converter and half wave converter.

Experiment 7: To design and implement controlled bridge rectifier using single-phase and three-phase SCR bridge modules.

Experiment 8: Study the isolated gate drivers for transistor-transistor logic (TTL) pulses.

Experiment 9: Operation of SCR based Series Inverter and MOSFET based Half-bridge Inverter.

Experiment 10: To design and implement assembled open PCB for MOSFET Bridge used as a chopper and as an inverter.

Experiment 11: To determine the speed-torque characteristics of single-phase AC motor using thyristorised AC voltage controller with open loop and closed loop control.

MICROCONTROLLER & COMPUTER ORGANIZATION (LAB) (EE-1652)

Programs on 8085 Kit

Experiment 1: Write a program to Add two 8 bit Data result may be (i) 8 bits (ii) 16 bits.

Experiment 2: WAP to Subtraction of two 8 bit Data.

Experiment 3: WAP to Add series of 8 bit numbers. Result by be 8 bit or 16 bit.

Experiment 4: WAP to find the 2's complement of 16 bit Number.

Experiment 5: WAP for (i) Multiplication and (ii) Division, data is of 8 bits and result bay be 8 or 16 bits.

Experiment 6: WAP for multi byte (i) Addition and (ii) Subtraction.

Experiment 7: WAP for multi byte Addition of number of series.

Experiment 8: WAP to find the (i) largest and (ii) smallest number from a Data array.

Experiment 9: WAP to arrange a Data array in (i) Ascending (ii) Descending order.

Experiment 10: WAP to Display your name and moving display.

Study cards:

Experiment 11: 8155, 8255, 8253, 8251, 8259 8279, 8257

Power

Experiment 12: Traffic light control
DC motor control
Thumbwheel control
Stepper motor control
Elevator Simulator
D/A converter
A/D converter
Keyboard Simulator
Experiment 13: Basic programs of 8086 microprocessor

INSTRUMENTATION (LAB) (EE-1653)

Experiment 1: Study and experimentation on displacement measurement using LVDT.
Experiment 2: Study and experimentation on speed Measurement.
Experiment 3: Study and experimentation on pressure measurement.
Experiment 4: Study and experimentation on Piezoelectric transducers for force/ Load measurement.
Experiment 5: Study and experimentation on temperature sensing transducers such as thermocouple, thermistor, and RTD.
Experiment 6: Study and experimentation on Strain Gauge measurement.
Experiment 7: Sample - Hold and ADC-DAC operations.
Experiment 8: Design and testing of low pass filters.
Experiment 9: Design and testing of high pass filter.
Experiment 10: Design with timer-555
Experiment 11: Design and testing of Instrumentation Amplifiers.
Experiment 12: Interfacing of transducer with Microprocessor.
Experiment 13: Study of process control trainer

PTMA

UNIT 1: Introduction of Drives-Concept of Electrical Drive, Classification of Drives, Block Diagram of an Electrical Drive, power modulators, Sources, Control Unit, Choice of Electrical Drive, Status of DC and AC Drive, Load Characteristics, Load With Rotational Motion and Transnational Motion, Classification of Load Torques, Load Torques function of Speed, Time, Path or Position Taken by the Load during Motion and Quadrant Operation 7(L)

UNIT 2: Dynamics of Electrical Drive-Electric motor speed torque characteristics, Joint Speed-Torque Characteristic of an Electric Motor and Driven Unit, Stability of Drive System, Determination of Moment Of Inertia, Load Equalization, Concept of Transient Stability, Selection of motor under Continuous Duty, for Continuous variable Duty, for Short Duty Load, and intermittent Duty Load, Effect of Load Inertia, Environmental Factors 7(L)

UNIT 3: Starting and Braking of DC Drives-Effect of starting on power supply, motor and load, Types of starters, Different methods of starting of a motor, Starting Circuit as a Function of Motor Speed, Function of Current and Function of Time, Thyristors and the resistance starter, Thyristor starting without resistance, Braking of DC Drives, Type of Braking, Friction Braking and Electrical 6(L)

UNIT 4: Speed Control of DC Drives-Performance parameters for Power Controller Fed DC Drives, Classify various power electronics controller fed DC drives, Types of controlled rectifier fed DC drives, Performance of Controlled Rectifier Fed DC Shunt Motor and Series Motor, Performance of Chopper fed DC drives 7(L)

UNIT 5: Starting and Braking of AC Drives-Need of using starters for AC Drives, Two (Star-Delta and Auto-transformer) types of starters used for Squirrel cage Induction motor, Starter using additional resistance in rotor circuit, for Wound rotor (Slip-ring), Starting of Synchronous Motor, Principle of electric braking for AC drives, Types of braking of AC drives 6(L)

UNIT 6: Speed Control of AC Drives-Different methods of speed control of induction motor, Advantage of low frequency starting of induction motor, Sources of Variable frequency generation, Variation of supply voltage, Injection of voltage in rotor circuit, static Scherbius Drive, Static Kramer Drives, Rotor resistance control Speed Control of Synchronous Motor Drives, Traction Motor drive 7(L)

Text/ Reference Books:

- Vineeta Agarwal, Electrical Drive, Agrawal Publisher, New Delhi,
- G.K.Dubey- Fundamental of electric drives. Narosa Publishing House
- S. K. Pillai, A First Course on Electrical Drives, New Age International Publishers
- P.C.Sen- Thyristor DC drives. Wiley inter science publication.
- B.K.Bose- Thyristor AC drives. Wiley inter science publication
- V. Subramanayam- Thyristor control of electric drives. Tata McGraw Hill Publication.
- S. B. Dewan- Thyristorized Power Controller Drives, Wiley Inter
- J. M. D. Murphy- Power electronics control of AC motors, Pergamon press, Newyork.

RENEWABLE ENERGY SOURCES AND DISTRIBUTED GENERATION (EE-1702)

UNIT 1 Distributed Generation Resources: Renewable energy types solar, wind, small-hydro, diesel generator, marine, fuel cells etc., distributed generation technologies, standalone, hybrid and grid connected 6(L)

UNIT 2 Wind Energy System: Wind Turbines, Fixed speed and variable speed wind turbines, Synchronous generator, PMSG, Induction generator, doubly fed synchronous generator, Land vs. offshore wind turbines, wind turbine characteristics. 7(L)

UNIT 3 Solar PV: Solar photovoltaic (PV) cell, PV characteristics, Modules and Arrays, Utility, Commercial and Residential PVs, Hybrid 7(L)

UNIT 4 Other DG Technologies: Energy Storage, Batteries, Capacitors, Ultra-capacitors, flywheel, Thermal Storage, Fuel Cells and its characteristics. 6(L)

UNIT 5 Grid Integration: Standards for grid connection, Power Quality, Eigen analysis, optimal location of DG, Islanding issues, Solar and Wind power park, Smart grid. 6(L)

UNIT 6 Power Electronics in DG: AC/DC, DC/DC and DC/AC converters in DG, Fully rated and partially rated converters, Battery charging, maximum power point tracking (MPPT) methods, Solar water pumping, Inverter topologies for solar and wind. 8(L)

Text/ Reference Books:

- Ghosh and G. Ledwich, *Power Quality Enhancement using Custom Power Devices*, Kluwer Academic Publisher, Boston, MA, 2002.
- Mukund R. Patel, "Wind and Solar Power Systems", CRC Press LLC, 1999.
- G. M. Masters, *Renewable and Efficient Electric Power Systems*
- M. H. Rashid (ed), *Power Electronics Handbook*, Academic Press, Florida, 2001.

ELECTRICAL DRIVES LAB (EE-1751)

- Determination of Moment of Inertia of a motor
- Two-Quadrant operation of a 1-phase Full Converter using D.C. drive.
- Performance & speed control of D.C motor by single phase Semi-converter
- Performance of Chopper fed D.C. Drive
- Operation of a four quadrant Chopper on D.C. Drive
- Operation of a 1-phase A.C. Voltage controller on motor load.
- Operation of a 3-phase A.C Voltage controller on a 3- phase Squirrel Cage Induction Motor.
- Performance & speed control of S.C. Induction motor by Static Rotor Resistance Controller.
- Performance & speed control of 3-phase Induction motor using 3-phase PWM Inverter.
- Performance & speed control of S.C. Induction motor using cyclo-converter

PROJECT (EE-1791)

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NEURAL NETWORK AND FUZZY SYSTEM (EE-1731)

- UNIT 1: Introduction of Artificial Intelligence techniques**-Role of artificial intelligence techniques in engineering; Characteristics of ANN and Fuzzy Systems 3(L)
- UNIT 2: Neural Networks Systems**-Biological neurons, NN terminology, Activation functions, Fundamental models of NN; McCulloch Pitt's, Hebb, Single layer perceptron, Adaline network, solving logic gate function using these models, Types of NN based on learning methods, Supervised learning (Hebb learning rule, Boltzmann learning, Delta learning rule, Gradient descent techniques, Adaptation, Generalized delta rule), Unsupervised learning, Reinforcement learning, Self-organizing mapping, Adaptive resonance theory 12(L)
- UNIT 3: Multilayer NNs**-Types according to architecture- Feedforward NN, Recurrent NN, Dynamic learning of NN, Applications of NNs- Identification (Nonlinear model structures-NNFIR, NNARX, NNFIR, NNARMAX, NNOE), Control (Direct inverse, internal model, feedforward) 5(L)
- UNIT 4: Fuzzy systems**-Introduction, Definition and terminology, Fuzzy set operations, Their properties, Fuzzy relations, its operations and properties, Fuzzy composition, Fuzzy linguistic variables, Rule structure- consequent and antecedent part, rule framing, Fuzzification, De-fuzzification (Max membership principle, Centroid, Weighted average, Mean max membership, Center of sums, Center of largest area), Inference system 12(L)
- UNIT 5: Fuzzy system applications**- Fuzzy controllers, approximate reasoning and approximation. 3(L)
- UNIT 6: NN-Fuzzy systems**-ANFIS- Block diagram and operation at different layers 2(L)

Text/ Reference Books:

- S. N. Sivanandam, S. Sumathi, S. N. Deepa, Introduction to Neural Networks using MATLAB 6.0, Tata McGraw Hill.
- S. Haykin, Neural Networks: A comprehensive Foundation, Pearson Education.
- Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley student edition, Wiley-India.
- J. S. R. Jang, C. T. Sun, and E. Mizutani, Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, Prentice Hall-India Ltd.

HIGH VOLTAGE ENGINEERING (EE-1732)

- UNIT 1: Break Down Phenomenon**-Basic Process of breakdown, breakdown phenomenon in gaseous, liquid & composite dielectrics, breakdown in vacuum insulation
- UNIT 2: Generation of High Test Voltages**-Generation of high d.c. voltage by voltage multiplier circuit and electrostatic generators, generation of high a.c. voltage by cascade transformers and resonant transformers, generation of impulse voltages, triggering & synchronization of impulse generators, generation of high impulse current.
- UNIT 3: Measurement of High Voltage & Current**-Resistance, capacitance and RC potential dividers, sphere gap, electrostatic voltmeter, generating voltmeter, impulse voltage measurement, measurement of high d.c., a.c. & impulse currents
- UNIT 4: High Voltage phenomenon and Insulation coordination**-Requirement of high voltage test circuits, L.S specifications; impulse and power frequency test of transformers, lighting arresters, bushing, power cables, circuit break and isolators; measurement of resistivity dielectric constant and loss factor, partial discharge measurement
- UNIT 5: Over Voltage Phenomenon and Insulation Coordination**-Lightning and switching phenomenon as caused by over voltage, protection of transmission line and substation against over voltage, insulation coordination
- UNIT 6: Testing of Materials and Electrical Apparatus**-Testing of Transformers, motors, generators. Non destructive testing
- UNIT 7: Design, Planning and Layout of High Voltage Laboratories**-Laboratory layouts, Switchyard layouts

Text/ Reference Books:

- E. Kuffel & W.S Zaegnel, "High Voltage Engineering", Pergamon Press
- M.S Naidu & V. Kamaraju, "High Voltage Engineering", Tata Mc-Graw Hill
- M.P Chaurasia, "High Voltage Engineering", Khanna Publishers.
- R.S Jha, "High Voltage Engineering",
- C.L Wadhwa, "High Voltage Engineering", Wiley Eastern Ltd.
- T. J. Gallagher and A. J. Pearmain, High Voltage Measurement, Testing and Design, NY: Wiley, 1983.
- L. L. Alston, High Voltage Technology, Oxford University Press, 1968.
- Arrilaga, J., "High voltage direct current transmission", Peter Peregrinver Ltd., London, U.K., 1983

UTILIZATION OF ELECTRICAL ENERGY & ELECTRIC TRACTION (EE-1733)

- UNIT 1: Electric Heating and Welding**-Salient features of electric heating, resistance heating, induction heating, electric arc heating, dielectric heating, methods of generating high frequency power illumination: Laws of illumination, polar curves, design of indoor and outdoor systems, street lighting. Electrolytic Process: Principle of electro deposition, laws of electrolysis, applications of electrolysis.
- UNIT 2: Electric Traction**-Electric traction-Salient features, comparison with other types of traction systems, types of electric traction; systems of track electrification, traction system in India, speed time curves, tractive effort and specific energy consumption, coefficient of adhesion, suitability of electric motors for traction service, conventional and solid state control of traction motors, electric braking, current collection systems, dc and ac substations, signalling system, diesel electric traction.

Text/ Reference Books:

- H.Pratab, Utilization of Electrical Energy, Dhanpat Rai & Sons.
- G.K. Dubey, Fundamentals of Electrical Drives, Narosa Publishing House.
- Dover, Electric Traction, Pitman & Sons.
- H. Cotton, Illumination Engineering, Pitman & Sons.
- E.O. Taylor, Utilization of Electrical Energy, Pitman & Sons.

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UNIT 1: Electric Heating, Advantages of electrical heating, Heating methods: Resistance heating, Heating, Electric arc heating, Dielectric heating, Infra-red heating, Microwave heating, Simple design problems of resistance heating element 7(L)

UNIT 2: Advantages of electric welding, Welding method, Principles and Types of resistance welding, Principle of arc production, electric arc welding, Comparison between AC and DC arc welding, Welding control circuits, Welding of aluminum and copper, Introduction to TIG, MIG Welding (Gas Tungsten Arc Welding (GTAW) (frequently referred to as TIG welding) Gas Metal Arc Welding (GMAW) (frequently referred to as MIG Welding) 8(L)

UNIT 3: Electrical Circuits used in Refrigeration and Air Conditioning and Water Coolers: Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants, 6.2 Description of Electrical circuit used in a) refrigerator, b) air-conditioner, and c) water cooler 5(L)

UNIT 4: Illumination, Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light, Laws of illumination, Different type of lamps, Illumination schemes, Illumination levels, Main requirements of proper lighting methods of generating high frequency power illumination: Laws of illumination, polar curves, design of indoor and outdoor systems, street lighting. Electrolytic Process: Principle of electro deposition, laws of electrolysis, applications of electrolysis. 8(L)

UNIT 5 Electric Traction: Advantages of electric traction, Different systems of electric traction, Types of services – urban, sub-urban, and main lines and their speed-time curves, Different accessories for track electrification, Factors affecting scheduled speed 6(L)

UNIT 6: Electrical block diagram of an electric locomotive, Types of motors used for electric traction, Starting and braking of traction motors, Introduction to EMU and metro railways 6(L)

Text/ Reference Books:

- Utilization of Electrical Energy by J.B. Gupta, Kataria Publications, Ludhiana
- Utilization of Electrical Energy by OS Taylor, Pitman Publications
- Generation, Distribution and Utilization of Electrical Power by C.L. Wadhwa, Wiley Eastern Ltd., New

ADVANCED SEMI-CONDUCTOR DEVICES (EE-1735)

UNIT 1: Status of development of power semiconductor Devices, Diodes Types - P-N junction, schottky, contact, Gunn diodes, IMPATT (Impact ionization Avalanche Transit-Time) diodes; Step recovery diodes; Electrical rating - Switching and steady state characteristics - switching aid circuits - Series and parallel operation, Resonant tunnelling structures, RTD oscillators 9(L)

UNIT 2: Special Types of Thyristors-Field controlled thyristors and MCTs: Electrical rating - Switching and steady state characteristics - protection - Gate circuit requirements-Turn ON and Turn OFF methods 5(L)

UNIT 3: Transistors Types – BJT, Hetro junction BJTs; (HBT), ratings - static and switching characteristics - driver circuit - switching aid circuit -Power Darlington. Static Induction Transistor SIT 6(L)

UNIT 4: Field Effect Transistors Types (JEFT, MESFET, Metal Semiconductor Field Effect Transistor, MOSFET, HEMT, High Electron Mobility Transistor). Transport in low dimensional structures: HEMTs: Design of high frequency amplifiers and oscillators 6(L)

UNIT 5: IGBTs, Principle of working – switching characteristics - Gate drive requirements, Emerging Devices: - Power Integrated circuit - Characteristics -- New semiconductor materials for devices, (SiC, GaAs, PwrSoc), 6(L)

UNIT 6: Intelligent power modules, Wide band gap devices, nano-electronics and ballistic devices, Terahertz and Millimeter Wave Devices 6(L)

Text/ Reference Books:

- Ned Mohan, Power Electronics, PHI
- M. H. Rashid, Power Electronics PHI
- Williams, B. W., "Power Electronic Devices, Applications and Passive Components", ELBS Oxford University Press, 1992
- Mohan, M.et.al."Power Electronics converters, Applications and Design", Second edition, John Wiley and sons, New York, 1995.
- Rashid, M. H., "Power Electronic Circuits, Devices and Applications," Second Edition, Prentice Hall of India, New Delhi, 1994.

NETWORK SYNTHESIS (EE-1736)

UNIT 1: Elements of Network Synthesis-synthesis of L- C Driving –point Immitances, , synthesis of R-C Impedances or R-L Admittances, Synthesis of certain R-L -C Functions. 5(L)

UNIT 2 Elements of Transfer function Synthesis: Properties of Transfer function, Synthesis of Y21 Z 21 with 1- Ω termination, Synthesis of Constant Resistance Networks. 7(L)

UNIT 3: Filter Design-Filter design problem, Low Pass Filter Approximations, Synthesis of Low Pass Filter, Magnitude and Frequency Normalization, Frequency Transformations. 6(L)

UNIT 4: Biquad Circuits-Biquad Circuits, Four Op-Amp Biquad Circuit, Frequency and Phase Response of Biquad Circuit .Butterworth Low Pass filter,Chebyshev,Bessel Thomson Filter, 7(L)

UNIT 5: Leapfrog Simulation of Ladders- Ladder Simulattion,Bandpass Leapfrog Filters,Active Resonators,Bandpass Leapfrog Design,Girling-Good Form of Leapfrog. 6(L)

UNIT 6: Switched Capacitor Filters-Switched Capacitor,Analog Operations ,Range of Circuit elements,Sizes,Bandpass Switched –Capacitor Filters. OP Amp Oscillators: Loop gain, Conditons for Third –Order Circuit Oscillations Amplitude Stabilization 6(L)

- Franklin F. Kuo, "Network Analysis and Synthesis", John Wiley
- M E Valkenberg, "Analog Filter Design", Oxford University Press.
- A S Sedra and P O Brackett, "Filter Theory and design: Active and Passive", Matrix Publishers.
- F.W. Stephenson, "RC Active Filter Design Handbook", John Wiley & Sons
- Wai-Kai Chen, "Passive and Active Filters Theory and Implementations", John Wiley & Sons.

VIRTUAL INSTRUMENTATION (EE-1737)

UNIT 1: Introduction, Virtual Instrumentation (VI) advantages	2(L)
UNIT 2: Graphical programming techniques, data flow programming, VI's and sub VI's	10(L)
UNIT 3: Structures, Arrays and Clusters	12(L)
UNIT 4: Data acquisition methods, File I/O, DAQ hardware, PC hardware; operating systems, Instrumentation buses, ISA, PCI, USB, PXI	8(L)
UNIT 5: Instrument control, Data communication standards, RS-232C, GPIB	4(L)
UNIT 6: Real time operating systems, Reconfigurable I/O, FPGA	4(L)

VIRTUAL INSTRUMENTATION LAB (EE-1751)

Exprtiment 1: Familiarization with LabVIEW Programming: Creating simple VI, navigation and editing, developing VI, converting VI into Sub-VI, boolean switch action.

Exprtiment 2: LabVIEW Functions & Debugging: Use of WHILE-loop, FOR-loop, IF-THEN, CASE structure, shift registers, local variables and debugging.

Exprtiment 3: Advance LabVIEW Functions: Mathematical functions, arrays, clusters, waveforms and charts, formula node, global variables.

Exprtiment 4: Data Acquisition: Analog I/O, digital I/O, application of measurement & automation explorer (MAX).

Exprtiment 5: VI Applications: Temprature measurement, signal analysis (RMS, FFT, DFT, etc.), PLL, PWM output etc.

Text/ Reference Books:

- Virtual Instrumentation Using LabVIEW, Jovita Jerome, PHI India New Delhi
- Virtual Instrumentation Using LabVIEW, S. Gupta & J. John., Tata McGraw-Hill, New Delhi INDIA, ISBN – 0-07-059099-0
- Labview 7 Express Student Edition, Robert Bishop, PHI, ISBN - 0-13-123926-0
- LabVIEW User Manual, National Instruments, Texas Instruments, USA, available at www.ni.com
- LabVIEW RT User Manual, National Instruments, Texas Instruments, USA April 2000, available at www.ni.com
- LabVIEW FPGA Module User Manual, National Instruments, Texas Instruments, USA, March 2004, available at www.ni.com
- Application LabView, Leonard Sokoloff, PHI, OSBN – 0-13-833949-X
- LabVIEW For Electrical Circuits, Machine Drives and Labs, Nesimi Ertugrul, PHI, ISBN – 0-13-0618860-1
- Advanced LabVIEW Labs, John Essick, PHI, ISBN – 0-13-833949-X
- LabVIEW Graphical Programming. Garry Johnsons, Mc Graw Hill.

PHI

UNIT 1: DC-DC converters & power supplies-Review of assumed knowledge and switching devices; Review of steady-state characteristics of DC-DC converter circuits. SEPIC and Cuk converters; PSIM models. 4(L)

Analysis of non-ideal switches and circuit elements in DC-DC converters, efficiency calculation, voltage transfer characteristics with continuous and discontinuous inductor current. PSIM models 4(L)

Representation of dynamics of buck, boost and forward converters; state-space averaging, PWM controller; control loop design, voltage control, current mode control; Limiting of inrush current; Inductor and capacitor components. 4(L)

Isolated DC-DC Converters: Full-Bridge and Half-Bridge Isolated Buck Converters, Forward Converter, Push-Pull Isolated Buck Converter, Flyback Converter, Boost-Derived Isolated Converters, Isolated Versions of the SEPIC and the Cuk Converter 4(L)

UNIT 2: DC-AC Inverters-Review of assumed knowledge on DC-AC inverter circuits; advanced modulation techniques, SVM; Compensation for dead time and device voltage drops. PSIM Models; Current source inverters, multi-level and Z-source inverters. Rectifier/inverter with bi-directional power flow. 6(L)

UNIT 3: Resonant converters-Hard switched and Soft Switched Converter: Zero-current switched (ZCS) DC-DC converter, Zero-voltage switched (ZVS) DC-DC converter, Load Resonant Converters, Series, Parallel and Hybrid Loaded Converters, Series-resonant converter/inverter, Parallel-resonant converter/inverter, Series-parallel resonant converter, Resonant DC-link inverter/converter. Resonant Switch Converter, DC-DC resonant link inverters, hybrid resonant link inverters, Quasi resonant link converters, switched mode rectifiers, synchronous link converters 6(L)

UNIT 4: Modern Rectifiers-Power and Harmonics in Nonsinusoidal Systems, Pulse-Width Modulated Rectifiers, Modeling, analysis, and control of low-harmonic rectifiers, Boost, flyback, and other topologies for controlling the input current waveform of an ac-dc rectifier, Average-current, peak-current-mode, critical conduction mode, and nonlinear carrier control techniques, Determination of rms currents, and comparison of performances of popular topologies, System considerations. Modelling losses. Simulation. 6(L)

UNIT 5: Converter dynamics and control-Advanced control techniques, Small signal modeling, Advanced converter transfer functions 2(L)

UNIT 6: Research studies, literature review and discussions in emerging power electronics topics such as-Solar Power Conversion Systems, Wind Power Conversion, Battery Charging, Power Factor Correction, Multilevel converters and Matrix converter. 4(L)

Text/ Reference Books:

- N. Mohan, T. M. Undeland & W. P. Robins, "Power Electronics; Converters, Applications and Design", John Wiley, Second Edition, 1995, New York.
- J. G. Kassakian, M.F. Schlecht & G.C. Verghese, "Principles of Power Electronics", Addison Wesley, 1991.
- R. W. Erickson, "Fundamentals of Power Electronics", Kluwer Academic Publications, 1997.
- D. W. Hart, "Introduction to Power Electronics", Prentice Hall International, 1997.
- Erickson and Maksimovic, *Fundamentals of Power Electronics*, 2nd edition, Springer Science+Business (2000), ISBN 0-7923-7270-0

ADVANCE POWER ELECTRONICS (LAB) (EE-1851)

A. EXPERIMENT BASED LABORATORY PRACTICAL

Experiment 1: To perform the Sensor less vector control drive for 3-ph, 1-hp induction motor.

Experiment 2: To implement Push-Pull Inverter based on IGBT.

Experiment 3: To perform the closed loop controlled MOSFET based matrix converter fed induction motor.

Experiment 4: To control the speed of BLDC motor using pulse width modulation (PWM) method.

Experiment 5: To control the speed of three-phase induction motor using three-phase AC voltage controller by varying the firing angle of thyristor.

Experiment 6: To study the Zero Current Source (ZCS) Resonant converter.

Experiment 7: To test the Microprocessor based 3-phase SCR Half/Full Converter.

Experiment 8: To perform the 3 ph closed loop resonant converter fed induction motor drive.

Experiment 9: To perform 3-ph VSI fed PWM inverter AC drive.

B. SIMULATION BASED LABORATORY PRACTICAL (Using PSPICE)

Experiment 10: To design a flyback converter and study its characteristics.

Experiment 11: To design a push pull converter and study its characteristics.

Experiment 12: To design forward converter & study its characteristics.

Experiment 13: To design a SEPIC converter & study its characteristics.

Experiment 14: To design a suitable single-phase three level inverter as follows

(a) Full bridge (H-bridge)

(b) Neutral point clamped (Diode clamped)

Experiment 15: To design a three-phase neutral point clamped three leg line frequency inverter.

PROJECT (EE-1891)



EHV AC & DC TRANSMISSION (EE-1831)

- UNIT 1: General aspects and converter circuits-** HVAC and HVDC links - comparison, reliability, choice of best circuit for HVDC converters- transformer connection. 7(L)
- UNIT 2: Bridge converters-** analysis and control – power reversal- desired features of control - actual control characteristics 9(L)
- UNIT 3: Mis-operation of converters and protection-** Converter disturbance - bypass action in bridges - commutation failure - basics of protection - DC reactors - voltage and current oscillations - circuit breakers – over voltage protection. 8(L)
- UNIT 4 Harmonics, filters and converter charts:** Characteristics and uncharacteristic harmonics - troubles due to harmonics - harmonic filters - converter charts of direct current and voltage - active and reactive power. 7(L)
- UNIT 5: Design of EHV lines-**based on steady state limits and transient over voltages - design of extra HV cable transmission 7(L)
- UNIT 6: XLPE cables-**gas insulated cables – corona. 2(L)

Text/ Reference Books:

- Rakesh Das Begamudre, "Extra High Voltage AC Transmission Engineering", Wiley Eastern Limited.
- K. R. Padiyar, "HVDC Power Transmission System", Wiley Eastern Limited.
- E. W. Kimbark, "EHV-AC and HVDC Transmission Engineering & Practice", Khanna Publishers.
- Arrilaga, J., "High voltage direct current transmission", Peter Peregrinver Ltd., London, U.K., 1983

ELECTRIC VEHICLE TECHNOLOGY (EE-1832)

- UNIT 1: Introduction to Alternative Vehicles-**Electric Vehicles, Hybrid Electric Vehicles, Electric and Hybrid Vehicle Components, Vehicle Mass and Performance, Electric Motor and Engine Ratings, Electric and Hybrid Vehicle History Well-to-Wheel Analysis, EV/ICEV Comparison, Electric Vehicle Market, Vehicle Mechanics, Roadway Fundamentals Laws of Motion, Vehicle Kinetics, Dynamics of Vehicle Motion, Propulsion Power, Velocity and Acceleration, Tire-Road Force Mechanics, Propulsion System Design
- UNIT 2: Alternative Vehicle Architectures-**Electric Vehicles, Hybrid Electric Vehicles, Plug-In Hybrid Electric Vehicle Powertrain Component Sizing, Mass Analysis and Packaging, Vehicle Simulation, Battery Energy Storage, Batteries in Electric and Hybrid Vehicles, Battery Basics, Battery Parameters, Electrochemical Cell Fundamentals, Battery Modeling Traction Batteries, Battery Pack Management
- UNIT 3: Alternative Energy Storage-**Fuel Cells, Ultracapacitors, Compressed Air Storage, Flywheels, Electric Machines Simple Electric Machines, DC Machines, Three-Phase AC Machines, Induction Machines, Permanent Magnet Machines Switched Reluctance Machines
- UNIT 4: Power Electronic Converters-**Power Electronic Switches, DC/DC Converters, Cell Balancing Converters
- UNIT 5: Electric Motor Drives-**Electric Drive Components, DC Drives, Operating Point Analysis, AC Drives, SRM Drives
- UNIT 6: Control of AC Machines-**Vector Control of AC Motors, dq Modeling, Induction Machine Vector Control, PM Machine Vector Control
- UNIT 7: Internal Combustion Engines-**Internal Combustion Engines, BMEP and BSFC, Vehicle Fuel Economy, Emission Control System
- UNIT 8: Powertrain Components and Brakes-**Powertrain Components, Gears, Clutches, Differential, Transmission, Vehicle Brakes
- UNIT 9: Cooling Systems-**Climate Control System, Powertrain Component Cooling System, Hybrid Vehicle Control Strategy
Vehicle Supervisory Controller, Mode Selection Strategy, Modal Control Strategies, Vehicle Communications, OSI Seven-Layer Model, In-Vehicle Communications, Controller Area Network

Text/ Reference Books:

- Electric Vehicle Battery Systems by Sandeep Dhameja, Elsevier
- Lightweight Electric/Hybrid Vehicle Design by John Fenton & Ron Hodkinson, Elsevier
- Build Your Own Electric Vehicle by Seth Leitman, Bob Brant, McGraw Hill
- Electric and Hybrid Vehicles: Design Fundamentals, Second Edition by Iqbal Husain CRC Press 2010
- Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, Second Edition Mehrdad Ehsani; Yimin Gao; Ali Emadi, CRC Press 2009

BIOMEDICAL-INSTRUMENTATION (EE-1833)

- UNIT 1: Theory, Analysis and design of biomedical transducers-**Electrical, mechanical, electromechanical, thermoelectric, photo-electric, electrochemical, and optical transducers, Applications to biomedical systems. Transducers for non-electrical quantities. Flow and pressure measuring instruments in biomedical engineering 8(L)
- UNIT 2: Electrodes-**Theory of electrodes, Lead configurations of ECG electrodes, various types of electrodes, Electrodes used for ECG, EEG and EMG measurement 6(L)
- UNIT 3:** Cardiovascular system, Sensor characteristics and design for measurement of medical parameters like ECG, arterial blood pressure, heart sounds, Nervous system, measurement of EEG. 7(L)
- UNIT 4:** Medical laboratory Instrumentation, Development of non-invasive diagnostic instruments for tissue abnormalities, Medical Ultrasonography, Latest biomedical Instruments, Electro surgical unit, Pulse Oximeter, Foetal ECG. 8(L)
- UNIT 5:** Patient monitoring equipments; pace makers, Defibrillators etc., organization in hospital, Patient safety-physiological effects of electrical currents. Grounding systems in hospital, safety codes for electro-medical equipments. 8(L)

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Text/ Reference Books:

- Khandpur R.S., “Hand book of Biomedical instrumentation”, TMH, 2003.
- Cormwell L. et al., “Bio medical Instrumentation & Measurements”, PHI
- Carr & Brown, “Introduction to Biomedical Equipment”, PHI, 2005.
- Webster J.G. “Medical Instrumentation”, 3rd Edition, John Wiley, 1997.
- Richard L. Drake et. Al., “Anatomy for students” Elsevier, 2005.
- Rangaraj M. Rangayyan, “Biomedical Signal Analysis” John Wiley & Sons, 2002.
- Shu Chien et. Al., “An Introductory Text to Bio-Engineering” World Scientific, 2008.

OPERATION RESEARCH (EE-1834)

UNIT 1: Introduction: Introduction to O.R., Necessity of OR in Business and Industry, Scope of OR in modern management, O.R. and Decision Making. Linear programming: Various definitions, statements of basic theorems and properties, Advantages, Limitations and Application areas of Linear Programming. Linear Programming – The Graphical method – Graphical Solution methods of Linear Programming problem, Maximization Linear Programming problem, Maximization Problem. Formulation, Identification of decision variables, Constructing Objective Functions and Constraints, Assumptions. 8(L)

UNIT 2:Methods of Solution: Graphical Method, Simplex method.- Phase I and Phase II of the Simplex Method, The Revised Simplex method, Primal and Dual Simplex Method, Simplex Algorithm for maximization case, Simplex Algorithm for minimization case – Two phase method and the Big –M method. 5(L)

UNIT 3: Duality theory and Sensitivity Analysis: Duality theory: Existence of Dual of a LP problem, Primal Dual relationships in formulation and their solutions. Sensitivity analyses or Post Optimality Analysis: Dual Simplex Method, Changes affecting feasibility, Changes affecting optimality. 5(L)

UNIT 4: Transportation and Assignment problems: The transportation algorithm: Formulation as a LP problem, Determination of Initial solutions, Stepwise Improvement to obtain optimal solution, Special cases Such as Multiple, Unbalanced, Degeneracy etc., The assignment model: Formulation as TP, The Hungarian method of solution. 6(L)

UNIT 5: Network models: Critical Path Analysis (CAP): Network representation of simple projects, Critical path computation: Construction of time schedule, crashing of project duration. 5(L)

UNIT 6: PERT & CPM: Basic differences between PERT and CPM. Arrow Networks, time estimates, earliest expected time, latest – allowable occurrences time, Forward Pass Computation, Backward Pass Computation, Representation in Tabular Form Critical Path, Probability of meeting scheduled date of completion, Calculation on CPM network. Various floats for activities, Critical path updating projects. Operation time cost tradeoff Curve project, Time cost – tradeoff Curve- Selection of schedule based on Cost Analysis, Crashing the network. 8(L)

Text/ Reference Books:

- Introduction to Operations Research (Frederick S.Hiller, Gerald J.Lieberman), McGraw-Hill Companies
- Operations Research An introduction by Hamdy A. Taha, Prentice-Hall
- Quantitative Technoques, by L.C. Jhamb, Everest Publishing house
- Operations Research by Kanti swarup, Gupta P.K. and ManMohan.
- Optimization Methods in Operations Research and System Analysis by Mital K.V.
- The Critical Path Method by Saffer L.R., Fitter J.B. and Meyer W.L.
- Operation Research by J.K. Sharma
- Introduction to Operation Research: A Computer Oriented Algorithm Approach by Filet B. E.

CONVENTIONAL AND COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES (EE-1835)

UNIT 1: Basic Considerations-Basic concept of design, limitation in design, standardization, modern trends in design and manufacturing techniques, Classification of insulating materials. Modes of heat dissipation & temperature rise time curves. Methods of cooling ventilation (induced & forced, radial & axial), direct cooling & quantity of cooling medium. Calculation of total MMF and magnetizing current. Specific permeance and leakage reactance 6(L)

UNIT 2: Transformer Design-Output equation design of core, yoke and windings, overall dimensions, Computation of no load current to voltage regulation, efficiency and cooling system designs. 10(L)

UNIT 3: Design of rotating machines - I: Output equations of rotating machines, specific electric and magnetic loadings, factors affecting size of rotating machines, separation of main dimensions, selection of frame size. Core and armature design of dc and 3-phase ac machines 7(L)

UNIT 4: Design of rotating machines – II: Rotor design of three phase induction motors. Design of field system of DC machine and synchronous machines. Estimation of performance from design data 7(L)

UNIT 5: Computer Aided Design-Philosophy of computer aided design, advantages and limitations. Computer aided design approaches analysis, synthesis and hybrid methods. Concept of optimization and its general procedure. Flow charts and ‘c’ based computer programs for the design of transformer, dc machine; three phase induction and synchronous machines. 10(L)

UNIT 6: Various commercial Software packages for electrical machine design

Text/ Reference Books:

- K. Sawhney, “A Course in Electrical Machine Design” Dhanpat Rai & Sons.
- K.G. Upadhyay, “Conventional and Computer Aided Design of Electrical Machines”, Galgotia Publications.
- M.G. Say, “The Performance and Design of AC Machines” Pitman & Sons.
- A.E. Clayton and N.N. Hancock, “The Performance and Design of D.C. Machines” Pitman & Sons.
- S.K. Sen, “Principle of Electrical Machine Design with Computer Programming” Oxford and IBM Publications.

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UNIT 1: Microcontroller Basics-8-Bit and 16-bit Microcontroller Internal Block Diagram, CPU, ALU, address bus, data bus, control signals, Working Registers, SFRs, Clock and Reset circuits, Stack and use of Stack Pointer, Program Counter. I/O Ports, Memory structure, Data Memory, Program Memory, and Execution of Program. Power saving modes and its operation, Timing diagram for execution cycle. Different Addressing Modes, Interrupts priority, interrupt handling, house keeping during power on and power off situations, self-check and recoveries. 6(L)

UNIT 2: Microprocessor Basics-8085 basic concepts & 8086 basic concepts 8(L)

UNIT 3: On Chip Peripheral Interfaces-Interfacing concept and design rule, Interfacing of digital input and output pin PWM, ADC, I/O Pins, Timers, counters, Interrupts, UART, I2C, SPI, ICSP, DATA EEPROM, FLASH RAM 6(L)

UNIT 4: External Interfaces-A to D, D to A, LCD, LED & keyboard interfacing, I/O expansion techniques, Memory expansion techniques, RS232, RS485 transceivers. Stepper motor interfacing, DC Motor interfacing, sensor interfacing, CAN Protocol and its interfacing, USB protocol and its interfacing, Blue-tooth, Zig-bee protocol and its interfacing 8(L)

UNIT 5: Integrated Development Environment (IDE) for Microcontrollers-(Specific examples of ATMEL 89C51 with Kiel IDE or PIC micro controllers with MPLAB IDE) Study of datasheets, programming using assembly language and "C" Cross compiler, programming tools such as simulator, assembler,"C" cross compiler, emulator and debugger. Illustrative applications and programming techniques, Tutorial programs should include programming using: Arithmetic instructions, Jump, Loop and Call instructions, I/O programming, Logic instructions, Single bit instructions, Timer/Counter Programming, UART programming, Interrupt Programming. 8(L)

UNIT 6: Analysis of any reference design-Application examples: Any reference circuit schematic with specification application and firmware analysis can be taken 4(L)

Text/ Reference Books:

- The 8051 microcontroller – Kenneth J. Ayala, Penram International, 3rd edition
- 8051 Microcontroller and embedded systems – M. Mazidi, Pearson Higher Education
- Programming and customizing the 8051 microcontroller – Myke Predko, TATA McGraw Hill Edition.
- Embedded System - Raj Kamal, TATA McGraw Hill Edition
- Microprocessor Architecture, Programming and Application with the 8085 – Ramesh S. Gaonkar
- Microprocessor & Interfacing – D. V. Hall

POWER SYSTEM OPERATION AND CONTROL (EE-1837)

UNIT 1: Characteristics of Modern Power Systems-Physical Structure, Operation and Control Functions and Hierarchies, Design and Operating Criteria 4(L)

UNIT 2: Equipment and Stability Constraints-Capabilities and Constraints of Generators/ Exciters/ Turbines/ Network Elements (Lines, Transformers etc.), Constraints of Energy Supply Systems, Load Characteristics, Introduction to Angle/Voltage Instability phenomena, Stability Constraints 10(L)

UNIT 3: Frequency and Voltage Control-Primary Control of Frequency: Governors, Secondary Control of Frequency: AGC, Voltage control: Automatic Voltage Regulators (generators), Shunt Compensation, SVC 15(L)

UNIT 4: Introduction to Power Flow Control-HVDC, FACTS, Load Curves, Unit Commitment, Introduction to the use of Optimization Methods 10(L)

UNIT 5: Load Dispatch Centre Functions-Preventive, Emergency and Restorative Control, Power system Security: Basic concept, Factors affecting security, contingency analysis: security analysis, linear sensitivity factors, AC power flow methods, contingency selections, concentric relaxation, bounding 4(L)

UNIT 6: Additional Topics-Related to new developments 4(L)

Text/ Reference Books:

- P.M. Anderson and A.A. Fouad, Power System Control and Stability, John Wiley & Sons, Inc. 2003.
- P. S. Kundur, Power System Stability and Control, McGraw-Hill Professional, 1994.
- E. W. Kimbark, Power System Stability, Wiley-IEEE, 1995.
- J. W. Bialek, J. Machowski, Power System Dynamics and Stability, John Wiley, 1997.
- P. W. Sauer, M. A. Pai, Power System Dynamics and Stability, Prentice Hall, 1998.
- K. R. Padiyar, Power System Dynamics: Stability and Control, John Wiley, 1996.
- L. L. Grigsby, Power System Stability and Control, Taylor & Francis, 2007.
- P S R Murty, "Operation And Control In Power Systems", BSP Books Pvt Ltd, 2008

DIGITAL PROTECTION OF POWER SYSTEMS (EE-1838)

UNIT 1: Evolution of relays from electromechanical relays-Performance and operational characteristics of digital protection. Mathematical background to protection algorithms: Finite difference techniques, Interpolation formulas: forward, backward and central difference interpolation. Numerical differentiation, Curve fitting and smoothing, Least squares method, Fourier analysis, Fourier series and Fourier transform, Walsh function analysis.

UNIT 2: Basic elements of digital protection-Signal conditioning : transducers , surge protection , analogue filtering , analogue multiplexers , Conversion subsystem : the sampling theorem , signal aliasing error, sample and hold circuits, multiplexers , analogue to digital conversion , digital filtering concepts , the digital relay as a unit consisting of hardware and software.

UNIT 3: Protection algorithms-Sinusoidal wave based algorithms: Sample and first derivative (Mann and Morrison algorithm) Fourier and Walsh based algorithms: Fourier algorithm: Full cycle window algorithm, fractional cycle window algorithm. Walsh function based algorithm.

UNIT 4: Other algorithms-Least squares based algorithms. Differential equation based algorithms. Travelling wave based techniques.

UNIT 5: Digital differential protection of Electrical Power system-Digital transformer protection. Digital line differential and distance protection. Digital protection of motors

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Text/ Reference Books:

- Digital Protection for Power Systems: A.T. Johns and S.K. Salman Peter Peregrinus Ltd. on behalf of the IEE London U.K.
- Power System Protection and Switchgear : Badri Ram and D.N. Vishvakarma TMH , New Delhi
- Transmission Network Protection : Theory and Practice : Y.G. Paithankar Marcel Dekker , USA
- Computer Relaying for Power Systems: Arun G. Phadke and J.S. Thorp John Wiley and Sons Ltd. England and Research Studies Press Ltd.
- Fundamentals of Power System Protection: Y.G. Paithankar and S.R. Bhide , 2nd Edition PHI Learning Pvt. Ltd , New Delhi India , July 2010
- J.L. Blackburn, Protective Relaying: Principles and Applications, Marcel Dekker, New York, 1987.
- Network Protection Application Guide: Areva
- Art and Science of Protective Relaying: C.R. Mason

Professional Elective IV

POWER QUALITY (EE-1841)

UNIT 1: Introduction-Electrical power distribution system, Reliability and Power Quality, Stiff and non-stiff feeders, linear and nonlinear loads, Utility and customers, Power Quality issues 4(L)

UNIT 2 Power Quality Characterization and Analysis: Load power factor, Harmonic distortion, transients, unbalancing, Voltage sag/swell, Power acceptability curves, Limits of harmonic distortions: IEEE 519, IEC standards, Power outages, Harmonic distortion indices, symmetrical components, Analysis of voltage sag/swell and flicker, Effects of harmonic distortion 8(L)

UNIT 3: Conventional Methods of Compensation-Load balancing, Capacitor banks, higher pulse converter, Transformer connections, Harmonic filter design, Tuned and damped filter design, Resonance effect, Transfer function based analysis of filter. 8(L)

UNIT 4: Power Converters and Control-Voltage source inverters (VSIs), Open loop and closed loop modulations, Current controllers, fundamental frequency and sinusoidal pulse width modulation (SPWM), hysteresis and ramp-comparison current control, Sliding mode control. 6(L)

UNIT 5: Reference Current Generation-Reference generation for single-phase compensators, Three-phase compensation, Instantaneous PQ theory, Instantaneous symmetrical component method 6(L)

UNIT 6: Custom Power Devices-Shunt, series and shunt-series active power filters, Uninterrupted power supply (UPS), Distribution static compensator (DSTATCOM), Dynamic voltage restorer (DVR), Unified power quality conditioner (UPQC), etc. 8(L)

Text/ Reference Books:

- Ghosh and G. Ledwich, Power Quality Enhancement using Custom Power Devices, Kluwer Academic Publisher, Boston, MA, 2002.
- G. J. Walkileh, "Power Systems Harmonics", Springer Verlag, New York, 2001.
- IEEE Standard 519-1992, IEEE recommended practices and requirements for harmonic control in electrical power systems, 1992.
- R. C Dugan, S. Santoso, M. F. McGranaghan and H. W. Beaty, Electric Power System Quality, McGraw- Hill, New York, 2003.
- M. H. Rashid (ed), Power Electronics Handbook, Academic Press, Florida, 2001.
- J. K Phipps, "A Transfer function approach to harmonic filter design". IEEE Industry Application Magazine, pp. 68-82, March/April, 1997.
- F. Z. Peng, "Application issues of active power filters", IEEE Ind. Applicat. Mag., vol.4, no.5, pp.21-30, Sept./Oct. 1998.
- M. Carpita and M. Marchesoni, "Experimental study of a power conditioning system using sliding mode control", IEEE Trans. Power Electronics, vol.11, no.5, pp.731-742, Sept. 1996.

MODELLING AND SIMULATION OF ELECTRICAL MACHINES (EE-1842)

UNIT 1: Review of electrical machines characteristics. Basic-drive schemes and drive applications. Fundamentals of energy conversion. Space vector, two-axis machine and reference frame theories. Torque production in cylindrical machines. Torque production in reluctance machines and elementary rotating machines. 7(L)

UNIT 2: Induction machine modelling. Space vector based modelling and matrix based approach. Transient and steady state performance of three phase induction motors. Induction motor control, (steady state approach). Induction machine drives, (slip ring induction motor drive, v/f drive and vector controlled drives) design and analysis. Starting and braking. Converter systems for drives. 7(L)

UNIT 3: Cylindrical and salient pole synchronous machine modeling and design. Transient and steady state performance of a synchronous machine connected to grid. Analysis of conventional and permanent magnet synchronous machine drives, including v/f and vector controlled drives. 7(L)

UNIT 4: DC machine modelling. Steady state and transient behaviour of various DC machines. Starting and braking methods of DC machines fed by a constant voltage supply. Thyristor controlled and transistor controlled DC machine drives analysis. 4(L)

UNIT 5: Simulation of Electrical Machines and Systems – I, Rotating Field Simulation in AC Machines. Dynamic Simulation of Three-Phase Induction (Asynchronous) Motor. 4(L)

UNIT 6: Simulation of Electrical Machines and Systems – II, Dynamic Simulation of Brushless Permanent Magnet AC Motor Drives. Dynamic Simulation of Direct Current Motors. Simulation of Stepper Motors 4(L)

Text/ Reference Books:

- Simmons and Kelly, Introduction to Generalized Machine Theory
- Hancock, Matrix Analysis of Electric Machinery
- LabVIEW® for Electric Circuits, Machines, Drives, and Laboratories, By: Nesimi Ertugrul, Publisher: Prentice Hall

ADVANCED INSTRUMENTATION (EE-1843)

- UNIT 1: Introduction**-Introduction to embedded systems and architecture, system design using specification and modeling tools. 10(L)
- UNIT 2: Computing Platforms**-Overview of embedded computing platforms; microprocessors, microcontrollers, DSPs and SoCs, hardware – software design and partitioning. 10(L)
- UNIT 3: Designs and trade-offs**-Design issues, consideration and trade-offs: performance memory, power, timing, cost, and development time. Memory hierarchy, system interfaces and communication with peripheral units, timers-counters, introduction to real-time system and real-time scheduling. 10(L)
- UNIT 4: RTOS**-Real-time software development: high level languages and programming issues, systems performance: networked embedded systems. 10(L)

Text/ Reference Books:

- Liu- Real-time systems (Pearson)

ELECTRICAL SYSTEM DESIGN (EE-1844)

- UNIT 1:** Overview of industry and their requirement of electrical systems, Scope of Electrical Engineers in Modern Industry, Basic Electrical Terms- Definitions, Glossary, Units, Knowing Client requirements & collection of specific data for projects, Understanding various phases of projects, Project management- Project Estimation, Testing & Commissioning, Planning, Procurement Process, Tendering, etc. 8(L)
- UNIT 2:** Use of International Standards, Electrical Codes & Standards - BS, NEC, IEE, IEEE, NFPA, IEC Design Basis, std. practices/procedure and specifications, Understanding, Basic Electrical Formulae, Basic Design requirement based on the type of various plants, Intra-discipline co-ordination with civil, process, mechanical, piping, telecom HVAC etc. 6(L)
- UNIT 3:** Wiring Accessories & Cable Management Systems, Cable Selection and Sizing and cable laying methods, Selection and sizing of electrical equipments used in various projects, Preparation of equipments specifications, High Voltage system requirements including substation design. 6(L)
- UNIT 4:** Lighting systems, Lighting Fixtures (Types & Applications), Lighting Design- Illumination Lux Levels, Emergency & Exit Lighting System, Specialized Engineering like Heat Tracing systems and cathodic protection design, Design of Earthlings system, Lightning system and lightning protection system, Low current systems- Fire alarm & detection system, CCTV system etc. 8(L)
- UNIT 5:** Generation, Transmission & Distribution of Electricity, Design of power distribution, Earthing and lighting protection systems system, Equipment vendor drawing review and approval. 4(L)
- UNIT 6:** Electrical System Drafting (CAD)- Preparation of lighting layouts, Preparation of Power Layouts, Preparation of Single Line Diagrams (SLD) or Riser Diagrams, Preparation of Electrical General Installation Details & Sections, Preparation of LV or Electrical Room Details, Procurement Requirements and installation standards., Inspection of Equipments/system.

Text/ Reference Books:

- Electrical System Design and Specification Handbook for Industrial Facilities, Steven J. Marrano, Faimount Press.
- Electrical System Design, Theodore R. Bosela.
- Efficient Electrical Systems Design Handbook, Albert Thumann; Harry Franz; 2009, Fairmount Press.
- Electrical Design Estimating and Costing, K.B. Raina.

FACTS (EE-1845)

- UNIT 1 FACTS controllers:** Introduction to Flexible AC Transmission Systems (FACTS), challenges and needs, Power Flow in AC transmission line, Power flow control, Description and definition of FACTS controllers 6(L)
- UNIT 2 Power Electronic Controllers:** Power Electronics Devices, ratings and control characteristics, Diodes, Thyristors, GTOs and IGBTs in FACTS, Static power converter structures, Thyristor circuits, Voltage-sourced and current-sourced converters, Converter output and harmonic control, six-pulse and multi-pulse converters, Sinusoidal pulse width modulation, Multi-level converters 7(L)
- UNIT 3 Shunt Compensation:** Static VAR compensator (SVC), Thyristor controlled reactor (TCR), Thyristor switched capacitor (TSC), TSC-TCR, FC-TCR, Static synchronous shunt compensator (STATCOM), Operation and control, Configurations and applications, Mid-point compensation 7(L)
- UNIT 4 Series Compensation:** Ideal series compensation, Sub-synchronous resonance (SSR), GTO capacitor series compensation (GCSC), Thyristor switched series capacitor (TSSC), voltage and impedance control mode, Thyristor controlled series compensator (TCSC), Static synchronous series compensator (SSSC), Operation and control, Configurations and applications 8(L)
- UNIT 5 Combination of Shunt series Compensation:** Unified power flow controller (UPFC), Power flow studies, operational constraints, Interline power flow controller (IPFC), Configurations and applications 7(L)
- UNIT 6 Other FACTS Controllers:** Thyristor controlled phase angle regulator (TCPAR), Thyristor Controlled Braking Resistors (TCBR) etc. 5(L)

Text/ Reference Books:

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- Transmission Systems, IEEE Press 2000.
- K.R. Padiyar, FACT's Controllers in Transmission & Distribution, New Age Publishers, Delhi, 2007.
- V. K. Sood, HVDC and FACTS Controllers: Applications of Static Converters in Power Systems, Springer 2004
- Enrique Acha, FACTS: Modelling and Simulation in Power Networks, John Wiley and Sons, 2004.

ANALYTICAL INSTRUMENTATION (EE-1846)

UNIT 1: Introduction-Basics of analytical instrumentation, use of computers in analytical instrumentation, statistical techniques.

UNIT 2: Emission and absorption spectroscopy-Introduction, em radiation, laws of absorption radiation, uv and visible radiation spectroscopy, calorimeters, double beam spectro-photometer; Infrared spectroscopy - Basic components, types, sample handling techniques. Atomic absorption spectro-photometers – principle, sources of interference, meter scale. 12(L)

UNIT 3: Flame photometers-Principle and construction, clinical types, expression for concentration, interferences, procedures for determination.

UNIT 4: Mass spectrometers-Types and principle of operation, inductively coupled mass-plasma spectrometer, trapped ion analyzers, ion cyclotron mass spectrometer (ICR), Quadruple ion trap mass spectrometer, uses of mass spectrometry; Separation techniques – Gas, ion and liquid chromatography and head space analysis. 12(L)

UNIT 5: Microscopy-Concept of scanning electron microscopy, transmission electron microscopy, tunneling microscopy, and atomic force microscopy; Applications in material characterization.

UNIT 6: Nuclear magnetic resonance-NMR spectroscopy, principle of NMR, types of NMR spectrometers, constructional details, variation T-60A NMR spectrometer, sensitivity enhancement for analytical NMR spectroscopy, Fourier transform NMR spectroscopy. 10(L)

UNIT 7: Application case studies 6(L)

Text/ Reference Books:

- Khandpur, R.S. – Handbook of analytical instruments (TMH)
- Willard, Meritt, Dean, Settle – Instrumental methods of analysis (CBS Pub)

MECHATRONICS (EE-1847)

UNIT 1: Introduction & Principles of Robotics 2(L)

UNIT 2: Motor Load modeling, Mechanical elements, Mechanisms, Machines, Types of motion, Kinematic Chains, The four-bar chain, The slider-crank mechanism, Cams: Classification of cam mechanisms, Modes of input/output motion, Follower configuration, Follower arrangement, Cam shape, Motion events, Constant velocity motion, Constant acceleration motion, Harmonic motion, etc 6(L)

UNIT 3: Power transmission and sizing, Gearboxes: Planetary gearbox, Harmonic gearbox, Cycloid gearbox, Lead and ball screws, Belt drives, Bearings: Conventional bearings, Air bearings, Magnetic bearings, Couplings, Shafts: Static behavior of shafts, Transient behavior of shafts 4(L)

UNIT 4: Velocity and position transducers, Rotating velocity transducers, Brushed d.c. tachogenerators, Brushless d.c. tachogenerators, Incremental systems, Electromechanical pulse encoders, Position transducers, Brushed potentiometers, Linear variable differential transformers - LVDT, Resolvers, Rotary and linear Inductosyn, Optical position sensors, Application of position and velocity transducers 4(L)

UNIT 5: Induction motor characteristics, Scalar control, Vector control : Vector Control using sensors and Sensorless Vector Control 6(L)

UNIT 6: Motors and actuators such as Voice Coils, Limited-angle torque motors, Piezoelectric motors, Switched Reluctance motors, Shape-memory alloy 2(L)

UNIT 7: Controllers for automation, Servo control, Digital controllers, Advanced control systems, Digital signal processors, Motion controllers, Programmable logic controllers 6(L)

UNIT 8: Networks, Network architecture, Industrial networking 2(L)

UNIT 9: Hardware-in-the-loop simulation and rapid prototyping of real-time closed-loop computer control of electromechanical systems 6(L)

Text/ Reference Books:

- Electric Drives and Electromechanical Systems Applications and Control by Richard Crowder, Elsevier
- Robert H. Bishop. Editor-in-chief. "The Mechatronics Handbook", CRC Press, with ISA– The Instrumentation, Systems, Automation Society (50 Chapters), 2002. ISBN: 0-8493-0066-5. PDF files
- Mechatronics Principles and Applications by Godfrey Onwubolu Elsevier

PROCESS CONTROL (EE-1848)

UNIT 1 Introduction: Motivation and applications; Objectives; Process control systems, configurations, examples; Role of control engineer; Chemical industry equipments and unit operations*; Process documentation. 4(L)

UNIT 2 Mathematical modeling of processes: Type of models; modeling procedure steps; empirical model identification; system identification; Input/Output transfer function and transfer matrix, state -space, time series – AR, MA, ARMA, ARIMA, ARMAX ..., Astrom's difference equn model, nonlinear models

Control problems, dynamics, modeling, selection, degree of freedom approach with examples. Modeling of temperature sensors, concentration response of isothermal CSTR- with no chemical reaction, first order reaction, higher order reactions. Pressure and liquid systems with linearization approach for real systems; Effect of change in valve positions; Modeling of interacting and non-interacting systems. 8(L)

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and key feature of control actions; Transient response of systems for set point control and regulatory actions for first, second and higher order systems with P, PI, PD, and PID control actions. Effect of measurement lag and process dead-time on response. PID Controller architectures and various process system models. 8(L)

UNIT 4 Complex control concepts in process systems: PID controller tuning methods*; Control valves- types*, dynamics and characteristics; Cascade control, feed-forward control, selector and redundant control concepts, example, design. 5(L)

UNIT 5 Concept of computer control: Real-time control, batch and continuous production; sequential, supervisory and DDC modes of operation; Digital implementation of PID controllers; Computer control architectures- hierarchial, DCS. 5(L)

UNIT 6 Advanced control strategies: Model predictive control; Dead-time compensation; Internal model control; Adaptive control*; Introduction to intelligent control*. 10(L)

*Students' seminars shall be integral components, once per week.

Text/ Reference Books:

- Harriot,P – Process control (TMH)
- Singh, S.K. - Computer Aided process control (PHI)
- Seborg,Edgar, Mellichamp –Process dynamics and control(Wiley)
- Marlin,T.E. – Process control – Designing processes & control systems.(MGH)
- Bennet, S. - Real time computer control (Pearson)

DISTRIBUTION AUTOMATION (EE-1849)

UNIT 1: Distribution system planning-Tools for distribution system planning and design 6(L)

UNIT 2: Substation Automation-Data acquisition from field devices and supervisory control of field devices, Fault location, Fault isolation, service restoration, substation reactive power control 7(L)

UNIT 3: Feeder level Automation-Data acquisition from Field devices at feeder level, supervisory control of field devices, Fault location, Fault isolation, service restoration, Feeder reconfiguration, feeder reactive power control. 7(L)

UNIT 4: Customer level Automation-automatic meter reading, Remote programming of time-of-use (TOU) meters, Remote service connect / disconnect, Automated customer claims analysis 6(L)

UNIT 5: Control hierarchy and control centre architecture-RTU's , IEDs, PLCs, Use of GPS and GIS systems for Asset/Facilities management. 6(L)

UNIT 6: Cost benefit analysis of Distribution Automation schemes-Review of distribution automation roadmaps of prominent utilities in Europe and US, Review of distribution automation in Indian utilities. 8(L)

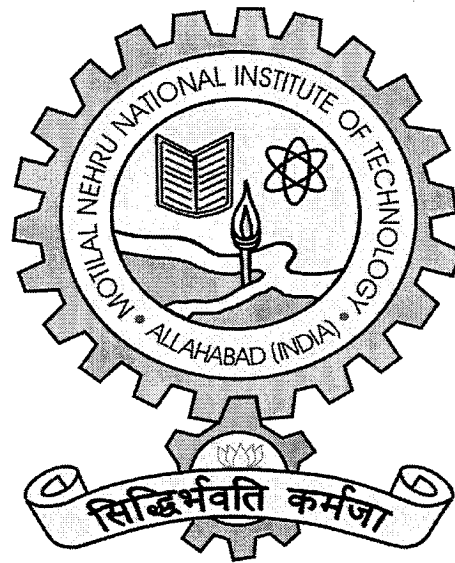
Text/ Reference Books:

- Mary S. Nardone, Direct Digital Control Systems: Application Commissioning, Kluwer.
- Klaus-Peter Brand and others Substation Automation Handbook

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Course Structure & Curriculum
For
B. Tech. Programme

In
ELECTRONICS & COMMUNICATION
ENGINEERING



Department of Electronics & Communication
Engineering
Motilal Nehru National Institute of Technology
Allahabad

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**Bachelor of Technology in
(Electronics and Communication Engineering)**

3rd Semester (Electronics and Communication Engineering)

Course Code	Course name	L	T	P	Credit
EC-1301	Principles of Electronics Engineering	3	1	0	4
MA-1302	Mathematics-III	3	1	0	4
CS-1302	Data Structures and Operating Systems	3	0	0	3
MA-1303	Numerical Methods and Statistical Techniques	3	0	0	3
EE-1305	Principles of Electrical Engineering and Measurement	3	0	0	3
EC-1302	Signals and Systems	3	0	0	3
EC-1351	Electronics Engineering Lab	0	0	3	2
EE-1352	Electrical Engineering and Measurement Lab	0	0	3	2
CS-1353	Data Structure Lab	0	0	3	2
Total		18	2	9	26

4th Semester (Electronics and Communication Engineering)

Course Code	Course name	L	T	P	Credit
EC-1401	Analog Communication	3	1	0	4
EC-1402	Digital Electronics	3	1	0	4
EE-1404	Networks & Systems	3	0	0	3
EC-1403	Electromagnetic Theory	3	1	0	4
EC-1404	Electronic Devices and Circuits	3	0	0	3
HS-1401	Principles of Management	3	0	0	3
EC-1451	Analog Communication Lab	0	0	3	2
EC-1452	Digital Electronics Lab	0	0	3	2
EC-1453	Electronic Devices and Circuits Lab	0	0	3	2
Total		18	3	9	27

5th Semester (Electronics and Communication Engineering)

Course Code	Course name	L	T	P	Credit
EC-1501	VLSI Technology and Device Modelling	3	0	0	3
EC-1502	Microprocessors and its Applications	3	0	0	3
EC-1503	Antenna and Wave Propagation	3	0	0	3
EC-1504	Electronic Circuit Design	3	1	0	4
EC-1505	Digital Communication	3	0	0	3
EE-1505	Automatic Control Systems	3	0	0	3
EC-1551	Microprocessors Lab	0	0	3	2
EC-1552	Electronic Circuit Design Lab	0	0	3	2
EC-1553	Digital Communication Lab	0	0	3	2
EE-1554	Automatic Control Systems Lab	0	0	3	2
Total		18	1	12	27

6th Semester (Electronics and Communication Engineering)

Course Code	Course name	L	T	P	Credit
EC-1601	Digital Signal Processing	3	0	0	3
EC-1602	RF and Microwave Engineering	3	0	0	3
EC-1603	Data Communication and Networks	3	1	0	4
EC-1604	Optical Communication	3	0	0	3
EC-1605	Microelectronics and VLSI Design	3	0	0	3
EC-1606	Computer Architecture	3	0	0	3
HS-1601	Communication Skill (Workshop)	0	0	2	0
EC-1651	Digital Signal Processing Lab	0	0	3	2
EC-1652	Microwave Engineering Lab	0	0	3	2
EC-1653	Microelectronics and VLSI Design Lab	0	0	3	2
Total		18	1	11	25

7th Semester (Electronics and Communication Engineering)

Course Code	Course name	L	T	P	Credit
EC-1701	Mobile and Wireless Communication	3	0	0	3
OE-1781	Open Elective I	3	0	0	3
EC-1731 to EC-1740	Prof. Elective-I	3	1	0	4
EC-1741 to EC-1750	Prof. Elective-II	3	1	0	4
EC-1751	Lab Elective	0	0	3	2
EC-1791	Project	0	0	12	6

8th Semester (Electronics and Communication Engineering)

Course Code	Course name	L	T	P	Credit
OE-1881	Open Elective II	3	0	0	3
EC-1801	Advanced Digital Signal and Image Processing	3	1	0	4
EC-1831 to EC-1840	Prof. Elective-III	3	1	0	4
EC-1841 to EC-1850	Prof. Elective-IV	3	1	0	4
EC-1851	Advanced Digital Signal and Image Processing Lab	0	0	3	2
EC-1891	Project	0	0	12	6
	Total	12	3	15	23

1st digit; 1: UG, 2nd digit; 2, 3, etc.: Semester

Code	Description
01-30	Theory Courses
31-40	Professional Elective -I
41-50	Professional Elective -II
51-70	Practical Courses
81-90	Open Elective
91-99	Project

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UNIT 1: Diodes- Introduction to *pn* diode and its applications as rectifier, rectifier as DC Power Supply, Clamper, Clipper, Voltage multiplier etc., Zener diode and its applications as regulator, Tunnel diode and Varactor diode. 8(L)

UNIT 2: Transistors- Review of Transistor working, characteristics & its parameters, Transistor as an amplifier, Biasing of bipolar junction transistors, *h*-parameters & transistor equivalent circuits, small signal single-stage amplifier, frequency response, concept of feedback. 8(L)

JFET and MOSFET Basic construction, working, concept of pinch-off, characteristics of JFET, MOSFET (Enhancement and Depletion), FET as a voltage variable resistor. 6(L)

UNIT3: Operational amplifier- Ideal & non-ideal characteristics, concept of summing junction and virtual ground. Application of operational amplifier as: Adder, Subtractor, Differentiator, Integrator, Multiplier, Unity gain amplifier & Logarithmic amplifier. 6(L)

UNIT 4 Introduction to Digital Electronics: Review of number systems, complements, codes, Boolean algebra, Logic gates, Minterm and Maxterms, Canonical and Standard forms, Logic functions & Logic circuits. Minimization of Boolean functions using K-map. 6(L)

UNIT 5 Measuring Instruments: Working of Cathode Ray Oscilloscope, Power supply, Multimeter and Function generator 6(L)

Text/ Reference Books:

- Electronic devices and circuit theory by Robert Boylested and Louis Nashelsky
- Electronic principles by Albert Malvino
- Integrated Electronics by Jacob Millman, Chistos C. Halkias
- Digital design by Morris Mano
- Modern Digital Electronics by R. P. Jain
- Modern electronics Instrumentation and Measurement Techniques by A. D. Helfrick and W. D. Cooper

MATHEMATICS -III (MA-1302)

UNIT 1: Power Series Solution- Ordinary and Singular points, Regular Points, Irregular Points, Power Series Solution, Frobenius Method. 4(L)

UNIT 2: Legendre Polynomial, Bessel's Functions, Sturm-Liouville Problem- Legendre Differential Equations and Legendre Polynomials, Rodrigue's Formula, Generating Functions, Recurrence Relation, Orthogonal Properties of Legendre Polynomials, Bessel's Differential Equations and Bessel's functions, Recurrence Relation, Orthogonal Properties of Bessel's Function. Sturm-Liouville problem, orthogonal polynomials and functions. 8(L)

UNIT 3: Function of Complex Variables- Function of a complex variable, Analyticity, Analytic function, Cauchy-Riemann Equation, Harmonic Function, Application of analytic function to flow problem, Construction of Analytic function, Conformal mapping and Bilinear Transformation 8(L)

UNIT 4: Contour Integration- Contour/Complex Integration, Cauchy's integral theorem and formula, Morera's Theorem, Zeros & Singularity, Calculus of Residue, Residue's Theorem,. 6(L)

UNIT 5: Probability Theory- Axiomatic definition of probability, Conditional probability and Baye's theorem, Random Variables, Discrete Random Variables, Continuous Random Variables, Probability function of Discrete Random Variables, Distribution function, Mean & Variance, Expectation and moments, Moment Generating functions. 6(L)

UNIT 6: Binomial, Poisson and Normal distributions- Binomial and Poisson Distributions, Normal Distribution, Mean & Variance, Moment Generation Function, Normal approximation to Binomial distribution, Mean, Variance, Median & Mode, Moment Generation Function, Mean Deviation from Mean. 6(L)

Text/ Reference Books:

- Legendre polynomials and factions by Refaat Elattar
- Complex Variables by Francis J. Flanigan
- Engineering Maths 4th Edition by Anthony croft, Robert Darison, Martin Hargreaven, James Flint
- Advanced Engineering Mathematics by L.R. Mustole
- Random variables & stochastic process by Papoulis.

DATA STRUCTURES AND OPERATING SYSTEMS (CS-1302)

UNIT 1: Basic Computer Architecture, Function and structure of Hardware and Software Components, CPU, ALU, Memory, I/O devices, System Software, Application Software. 6(L)

UNIT 2: Introduction, Motivation, and Overview of an Operating System with an emphasis on its role as a Manager of Hardware Resources, History of Computer Hardware (including a review of H/W structures) and how Operating Systems Evolved in tandem with the Hardware. 7(L)

UNIT 3: Programming software (Writing software), Program and Process, Program specifications and design, Abstract data types, Basics of C, Time and space complexity of Programs. 5(L)

UNIT 4: Need of Data Structures, Linear and nonlinear Data structure, Stack, Queue, Tree, Graph, B-tree 5(L)

UNIT 5: Processor and Memory Management, Process Management, Concurrent Process, Semaphores, Fork and Join, CPU Scheduling including Preemptive, and Non-Preemptive, Application of Stack and Queue, Sequential and linked implementation, in designing program for CPU and Disk scheduling, Page Tables, Page Replacement Algorithms. 7(L)

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- Fundamentals of data structures by Horowitz and Sahni
- Data Structure Using C by Tanenbaum
- Operating System Concepts, Abraham Silberschatz and Peter Galvin

NUMERICAL METHODS AND STATISTICAL TECHNIQUES (MA-1303)

UNIT 1: Algebraic and Transcendental Equations-Errors in numerical computation and their analysis, Bisection method, Iteration method, Newton-Raphson Method, Method of False Position, rate of convergence, Method for complex root, Muller's Method, Quotient Difference method. 8(L)

UNIT 2: Interpolation-Introduction, Errors in Polynomial interpolation, Finite differences, Decision of errors, Newton's formula for interpolation, Gauss, Sterling, Bessel's, Everett's Formula, Interpolation by unevenly spaced points, Lagrange interpolation formula, Divided Difference, Newton's General interpolation Formula. 9(L)

UNIT 3: Curve Fitting, Cubic Spline & Approximation-Introduction, Method of Least Square curve fitting procedures, Fitting a straight line, Curve fitting by sum of exponential, Data fitting with cubic splines, Approximation of functions. 7(L)

UNIT 4: Numerical Integration and Differentiation-Introduction, Numerical differentiation, Picard Iteration Method of Solution, Numerical integration, Trapezoidal rule, Simpson 1/3 rule, Simpson 3/8 rule, Booles & Weddells rule, Euler- Maclaurin's formula, Gaussian Formula, Numerical evaluation of singular integrals. 5(L)

UNIT 5: Numerical Linear Algebra-Numerical techniques for finding solution of system of linear equations and eigen values: Gauss Jordan, Gauss Seidel methods, Power method for estimating eigen values: LU and LL* factorization of matrices. 6(L)

UNIT 6: Statistical Computations-Frequency Chart, Regression Analysis, Least Square fit, Polynomial fit, Linear and Nonlinear Regression, Multiple Regression, Statistical Quality Control Methods. 7(L)

Text/ Reference Books:

- C. F. Gerald and P.O.Wheatley, Applied Numerical Analysis, Pearson Education
- M.K.Jain, S.R.K.Iyenger and R.K.Jain, Numerical Methods for Scientific and Engineering Computation, Wiley Eastern Ltd.
- S.S Sastry, Introductory Methods of Numerical Analysis, Prentice Hall
- S. Rajasekharan, Numerical Methods for Science and Engineering, S.Chand.
- James I. Buchman and Peter R. Turner, Numerical Methods and Analysis, McGraw-Hills Inc.

PRINCIPLES OF ELECTRICAL ENGINEERING AND MEASUREMENT (EE-1305)

UNIT 1: D.C. Network Theory-Circuit Theory Concepts – Mesh and Node Analysis; Network Theorems; Superposition, Thevenin, Norton and Max. Power Transfer Theorem, Star – Delta Transformation. 6(L)

UNIT 2: Steady State Analysis of AC Circuits- Sinusoidal and Phasor Representation of Voltage and Current, Single Phase AC circuit behavior of R, L & C, Combination of R, L & C in series and parallel, Resonance, Bandwidth and Quality Factor 8(L)

UNIT 3: Three-Phase A.C. Circuits-Line and phase voltage/current relationships for star and delta connection, Power measurement in 3-phase A.C. circuits.

Measuring Instruments: Construction & Principle of operation of voltage and current measuring instruments, Introduction to Wattmeters and Energy Meters. 6(L)

UNIT 4: Magnetic Circuits and Transformer:- Magnetic Circuits, Principle of Operation & Construction of 1 ϕ transformer, Phasor diagram, Equivalent Circuit, O.C. and S.C. test, Efficiency and voltage Regulation 6(L)

UNIT 5 Introduction to Rotating Machines: Principle of Electromagnetic Energy Conversion; Types of d.c. machines, emf equation, magnetization and load characteristics, losses and efficiency of d.c. machines, Starting and speed control of d.c. motors, 3- ϕ induction motors - working principle and applications, 1- ϕ Induction motor - working principle and applications, Stepper motors. 8(L)

UNIT 6: Power Systems-Generation- Types of power Plant, Functional Block diagram of Generating stations (Hydel & Thermal Stations); Transmission- Standards (AC & DC), Substations, Grids; Distribution- Industrial, Commercial and Domestic Standards; Utilization- Types of loads, UPS and domestic inverters; Domestic Wiring- Materials, accessories & ratings of the wiring materials, types of wiring: fluorescent tube and simple domestic wiring layout, earthing rules.

Text/ Reference Books:

- I.V. Del Toro: Principle of Electrical Engineering, PHI, New Delhi.
- W.H.Hayt & J.E.kemmerly: Engineering Circuit analysis Mc Graw Hill New Delhi
- I.J.Nagrath: Basic Electrical Engineering, Tata Mc Graw Hill New Delhi
- W.D.Coper: Electronic Instruments & Measurement Technique, Prentice Hall India
- S.L.Uppal: Electrical Wiring, Estimating and Costing, Khanna Publishers Delhi.
- S.N.Singh; Electric Power Generation, Transmission and Distribution, PHI

SIGNAL AND SYSTEM (EC-1302)

UNIT 1: SIGNALS AND THEIR REPRESENTATION-Analogy between vectors and signals, Orthogonal signal space, Signal approximation using orthogonal functions, Mean square error, Closed or complete set of orthogonal functions, Orthogonality in complex functions, Eigen analysis, Hilbert spaces Types of signals, Continuous-time and Discrete-time signals: Energy and Power signals, Periodic and Aperiodic signals, Even and Odd signals, Exponential and sinusoidal signals etc., Transformations of the independent variable, Concepts of Unit impulse and Unit sample signals, Signum

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UNIT 2: LINEAR TIME-INVARIANT (LTI) SYSTEMS-Discrete and Continuous time LTI systems, convolution sum, convolution Integral, properties of LTI systems, causal LTI systems described by difference equations, Singularity functions. MATLAB Exercises. 4(L)

UNIT 3: FOURIER SERIES REPRESENTATION OF PERIODIC SIGNALS-Continuous-time and discrete-time signals and their Fourier series representation, properties of Fourier series, Dirichlet's conditions, Complex Fourier spectrum. MATLAB Exercises. 4(L)

UNIT 4: REPRESENTATION OF APERIODIC SIGNALS BY FOURIER TRANSFORMS-Continuous-time and discrete-time signals and their Fourier Transforms, Fourier Transforms of periodic signals and standard signals, properties of Fourier Transforms, System characterized by linear constant coefficient differential equation. MATLAB Exercises. 4(L)

UNIT 5: Z-TRANSFORMS-Principles of Z-Transform, definition, The Region of Convergence (ROC), properties of ROC, Relationship between Z-Transform and Fourier Transform, properties of Z-transform, Inverse Z-transform, pole zero plot, Power series expansion and partial fraction expansion, Initial value and Final value Theorems, Analysis and characterization of LTI system using Z-Transforms. MATLAB Exercises 7(L)

UNIT 6: SAMPLING-Representation of Continuous-time signals by its samples, Sampling theorem, Impulse train sampling, Sampling with Zero Order Hold (ZOH), Natural and Flat top sampling, Reconstruction of signal from its samples using interpolation, Effect of under sampling – Aliasing, sampling of Band pass signals. Discrete time processing of continuous time signals, Digital differentiator, Half sample delay, Sampling of Discrete-time signals, Decimation and interpolation. MATLAB Exercises. 8(L)

UNIT 7: RANDOM SIGNALS-Review of probability theory, Random signals and their representation, Continuous and Discrete Random variable, their description and examples, Statistical averages. MATLAB Exercises 3(L)

Text/ Reference Books:

- Signals and Systems by A. V. Oppenheim, A. S Willsky, and S. H. Nawab, Prentice-Hall, Englewood Clieffs.
- Fundamentals of Signals and Systems by Michel J. Robert, MGH International Edition, 2008
- Signals and Systems by B. P. Lathi.
- Signals and Systems by Simon Haykin and Van Veen, Wiley, 2nd Edition.
- Probability, random variables and stochastic Processes by A. Papoulis, McGraw-Hill.

ELECTRONICS ENGINEERING LAB (EC-1351)

Experiment 1: Familiarization to basic test and measuring instruments like Cathode Ray Oscilloscope (CRO), Function Generator, Power supply, Breadboard etc.

Experiment 2: To measure the frequency and amplitude of various waveforms using CRO.

Experiment 3: To verify the truth tables of different logic gates by using ICs and implement different logic gates using IC 7400.

Experiment 4: To study the *pn* junction diode characteristics under forward and reverse bias conditions.

Experiment 5: To study the application of a zener diode as voltage regulator.

Experiment 6: To determine the ripple factor of Half-Wave and Full-wave (Bridge) rectifiers.

Experiment 7: To observe the clipping wave forms in different clipping configurations.

Experiment 8: To observe the clamping wave forms in different clamping configurations.

Experiment 9: To determine the CE (Common Emitter) characteristics of a given BJT.

Experiment 10: To plot the drain and transfer characteristics of a given FET and to find drain resistance.

Experiment 11: To verify the addition and subtraction operation using op-amp 741.

ELECTRICAL ENGINEERING AND MEASUREMENT LAB (EE-1352)

Experiment 1: Verification of circuit laws and theorems.

Experiment 2: Study of resonance in RLC circuits.

Experiment 3: Measurement of power in three phase-circuit using two-wattmeter method.

Experiment 4: Energy measurement of single-phase circuits.

Experiment 5: Open circuits and short circuits test on single-phase transformer.

Experiment 6: Load test on single phase transformer.

Experiment 7: Magnetization characteristic of d.c. generators.

Experiment 8: Starting and running of DC motor.

Experiment 9: Study of the characteristics of d.c. series motors.

Experiment 10: Speed control of DC motors using (a) Field Control (b) Armature Control

Experiment 11: Starting, running and reversing three phase squirrel cage induction motor.

DATA STRUCTURE LAB (EC-1353)

Experiment 1: Pointers Structures & its functions

Experiment 2: Arrays

Experiment 3: Link List

Experiment 4: Binary trees

Experiment 5: Sorting algorithmes

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ANALOG COMMUNICATION (EC-1401)

UNIT 1: Review of Signal Representations, Frequency domain analysis of signals using Fourier Transforms. Introduction to Communication systems, guided and unguided transmission media, radio frequency spectrum, Concept of bandwidth, Mathematical models for communication channels Linear filter channel, Linear time-invariant channel 4(L)

UNIT 2: Analog Signal Transmission and reception: Modulation, Amplitude Modulation: Equation or AM wave, Modulation Index and Power relationships. AM transmitter: Generation of AM. AM demodulator: Theory and Mathematical analysis of Square Low detector, Envelope detector and synchronous detector. AM demodulator: Theory and Mathematical analysis of Square Low detector, Envelope detector and synchronous detector. DSB AM: Principle of nonlinear resistance, Balance modulator and Switching Modulator DSB Demodulation through product modulator, Costas receiver. SSB AM: Time domain representation of SSB signal, Generation methods: Filter, Phase shift method using Hilbert Transformer, SSB demodulator. VSB-AM generation, Demodulation using sideband filters, Quadrature Carrier multiplexing, FDM with basic groups, super groups, mastergroups. 3(L)

UNIT 3: Frequency and phase modulation, NBFM, WBFM, Multiplexed Stereo FM system Generation of Frequency Modulation: Reactance modulator and Indirect method, Multiplexed Stereo FM system 4(L)

UNIT 4: Radio receivers: Tuned radio frequency receiver, Superheterodyne receiver Sensitivity and selectivity, selection of IF. Block diagram and features of Communication Receiver. 3(L)

UNIT 5: FM receiver: block diagram, FM discriminates: slope detector, balance slope detector and phase discriminator. 3(L)

UNIT 6: Noise in Communication Systems: Thermal noise, Shot noise, S/N ratio, noise Equivalent bandwidth, Concept of Random Variables, PDF, CDF, Different types of Pdfs, Gaussian Rayleigh PDF, Noise performance of AM, DSB,SSB, FM systems under AWGN 3(L)

UNIT 7: Sampling Theorem, Analog Pulse modulation schemes PAM, PPM, PWM. Quantization Process, Quantization Error, Pulse Code Modulation, Line codes Differential pulse code modulation Delta modulation, adaptive delta modulation, Time division multiplexing (Analog and digital types) 4(L)

Text/ Reference Books:

- Communication System Engineering – John G Proakis
- Communication Systems- Simon Haykin
- Modern Digital and Analog Communication Systems- B.P. Lathi, 3rd edition, Oxford University Press, 1998.
- Principles of Communication Systems - Toab & Schilling
- Digital & Analog communication systems-K.S .Shanmugham
- Electronics Communication Systems - Roddy and Coolen
- Contemporary Communication Systems using Matlab- John G Proakis

DIGITAL ELECTRONICS (EC-1402)

UNIT 1: A brief review of Minimization Techniques. 2(L)

UNIT 2: COMBINATIONAL LOGIC: Introduction, Design Procedure, Adders, Subtractors, Code Converters, Magnitude Comparator, BCD to Seven Segment decoder, Parity generator and Checker, Decoders, Encoders, Multiplexers, Demultiplexers, ROMs, Design of the circuits using Decoders, Multiplexers, ROMs. 7(L)

UNIT 3: PROGRAMMABLE LOGIC DEVICES: Programmable Logic Array (PLA), Programmable Array Logic (PAL), Design of the circuits using PLA and PAL, Field Programmable Gate Array (FPGA). 5(L)

UNIT 4: SEQUENTIAL LOGIC: Introduction, Flip-Flops, Flip-Flop Excitation Tables, Triggering of Flip-Flops, Analysis of Clocked Sequential Circuits, State Reduction and Assignment, Race Around Condition, Master-Slave flip-flops, Conversion design of flip-flops. 4(L)

UNIT 5: Design of synchronous & ripple counters, Mod-k or Divide-by-k counters, Decade counter, BCD Counter, UP/DOWN Counters, Lock Out problem, Design with State Equations. 6(L)

UNIT 6: Shift register, Serial to Parallel Converter, Parallel to Serial Converter, Ring counters, Twisted-ring counter, Sequence Generator. 3(L)

UNIT 7: TIMING CIRCUITS: Multivibrators. 2(L)

UNIT 8: LOGIC FAMILIES: Characteristics of Digital ICs, DTL, TTL, ECL, MOS Logic & CMOS Logic, Calculation of noise margins and fan-out. 8(L)

UNIT 9: INTRODUCTION to VHDL: Basics, Simulation of Multiplexers, Demultiplexers etc 3(L)

Text/ Reference Books:

- M. Morris Mano: Digital Design, Third Edition, Prentice Hall
- R. P. Jain: Modern Digital Electronics, Third Edition, TMH
- Taub and Schilling: Digital Integrated Electronics, McGRAW HILL
- Sandige: Digital concept Using standard ICs
- R. J. Tocci: Digital Systems: Principles and Applications, Fourth Edition, Prentice Hall

NETWORK AND SYSTEMS (EE-1404)

UNIT – I : Introduction: Network Classification and Characterization, Network Elements, Network Graph Theory- tree, Incidence matrix, cut set matrix, Tie set matrix, Analysis of Linear Time-Invariant Networks, Mesh and Nodal analysis. 6(L)

UNIT – III : Network Analysis: Initial conditions, Time domain analysis of RL, RC and RLC networks, Responses for unit step, ramp, square pulse and impulse function, Steady-state analysis of AC circuits: Sinusoidal and phasor representation of Voltage & current, single phase ac circuit behavior of R, L and C. Combinations. 8(L)

UNIT – IV: Circuit Analysis in s- domain: Concept of Complex frequency , Laplace transform and their application for circuit analysis, Network Functions-Transform Impedances Network functions of one port and two port networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot. 8(L)

UNIT –V: Two Port Networks: Characterization of two port networks. z, y, ABCD and h parameters, Reciprocity and Symmetry of two port network. Relationships between the parameters, inter-connections of two port networks. 5(L)

Unit – VI: Network Synthesis: Positive real function; definition and properties; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions using Foster and Cauer first and second forms. 5(L)

Text/ Reference Books:

- M.E. Van Valkenberg, "Network Analysis" Prentice Hall
- M.E. Van Valkenberg, "Network Synthesis" Prentice Hall
- D. Roy Choudhary, "Networks & Systems" New Age-Publication
- W. H. Hayt & J. E. Kemmerly, "Engineering circuit Analysis", TMH
- A Chakrabarti & S. Bhadra, "Networks & Systems" Dhanpat Rai & Co.

ELECTROMAGNETIC THEORY (EC-1403)

UNIT 1: INTRODUCTION- Review of scalar and vector field, Vector representation of line, surface and volume integrals, Physical interpretation of gradient, divergence and curl, Divergence and Stokes theorem, Different coordinate systems. 4(L)

UNIT 2: ELECTROSTATIC FIELDS- Electric field due to point, surface and volume charges, Electrostatic potential for different charge distributions, Gauss's law and their applications, Solution of Laplace's and Poisson's equation in one dimension, Method of images applied to plane boundaries, Electric flux density, Boundary conditions, Capacitance, Electrostatic energy. 8(L)

UNIT 3: MAGNETOSTATIC FIELDS- Biot- Savart's law , Ampere's law, magnetic flux density, Boundary conditions, Faraday's law, Energy stored in magnetic field, Scalar and Vector Magnetic Potential. 8(L)

UNIT 4: TIME VARYING ELECTROMAGNETIC FIELDS-Continuity equation, Displacement current, Maxwell's equations in point form and integral form, Retarded vector potential, Plane wave equation and its solution in conducting and non conducting mediums, Phase velocity, Group velocity, Plane waves in lossy dielectrics, Propagation in good conductors: skin effect, impedance of conducting medium, Polarization, Reflection and Refraction of plane waves at plane boundaries, Poynting Vector, Poynting theorem and power considerations. 8(L)

UNIT 5: TRANSMISSION LINES-Transmission line equations, parameters- primary and secondary constants, Analogy of transmission lines, Determination of α , β , γ and v_p , characteristics impedance, Input impedance of a lossless line, open and short circuited lines, distortion-less lines, reflection coefficient and standing wave ratio, matched transmission line, Impedance matching, Smith chart and its applications. 8(L)

UNIT 6: COMPUTATIONAL ELECTROMAGNETICS-Finite element method (FEM) and Finite difference time domain method (FDTD) 4(L)

Text/ Reference Books:

- Hayt William., "Engineering Electromagnetics", Tata Mc Graw Hill
- Matthew N.O. *Sadiku* 'Elements of Electromagnetics' Oxford University Press
- Kraus J.D, "Electromagnetics" Tata Mc Graw Hill
- Complex Electromagnetic Problems and Numerical Simulation Approaches, Levent Sevgi, IEEE Press and John Wiley, New York, 2003.
- Jordan E.C. and Balmain K.G., "Electromagnetic waves and Radiating Systems"PHI
- Plonsey R. and Collin R.E., "Principles and Applications of Electromagnetic fields", Tata Mc Graw Hill.

ELECTRONIC DEVICES AND CIRCUITS (EC-1404)

UNIT 1: Bipolar Junction Transistor: Transistor switching characteristics, breakdown in Transistors, Ebers-Moll transistor equations, Analysis of transistor cutoff and saturation regions, small signal low frequency transistor hybrid model, simplified hybrid model, practical circuit of a transistor amplifier, effect of C_e and C_c on low frequency and high frequency response, high frequency model of a transistor-hybrid π model. 12(L)

UNIT 2: JFET & MOSFET: Review of device structure operation and V-I characteristics. MOSFET as an Amplifier and switch, Biasing of MOSFET amplifier circuits, small-signal operation and models, single stage MOSFET amplifier, CS, CD and CG amplifiers, MOSFET internal capacitances and high frequency model, frequency response of CS amplifier, Large signal analysis 8(L)

UNIT 3: Feedback amplifiers: Classification of amplifiers, Concept of feedback, transfer gain with feedback, General characteristics of negative feedback amplifiers, Effect of feedback on amplifier characteristics, Method of analysis of a feedback amplifier, Voltage-Series feedback, Current-Series feedback, Current-Shunt feedback, Voltage-Shunt feedback. 7(L)

UNIT 4: Oscillators: Basic principles of sinusoidal oscillators, Phase Shift oscillators, Resonant-Circuit oscillators, General form of an oscillator circuit (Hartley and Colpitts oscillators), Wien-bridge oscillator, Crystal oscillators, Frequency Stability. 7(L)

Text/ Reference Books:

- Electronic circuits: Discrete and Integrated by D. L. Schilling, Charles Belove .
- Microelectronic Circuits by A. S. Sedra and K. C. Smith.
- Integrated Electronics by J. Milliman and C. C. Halkias
- Microelectronics by J. Milliman and A. Grabel

PRINCIPLES OF MANAGEMENT (HS-1401)

UNIT 1: Introduction to Management-Definition of Management – Science or Art – Management and Administration, Functions of Management – Types of Business Organization. Levels of management and Managerial skills 5(L)

UNIT 2: School of Management Thoughts: Evolution of Management thoughts, classical approach, neo- classical approach, contribution of Taylor, Weber and Fayol, modern approach. 6(L)

UNIT 3: Planning Nature & Purpose – Steps involved in Planning ,Objectives, Setting Objectives, Process of Managing by Objectives ,Strategies, Policies & Planning Premises Forecasting Decision-making. 8(L)

UNIT 4:Organizing Nature and Purpose – Formal and informal organization – Organization Chart – Structure and Process – Departmentation by difference strategies – Line and Staff authority – Benefits and Limitations – De-Centralization and Delegation of Authority – Staffing – Selection Process-Techniques-HRD-Managerial-Effectiveness. **Directing:** Scope – Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment – Communication – Process of Communication – Barriers and Breakdown – Effective Communication – Electronic media in Communication. 11(L)

UNIT 5:Controlling-System and process of Controlling – Requirements for effective control – The Budget as Control Technique – Information Technology in Controlling – Use of computers in handling the information – Productivity – Problems and Management – Control of Overall Performance. Coordination. 5(L)

UNIT 6: Organisational Behaviour- Organisational change, Conflict Management and Stress Management
Functional management: Human Resource Management, Financial management, Marketing Management. 5(L)

Text/Reference Books:

- Tripathy PC and Reddy PN, “Principles of Management”, Tata McGraw-Hill, 1999.
- Decenzo David, Robbin Stephen A, “Personnel and Human Reasons Management”, Prentice Hall of India, 1996
- JAF Stomer, Freeman R. E and Daniel R Gilbert, “Management”, Pearson Education, Sixth Edition, 2004.
- Fraidoon Mazda, “Engineering Management”, Addison Wesley, 2000.
- Harold Kooritz & Heinz Weihrich “Essentials of Management”, Tata McGraw-Hill, 1998
- Joseph L Massie “Essentials of Management”, Prentice Hall of India, (Pearson) Fourth Edition, 2003

ANALOG COMMUNICATION LAB (EC-1451)

Experiment 1: To design and implement a Band Pass Filter for the range (400Hz-1KHz).

Experiment 2: To implement Amplitude Modulation (AM), demodulation and calculate the modulation index.

Experiment 3: To implement Frequency Modulation (FM) using IC 2206 and demodulation using IC 565.

Experiment 4: To implement Pulse Amplitude Modulation (PAM) and Demodulation.

Experiment 5: To implement Pulse Position Modulation (PPM).

Experiment 6: To implement Pulse Width Modulation (PWM).

Experiment 7: To implement Phase Locked Loop (PLL)and find out the lock range and capture range.

Experiment 8: To design and test the circuit of Voltage to Frequency Converter (VCO) using IC 555.

Experiment 9: To design and test a Mixer Circuit using PLL IC 565.

Experiment 10: To study and implement Pre-emphasis and De-emphasis circuits.

Experiment 11: To study and observe frequency response of Low-pass, High-pass, Band-pass and Notch filter using Spectrum Analyzer.

Experiment 12: To determine the spectrum of AM using spectrum analyzer.

Experiment 13: To determine the spectrum of FM using spectrum analyzer.

Experiment 14: To determine the performance of PCM.

Experiment 15: To determine the performance TDM (PAM) and TDM (PCM).

DIGITAL ELECTRONICS LAB (EC-1452)

Experiment 1: Verification of operation of Full Adder and Full Subtractor.

Experiment 2: Design & verification of 4-bit binary adder/subtractor using binary adder IC.

Experiment 3: Realization of operation of full adder and full subtractor using IC 74151/74153 MUX.

Experiment 4: Design & verification of full adder and full subtractor using an inverted output 3 to 8 line decoder.

Experiment 5: Design and verification of operation of a BCD Adder using IC 7483.

Experiment 6: Realization of 4 X 1 MUX using basic gates.

Experiment 7: Verification of operation of BCD to Seven segment code conversion using IC 7447.

Experiment 8: Verification of Truth Tables of SR & D Flip flops.

Experiment 9: Verification of Truth Tables of Master Slave JK Flip-Flop.

Experiment 10: Design of MOD-8 UP/Down synchronous counter.

Experiment 11: Design of BCD ripple counter.

Experiment 12: Design of Universal Shift Register.

Experiment 13: Design of a sequential circuit from given state diagram.

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Experiment 16: Implementation of Basic Combinational and sequential circuits using VSM (Virtual System Modelling)

Experiment 17: Implementation of Basic Combinational and sequential circuits using VHDL

ELECTRONIC DEVICES AND CIRCUITS LAB (EC-1453)

Experiment 1: To determine the quiescent operating conditions of fixed and self bias BJT Configurations

Experiment 2: Measurement of *h*-parameters of a BJT in CB, CE and CC configurations

Experiment 3: To plot the drain and transfer characteristics of a given FET and find the drain resistance, amplification factor and transconductance.

Experiment 4: To study the frequency response of an *RC* coupled amplifier and compute its bandwidth.

Experiment 5: To study the frequency response of a *CC* amplifier and compute its bandwidth

Experiment 6: To study the frequency response of a *CS FET* amplifier and compute its bandwidth

Experiment 7: To find the Gain and Bandwidth of a voltage series feedback amplifier.

Experiment 8: To find the Gain and Bandwidth of a current series feedback amplifier

Experiment 9: Study of RC-phase shift and Wien-Bridge oscillators.

Experiment 10: Study of Power amplifiers
a) Class A power amplifier
b) Class B complementary symmetry power amplifier

VLSI TECHNOLOGY AND DEVICE MODELLING (EC-1501)

UNIT 1: Introduction to VLSI Technology: Classification of ICs, features of ICs, monolithic and hybrid ICs.

Crystal Growth and Wafer Preparation: silicon crystal growth from the melt, GaAs crystal growth techniques, crystal orientations, various defects in crystal, wafer preparation and wafer specifications. 6(L)

UNIT 2: Epitaxy: Epitaxy and its concepts, growth kinetics of epitaxy, vapour phase epitaxy, molecular beam epitaxy, silicon on insulator epitaxy.

Oxidation: Theory of growth of silicon dioxide layer, calculation of SiO₂ thickness and oxidation kinetics, dry, wet and high pressure oxidation, plasma oxidation, properties of oxidation, defects induced due to oxidation. 9(L)

UNIT 3: Lithography- Photolithography and pattern transfer, optical and electron photolithography, X-ray and ion-beam lithography, photoresist, types of photoresist, Etching- dry & wet etching, basic regimes of plasma etching, reactive ion etching and its damages, sputter etching, merits and demerits of etching.

Diffusion Process- Diffusion models of solid, Fick's theory of diffusion, diffusivities, measurement techniques, diffusion in polycrystalline silicon and silicon dioxide. 10(L)

UNIT 4: Ion implantation- Implantation equipments, high energy implantation, scattering phenomenon, range of implanted ions, implantation damage, annealing.

Metallization- Metallization applications, metallization choices, physical vapour deposition, patterning & problems in metallization. 9(L)

UNIT 5: Device Modelling & Simulation- Need and importance of semiconductor device simulators, understanding of Poisson's and continuity equation for semiconductor device simulation, key elements of physical device simulation, second order effects, introduction to simulation tools. 4(L)

Text/Reference Books:

- VLSI Technology – S M Sze, McGraw Hill, 2nd Ed.
- VLSI Fabrication Principles – S.K Gandhi, Wiley, 2nd Ed.
- The Science & Engineering of Microelectronic Fabrication – Stephen A Campbell, 2nd Oxford University Press.

MICROPROCESSORS AND ITS APPLICATIONS (EC-1502)

Unit 1: (a) Introduction: Evolution of Microprocessors and Microcomputers, Bus Organization, Bus Contention, Standard Bus Drivers & Transceivers, 3-State Buffers & Latches. 2(L)

(b) Architecture of a 8-bit Microprocessor: Internal organization of 8085, Signal descriptions, Machine Cycles & Timing diagrams, CPU Module Organization 4(L)

Unit 2: (a) Assembly Language Programming: Data Addressing modes, Instruction Set and Programming. 5(L)

(b) Special Architectural Features: Organization of Stack, Interrupts Structure, Interrupt Programming. 4(L)

Unit 3: (a) Basic Interfacing: Memory interfacing, Programmable Peripheral Interface (8255), Programmable Interval Timer (8253/8254) and Operating Modes, Minimum 8085 System Configuration with 8355/8755. 6(L)

(b) Direct Memory Access: Basic DMA operations and timings, 8257 Programmable DMA Controller and its interfacing. 2(L)

Unit 4: (a) Architecture of a 16-bit Microprocessor: Internal organization of 8086, Signal descriptions, Physical memory organization, BIU, EU, Bus Organization and Timing, Addressing modes, Instruction Set, Assembler directives. 8(L)

(b) Special Architectural Features: Minimum & Maximum Mode of Operation, 8288 Bus Controller, Interrupt Vector Table, The IRET instruction, Writing ISRs, Interrupts due to Errors. 5(L)

Unit 5: Exemplary System Design: Interfacing A/D and D/A converters and Measurement of Physical & Electrical Quantities, Waveform Generators, Design of Digital IC Tester, Security System, Process Monitoring/Control System. 4(L)

Text/Reference Books:

- Ramesh S. Gaonkar, "Microprocessors: Architecture Programming and applications with 8085".
- Microprocessor and Interfacing - D. V. Hal
- Microprocessor System: The 8086/8088 family- Liu and Gibson

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ANTENNA AND WAVE PROPAGATION (EC-1503)

UNIT 1: Electromagnetic Radiation and Antenna Fundamentals-Review of Maxwell's equations: Retarded vector potential, Solution of wave equation in retarded case, Concept of radiation, Antenna equivalent circuits, Antenna characteristics: Radiation pattern, Beam solid angle, Radiation intensity, Directivity, Gain, Input impedance, Polarization, Bandwidth, Effective aperture, Antenna effective height, Antenna temperature. 8(L)

UNIT 2: Wire Antenna and Antenna Arrays-Wire antennas: Hertzian dipole, Short dipole, Radiation resistance and Directivity, Half wave Dipole, Monopole, Small loop antennas. Antenna Arrays: Linear Array and Pattern Multiplication, Two-element Array, Uniform Array, Array with non-uniform Excitation, Binomial Array. 8(L)

UNIT 3: Aperture Antennas-Aperture Antennas: Slot antenna, Horn Antenna, Pyramidal Horn Antenna, Reflector Antenna-Flat reflector, Corner Reflector, Common curved reflector shapes, parabolic reflector, Lens Antenna. 8(L)

UNIT 4: Special and Broad band Antennas-Special Antennas: Long wire, V and Rhombic Antenna, Yagi-Uda Antenna, Turnstile Antenna, Helical Antenna- Axial and Normal mode helix, Bi-conical Antenna, Frequency Independent Antenna, Log periodic Dipole Array, Spiral Antenna, Microstrip Patch Antennas. 8(L)

UNIT 5: Radio Wave Propagation-Ground Wave Propagation, Free-space Propagation, Ground Reflection, Surface waves, Diffraction, Wave propagation in complex Environments, Tropospheric Propagation, Space waves, Ionospheric propagation: Structure of ionosphere, Sky waves, Skip distance, Virtual height, Critical frequency, MUF, Electrical properties of ionosphere, Effects of earth's magnetic fields, Faraday rotation. 8(L)

Text/Reference Books:

- John D.Kraus, "Antennas", Tata McGraw-Hill.
- G.S.N.Raju, "Antenna Wave Propagation", Pearson Education,
- Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley and Sons
- E.C.Jordan and Balmain, "Electromagnetic waves and Radiating Systems", Pearson Education
- A.R.Harish, M.Sachidanada, "Antennas and Wave propagation", Oxford University Press,
- W.L Stutzman and G.A. Thiele, "Antenna analysis and design", John Wiley and Sons

ELECTRONIC CIRCUIT DESIGN (EC-1504)

UNIT 1: Single Stage Integrated Circuit Amplifiers: IC Biasing (Current Source, Current Mirrors and Current – Steering circuit), Common source and Common Emitter Amplifier with active load, Common Gate and Common Base amplifier with active load, Cascode amplifier. CMOS Current mirror, CS, CD & CG Amplifier & their frequency response, Bipolar Current mirrors. 14(L)

UNIT 2: Differential and Multistage Amplifier: BJT Differential Pair, Block diagram of MOS Differential Pair, Differential Amplifier with active load, Multistage Amplifier 2(L)

UNIT 3: Operational Amplifier and its Applications: Internal Architecture, Bipolar Op-Amp circuit, JFET Operational amplifier circuit, CMOS operational amplifier circuit, Measurement of OP-Amp parameter, Frequency response and compensation, Inverting and Non inverting amplifier, Difference amplifier, Instrumentation amplifier, Precision Rectifier, Schmitt Trigger, Sine Wave generator, Triangular wave generator, Log and Antilog amplifier 6(L)

UNIT 4: Active Filter Circuit: Comparison of active and passive filter, Design of Low pass, High pass, Band pass, band stop and all pass active filter, Switched Capacitor Circuits: Basic building blocks, Basic operation and analysis, Bi-quad filter, Switched capacitor filter. 4(L)

UNIT 5: Timer Circuit: Internal architecture of 555 timer, 555 timer as Mono-stable and Astable multivibrator, voltage to frequency converter using 555 timer. 3(L)

UNIT 6: Phase Locked Loop: Basic architecture, PLL operation, and application. 2(L)

UNIT 7: Instrumentation: Data Acquisition system, telemetry, Transducers and its various types, Instruments types and performance characteristics, static and dynamic characteristics of instruments, Digital meters, AC Bridge. 5(L)

UNIT 8: Information Distribution System: Digital design in space domain, time domain, serial & pipeline organization. 2(L)

Text/Reference Books:

- Design of Analog CMOS Integrated circuits- Behzad Razavi-TMH.
- Digital Integrated circuits- J.M Rabaey- PHI.
- CMOS Analog Circuit Design- 2nd Edition – Phillip E. Allen, Douglas R. Holberg – Oxford Uni. Press.
- Analysis and Design of Analog Integrated Circuits- 4th Edition – Gray, Hurst, Lewis, Mayer- Wiley.
- Microelectronic Circuits Theory and Applications- 5th Edition- Adel S. Sedra, Kenneth C. Smith- Oxford Uni. Press.

DIGITAL COMMUNICATION (EC-1505)

UNIT 1: Introduction to digital communication systems: Principles of digital data transmission. 2(L)

UNIT 2: Information and channel capacity, Entropy, Discrete and Continuous channels, BSC, Source coding theorem, Fano and Huffman's coding, Lempel-Ziv Source coding, Rate Distortion Theory, Differential Entropy, Rate distortion Function, Shannon's Channel capacity theorem, Trading bandwidth for S/N etc. Shannon's limit. Performance of digital communication system. 5(L)

UNIT 3: Baseband data transmission systems, Error probability, ISI, pulse shaping, matched filters, M-ary signalling schemes, Equalization. Symbol synchronization. Gram-Schmitt orthogonalization, Two Dimensional Signal Waveform, Two Dimensional Bandpass Signals, orthonormal Basis functions 6(L)

UNIT 4: Digital modulation schemes, ASK, PSK, QPSK, DPSK, GMSK, FSK and QAM systems, Probability of error of each scheme, Matched filter receiver and its characteristics and Implementation, Signal space representation of

UNIT 5: Digital transmission, Fading on multipath channels, Performance comparison of various digital modulation schemes. 3(L)

UNIT 6: Error control coding, Hamming distance, Linear block codes, Cyclic codes, Convolution codes, Code generation and detection methods, Viterbi coding and decoding practical applications of coding, the trellis diagram of viterbi decoding, Waveform coding. 7(L)

UNIT 7: Linear predictive coding, Subband coding Adaptive transform coding, Digital audio transmission and Digital Audio recording. 4(L)

Text/Reference Books:

- John Proakis, Digital Communications
- K.S. Shammugham, Digital & Analog Communication Systems –
- Simon Haykin, Communication Systems, 4th ed., John Wiley & Sons, 2001.
- B.P. Lathi, Modern Digital and Analog Communication Systems”, 3rd edition, Oxford University Press, 1998.
- P. Chakravarti, Principles of Digital Communication
- M.S. Roden, Digital Communication System Design
- M. Rice, Digital Communications - A Discrete-Time Approach, Prentice-Hall, 2009.
- B. Sklar, Digital Communications: Fundamentals & Applications, 2nd ed., Prentice Hall, 2001.

AUTOMATIC CONTROL SYSTEMS (EE-1505)

UNIT 1: System Modeling and Closed Loop System–Introduction, Classification based on differential equations, Modeling of various physical systems, Open-loop and Closed-loop control, Transfer Functions, Block diagram representations, disturbance rejection, Block diagram reduction rules, Signal flow graph and Mason’s gain formula 9(L)

UNIT 2: Time Response Analysis: Various standard test signals, Time response of first order and second order systems, Second order design specifications, Steady state error analysis, dominant poles 8(L)

UNIT 3: Stability and Root locus plot: Concept of stability, Routh-Hurwitz criteria, Critical stability, Root locus plots, Rules for plotting root-locus. 5(L)

UNIT 4: Frequency Response Analysis: Frequency response of linear systems, Bode plots, Polar plots, Nyquist stability criteria, Gain margin and phase margin. 7(L)

UNIT 5: Compensator design and controllers–PID-controllers, Compensator design using root locus and bode plots, Lead, lag and lag-lead compensators 5(L)

UNIT 6: State-Space Analysis–State-space representations, Similarity transformation, Conversion from SS to transfer function, Solution of state equation, Controllability and Observability, Pole-placement and Observer design 6(L)

Text/Reference Books:

- K. Ogata, Modern Control Engineering, Prentice Hall, Inc., Englewood Cliffs, N.J., 5th ed., 2001.
- I. J Nagrath and M. Gopal, Control Systems Engineering, New Age International Pub., 4th ed., New Delhi, 2006.
- B. C. Kuo, Automatic Control System, Prentice-Hall, N.J., 7th ed., 1995.
- R. T Stefani, B. Shahian, J. Savant, Jr., G. H. Hostetter, Design of Feedback Control System, Oxford Univ. Press, New York, 2002.
- R. C Dorf and R. H. Bishop, Modern Control System, Addison-Wesley Longman, Inc., USA, Reprint India 1999.

MICROPROCESSORS LAB (EC-1551)

(A) 8085 Based Experiments

Experiment 1: Familiarization with SDK-85

- a. Decoding, Storing and Executing programs in SDK-85 trainer kit: Register Addition, Indirect Subtraction and Immediate Add with Carry.
- b. Use of RST 5 in SDK-85 and obtaining PSW Status at the end of execution.

Experiment 2: Write a program to ADD/ SUBTRACT two 16-bit numbers stored in memory.

Experiment 3: Write a program to ADD/ SUBTRACT two BCD numbers stored in memory.

Experiment 4: Write a program to search a data from a given table.

Experiment 5: Write a program to find out Smallest/Largest data from a table.

Experiment 6: Write a program to sort out a table in Ascending/Descending order.

Experiment 7: By using a Lookup Table stored in memory write a program to find out

- a. ASCII code of a hexadecimal integer from a look table.
- b. Hexadecimal integer corresponding to given ASCII code.

Experiment 8: Write a program to multiply two 8-bit numbers; result may be 16-bits.

Experiment 9: Write a program to divide two numbers.

Experiment 10: Study and verification of interrupts: (i) RST 7.5 and (ii) RST 7.

Experiment 11: Write a program to count and display the number of hardware interrupt requests that arrived in 5 seconds, using on-board display routines of SDK-85.

(B) Interfacing Experiments

Experiment 12: Study & verification of Mode 0 operation and BSR mode operation of 8255.

Experiment 13: Study & verification of various operating modes of PIT 8253/8254 by

(i) Mode 0 operation, (ii) Mode 1 operation and (iii) Mode 3 operation.

Experiment 15: Study of Microprocessor Applications.

- a) Study & verify traffic light control system.
- b) Study & verify the interfacing of a Hex-pad.
- c) Study & verify the interfacing of keyboard.
- d) Study & verify the elevator system via simulator.
- e) Study & verify the interfacing of thumbwheel control.

(C) 8086 Based Experiments

Experiment 16: Basic Assembly Language Programming

- a) Write a program to add two 16-bit numbers stored in Data Segment.
- b) Write a program to count odd numbers and even numbers in table stored in Data Segment.
- c) Write a program to ADD/ SUBTRACT two BCD numbers, stored in Data Segment, via BCD instructions.

Experiment 17: Write a program to

- a) ADD a series of 16-bit numbers stored in Data Segment via LEA.
- b) Find out square of an integer from a look table via XLAT.

Experiment 18: Write a program to fill a given character in a table stored in Data Segment.

Experiment 19: Given the two ASCII coded integers stored in Extra Segment, write a program to (i) ADD and (ii) Multiply these two ASCII coded integers.

ELECTRONIC CIRCUIT DESIGN LAB (EC-1552)

Experiment 1: To design a comparator circuit and study the non-linear applications of Op- Amp.

Experiment 2: To design and test the Schmitt Trigger for the given UTP and LTP using IC 741 Op-Amp.

Experiment 3: To design a circuit and study the following waveform generators using IC 741 Op-Amp.

- (a) Sine wave generator.
- (b) Square wave generator.
- (c) Triangular wave generator.
- (d) Sawtooth wave Generator.

Experiment 4: To design and test the following circuits using IC-555

- (a) Astable Multivibrator.
- (b) Monostable Multivibrator.
- (c) Voltage to Frequency converter.
- (c) Schmitt Trigger.

Experiment 5: To design Voltage Limiter circuit and Precision rectifier using IC741 Op-Amp.

Experiment 6: To design and study the circuit of a voltage to frequency converter using IC741 Op-Amp.

Experiment 7: To design and study the performance of an Instrumentation amplifier.

Experiment 8: To design an integrator and differentiator using IC 741 Op-Amp.

Experiment 9: To design a band pass filter and notch filter using IC 741 Op-Amp.

Experiment 10: To design and test a 2nd order low pass filter and high pass filter using IC 741 Op-Amp.

DIGITAL COMMUNICATION LAB (EC-1553)

Experiment 1: To perform the generation of Pseudo Random Binary sequence and determine the chip rate using PN sequence.

Experiment 2: To perform PCM generation and demodulation.

Experiment 3: To perform Amplitude Shift Keying (ASK) modulation and demodulation

Experiment 4: To perform Binary-Frequency Shift Keying (B-FSK) modulation and demodulation.

Experiment 5: To perform Binary-Phase Shift Keying (B-PSK) modulation.

Experiment 6: To study and implement Digital Phase Detector and to detect the phase difference between two sinusoidal waves.

Experiment 7: To study and implement Frequency Synthesizer.

Experiment 8: To test the various AT commands on GSM Evaluation Kit for IMSI Information along with performing basic implementation of GSM based Mobile Phone Kit.

Experiment 9: To study and perform basic implementation of CDMA (DSSS) on CDMA Evaluation Kit.

Experiment 10: To study and implement TDM based experiments related to various modulation schemes on Evaluation Kit.

AUTOMATIC CONTROL SYSTEMS LAB (EC-1554)

Experiment 1: Determine the transfer function of a separately excited DC generator.

Experiment 2: Obtain the frequency response characteristics of the first and second order active LPF.

Experiment 3: Obtain the graph between output errors and angular position difference of a given potentiometer error detector.

When the excitation is DC.

When the excitation is AC.

Experiment 4: Determine the time response of different order of system using linear system simulator.

- (a) Determine the time constant of first order system for open loop system
- (b) Determine the time constant of type-1 system for closed loop system.

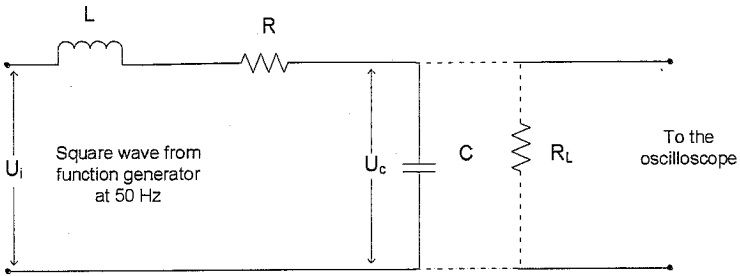
Experiment 5: Determine the frequency response of given open loop linear system and time response of closed loop

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Experiment 6: Obtain the frequency response of L,R,C and Lead-Lag Compensator.
Experiment 7: To draw the frequency response of a given L,R,C network theoretically and to capture the time response for a given square wave input at 50Hz (power supply).

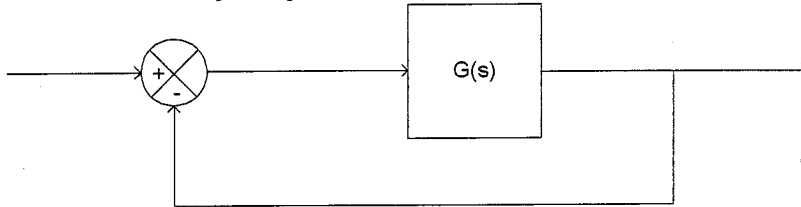
Draw the bode plot for

$$\frac{U_c}{U_i} = \frac{1}{LCs^2 + RCs + 1}$$



Design L, C, R such that 50Hz or 314 rad/sec comes in the pass band.

Experiment 8: Use designed Lag and Lead compensator (Experiment No. 6) with the given closed loop system and show that the lead compensator improves transient performance and lag compensator improves the steady state characteristics. Setup: Compensator Design Kit.



Experiment 9: MATLAB based experiments

File

UNIT 1: Introduction, Overview of Digital Signal Processing	1(L)
UNIT 2: Discrete Time Signals: Introduction, Classification of Signals, Simple Manipulations on discrete time signals, Sampling and Reconstruction of signals.	2(L)
UNIT 3: Discrete Systems: Representation of Systems, Properties of DSP systems, Difference equation and its relationship with system function, Impulse response and frequency response.	2(L)
UNIT 4: Discrete time Fourier analysis: Introduction, Discrete Time Fourier Transform and its properties, Frequency domain representation of LTI systems.	2(L)
UNIT 5: Z-Transform: Introduction, Unilateral and Bilateral Z-Transform and its properties, Inverse Z-Transform, System representation.	4(L)
UNIT 6: The Discrete and Fast Fourier Transform: Introduction, Discrete Fourier Series, DFT and its properties, linear convolution using DFT, Computation of an IDFT, Various algorithm for FFT computation.	6(L)
UNIT 7: Realization of digital linear systems: Introduction, Basic Realization, Block diagram representation and signal flow graph, Basic structures for IIR and FIR systems.	4(L)
UNIT 8: Infinite Impulse Response (IIR) Filters: Introduction, Filter design by approximation of derivatives, impulse invariance method, bilinear transformations, Design of Butterworth, Chebyshev, Inverse Chebyshev filters, Frequency transformation	4(L)
UNIT 9: Infinite Impulse Response (IIR) Filters: Introduction, Filter design by approximation of derivatives, impulse invariance method, bilinear transformations, Design of Butterworth, Chebyshev, Inverse Chebyshev filters, Frequency transformation	4(L)
UNIT 10: Finite Impulse Response (FIR) Filters: Introduction, Frequency response of linear phase FIR filters, Design techniques of FIR filters.	4(L)
UNIT 11: Effect of Finite Word Length in Digital Filters: Introduction, Rounding & Truncation errors, quantization effects in analog to digital conversion of signals, Limit cycle oscillations.	4(L)
UNIT 12: Multirate Digital Signal Processing: Introduction, Sampling Rate Conversion, Filter Structures, Polyphase Decomposition	3(L)
UNIT 13: Introduction to Homomorphic signal processing	2(L)
UNIT 14: Applications of Digital Signal Processing	2(L)

Text/Reference Books:

- Discrete-time Signal Processing - A.V. Oppentiem and R.W. Schafer
- Digital Signal Processing - A.V. Oppentiem and R.W. Schafer
- Signals and Systems - A.V. Oppenheim, A.S. Willsky, and I.T. Young.
- Digital Signal Processing: Principles, Algorithms, and Applications by J. G. Proakis and D. G. Manolakis.
- Multirate Digital Signal Processing by R. E. Crochiere and L. R. Rabiner.

RF AND MICROWAVE ENGINEERING (EC-1602)

UNIT 1: Introduction -Microwave frequencies, Standard Frequency bands, Behaviour of circuits at Conventional and microwave frequencies, Microwave applications.	4(L)
UNIT 2: Waveguide -Review of Rectangular waveguide, Circular Waveguides. Solution of wave equation in cylindrical co-ordinates, Derivation of field equations for TE & TM modes, degenerate and dominant mode, Power Transmission and Power loss, Excitation of waveguides, Cavity Resonator.	8(L)
UNIT 3: Microwave Passive Components -Scattering matrix -Concept of N port Scattering matrix representation Properties of S matrix- S matrix formulation of two-port junction. Microwave junctions -Tee junctions E-Plane Tee, H-Plane Tee and Magic Tee , Rat race, Corners , bends and twists , Directional couplers -two hole directional couplers- Ferrites - important microwave properties and applications, Isolator, Circulator , Attenuator , Phase shifter.	8(L)
UNIT 4: Microwave Semiconductor Devices -Principles of operation - characteristics and application of tunnel diodes, PIN diode and LSA. Transferred Electron Devices -Gunn diode- Avalanche Transit time devices IMPATT and TRAPAT. Parametric devices -Principles of operation - applications of parametric amplifier.	8(L)
UNIT 5: Microwave tubes: Limitations of conventional tubes in the microwave frequency range, O-type and M-type tubes. Klystron amplifier, Reflex Klystron oscillator, Magnetron, Traveling wave tube.	8(L)
UNIT 6: Microwave measurements: Microwave test bench, Measurement of power, wavelength, frequency, impedance, SWR, attenuation and phase shift.	4(L)

Text/Reference Books:

- Samuel Y Liao, "Microwave Devices & Circuits", Prentice Hall of India,
- D.M.Pozar, "Microwave Engineering.", John Wiley & sons, Inc.,
- Robert. E.Collin-"Foundation of Microwave Engineering" -Tata Mc Graw Hill.
- Annapurna Das and Sisir K. Das, "Microwave Engineering", Tata Mc Graw-Hill Inc.
- M.M.Radmanesh , "RF & Microwave Electronics Illustrated", Pearson Education, 2007.
- Robert E.Colin, "Foundations for Microwave Engineering", Tata McGraw Hill,

DATA COMMUNICATION AND NETWORKS (EC-1603)

UNIT 1: Introduction: Data Communications, Networks, The Internet, Protocols and Standards, Network Models, Layered Architecture, The OSI Model, Layers in the OSI Model, TCP/IP Protocol Suite, ATM-reference model, Addressing, Physical Layer and Transmission Media, Switching: circuit switching, packet switching, message switching, ATM switching, Switch fabrics for fast switching.	8(L)
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Circuit Networks, Structure of a Switch, Using Telephone and Cable Networks for Data Transmission, Telephone Networks, Dial-up Modems, Digital Subscriber Line, Cable TV Networks, Cable TV for Data Transfer, Different PCM, TDM transmission standards. Multiple Access Techniques. 8(L)

UNIT 3: Data Link Control, Framing, Flow and Error Control, Protocols, Noiseless Channels, HDLC, Point-to-Point Protocol, Multiple Access, Random Access, Aloha, Controlled Access, Channelization, MAC Level IEEE Standards, Standard Ethernet, Changes in the Standard, Fast Ethernet, Gigabit Ethernet, IEEE 802.11, Bluetooth. 6(L)

UNIT 4: Connecting LANs, Backbone Networks and Virtual LANs, Connecting Devices, Backbone Networks, Virtual LANs, Cellular Telephony, Satellite Networks, Sonet/SDH, Architecture, Sonet Layers, Sonet Frames, STS Multiplexing, Sonet Networks, Virtual Tributaries, Virtual-Circuit Networks: Frame Relay and ATM, Frame Relay, ATM, ATM LANs. 6(L)

UNIT 5: Networks Layer: Logical Addressing, IPv4 Addresses, IPv6 Addresses, Network Layer: Internet Protocol, Internetworking, IPv4, IPv6, Transition from IPv4 to IPv6, Network Layer: Address Mapping, Error Reporting, Forwarding and Routing, Unicast Routing Protocols. 7(L)

UNIT 6: Transport Layer: Process-to-Process Delivery UDP, TCP and SCTP, Process-to-Process Delivery, User Datagram Protocol (UDP), TCP, Congestion Control and Quality of Service, Data Traffic, Congestion, Congestion Control, Two Examples, Quality Service, Techniques to improve QoS, Integrated Services, Differentiated Services, QoS in Switched Networks wireless TCP. 5(L)

Text/Reference Books:

- Data Communications and Networking, Fourth Edition by Behrouza A. Forouzan, TMH.
- Computer Networks, A.S. Tanenbaum, 4th edition, Pearson education.
- Introduction to Data communications and Networking, W.Tomasi, Pearson education.
- Data and Computer Communications, G.S. Hura and M. Singhal, CRC Press, Taylor and Francis Group.
- An Engineering Approach to Computer Networks-S. Keshav, 2nd Edition, Pearson Education.
- Computer Networks, L.L. Peterson and B.S. Davie, 4th edition ELSEVIER.
- Computer Networking: A Top-Down Approach Featuring the Internet, James F.Kurose, K.W. Rose, 3rd Edition, Pearson Education.
- Data and Computer Communications, William Stallings, Prentice Hall.
- Data Communications, Computer Networks, and Open Systems, F. Halsall, Addison-Wesley.

OPTICAL COMMUNICATION (EC-1604)

UNIT 1: Optical evolution and fiber optics-

- Optical evolution, advantages of optical communication, its representations 1(L)
- Optical waveguides, basic optical laws, acceptance angle, numerical aperture Skew rays 3(L)
- Rays and modes, step-index, graded-index fibers, phase and group velocities 3(L)
- Signal degradation in optical fibers, attenuation units, absorption, scattering Dispersions 3(L)
- Optical amplifiers 1(L)

UNIT 2: Optical sources and communication-

- Optical sources, modulators, transmitted optical fields, optical field expansion 3(L)
- Photo detection processes, count statistics, photo counting with receiver fields, photo counting with random photo multiplication 3(L)
- Shot noise processes, PSD of shot noise 2(L)
- Coherent and Non-coherent detection, system model, single mode and multi mode detection, SNR performance 5(L)
- AM/IM, FM/IM systems 2(L)
- Multiplexed FM/IM systems, heterodyne SNRs 2(L)

UNIT 3: Optical digital communication-

- Optical digital communications, heterodyne ASK, FSK, PSK, Systems, PLL Loop receiver and their noise performancesb 8(L)
- WDM, optical link design 2(L)
- Optical networks (SONET) 2(L)

Text/Reference Books:

- Optical Fiber Communications(3rd edition)- Gerd keiser
- Optical Fiber Communications -John M Senior
- Optical Fiber Communications -Robert .Gagliardi, Sherman Karp
- Principles of light wave communications-Goran Einarsson

MICROELECTRONICS AND VLSI DESIGN (EC-1605)

UNIT 1: Basic Electrical Properties - NMOS Inverter, Z_{pu}/Z_{pd} ratio, CMOS Inverter, Regions of Operation, BiCMOS Inverters. 6(L)

UNIT 2: Basic Circuit concepts & Characterization- Sheet Resistance, Standard unit of capacitance, delay unit, switching characteristics, Inverter delay, propagation delay, power dissipation. 6(L)

UNIT 3: Scaling - Scaling models and factors, scaling factors for various device parameters, limits due to sub-threshold currents, limits on logic levels & supply voltages due to noise, limits due to current density. 8(L)

UNIT 4: MOS Circuits and logic design: Switching logic, gate logic, Two/Three input NMOS, CMOS & BiCMOS, NAND & NOR gates, CMOS logic structures, clocked and sequential circuits, design processes, single bit adder, Bit-parallel adder, Carry Look-ahead adder. 12(L)

UNIT 5: Testability: Test Principles, DFT Principles, design strategies, IDDQ testing. 6(L)

- Basic VLSI Design – By - Pucknell & Kamran Eshraghian
- Principles of CMOS VLSI Design – By ‘ Neil H.E Weste & Kamran Eshraghian’

COMPUTER ARCHITECTURE (EC-1606)

- UNIT 1: Data Representation-** Sign magnitude representation, Fixed point number and its representation, Floating point number and its representation, IEEE standards. 2(L)
- UNIT 2: Central processing Unit-** CPU Architecture and functions, Type of operands and instructions, Addressing modes, and formats, Instruction cycles, Fixed point arithmetic, multiplication algorithms, Booths algorithm, hardware implementation, Division algorithm, Floating point arithmetic. 8(L)
- UNIT 3: Control Units-** Design methodology (processor level, register level and gate level design), Register Transfer and Micro orations, Hardwired and Micro Programmed control unit design concept, Microprogramming. 6(L)
- UNIT 4: Memory-** Internal memory, Characteristics of memory systems, memory hierarchy, Main memory organization, cache memory, organization, mapping, replacement algorithms, Pentium cache organization, Performance Characteristics, Associative memories, Virtual memory implementation. Secondary storage. 10(L)
- UNIT 5: Peripheral Devices-** Programmed I/O, Interrupt driven I/O, I/O controller, DMA controller, Device drivers, Peripheral devices and their characteristics: Printer, Keyboards. 4(L)
- UNIT 6: Bus architectures-** Uni-bus and multi-bus architectures. 2(L)
- UNIT 7:** Introduction of Parallel processing and pipeline processing. 4(L)

Text/Reference Books:

- Mano Moris, , “Computer system Architecture”, PHI
- John P. Hayes, “Computer Architecture and Organization” McGraw hill
- Hamacher, “Computer Organization”, McGraw hill.
- Tennenbaum,” Structured Computer Organization”, PHI
- B. Ram, “Computer Fundamentals architecture and organization”, New age international
- Gear C. W., “Computer Organization and Programming”, McGraw hill
- William Stalling, Computer Organization and Architecture, PHI fourth edition

COMMUNICATION SKILL WORKSHOP (HS-1601)

- Experiment 1:** Art of communication: What is communication, good communication and effective communication, barriers and filters, activity on barriers and filters.
- Experiment 2:** Body language: verbal and non –verbal behavior interpretation, activity on non-verbal communication.
- Experiment 3:** Active listening. Active listening quiz.
- Experiment 4:** Feedback: How to give and receive feedback, Activity on feedback.
- Experiment 5:** Hidden date of communication: Feelings. Activity on how to handale feelings.
- Experiment 6:** Practical skills: assertiveness, activity on assertiveness, self-confidence, activity.
- Experiment 7:** In the world of teams: the team concept, element of teamwork. Team formation, effective team, exercise on team, Team players, activity.
- Experiment 8:** Discussions, decisions and presentations: Structured and un-structured group discussions. Activity on each.
- Experiment 9:** Adapting to Corporate life: exercise on grooming and dressing, getting ready for interview.
- Experiment 10:** Business Etiquette/Dining etiquette.

DIGITAL SIGNAL PROCESSING LAB (EC-1651)

- Experiment 1:** Plot the following function

$$h(n)=4r^n \cos[\pi n(1+r)/M] + M \sin[\pi n(1-r)/M] / [1-(4r^n/M)^2] \pi n M$$

$$h(0)=1/M+r/M(4/\pi-1)$$

$$h(\pm M/4r)=-r/M[2 \cos(\pi/4r(1+r))-\cos\pi(1-r)/4r] \text{ for } M=4, r=0.1$$
- Experiment 2:** Generate Gaussian number with mean=20 and variance=40. Plot probability Density function of the generated numbers
- Experiment 3:** Generate Gaussian number with mean=0 and variance=1. Plot the Generated Numbers and calculate third moment i.e. skew-ness using

$$\text{Skew}(x_1, x_2, \dots, x_n) = 1/N \sum_{j=1}^N [(x_j - \text{mean}) / (\text{variance})]^3$$

- Experiment 4:** Generate Gaussian distributed number and uniform distributed number and Find the correlation between them.
- Experiment 5:** Plot the following function unit sample sequence $u(n)$, Ramp sequence $n u(n)$. Also down sample each of the above sequences
- Experiment 6:** Write the program to generate the signal corrupted by the noise $d(n)$, Resulting $S(n)$ is
- $$X(n) = S(n) + d(n)$$
- $$S(n) = 2n (0.8)^n$$
- Also down sample the sequence

- Experiment 7:** Write a program to develop a signal $y[n]$ generated by a convolution of two sequences $x[n]$ and $h[n]$, where $x[n] = [-2, 1, -1, +2, -0.5]$ and $h[n] = [0, 2, 0, -1, 1, 0]$ Verify by using convolution theorem.
- Experiment 8:** Plot the following expression of $H(z)$ in z-plane

Done

- Experiment 9:** A LTI system is given by
 $y[n] + 0.75y[n-1] - 0.48y[n-2] - 0.9y[n-3] = 0.58x[n] + 0.95x[n-1] + 0.49x[n-2] + x[n-3]$
 Write a program to compute and plot the impulse response of the system.
- Experiment 10:** Write a program to determine the m-point DFT the following n-point Sequence $X[n]$
 $X[n] = n, 0 < n < N-1$
 $= 0$ otherwise Take $N=16, M=32$
- Experiment 11:** Write a program to compute IDFT of n-point sequence given by
 $X[k] = k/N; 0 < k < N-1$
 $= 0$ otherwise

Note: - Do not use IFFT/FFT function of mat lab.

- Experiment 12:** Determine the factor form of the following Z-transform:
 (a): $G(z) = [2z^4 + 7z^3 + 48z^2 + 56z] / [32z^4 + 3z^3 - 15z^2 + 18z - 12]$
 (b): $G(z) = [4z^4 - 9z^3 + 15z^2 - 7] / [z^4 - 2z^3 + 10z^2 + 6z + 64]$

- Experiment 13:** Develop an efficient program to scan the elements of 8*8 matrixes Given below in zig-zag order (i.e. from 0 to 63 in order)

0	1	5	6	14	15	27	28
2	4	7	13	16	26	29	42
3	8	12	17	25	30	41	43
9	11	18	24	31	40	44	53
10	19	23	32	39	45	52	54
20	22	33	38	46	51	55	60
21	34	37	47	50	56	59	61
35	36	48	49	57	58	62	63

- Experiment 14:** Generate and plot the complex exponential sequence
 $1.5 \exp [(0.3 + j\pi/3)n]$; for $n \leq 50$

LIST OF EXPERIMENTS ON TMS320C6713 DSK DSP KIT

- Experiment 1:** DESIGN & CONDUCT IIR HIGH PASS FILTER
Experiment 2: DESIGN & CONDUCT IIR LOW PASS FILTER
Experiment 3: DESIGN & CONDUCT FIR LOW PASS FILTER
Experiment 4: DESIGN & CONDUCT FIR HIGH PASS FILTER
Experiment 5: GENERATION OF WAVE FORM
 a) Square Waveform
 b) Saw tooth Waveform
 c) Sinusoidal Waveform

MICROWAVE ENGINEERING LAB (EC-1652)

- Experiment 1:** To Study the Characteristics of Reflex Klystron and to determine its electronic tuning range.
Experiment 2: To determine the frequency and wavelength in a rectangular waveguide working in TE₁₀ mode.
Experiment 3: To Measure the Standing Wave Ratio (SWR) and Reflection Coefficient.
 (a) Low VSWR (b) High VSWR
Experiment 4: To measure an unknown impedance with smith chart.
Experiment 5: To study V-I characteristics of GUNN diode.
Experiment 6: Study the function of directional coupler by measuring the following parameters
Experiment 7: To measure main line and main line VSWR
Experiment 8: To measure the coupling factor and directivity

Experiment 9: Study of Magic Tee.
Experiment 10: To measure the polar pattern and gain of a Horn antenna.
Experiment 11: Simulation of basic microwave components.
Experiment 12: Design of RF amplifier

MICROELECTRONICS AND VLSI DESIGN LAB (EC-1653)

- Experiment 1:** To write a hardware description of 4-bit adder and subtractor and test its operation
Experiment 2: To write a hardware description of Degree to radian converter
Experiment 3: To write a hardware description of 4-bit mod 13 counter and test its operation
Experiment 4: To write a hardware description of 8-bit register with shift left and shift right operation and test its operation
Experiment 5: To write a hardware description of 4-bit array Multiplier
Experiment 6: To write a hardware description of Booth Multiplier
Experiment 7: To Design NOT, NOR, NAND gates using MENTOR GRAPHICS and compute the delay between input and output waveforms
Experiment 8: To Design 2:1 MUX using MENTOR GRAPHICS and compute the delay between input and output waveforms
Experiment 9: To Design XOR, NOR, NAND gates using MENTOR GRAPHICS and compute the delay between input and output waveforms and compare the difference between CMOS and pseudo technique.

Prna

and compute the delay between input and output waveforms and compare them
Experiment 11: To Design and simulate D-FLIP FLOP as a MASTER-SLAVE configuration using MENTOR GRAPHICS

Experiment 12: To Design Ring Oscillator using MENTOR GRAPHICS and compute the delay between input and output waveforms.

Experiment 13: To Design 2:1 MUX using transmission gates using MENTOR GRAPHICS

Experiment 14: To Design 6-T SRAM using MENTOR GRAPHICS and compute the delay between input and output waveforms

MOBILE AND WIRELESS COMMUNICATION (EC-1701)

UNIT 1: Introduction to mobile communication systems, Comparison of wireless systems and trends. 2(L)

UNIT 2: Cellular concept and system design fundamentals, channel assignment strategies, Hand-off strategies. Interference and system capacity. Improving capacity in cellular systems. 4(L)

UNIT 3: Mobile radio propagation, Ground reflection model, diffraction sculpturing, Indoor propagation models, outdoor propagation models, ray tracing and site specific signalling 6(L)

UNIT 4: Modulation techniques for mobile radio, diversity, Multipath fading using Rayleigh and Rician PDF, Flat fading and frequency selective fading, fading effects due to Doppler spread, speech coding, channel coding, 7(L)

UNIT 5: RAKE Receiver multiple access techniques for mobile communication, capacity of cellular systems 3(L)

UNIT 6: Multiple access techniques, FDMA, TDMA, CDMA 4(L)

UNIT 7: Wireless systems and standards. GSM, IS-95, 3G (IMT-2000, UMTS), 4G (WIMAX) 4(L)

UNIT 8: Introduction to wireless networking Development of wireless network, wireless data services, Mobile Satellite communication, Common channel signalling. 5(L)

UNIT 9: Protocols for network access network databases 2(L)

Text/Reference Books:

- Wireless Communication - Principle and practice – T.S. Rappaport
- Mobile Communication – Schwartz
- Wireless Communications and Networks- William Stallings.
- Designing CDMA 2000 Systems – Leonard Korowajczuk, Bruno Desouza, Abren Xavier and Arlindo Morieira Fartes
- CDMA Access and Switching for Terrestrial and Satellite Networks- Diakoumis, Gerakoulis, Evaggelos

LAB ELECTIVE (EC-1721 to EC-1730)

PROJECT (EC-1791)

ADVANCE WIRELESS AND OPTICAL COMMUNICATION LAB (EC-1721)

Experiment 1: Introduction to Lab VIEW software and the RF Hardware

Experiment 2: Baseband QAM modulation.

Experiment 3: Baseband QAM Demodulation.

Experiment 4: Channel Estimation and synchronization.

Experiment 5: Frequency Offset Estimation and Correction.

Experiment 6: OFDM Modulator and Demodulator.

Experiment 7: OFDM Synchronization, Frequency Offset, and Channel Estimation.

Experiment 8: Wireless sensor networks based on motes to form a base station and its neighbor to realize physical parameters like temperature, humidity.

Experiment 9: Study of fiber optic Transmitters and Detectors

Experiment 10: Study Of Simplex and Duplex Fiber Optic Link

Experiment 11: Study Of digital Transceiver

Experiment 12: Determination of numerical aperture of optical fibers

Experiment 13: Transmission of an audio signal through an optical fiber

Experiment 14: Fiber optic characterization: attenuation, chromatic dispersion, polarization dispersion (PMD).

Experiment 15: Verification of installations and fiber links with OTDR (optical time domain Reflectometer)

ADVANCED MICROPROCESSORS LAB (EC-1722)

Programming Experiments on TASM/MASM Assembler:

Experiment 1: Write a program to add the two data tables stored in memory. Assume 8-bit data and store the result in another table present in Data Segment.

Experiment 2: Write a program to ADD/ SUBTRACT two BCD numbers, stored in Data Segment, via BCD instructions.

Experiment 3: Write a program to Sort a data array in ascending and descending order.

Experiment 4: Write a program to read the keyboard entries and display on the screen by using INT Function Calls.

Experiment 5: Write a user interactive program to find factorial of an 8-bit integer, recursively.

Experiment 6: Write a user interactive program to multiply two 3 X 3 matrices stored in Data Segments.

DMG

Experiment 1: Familiarization with SDK-86

- a. Storing and Executing programs in SDK-86 trainer kit: Register Addition, Indirect Subtraction and Immediate Add with Carry.
 - b. Obtaining PSW Status at the end of execution.
- Experiment 2:** Write a program to verify the INT instructions for (i) Overflow and (ii) Divide by Zero error.
- Experiment 3:** Write a program to ADD a series of 16-bit numbers stored in memory via LEA.
- Experiment 4:** Write a program to find out square of an integer from a look table via XLAT.
- Experiment 5:** Write a program to transfer a table from one memory location to another location in Extra Segment by using string instructions of 8086.
- Experiment 6:** Write a program to search a character in a given table, stored in Extra Segment by using string instructions of 8086.
- Experiment 7:** Interface 8 serial switches and 8 LEDs to 8086 through 8255 and write a program to display the status of switches on LEDs continuously.
- Experiment 8:** Write a program to transfer 10 bytes from one SDK-86 kit to another by using MODE-1 operation of 8255.
- Experiment 9:** Interface an 8259 Priority Interrupt Controller to 8086 and write a program to verify the Fully Nested Mode and AEOI mode of operation of 8259.
- Experiment 10:** Interface two 8259 Priority Interrupt Controllers to 8259 and write a program to verify the master/slave operation of 8259.
- Experiment 11:** Write a program to display '8086' on the 7-segment display digits by using the 8279 programmable keyboard/display controller IC.
- Experiment 12:** Write a program for the moving display '8086' on the 7-segment display digits by using the 8279 programmable keyboard/display controller IC.
- Experiment 13:** Interface an 8251 to 8086 and write a program to verify the asynchronous mode of operation of 8251.
- Experiment 14:** Interface an 8251 to 8086 and write a program to verify the synchronous mode of operation of 8251.
- Experiment 15:** Interface an 8257 to 8086 and write a program to transfer a data block from one memory location to another by using the DMA.
- Experiment 16:** Interface an Analog to Digital converter and write a program to verify the operation of ADC.
- Experiment 17:** Interface a Digital to Analog converter and write a program to verify the operation of DAC.
- Experiment 18:** Study & Verification of (i) DC Motor Control (ii) Stepper Motor Control.
- Experiment 19:** Measurement of frequency of an unknown sinusoid.
- Experiment 20:** Measurement of a electrical quantity such as voltage and current.
- Experiment 21:** Measurement of a physical quantity such as temperature, pressure etc.

ADVANCED VLSI-LAB (EC-1723)

- Experiment 1:** To Design NOT, NOR, NAND gates using HSPICE & CADENCE and compute the delay between input and output waveforms
- Experiment 2:** To Design 2:1 MUX using HSPICE & CADENCE and compute the delay between input and output waveforms
- Experiment 3:** To Design XOR, NOR, NAND gates using HSPICE & CADENCE and compute the delay between input and output waveforms and compare the difference between CMOS and pseudo technique.
- Experiment 4:** To Design XOR gate using CMOS and pseudo NMOS technique using HSPICE & CADENCE and compute the delay between input and output waveforms and compare them
- Experiment 5:** To Design and simulate D-FLIP FLOP as a MASTER-SLAVE configuration using HSPICE & CADENCE
- Experiment 6:** To Design Ring Oscillator using HSPICE & CADENCE and compute the delay between input and output waveforms.
- Experiment 7:** To Design 2:1 MUX using transmission gates using HSPICE & CADENCE
- Experiment 8:** To Design 6-T SRAM using HSPICE & CADENCE and compute the delay between input and output waveforms
- Experiment 9:** To Design and simulate CS-Amplifier and calculate transconductance using CADENCE
- Experiment 10:** To Design and simulate Current-Mirror circuit and calculate transconductance using CADENCE
- Experiment 11:** To Design and simulate Differential-Amplifier circuit and calculate transconductance using CADENCE

W/L using CADENCE

Experiment 13: To Design and simulate INVERTER Circuit and perform transient, DC, Parametric, Noise and PSS analysis using CADENCE

Experiment 14: To Design and simulate INVERTER, NAND, NOR Circuits and calculate noise margin using HSPICE & CADENCE

Experiment 15: Design and simulate INVERTER, NAND, XOR Circuits and calculate delay, power for pre-layout and post-layout using CADENCE

FPGA LAB (EC-1724)

Experiment (Any 10)

All experiments to be dumped to FPGA and tested.

Experiment 1: Design and Simulation of 4-bit parallel Adder

Experiment 2: Design and Simulation of 4 X 1 MUX

Experiment 3: Design and Simulation of D Flip-Flop

Experiment 4: Design and Simulation of JK Flip-Flop

Experiment 5: Design and Simulation of T Flip-Flop

Experiment 6: Design and Simulation CLOCK GENERATOR

Experiment 7: Design and Simulation of UP-DOWN Counter

Experiment 8: Design and Simulation of BCD to Excess-3 code

Experiment 9: Design and Simulation of 3 to 8 Decoder

Experiment 10: Design and Simulation of 4to 16 Decoder

Experiment 11: Design and Simulation of 4 bit ripple counter

Experiment 12: Design and Simulation of 4 bit Adder and Subtractor

Experiment 13: Design and Simulation of 4 bit mod 13 counter

Experiment 14: Design and Simulation of 8 bit register

PROFESSIONAL ELECTIVE-I

ADVANCED COMPUTER ARCHITECTURE (EC1731)

UNIT 1: Introduction to parallel processing-Necessity of high performance, Constraints of conventional architecture, Parallelism in uni processor system, Evolution of parallel processors, Future trends, Architectural classification, Applications of parallel processing, Programming and networking properties, Principles of scalable performance, Conditions of parallelism, Data and resource dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain size and latency, Program flow mechanisms, Control flow versus data flow, Data flow architecture. 8(L)

UNIT 2: Pipelining-Linear pipeline processor, Nonlinear pipeline processor, Instruction pipeline design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch handling techniques, Arithmetic Pipeline Design, Computer arithmetic principles, Static arithmetic pipeline, Multifunctional arithmetic pipelines. 8(L)

UNIT 3: Processors Technology-Advanced processor technology, Instruction-set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar Processors, VLIW Architectures, Vector Processing Principles, Vector instruction types, Vector-access memory schemes, CRY-1 architecture. 8(L)

UNIT 4: Memory Technology-Hierarchical memory technology, Inclusion, Coherence and Locality, Memory capacity planning, Virtual Memory Technology. 5(L)

UNIT 5: System Interconnect Architectures: Network properties and routing, Static interconnection networks, Dynamic interconnection Networks, Multiprocessor system interconnects, Hierarchical bus systems, Crossbar switch and multiport memory, Multistage and combining network. 5(L)

UNIT 6: Synchronous Parallel Processing : SIMD Architecture and Programming Principles, SIMD Parallel Algorithms, SIMD Computers and Performance Enhancement, SIMD matrix multiplication, Parallel sort, FFT. 6(L)

Text/Reference Books:

- Kai Hwang, "Advanced computer architecture"; TMH.
- Hwan and Briggs, "Computer Architecture and Parallel Processing"; MGH.
- Hennessy and Patterson, "Computer Architecture: A Quantitative Approach", 3rd edition, Morgan Kauffmann
- Harvey G.Cragon, "Memory System and Pipelined processors"; Narosa Publication.
- V.Rajaraman & C.S.R.Murthy, "Parallel computer"; PHI.
- R.K.Ghose, Rajan Moona & Phalguni Gupta, "Foundation of Parallel Processing"; Narosa Publications. Kai Hwang and Zu, "Scalable Parallel Computers Architecture"; MGH.
- D.Sima, T.Fountain, P.Kasuk, "Advanced Computer Architecture-A Design space Approach," Addison Wesley, 1997.
- M.J Flynn, "Computer Architecture, Pipelined and Parallel Processor Design"; Narosa Publishing

EMBEDDED SYSTEMS (EC-1732)

Unit 1: Introduction to Embedded systems- Introduction, Categorization of Embedded Systems, Exemplary Systems, Selection of Processor and Memory for Embedded Systems, DMA, I/O Devices, Interrupt Service Handling

Unit 2: 8-bit Microcontrollers- Introduction to MCS-51 Family, Architectural Features, Organization of Data & Program Memories, Orthogonal Architectural Features, Addressing modes, Instruction Set, Programming, 8051 Interrupts, Writing ISRs, SFRs, Programming on-chip Devices, UART and Serial Port Programming, Power Saving Modes. 10(L)

Unit 3: Interfacing & Applications- External Memory Interfacing, Interfacing ADC, Display Systems (7-Seg & LCDs), Potentiometer Position Measurements, Temperature Monitoring/Control for ACs, Light Sensors for Robotics, Ultrasonic Distance Measurements, PWM Motor Control, RS-232 Interface, Servo Positioner System. 10(L)

Unit 4: Enhanced MCS-51 Features- Architectural Enhancements in Scratchpad RAM, Watchdog Timers, Onboard PWM, HSM Controllers, High Speed Serial Port, Introduction to MCS—151/251. 6(L)

Unit 5: Real Time Operating System- Introduction to OS Concept, System Services, RTOS basics, Task Scheduling, Interrupt latency, Example RTOS for MCS-51: RTOSLITE & FULLRTOS. 8(L)

Text/Reference Books:

1. Raj Kamal, Embedded System Architecture, Programming and Design, 2nd Ed, Tata McGraw Hill.
2. Myke Predko, Programming and Customizing the 8051 Microcontroller, Tab Books/ Tata McGraw Hill.
3. M.A. Mazidi, J.G. Mazidi, R.D. McKinlay, The 8051 Microcontrollers and Embedded Systems: Using Assembly and C, 2nd Ed, Pearson Education.
4. John Catsoulis, Designing Embedded Hardware, O'Reilly Media, Inc.
5. K. J. Ayala, The 8051 Microcontrollers Architecture Programming & Applications, 2nd Ed, Penram International.
6. L. B. Das, Embedded Systems: An Integrated Approach, Pearson Education.

MICRO-COMPUTER BASED SYSTEM DESIGN (EC-1733)

Unit 1 Review of 8086 & Programming through PC- BIU & EU, Addressing Modes & Programming and CPU Module Design: Bus Buffering and Latching, Fully Buffered Systems, Bus Timings, Read & Wait etc. Use of Memory Models, Realization of Array Structures, Display Screen & Keyboard Processing with INT and BIOS Functions Calls, .COM and .EXE Programs, Use of Macros, LOCAL, EXTRN and PUBLIC. 8(L)

Unit 2 Interfacing with 8086

(a) Memory Interfacing- Physical Memory Organization, Memory Interfacing, Parity Error Detection & Correction, DRAM Interfacing. 4(L)

(b) Special Interfacing Devices- Interrupt Response of 8086, Interfacing 8259 Priority Interrupt controller, Interrupt modes, Master/Slave Configuration, DMA Response of 8086, Interfacing 8237 DMA Controller and DMA Modes, The 8279 Controller, Keyboard Formats & Display Modes, Interfacing Keypad and Alphanumeric Displays for SDK-86 System. 8(L)

Unit 3 Serial Communication

(a) Introduction & USART Interfacing- Formats and Protocols, Interfacing 8251 USART Operating Modes, Modem Control, Serial Transfer between two 8086 single board microcomputers. 4(L)

(b) Using PCs Serial Port- Architecture & Configuration of Port, IRQ Conflicts, Linking Two Devices with RS-232, Linking RS-232 Applications such as 2-PC Link, PC-to-Basic Stamp Link, PC-to 8052-Basic Link. 4(L)

Unit 4 Measurement/Instrumentation- Interfacing A/D Converters, Analog Multiplexers, Sample and Hold, D/A Converters, Measurement of Frequency, Measuring KWH, Power Factor, Measurement & Display of Motor Speed, Microcomputer based smart scale etc. 6(L)

Unit 5 Industrial Process Control- Overview, Liquid Level Monitoring & Control, Microprocessor based Protective Relays, Temperature Control in Vacuum Furnaces, Servo Motor Control etc. 6(L)

Text/Reference Books:

- D.V. Hall, Microprocessors and Interfacing, 2nd Ed, TMH.
- Liu & Gibson, Microcomputer Systems: The 8086/8088 Family Architecture, Programming and Design, 2nd Ed, PHI.
- Barry B Brey, The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, Pentium, and Pentium Pro Processors, PHI
- Jan Axelson, Serial Port Complete Programming & Circuits for RS-232 and RS-485 Links and Networks, Penram International.
- Peter Abel, IBM PC Assembly Language and Programming, 3rd Ed, PHI.
- The Intel Handbook of peripheral devices.

MEMS AND INTEGRATED SENSORS (EC-1734)

UNIT 1: Introduction to MEMS; MEMS technologies; Applications; 6(L)

UNIT 2: Micromachining- surface and bulk; MEMS processes; 6(L)

UNIT 3: Principle of sensors; Smart sensors, temperature sensors, pressure and strain gauges, optical sensors, PH sensors, On-chip integration of sensors; 10(L)

UNIT 4: Micropower OP AMPS; BIMOS chips for analog and digital functions; 6(L)

UNIT 5: Micromachined actuators; flow sensors, accelerometers, gyro; 6(L)

UNIT 6: Biomedical and process control chips with integrated sensors. 6(L)

Radar

- UNIT 1** Introduction: Principle of detection and ranging, Radar frequencies and bands. Applications, Radar block diagram and operation. Radar Range Equation: Range prediction, Minimum detectable signal, Receiver noise SNR, Integration of radar pulses, 5(L)
- UNIT 2** Radar cross section of targets, Transmitter Power, PRF and system losses & Propagation effects. 3(L)
- UNIT 3** CW FM Radar: Doppler effect, CW Radar, Frequency-modulated CW Radar, Multiple-frequency CW Radar. MTI and Pulse Doppler Radar: MTI delay lines, Delay line Cancellers, Coherent and Non-Coherent MTI, Pulse Doppler Radar 8(L)
- UNIT 4** Tracking radar, Earth penetrating radar, Radar clutter, Radar antenna 4(L)

Satellite

- UNIT 5** Introduction: Communication satellites, Orbiting satellites, Orbital mechanics Frequencies and bands, Satellite Transponder: Transponder model, Satellite signal processing RF-RF translation, IF demodulation. 5(L)
- UNIT 6** Satellite link analysis for uplinks and downlinks, Satellite Channel: Power flow, Polarization, Atmospheric losses, Earth station technology, Receiver noise, CNR. 5(L)
- UNIT 7:** Modulation and multiplexing techniques for satellite links, Multiple-Access: FDMA, TDMA, Synchronization, SS-TDMA; CDMA; DS CDMA, Frequency-hopped, CDMA. Carrier recovery & bit timing 5(L)
- UNIT 8:** Global positioning system, DTH, V-SAT, mobile satellite communication. 5(L)

Text/Reference Books:

- Introduction to Radar Systems - M.I. Skolnik
- Satellite Communication - T. Pratt & C.W. Boston
- Radar Fundamentals - G.J. Wheeler.
- Radar – principles, technology, applications – Byron Edde
- Digital satellite communication- T. Ha
- Satellite Communication - R.M. Gagliardi
- Satellite Communication System Design Principles - M. Richharia

ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY (EC-1742)

- UNIT 1: EMI ENVIRONMENT**-Sources of EMI, conducted and radiated EMI, Transient EMI, EMI-EMC Definitions and units of parameters. 6(L)
- UNIT 2: EMI COUPLING PRINCIPLES**-Conducted, Radiated and Transient Coupling, Common Impedance Ground Coupling, Radiated Common Mode and Ground Loop Coupling, Radiated Differential Mode Coupling, Near Field Cable to Cable Coupling, Power Mains and Power Supply Coupling. 8(L)
- UNIT 3: EMI SPECIFICATIONS/STANDARDS/ LIMITS**-Units of specifications, Civilian standards Military standards. 6(L)
- UNIT 4: EMI MEASUREMENTS**-EMI Test Instruments /Systems, EMI Test, EMI Shielded Chamber, Open Area Test Site, TEM Cell Antennas, Conductors Sensors/Injectors/Couplers, Military Test Method and Procedures, Calibration Procedures. 6(L)
- UNIT 5: EMI CONTROL TECHNIQUES**-Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting. 6(L)
- UNIT 6: EMC DESIGN OF PCBs**-PCB Traces Cross Talk, Impedance Control, Power Distribution Decoupling, Zoning, Motherboard Designs and Propagation Delay Performance Models. 8(L)

Text/Reference Books:

- Bernhard Keiser, "Principles of Electromagnetic Compatibility ", Artech house, 3rd Ed, 1986.
- Henry W.Ott, "Noise Reduction Techniques in Electronic Systems ", John Wiley and Sons, 1988.
- V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies ", IEEE Press, 1996.
- Learning Materials on Electromagnetic Interference and Compatibility, prepared by IIT, New Delhi, for the project IMPACT, DoE, Government of India, 1997.

DIGITAL TRANSMISSION (EC-1743)

- UNIT 1:** Elements of Communication systems, communication Channels and their characteristics, Mathematical model for communication Channels, Characterization of communication signals and systems, Representation of bandpass signals and systems, signal space representation, spectral characterization of digitally modulated signals 10(L)
- UNIT 2:** Optimum receivers for the additive white Gaussian noise channels, performance of the optimum receivers for memoryless modulation, carrier and symbol synchronization, signal design of bandlimited channels, adaptive linear equalizer 10(L)
- UNIT 3:** Digital transmission through fading multipath channels, characterization of fading multipath channels, performance of fading multipath channels, Digital signaling over a frequency selective slowly fading channel, 10(L)
- UNIT 4:** Diversity techniques for fading multipath channels, Introduction to multiuser communication systems and their applications, Simulation of Communication Systems. 10(L)

Text/Reference Books:

- John J. Proakis, "Digital communication" Fourth Ed. MGH
- D. R. Smith, "Digital Telecommunication", Springer
- B. Sklar, "Digital communication: Fundamentals and applications" Prentice Hall

UNIT 1: Review of communication concepts from circuit designer perspective. General VLSI optimization techniques, partitioning and synthesis of different telecommunication blocks. Telecommunication system integration in single chip/multichip module, high throughput and low delay/latency design requirement for real time communication, critical path analysis for high speed VLSI design, switched capacitor circuits, high speed A/D and D/A converters. Receiver architectures for different systems. Active and passive mixers. Frequency synthesizer circuits.

VLSI CAD tools, softwares and languages, low power circuits/architecture design methodologies, high speed switching circuits, high speed memory organization, high speed control & decision circuits, design of analog front ends, impedance matching with bonding pads, Si-Ge devices for RF circuits, interface for optical fibres, VLSI for generation and detection of PSK, FSK, QAM etc., subscriber line interface circuits, network switching circuits, VLSI systems for modem design, adaptive filters, equalizers, CVSD codecs, PLL, ISDN, UDLT, USART, Viterbi decoding, data encryption, DSPs, audio/video compression, video conferencing, Case studies for implementation of specific protocols currently in vogue.

UNIT 2: VLSI implementation and design issues related to Discrete Fourier transform, digital filter design techniques; computation of discrete Fourier transform; discrete Hilbert transform; discrete random signals; effect of finite register length in digital signal processing; power spectrum estimation. Design issues related to VLSI for signal processing.

Text/Reference Books:

- VLSI for Wireless Communication: Pearson Education, Low Price Edition, Bosco Leung, Charles G. Sodini.



UNIT 1: Statistical Signal Processing: Method of least squares (LS). Recursive LS. Parameter estimation. Nonparametric Estimation: Correlation and spectral analysis. Cepstrum. Yule-Walker equation. Singular Value Decomposition (SVD) and Introduction to Adaptive Signal Processing 7(L)

UNIT 2: Multirate DSP: up-sampler and down-sampler, filters in sampling rate alternation systems; multi-stage design of decimator and interpolator, polyphase decomposition; arbitrary sampling rate converter, Lagrange interpolation, digital filter banks, uniform DFT filter banks, Nyquist filters, quadrature-mirror filter banks, perfect reconstruction two-channel FIR filter banks, multi-level filter banks. 7(L)

UNIT 3: 2D systems and mathematical preliminaries, Linear operations on images. Digital Representation of Binary & Gray Scale and colour Images 4(L)

UNIT 4: Fundamental steps in image processing. Elements of Digital Image Processing Systems, Some basic relationship between pixels 2(L)

UNIT 5: Image sampling and quantization: 2D Sampling on rectangular and nonrectangular sampling lattice, Aliasing, Image Quantization, Visual Quantization 2(L)

UNIT 6: Image transforms: 2D Orthogonal and Unitary Transforms Basis image, Properties of Unitary Transforms, 1D and 2D Discrete Fourier transform and its properties DCT, DST and its properties, Walsh, Hadamard Transform, Harr & Slant transform, and KLT 5(L)

UNIT 7: Fundamentals of Wavelet transform and it application, Image analysis using multi-resolution techniques. 2(L)

UNIT 8: Image Enhancement Techniques: Spatial domain and frequency domain Methods, Gray scale transformation, Histogram matching and equalization, Smoothing:- Noise Removal, Averaging, Median, Min/Max. Filtering sharpening of Images is using differentiation, the Laplacian, High Emphasis filtering, Edge detection 4(L)

UNIT 9: Image restoration: Degradation model, averaging, inverse and Wiener filtering 4(L)

UNIT 10: Image Data Compression, Image redundancies, Lossy and Lossless Compression, Pixel coding, Predictive coding, Fidelity criteria. DCT and wavelet based Transform Coding schemes, Huffman, Run-length and Arithmetic coding, JPEG and JPEG2000 5(L)

UNIT 11: Image Segmentation: Line and Edge Detection, Detection of discontinuities, edge labelling and boundary detection, Edge linking, Hough Transform, Thresholding histogram Technique. Image segmentation using similarities: region growing, Split and Merge 3(L)

Text/Reference Books:

- Digital Signal Processing: A Computer Based Approach, 3e, McGraw Hill- Sanjit K. Mitra,
- Fundamentals of Statistical Signal Processing- S. M. Kay,
- Digital Image Processing –R. C. Gonzalez & Richard E. Woods
- Fundamentals of Digital Image Processing – A. K. Jain
- Digital Signal Processing: Principles, Algorithms, and Applications by J. G. Proakis and D. G. Manolakis.
- Digital Image Processing – C. Rafel & Paul Wintz
- Digital Picture Processing – A. Rosenfield & A.C. Kak
- Orthogonal Transform for Digital Signal Processing – N. Ahmad & K.R. Rao
- Discrete-Time Signal Processing - Alan V. Oppenheim, Ronald W. Schaffer, and John R. Buck,
- Digital Video Processing, Prentice-Hall, 1995 - A.M. Tekalp.,
- Handbook of Image and Video Processing, Academic Press, 2000. - A. Bovik,
- Wavelets and Subband Coding, Prentice-Hall, 1995- M. Vetterli and J. Kovacevic,
- Multirate Systems and Filterbanks, Prentice Hall, 1993 - P.P. Vaidyanathan.,
- Statistical Signal Processing and Modeling- M. Hayes

ADVANCED DIGITAL SIGNAL AND IMAGE PROCESSING LAB (EC-1851)

Experiment 1: Speech Processing

A speech processing experiment, separated to two parts:

- In this experiment the students will become familiar with speech signals, their statistical properties and with a model that represents the production of such a signal.
An encoder-decoder system will be built and tested using Matlab.
- The blocks that assemble such systems are a VAD (Voice Activity Detection), a voiced/unvoiced classifier, a pitch (the basic frequency of speech) detector and a parametric model of a speech signal.

Experiment 2: Real-time Implementation of Digital Filters

A Real-Time experiment, based on Texas Instrument's TMS320c6713, A well known and wide used DSP. The experiment is separated into two parts:

- Digital filter (FIR) design, with special attention to quantization and fixed-point implementation.
- Comparison of FIR and IIR filters design, with DFT/FFT usage example, by tuning piano tones.

Experiment 3: Image Compression

In this experiment the students will become familiar with the basics and principles of image processing and compression techniques, specifically with the well known and widely used JPEG standards. The experiment is separated into two parts:

- Feature extraction and other image processing operations
- Image basics, terminology and techniques used for image processing and compression are learned. This part includes a "JPEG-like" Matlab based implementation of these basic ideas.

Experiment 4: Wavelet and Multirate Signal Processing

- Up-sampler and down-sampler, filters in sampling rate alternation systems; multi-stage design of decimator and interpolator, polyphase decomposition; arbitrary sampling rate converter, digital filter banks, uniform DFT filter banks,

PROFESSIONAL ELECTIVE-III**DIGITAL HARDWARE DESIGN (EC-1831)**

UNIT 1: Revision of Combinational and sequential logic- Review of POS and SOP minimization, Multi output function, Variable entered mapping, Computer Arithmetic, ASM, FSM, Shift register, Timing and triggering, Clock skew, Device technologies, System representation, Levels of Abstraction, Development tasks and EDA software, Development flow. 8(L)

UNIT 2: Hardware Description Languages-Digital Hardware Elements and Their Description in Hardware Description Language, System Structuring Methodology, (VHDL/Verilog), Simulation and its different types.8(L)

UNIT 3: Circuit Design- Combinational Circuit Design, Sequential Circuit Design, Finite State Machine, Register Transfer Methodology, Hierarchical design, Clock and Synchronization. 8(L)

UNIT 4: Microprocessor design- Data Path design, Control unit design, Hardware, Software and Firmware Considerations in Designing Control units, Arithmetic and Logic unit of Processors, Example of dedicated processor (GCD), General purpose processor design. 8(L)

UNIT 5: FPGA Based design- Programmed Logic Devices, Fundamental concept of FPGA, Architecture of FPGA, FPGA programming, Schematic and HDL based design flow, Serial Communication, Memory, Digital filters, DSP based design, IP. 8(L)

Text/Reference Books:

- An Engineering approach to Digital Design - W.I. Fleccher
- Switching and finite automata theory- Zvi Kohavi
- Digital logic and microprocessor design with VHDL- Hwang
- Digital System design using VHDL- C H Roth
- RTL Hardware design using VHDL- PP Chu
- VHDL programming by example- perry , perry

SWITCHING CIRCUITS AND FINITE AUTOMATA THEORY (EC-1832)

UNIT 1: Structural properties of switching functions- Functional decomposition, Symmetric networks, Identification of symmetric functions, Threshold Logic, analysis and synthesis of threshold networks. 6(L)

UNIT 2: Reliable Design and Fault Diagnosis in combinational circuits- Hazards, Fault models, Fault detection and location in combinational circuits, Fault detection by fault-table, path sensitizing, and Boolean difference methods, D-algorithm, Delay fault testing, Detection of multiple faults, Failure-tolerant design, Quadded logic. 7(L)

UNIT 3: Synchronous sequential circuits- Finite-state model, Capabilities and limitations of finite-state machines, State equivalence and machine minimization, Analysis and synthesis of synchronous sequential circuits, Simplification of incompletely specified machines. 7(L)

UNIT 4: Asynchronous Sequential Circuits- Fundamental-mode circuits, Analysis and synthesis of asynchronous sequential circuits, State assignment in asynchronous sequential circuits, Hazard-free asynchronous circuits. 7(L)

UNIT 5: Fault-Detection and Location in Sequential Circuits- Homing experiments, Distinguishing experiments, Machine identification, Fault-detection experiments, Design for testability, Scan design, Built-in Self-Test (BIST).6(L)

UNIT 6: Memory, Definiteness, and Information Losslessness of Finite Automata- Properties of finite-memory machines, Definite machines, Tests for definiteness, Finite output memory machines, Information lossless machines, Inverse machines. 7(L)

Text/Reference Books:

- Z. Kohavi and N. K. Jha, Switching and Finite Automata Theory, Tata McGraw-Hill, Third Edition
- M. Abramovici, M. A. Breuer, and A. D. Friedman, Digital Systems Testing and Testable Design, Wiley-IEEE press, 1994. IL.
- R. D. Adams, High Performance Memory Testing, Kluwer Academic Publishers, 2002.
- J. Altet and A. Rubio, Thermal Testing of Integrated Circuits, Kluwer Academic Publishers, 2002.

LOW POWER VLSI DESIGN (EC-1833)

UNIT 1: Introduction- IC Power consumption concerns. Limits of Power in Microelectronics. Low-power design methodologies. 3(L)

UNIT 2: Power Consumption in CMOS Digital Designs- Switching component of power. Switching energy per transition. Conventional CMOS circuits with rail-to-rail swing. Charge sharing. Components of node capacitance. Definition of transition activity factor. Influence of logic level statistic and circuit topologies on the node transition activity factor. Word level signal statistics influencing activity. Influence of voltage scaling. Short-circuit component of power. Leakage component of power. Diode Leakage. Sub-threshold leakage. Static Power. Reduced voltage levels feeding CMOS gates. Pseudo-NMOS logic style. 12(L)

UNIT 3: Voltage Scaling Approaches- Reliability-driven voltage scaling. Technology-driven voltage scaling. Energy x delay minimum based voltage scaling. Voltage scaling through optimal transistor sizing. Voltage scaling using threshold reduction. Architecture-driven voltage scaling. Trading area for lower power through hardware

hardware pipelining. Noise Considerations at reduced supply voltage. Digital design with multiple supplies. 9(L)
UNIT 4: Adiabatic Switching- Adiabatic charging. Adiabatic amplification. One-stage adiabatic buffer in conventional system. Two-stage adiabatic buffer in conventional system. Fully-adiabatic system. Comparison with conventional buffer. Supply voltage influence. Adiabatic logic gates. Fully-adiabatic sequential circuits. Partially-adiabatic sequential circuits. Stepwise charging. Pulsed-power supplies. Optimization algorithms. 8(L)
UNIT 5: Leakage Power Reduction- Leakage current in deep submicron ICs. Gate oxide tunneling. Supply power control. Bulk-source biasing. Bias voltage generator. Logic gate optimization for leakage power. Input vector selection for standby mode. 5(L)

Text/Reference Books:

- Low Power CMOS VLSI circuit design By Kaushik Roy and S.C Prasad, Publisher : John Wiley & Sons.
- CMOS/BiCMOS VLSI : Low Voltage Low Power By K.S.Yeo, S.S.Rofail, W.L.Goh Publisher : Prentice Hall.
- Low Power Digital CMOS Design By A.P.Chandraksen, R.W.Brodersen Publisher : Kluwer Academics

ADVANCED DSP ARCHITECTURE (EC-1834)

UNIT 1: Introduction in concepts and architectures used in digital signal processing 2(L)
UNIT 2: Parallel architectures specialized in digital signal processing 2(L)
UNIT 3: Digital signal processors, Processing architectures : von Neuman (SISD), Harvard, SIMD, MIMD. Comparison: CISC-RISC vs. Transputers. DSP types: fixed point, floating point. TI DSP family. 4(L)
UNIT 4: Fixed point DSP fundamentals (structure of TMS320C25 family), Internal architecture. External connections. Memory organization. Peripherals. Interrupts. 5(L)
UNIT 5: Instruction set of TMS320C2x family, Addressing modes- direct, immediate, indirect, bit-reverse. Instructions. COFF format. Q15 representation. 4(L)
UNIT 6: Other DSP structures (enhanced fixed point-TMS320C5x, C54x, floating point- 3x, 4x families, high performance 8x, 6x), Internal architecture- improvements compared with C2x. Hardware implementation of loops. Memory organization. Interrupts. Addressing modes. Instruction set. MVP TMS320C80 - internal architecture. TMS320C54x. Architecture. Improvements. TMS320C6x. VLIW Architecture - VelociTI. C6201 chip. 6(L)
UNIT 7: Mathematical fundamentals of filter and FFT design- Digital filters. FIR filters. IIR filters, FFT-properties. Base algorithm. Fast algorithms. 4(L)
UNIT 8: Interconnection in DSP systems (high performance buses) 2(L)
UNIT 9: Testing DSP based systems (Jtag interfaces) 2(L)
UNIT 10: Practical applications using DSP 3(L)

Text/Reference Books:

- Chassaing, Rulph, Digital Signal Processing: Laboratory Experiments Using C and the TMS320C31 DSK. John Wiley & Sons, Inc., New York, 1999.
- Dake Liu, Design of embedded DSP processors, compendium
- Phil Lapsley, Jeff Bier, Amit Shoham "DSP Processor Fundamentals, Architectures and Features", IEEE Press.
- Michael J. Flynn "Computer Architecture. Pipelined and parallel processor design", Jones and Bartlett, 1995.
- Kehtarnavaz, Nasser; Simsek, Burc, C6x-Based Digital Signal Processing. Prentice Hall, New Jersey, 2000.
- Gomaa, Hassan, Software Design Methods for Concurrent and Real-Time Systems. Addison-Wesley Publishing Company, Inc., 1993.

PROFESSIONAL ELECTIVE-IV

INFORMATION THEORY AND CODING (EC-1841)

UNIT 1: Information and its measure, Entropy, Eisenstein's axiomatic approach, Source Entropy and its extensions, uncertainly. 6(L)
UNIT 2: Source coding theories, Data compaction Huffman coding, Huffman Tree, Lemopel - ziv coding 6(L)
UNIT 3: Discrete Memory less Channels, binary symmetric channel, mutual information, channel capacity, channel coding theorem. Information capacity Theorem, sphere packing. 6(L)
UNIT 4: Cascaded and special channels, markov processes & their entropy, information capacity of coloured Noise Channel. 5(L)
UNIT 5: Rate distortion Theory, Data compression calculation of syndrome. 4(L)
UNIT 6: Error control coding, Error detection and correction, Linear block codes, cyclic codes, Generator polynomial, Hamming codes, BCH codes, convolutional codes, Parallel concatenated convolution code (PCCC), Serial concatenated convolution codes (SCCC) & their applications. 9(L)
UNIT 7: Maximum likelihood Decoding of convolution codes, Viterbi Algorithm, Asymptotic coding gain. 4(L)

Text/Reference Books

- Gareth & Jones, Jodephine Man "Information & Coding Theory"
- J.H. Ewing, Itatmos Branka "Coding and Information Theory".
- Veucetic, Jinhong Yhan "Turbo coding"
- John. J Proakis "Communication System"
- Simon Haykin "Communication System".

Unit I : Introduction to Optical Networks- Principles and Challenges and its Generation, Optical Transmission systems, Wavelength Division Multiplexing, Wavelength Add/Drop Multiplexer, Optical Filters, Optical Amplifiers, Wavelength cross connect, Evolution of WDM Optical Network, WDM Point-to-point Link. 8(L)

Unit II : Enabling technologies for WDM optical networks, WDM optical networks architecture, Broadcast-and-select network, Wavelength routed network, linear light wave network. 6 (L)

Unit III : Issues in wavelength routed network, Routing and wavelength assignment, Wavelength convertible networks, Multifiber networks, Virtual topology design, Virtual topology reconfiguration, Survivable networks, Optical multicast routing, Network control and management. 8 (L)

Unit IV : Transmission impairment, Ring networks and traffic grooming, VPN over WDM Optical network, Access network and Next generation optical Internet Networks, Introduction of All Optical Network. 6 (L)

Text/Reference Books

- R. Ramaswami, & K. N. Sivarajan, "Optical Networks a Practical perspective", Morgan Kaufmann Publishers, 3rd Ed.
- B. Mukherjee, *Optical Communication Networks*, New York, NY: McGraw-Hill, July 1997.
- U. Black, "Optical Networks: Third Generation Transport Systems"/ Pearson Educations
- Biswanath Mukherjee "Optical WDM Networks" Springer Pub 2006.
- "Fiber Optic Communication System", G. P. Agrawal, John Wiley, NY

MULTIMEDIA COMMUNICATION (EC-1843)

UNIT 1: Multimedia Communications- Introduction, information representation, networks, Applications and networking terminology, multimedia Information Representation-text, images, audio, video 6(L)

UNIT 2: Text and Audio Compression- Huffman coding, Arithmetic coding, LZ coding.. Audio compression-Linear predictive coding, perceptual coding, MPEG audio coder. 6(L)

UNIT 3: Image and Video Compression- JPEG, Wavelet based image compression Video compression-Video compression principle, H.261, H.263, MPEG video coders. 6(L)

UNIT 4: Standards for Multimedia Communications- Reference models, interpersonal communication. Interactive applications over internet, e-commerce Entertainment applications, video-on-demand, interactive television transmission media, Asynchronous & synchronous transmission, Error detection methods, Protocol basics. 6(L)

UNIT 5: Multimedia Networks Circuit-Switched Networks- DSL, switching systems, signaling systems. Broadband ATM networks- switch architecture, protocol architecture ATM LANs, ATM MANs, wide area ATM networks. Enterprise Network- LAN, FDDI LAN protocols. Entertainment Networks- Cable TV network, and satellite TV networks 8(L)

UNIT 6: Multimedia Information Security Support Functions- ASN.1, security, data encryption, authentication, data hiding, watermarking, network security. 4(L)

UNIT 7: Internet Applications- IP datagram, routing algorithms ICMP, QoS support, IPv6, DNS, E-mail, FTP, TFTP, Wi-Fi Internet, internet telephony, Multimedia over wireless networks (satellite, 3G, WiMAX) 4(L)

Text/Reference Books:

- Multimedia Communications: Applications, Networks, Protocols and Standards by Fred Halsall, Preason Education, 4th Ed.
- Introduction to Data Compression by Khalid Sayood
- Multimedia Communication Technology by Jens-Rainer Ohm
- Data Communications & Networking by Forouzan
- Data Hiding Fundamentals & Applications: Content Security in Digital Multimedia by Husrev T. Sencar, Ramkumar & Ali N. Akansu, Springer, 1st Ed.

MIXED - MODE SIGNAL PROCESSING (EC-1844)

UNIT 1: Active & Passive elements- GIC, FDNR, NIC realizations, Immittance & Inductor Simulation, Deboo circuits & Riordan Gytrators, Current Conveyors (CC^+ & CC^{++}), FTFN & CFAs, Generalized active RC realizations, Delyiannis-Friend Circuits, Multiple VCVS & KHN realizations using CFAs, state variable & switched capacitor filters, Relative sensitivity, Pole position & coefficient (Q , W_n) sensitivity, spread considerations. 12(L)

UNIT 2: Basic CMOS Circuit Techniques & Current mode signal processing- Mixed-signal VLSI chips-Basic CMOS Circuits-Basic Gain Stage-Gain Boosting Techniques-Super MOS Transistor, MOS Multipliers and Resistors-CMOS, Bipolar and Low-Voltage BiCMOS building block, Continuous time signal processing, Current Mode low power Neural Networks signal processing blocks. 12(L)

UNIT 3: Mixed- Signal Circuits, Nonlinear Analog Circuits, Dynamic Analog Circuits, Sampled-Data Analog Filters, Over Sampled A/D Converters, D/A Converters and Analog Integrated Sensors: First -order and Second SC Circuits-Bilinear Transformations 4(L)

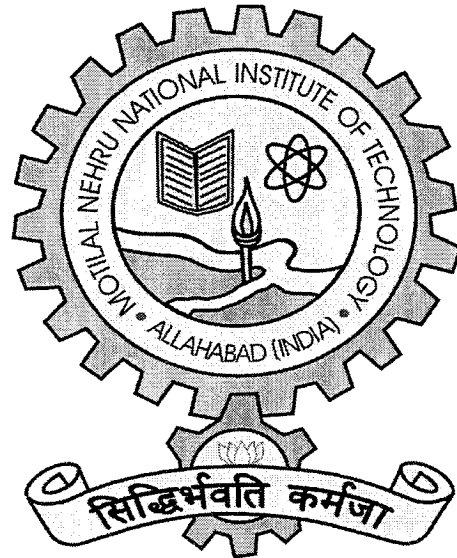
UNIT 4: Digital Tuning /Digital Programmability- SPRA/SPCA (switched programmable resistor array & switched programmable capacitor array), m-DAC (Multiplier-DA converter) and their interfacing to microcontroller/micro computer system, digitally programmable active RC network using high speed analog/ mixed- signal building block. 12(L)

- Mohammed Ismail, Terri Fiez, "Analog VLSI signal and Information Processing "; McGraw-Hill International Editions, 1994.
- Malcom R. Haskard, Lan C. May "Analog VLSI Design- NMOS and CMOS", Prentice Hall, 1998.
- Randall L Geiger, Phillip E. Allen, "Noel K. Strader, VLSI Design Techniques for Analog and Digital Circuits", Mc Graw Hill International Company, 1990.
- Jose E. France, Yannis Tsvividis, "Design of Analog-Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.
- C. Toumazou, F.J. Lidgley & D.G. Haigh, Analog IC Design. The Current-Mode Approach, Peter Peregrinus Ltd., 1990.

Power

Course Structure & Curriculum
For
B. Tech. Programme

In
INFORMATION TECHNOLOGY



Department of Computer Science & Engineering
Motilal Nehru National Institute of Technology
Allahabad

1/1/10

3rd Semester (Information Technology)

Course Code	Course name	L	T	P	Credit
CS-1301	Data Structures	4	-	-	4
MS-1301	Management of IT Industries	3	-	-	3
CS-1303	Analog & Digital Electronics	4	-	-	4
CS-1304	Foundations of Logical Thought	4	-	-	4
CS-1305	Technical Writing	3	-	-	3
CS-1351	Programming Tools – I (Shell)(Lab)	-	-	3	2
CS-1352	Data Structures (Lab)	-	-	3	2
CS-1353	Analog & Digital Electronics (Lab)	-	-	3	2
	Total	18		9	24

4th Semester (Information Technology)

Course Code	Course name	L	T	P	Credit
CS-1401	Analysis of Algorithms	3	-	-	3
CS-1402	Graph Theory & Combinatorics	3	-	-	3
CS-1403	Computer Organization	3	-	-	3
CS-1404	Automata Theory	4	-	-	4
EC-1405	Communication Foundations	3	-	-	3
CS-1405	Contemporary Issues in Information Technology	2	-	-	2
CS-1451	Programming Tools – II (System Call)(Lab)	-	-	3	2
CS-1452	Analysis of Algorithms (Lab)	-	-	3	2
EC-1454	Communication Foundations (Lab)	-	-	3	2
CS-1453	Automata & Compilers (Lab)	-	-	3	2
	Total	18		12	26

5th Semester (Information Technology)

Course Code	Course name	L	T	P	Credit
CS-1507	Computer Graphics	3	-	-	3
CS-1502	Operating Systems	4	-	-	4
CS-1503	Computer Network	4	-	-	4
CS-1504	Object Oriented Modeling	3	-	-	3
CS-1505	Operations Research	3	-	-	3
CS-1506	Cryptography	3	-	-	3
CS-1551	Programming Tools – III (Web)(Lab)	-	-	3	2
CS-1555	Computer Graphics (Lab)	-	-	3	2
CS-1553	Operating Systems (Lab)	-	-	3	2
CS-1554	Computer Network (Lab)	-	-	3	2
	Total	20		12	28

6th Semester (Information Technology)

Course Code	Course name	L	T	P	Credit
CS-1607	Multimedia Technology	3	-	-	3
CS-1602	Scientific Computing	3	-	-	3
CS-1608	Business Intelligence	3	-	-	3
CS-1604	Wireless Network Security	3	-	-	3
CS-1605	Database Management System	4	-	-	4
CS-1606	Software Engineering	3	-	-	3
CS-1652	Network Security (Lab)	-	-	3	2
CS-1654	Database Management System (Lab)	-	-	3	2
CS-1655	Multimedia Technology (Lab)	-	-	3	2
CS-1651	Mini Project	-	-	3	2
	Total	19		12	27

Forue

Course Code	Course name	L	T	P	Credit
CS-1703	Image Processing	4	-	-	4
CS-1702	Professional Ethics	2	-	-	2
OE-1781	Open Elective – I	3	-	-	3
CS-1731 to CS-1740	Professional Elective – I	3	-	-	3
CS-1741 to CS-1750	Professional Elective – II	3	-	-	3
CS-1791	Project	-	6	-	6
CS-1754	Image Processing (Lab)	-	-	3	2
Total		15	6	3	23

8th Semester (Information Technology)

Course Code	Course name	L	T	P	Credit
CS-1803	Privacy Preserving Publishing	4	-	-	4
CS-1804	Research Trends in IT	3	-	-	3
CS-1831 to CS-1840	Professional Elective – III	3	-	-	3
CS-1841 to CS-1850	Professional Elective – IV	3	-	-	3
OE-1881	Open Elective – II	3	-	-	3
CS-1891	Project	-	6	-	6
Total		16	6	-	22

1st digit; 1: UG, 2nd digit; 2, 3, etc.: Semester

Code	Description
01-30	Theory Courses
31-40	Professional Elective –I
41-50	Professional Elective –II
51-70	Practical Courses
81-90	Open Elective
91-99	Project

Done

UNIT 1: Introduction, Elementary Data Organization, Data Structure Operations, Algorithms Complexity, Time Space Trade off	6(L)
UNIT 2: Arrays, Linked List, stacks and Queues	10(L)
UNIT 3: Tree, Binary tree, Search tree, Heap, B+ tree	12(L)
UNIT 4: Sorting methods, External Sorting/Searching, Hashing	8(L)
UNIT 5: Graphs	6(L)

Text/Reference Books

- The Art of Computer Programming (Volume 1 and Volume 3) - D E Knuth,
- Data Structures Using C & C++, Langsam, Augenstein&Tenenbaum,
- Data Structures – A Programming Approach with C, Kushwaha& Mishra,
- R.L. Kruse, B.P. Leary, C.L. Tondo, “Data structure and program design in C”
- Fundamentals of Data Structures in C, by Ellis Horowitz, SartajSahni, and Susan Anderson-Freed

MANAGEMENT OF IT INDUSTRIES (MS-1301)

UNIT 1: Introduction, Nature & Concept of Management; Managerial skills; Evolution of management thought; Concept of functional management; Management styles, Productivity measurement, productivity index, types of production system.	3(L)
UNIT 2: Human Resource Management: Definition and theories of Managing People for IT Industry, Human Resource Planning, responsibility assignment matrix, resource management, developing and managing the project team, Case Studies.	6(L)
UNIT 3: IT Industry Supply Chain Management: Types, Business processes, Strategic, tactical, and operational decisions in supply chains, performance measures, inventory management, bullwhip effect, e-marketplaces, e-procurement, e-logistics, e-fulfillment, customer relationship management, web services, ERP and supply chains, Case Studies	6(L)
UNIT 4: IT Project Quality Management: Tools and techniques for quality control (Pareto Analysis, Statistical sampling, testing), process control, SQC control charts, single, double and sequential sampling, TQM. Case Studies	6(L)
UNIT 5: Environmental Issues, Pollution Control Acts, Green IT Practices, Establishing a Green IT Action Plan, techniques and technologies available to enable Green IT Case Studies	
UNIT 6: Comprehensive Case studies: Any three from TCS, Cisco, Infosys, Wipro, Facebook, Accenture, Google, IBM, Microsoft etc.	3(L)

Text/Reference Books

- Management :Global Perspectives, by Koontz and Wehrich
- Principles of Management by Prasad, L.M.,
- Environmental and Pollution Awareness by Sharma B.R.

ANALOG AND DIGITAL ELECTRONICS (CS-1303)

UNIT 1: Introduction to semiconductor physics. Diode, Zener Diode, Diode as a switch, Rectifier, Clipping and Clamping Circuits	6(L)
UNIT 2: Bipolar Junction Transistor, Biasing of Transistor, Transistor configurations, Transistor as an Amplifier, Transistor as a Switch.	8(L)
UNIT 3: Introduction to FET, MOSFET, Operational Amplifier, SCR, UJT and other devices	6(L)
UNIT4: Introduction to Boolean Algebra and fundamental theorems, Basic Logic Gates, Realization of combinational circuits using universal gates, Gate level minimization	8(L)
UNIT 5: Important Digital Circuits Decoder, Multiplexer, PLA, ROM, RAM	4(L)
UNIT 6: Flip Flops, Design of Sequential Circuits, Registers, Counters	8(L)

Text/Reference Books

- Digital Design by M Morris Mano, M D Ciletti
- Integrated Electronics by Millman&Halkias
- Electronic Principles by Malvino
- Foundations of Analog and Digital Electronic Circuits by AnantAgarwal and Jeffrey Lang

FOUNDATIONS OF LOGICAL THOUGHT (CS-1304)

UNIT 1: Introduction, Set theory, Notion of proofs, Linear congruence	8(L)
UNIT 2: Formal logic: Propositional Logic, Relational logic, First order logic, and related issues	8(L)
UNIT 3: Lattices and related issues	8(L)
UNIT 4:Group Theory and related issues	6(L)
UNIT 5: Finite Fields and related issues	6(L)
UNIT 6: Generating Functions and related issues	4(L)

Text/Reference Books

- The Essence of Logic, by John Kelly, Ed.
- Logic for Applications, AnilNerode and Richard A. Shore, Ed.
- Logic, Sets, and Recursion, by Robert L. Causey, Ed.
- Concrete mathematics: a foundation for computer science, by R. Graham, D. Knuth, O. Patashnik,
- A Mathematical Introduction to Logic, Enderton, H
- ‘Discrete Mathematical Structure with Application to Computer Science’, J.P Trembley, & R. Manohar

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UNIT 1: Introduction, Introduction To Latex, Introduction to Xfig and other drawing software.	8(L)
UNIT 2: English usage, when English is a foreign language.	6(L)
UNIT 3: Reading a draft, Writing a draft, revising a draft, Introduction to IEEE, ACM style files	6(L)
UNIT 4: Writing a technical talk, presenting the technical talk	4(L)
UNIT 5: Writing a project/thesis. Introduction to various styles.	4(L)
UNIT 6: Copyright issues and plagiarism	2(L)

Text/Reference Books

- Handbook of Writing for the Mathematical Sciences By Nicholas J. Higham
- *The Elements of Style*, William Strunk, ISBN 0-205-30902-X
- LaTeX: A document preparation system, User's guide and reference manual *Leslie Lamport*, ISBN 0-201-52983-1
- Cambridge English for Engineering, Mark Ibbotson

PROGRAMMING TOOLS – I (SHELL) (LAB) (CS-1351)

This is first independent lab course in programming tools which intends to introduce shell programming skills. UNIX is popular alternative to the Windows environment, especially in high-performance PC Linux servers and other UNIX-based web servers. Topics include: Unix utilities and file structure, Links and symbolic links, Data processing and process control in the Unix shell, Shell programming, Regular expressions, Exposure to different shells like bash, csh, ksh. Introduction to the Python/Perl programming in the Unix environment.

DATA STRUCTURES (LAB) (CS-1352)

Data structures represents the logical way for organizing the stored data. The study of data structures is very necessary because it enables the student to learn, analyze and then subsequently apply, proper the efficient operations over the data items used in the programs or software applications. This lab course is in alignment with the subject's theory classes and it will strengthen the basic concepts which are mandatory prerequisites for understanding any other field related to computer science and engineering. In this lab course would learnb, use of different data structures for the same algorithms (Wherever applicable) to see its effect on time and space, comparison of different algorithms for the same problem etc. programs include: stack, queue linked list, heap, tree, binary search tree and graph using C/C++.

ANALOG & DIGITAL ELECTRONICS (LAB) (CS-1353)

This lab course introduces the students fundamentals of basic electronics and takes them forward to experiments on digital circuits.

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ANALYSIS OF ALGORITHMS (CS-1401)

UNIT 1: Introduction, Review of basic concepts, advanced data structures like Binomial Heaps, Fibonacci Heaps	5(L)
UNIT 2: Divide and Conquer with examples such as Sorting, Matrix Multiplication, Convex hull etc	6(L)
UNIT 3: Dynamic programming with examples such as Knapsack, All pair shortest paths etc	4(L)
UNIT 4: Backtracking, Branch and Bound with examples such as Travelling Salesman Problem etc	6(L)
UNIT 5: Algorithms involving Computational Geometry	4(L)
UNIT 6: Selected topics such as NP-completeness, Approximation algorithms, Randomized algorithms, String Matching	5(L)

Text/Reference Books

- Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson and Ronald L. Rivest
- Fundamentals of Computer Algorithms by E. Horowitz & S Sahni
- The Design and Analysis of Computer Algorithms by Aho, Hopcraft, Ullman,

GRAPH THEORY AND COMBINATORICS (CS-1402)

UNIT 1: Combinatorics Basic counting techniques, pigeon-hole principle, recurrence relations, Polya's counting theorem. Introduction to probabilistic method in combinatorics	6(L)
UNIT 2: Fundamental concepts of graphs and digraphs,	4(L)
UNIT 3: Spanning tree, connectivity, optimal graph traversals	5(L)
UNIT 4: Planarity of Graphs, Drawing graphs and maps, graph coloring	5(L)
UNIT 5: Special digraph models, network flow and applications	6(L)
UNIT 6: Algebraic specifications of Graphs, Non planar layouts	4(L)

Text/Reference Books

- Introduction to Enumerate Combinatorics, M. Bona,
- Introduction to Graph Theory, D.B.West
- Graph Theory and Applications J.A. Bondy and U.S.R.Murty: (Freely downloadable from Bondy's website; Google-Bondy)
- Graph Theory: Modeling, Applications, and Algorithms, by GeirAgnarsson and Raymond Greenlaw
- Introductory Combinatorics by R A Brualdi,

COMPUTER ORGANIZATION (CS-1403)

UNIT 1: Introduction, Register Transfer Language, Bus and Memory Transfers, Bus Architecture, Arithmetic Logic Unit	6(L)
UNIT 2: Fundamental concepts of controller design.	6(L)
UNIT 3: Processor design and related issues	8(L)
UNIT 4: Input/Output Organization and related concepts	4(L)
UNIT 5: Optical, magnetic and semiconductor memory devices, Memory organization	6(L)

Text/Reference Books

- Computer Organization and Design: The Hardware-Software Interface, by David Patterson and John Hennessy.
- Computer Organization, by Vravice, Zaky&Hamatcher
- Structured Computer Organization, by Tannenbaum
- Computer System Architecture, by M. Mano

AUTOMATA THEORY (CS-1404)

UNIT 1: Introduction, inductive Proofs Relations and Functions	4(L)
UNIT 2:Regular Languages DFA, NFA Machines and their equivalence, Regular Expressions, Equivalence of Regular Expressions and Finite State Machines, Closure Properties of Regular Languages Proving Non-Regularity	8(L)
UNIT 3: Context-free Languages Context-free Grammars, Derivations, Leftmost, Rightmost, Inherent Ambiguity, Parse Trees, Normal Forms, Proof of Containment of the Regular Languages Pushdown Automata, Equivalence of PDAs and Context-free Grammars Closure Properties of Context-free Languages	12(L)
UNIT 4: Pumping Lemma for both Regular & Context-free Languages, Proving Some Languages are not Context-free.	6(L)
UNIT 5: Recursive and Recursively Enumerable Languages, Turing Machines Definition of Recursive and Recursively Enumerable, Church's Hypothesis, Computable Functions, Methods for Turing Machine Construction	10(L)

Text/Reference Books

- Introduction to the Theory of Computation, by Michael Sipser
- Introduction to Automata Theory, Languages, and Computation, by Hopcroft, Motwani, and Ullman (ISBN 0-321-45536-3)
- Theory of Computer Sciences Korral,
- Automata, Computability and Complexity: Theory and Applications. by E Rich

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COMMUNICATION FOUNDATIONS (EC-1405)

- UNIT 1:** Introduction, Elements of communication systems, review of signal
- UNIT 2:** Representations in time and frequency domain, bandwidth, filters, Electromagnetic spectrum 6(L)
- UNIT 3:** Sky waves, ground waves and space waves, Antenna fundamentals and types of antennas 4(L)
- UNIT 4:** Amplitude Modulation, Frequency modulation, Radio receivers 4(L)
- UNIT 5:** Sampling theorem, quantization and pulse code modulation, digital modulation techniques 6(L)
- UNIT 6:** Fundamentals of guided waves, wave guides, coaxial cables, fiber optic cables, cable types and specifications. 6(L)
- UNIT 7:** Case studies: FM Broadcast, satellite communication, telephone systems, mobile telephony

Text/Reference Books

- Communication Systems Engineering by Proakis, John, and MasoudSalehi
- Electronic Communication Systems by Kennedy D
- Computer Networks by Tanenbaum, Andrew
- Communication Systems by Haykin, Simon.

CONTEMPORARY ISSUES IN INFORMATION TECHNOLOGY (CS-1405)

- UNIT 1:** Introduction, Information technology in the past, present, and in the future 4(L)
- UNIT 2:** Contemporary theoretical and research issues which include the digital divide, optical and quantum computing, human computer interfaces and computing limitations. 8(L)
- UNIT 3:** Applying information technology across disciplines 4(L)
- UNIT 4:** Case study of famous IT professionals 4(L)

Text/Reference Books (Not Applicable)

- CSI Communications (latest 12 issues)
- Communications of ACM (latest 12 issues)
- IEEE Software (latest 12 issues)
- IEEE Computer (latest 12 issues)
- IEEE Spectrum (latest 12 issues)

PROGRAMMING TOOLS -II (SYSTEM CALL) (LAB) (CS-1451)

This is second independent lab course in programming tools which intends to introduce programming involving system calls. System calls are commands that are executed by the operating system. System calls are the only way to access kernel facilities. In this lab course students would learn to use these system calls as file system, multitasking mechanisms and the inter-process communication primitives.

ANALYSIS OF ALGORITHMS (LAB) (CS-1452)

Implementation of algorithms covered in class: This will involve running the algorithms under varying input size and measuring running times, use of different data structures for the same algorithms (wherever applicable) to see its effect on time and space , comparison of different algorithms for the same problem etc.

Following areas should be covered: Dynamic Programming, Divide and conquer, Branch and Bound, Backtracking.
Programming language: C/C++.

COMMUNICATION FOUNDATIONS (LAB) (EC-1454)

Automata theory is the study of abstract computational devices. They have applications in modelling hardware, lexical analysis, machine design, syntax analysis, parser generation, program verification, text editing and so on. The students would do experiments on compiler construction.

AUTOMATA & COMPILERS (LAB) (CS-1453)

Lex and Yacc- Generation of Intermediate Code for Expression Grammar – Construction of Predictive Parsing Table –LR Parsing Tables – Parsing Actions. The aim is to write a compiler for a small language. Familiarity with compiled codes (assembly language) of RISC and CISC machine, writing a scanner, writing a predictive parser for a small language, a small experiment with scanner (lex/ flex) and parser (Yacc/ byson) generator (such as translation as regular expressions to NFA or the construction of parse tree), writing scanner –parse specification for a small language, translation of language to an intermediate form (e.g. three-address code), generation of target code (in assembly language). Code improvement (optional).

Programming languages and Tools: Lex, Yacc/ byson

UNIT 1: Introduction, Input-Output devices, Line Scan algorithms, Mid-point Circle and Ellipse Generating algorithms, Polygon Filling, Clipping	7(L)
UNIT 2: Geometrical Transformations (2D & 3D), Projections, Visible-Surface Determination	9(L)
UNIT 3: Representation of Curves and Surfaces, Solid Modeling	6(L)
UNIT 4: Color models and applications	4(L)
UNIT 5: CAD/CAM and Applications of computer Graphics	4(L)

Text/Reference Books (Not Applicable)

- Computer Graphics, by Hearn and Bakerand
- Procedural Elements of Computer Graphics by Rogers
- Principle of Interactive Computer Graphics by Newman and Sproul
- Computer Graphics, A programming Approach by Steven Harrington

OPERATING SYSTEMS (CS-1502)

UNIT 1: Introduction and Overview	2(L)
UNIT 2: Process fundamentals, scheduling, synchronization	12(L)
UNIT 3: Inter-process communication, Deadlock	8(L)
UNIT 4: Memory management and virtual memory	7(L)
UNIT 5: File system and secondary storage	5(L)
UNIT 6: Protection and security issues, Case studies e.g. Linux, Solaris and Android	6(L)

Text/Reference Books

- Operating Systems, by William Stallings
- Operating Systems Concepts by Silberschatz, Galvin, and Gagne
- The Design of the UNIX Operating System, by Maurice J. Bach
- Advanced Programming in the UNIX Environment, by W. R. Stevens & S. A. Rago
- The Design and implementation of the 4.4 BSD UNIX operating system by Marshall Kirk McKusick, Keith Bostic, Michael J. Karels, John S. Quarterman

COMPUTER NETWORKS (CS-1503)

UNIT 1: Introduction, Fundamental requirements of network, OSI & TCP/IP model	3(L)
UNIT 2: Physical and Link layer issues	4(L)
UNIT 3: Medium Access protocols (IEEE 802.3 ...) and related issues	8(L)
UNIT 4: Network layer: IP and other protocols, Routing protocols, and LAN design.	11(L)
UNIT 5: Transport layer Protocols and related Issues	8(L)
UNIT 6: Basic client server architecture, introduction to different application layer protocols like ftp, telnet, mail(SMTP), HTTP, DNS, DHCP and peer to peer	6(L)

Text/Reference Books

- Computer Network – Top down approach by James. F. Kurose & Keith W. Rose,
- Computer Network – A system approach by Larry.L.Peterson&Bruce.S.Davie
- Data Communication & Networking by BehrouzForouzan
- Unix Network Programming –volume-I by W.Richard Stevens

OBJECT ORIENTED MODELING (CS-1504)

UNIT 1: Introduction, Need for formal and semi-formal modeling, UML-2 Meta-model	4(L)
UNIT 2: UML-2 Concepts and Examples: Object, Class, Relationship, Interface, Types, roles, Use Case, Interaction and Activity Diagrams, State Machine and State-chart Diagram, Events, signals, Process and threads	8(L)
UNIT 3: Software System Design, Design Patterns, Pattern Classification, Creational, Structural and Behavioral patterns, Idoms	12(L)
UNIT 4: Agents and Agent Modeling, Multi-Agent Systems Modeling, Case Study	6(L)

Text/Reference Books

- Object-Oriented Modeling and Design with UML - Michael Blaha, James Rumbaugh
- Pattern-Oriented Software Architecture A System of Patterns, Volume 1 - Frank Buschmann, RegineMeunier, Hans Rohnert, Peter Sommerlad, Michael Stal
- Object-Oriented Analysis and Design with Applications - Grady Booch et al
- Object-Oriented Design with UML and JAVA - K. Barclay, J. Savage
- Practical Object-Oriented Design with UML - Mark Priestley

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UNIT 1: Introduction, Linear programming (LP) models,	4(L)
UNIT 2: Simplex & revised simplex algorithms, Duality and sensitivity analysis in LP	4(L)
UNIT 3: Basics of Game theory, Transportation and assignment problems, Project scheduling (critical path method & PERT)	10(L)
UNIT 4: Integer programming models, Stochastic processes: Markov chains and birth/death processes, Queuing theory	6(L)
UNIT 5: Network Analysis and Inventory Control	4(L)

Text/Reference Books

- *Operations Research Models and Methods*, by Paul A. Jensen and Jonathan F. Bardto
- *Operation Research* by Hamdy.ATaha
- *Introduction to Operations Research*, by Frederick Hillier & Gerald Lieberman
- *Linear Programming* byHadely G.

CRYPTOGRAPHY (CS-1506)

UNIT 1: Introduction, Prime Number Generation, Shannon's Theory of Perfect Secrecy	5(L)
UNIT 2: Asymmetric Key Cryptosystem and related issues	5(L)
UNIT 3: Public Key Cryptography and related concepts/methodologies	10(L)
UNIT 4: Cryptographic Hash Functions design and implementation issues.	5(L)
UNIT 5: Digital Signatures and related issues	5(L)

Text/Reference Books

- *Modern Cryptography : Theory and Practice* by W Mao
- *Applied cryptography* by Bruce Schiener
- "Cryptography: Theory & Practice" D R Stinson,
- *Introduction to cryptography* by Johannes A Buchmann
- *Network Security and Cryptography* by Bernard Menezes

PROGRAMMING TOOLS III (WEB) (LAB) (CS-1551)

This is third independent lab course in programming tools which intends to introduce web programming skills. The web is an integral part of society and our lives. The web browser has also grown to be a critical piece of software on many platforms: PC, Laptop, mobile devices, and video game consoles. This course will follow the course tradition of "looking under the hood," exploring ways to create web content and applications. Include search, retrieval and classifications for web. T he student would learn XML, ontology language (OWL), resource description framework to development of intelligent internet agent.

COMPUTER GRAPHICS (LAB) (CS-1555)

In this lab course students will do experiments for creating graphical images on the computer.

OPERATING SYSTEMS (LAB) (CS-1553)

Unix command implementation (6-10), Signal handling , Matrix and Graph operations using pthreads, Classical synchronization problems using IPC and pthreads, Thread Library implementation, CPU scheduling algorithms as part of thread library and also using IPC, Deadlock handling algorithms , Page replacement algorithms using pthreads and IPC, sample file system inside disk image file.

COMPUTER NETWORKS (LAB) (CS-1554)

In the of course computer network students will learning about hardware component like RJ-45 connector, CAT-6 Cable, configuration of router, hub switch etc, configuration of server in programming mode they will lean about socket programming , client server programming for deeply understanding TCP/ IP model and various protocols.

In simulation area they will work on Cisco networking, NS-2 or NS-3 tools for more clearly understanding about computer network

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MULTIMEDIA TECHNOLOGY (CS-1607)

- UNIT 1:** Introduction, Multimedia Information, Multimedia Objects, Convergence of Computer, Communication and Entertainment products, Digital representation 6(L)
- UNIT 2:** Multimedia hardware, Memory & storage devices, Communication devices, Multimedia software's, presentation tools, tools for object generations, video, sound, image capturing, authoring tools, card and page based authoring tools 6(L)
- UNIT 3:** Introduction to Text, hypertext & hypermedia, Sound, MIDI, Digital Audio concepts, audio file formats Sampling Variables, Loss less compression of sound, Audio Capture. 6(L)
- UNIT 4:** Introduction to video&images :Multiple monitors, bitmaps, Vector drawing, Image format conversion, image compression, JPEG Compression, image & video file formats, animation, animation file formats. Video representation, Video Compression, color models, MPEG standards, Video Streaming on net, Video on demand. 6(L)
- UNIT 5:** Introduction to multimedia communications. multimedia over IP, multimedia Over ATM Networks, multimedia Data Base, content based retrieval in Digital libraries, multimedia over wireless networks. Serial port programming and interrupts 6(L)

Text/Reference Books

- Fundamental of Multimedia by Li and Drew
- Principle of Multimedia by Rajan Parekh
- Multimedia, Making it Work by Tay Vaughan

SCIENTIFIC COMPUTING (CS-1602)

- UNIT 1:** Introduction, Algebraic and Transcendental Equations and related issues 8(L)
- UNIT 2:** Discussion on different Interpolation concepts and methods 8(L)
- UNIT 3:** Curve Fitting, Cubic Spline & Approximation 7(L)
- UNIT 4:** Numerical Integration and Differentiation. 6(L)
- UNIT 5:** Numerical Linear Algebra 5(L)
- UNIT 6:** Statistical Computations 6(L)

Text/Reference Books

- Numerical Recipes in C The Art of Scientific Computing by W H Press, S A Teukolesky, W T Vetterling and B P Flannery
- Numerical Methods for Scientific and Engineering by M.K.Jain, S.R.K.Iyenger and R.K.Jain
- Numerical Methods and Analysis by James I. Buchman and Peter R.Turner
- Applied Numerical Analysis by C.F.Gerald and P.O.Wheatley

BUSINESS INTELLIGENCE (CS-1608)

- UNIT 1:** Introduction, Overview of Business Intelligence, deduction, induction, machine learning and neural networks, 5(L)
- UNIT 2:** Introduction to analysis, quantitative methods for data analysis and knowledge extraction: classification and regression, Bayesian approaches, belief networks. 8(L)
- UNIT 3:** Introduction to DSS development, Traditional system development life cycle, Alternate development methodologies, Prototyping: DSS Methodology, Tools for DSS development, DSS Technology levels and tools 8(L)
- UNIT 4:** Enterprise system : Concept and definition, Enterprise Decision Support System, Evolution of executive and enterprise information system (EIS), Characteristics and capabilities of EDSS , Comparing and integrating EIS and DSS 6(L)
- UNIT 5:** BI applications: Knowledge management, Decision analysis, Investment Strategies, Marketing Campaigns 3(L)

Text/Reference Books

- Decision Support Systems and Intelligent Systems by Efrain Turbon.
- Adaptive Business Intelligence by Michalewicz Z., Schmidt M., Michalewicz M. and Chiriac C.
- Business Intelligence: A Managerial Approach by Turban E., Sharda R., Aronson J.E. and King, D.
- Advanced Management Information Systems by W.S. Jawadeka

WIRELESS NETWORK SECURITY (CS-1604)

- UNIT 1:** Introduction, Wireless Communications 2(L)
- UNIT 2:** Wireless devices and Middleware, Design of Wireless Networks 2(L)
- UNIT 3:** Ad-hoc wireless networks, wireless sensor networks 2(L)
- UNIT 4:** Security threats in wireless networks. Security requirements of wireless networks 4(L)
- UNIT 5:** Security case studies for Wireless LAN and Ad-hoc wireless networks 6(L)
- UNIT 6:** Speech Cryptology 5(L)
- UNIT 7:** Protocols and Applications of Cellular, Personal Communications Systems, and Bluetooth. Security issues and services. 9(L)

Text/Reference Books

- Wireless Security Models, Threats, and Solutions By: Randall K. Nichols, Panos C. Lekkas
- Wireless Communications: Principles & Practice, by Ted Rappaport,
- Wireless Network Design: Optimization Models and Solution Procedures, by J. Kennington et. al.
- Security and Cooperation in Wireless Networks, by LeventeButtyán and Jean-Pierre Hubaux [Available Online]
- The IEEE 802.11 Handbook: A designers companion by Bob O Hara, Al Petrick

DATABASE MANAGEMENT SYSTEM (CS-1605)	
UNIT 1: Database system concept and architecture, Entity Relationship and Enhanced E-R	5(L)
UNIT 2: Relational Data Model and Relational Algebra, SQL, Indexing, Query Optimization	10(L)
UNIT 3: Relational Database Design, Normalization principles and normal forms	8(L)
UNIT 4: Transaction concept and concurrency control	8(L)
UNIT 5: Web Interface to DBMS, Semi-structured databases, Object oriented databases	6(L)
UNIT 6: DBMS Case studies	3(L)

Text/Reference Books

- Database system concepts, by Korth, Silberschatz, and Sudarshan
- Fundamentals of Database Systems by Elmasari and Nawathe
- Databases by O Neil,
- Database Systems The Complete Book by Garcia-Molina, Ullman, & Widom
- Database Management System by Ramakrishnan and Gehrke

SOFTWARE ENGINEERING (CS-1606)

UNIT 1: Introduction, Software life-cycle models	4(L)
UNIT 2: Software requirements, Requirements Specification	6(L)
UNIT 3: Software design and Software user interface design	7(L)
UNIT 4: Coding Issues, Software integration and testing.	6(L)
UNIT 5: Software support processes and Quality Assurance, IEEE Software Engineering Standards	4(L)
UNIT 6: Software maintenance, Software reuse,	3(L)

Text/Reference Books

- Software Engineering – A Practitioner’s Approach, by Pressman R. S. and Ince D
- Software Engineering by Sommerville
- Software Engineering, Volume 1 and Volume 2, by Thayer, and Christiansen,
- Fundamentals of Software Engineering by Rajib Mall

NETWORK SECURITY (LAB) (CS-1652)

The lab work will include implementation of algorithms of cryptography (RSA, AES, and DES etc). In network security, the lab work will include firewall implementation, SSH certificates and security tools implementation, database security, program security etc. The lab work will also include configuring DNS, DHCP, NAT etc, router configuration, WAN networking, Building VPN and network security tools (Nmap, Nessus, and Wirelesshark etc.)

Programming Languages and Tools: Java (Security Library, JCE, JCA)/C or C++, Nmap, wireshark, Cain n able, Nessus etc.

DATABASE MANAGEMENT SYSTEM (LAB) (CS-1654)

Familiarization of Oracle RDBMS, SQL* Plus, Design and development of database using Oracle, implementation of application with GUI, Implementation of relational operators using C/C++, DSL, Front end development. Web interface to DBMS (using PHP/.Net/JSP)

MULTIMEDIA TECHNOLOGY (LAB) (CS-1655)

In this lab course students will do the experiments to develop basic understanding of the working of the multimedia systems.

MINI PROJECT (CS-1651)

In this mini project students will do the experiments to develop basic understanding of the software requirement specification and design issues.

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IMAGE PROCESSING (CS-1703)

UNIT 1: Introduction, digital image fundamentals Elements of digital image processing systems, Elements of visual perception, brightness, contrast, hue, saturation, Color image fundamentals - RGB, HSI models, Image sampling, Quantization, dither, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT, KLT, SVD. 6(L)

UNIT 2: Image enhancement Histogram equalization and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Contraharmonic mean filters, Homomorphic filtering, Color image enhancement. 8(L)

UNIT 3: Image Restoration - degradation model, Unconstrained restoration - Lagrange multiplier and Constrained restoration, Inverse filtering-removal of blur caused by uniform linear motion, Wiener filtering, Geometric transformations-spatial transformations. 8(L)

UNIT 4: Image segmentation, Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and Merging – Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm. 8(L)

Need for image compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, Vector Quantization, Transform coding, JPEG standard, MPEG. 8(L)

Text/Reference Books

- Digital Image Processing by Rafael C. Gonzalez, Richard E. Woods,
- Fundamentals of Digital Image Processing by Anil K. Jain,
- Digital Image Processing by William K. Pratt
- Professional Ethics(VII Semester CSE & IT 2L)

PROFESSIONAL ETHICS (CS-1702)

UNIT 1: Introduction, Ethical theories 4(L)

UNIT 2: Ethics in IT societies, Intellectual rights and privacy 6(L)

UNIT 3: Professional Relationships, Professional Responsibilities, Professional Ethics in Computing 6(L)

UNIT 4: Online crime, hacking, Legal aspects of Professional Ethics 4(L)

Text/Reference Books

- IEEE/ACM Software Engineering Code of Ethics and Professional Practice (online)
- Computer Ethics by Deborah Johnson
- Ethics in Engineering by Martin M.W., Schinzinger R.
- Ethics in Information Technology by George Reynolds
- Readings in Cyber Ethics, Edited by Richard Spinello and Herman Tavani.

PROJECT (CS-1791)

IMAGE PROCESSING (LAB) (CS-1754)

In this lab course students will do the experiments to develop basic understanding of the working of the image processing systems.

Course Code	Subject
CS-1731	Artificial Intelligence
CS-1732	Data Compression
CS-1733	Data Warehousing and Mining
CS-1734	Design Pattern
CS-1735	Functional Programming
CS-1736	Genetic Algorithm
CS-1737	Network Administration
CS-1738	Neural Network
CS-1739	SOSE (Service Oriented Software Engg.)
CS-1740	XML Based Applications

ARTIFICIAL INTELLIGENCE (CS-1731)

UNIT 1: Introduction, Intelligent agents, reactive, deliberative, goal-driven, utility-driven, and learning agents, Artificial Intelligence programming 5(L)

UNIT 2: Defining problems at state space search, Production system, Problem and production system characteristics, Forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications. Issues in design of search programs 7(L)

UNIT 3: foundations of knowledge representation and reasoning, issues in knowledge representation, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, sample applications. 6(L)

UNIT 4: Planning as search, partial order planning, construction and use of planning graphs, planning and acting in the real world 3(L)

UNIT 5: Basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications. 4(L)

UNIT 6: Learning from memorization, examples, explanation, and exploration. Supervised and un-supervised learning, learning nearest neighbor, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications. Sample Applications of AI 5(L)

Text/Reference Books

- Artificial Intelligence: A Modern Approach, by Stuart Russell and Peter Norvig,
- Artificial Intelligence by Eliane Rich, Kevin Knight and Shivashankar B Nair,
- Introduction to Artificial Intelligence by Charniak, McDermott

DATA COMPRESSION (CS-1732)

UNIT 1: Information theoretic foundations, Arithmetic coding 6(L)

UNIT 2: Dictionary techniques, Context modeling 6(L)

UNIT 3: Lossless image compression, Lossy coding preliminaries 6(L)

UNIT 4: Scalar and vector quantization 6(L)

UNIT 5: Differential encoding, Transform coding 6(L)

Text/Reference Books

- Introduction to Data Compression by Sayood, Khalid,
- Data Compression: The Complete Reference by M. Nelson,

DATA WAREHOUSING AND MINING (CS-1733)

UNIT 1: Introduction and overview of data mining processes 3(L)

UNIT 2: Data Warehousing: Overview, Definition, Delivery Process, Multi Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept hierarchy, Process Architecture, 3 Tier Architecture, Data Marting. 5(L)

UNIT 3: Data clustering and classification techniques 9(L)

UNIT 4: Association rule mining 5(L)

UNIT 5: Tuning Data Warehouse, Testing Data Warehouse Data Mining interface, Historical information, Query Facility, OLAP function and Tools. OLAP Servers, ROLAP, MOLAP, HOLAP, Security, Backup and Recovery 5(L)

UNIT 6: Applications and case studies 3(L)

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- Data Mining: Concepts and Techniques by J. Han and M. Kamber,
- Introduction to Data Mining by Pang-Ning Tan, Michael Steinbach and Vipin Kumar
- Data Warehousing in the Real World : A Practical Guide for Building Decision Support Systems by Sam Anahory, Dennis Murray

DESIGN PATTERNS (CS-1734)

UNIT 1: Introduction To Design Patterns, Introduction To Java, Some OO Design Principles, The Observer Pattern, The Template Method Pattern	6(L)
UNIT 2: Factory Patterns: Factory Method and Abstract Factory, The Singleton Pattern, The Iterator Pattern, The Composite Pattern, The Facade Pattern	6(L)
UNIT 3: The State and Strategy Patterns, Functors and the Command Pattern, The Proxy Pattern	5(L)
UNIT 4: RMI, The Adapter Pattern, The Decorator Pattern	4(L)
UNIT 5: Dynamic Proxies In Java, The Chain of Responsibility Pattern, Concurrency Patterns, The Visitor Pattern, Anti Patterns	5(L)
UNIT 6: Layer, Pipe and Filters, Black Board Broker, Case Studies	4(L)

Text/Reference Books

- Design Patterns - Elements Of Reusable Object-Oriented Software, Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides,
- Head First Design Patterns, Eric Freeman and Elisabeth Freeman
- Applied Java Patterns, Stephen Stelting and Olav Maassen,
- Java Design Patterns - A Tutorial, James W. Cooper,
- Refactoring To Patterns, Joshua Kerievsky,

FUNCTIONAL PROGRAMMING (CS-1735)

UNIT 1: Introduction, Problem Solving with Functional Language, Programming with functions, List constructors and selectors, Recursive functions, Accumulating parameters, Local definitions, Higher Order functions, Dot notation, and example simple functional programs	12(L)
UNIT 2: Un-typed and Typed Lambda Calculus and Combinators, Term structure and substitution, alpha and Beta reductions and Beta Equality, Normal Form, Combinators, Church Numerals, Reduction Rules, Y-Combinator, Bracket Abstraction, Standard Combinator Expressions, Typed Lambda Calculus and Reduction Rules	10(L)
UNIT 3: Lambda Calculus Semantics: Reduction Machines SECD Machine , Graph Reduction Machine, Lazy/delayed Evaluation,	8(L)

Text/Reference Books

- Functional Programming : Application and Implementation by Peter Henderson
- Lambda Calculus, Combinators and Functional Programming by G. Revesz
- Lambda Calculus and Combinators : An Introduction by J. Roger Hindley and Jonathan P. Seldin

GENETIC ALGORITHM (CS-1736)

UNIT 1: Basics of Optimization, Optimization Problems, Point to Point Algorithms, Simulated Annealing	3(L)
UNIT 2: Population Based Algorithms, Brief Overview of Evolutionary Computation, Genetic Algorithms (Theory and Advanced Operators), Genetic Representation, search operators, selection schemes and selection pressure.	7(L)
UNIT 3: Operators on Real-valued Representations, Niche and fitness sharing, Particle Swarm Optimization, Memetic Algorithms	7(L)
UNIT 4: Evolution Strategies, Genetic Programming, Evolutionary Programming, Differential Evolution	6(L)
UNIT 5: Constraint Handling in optimization problems, Real Life application of optimization Algorithms, Introduction of Multi-objective Evolutionary Algorithms	7(L)

Text/Reference Books

- Genetic Algorithms in Search, Optimization & Machine Learning by D E Goldberg
- Multi-Objective Optimization Using Evolutionary Algorithms by K. Deb
- Handbook on Evolutionary Computation by T. Baeck, D. B. Fogel, and Z. Michalewicz (eds.)

NETWORK ADMINISTRATION (CS-1737)

UNIT 1: Introduction, Basic System Administration	3(L)
UNIT 2: Windows Installation, Linux Installation and Package Management, Backup and Security, Monitoring and Managing Processes/Daemons, Scripting basics and start-up scripts	8(L)
UNIT 3: Unix Networking, Network Protocols - TCP, IP, UDP, NetBIOS, TCP/IP Concepts and Configuration - the basics, Sub netting Implementation, Basic Network Trouble-Shooting and Monitoring Tools	8(L)
UNIT 4: Server configuration and management, DHCP, NIS, NFS, LDAP and Samba	6(L)
UNIT 5: Apache Web Server with PHP, DNS, BIND and Sendmail, Tools like Webmin, Webalizer, and Phpmadmin; Security and firewall	5(L)

Text/Reference Books

- TCP/IP Network Administration?, by Craig Hunt,
- Neural Networks and Learning Machines by S. Haykin
- Artificial Neural Networks by Robert J. Schalkoff
- Multi-Objective Optimization Using Evolutionary Algorithms by Deb Kalyanmoy
- Genetic Algorithms + Data Structures = Evolution Programs by Z Michalewicz

NEURAL NETWORKS (CS-1738)

UNIT 1: Introduction, Brain Physiology, Neuron Model and Network Architectures	4(L)
UNIT 2: Nonlinear dynamical system theory	6(L)
UNIT 3: The Hopfield Model, Spin Glasses, Stochastic Neural Networks, Boltzmann Machine	8(L)
UNIT 4: Multilayer Feedforward Networks For Supervised Learning	6(L)
UNIT 5: Unsupervised and Competitive Learning Algorithms, Bifurcating Neural Networks	6(L)

Text/Reference Books

- Neural Networks: A Comprehensive Foundation by S. Haykin,
- Neural Networks and Learning Machines by S. Haykin
- Artificial Neural Networks by Robert J. Schalkoff
- Multi-Objective Optimization Using Evolutionary Algorithms by Deb Kalyanmoy
- Genetic Algorithms + Data Structures = Evolution Programs by Z Michalewicz

SERVICE ORIENTED SOFTWARE ENGINEERING (CS-1739)

UNIT 1: Concepts of Service orientation	8(L)
UNIT 2: Service oriented Software architecture concepts	5(L)
UNIT 3: Requirements Analysis & Design Process	7(L)
UNIT 4: Service Testing and Estimation models	6(L)
UNIT 5: Cloud based services models	4(L)

Text/Reference Books

- Service Oriented Architecture – Concept Technology & Design by Thomas Earl
- Enterprise SOA – Designing IT for Business Innovation by Woods &Mattem
- Web Service Essentials, EibanCerami, O’Reilly

XML AND APPLICATIONS (CS-1740)

UNIT 1: Emerging Technologies; XML Documents: Syntax, Well formed and Valid; CCS and XHTML; Document Type Definition(DTD); XML Schema : XSD, XDR, Examples; JavaScript	12(L)
UNIT 2: SAX and DOM Parser and APIs, Example of API usage; XPATH, XLink, Xpointer; XSL: XSLT	10(L)
UNIT 3: Applications: RDF and RDFS, JENA API, Case Study	8(L)

Text/Reference Books

- XML The Microsoft Way By Peter G. Aitken
- Learning XML By Erik T. Ray and Christopher R. Maden
- XML How to Program By Harvey M. Deitel, Paul J. Deitel, Tem R. Nieto, Ted Lin and Praveen Sadhu



PRIVACY PRESERVING PUBLISHING (CS-1803)

- UNIT 1:** Introduction, Attack Models and Privacy Models 7(L)
UNIT 2: Anonymization Operations and Algorithms, Anonymization for Cluster Analysis. 9(L)
UNIT 3: Anonymizing Incrementally Updated Data Records, Collaborative Anonymization for Vertically Partitioned Data and Horizontally Partitioned Data. 8(L)
UNIT 4: Anonymizing Complex Data e.g. Anonymizing Transaction Data, Anonymizing Trajectory Data. 8(L)
UNIT 5: Anonymization for data mining, Anonymizing Social Networks. 8(L)

Text/Reference Books

- Introduction to Privacy-Preserving Data Publishing Concepts and Techniques By Benjamin C.M. Fung, Ke Wang, Ada Wai-Chee Fu, Philip S. Yu
- Privacy-Preserving Data Publishing: An Overview by Raymond Chi-Wing Wong & Ada Wai-Chee Fu
- Research papers

RESEARCH TRENDS IN IT (CS-1804)

- UNIT 1:** Introduction, History of information technology, 3(L)
UNIT 2: Presentation Schedule

Text/Reference Books (Not applicable)

- DBLP to identify areas and TOC of Journals and Conference Proceedings
- INDEST, ACM digital Library, IEEE Digital Library etc to browse papers
- Handbook of Writing for the Mathematical Sciences By Nicholas J. Higham

PROJECT (CS-1891)

Done

PROFESSIONAL ELECTIVE III & IV (CS-1830/CS-1831) (POOL 2)

Course Code	Subject
CS-1831	Distributed & Parallel Algorithms
CS-1832	E-Commerce
CS-1833	Gaming and Animation
CS-1834	Information Retrieval
CS-1835	Pattern Recognition
CS-1836	Semantic Web (Web Ontology)
CS-1837	Software Metrics & Quality Assurance
CS-1838	Software Testing
CS-1839	Theory of Virtualization
CS-1840	Web Mining

Note : The list of Professional Electives would be enriched further.

DISTRIBUTED AND PARALLEL ALGORITHMS (CS-1831)

- UNIT 1:** Introduction, architectures and languages for parallel and distributed processing. 3(L)
- UNIT 2:** Abstract models of parallel computing, PRAM (Parallel Random Access Machine). Distributed and parallel algorithms and their complexity. Interaction between processes, communication, synchronization. 9(L)
- UNIT 3:** Topologies, synchronous and asynchronous algorithms. Algorithms for parallel sorting. Algorithms for parallel searching. 6(L)
- UNIT 4:** Parallel matrix operations. All prefix sums and their applications. Graph and list algorithms. Synchronization algorithms and tasks. 6(L)
- UNIT 5:** Mechanisms and language constructs for synchronization. Recently published algorithms. 6(L)

Text/Reference Books (Not applicable)

- Parallel Computation, Model and Methods by Akl,
- An Introduction to Parallel Algorithms
- Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes by Leighton,
- Synthesis of Parallel Algorithms by J. H. Rief,
- Introduction to Distributed Algorithms by Gerard Tel,

E-COMMERCE (CS-1832)

- UNIT 1:** Introduction to e-Commerce and Network Infrastructure for e-commerce. 4(L)
- UNIT 2:** E-commerce Models, e-Advertising & Marketing 6(L)
- UNIT 3:** Electronic Payment Systems and Electronic Data Exchange 6(L)
- UNIT 4:** E-commerce Security 4(L)
- UNIT 5:** E-CRM 6(L)
- UNIT 6:** Mobile Commerce 4(L)

Text/Reference Books

- Introduction to E-commerce by Jeffrey F. Rayport & Bernard J. Jaworski
- Frontiers of E-commerce by Kalakota & Winston
- E-Commerce- Strategy technologies and Applications by David Whiteley
- E-Commerce-Concepts, Models & Strategies by C.S.V. Murthy
- E-Commerce by Perry

GAMING AND ANIMATION (CS-1833)

- UNIT 1:** Introduction, Fundamental Principles of Animation and gaming 6(L)
- UNIT 2:** Rigging & Posing Techniques, Fundamentals of Character Animation, Facial Animation and Lip Sync Techniques 8(L)
- UNIT 3:** Fundamentals of Motion Capture, Principles of Motion Simulation 6(L)
- UNIT 4:** Game design principles and processes 8(L)

Text/Reference Books

- Fundamentals of Game Design. By E. Adams.
- The Art of Game Design by J. Schell
- Computer Animation: Algorithms and Techniques by Rick Parent

INFORMATION RETRIEVAL (CS-1834)

UNIT 1: Introduction to IR models and methods, Text analysis / Web spidering Text properties	5(L)
UNIT 2: Vector-based model, Boolean model, Probabilistic model, other IR models; IR evaluation and IR test collections; Relevance feedback, query expansion	8(L)
UNIT 3: Web search: link based and content based; Query-based and content sensitive link analysis; Search engine technologies	8(L)
UNIT 4: Text classification and clustering; Question answering on offline and online collections	5(L)
UNIT 5: Personalized IR, Cross-language IR, Web 2.0,	4(L)

Text/Reference Books

- Introduction to Information Retrieval by Christopher D. Manning, PrabhakarRaghavan, HinrichSchütze (available online)
- Information Retrieval: Algorithms and Heuristics. By D.A. Grossman, O. Frieder
- Readings in Information Retrieval by K.Sparck Jones and P. Willett

PATTERN RECOGNITION (CS-1835)

UNIT 1: Introduction to Pattern Recognition, Feature Detection, Classification, Decision Theory, ROC Curves, Likelihood Ratio Test, Linear and Quadratic Discriminants, Fisher Discriminant, Sufficient Statistics, Coping with Missing or Noisy Features, Template-based Recognition, Feature Extraction, Eigenvector and Multilinear Analysis	10(L)
UNIT 2: Training Methods, Maximum Likelihood and Bayesian Parameter Estimation, Linear Discriminant/Perceptron Learning, Optimization by Gradient Descent, Support Vector Machines, K-Nearest-Neighbor Classification	6(L)
UNIT 3: Non-parametric Classification, Density Estimation, Parzen Estimation, Unsupervised Learning, Clustering, Vector Quantization, K-means, Mixture Modeling, Expectation-Maximization	6(L)
UNIT 4: Hidden Markov Models, Viterbi Algorithm, Baum-Welch Algorithm, Linear Dynamical Systems, Kalman Filtering, Decision Trees, Multi-layer Perceptrons, Reinforcement Learning with Human Interaction	8(L)

Text/Reference Books

- Pattern Classification by Richard O. Duda, Peter E. Hart and David G. Stork
- Pattern Recognition and Machine Learning by C. M. Bishop
- Pattern Recognition by S. Theodoridis and K. Koutroumbas

SEMANTIC WEB (CS-1836)

UNIT 1: Review of XML; Meta-model and Meta-data, RDF & RDFS; OWL; Ontology Engineering and tools	12(L)
UNIT 2: Description Logic(DL); Programming with DL; Example Application	12(L)
UNIT 3: Knowledge Acquisition and Management System,	6(L)

Text/Reference Books

- A Semantic Web Primer by Antoniou, Grigoris and Frank van Harmelen
- The Description Logic Handbook: Theory, Implementation and Applications by Franz Baader, Deborah L. Guinness, Daniele Nardi, and Peter F. Patel-Schneider (Eds.)
- An Introduction to Description Logic by Daniele Nardi and Ronald J. Brachman

SOFTWARE METRICS & QUALITY ASSURANCE (CS-1837)

UNIT 1: The state of IT project management & basics of measurement	6(L)
UNIT 2: Measuring internal product attributes: size and structure	6(L)
UNIT 3: Measuring cost and effort	6(L)
UNIT 4: Measuring external product attributes: Quality & Reliability	6(L)
UNIT 5: Software test metrics	6(L)

Text/Reference Books

- Software Metrics: A Rigorous and Practical Approach by N.E. Fenton and S.L. Pfleeger
- Metrics and Models in Software Quality Engineering by Stephen H. Kan
- Software Project Management in practice by PankajJalote
- Software Project Management by Bob Hughes and Mike Cotterell

SOFTWARE TESTING (CS-1838)

UNIT 1: Fundamentals of Testing and its current state of art	8(L)
UNIT 2: Various approaches to Testing	6(L)
UNIT 3: Test planning and Management	6(L)
UNIT 4: Test Strategies - Preventive, Reactive Approach, Analytical, Heuristic, Configuration Management	6(L)

Text/Reference Books

- Software Testing Techniques by BorrisBeizer
- Software Testing – A Craftman’s Approach by Paul C. Jorgensen
- Software Testing by Hambling, Samaroo& Williams.
- Software Testing Practice: Test Management by Spillner, Rossner, Winter & Linz

THEORY OF VIRTUALIZATION (CS-1839)

UNIT 1: Introduction, Overview of virtualization	8(L)
UNIT 2: Hardware/Server virtualization	8(L)
UNIT 3: Network virtualization	8(L)
UNIT 4: Virtual machines	6(L)

Text/Reference Books

- Virtual Machines: Versatile Platforms for Systems and Processes by James E. Smith, Ravi Nair,
- Virtualization: From the Desktop to the Enterprise by Chris Wolf, Erick M. Halter
- Network virtualization by Kumar Reddy, Victor Moreno,
- Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center by David Marshall, Wade A. Reynolds,

WEB MINING (CS-1840)

UNIT 1: Introduction, Practical web mining applications overview	3(L)
UNIT 2: Natural Language Processing methods used for web information retrieval	6(L)
UNIT 3: Web Content Mining	5(L)
UNIT 4: Web Structure Mining	5(L)
UNIT 5: Web Usage Mining	6(L)
UNIT 6: Specific applications and case studies	5(L)

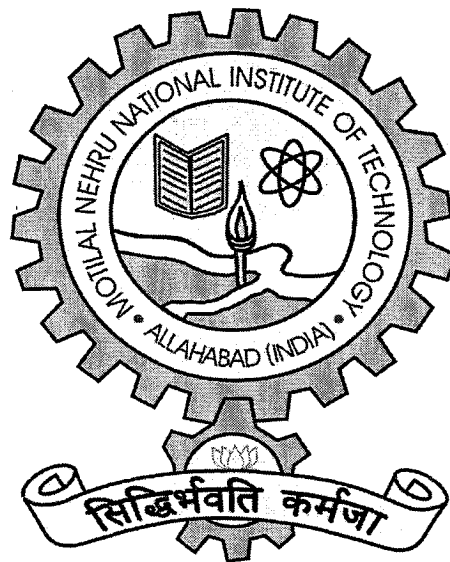
Text/Reference Books

- Web data mining: exploring hyperlinks, contents, and usage data by LIU, B.
- Mining the Web - Discovering knowledge from hypertext data, by SoumenChakrabarti,
- Ontology learning and population from text : algorithms, evaluation and applications by CIMIANO, P.

PDMA

Course Structure & Curriculum
For
B. Tech. Programme

In
MECHANICAL ENGINEERING



Department of Mechanical Engineering
Motilal Nehru National Institute of Technology
Allahabad

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3rd Semester (Mechanical Engineering)

Course Code	Course name	L	T	P	Credit
ME-1301	Engineering Thermodynamics	3	1		4
AM-1302	Kinematics of Machines	3	1		4
AM-1303	Material Science and Engineering	3			3
AM-1304	Strength of Materials	3	1		4
EE-1305	Basic Electrical and Electronics	3			3
MA-1301	Numerical Methods and Statistical Techniques	3	1		4
ME-1351	Computational Lab			3	2
AM-1352	Material Science Lab			3	2
AM-1353	Strength of Materials Lab			3	2
EE-1354	Basic Electrical and Electronics Lab			3	2
Total		18	4	12	30

4th Semester (Mechanical Engineering)

Course Code	Course name	L	T	P	Credit
ME-1401	Automatic Control	3	1		4
ME-1402	Industrial Engineering	3			3
ME-1403	Measurement and Metrology	3			3
AM-1401	Fluid Mechanics	3	1		4
ME-1405	Heat and Mass Transfer	3	1		4
AM-1402	Dynamics of Machines	3	1		4
ME-1451/ ME-1452	Measurement and Metrology/ Automatic Control Lab			3	2
ME-1453	Thermal Engineering Lab – I			3	2
AM-1451	Fluid Mechanics and Hydraulics Lab			3	2
Total		18	4	9	28

5th Semester (Mechanical Engineering)

Course Code	Course name	L	T	P	Credit
ME-1501	Computer Aided Design	3	1		4
ME-1502	Machine Design-I	3	1		4
ME-1503	Manufacturing Science and Technology-I	3	1		4
ME-1504	Steam Power Engineering	3	1		4
HS-1501	Principles of Management	3			3
ME-1551	Computer Aided Design Lab			3	2
ME-1552	Machine Design Lab –I			3	2
ME-1553	Manufacturing Technology Lab-I			3	2
ME-1554	Thermal Engineering Lab – II			3	2
Total		15	4	12	27

6th Semester (Mechanical Engineering)

Course Code	Course name	L	T	P	Credit
ME-1601	Computer Aided Manufacturing	3	1		4
ME-1602	Machine Design-II	3	1		4
ME-1603	Manufacturing Science and Technology-II	3	1		4
ME-1604	Automobile Engineering	3	-		3
ME-1605	Internal Combustion Engine	3	1		4
HS-1601	Communication Skill (Workshop)			3	0
ME-1651	Computer Aided Manufacturing Lab			3	2
ME-1652	Machine Design Lab –II			3	2
ME-1653	Manufacturing Technology Lab – II			3	2
ME-1654	Thermal Engineering Lab – III			3	2
Total		15	4	15	27

7th Semester (Mechanical Engineering)

Course Code	Course name	L	T	P	Credit
ME-1701	Refrigeration and Air Conditioning	3	1		4
HS-1701	Economics	3			3
ME-1731 to ME-1740	Professional Elective – I	3	1		4
ME-1741 to ME-1750	Professional Elective – II	3	1		4
OE-1781	Open Elective – I	3			3
ME-1791	Major Project (Stage 1)			12	6
ME-1751	Thermal Engineering Lab – IV			3	2
	Total	15	3	15	26

8th Semester (Mechanical Engineering)

Course Code	Course name	L	T	P	Credit
ME-1801	Product Design and Development	3	1		4
ME-1831 to ME-1840	Professional Elective – III	3	1		4
ME-1841 to ME-1850	Professional Elective – IV	3	1		4
OE-1881	Open Elective – II	3			3
ME-1891	Major Project (Stage 2)			12	6
	Total	12	3	12	21

1st digit; 1: UG, 2nd digit; 2, 3, etc.: Semester

Code	Description
01-30	Theory Courses
31-40	Professional Elective –I
41-50	Professional Elective –II
51-70	Practical Courses
81-90	Open Elective
91-99	Project

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- UNIT 1:** Introduction to thermodynamics System, surroundings, boundaries, classification of systems. Unit and dimensions, conversion factors. Properties of systems, equilibrium, processes, heat and work interaction. The work interaction. Thermodynamic definition of work, characteristics of the work interaction. Evaluation of work. Adiabatic systems and processes. 9(L)
- UNIT 2:** Diathermic boundary, Zeroth law. Isothermal states. Empirical temperature. Principles of thermometry. Scales of temperature. Gas thermometer. The ideal gas. Ideal gas temperature scale. 4(L)
- UNIT 3:** The first law. Basic form. Energy of a system. The heat interaction. Sign convention. First law for open systems. Steady-flow energy equation and its applications. 4(L)
- UNIT 4:** Equations of state. Properties of gases. Properties of steam. Introduction to steam tables. Other equations of state. Van-der-waals gas. Critical state. Reduced equation of state. 4(L)
- UNIT 5:** The second law. Kelvin-Planck and Clausius statements. Equivalence of statements. Carnot theorem. Thermodynamic temperature. Kelvin scale. Carnot engine, refrigerator and heat pump. 6(L)
- UNIT 6:** Clausius inequality. Definition of entropy. Combined first and second law, Evaluation of entropy. Principle of increase of entropy. 4(L)
- UNIT 7:** Irreversibility and exergy. Lost work. 3(L)
- UNIT 8:** Introduction to cycles. Classifications of cycles. Gas power cycles- Otto, Diesel, Brayton. Vapour power cycle- Rankine cycle, vapour-compression refrigeration cycle. 5(L)

Text/Reference Books

- Engineering thermodynamics by P K Nag, Tata McGraw Hill
- Thermodynamics : An engineering approach by Cengel & Boles, McGraw Hill

KINEMATICS OF MACHINES (AM-1302)

- UNIT 1: Introduction-** Kinematics and Dynamics, Kinematic Links, Kinematic Pairs, Types of constrained Motion, Classification of Kinematic Pair, Kinematic Chain, Types of Joints in A Chain, Mechanism, Number of Degree of Freedom for Planar Mechanism, Grubler's Criteria for Plane Mechanisms, Inversion of Mechanism, Types of Kinematic Chains. 8(L)
- UNIT 2: Velocity and Acceleration in Mechanism-** Velocity of A Link of A Machine, Relative Velocity Method, Instantaneous Center Method, Kennedy's Theorem for Three Centers, Acceleration Diagram, Coriolis Component of Acceleration, Klein's Construction. 8(L)
- UNIT 3: Friction (Belt, Rope and clutches)-** Types of Friction, Laws of Friction, Pivot and Coller Friction, Uniform Wear and Uniform Pressure, Frictional Clutches, Single Disc or Plate Clutch, Multi Plate Disc Clutch, Introduction to Cone Clutch and Centrifugal Clutches. Selection of A Belt Drive, Types of Belt Drive, Types of Belts, Toothed Belt, Materials used for Belts, Types of Flat Belt Drives, Velocity Ratio of Belt Drive, Slip of Belt, Creep in Belt, Condition for Maximum Power Transmission, V-Belt Drive. Fiber Ropes, Wire Ropes, Rope Drive and Introduction to Chain Drive. 8(L)
- UNIT 4: Cams-** Classification of Cams and Followers, Nomenclature, Types of Follower Motion, Generation of Cam Profile with Uniform Velocity, SHM, Uniform Acceleration and Retardation, Cycloidal Motion of The Follower, Cam Applications and Manufacturing. 8(L)

UNIT V: (8 Lectures)

Gear and Gear Trains:

Types of Gears: Spur Helical, Bevel, Spiral and Worm, Gears – Terminology, Fundamental Law of Gearing, Gear Profiles, Law of Gearing and Undercutting.

Gear Trains: Simple, Compound, Reverted and Epicyclic Gear Trains, Gear Box, Differential.

Text/Reference Books

- The Theory of Machines by Thomas Bevan, CBS Publishers & Distributors.
- Theory of Machines and Mechanisms by John J. Uicker, Jr. Gordon R. Pennock & Joseph E. Shigley, Oxford University Press, New York.
- Theory of Mechanisms and Machines by Dr. Jagdish Lal, Metropolitan Book Co. Pvt. Ltd.
- Theory of Machines by S.S. Ratan, Tata McGraw-Hill

MATERIAL SCIENCE AND ENGINEERING (AM-1303)

- UNIT 1: Introduction-** Historical perspective of Materials Science, Structure and properties relationship of Engineering Materials, Classification of materials, Advanced Materials. 3(L)
- UNIT 2: Structure of Solids and Characterization of Materials-** Introduction to crystal structures and systems, Metallic structures, Ceramic crystal structures, Carbon nano-structures, Crystallographic directions and planes, Miller indices, Density computations, Crystallography, Diffraction methods, Electron microscopy, Metallography, Thermal characterization techniques. 6(L)
- UNIT 3: Imperfections in Solids-** Point defects, Dislocations, Interfacial Defects, Bulk defects. 4(L)
- UNIT 4: Diffusion-** Diffusion mechanisms, steady and non-steady state diffusion, Factors that influence diffusion, Law's of diffusion, Applications of Diffusion. 4(L)
- UNIT 5: Mechanical Behaviour of Materials-** Elastic and plastic properties, Creep, Fatigue, Fracture, Heat treatment of steels. 6(L)
- UNIT 6: Phase Diagrams and Phase Transformations-** Unary, Binary, Equilibrium phase diagrams, Eutectic, Eutectoid, Peritectic and peritectoid reactions, Transformation rate effects and TTT diagrams. Microstructure and property changes in iron-carbon system, Iron-Carbon (Fe-C or Fe-Fe₃C) Diagram. 6(L)
- UNIT 7: Ceramic Materials-** Ceramic types, Properties, Processing Application, Advanced ceramics. 2(L)
- UNIT 8: Composites-** Introduction, Applications, Particle reinforced composites, Fiber reinforced composites, Structural composites. 2(L)
- UNIT 9: Thermal, Electrical, Magnetic, Optical Properties-** Heat capacity, Thermal expansion, Thermal conductivity, Thermal stresses, Electrical conduction, Semi conductivity, Super conductivity, Electrical conduction in ionic ceramics and in polymers, Dielectric behaviour, Ferroelectricity, Piezoelectricity, Diamagnetism and paramagnetism, Ferromagnetism, Antiferromagnetism and ferrimagnetism, Influence of temperature on magnetic behaviour, Domains and hysteresis, Optical properties of metals, Optical properties of non-metals, Application of optical phenomena. 5(L)

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Text/Reference Books

- Callister W. D. Jr., Materials Science and Engineering An Introduction.
- Van Vlack, Material Science.
- Raghavan V, Material Science.
- K. M. Gupta, Material Science and Engineering.

STRENGTH OF MATERIALS (AM-1304)

UNIT 1: Analysis of Stress & Strain-Uniaxial stress and strain: Stress, Strain, Hooke's Law, Stress-strain curves, Elastic Constants, Strain Energy, Statically Indeterminate problems, Thermal Effects, Impact Loading; Biaxial stress and strain: Stress at a Point, Variation of Stress, Stress Transformation, Analysis of Strain, Strain-displacement relations, Strain transformation, Strain Measurements, Constitutive equations, Principal stresses and strain. 10(L)

UNIT 2: Bending & Shear Stresses-Introduction, Pure Bending, Normal stresses in beams, Combined Bending and Axial Stress, Composite Beams, Shear Stress, Shear Centre, Strain energy in bending 6(L)

UNIT 3: Torsion-Introduction, Torsion of Circular Shaft, Power Transmitted by a Shaft, Compound Shaft, Tapered Shaft, Strain Energy in Torsion, Combined Bending and Twisting, Torsion of Thin Walled Tubes, Open and Closed Coiled Springs 6(L)

UNIT 4: Thin & Thick Cylinders & Spheres-Introduction, Thin Walled Shells, Thick Shells, Compound Cylindrical Shell 6(L)

UNIT 5: Deflections Of Beams-Introduction, Equation of Elastic Curve, Methods for Determining Deflections - Double Integration, Macaulay's Method, Moment-Area Method, Conjugate-beam method, Castigliano's Theorem 5(L)

UNIT 6: Columns and Theories of Failure-Introduction, Euler's Theory for Long Columns, Rankine-Gordon Formula, Empirical Formulae, Eccentrically Loaded Columns 7(L)

Text/Reference Books

- Elements of Strength of Materials, S.P. Timoshenko and D.H. Young, East-West Press Pvt. Ltd. Publications.
- Mechanics of Materials, Pytel and Kiusalaas, Cengage Learning Publications.
- Mechanics of Materials, Gere and Timosheinko, CBS Publications.
- Mechanics of Materials, E. P. Popov, Prentics Hall Publications.
- Strength of Materials, G. H. Ryder, Macmillan India Limited.
- Strength of Materials- Pytel and Singer, Harpercollins College division publications.
- Strength of Materials, Crandal, Dahal and Lardener, Tata Mcgraw Hill Publications.
- Mechanics of Materials- Riley, Struges and Morris, John Wiley & Sons.

BASIC ELECTRICAL AND ELECTRONICS (EE-1305)**Electrical Engineering:**

Introduction to Electrical Energy: Generation: Types of power Plant, Functional Block diagram of generating stations (Hydel & Thermal Stations); Transmission, Distribution and Utilization, Domestic Wiring: Materials, accessories & ratings of the wiring materials, types of wiring, earthing and electricity rules.

Electric Circuits: Basic Circuit Elements, Ohm's law, KCL & KVL, Node & Loop Analysis, Superposition, Thevenin's Theorem & Norton's Theorem, Maximum Power Transfer Theorem.

Steady-state analysis of AC circuits: Sinusoidal and phasor representation of Voltage & current, single phase ac circuit behaviour of R, L and C. Combination of R, L and C in series and parallel, Resonance. three-phase circuits.

Transformer & Rotating Machines: Principle of operation and construction of single-phase transformer, efficiency and voltage regulation. Principle of electromagnetic energy conversion, Starting and speed control of DC and AC motors.

Electronics Engineering:

Semiconductor Devices: Junction Diode, Bipolar -junction Transistor, JFET and MOSFET, Linear IC and its applications

Digital circuits: Number systems, conversion of bases, Boolean Algebra, logic gates, Concept of universal gate, Flip-Flops and counter.

Measurement and Mechatronics Instrumentation:

Measuring Instruments: Types of instruments, working principles of Ammeter, Voltmeter, Wattmeter & Energy meter, Digital instruments, Oscilloscopes.

Unit-Transducers and Sensors: for measurement of displacement, velocity, acceleration, force, torque, liquid level, flow, temperature etc.

Signal Conditioning: Operational Amplifiers and Circuits, Instrumentation amplifiers, Voltage to Current converters and Current boosters, Logarithmic amplifiers filters.

Timing Circuits: VCO, Waveform Generator, 555 timer circuits

Converters: Analog to Digital and Digital to Analog Conversion, Sample and Hold circuits, Analog, multiplexers, de-multiplexers

Power Control: SCRs, Triacs and other solid state devices various power converters and power control

Actuators and Motors: Actuators, Brushed DC servo motors, Brushless PM motors and controllers, The AC induction motor as a servo drive, stepper motor.

Controllers for automation: Introduction to microprocessors, Automation of systems using microcontrollers.

Text/Reference Books

- V. Del Toro: Principle of Electrical Engineering, PHI
- W. H. Hayt & Kemmerley, Engineering Circuit Analysis, McGraw Hill.
- Millman & Halkias, Integrated Electronics, TMH
- Boylstad & Nashishky, Electronic Devices & circuits, PHI
- Mavino & Leach, Digital Principles and applications.
- W. D. Cooper Electronic Instrumentation & Measurement Techniques, PHI
- D. V. S. Murthy, Transducer and Instrumentation,
- Richard M. Crowder, Electric Drives and their Controls
- Douglas V. Hall, Microprocessors and interfacing programming and Hardware
- Scot Mackenzie, The 8051 Microcontrollers

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UNIT 2: Algebraic and Rational Equation-Bisection method, Method of False Position, Iteration Method, Newton-Raphson method, Secant method, Rate of convergence, Methods for Complex Roots: Muller's method, Lin-Bairstow's method, Quotient difference method, Gauss-Seidel iterative method for solving system of equations. 8(L)

UNIT 3: Interpolation-Introduction, Errors in Polynomial Interpolation, Interpolation by Evenly spaced points: Finite Differences, Detection of Errors, Newton's Formulae for Interpolation, Gauss, Stirling, Bessel's and Everett's Formulae, Interpolation by Unevenly spaced points: Lagrange Interpolation Formula, Divided Difference, Newton's General Interpolation Formula. 7(L)

UNIT 4: Curve Fitting, Cubic Splines and Approximation-Introduction, Least-squares curve fitting procedures, Weighted Least-squares curve fitting, Curve fitting by sum of exponentials, Data fitting with cubic splines, Approximations of Functions. 5(L)

UNIT 5: Numerical Differentiation and Integration-Introduction, Numerical differentiation, Numerical integration, Trapezoidal Rule, Simpson 1/3 rule, Simpson 3/8 rule, Boole's and Weddle's Rule, Euler-Maclaurin Formula, Gaussian Formula, Numerical Evaluation of Singular Integrals. 4(L)

UNIT 6: Statistical Techniques-Discrete and continuous distribution function; Poisson and Normal Distribution. Moment Generating function, linear statistical models, theory of least squares and analysis of variance, least squares estimates and their precision. Test of significance and interval estimates based on least squares theory in one-way, Two-way and three-way classified data. Regression analysis, linear regression, curvilinear regression and orthogonal polynomials, Discriminate analysis. 12(L)

Text/Reference Books

- Gerald and Wheatley, Applied numerical analysis, Addison Wesley.
- Flowers, Numerical Methods in C++, Oxford University Press.
- E. Balaguruswamy, Numerical Methods. TMH.
- S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India
- Jain, Iyengar, Jain, Numerical Methods for Scientific & Engineering Computation, New Age International

COMPUTATIONAL LAB (ME-1351)

Experiment 1: Make a program to evaluate a given polynomial $f(x)$ for a given value of x using Horner's Rule.

Experiment 2: Make a program to find the derivative of a given polynomial $f(x)$ for a given value of x .

Experiment 3: Make a program to find the roots of a given polynomial $f(x)$ using following methods:

- a) Bisection method.
- b) Method of False Position.
- c) Iteration method.
- d) Newton-Raphson method.
- e) Secant method.
- f) Muller's method.
- g) Lin-Bairstow's method.
- h) Quotient-Difference method.

Experiment 4: Make a program to solve the given set of equations using Gauss-Seidel Iterative method.

Experiment 5: Make a program to determine the following difference tables for given data points:

- a) Forward Difference table.
- b) Backward Difference table.
- c) Central Difference table.
- d) Divided Difference table.

Experiment 6: Make a program to find the interpolation polynomial / interpolation value of $f(x)$ at a specified value for evenly spaced data points using the following methods:

- a) Newton's Forward and Backward Difference methods.
- b) Gauss, Stirling, Bessel's and Everett's methods.

Experiment 7: Make a program to find the interpolation polynomial / interpolation value of $f(x)$ at a specified value for unevenly spaced data points using the following methods:

- a) Lagrange Interpolation method
- b) Newton's General Interpolation method.

Experiment 8: Make a program to fit a given polynomial to the given set of data points and to evaluate it at a specified value of x .

Experiment 9: Make a program to find the n^{th} ($n = 1, 2$ and 3) derivative of $f(x)$ at a specified value of x for the given set of data points.

Experiment 10: make a program to find the numerical integration of $f(x)$ at a specified value of x for the given set of data points using the following rules:

- a) Trapezoidal rule.
- b) Simpson 1/3 & Simpson 3/8 rules.
- c) Boole's and Weddle's rules.
- d) Gaussian formula

MATERIAL SCIENCE (LAB) (AM-1352)

Experiment 1: Study of various dislocation models, drawing burgers circuit and finding Burgers vector.

Experiment 2: Study of various unit cells and crystals for,

- a) Their geometry and symmetry,
- b) Total number of atoms and their arrangement,
- c) Effective number of atoms per unit cell,
- d) Co-ordination number,
- e) Atomic packing efficiency,
- f) Determining density,
- g) Concept of Miller indices and Inter-planer spacing.

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- Experiment 5:** To predict creep characteristic of materials by plotting strain vs. time curves for different loadings.
Experiment 6: Comparative study of microstructures of different given specimens (mild steel, grey C.I., brass, and copper).
Experiment 7: Specimen preparation for micro structural examination by cutting, grinding, polishing and etching of aluminium specimen.
Experiment 8: Fabrication of composite by hand-lay up technique.
Experiment 9: Mechanical testing of composite made by hand-lay up technique in experiment no. 8.
Experiment 10: To study the fatigue behaviour of a given sample.

STRENGTH OF MATERIALS (LAB) (AM-1353)

- Experiment 1:** Tension Test
Experiment 2: Compression Test
Experiment 3: Torsion Test
Experiment 4: Beam Bending
Experiment 5: Impact Tests
Experiment 6: Closed and Open coiled springs
Experiment 7: Shear Test
Experiment 8: Buckling of Struts
Experiment 9: Hardness Test (Brinell and Rockwell)
Experiment 10: Tensometer (Tension Test)

BASIC ELECTRICAL AND ELECTRONICS (LAB) (EE-1354)

- Experiment 1:** Verification of Network Theorems.
Experiment 2: Study of the phenomenon of resonance in RLC series circuit.
Experiment 3: Measurement of Power in three phase circuits by two-wattmeter method.
Experiment 4: Determination of parameters and losses in a single phase transformer by OC and SC tests.
Experiment 5: DC generator characteristics.
Experiment 6: Speed control of DC shunt motor.
Experiment 7: Study of running & reversing of three-phase induction motor.
Experiment 8: Study of single-phase energy meter.
Experiment 9: Study of Diode Characteristics.
Experiment 10: Determination of common base 7 common emitter characteristics of a transistor.
Experiment 11: Study of various logic gates.
Experiment 12: To study a half wave and full wave rectifier circuits with and without capacitor filter and determination of ripple factor.

Pran

Modeling of dynamic systems, State-space modeling, Modeling and simulation of dynamic systems in Matlab/Simulink. Modeling of electromechanical systems, Properties of Laplace transform, Laplace transforms of electromechanical systems, Laplace transform of state equations, Transfer functions, Poles, zeros. Representation of multiple subsystems: Block diagrams, Signal flow graphs. 8(L)

UNIT2:Sensors and Transducers-Characteristics, contact and non-contact type, pressure switches, proximity and position sensors. Actuators: solenoids, hydraulic and pneumatic actuators, valves and circuits. 4(L)

UNIT 3: Time response patterns-Response of first and second order systems, System response versus pole and zero location, approximation of high order system by low order system. Stability analysis: Stability analysis using the Routh-Hurwitz test. Feedback systems: Steady state and tracking analysis, The PID compensator, Tuning rules of PID compensator. 8(L)

UNIT 4:Root locus analysis-Sketching a root locus, Selection of gain from the root locus, Controller design using the root locus: Lead compensation, Lag compensation. 6(L)

UNIT5: Frequency response of linear systems- Frequency response analysis, Bode plot techniques, Stability Analysis: The Nyquist theorem, Stability Margins, Closed loop frequency response, Frequency domain compensation techniques: Lead and lag compensators. 6(L)

UNIT6:Linear discrete time systems-Z-transform, mathematical modeling, stability analysis, steady-state error, dynamic performance of discrete time systems 8(L)

Text/Reference Books

- Ogata, K., Modern Control Engineering, Pearson Education.
- Gopal, M., Control Systems: Principles and Design, Tata McGraw-Hill.
- Raven, F. H., Automatic Control Engineering, McGraw-Hill.
- Nagrath, I. J. and Gopal, M., Control Systems Engineering, New Age International.
- Kuo, B. C. and Golnaraghi, F., Automatic Control Systems, Wiley.
- Franklin, G. F., Powell, J. D., and Emami-Naeini, A., Feedback Control of Dynamic Systems, Prentice-Hall.

INDUSTRIAL ENGINEERING (ME-1402)

UNIT 1: Introduction, Engineering Economy and Costing-Cost Analysis, Break-even Analysis, Methods of Depreciation, Productivity Concepts and Measurements. 8(L)

UNIT 2: Job evaluation, Benefits of Job evaluation, Methods of Job evaluation, Merit Rating, Methods of Merit Rating, Requirements for success of Merit Rating System, Objectives of a Good Wage-Incentive Plan, Basis of a Good Wage-Incentive Plan, Types of Wage-Incentive Plans. 10(L)

UNIT 3: Work Measurement, Time Study, PMTS, Work Sampling, Method Study, Micro Motion Study, Principles of Motion Economy. 10(L)

UNIT 4: Material Handling System- principles, types, and devices. 7(L)

UNIT 5: Maintenance Management- Probabilistic Failure and Repair Times, Preventive Maintenance and Replacement, Total Preventive Maintenance, Concurrent Engineering- steps and CE Environment. 10(L)

Text/Reference Books

- Turner, W.C., et. Al, 1993, "Introduction to Industrial and System Engineering", Prentice Hall.
- Del Mar, Donald , "Operations and industrial management: designing and managing for productivity", McGraw-Hill, 2007
- Ralph M. Barnes, "Motion and Time Study: Design and Measurement of Work", Wiley Publishers
- Chandler Allen Phillips, "Human Factors Engineering", John Wiley and Sons, New York,
- S.K. HajraChoudhary, Nirjhar Roy, and A. K. HajraChoudhary, "Production Management: An integrated approach to Industrial Engineering", Media Promoters and Publishers.

MEASUREMENT & METROLOGY (ME-1403)

UNIT 1: Introduction to measurement and measuring instrument, generalized measuring system and functional elements, static and dynamic performance, characteristics of measurement devices, concept of error, sources of error, statistical analysis of errors. 6(L)

UNIT 2: Sensors and transducers- types and their characteristics, measurement of pressure, direct acting and elastic pressure transducers, measurement of very low pressures. Strain measurement- types of strain gauges and their working, strain gauge circuits, temperature strain rosettes. 5(L)

UNIT 3: Measurement of force and torque, temperature measurement by thermometers, bimetallic thermocouples, thermistors and pyrometers. Measurement of flow, vibration and noise measurement, seismic instruments. Data acquisition system. 5(L)

UNIT 4: Standards of liner measurement, line and end standards, system of limits and fits, linear and angular measurement devices and systems, limit gauges and their design. 6(L)

UNIT 5: Measurements of geometric forms like straightness, flatness, roughness and circularity, optical projectors, tool , makers microscope, autocollimators, principle and use of interferometry, optical flat interferometers, laser interferometers. Comparators-types, working principles and magnification range, measurement of screw threads and gears. 6(L)

UNIT6:Surface texture-quantitative evaluation of surface roughness and its measurement, introduction to CMM, in-process gauging systems, inspection- in-process and final inspection, sampling and 100% inspection, sampling plans. 6(L)

Text/Reference Books

- Beckwith Thomas G., Mechanical Measurement, Narosa Publishing House.
- Doeblein, E.O., Measurement Systems: Application and Design, McGraw Hill.
- Hume, K.J., Engineering Metrology, MacDonal and Co.
- Gupta, I.C., Engineering Metrology, DhanpatRai& Sons.
- Bewoor, A.K. and Kulkarni, V. A., Metrology & Measurement, Tata McGraw-Hill Education Pvt. Ltd.
- Sawhney, A.K. and Mahajan, M., A text book of measurement and metrology, DhanpatRai& Co.

FLUID MECHANICS (AM-1401)

UNIT 1: Introduction to Fluid Mechanics- Statics and Kinematics Fluid and continuum, Physical properties of fluids, Types of fluid flows, Rheology of fluids. Manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, fluid masses subjected to linear acceleration and uniform rotation about an axis. Kinematics of Fluid flow: steadiness, uniformity, rotational and irrotational flows, streamline, streakline, pathline, continuity equation, stream function and velocity potential, applications of potential flow. 8(L)

important dimensionless numbers and their physical significance, geometric, kinematic, dynamic similarity, model studies, Hydraulic similitude. 8(L)

UNIT 3: Laminar and Turbulent Flows- Equation of motion for laminar flow through pipes, Stokes law, transition from laminar to turbulent flow, types of turbulent flow, isotropic and homogenous turbulence, scale and intensity of turbulence, eddy viscosity, Prandtl's mixing length theory, velocity distribution in turbulent flow over smooth and rough surfaces, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, three reservoir problems and pipe network. 10(L)

UNIT 4: Hydrodynamic Boundary Layer- Introduction with a historical background, boundary layer, displacement and momentum thickness, boundary layer over a flat plate, Prandtl boundary layer equation, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub-layer, separation and its control, drag and lift, drag on a sphere, 2D cylinder and airfoil, Magnus effect. 8(L)

UNIT 5: Measurement Techniques- Flow measurement by Pitot tube, orifice, Venturi, nozzle, and bend meter, rotameter, notches and weirs, hot-wire anemometer, LDV and PIV, Turbine flowmeter, Vortex shedding flowmeter, magnetic flowmeter, Doppler Ultrasonic flowmeter, Coriolis flowmeter etc. 4(L)

UNIT 6: Introduction to Hydraulic Machines- Introduction to Hydroelectric power station and its components, Classification of turbines and pumps, similarity laws and specific speed, efficiency, cavitation. 4(L)

Text/Reference Books

- Fox, R.W., McDonald, A.T., Introduction to Fluid Mechanics, 7th edition, Wiley India.
- Ojha, C.S.P., Berndtsson, R., Chandramouli, P.N., Fluid Mechanics and Machinery, Oxford University Press, New Delhi.
- Majumdar, B., Fluid Mechanics with Laboratory Manual, PHI Learning, New Delhi.
- Som, S.K. and Biswas G, Introduction of Fluid Mechanics & Fluid Machines, TMH, New Delhi.
- Mohanty, A.K., Fluid Mechanics, PHI Learning, New Delhi.
- Shames, I.H., Mechanics of Fluids, McGraw Hill, International Students Edition.
- Agarwal, S.K., Fluid Mechanics and Machinery, TMH, New Delhi.
- Rathakrishnan E., Instrumentation, Measurements and Experiments in Fluids, CRC Press, New York.
- Garde, R.J., Fluid Mechanics through Problems, New Age International Pvt. Ltd, New Delhi.
- Lal, J., Hydraulic Machines, Metropolitan Book Co. Pvt. Ltd., Delhi.

HEAT & MASS TRANSFER (ME-1405)

UNIT 1: Introduction to Heat Transfer: Concepts of the mechanisms of heat flows; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism. 2(L)

Conduction-One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions. 3(L)

Steady State one-dimensional Heat conduction-Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance; Critical thickness of insulation. 3(L)

Two dimensional steady state heat conduction-solution by Numerical Relaxation method. 2(L)

UNIT 2: Fins-Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells. 3(L)

Transient Conduction-Transient heat conduction; Lumped heat capacity method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts. 4(L)

UNIT 3: Convective heat transfer fundamentals-Newton's law of cooling, Types of convective heat transfer, Laminar and Turbulent flows, Hydrodynamic boundary layer, Thermal boundary layer, Non-dimensional numbers, Buckingham Pi Theorem. 3(L)

Forced Convection-Flow over a flat plate; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow across a single cylinder and a sphere; Flow inside ducts; Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer. 5(L)

Natural Convection-Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere; Combined free and forced convection. 3(L)

UNIT 4: Thermal Radiation-Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; ; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection. 6(L)

UNIT 5: Heat Exchanger-Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers. 3(L)

Condensation and Boiling-Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convective boiling. 3(L)

Introduction to Mass Transfer-Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion through a stagnant gas film. 2(L)

Text/Reference Books

- Heat and Mass Transfer (In SI units) A practical approach By Yunus A. Cengel, TMH Education pvt. Ltd.
- Heat Transfer By J.P. Holman, McGraw-Hill International edition.
- Fundamentals of engineering Heat & Mass transfer, By Sachdeva, R.C., New Age International (P) Ltd. Publishers
- Principles of Heat Transfer by Frank Kreith, McGraw-Hill Book co.
- Fundamentals of Momentum, Heat and Mass Transfer By James R. Welty; John Wiley & Sons (Pvt). Ltd.
- Fundamentals of Heat & Mass transfer, By Incropera F.P. Dewitt.D.P., John Wiley & Sons (Pvt). Ltd.
- Heat Transfer, By Y.V.C. Rao, University Press.
- Heat Transfer, By R. Yadav, Central Publishing House, Allahabad.

Yadav

UNIT 1: Static and Dynamic Force Analysis-Static Force Analysis of Planer Mechanisms, Dynamic Force Analysis including inertia And Frictional Forces of Planer Mechanisms. 8(L)

Turning Moment & Flywheel-Turning Moment Diagram for Engines and Speed Fluctuation, Flywheel. 4(L)

UNIT 2: Balancing of Rotating Masses-Static Balance, Dynamic Balance, Balancing of Rotating Masses, Two Plane Balancing, Graphical and Analytical Methods, Balancing of Rotors, Balancing Machines. 5(L)

Balancing of Reciprocating Masses-Balancing of Single Cylinder Engine, Balancing of Multi Cylinder; Inline, Radial and V Type Engines, Firing Order. 3(L)

UNIT 3:Governor-Introduction, Types of Governors, Characteristics of Centrifugal Governors, Gravity Controlled and Spring Controlled Governors, Hunting of Centrifugal Governors, Inertia Governors. 6(L)

UNIT 4: Gyroscopic Motion-Gyroscopes, Gyroscopic Forces and Couples, Gyroscopic Stabilization, Ship, Plane Stabilization, Stability of Four Wheel and Two Wheel Vehicles Moving on Curved Paths. 6(L)

UNIT 5:Mechanical Vibration-Vibration of Mechanical Systems, Types of Vibration; Lumped Parameter Models, Linearization of System Elements, Degrees of Freedom, Types of Restoration and Dissipation Mechanisms, Types of Excitation.Free Undamped Vibration of Single Degree of Freedom Systems, Determination of Natural Frequency, Equivalent Inertia and Stiffness, Energy Method.Free Vibration with Viscous Damping, Critical Damping and A Periodic Motion, Logarithmic Decrement, Systems with Coulomb Damping.Forced Vibration with Harmonic Excitation, Undamped Systems and Resonance, Viscously Damped Systems, Systems with Base Excitation, Transmissibility and Vibration Isolation, Whirling of Shafts and Critical Speed. 8(L)

Text/Reference Books

- The Theory of Machines by Thomas Bevan, CBS Publishers & Distributors.
- Theory of Machines and Mechanisms by John J. Uicker, Jr. Gordon R. Pennock& Joseph E. Shigley, Oxford University Press, New York.
- Theory of Mechanisms and Machines by Dr.JagdishLal, Metropolitan Book Co. Pvt. Ltd.
- Theory of Machines by S.S. Ratan, Tata McGraw-Hill

MEASUREMENT AND METROLOGY LAB (ME-1451)

Measurement lab

Experiment 1: Study of displacement and current characteristics in Linear variable differential transformer (LVDT)

Experiment 2: Find the relationship between displacement and change in signal generated due to Capacitive type transducer (Proximity tutor)

Experiment 3: To draw the calibration graph for the Bimetallic transducer using a thermometer as standard and determine the time constant for the transducer

Experiment 4: Find the relationship between displacement and change in signal generated due to Strain gauge

Experiment 5: To calibrate the given force measuring elastic transducer for compression and tensile loads

Experiment 6: To plot the calibration graph between the temperature and RTD readings

Experiment 7: To study the variation of light intensity with distance from source with a luxmeter

Experiment 8: Calibration of Bourdon pressure gauge for (i) above atmospheric pressure conditions, and (ii) below atmospheric pressure conditions.

Metrology Lab

Experiment 1: To measure the screw parameters i.e. external diameter, pitch, flank angle by using Tool makers microscope

Experiment 2: To make the study and use of micrometer and depth gauge

Experiment 3: To measure the angle of a given taper specimen with the help of a clinometers first and then calculate the accurate value using a Sine bar.

Experiment 4: To determine the outside and core diameter of a given specimen with the help of Floating carriage micrometer.

Experiment 5: To determine the diameter of a specimen and the error in given specimen with the help of passameter and slip gauges.

AUTOMATIC CONTROL LAB (ME-1452)

Experiment 1: Dynamic response of systems using transfer-function approach in MATLAB®

Experiment 2: Dynamic response of systems using transfer-function approach in Simulink®

Experiment 3: Dynamic response of systems using State-Space approach in MATLAB®

Experiment 4: Dynamic response of systems using State-Space approach in Simulink®

Experiment 5: Closed-loop control of systems with PID controller using transfer-function and State-Space approaches in MATLAB®

Experiment 6: Closed-loop control of systems with PID controller using transfer-function and State-Space approaches approach in Simulink®

Experiment 7: Closed-loop control of systems using Root-Locus design in MATLAB®

Experiment 8: Frequency response of systems in MATLAB®

Experiment 9: Dynamic response of systems with digital control in MATLAB®

Experiment 10: Dynamic response of systems with digital control in Simulink®

THERMAL ENGINEERING LAB-I (ME-1453)

Experiment 1: Study of the heat transfer in pin fin apparatus

Experiment 2: Study of the heat transfer in natural convection apparatus

Experiment 3: Study of the heat transfer in the forced convection apparatus

Experiment 4: Study of the Stefan Boltzman apparatus and estimation of Stefan Boltzman's constant

Experiment 5: Study of the heat transfer in drop-wise and film wise condensation.

Experiment 6: To estimate the thermal conductivity of metal bar

flow

- Experiment 9:** Study of the emissivity measurement apparatus
Experiment 10: To estimate the thermal conductivity of insulating powder
Experiment 11: To study the Heat transfer in lagged pipe apparatus
Experiment 12: To estimate effectiveness in Shell-and-Tube Heat Exchanger
Experiment 13: To estimate effectiveness in double pipe heat exchangers

FLUID MECHANICS & HYDRAULIC MACHINES LAB (AM-1451)

Pre-requisite: Fluid Mechanics/ Fluid Flow Operations

- Experiment 1:** To verify the momentum equation using the experimental set-up on diffusion of submerged air jet.
Experiment 2: To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.
Experiment 3: To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
Experiment 4: To study the variation of friction factor ' f ' for turbulent flow in commercial pipes.
Experiment 5: To calibrate an orifice meter, venturimeter, and bend meter and study the variation of the co-efficient of discharge with the Reynolds number.
Experiment 6: To study the impact of jets in a flat plate.
Experiment 7: To study performance of a Pelton wheel/ Francis turbine/ Kaplan Turbine.
Experiment 8: To study performance of two Centrifugal pumps connected in series and parallel.
Experiment 9: To study performance of a Reciprocating pump.

Text/Reference Books

- Singh, S. Experiments in Fluid Mechanics, PHI Learning, New Delhi.
- Prakash, M. N. S., Experiments in Hydraulics and Hydraulic Machines: Theory and Procedures, PHI Learning, New Delhi.
- Majumdar, B., Fluid Mechanics with Laboratory Manual, PHI Learning, New Delhi.



UNIT 1: Definitions, Historical Development. Nameable and Unnameable shapes, Explicit and Implicit Equations, Intrinsic Equations, Parametric Equations, Coordinate Systems. Design of Curves: Algebraic and Geometric Forms, Parametric space of a curve, Blending functions, Reparametrization, Truncating, Extending and subdividing, Space curve, Four point form, Straight lines, Spline Curves, Bezier Curves, B-spline Curves, Rational Polynomials, introduction to NURBS. 12(L)

UNIT 2: Geometric Transformation and Projection: Transformations: Translation, Rotation, Scaling Symmetry and Reflection, Homogeneous Transformations. Orthographic Projections, Axonometric Projections, Oblique Projections, Perspective Transformation. 6(L)

UNIT 3: Design of Surfaces: Algebraic and Geometric form, Tangent and Twist Vectors, Normal, Parametric space of a surface, Blending Functions, Reparametrization of a surface patch, subdividing, Sixteen Point form, Four Curve Form, Plane surface, Cylindrical Surface, Ruled surface, Surface of Revolution. Bezier Surface, B-Spline Surface. 8(L)

UNIT 4: Design of Solids and Solid modeling schemes. Solid Modelling Fundamentals: Topology of Closed Paths, Piecewise flat surfaces, topology of closed curved surfaces, Generalized Concept of boundary, Set theory, Boolean operators, Set-membership Classification, Euler operators, Formal Modelling Criteria. Solid Model Construction: Graph Based methods, Boolean models, Instances and Parameterized Shapes, Cell Decomposition and spatial-Occupancy Enumeration, Sweep Representation, Constructive Solid Geometry, Boundary Representation. Assemble Modelling. 12(L)

UNIT 5: Data transfer formats: Neutral data format, IGES, STEP and XML. Applications of Solid Models: Rapid Prototyping, FEM, Medical Applications. 4(L)

Text/Reference Books

- Geometric Modelling: Michael E. Mortenson, John Wiley, 2006
- Mathematical Elements of Computer Graphics: Roger and Adams, McGraw Hill, 1994.
- CAD CAM Theory and Practice: I. Zeid, McGraw Hill, 1994.

MACHINE DESIGN-I (ME-1502)

UNIT 1: General Introduction and Selection of Materials-Definition, Methods, Standards in Design and Selection of Preferred Size, BIS system of Designation of Steels, Steels and Alloys, Plastics and Rubbers. 5(L)

UNIT 2: Design against Static and Fluctuating Load-Concept of Three Dimensional State of Stress and Strain, Stress-Strain Relationship, Principle Stresses, Stress Concentration, Stress Concentration Factor and Notch Sensitivity Factor, Factor of Safety, Theories of Failure, Fluctuating Stress, Fatigue Failure, Endurance Limit, Design for Finite and Infinite Life, Soderberg and Goodman Criteria. 9(L)

UNIT 3: Shafts, keys and coupling-Design of Shafts against Static and Fluctuating Load, Strength and Rigidity Design, Design of Square and Flat Keys and Splines, Rigid and Flexible Couplings. 5(L)

UNIT 4: Power Screws and Joints-Form of Threads, Square Threads, Trapezoidal Threads, Stresses in Screw, Design of Screw Jack, Screwed Joints, Riveted Joints, Welded Joint and Eccentric Loading of above Joints, Design for Fatigue Loading. 9(L)

UNIT 5: Mechanical Springs-Helical Springs, Stress Equations, Deflection Equation, Design against Static and Fatigue Loading, Multi Leaf Springs, Spiral Springs. 7(L)

UNIT 6: Belts, Brakes and Clutches-Flat Belts, V Belts, Static Analysis of Brakes and Clutches, Internal Expanding and External Contracting Rim Brakes and Clutches, Band type Brakes and Clutches, Frictional contact Axial Clutches, Disc Brakes, Cone Clutches and Brakes 7(L)

Text/Reference Books:

- Machine Design An Integrated Approach by R. L. Norton, Pearson Prentice Hall
- Mechanical Engineering Design by J. E. Shigley, McGraw-Hill
- Design of Machine Element by V. B. Bhandari, Tata McGraw-Hill
- Design Data – PSG College of Technology

MANUFACTURING SCIENCE AND TECHNOLOGY-I (ME-1503)

UNIT 1: Metal Casting Science and Technology- Need and Classification; Expendable Green Sand Mould Metal Casting: Preparation, Composition, Properties and Testing of Green Sand; Function, Materials, Allowances and Types of Patterns; Function and Types of Cores; Core prints and Chaplets; Molding Methods; Gating Design; Cooling and Solidification-Mechanism and Rate; Riser Design and Placement; Expendable Precision Sand Mould Metal Castings: Shell Mould Casting, Vacuum Mould Casting and CO₂ Mould Casting; Investment Casting (Lost Wax) and Evaporative Casting (Lost Foam); Expendable Plaster Mould (Antioch process) and Ceramic Mould (Shaw process) Casting; Permanent Metal Mould Metal Casting: Gravity Die and Pressure Die Casting, Vacuum Die and Slush Die Casting; Special Metal Casting Processes: Centrifugal, Continuous, Squeeze and Chilled Metal Casting; Casting Defects and Inspection of Casting; 9(L)

UNIT 2: Plastic Moulding Science and Technology: Classification of Moulding Processes, Extrusion and Injection Moulding, Compression and Transfer Moulding, Blow and Rotational Moulding; Glass-working Science and Technology: Raw material preparation; shaping of Piece Ware and Flat and Tubular glass; Powder Metallurgy Science and Technology: Powder preparation; Blending and/or Mixing of Powders, Compacting and Sintering of powders; Hot Isostatic Pressing (HIP), Powder Injection Moulding (PIM), and Electro-Spark Pressing (ESP) 6(L)

UNIT 3: Massive Metal Forming Science and Technology- Need and Classification, Elastic and Plastic deformation-Yield and Flow; Rolling: Classification of Rolling, Process geometry and Analysis of Plate rolling for Rolling load and power calculations; Rolling mills and Roll pass design; Defects in Rolled Products; Forging: Classification of Forging, Process Geometry and Analysis of Strip and Disc forging for Forging Load and Power calculations; Defects in Forged Products; Drawing: Process Geometry and Analysis of Wire and Sheet Drawing for Load and Power calculations, Maximum Reduction Possible. Extrusion: Classification, Process Geometry and Analysis of Rod and Sheet Extrusion for Load and Power calculations, Maximum Reduction Possible; Defects in Extruded Product. 12(L)

UNIT 4: Sheet Metal Forming Science and Technology- Need and classification; Blank preparation by sheet cutting; Press Forming: Bending and Drawing- Process Geometry and Calculation for Force and Power; Impulse Forming: Explosive forming, Electro-hydraulic forming and Electro-magnetic forming; Laser Forming: Laser Bending and Laser Drawing 6(L)

UNIT 5: Rapid Prototyping Science and Technology: Need and Classification of Rapid Prototyping Processes; Process Principle, Equipments and Applications of Stereo Lithography(SLA), Solid Ground Curing (SGC), Selective Laser Sintering (SLS) and Three Dimensional Printing (TDP), Fused Deposition Modelling (FDM) and Laminated Object Manufacturing (LOM). Surface Coating Science and Technology: Need and Classification; Process Principle, Equipments and Applications of Physical Vapour Deposition (PVD), Chemical Vapour Deposition (CVD), Electro-Plating, Electroless-Plating, Powder Coatings, Thermal Coating and Chemical Coating; Choice of coating materials and processes; Testing of surface coatings 6(L)

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- Fundamentals of Modern Manufacturing by M. P. Groover, John Wiley and Sons, New Delhi
- Fundamentals of Metal Forming Processes by B. L. Juneja, New Age International Ltd., New Delhi
- Manufacturing Engineering and Technology by Kalpakjian and Schmid, Pearson Education Pvt. Ltd. New Delhi

STEAM POWER ENGINEERING (ME-1504)

UNIT 1: Introduction-Introduction to the subject , review of Carnot and Rankine Cycles, Effects of operating condition on thermal efficiency of Rankine cycle, Methods of increasing thermal efficiency, Efficiencies, Requirement of Ideal working fluid, Binary Vapour Cycle, Reheating and Regenerating Feed Heating Cycles, Feed Heater, Deaerators.

UNIT 2: Nozzles and Diffusers-Introduction, Effects of Flow of Wet Steam in Nozzles, Classification, Steady Flow Energy Equation through Nozzles, Momentum Equation, Efficiencies, Critical Flow in Nozzles, Physical Meaning of Critical Pressure, General Relationship Between Area, velocity and pressure, Supersaturated Flow in Nozzles, Effects of variation of Back pressure in Nozzles, Introduction to Diffusers, Types, Pressure Recovery and Losses.

UNIT 3: Flow of Steam Through steam turbines: Principles of Working, Classification, Computing of Steam Turbine, Velocity Diagram for Impulse and Reaction Turbines, Power Output, Axial thrust, Diagram Efficiency, Optimum Value of Blade to steam Speed Ratio.

UNIT 4: Turbine Performance and Constructional details-Losses in Steam Turbine State Point Locus and Reheat factor, Governing of Steam Turbine, Constructional Details, Material of Steam Turbine Components.

UNIT 5: Steam Condensers-Introduction, Condensers Classification, Condensers and Vacuum Efficiency, Cooling Ponds and Cooling Towers, Constructional details

UNIT 6: Steam Generators-Modern Trends in Design , Heat Absorption in Water Tube Boilers, Circulation in Downcommer and Riser, Steam Drum and Internal details , Modern boilers, Fluidized Bed Boilers , Fuel Handling and Ash handling System , Control , Mounting and Accessories , Performances.

Text/Reference Books:

- Steam and Gas turbines and power Plant Engineering by R.Yadav, Central publishing House, Allahabad
- Steam Turbine : Theory and practices By W.J Kearnon, Sir Isaac pitman And Sons Ltd. London
- Steam turbines by Shlyakhin P, Foreign language Publishing House, Moscow
- Steam Turbines by Church E F, McGraw Hill Book Company Inc. New York
- Applied Thermo Sciences by Shyam K Agrawal, Viva Books Pvt. Ltd. New Delhi
- Fundamentals of classical Thermodynamics By Gordon J, VanWhlwn and Richard E, Sountag , John Wiley and sons, New York
- Fundamental of Engineering Thermodynamics By Michael J, Moran and Howard N Shapiro John Wiley E Sons, New York
- Power Plant Engineering By PK Nag, Tata McGra Hill
- British Electricity International , London (CSEG), Modern Power Station practices, Vol (I-VIII), Pergamon Press ,Oxford.
- Combined Heat and Power by J H Horlock , Pergamon Press, Oxford

PRINCIPLES OF MANAGEMENT (HS-1501)

UNIT1: Introduction to Management-Definition of Management – Science or Art – Management and Administration, Functions of Management – Types of Business Organization. Levels of management and Managerial skills 5(L)

UNIT2: School of Management Thoughts: Evolution of Management thoughts, classical approach, neo- classical approach, contribution of Taylor, Weber and Fayol, modern approach. 6(L)

UNIT3: Planning Nature & Purpose – Steps involved in Planning ,Objectives, Setting Objectives, Process of Managing by Objectives ,Strategies, Policies & Planning Premises Forecasting Decision-making. 8(L)

UNIT 4:Organizing Nature and Purpose – Formal and informal organization – Organization Chart – Structure and Process – Departmentation by difference strategies – Line and Staff authority – Benefits and Limitations – De-Centralization and Delegation of Authority – Staffing – Selection Process-Techniques-HRD-Managerial-Effectiveness. **Directing:** Scope – Human Factors

– Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment – Communication – Process of Communication – Barriers and Breakdown – Effective Communication – Electronic media in Communication. 11(L)

UNIT 5:Controlling-System and process of Controlling – Requirements for effective control – The Budget as Control Technique – Information Technology in Controlling – Use of computers in handling the information – Productivity – Problems and Management – Control of Overall Performance.Coordination. 5(L)

UNIT 6: Organisational Behaviour- Organisational change, Conflict Management and Stress Management**Functional management:** Human Resource Management, Financial management, Marketing Management. 5(L)

Text/Reference Books:

- Tripathy PC and Reddy PN, “Principles of Management”, Tata McGraw-Hill, 1999.
- Decenzo David, Robbin Stephen A, “Personnel and Human Reasons Management”, Prentice Hall of India, 1996
- JAF Stomer, Freeman R. E and Daniel R Gilbert, “Management”, Pearson Education, Sixth Edition, 2004.
- Fraidoon Mazda, “Engineering Management”, Addison Wesley, 2000.
- Harold Kooritz& Heinz Weihrich “Essentials of Management”, Tata McGraw-Hill, 1998
- Joseph L Massie “Essentials of Management”, Prentice Hall of India, (Pearson) Fourth Edition, 2003

COMPUTER AIDED DESIGN LABORATORY (ME-1551)

Experiment 1: Design of Hermite curves

Experiment 2: Design of Bezier curves

Experiment 3: Design of B-Spline curves

Experiment 4: Geometric transformation on curves.

Experiment 5: Design of Bi-cubic Surfaces

Experiment 6: Design of Bezier surfaces

Experiment 7: Design of B-Spline Surfaces of surfaces.

Experiment 8: Transformations and projection

Experiment 9: Solid Modeling of few objects

MACHINE DESIGN LAB –I (ME-1552)

Experiment 1: Assembly drawing of machine elements using AutoCAD/Solid works

- a) Threaded joints.
- b) Cotter and Knuckle joint.
- c) Couplings.
- d) Screw Jack.
- e) Tailstock.
- f) Plummer block.
- g) Rams bottom safety valve.
- h) Cylinder relief valve.
- i) Blow-off cock.
- j) Tool post.
- k) Gear box.

MANUFACTURING TECHNOLOGY LAB-I (ME-1553)

Experiment 1: Design and Preparation of a wooden pattern for the given dimensions of a casting of V- block made of Cast Iron/Steel

Experiment 2: Preparation of machine mould as per the dimensions of a given part and study of moulding methods used in Foundry Shop.

Experiment 3: To find green compression and shear strength of a given sample of green sand.

Experiment 4: To find shatter index of a given sample of green sand.

Experiment 5: To find the moisture content in a given sample of green sand.

Experiment 6: Study of Sieve Shaker and to find Grain Fineness Number for a given sample of foundry sand.

Experiment 7: Study of Permeability Tester and to find Permeability Number for a given sample of foundry sand

Experiment 8: Determination of sheet length and bending force required for forming the given 'Z' section.

Experiment 9: Study of Power Press and Power Hammer

Experiment 10: Study of Laser Beam Machine.

THERMAL ENGINEERING LAB – II (ME-1554)

Experiment 1: Study and performance of Nestler Boiler (To find the equivalent evaporation, Boiler efficiency and prepare the heat balance).

Experiment 2: Study and performance of Steam Turbine

Experiment 3: Study and performance of surface condenser

Experiment 4: Study and performance of complete steam power plant

Experiment 5: To find the dryness fraction of wet steam using separation throttling calorimeter.

Experiment 6: Study and performance of vertical steam engine

Experiment 7: Study of 600 Rovers Gas Turbine and to draw the air fuel, lubrication and power cycles.

Experiment 8: Study and performance of two stage reciprocating air compressor.

Experiment 9: Study of steam boiler models of Lancashire, locomotive and Babcock & Wilcox.

Experiment 10: Study of simple Impulse turbine and Parson's reaction turbine models

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Engineering - Group Technology - Design for Manufacturing and Assembly - Process Planning Techniques Concurrent Engineering - Rapid prototyping. **Numerical control in CAM:** Definition, Historical background, basic components of NC system, Classification, fundamentals of NC, Procedure, Co-ordinate system, motion control systems, Advantages of NC system; Features of CNC Machine tools, Economics of NC machining centers. 9(L)

UNIT 2: Introduction to automation and need and future on NC systems and CAM. Advantage and disadvantages. **Features in NC Machines:** Difference between ordinary and NC machine tools. Methods for improving Accuracy and Productivity, drives 6(L)

UNIT 3: Computer Numerical Control-Principle of operation of CNC, Features of CNC, and Development in CNC systems, Adaptive Control, Direct Numerical Control (DNC) Standard Communication Interfaces, Programmable Logic Controllers (PLCs) Communication networks, New development in NC. **Constructional Features of CNC Machines:** Design considerations of CNC machines for improving machining accuracy-Structural members-Slideways - Sides linear bearings - Ball screws - Spindle drives and feed drives - work holding devices and tool holding devices -Automatic Tool changers. Principles of Operation-Machining Centers - Tooling for CNC machines. 12(L)

UNIT 5: NC Part Programming:

- (a) Manual (word address format) programming. Examples, Drilling and Milling
- (b) Higher level programming.

Feed Back Devices: stepping motors, Feedback devices such as encoder, counting devices, Digital to Analog converter and vice versa; **Interpolators-**Principle, Digital Differential Analyzer. Linear Interpolator, Circular Interpolator and its software interpolator. 6(L)

UNIT 5: Control of NC System- Open and closed loops. Automatic control of closed loops with encoder & tachometers. Speed variation of DC motor. Adaptive control. **Computer Integrated Manufacturing System-** Manufacturing cell, Transfer lines. FMS, CIM, CAD/CAM concept. 6(L)

Text/Reference Books:

- Automation, Production Systems and Computer Integrated Manufacturing by M.P. Grover, PHI.
- Principal of Computer Integrated Manufacturing by S.Kant Vajpayee.
- Numerical Control and Computer Aided Manufacturing, Kundra, Rao and Tiwari, TMH.
- Computer Control of Manufacturing Systems by Yoram Koren, McGraw-Hill Book Company
- CNC – Machining Techniques - Vol. 1, 2 & 3 by G. T. Smith, Verlag

MACHINE DESIGN II (ME-1602)

UNIT 1: Surface Failure-Introduction, Surface geometry, mating surfaces, friction, wear, corrosion wear, surface fatigue, general contact, dynamic contact stresses, surface fatigue failure, designing to avoid surface failure. **Spur Gears:** Kinematics of gears, Conjugate Action, Standard tooth systems for spur gears, Profile shifted gears, Involutometry, gear cutting methods, Modes of gear failure, Spur gear tooth force analysis, Tooth bending stress – AGMA procedure, Bending fatigue strength – AGMA procedure, Buckingham equation for dynamic load on gears, Buckingham contact stress equation, Contact stress – AGMA procedure, Surface fatigue strength – AGMA procedure, Gear materials. 9(L)

UNIT 2: Helical Gears-Kinematics, geometry and nomenclature, force analysis, Design of helical gears: bending stress, contact stress, Crossed helical gears **Worm Gears:** Geometry and nomenclature, Force analysis, Friction analysis and efficiency, thermal capacity, bending and surface strength, power rating efficiency, worm gear standards and proportions. 6(L)

UNIT 3: Bevel Gears-Introduction, Geometry and terminology, Force analysis, Bending stress analysis, Contact stress analysis, Permissible bending fatigue stress, Permissible contact fatigue stress Spiral bevel gears, hypoid gears. 6(L)

UNIT 4: Antifriction bearing-Types of ball bearings, roller bearings, needle bearings, friction life of bearings, reliability considerations, selection of ball bearings, roller bearing, tapered roller bearing, thrust bearing, lubrication and sealing, Mounting of bearings. 6(L)

UNIT 5: Lubrication and sliding bearings-Type of lubrication, viscosity, hydrodynamic theory of lubrication, types of bearing, design of bearing using design charts, boundary lubrication, hydrostatic bearing, hydrodynamic thrust bearings. 7(L)

UNIT 6: System Design-Introduction, Design and design process, Design axioms (Independence and Information) and corollaries, Case studies: Design of products/Systems 6(L)

Text/Reference Books:

- Joseph E. Shigley, "Mechanical Engineering Design", McGraw Hill Publications.
- Richard M. Phelan, "Fundamentals of machine design" Tata Mc-graw Hill pub.
- Robert L. Norton, "Machine Design: An Integrated approach" Prentice Hall
- Robert C Juvinall and Kurt M. Marshek, " Fundamentals of Machine Component Design, Wiley-India
- Nam P. Suh, "Principles of Design", Oxford University Press, 1990.
- V. B. Bhandari, "Design of Machine Elements" 3rd Ed., Tata McGraw Hill

MANUFACTURING SCIENCE AND TECHNOLOGY-II (ME-1603)

UNIT 1: Metal Cutting Principle-Mechanism of Chip Formation; Types of Chips; Orthogonal and Oblique cutting, Cutting Forces and Merchant Circle Diagram, Shear angle and Friction angle, Shear Velocity and Chip Velocity, Length of shear and friction plane, Stresses in shear and friction plane, Energy in shear and friction plane, Strains in shear and friction plane, Temperature in shear and friction plane; **Cutting Tools and Fluids:** Cutting Tool Materials, Cutting Tool Life, Cutting Tool Geometries, and Cutting Fluid Applications 6(L)

UNIT 2:Cutting Machining Operations-Cutting Tool Technology, Machine Tool Technology and Holding Tool Technology, Process Geometry, Cutting Conditions, Calculation of Material Removal Rate (MRR), Surface Roughness (Ra), Cutting Forces and Power for Turning and related operations; Drilling and related operations; Milling and Gear Cutting, Shaping and Planning; Broaching and Sawing operations; Economics of Machining by Cutting 12(L)

UNIT 3: Abrasive Machining Operations-Features, Need and Classifications of Abrasive Machining; Abrasive Grinding- Wheel Specification, Wheel Life; Balancing, Truing and Dressing of Wheels; Classifications of Abrasive Grinding Processes; Chipping action in grinding, Calculation of Grinding Time and Material Removal Rate, Forces and Power, Heat and Temperature; Working Principle and Applications of grinding processes for prismatic and rotational surfaces; Abrasive Finishing-Conventional abrasive finishing-Honing, Lapping, Polishing and Buffing; Modern Abrasive Finishing - Abrasive Flow Finishing and Magnetic Abrasive Finishing 12(L)

UNIT 4: Advanced Machining Operations-Need and Classification of Erosion based Machining Processes; Process Principle, Equipments and Applications of Electro-Discharge Machining (EDM) and Beam Machining Processes (e.g. LBM, EBM, IBM,); Electro-Chemical

UNIT 5: Welding Science and Technology: Need and Classifications of Joining Processes; Solid Welding-Diffusion, Friction, Forge and Roll Welding; Explosive and Ultra-sonic Welding; Fusion Resistance Welding- Spot, Projection and Seam welding, Resistant Butt and Flash Butt welding; High Frequency Resistance and High Frequency Induction welding; Fusion Arc Welding- Non consumable electrode arc welding-CAW, GTAW, PAW and Consumable electrode arc welding-SMAW and GMAW, SAW and ESW; Twin electrode arc welding-twin carbon and tungsten; Fusion Gas Welding: Oxy Acetylene and Oxy Hydrogen; Thermit Welding; Fusion Beam Welding: LBW and EBW; Welding Defects and Inspection; Characteristics and applications of Brazing and Soldering 6(L)

Text/Reference Books:

- Manufacturing Science by **Ghosh and Mallik**, East West Press Pvt. Ltd., New Delhi
- Fundamentals of Modern Manufacturing by **M. P. Groover**, John Wiley and Sons, New Delhi
- Introduction to Machining Science by **G. K. Lal**, New Age International Ltd., New Delhi
- Manufacturing Engineering and Technology by **Kalpakkian and Schmid**, Pearson Education Pvt. Ltd. New Delhi

AUTOMOBILE ENGINEERING (ME-1604)

UNIT 1: Introduction to auto vehicles, various systems of automobiles. Power transmission necessities, Advantages and disadvantages, Recent trends, Purpose of clutch, types of clutches and their working.

Unit 2: Resistance calculation, Engine power calculation, Necessity of gear box, types of gear boxes, sliding mesh, constant mesh, synchromesh gear box, Transaxle, Automatic transmission,

UNIT 3: Universal coupling, telescopic joint and propeller shaft. Purpose of differential, types of differential and their construction, type of axles, Suspension systems: type of chassis, dependent and independent suspension, coil and leaf spring suspension, shock absorbers.

UNIT 4: Steering system: definition of true steering, Ackerman's steering linkages and steering gear boxes. Wheel alignment, Centre Point Steering, caster, camber, king pin inclination Tyres, wheels

UNIT 5: Braking system: Mechanical, Hydraulic, vacuum and pneumatic brake, their merits and demerits, types of brake, drum and disc type, Tires, Wheels. Road safety, Influence of vehicle characteristic on accidents.

Books and References:

- The Motor Vehicle: by- Newton and Steed,
- Automotive Mechanics: by- Heitner J.
- Advanced Vehicle Technology- HEINZ HEISLER
- Any other referenced discussed in class for specific topics.

INTERNAL COMBUSTION ENGINE (ME-1605)

UNIT 1: Overview and Basics of Engine Operation, Engine Geometry, Performance Parameters, Ideal Cycle Analysis, Combustion Stoichiometry, Fuel-air Cycle Model 6(L)

UNIT 2: Gas Exchange: 4-Stroke, Gas Exchange: 2-Stroke, Turbocharging, Mixture Preparation, Fuel Injection System in Diesel Engine 7(L)

UNIT 3: Ignition System, Spark-ignition Engine Combustion, Knock, Diesel Combustion 7(L)

UNIT 4: SI Engine Emissions, Diesel Emissions Emission Control Technology, Engine Heat Transfer 6(L)

UNIT 5: 2-Stroke and 4-Stroke Spark Engine Performance and Testing, Diesel Engine Performance and Testing, Alternative fuels. 7(L)

UNIT 6: Overview and Basics of Gas Turbine and Compressor Operation, Classification, Ideal Cycles, Design Point Performance Calculations, Comparative Performance of Practical Cycles, Combined Cycle and Cogeneration Schemes. 7(L)

Books and References:

- Heywood, John B. Internal Combustion Engine Fundamentals. New York: McGraw-Hill, 1988. ISBN: 9780070286375
- I. C. Engine by V. Ganeshan
- I. C. Engines and Air Pollution by R. Yadav, II Edition. 2004, Central Publishing House
- Fundamental of Internal combustion Engine by Gill, Smith, Ziurys
- Internal Combustion Engine by Willard W. Pulkrabek
- Gas Turbine Theory by Cohen and Rogers

COMMUNICATION SKILL WORKSHOP (HS-1601)

Experiment 1: Art of communication: What is communication, good communication and effective communication, barriers and filters, activity on barriers and filters.

Experiment 2: Body language: verbal and non-verbal behavior interpretation, activity on non-verbal communication.

Experiment 3: Active listening. Active listening quiz.

Experiment 4: Feedback: How to give and receive feedback, Activity on feedback.

Experiment 5: Hidden date of communication: Feelings. Activity on how to handle feelings.

Experiment 6: Practical skills: assertiveness, activity on assertiveness, self-confidence, activity.

Experiment 7: In the world of teams: the team concept, element of teamwork. Team formation, effective team, exercise on team, Team players, activity.

Experiment 8: Discussions, decisions and presentations: Structured and un-structured group discussions. Activity on each.

Experiment 9: Adapting to Corporate life: exercise on grooming and dressing, getting ready for interview.

Experiment 10: Business Etiquette/Dining etiquette.

COMPUTER AIDED MANUFACTURING LAB (ME-1651)

Experiment 1: Study of CNC Lathe and prepare a Part programming using GM codes for a given part drawing and verify it on computer.

Experiment 2: Study of CNC Drilling and prepare a Part programming using GM codes for a given part drawing and verify it on computer.

Experiment 3: Study of CNC Milling and prepare a Part programming using GM codes for a given part drawing and verify it on computer.

Experiment 4: Prepare a Part programming Manuscript using GM codes for a given part drawing and verify it.

Experiment 5: Write a program for a given part drawing using "APT" language.

Whe

- Experiment 8:** Study of PMT CNC Lathe.
Experiment 9: Study of various types of Automatic Tool changers.
Experiment 10: Study of different components of robot.
Experiment 11: Programming on HMT Trainer Lathe.
Experiment 12: Programming on HMT milling machine.

MACHINE DESIGN LAB II (ME-1652)

- Experiment 1:** Development of algorithm and program for design of shaft, keys and coupling.
Experiment 2: Development of algorithm and program for design of Power screw/bolt nut.
Experiment 3: Development of algorithm and program for design of springs.
Experiment 4: Two dimensional computer drafting of single gear set with involute tooth profile in meshing condition: Knowledge of computer graphics facility on C/C+ development of algorithm.
Experiment 5: Development of algorithm and program for design of spur/spiral/helical gear set. Design problem of spur gear on solid works.
Experiment 6: Development of algorithm and program for design of bevel gear set. Design Problem of bevel gear on solid works.
Experiment 7: Development of algorithm and program for design of hydrodynamic bearing. Design problem of hydrodynamic bearing on solid works.
Experiment 8: Development of algorithm and program for selection design of ball bearing.
Experiment 9: Some case studies on Axiomatic Design of Suh.

MANUFACTURING TECHNOLOGY LAB II (ME-1653)

- Experiment 1:** Preparation of a SINGLE POINT CUTTING TOOL as per the given tool specification. Also write the process sheet for the same.
Experiment 2: To make a job as per drawing on the CAPSTAN LATHE. Write the process sheet and draw the sketches of the machine tool and tools used.
Experiment 3: To make a job as per drawing using RADIAL DRILLING MACHINE. Write the process sheet and draw the sketches of the machine tool and tools used.
Experiment 4: Study of Indexing Mechanism for Gear Cutting and to cut gear on a gear blank using Indexing Mechanism on HORIZONTAL MILLING MACHINE. Write the process sheet and draw the sketches of the machine tool and tools used.
Experiment 5: To make a slot as per drawing using VERTICAL MILLING MACHINE. Write the process sheet and draw the sketches of the machine tool and tools used.
Experiment 6: To make a job as per drawing using CYLINDRICAL GRINDING MACHINE. Write the process sheet and draw the Sketches of the machine tool and tools used.
Experiment 7: To make a job as per drawing using SURFACE GRINDING MACHINE. Write the process sheet and draw the Sketches of the machine tool and tools used.
Experiment 8: Study of SHAPER, PLANER and SLOTTER
Experiment 9: Study of MIG WELDING MACHINE and preparation of T-joint. Study the welding defects induced. Also draw the sketches of the tools used.
Experiment 10: Demonstration and study about CUTTING, DRILLING AND WELDING operation on LASER BEAM MACHINE
Experiment 11: Study of ELECTRICAL DISCHARGE MACHINE

THERMAL ENGINEERING LAB III (ME-1654)

- Experiment 1:** Study of Four Stroke and Two stroke Spark and Diesel Engine model.
Experiment 2: To draw Valve Timing Diagram of Diesel and Petrol Engine.
Experiment 3: To find out IP of the engine using Morse Test. on four-cylinder petrol engine
Experiment 4: To conduct a performance test of Multi cylinder Diesel engine.
Experiment 5: To conduct a performance test on four-cylinder petrol engine, to find out the efficiency of the engine and draw heat balance sheet.
Experiment 6: To know the A/F Ratio variation with load for a diesel engine.
Experiment 7: Heat release analysis of single cylinder SI engine using in-cylinder pressure data.
Experiment 8: Performance and emission test of a vehicle on a Chassis Dynamometer
Experiment 9: To conduct a performance test on a variable compression ratio engine with change in compression ratio
Experiment 10: To conduct a study of transmission system of both rear and front wheel drive vehicle
Experiment 11: To conduct a study of automatic transmission system
Experiment 12: To conduct a study of various steering systems
Experiment 13: To conduct a study of various suspension systems
Experiment 14: To conduct a study of chassis of a four wheel vehicle.

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UNIT 1: Refrigeration -Introduction, methods of refrigeration, Applications, Carnot refrigeration cycle, Unit of refrigeration capacity, Coefficient of Performance, Heat Pumps	5(L)
UNIT2: Vapour compression system -Analysis of ideal vapour compression cycle, Use of T-s and p-h charts, Effect of pressure changes, sub cooling of condensate and superheating of suction vapour on COP, Actual Vapour-Compression cycle, Cascade refrigeration systems	8(L)
UNIT 3: Vapour Absorption system -Comparison between absorption and compression systems, Water-Lithium Bromide and Ammonia – water absorption systems, Single-effect and double-effect systems.	4(L)
UNIT 4: Air refrigeration cycle :Brayton refrigeration cycle and its analysis, Aircraft refrigeration systems.	4(L)
UNIT 5: Refrigerants -Classification and nomenclature, Desirable properties of refrigerants, conventional and CFC free (ozone friendly) refrigerants.	3(L)
UNIT 6:Psychrometry -Psychrometric terms and definitions, Psychrometric processes, comfort chart.	7(L)
UNIT 7: Air-conditioning systems -Cooling and heating loads calculations, Apparatus Dew Point and By-pass factor of cooling coils, window, split and central air-conditioning systems.	6(L)

Text/Reference Books:

- Refrigeration and Air-conditioning by C.P.Arora, Tata McGraw-Hill
- Principles of refrigeration by Roy J Dossat, Prentice Hall
- Refrigeration and Air-conditioning by Manohar Prasad, New Age International
- Refrigerant Tables and Charts by Banwait&Laroiya ,Birla Publications.

ECONOMICS (HS-1701)

UNIT 1: Introduction to Economics; Nature and Scope of Economics, Significance, Branches of Economics, Micro and Macro, fundamental concepts. Objectives of a firm.	6(L)
UNIT2: Utility Analysis: cardinal and ordinal view, laws. Demand Analysis; Law of Demand, Exceptions to the law of Demand, Determinants of Demand. Elasticity of Demand- Price, Income, Cross and Advertising Elasticity; Uses of Elasticity of Demand for managerial decision making, measurement of Elasticity of Demand. Demand forecasting meaning, significance and methods.	8(L)
UNIT 3: Supply Analysis; Law of Supply, Supply Elasticity; Analysis and its uses for managerial decision making. Production concepts & analysis; Production function, single variable-law of variable proportion, two variable-Law of returns to scale. Cost concept and analysis, short-run and long-run cost curves and its managerial use.	8(L)
UNIT 4: Market Equilibrium and Average Revenue Concept. Market Structure: Perfect Competition, features, determination of price under perfect competition. Monopoly: Feature, pricing under monopoly, Price Discrimination. Monopolistic: Features, pricing under monopolistic competition, product differentiation. Oligopoly: Features, kinked demand curve, cartels, price leadership.	8(L)
UNIT 5 : Pricing Strategies; Price determination, full cost pricing, product line pricing, price skimming, penetration pricing.	4(L)
UNIT 6: Indian Economy: National Income; Concepts and various methods of its measurement, Inflation, types and causes, Business Cycle.	6(L)

Text/Reference Books:

- Damodaran Suma – Managerial Economics (Oxford 2006)
- Hirschey Mark – Economics for Managers (Thomson, India Edition, 2007)
- Dominick Salvatore - Managerial Economics (Oxford, 2007))
- Mithani D.M. - Principles of Economics (Himalaya Publishing House, 2005).
- Dwivedi D.N. - Managerial Economics (Vikas Publication, 7th Edition)

Professional Elective – I

OPTIMIZATION METHODS IN ENGINEERING (ME-1731)

UNIT 1: Introduction -Optimization Problem Formulation, Design Variables, Constraints, Objective Function, Variable Bounds, Engineering Optimization Problems, Optimization Algorithms.
UNIT 2: Single Variable Optimization Problems -Optimality Criterion, Bracketing Methods: Exhaustive Search Method, Bounding Phase Method.
UNIT 3: Region Elimination Methods -Interval Halving Method, Fibonacci Search Method, Golden Section Search Method.
UNIT 4: Point Estimation Method -Successive Quadratic Estimation Method.
UNIT 5: Gradient Based Methods -One of the followings-Newton-Raphson Method, Bisection Method, Secant Method, Cubic Search Method.
UNIT 6: Multivariable Optimization Algorithms -Optimality Criteria, Unidirectional Search, Direct Search Methods: Any two of the followings-Evolutionary optimization method, Simplex Search Method, Hooke-Jeeves pattern search method, Powell's Conjugate Direction Method.
UNIT 7: Gradient Based Methods -Cauchy's Steepest Descent Method. Newton's method, Marquardt's Method. Conjugate Gradient Method, Variable-metric Method.
UNIT 8: Constrained Optimization Algorithms, Kuhn Tucker Conditions, Transformation Methods -Penalty Function Method, Method of Multipliers. Sensitivity analysis
UNIT 9: Specialized Algorithms, Integer Programming -Penalty Function Method, Branch and Bound Method., Geometric Programming
UNIT 10: Non-Traditional Optimization Algorithms - Genetic Algorithms: Working Principle, Differences between Gas and traditional methods, GAs for constrained optimization. Other GA operators.
UNIT 11: Simulated Annealing -Analogy, Algorithm, Application.

DYNAMIC DESIGN OF MECHANICAL SYSTEMS (ME-1732)

UNIT 1: Introduction to modal testing -Overview of dynamic design and modal analysis. Use of MATLAB for solving vibration engineering problems. Basics of modal analysis and presentation and properties of FRF data for SDOF system, undamped multi-degrees-of-freedom systems(MDOF), proportional damping, hysteretic damping, viscous damping, characteristics and presentation of MDOF FRF data.

Boxe

UNIT 2: Mobility measurement techniques-Basic measurement system, structure preparation, excitation of the structure, transducers and amplifiers, analyzers, digital signal processing, use of different excitation types, calibration, mass cancellation.

UNIT 3: Modal parameter extraction methods-System identification techniques (SDOF and MDOF), Preliminary checks of FRF data, SDOF modal analysis – Peak amplitude, circle-fit method, inverse method, residuals, introduction to MDOF curve-fitting procedure – extension of SDOF method.

UNIT 4: Derivation of Mathematical models: Modal models, display of modal model, response models, spatial models, mobility skeletons and system models.

UNIT 5: Application: comparison of experiment and predication, correction or adjustment of models. Structural modifications and its optimization. Response predication and force determination. Application of modal analysis to real structures. Case studies.

Text/Reference Books:

- Modal Analysis: by Jimin He and Zhi-Fang Fu, 2001, Butterworth-Heinemann, Woburn, MA, USA.
- Modal testing; Theory, Practice and application, second edition, D J Ewins, research studies Press Ltd., Baldock Hertfordshire, England.
- Fundamental of mechanical Vibration, 1993, S grahm Kelly, McGraw-Hill Intl. Editions.
- Mechanical Vibration, 1990, S S Rao, Addition-Wesley publishing company.

ADVANCED MANUFACTURING PROCESSES (ME-1734)

UNIT 1: Introduction- Need and classification of unconventional manufacturing processes, brief overview.

UNIT 2: Unconventional Machining Processes-Process Principle, Analysis and Applications of Electric Discharge Machining, Laser Beam Machining, Electron Beam Machining, Ion Beam Machining, Plasma Beam Machining, Ultra-Sonic Machining, Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ice Jet Machining, Electrochemical Machining, Chemical Machining, Bio Chemical Machining. Hybrid Machining Processes: Electrochemical Discharge Machining, Electro-Chemical Abrasive Grinding, Electro Discharge Abrasive Grinding.

UNIT 3: Unconventional Finishing Processes- Need, classification, process principle and applications of Abrasive Flow Finishing, Magnetic Abrasive Flow Finishing, Magnetic Abrasive Finishing, Electrogel Magnetic Abrasive Finishing, Magneto-Rheological Finishing.

UNIT 4: Unconventional Welding Processes-Laser Beam Welding, Electron Beam Welding, Ultra-Sonic Welding, Plasma Arc Welding, Explosive Welding, Under Water Welding, Welding in Space, Micro Welding Processes.

UNIT 5: Generative Manufacturing Processes- Concept of generative manufacturing, need and Classification, Process principle and Applications of Selective Laser Sintering, Fused Deposition Manufacturing, SterioLithography, Ballistic Particle Manufacturing, Three Dimensional Printing, Laminated Object Manufacturing.

UNIT 6: Unconventional Forming Processes-Explosive forming, Electro hydraulic forming, Electro- magnetic forming, Laser Bending, Powder rolling, Spray rolling, Hydro forming, Hydrostatic and Powder extrusion, powder, rotary and isothermal forming.

KNOWLEDGE MANAGEMENT (ME-1735)

UNIT 1: Define Data, Information, and knowledge. Study the different methods for conversion of data into information. Difference between data, information and knowledge. Different methods for conversion of data into information. Types of knowledge. Define knowledge management. Knowledge management framework and value propositions for knowledge management implementation. Knowledge management Enablers for implementation, knowledge management barriers for implementation. Knowledge management processes and knowledge management technologies. Selection criteria for knowledge management team members. Knowledge management is an essential survival imperative. Knowledge sharing enablers and knowledge sharing barriers. Categorization of knowledge sharing barriers: group/individual, organizational, and technological. Application of ISM methodology, Similarity coefficient methodology, AHP methodology for the categorization, similarity and quantify. the critical variables.

REFRIGERATION AND AIR CONDITIONING (ME-1736)

UNIT 1: Refrigeration-Introduction to refrigeration system: Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration capacity, C.O.P., applications. Air refrigeration cycle, Bell Coleman air refrigeration cycle, Brayton refrigeration cycle, optimum C.O.P. & pressure ratio, air craft refrigeration system, classification of air craft refrigeration system, Actual power for refrigeration system, Dry Air Rated Temperature [DART]

UNIT 2: Refrigerants-Classification, Nomenclature, Desirable properties of refrigerants, common refrigerants secondary refrigerants and CFC free refrigerants.

UNIT 3: Vapor Compression System- Single stage system, Analysis of vapor compression cycle, Effect of pressure change on C.O.P. use of T-S and p-h chart, Effect of subcooling of condensate on C.O.P. and capacity, effect of super heating of vapor-compression constructional details of Refrigerator and Air conditioners. Multi stage compression.

UNIT 4: Vapor-Absorption System-Working Principle of continuous Absorption System, compression between Absorption & compression system. Theory of mixtures, Temp-concentration Diagram, Enthalpy concentration diagram. Adiabatic mixing of two systems, Lithium-Bromide water-vapor absorption system. Working principle, compression with Ammonia-water system.

UNIT 5: Air Conditioning-Introduction to air-conditioning, psychrometric terms, Definitions, Adiabatic saturation & Thermodynamic, web-bulb temperature, psychrometers use of psychrometric chart, Air conditioning requirement for comfort and industrial processes, comfort chart & comfort zones, cooling towers, cooling & heating load calculations.

UNIT 6: Refrigeration Equipment & Application-Expansion device, Duct design. Food preservation cold storage, refrigerators, freezers, ice plant, water coolers, thermal analysis for human body. Automotive air conditioning-brief overview. Introduction to solar radiation distributions. Empirical methods to evaluate heat transfer through walls & roofs, infiltration, passive heating & cooling of buildings.

QUALITY ENGINEERING (ME-1737)

UNIT 1: Introduction-Concept of quality, basic statistical concepts, Control of accuracy and precision, Process capability, standardization and interchangeability; Statistical Quality Control: Objectives, Applications, organization, cost aspects, theory of statistical tolerance.

UNIT 2: Control Charts-General theory of Control Charts, Group Control Charts. Shewhart control chart for process control; Control Charts for variables such as X, R Control Charts for charts for attributes such as c and p charts; Acceptance control chart;

variables, Advantages limitations. Sampling plans using different Criteria. Comparison of various types of sampling plans. Recurring Inspection.

UNIT 4: Reliability, Availability and Maintainability-Introduction to reliability, Bath tub curve, Series and Parallel system; MTBF, Evaluation of Availability and Maintainability.

UNIT 5: Quality Design-Design of experiment concept, System, Parameter and Tolerance Design; Concept of Robust Design, Taguchi Concept-Orthogonal Arrays and S/N ratio.

MODELING AND SIMULATION IN ENGINEERING (ME-1739)

UNIT 1: Fundamental aspect of modeling-Technical and Commercial aspects, types of modeling- Analytical, experimental, mechanistic, numerical, AI based and stochastic. Model testing, Principles of simulation, Discrete event simulation. Applications in design and manufacturing.

PRESSURE VESSEL DESIGN (ME-1739)

UNIT 1: Basic principles-Elastic analysis of shells of revolution, membrane solutions, spherical and cylindrical shells, Junctions of shells of different geometry, Limit analysis, Shakedown.

UNIT 2: Pressure vessel branches- Radial nozzle in spherical shell, stress concentration factors due to combined loadings, design methods to reduce SCF, nonradial nozzles in spherical shells, Junction analysis of radial and non-radial nozzles in cylindrical shells.

UNIT 3: Pressure vessel ends-different design forms.

UNIT 4: Flanges-Stress analysis and design methods.

UNIT 5: Local loading and local attachments-Supports design. Creep and fatigue in thin pressure vessels and its components. Pressure vessel design codes.

UNIT 6: Thickwall design-monoblock cylinders and spheres, multiplayer constructions. Pre-stressing of thick shells, shrink fit construction, wire and ribbon wound cylinders, Plastic radial expansion autofretting. Thermal stress, creep and stress rupture; Dynamic and fatigue behaviour.

UNIT 7: Case studies-Vessels for special purposes. Computer aided design of pressure vessels

Text/Reference Books:

- Harvey J F, 'Pressure vessel design' CBS publication
- Brownell. L. E & Young. E. D, 'Process equipment design', Wiley Eastern Ltd., India
- ASME Pressure Vessel and Boiler code, Section VIII Div 1 & 2, 2003
- American standard code for pressure piping , B 31.1
- Henry H Bednar, Pressure vessel Design Hand book, CBS publishers and distributors
- Stanley M Wales, Chemical Process equipment, selection and design, Butterworths, series in Chemical Engineering, 1988
- William.j.,Bees, "Approximate methods in the Design and Analysis of pressure vessels and piping", ASME Pressure vessels and piping conference, 1997

Professional Elective-II

FINITE ELEMENT METHODS IN ENGINEERING (ME-1741)

UNIT 1: Approaches of FEM-Discrete, Variational and Weighted Residual; Direct Problems- Spring, Hydraulic Network; Resistance Network and Truss Systems; 1-D Field and Beam Bending Problems; 2-D and Axisymmetric Field and Stress Problems; Plate Bending; 3-D Stress Analysis; Solutions of Unsteady Problems related to Stress Analysis, Heat Conduction, Fluid flow and Vibration. Solutions of Plane Stress, Plane Strain and Axisymmetric Plasticity Problems.

FUELS COMBUSTION AND POLLUTION (ME-1742)

Unit 1: Chemistry of Combustion-Combustion and its Chemistry, Heat, Types of Fuel, Molecularity and order of reaction, Rates of reaction, Arrhenius equation. Conservation equations of mass, momentum, energy and species for a multicomponent system.

Unit 2: Combustion of gaseous fuel jets-Premixed and diffusion flames, Laminar and turbulent flames. Concepts of kinetically controlled and diffusion controlled reactions, Flammability limits, Ignition, Burning velocity, Flame structure and Stability for laminar flames.

Unit 3: Liquid Fuel combustion-Atomization of liquid, Various atomizers and their performances Evaporation of droplets in high temperature gas streams, Simple model of droplet burning, Physical and mathematical models of spray flames.

Unit 4: Combustion of Solids-Description of carbon sphere combustion, Diffusional theory of carbon combustion of pulverized coal.

Unit 5: Pollution-Pollutant formation in various combustion processes and their controlling measures.

Text/Reference Books:

- An Introduction to Combustion: Concepts and Applications by *Stephen R. Turns*
- Combustion Engineering by G. L. Borman, K. W. Ragland

ROBOTICS (ME-1743)

Unit 1: Introduction-Past, Present & Future; Robot Terminology; Applications, Components and Subsystems; Classification of Robot, End Effectors, Different types of grippers and design concepts.

Unit 2: Robot Kinematics-Object location; Homogenous, Transformations, Direct and Inverse Kinematics, Manipulator motion,

Unit 3: Robot Drives, Actuators and Control-Drive systems Hydraulic, Pneumatic and Electrical : DC Motor, Stepper Motor, Robot Motion and Path control, controller.

Unit 4: Sensors and Perception-Types of sensors, vision system. Computer Interfaces.

ADVANCED WELDING TECHNOLOGY (ME-1744)

Unit 1: Introduction-A review of various metal joining techniques such as welding, brazing, soldering and adhesive bonding, welding compared with other processes of fabrication. Classification of welding processes. Application of welding processes.

Unit 2: Fusion Welding-Mechanism of arc initiation and maintenance, Temperature distribution. Techniques, scope and limitations of manual metal arc. TIG, MIG, submerged arc. Electroslag welding. Plasma Arc and Electro gas welding. Various gas welding

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applications. Solid state welding processes viz. Friction, Diffusion, cold pressure process and their applications.

Unit 4: Oxygen cutting Plasma Arc cutting-laser cutting processes etc.

Unit 5: Brazing, soldering and adhesive bonding-Scope and application.

Unit 6: Welding defects and remedies-Weld cracking and prevention. Testing and inspection of welds.

RELIABILITY ENGINEERING (ME-1745)

Unit 1: Elements of probability theory-Elements of statistical theory. Some general stochastic processes. Statistical failure models. System reliability. reliability improvement. Maintainability and availability. fault tree analysis, Failure mode effect analysis. Reliability physics models.

Unit 2: Optimization techniques for systems reliability with redundancy. Heuristic methods applied to optimal system reliability. Dynamic programming applied to optimal system reliability. Discrete maximum principle applied to optimal; system reliability. Sequential unconstrained minimization techniques. Generalised reduced gradient method. Method of Lagrangian multiplier and Kuhn-Tucker conditions applied to optimal system reliability. Generalized Lagrangian function. Geometric and integer programming methods applied to optimal system reliability. Other methods to system reliability optimization problems. Determination of component reliability and redundancy for optimum system reliability.

Unit 3: Point and interval estimation procedure for life time distributions. Testing reliability hypotheses. Bayes methods in reliability. Design and analysis of life test experiments. Accelerated life testing. Non-parametric methods.

Unit 4: Introduction to engineering design-design morphology - production process & material selection. Concept of load, strength optimization and safety. Reliability principles, product life cycle, design and development, risk reliability, product liability. Failure analysis techniques, Case histories of failures. Quality Control. Design for maintenance. Ergonomics in design, Probabilistic concept in design. Cost evaluation and economic decision making. Case studies of reliability design process in allied engineering systems (Electrical, Aeronautical, Mechanical, Civil etc.)

Unit 5: Detail Part Consideration :- Component reliability, derating, failure analysis of passive components and integrated circuits, Accelerated testing, Electrostatic Discharge, VLSI reliability issues.

NON-CONVENTIONAL ENERGY RESOURCES (ME-1746)

Unit 1: Introduction-the energy crisis – causes and options, renewable and non-renewable forms of energy and their characteristics, availability of renewable energy and land area requirements.

Unit 2: Biomass energy-thermo-chemical and biological conversion to solid, liquid and gaseous fuels; production of bioethanol, biogas and producer gas.

Unit 3: Ocean, wave and tidal energy-Ocean thermal energy conversion – closed and open cycles and their limitations, Wave energy and its conversion through oscillating water column, Tidal energy – nature of the tides and tidal barrages for power generation.

Unit 4: Wind energy-power in the wind, site selection, maximum power coefficient, wind turbine types – horizontal axis and vertical axis machines, performance of wind machines.

Unit 5: Geothermal energy-hot aquifers and hot dry rock systems.

Unit 6: Solar energy-(i) solar radiation at the earth's surface, flat-plate and concentrating collectors, solar ponds and energy storage, solar thermal power generation. (ii) Solar photovoltaic power generation: monocrystalline, polycrystalline and amorphous silicon modules and their production technology.

CAD OF THERMAL SYSTEMS (ME-1747)

Unit 1: Study of the design aspects. Fluid flow and heat transfer characteristics and materials requirements of at least two of the following types of heat exchange equipment: Liquid-to-liquid. Liquid -to-gas and gas-to-gas heat exchangers. Cooling tower, Familiarity with the use of the design related international/national and other codes. Preparation of necessary computer programs for designing the thermal system. Learning of the techniques for presenting design features of the thermal equipment.

ADVANCED AUTOMOBILE ENGINEERING (ME-1748)

Unit 1: Introduction and overview –Beginnings Growth and refinement. 3(L)

Unit 2: Prime movers–types-advantages & limitations of different fuel based prime movers - alternative technologies. Comparison on Well to wheel basis. 4(L)

Unit 3: Types of suspension & Drive- front mounted engines- rear mounted drive- advantages and limitations, rear and mid mounted engines drive, front wheel drive- types of design- advantages and disadvantages, four wheel drive advantages and disadvantages 6(L)

Unit 4: Automotive vehicle safety, basic concepts of vehicle safety, fail safe, alternative designs, safety factors, designs for uncertainty, crash testing 4(L)

Unit 5: Introduction to Traffic Engineering -Highway Engineering- geometric design of highways – Accident causes. 4(L)

Unit 6: Tyres & Wheels requirements, Wheel travel & Elastokinematics 6(L)

Unit 7: Steering- systems -types-limitations. Hydraulic, electro hydraulic and electrical power steering, steering column, steering damper. 4(L)

Unit 8: Springing- comfort requirements- weights and axle loads, Shock absorbers, spring damper units 4(L)

Unit 9: Chassis – Vehicle and body centre of gravity and handling properties, axle weight and axle centre of gravity, body weight and body centre of gravity, Braking behavior –stability, anti dive control, traction behavior. 6(L)

Unit 10: Future -vehicle safety, techno legal issues- ethics, testing of automotive components, failure investigations- (to be continued with topic. 4(L)

Text/Reference Books:

- The Automotive Chassis by J. Reimpell, H Stoll- SAE International
- The Motor Vehicle: by- Newton and Steed
- Automotive vehicle safety – George A Peters & Barbara J Peters
- Automotive Engineering Fundamentals – Richard Stone and J K Ball
- Chassis design – Principles and Analysis
- Electric Vehicle Technology Explained – James Larminie, John Lowry
- Highway Design & Traffic Safety Engineering Handbook Ruediger Lamm

Handwritten signature

Various trade magazines published nationally and internationally.

A watchful eye on news paper reports on automobile related accidents for the purpose of analyzing the cause of accident such that the accident can be reduced in the society.

Visit to automobile repair shops for the feel of Engineering.

Motor vehicle acts and rules being enforced from time to time available from law book stores.

Production catalogue from various automobile manufactures and if possible the service manual of the vehicles.

During the course students are required to work on projects allotted to them.

CONCURRENT ENGINEERING (ME-1749)

Unit 1: Meaning and Purpose of Concurrent Engineering, Techniques of Concurrent Engineering - Quality Function Deployment (QFD), Design for manufacture (DFM), Design for assembly (DFA), Taguchi method for Robust design (TMRD), Failure mode and effect analysis (FMEA), Design for reliability, maintainability and serviceability, Implementation

NOISE AND VIBRATION (ME-1750)

UNIT 1: Noise-Random aspects of noise, traffic noise community noise, automobile noise, jet noise, aircraft noise. Sonic bang, acoustic fatigue. Industrial noise, noise in piping system. Noise in machines and components of reciprocating and rotating machines.

UNIT 2: Noise control systems-types and design of exhaust mufflers, sound absorbing materials.

UNIT 3: Noise measurement and instrumentation-Effect of noise on human beings.

UNIT 4: Vibration-Systems with one degree of freedom, Free and forced vibration, torsional vibration. Analysis by Rayleigh's method. Stodola method and iterative method of Holtzer. Analysis and application of forced vibration in steady state as well as transient state, self excited vibrations. Free vibrations of systems with several degrees of freedom. Free vibration of elastic bodies, Free longitudinal vibrations of Prismatic bar, orthogonality principle.

Open Electives

ENERGY MANAGEMENT

Unit 1: Introduction-the energy-economy link, patterns of energy use in developing countries, the electricity-economy link for developing economies, options to overcome the energy crisis, characteristics of conventional and non-conventional energy resources. Conventional energy resources and their utilization; thermal, nuclear and hydro-electric power plants, use of diesel engines and gas turbines for power generation, combined cycles for efficient power generation.

Unit 2: Non-conventional energy resources and their utilization-solar, geothermal, wind, wave, biomass and ocean-thermal energy conversion and their limitations. Energy storage techniques.

Unit 3: Energy conservation-energy auditing, process energy and gross energy requirements, energy recovery: insulation, heat recovery heat exchangers, heat-pumps, combined heat and power plants (cogeneration), efficient lighting and energy conservation in buildings.

Unit 4: Environmental aspects of energy resource utilization-combustion generated air pollution, global warming, acid rain, fly ash disposal, radioactive pollution and nuclear waste disposal.

NON-CONVENTIONAL ENERGY RESOURCES

Unit 1: Introduction-the energy crisis – causes and options, renewable and non-renewable forms of energy and their characteristics, availability of renewable energy and land area requirements.

Unit 2: Biomass energy-thermo-chemical and biological conversion to solid, liquid and gaseous fuels; production of bioethanol, biogas and producer gas.

Unit 3: Ocean, wave and tidal energy-Ocean thermal energy conversion – closed and open cycles and their limitations, Wave energy and its conversion through oscillating water column, Tidal energy – nature of the tides and tidal barrages for power generation.

Unit 4: Wind energy-power in the wind, site selection, maximum power coefficient, wind turbine types – horizontal axis and vertical axis machines, performance of wind machines.

Unit 5: Geothermal energy-hot aquifers and hot dry rock systems.

Unit 6: Solar energy-(i) solar radiation at the earth's surface, flat-plate and concentrating collectors, solar ponds and energy storage, solar thermal power generation.(ii) Solar photovoltaic power generation: monocrystalline, polycrystalline and amorphous silicon modules and their production technology.

OPERATIONS RESEARCH

Unit 1: Introduction-History of operations research. Nature & Scope of Operations Research. Allocation, assignment and transportation models, construction and Solution of these models.

Unit 2: Linear Programming-Introduction, Mathematical formulation of the problem. Graphical solution methods. Mathematical solution of linear programming problem, Slack, and surplus variables. Matrix formulation of General linear Programming Problem.

Unit 3: The Simplex Method-Fundamental properties of solution corroboration of extreme points. Simplex algorithm, computational procedures. Artificial variables. Two phase simplex method. Formulation of linear Programming Problems and its solution by simplex method. Unrestricted variables, problems of degeneracy. Principle of duality in Simplex method. Formation of dual with mixed type of constraints. Solution of primal and dual (solution of dual contains solution of Primal also) Sensitivity analysis.

Unit 4: Integer Programming-Formulation and solution of Integer Programming problem.

Unit 5: Game Theory-Introduction. Two persons zero sum games. The Maxxmini and Minimax principles.

Unit 6: Graphical Solution-Reduction of Game problem to L.P.P. The transportation problem Matrix form of transportation problem, initial basic feasible solution. Selecting the entering variable. Selecting the leaving variable. Transportation algorithm. Degeneracy in transportation problem. Inventory Control.

MAJOR PROJECT (STAGE 1) (ME-1791)

- Experiment 1:** Study of vapour compression refrigeration tutor
- Experiment 2:** Study and performance of air refrigeration system
- Experiment 3:** Study of air conditioner tutor and window air conditioner.
- Experiment 4:** Study of vapour absorption system
- Experiment 5:** Study and performance of desert cooler
- Experiment 6:** Study and performance of vortex tube refrigerator tutor
- Experiment 7:** Study and performance of steam jet refrigeration system

ADVANCED MANUFACTURING LAB (1755)

- Experiment 1:** Determination of Material Removal Rate (MRR) during Sinking-Electro-Discharge Machining (Sinking-EDM).
- Experiment 2:** Determination of material Removal Rate (MRR) during Drilling-Electro-Discharge Machining (Drilling-EDM).
- Experiment 3:** Determination of material Removal Rate (MRR) during Electro-Discharge Diamond Grinding (EDDG).
- Experiment 4:** Cutting of curved profile as per drawing on Mild Steel Sheet using Nd-YAG Pulsed Laser Beam Machine.
- Experiment 5:** Drilling of holes on Mild Steel Sheet using Nd-YAG Pulsed Laser Beam Machine.
- Experiment 6:** Welding of Mild Steel Sheets using Nd-YAG Pulsed Laser Beam Machine.
- Experiment 7:** Study of Fused Deposition Modeling (FDM) Rapid Prototyping Machine



PRODUCT DESIGN AND DEVELOPMENT (ME-1801)

UNIT 1: Introduction-Introduction to product design, Significance of product design, product design and development process, sequential Engineering design method, the challenges of product development,

Development Process and Organizations-Generic Development Process, Concept Development, Adapting the generic PD process flows, AMF development Process, Product Development Organizations, The AMF Organization.

UNIT 2: Product Planning and Identifying Customer Needs-Product Planning process, Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs, review of the process.

Product Specifications:-Establish target specifications, setting final specifications,

UNIT 3: Concept Generation-Activities of concept generation, clarifying problem, search both internally and externally, explore the output, **Concept Selection**:-Overview, concept screening and concept scoring, methods of selection.

Concept Testing-Elements of testing: qualitative and quantitative methods including survey, measurement of customers' response.

Product Architecture-Modular and Integral architecture, implications, establishing the architecture, Delayed differentiation, Platform Planning.

Industrial Design-Assessing need for industrial design, Impact of industrial Design, industrial design process, management of industrial design process, assessing quality of industrial design.

UNIT 4: Embodiment Design: Design for Manufacturing, prototyping, Robust Design

Intellectual Property and Environmental Guidelines-Intellectual Property: Elements and outline, patenting procedures, claim procedure, Environmental regulations from government, ISO system.

Text books and references:

- Ulrich K. T, and Eppinger S. D, Product Design and Development, Tata McGraw Hill
- Otto K, and Wood K, Product Design, Pearson
- Engineering of creativity: introduction to TRIZ methodology of inventive Problem Solving, By Semyon D. Savransky, CRC Press.

ENERGY CONSERVATION (ME-1802)

UNIT 1: Introduction – the energy crisis, options to ameliorate the energy crisis and their impact, the energy conservation option, energy auditing – scope and purpose, process energy and gross energy requirements. 6(L)

UNIT 2: Efficient energy conversion, combined cycles, combined heat and power plants, combined cooling and power plants (Goswami cycle), tri-generation and multi-generation systems. 9(L)

UNIT3: Energy recovery in refrigeration and air conditioning systems, desiccant cooling, heat pumps; mechanical vapour recompression systems applied to evaporation, distillation and drying processes; energy efficiency through cascade refrigeration with V-C and V-A systems; double-effect V-A systems for COP improvement. 9(L)

UNIT 4: Energy conservation in buildings, thermal load reduction through insulation and solar passive techniques. 6(L)

UNIT 5: Case studies from industrial and commercial sectors. 6(L)

Text/Reference Books:

- "Energy Efficiency" by Eastop and Croft; Longman Scientific and Technical
- "Managing energy in commerce industry" by Gordon A. Payne; Butterworth
- www.bee-india.nic.in (Bureau of Energy Efficiency, Ministry of Power, GOI.
- "Energy: Management, Supply and Conservation" by Clive Beggs, Butterworth-Heinemann

PROFESSIONAL ELECTIVE – III

DESIGN AGAINST FATIGUE AND FRACTURE (ME-1831)

Fracture of Cracked Members

Unit 1: Introduction-cracks as stress raisers, behavior at crack tips in real materials, effects of cracks on strength, effect of cracks on brittle versus ductile behaviors.

Unit 2: Mathematics concepts of-strain energy release rate, G_c , stress intensity factor K .

Unit 3: Application of k to design & analysis-mathematical form used to express K , cases of special interest for practical applications, discussion.

Unit 4: Fracture toughness values and trends-trends of KIC with material, effects of temperature and loading rate, micro structural influences on KIC.

Unit 5: Plastic zone size and plasticity limitation on LEFM-plastic zone size for plane stress, plastic zone size for plane strain, plasticity limitation on LEFM.

Unit 6: Standard test methods for-fracture toughness testing, effect of thickness on fracture behavior

OPERATIONS RESEARCH (ME-1832)

Linear programming, graphical and simplex method, Transportation and assignment model

Unit 1: Inventory control-ABC analysis, EOQ model, Inventory functions costs, Classifications – deterministic and probabilistic models, Quantity discount model, safety stock, Inventory control system Single server queuing model, Network flow model, Constraint optimization and Lagrange multipliers, Dynamic programming, Simulation

Unit 2: PERT and CPM-Time cost trade off, Resource leveling

Unit 3: Game Theory-Introduction to Evolutionary optimisation methods

DMO

Unit 1: The energy crisis: causes and options, renewable and non-renewable forms of energy and their characteristics, solar energy option – availability and land area requirements. Solar radiation outside the earth's atmosphere and at the earth's surface, instruments for measuring solar radiation, solar radiation geometry, basic earth-sun angles, flux on tilted surfaces.

Unit 2: Liquid flat-plate collectors-design and performance parameters, solar air heaters, concentrating collectors, solar ponds and energy storage.

Unit 3: Solar thermal power generation-low, medium and high temperature cycles, solar cooling, drying and desalination, solar air and water heating, solar passive architecture.

Unit 4: Solar photovoltaic power generation-monocrystalline, polycrystalline and amorphous cells, Fabrication and performance of SPV modules.

Unit 5: Indirect methods of solar energy utilization-biomass, wind, wave and ocean thermal energy conversion technologies. Economic considerations.

MECHATRONICS (ME-1834)

Unit 1: Fundamentals of Mechatronics, definitions and Concepts; Conventional vs. Mechatronics Systems; Need of Mechatronics in Mechanical Engineering; Sensors and Transducers with Special reference to Mechatronics. Signals System and actuating devices; real time interfacing. Applications of Mechatronics in Manufacturing and Automation Case Studies.

METAL FORMING (ME-1837)

Fundamentals of Elasticity, Plasticity and Viscoplasticity, Stress and strain invariant

Unit 1: Elasticity-State of stress and strain, stress-strain relations, strain-displacement relations.

Unit 2: Plasticity and Viscoplasticity-Yield criterion, effective stress and strain, state of plastic strain, Plastic strain rate, Flow rule, Effective strain rate, plastic anisotropy and viscoplasticity (determination of load and power) concept of solid and flow formulations.

Analysis of Deformation Processes using SSM, UBM & SLM

Unit 3: Plain strain Problems-Drawing and Extrusion of sheet, Rolling and forging of strips.

Unit 4: Axisymmetric Problems-Drawing and Extrusion of bar and tube, forging of solid and Hollow disc.

Unit 5: Sheet metal problems-Axisymmetric deep drawing and stretching.

COMPUTER-INTEGRATED MANUFACTURING (ME-1840)

Unit 1: Fundamentals of Automation in Manufacturing Systems-Manufacturing Systems: Concept Objectives, Types and Trends; Concepts of Mechanization, Automation and Integration

Unit 2: Functions and Components of CIM System-Concept of CAD/CAM and CIMS

Unit 3: Software Technology for CIM System-Business Database System: File processing, Data Processing and Database Design, File Organization and Relational Analysis; Decision Support System, Personal/Distributed Computing and Local Area Network

Unit 4: Group Technology and Cellular Manufacturing-Concept of Group Technology and its Application, classification and Coding Techniques; Clustering Techniques and Cellular Manufacturing

Unit 5: Planning and Scheduling Functions in CIM System-Aggregate Production Planning (APP), Master Production Schedule (MPS), Material Requirement Planning (MRP), Capacity Requirement Planning (CRP), Manufacturing Resource Planning (MRP-II), Just-In-time Production Systems and Concept of Enterprise Resource Planning (ERP).

Unit 6: Computer-Aided Process Planning-Approaches – Variant and Generative, Feature Classification and Recognition; Process Classifications and Selections, Machines and Tool Selection, Setting Process Parameters, Process Sheet Documentation

Unit 7: Automated Material Handling Systems-Industrial Robots, Conveyors, AGVs, Automatic Storage and Retrieval Systems

Unit 8: Advanced Manufacturing Systems-Lean Manufacturing systems, Agile Manufacturing systems, Reconfigurable Manufacturing Systems, Holonic Manufacturing Systems and Agent-Based Manufacturing Systems

Text/Reference Books:

- Nanua Singh, 1995, Systems Approach to Computer Integrated Design and manufacturing, John Wiley & Sons.
- James A. Rehg and Henry W. Kraebber, 2005. *Computer-Integrated Manufacturing*. Second Edition, Pearson Education (Singapore) private Ltd., Delhi.
- Mikell P. Groover, 2005. *Automation, Production Systems and Computer-Integrated Manufacturing*. Second Edition, Pearson Education (Singapore) private Ltd., Delhi.
- Andrew Kusiak, 1990. *Intelligent Manufacturing Systems*, Englewood Cliffs, New Jersey: Prentice Hall.

PROFESSIONAL ELECTIVE – IV

PRECISION ENGINEERING (ME-1842)

History, Basic concepts, Dynamic characteristics of device Elements like bearings, locks and stops, coupling clutches, energy storing elements etc. Gear, Wedge, Screw and linkage mechanism Instruments for displacement, velocity acceleration, force and torque. Precision systems like video discs and drives, laser printer etc. Design considerations for environments cooling electronic equipment. Systematic approach for design.

TOTAL QUALITY MANAGEMENT (ME-1844)

Concept of quality, quality control and quality management, Science of quality, human resources and quality, Quality organization and management: Quality manual, quality cost, quality related tasks, Quality information system: Planning, hardware-software, Statistical process control and quality deployment techniques, Controlling quality through measurement and through counting, Quality system and I.S.O. 9000 series, Quality assurance, Reports on quality, quality audit, quality training, Newer quality management approaches, Quality tools.

RAPID PROTOTYPING (ME-1845)

Unit 1: Introduction-Phases of Prototyping. Fundamentals of R.P. Classification of R.P. Processes.

Unit 2: Rapid Prototyping Process-Automated Processes, Difference between Additive and Subtractive Processes, Process Chain, steps involved in R.P.

SUPPLY CHAIN MANAGEMENT (ME-1846)

Unit 1: Introduction to Logistics and Supply Chain Management, Concepts, Drivers and obstacles, Planning Demand and supply in a supply chain-Demand forecasting, Aggregate Planning, Management of Inventory in global supply Chain, Role of Information Technology in supply chain. e-Business and the supply chain, Factors influencing logistics and decision, Bench making and performance measurement.

TOOL DESIGN (ME-1848)

Unit 1: Broad Classification-of Tools-Cutting tools, Dies, Holding and Measuring tools

Unit 2: Design of Cutting Tools-Single Point and multi-point cutting tools.

Unit 3: Single Point Cutting Tools-Classification, Nomenclature, geometry, design of single point tools for lathes, shapers, planers etc. Chip breakers and their design.

Unit 4: Multipoint Cutting Tools-Classification and specification, nomenclature, Design of drills, milling cutters, broaches, taps etc.

Unit 5: Design of Form Tools-Flat and circular form tools, their design and application.

Unit 6: Design of Dies-Classification of dies, Design of Dies for Bulk metal Deformation-Wire Drawing, Extrusion, Forging and Rolling; Design of Dies for Sheet metal: Blanking and Piercing, Bending and Deep-drawing; Design of Dies used for Casting and Molding, Powder Metallurgy die design;

Unit 7: Design of Jigs and Fixtures-Classification of Jigs and Fixtures, Fundamental Principles of design of Jigs and Fixtures, Location and Clamping in Jigs and fixtures, Simple design for drilling Jigs, Milling fixtures etc. Indexing Jigs and fixtures.

Unit 8: Design of limit Gauges

Energy Management (ME-1850)

Unit 1: Introduction, energy crisis - causes and options, renewable and non-renewable forms of energy and their characteristics. **6(L)**

Unit 2: The energy-economy link, patterns of energy use in developed and developing countries, the electricity-economy link for developing economies. **6(L)**

Unit 3: Environmental aspects of energy resource utilization, combustion generated air pollution, global warming due to (a) green house effect (b) use of non-equilibrium energy sources i.e. nuclear and fossil fuels, acid rain, fly ash disposal, radioactive pollution and nuclear waste disposal. **6(L)**

Unit 4: Energy conservation, Energy auditing, process energy and gross energy requirements, energy recovery: insulation, heat recovery: heat pumps, combined heat and power plants (cogeneration and tri-generation systems), Solar Passive architecture and solar water heating. **12(L)**

Unit 5: Sustainable energy supply options, biofuels and solar photovoltaic power generation. **6(L)**

Unit 6: Case studies in energy management. **4(L)**

Text/Reference Books:

- Energy for a sustainable world, by Goldemberg et al, Wiley Eastern.
- Energy efficiency, by Eastop and Croft, Longman Scientific and Technical.
- www.bee-india.nic.in, Bureau of energy efficiency, Ministry of power, Govt. of India.
- Solar Energy, by Sukhatme, Tata McGraw Hill.

Open Electives

ENERGY MANAGEMENT

Unit 1: Introduction-the energy-economy link, patterns of energy use in developing countries, the electricity-economy link for developing economies, options to overcome the energy crisis, characteristics of conventional and non-conventional energy resources. Conventional energy resources and their utilization; thermal, nuclear and hydro-electric power plants, use of diesel engines and gas turbines for power generation, combined cycles for efficient power generation.

Unit 2: Non-conventional energy resources and their utilization-solar, geothermal, wind, wave, biomass and ocean-thermal energy conversion and their limitations. Energy storage techniques.

Unit 3: Energy conservation-energy auditing, process energy and gross energy requirements, energy recovery: insulation, heat recovery heat exchangers, heat-pumps, combined heat and power plants (cogeneration), efficient lighting and energy conservation in buildings.

Unit 4: Environmental aspects of energy resource utilization-combustion generated air pollution, global warming, acid rain, fly ash disposal, radioactive pollution and nuclear waste disposal.

NON-CONVENTIONAL ENERGY RESOURCES

Unit 1: Introduction-the energy crisis – causes and options, renewable and non-renewable forms of energy and their characteristics, availability of renewable energy and land area requirements.

Unit 2: Biomass energy-thermo-chemical and biological conversion to solid, liquid and gaseous fuels; production of bioethanol, biogas and producer gas.

Unit 3: Ocean, wave and tidal energy-Ocean thermal energy conversion – closed and open cycles and their limitations, Wave energy and its conversion through oscillating water column, Tidal energy – nature of the tides and tidal barrages for power generation.

Unit 4: Wind energy-power in the wind, site selection, maximum power coefficient, wind turbine types – horizontal axis and vertical axis machines, performance of wind machines.

Unit 5: Geothermal energy-hot aquifers and hot dry rock systems.

Unit 6: Solar energy-(i) solar radiation at the earth's surface, flat-plate and concentrating collectors, solar ponds and energy storage, solar thermal power generation.(ii) Solar photovoltaic power generation: monocrystalline, polycrystalline and amorphous silicon modules and their production technology.

OPERATIONS RESEARCH

Unit 1: Introduction-History of operations research. Nature & Scope of Operations Research. Allocation, assignment and transportation models, construction and Solution of these models.

Unit 2: Linear Programming-Introduction, Mathematical formulation of the problem. Graphical solution methods. Mathematical solution of linear programming problem, Slack, and surplus variables. Matrix formulation of General linear Programming Problem.

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method. Unrestricted variables, problems of degeneracy. Principle of duality in Simplex method. Formation of dual with mixed type of constraints. Solution of primal and dual (solution of dual contains solution of Primal also) Sensitivity analysis.

Unit 4: Integer Programming-Formulation and solution of Integer Programming problem.

Unit 5: Game Theory-Introduction. Two persons zero sum games. The Maxxmini and Minimax principles.

Unit 6: Graphical Solution-Reduction of Game problem to L.P.P. The transportation problem Matrix form of transportation problem, initial basic feasible solution. Selecting the entering variable. Selecting the leaving variable. Transportation algorithm. Degeneracy in transportation problem. Inventory Control.

MAJOR PROJECT (STAGE 1) (ME-1891)

File

***Course Structure & Curriculum
For
B. Tech. Programme***

**In
PRODUCTION & INDUSTRIAL ENGINEERING**



**Department of Mechanical Engineering
Motilal Nehru National Institute of Technology
Allahabad**

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**Curriculum for
Bachelor of Technology in
Production and Industrial Engineering**

3rd Semester (Production and Industrial Engineering)

Course Code	Course name	L	T	P	Credit
ME-1301	Engineering Thermodynamics	3	1		4
ME-1302	Quality Engineering	3	1		4
AM-1303	Material Science and Engineering	3			3
AM-1304	Strength of Materials	3	1		4
EE-1305	Basic Electrical and Electronics	3			3
MA-1301	Numerical Methods and Statistical Techniques	3	1		4
ME-1351	Computational Lab			3	2
AM-1352	Material Science Lab			3	2
AM-1353	Strength of Materials Lab			3	2
EE-1354	Basic Electrical and Electronics Lab			3	2
Total		18	4	12	30

4th Semester (Production and Industrial Engineering)

Course Code	Course name	L	T	P	Credit
ME-1401	Automatic Control	3	1		4
ME-1402	Industrial Engineering	3			3
ME-1403	Measurement and Metrology	3			3
AM-1401	Fluid Mechanics	3	1		4
ME-1407	Thermal Engineering	3	1		4
AM-1403	Kinematics and Dynamics of Machines	3	1		4
ME-1451/ ME-1452	Measurement and Metrology/ Automatic Control Lab			3	2
ME-1453	Thermal Engineering Lab-I			3	2
AM-1451	Fluid Mechanics and Hydraulics Lab			3	2
Total		18	4	9	28

5th Semester (Production and Industrial Engineering)

Course Code	Course name	L	T	P	Credit
ME-1501	Computer Aided Design	3	1		4
ME-1502	Machine Design-I	3	1		4
ME-1503	Manufacturing Science and Technology-I	3	1		4
ME-1505	Operation Research	3	1		4
HS-1501	Principles of Management	3			3
ME-1551	Computer Aided Design Lab			3	2
ME-1552	Machine Design Lab - I			3	2
ME-1553	Manufacturing Technology Lab - I			3	2
ME-1555	Industrial Engineering Lab			3	2
Total		15	4	12	27

6th Semester (Production and Industrial Engineering)

Course Code	Course name	L	T	P	Credit
ME-1601	Computer Aided Manufacturing	3	1		4
ME-1602	Machine Design-II	3	1		4
ME-1603	Manufacturing Science and Technology-II	3	1		4
ME-1607	Production and Operations Management	3	0		3
ME-1608	Tool Engineering	3	1		4
HS-1601	Communication Skill (Workshop)			3	0
ME-1651	Computer Aided Manufacturing Lab			3	2
ME-1652	Machine Design Lab - II			3	2
ME-1653	Manufacturing Technology Lab - II			3	2
ME-1655	Tool Engineering Lab			3	2
Total		15	4	15	27

7th Semester (Production and Industrial Engineering)

Course Code	Course name	L	T	P	Credit
ME-1703	Advanced Manufacturing Processes	3	1		4
HS-1701	Economics	3			3
ME-1731 to ME-1740	Professional Elective - I	3	1		4
ME-1741 to ME-1750	Professional Elective - II	3	1		4
OE-1781	Open Elective - I	3			3
ME-1791	Major Project (Stage 1)			12	6
ME-1755	Advanced Manufacturing Lab	0	0	3	2
Total		15	3	15	26

DDM

8th Semester (Production and Industrial Engineering)

Course Code	Course name	L	T	P	Credit
ME-1801	Product Design and Development	3	1		4
ME-1831 to ME-1840	Professional Elective – III	3	1		4
ME-1841 to ME-1850	Professional Elective – IV	3	1		4
OE-1881	Open Elective – II	3			3
ME-1891	Major Project (Stage 2)			12	6
	Total	12	3	12	21

1st digit; 1: UG, 2nd digit; 2, 3, etc.: Semester

Code	Description
01-30	Theory Courses
31-40	Professional Elective –I
41-50	Professional Elective –II
51-70	Practical Courses
81-90	Open Elective
91-99	Project

PTM

ENGINEERING THERMODYNAMICS (ME-1301)

- UNIT 1:** Introduction to thermodynamics System, surroundings, boundaries, classification of systems. Unit and dimensions, conversion factors. Properties of systems, equilibrium, processes, heat and work interaction. The work interaction. Thermodynamic definition of work, characteristics of the work interaction. Evaluation of work. Adiabatic systems and processes. 9(L)
- UNIT 2:** Diathermic boundary, Zeroth law. Isothermal states. Empirical temperature. Principles of thermometry. Scales of temperature. Gas thermometer. The ideal gas. Ideal gas temperature scale. 4(L)
- UNIT 3:** The first law. Basic form. Energy of a system. The heat interaction. Sign convention. First law for open systems. Steady-flow energy equation and its applications. 4(L)
- UNIT 4:** Equations of state. Properties of gases. Properties of steam. Introduction to steam tables. Other equations of state. Van-der-waals gas. Critical state. Reduced equation of state. 4(L)
- UNIT 5:** The second law. Kelvin-Planck and Clausius statements. Equivalence of statements. Carnot theorem. Thermodynamic temperature. Kelvin scale. Carnot engine, refrigerator and heat pump. 6(L)
- UNIT 6:** Clausius inequality. Definition of entropy. Combined first and second law, Evaluation of entropy. Principle of increase of entropy. 4(L)
- UNIT 7:** Irreversibility and exergy. Lost work. 3(L)
- UNIT 8:** Introduction to cycles. Classifications of cycles. Gas power cycles- Otto, Diesel, Brayton. Vapour power cycle- Rankine cycle, vapour- compression refrigeration cycle. 5(L)

Text/Reference Books

- Engineering thermodynamics by P K Nag, Tata McGraw Hill
- Thermodynamics : An engineering approach by Cengel & Boles, McGraw Hill

QUALITY ENGINEERING (ME-1302)

- UNIT 1: Introduction:** Concept of quality, basic statistical concepts, Control of accuracy and precision, Process capability, standardization and interchangeability 3(L)
- UNIT 2: Statistical Quality Control fundamentals-** Objectives, Applications, organization, cost aspects, theory of statistical tolerance 3(L)
- UNIT 3: Control Charts:** General theory of Control Charts, Group Control Charts. Shewhart control chart for process control; Control Charts for variables such as \bar{x} , R Control Charts for charts for attributes such as c and p charts, Acceptance control chart; Cumulative Sum Control Charts; Subgroup selection; Process Capability, Cause-Effect and Pareto diagrams 9(L)
- UNIT 4: Acceptance Sampling:** Multiple and Sequential Sampling Plans, Multi-Continuous Sampling Plan, Acceptance Sampling by Variables, Advantages limitations. Sampling plans using different Criteria. Comparison of various types of sampling plans. Rectifying Inspection. 9(L)
- UNIT 5: Reliability, Availability and Maintainability:** Introduction to reliability, Bathtub curve, Series and Parallel system; MTBF, Evaluation of Availability and Maintainability. 6(L)
- UNIT 6: Quality Design:** Design of experiment concept, System, Parameter and Tolerance Design; Concept of Robust Design, Taguchi Concept-Orthogonal Arrays and S/N ratio 6(L)
- UNIT 7: Discussions and Interaction sessions** 4(L)

Text/Reference Books

- Introduction to Quality Control by Archibald Jamieson, Reston Pub. Co
- Statistical Quality Control by Eugene L Grant, Richard S Leavenworth, McGraw-Hill
- Introduction to Statistical Quality Control by Douglas C. Montgomery, Wiley
- Reliability Engineering by A. K. Govil, Tata McGraw-Hill Publishing Co. Ltd

MATERIAL SCIENCE AND ENGINEERING (AM-1303)

- UNIT 1: Introduction-** Historical perspective of Materials Science, Structure and properties relationship of Engineering Materials, Classification of materials, Advanced Materials. 3(L)
- UNIT 2: Structure of Solids and Characterization of Materials-** Introduction to crystal structures and systems, Metallic structures, Ceramic crystal structures, Carbon nano-structures, Crystallographic directions and planes, Miller indices, Density computations, Crystallography, Diffraction methods, Electron microscopy, Metallography, Thermal characterization techniques. 6(L)
- UNIT 3: Imperfections in Solids-** Point defects, Dislocations, Interfacial Defects, Bulk defects. 4(L)
- UNIT 4: Diffusion-** Diffusion mechanisms, steady and non-steady state diffusion, Factors that influence diffusion, Law's of diffusion, Applications of Diffusion. 4(L)
- UNIT 5: Mechanical Behaviour of Materials-** Elastic and plastic properties, Creep, Fatigue, Fracture, Heat treatment of steels. 6(L)
- UNIT 6: Phase Diagrams and Phase Transformations-** Unary, Binary, Equilibrium phase diagrams, Eutectic, Eutectoid, Peritectic and peritectoid reactions, Transformation rate effects and TTT diagrams. Microstructure and property changes in iron-carbon system, Iron-Carbon (Fe-C or Fe-Fe₃C) Diagram. 6(L)
- UNIT 7: Ceramic Materials-** Ceramic types, Properties, Processing Application, Advanced ceramics. 2(L)
- UNIT 8: Composites-** Introduction, Applications, Particle reinforced composites, Fiber reinforced composites, Structural composites. 2(L)
- UNIT 9: Thermal, Electrical, Magnetic, Optical Properties-** Heat capacity, Thermal expansion, Thermal conductivity, Thermal stresses, Electrical conduction, Semi conductivity, Super conductivity, Electrical conduction in ionic ceramics and in polymers, Dielectric behaviour, Ferroelectricity, Piezoelectricity, Diamagnetism and paramagnetism, Ferromagnetism, Antiferromagnetism and ferrimagnetism, Influence of temperature on magnetic behaviour, Domains and hysteresis, Optical properties of metals, Optical properties of non-metals, Application of optical phenomena. 5(L)

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Text/Reference Books

- Materials Science and Engineering An Introduction by Callister W. D. Jr.
- Material Science by Van Vlack.
- Material Science by Raghavan V.
- Material Science and Engineering by K. M. Gupta.

STRENGTH OF MATERIALS (AM-1304)

UNIT 1: Analysis of Stress & Strain-Uniaxial stress and strain: Stress, Strain, Hooke's Law, Stress-strain curves, Elastic Constants, Strain Energy, Statically Indeterminate problems, Thermal Effects, Impact Loading; Biaxial stress and strain: Stress at a Point, Variation of Stress, Stress Transformation, Analysis of Strain, Strain-displacement relations, Strain transformation, Strain Measurements, Constitutive equations, Principal stresses and strain. 10(L)

UNIT 2: Bending & Shear Stresses-Introduction, Pure Bending, Normal stresses in beams, Combined Bending and Axial Stress, Composite Beams, Shear Stress, Shear Centre, Strain energy in bending 6(L)

UNIT 3: Torsion-Introduction, Torsion of Circular Shaft, Power Transmitted by a Shaft, Compound Shaft, Tapered Shaft, Strain Energy in Torsion, Combined Bending and Twisting, Torsion of Thin Walled Tubes, Open and Closed Coiled Springs 6(L)

UNIT 4: Thin & Thick Cylinders & Spheres-Introduction, Thin Walled Shells, Thick Shells, Compound Cylindrical Shell 6(L)

UNIT 5: Deflections Of Beams-Introduction, Equation of Elastic Curve, Methods for Determining Deflections - Double Integration, Macaulay's Method, Moment-Area Method, Conjugate-beam method, Castigliano's Theorem 5(L)

UNIT 6: Columns and Theories of Failure-Introduction, Euler's Theory for Long Columns, Rankine-Gordon Formula, Empirical Formulae, Eccentrically Loaded Columns 7(L)

Text/Reference Books

- Elements of Strength of Materials, S.P. Timoshenko and D.H. Young, East-West Press Pvt. Ltd. Publications.
- Mechanics of Materials, Pytel and Kiusalaas, Cengage Learning Publications.
- Mechanics of Materials, Gere and Timoshenko, CBS Publications.
- Mechanics of Materials, E. P. Popov, Prentice Hall Publications.
- Strength of Materials, G. H. Ryder, Macmillan India Limited.
- Strength of Materials- Pytel and Singer, Harpercollins College division publications.
- Strength of Materials, Crandal, Dahal and Lardener, Tata McGraw Hill Publications.
- Mechanics of Materials- Riley, Struges and Morris, John Wiley & Sons.

BASIC ELECTRICAL AND ELECTRONICS (EE-1305)

Electrical Engineering:

Introduction to Electrical Energy: Generation: Types of power Plant, Functional Block diagram of generating stations (Hydel & Thermal Stations); Transmission, Distribution and Utilization, Domestic Wiring: Materials, accessories & ratings of the wiring materials, types of wiring, earthing and electricity rules.

Electric Circuits: Basic Circuit Elements, Ohm's law, KCL & KVL, Node & Loop Analysis, Superposition, Thevenin's Theorem & Norton's Theorem, Maximum Power Transfer Theorem.

Steady-state analysis of AC circuits: Sinusoidal and phasor representation of Voltage & current, single phase ac circuit behaviour of R, L and C. Combination of R, L and C in series and parallel, Resonance. three-phase circuits.

Transformer & Rotating Machines: Principle of operation and construction of single-phase transformer, efficiency and voltage regulation. Principle of electromagnetic energy conversion, Starting and speed control of DC and AC motors

Electronics Engineering:

Semiconductor Devices: Junction Diode, Bipolar-junction Transistor, JFET and MOSFET, Linear IC and its applications

Digital circuits: Number systems, conversion of bases, Boolean Algebra, logic gates, Concept of universal gate, Flip-Flops and counter.

Measurement and Mechatronics Instrumentation:

Measuring Instruments: Types of instruments, working principles of Ammeter, Voltmeter, Wattmeter & Energy meter, Digital instruments, Oscilloscopes.

Transducers and Sensors: for measurement of displacement, velocity, acceleration, force, torque, liquid level, flow, temperature etc.

Signal Conditioning: Operational Amplifiers and Circuits, Instrumentation amplifiers, Voltage to Current converters and Current boosters, Logarithmic amplifiers filters.

Timing Circuits: VCO, Waveform Generator, 555 timer circuits

Converters: Analog to Digital and Digital to Analog Conversion, Sample and Hold circuits, Analog, multiplexers, de-multiplexers

Power Control: SCRs, Triacs and other solid state devices various power converters and power control

Actuators and Motors: Actuators, Brushed DC servo motors, Brushless PM motors and controllers, The AC induction motor as a servo drive, stepper motor.

Controllers for automation: Introduction to microprocessors, Automation of systems using microcontrollers.

Text/Reference Books

- V. Del Toro: Principle of Electrical Engineering, PHI
- W. H. Hayt & Kemmerley, Engineering Circuit Analysis, McGraw Hill.
- Millman & Halkias, Integrated Electronics, TMH
- Boylstad & Nashishky, Electronic Devices & circuits, PHI
- Mavino & Leach, Digital Principles and applications.
- W. D. Cooper Electronic Instrumentation & Measurement Techniques, PHI
- D. V. S. Murthy, Transducer and Instrumentation,

John

- Richard M. Crowder, Electric Drives and their Controls
- Douglas V. Hall, Microprocessors and interfacing programming and Hardware
- Scot Mackenzie, The 8051 Microcontrollers

NUMERICAL METHODS AND STATISTICAL TECHNIQUES (MA-1301)

UNIT 1: Introduction-Errors in Numerical Computation, Mathematical Preliminaries, Errors and their analysis. 3(L)

UNIT 2: Algebraic and Transcendental Equation-Bisection method, Method of false position, Iteration Method, Newton-Raphson method, Secant method, Rate of convergence, Methods for Complex Roots: Muller's method, Lin-Bairstow's method, Quotient difference method, Gauss-Seidel iterative method for solving system of equations. 8(L)

UNIT 3: Interpolation-Introduction, Errors in Polynomial Interpolation, Interpolation by Evenly spaced points: Finite Differences, Detection of Errors, Newton's Formulae for Interpolation, Gauss, Stirling, Bessel's and Everett's Formulae, Interpolation by Unevenly spaced points: Lagrange Interpolation Formula, Divided Difference, Newton's General Interpolation Formula. 7(L)

UNIT 4: Curve Fitting, Cubic Splines and Approximation-Introduction, Least-squares curve fitting procedures, Weighted Least-squares curve fitting, Curve fitting by sum of exponentials, Data fitting with cubic splines, Approximations of Functions. 5(L)

UNIT 5: Numerical Differentiation and Integration-Introduction, Numerical differentiation, Numerical integration, Trapezoidal Rule, Simpson 1/3 rule, Simpson 3/8 rule, Boole's and Weddle's Rule, Euler-Maclaurin Formula, Gaussian Formula, Numerical Evaluation of Singular Integrals. 4(L)

UNIT 6: Statistical Techniques-Discrete and continuous distribution function; Poisson and Normal Distribution. Moment Generating function, linear statistical models, theory of least squares and analysis of variance, least squares estimates and their precision. Test of significance and interval estimates based on least squares theory in one-way. Two-way and three-way classified data. Regression analysis, linear regression, curvilinear regression and orthogonal polynomials, Discriminate analysis. 12(L)

Text/Reference Books

- Gerald and Wheatley, Applied numerical analysis, Addison Wesley.
- Flowers, Numerical Methods in C++, Oxford University Press.
- E. Balaguruswamy, Numerical Methods. TMH.
- S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India
- Jain, Iyengar, Jain, Numerical Methods for Scientific & Engineering Computation, New Age International

COMPUTATIONAL LAB (ME-1351)

Experiment 1: Make a program to evaluate a given polynomial $f(x)$ for a given value of x using Horner's Rule.

Experiment 2: Make a program to find the derivative of a given polynomial $f(x)$ for a given value of x .

Experiment 3: Make a program to find the roots of a given polynomial $f(x)$ using following methods:

- Bisection method.
- Method of False Position.
- Iteration method.
- Newton-Raphson method.
- Secant method.
- Muller's method.
- Lin-Bairstow's method.
- Quotient-Difference method.

Experiment 4: Make a program to solve the given set of equations using Gauss-Seidel Iterative method.

Experiment 5: Make a program to determine the following difference tables for given data points:

- Forward Difference table.
- Backward Difference table.
- Central Difference table.
- Divided Difference table.

Experiment 6: Make a program to find the interpolation polynomial / interpolation value of $f(x)$ at a specified value for evenly spaced data points using the following methods:

- Newton's Forward and Backward Difference methods.
- Gauss, Stirling, Bessel's and Everett's methods.

Experiment 7: Make a program to find the interpolation polynomial / interpolation value of $f(x)$ at a specified value for unevenly spaced data points using the following methods:

- Lagrange Interpolation method
- Newton's General Interpolation method.

Experiment 8: Make a program to fit a given polynomial to the given set of data points and to evaluate it at a specified value of x .

Experiment 9: Make a program to find the n^{th} ($n = 1, 2$ and 3) derivative of $f(x)$ at a specified value of x for the given set of data points.

Experiment 10: Make a program to find the numerical integration of $f(x)$ at a specified value of x for the given set of data points using the following rules:

- Trapezoidal rule.
- Simpson 1/3 & Simpson 3/8 rules.
- Boole's and Weddle's rules.
- Gaussian formula.

MATERIAL SCIENCE (LAB) (AM-1352)

Experiment 1: Study of various dislocation models, drawing burgers circuit and finding Burgers vector.

Experiment 2: Study of various unit cells and crystals for,

- Their geometry and symmetry,
- Total number of atoms and their arrangement,
- Effective number of atoms per unit cell,

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- d) Co-ordination number,
- e) Atomic packing efficiency,
- f) Determining density,
- g) Concept of Miller indices and Inter-planer spacing.

Experiment 3: To study the effect of a surface treatment (Etching) on the strength of glass.

Experiment 4: Heat treatment processes (Annealing, Normalizing, Quenching) and comparison of hardness before & after heat treatment.

Experiment 5: To predict creep characteristic of materials by plotting strain vs. time curves for different loadings.

Experiment 6: Comparative study of microstructures of different given specimens (mild steel, grey C.I., brass, and copper).

Experiment 7: Specimen preparation for micro structural examination by cutting, grinding, polishing and etching of aluminium specimen.

Experiment 8: Fabrication of composite by hand-lay up technique.

Experiment 9: Mechanical testing of composite made by hand-lay up technique in experiment no. 8.

Experiment 10: To study the fatigue behaviour of a given sample.

STRENGTH OF MATERIALS (LAB) (AM-1353)

Experiment 1: Tension Test

Experiment 2: Compression Test

Experiment 3: Torsion Test

Experiment 4: Beam Bending

Experiment 5: Impact Tests

Experiment 6: Closed and Open coiled springs

Experiment 7: Shear Test

Experiment 8: Buckling of Struts

Experiment 9: Hardness Test (Brinell and Rockwell)

Experiment 10: Tensometer (Tension Test)

BASIC ELECTRICAL AND ELECTRONICS (LAB) (EE-1354)

Experiment 1: Verification of Network Theorems.

Experiment 2: Study of the phenomenon of resonance in RLC series circuit.

Experiment 3: Measurement of Power in three phase circuits by two-wattmeter method.

Experiment 4: Determination of parameters and losses in a single phase transformer by OC and SC tests.

Experiment 5: DC generator characteristics.

Experiment 6: Speed control of DC shunt motor.

Experiment 7: Study of running & reversing of three-phase induction motor.

Experiment 8: Study of single-phase energy meter.

Experiment 9: Study of Diode Characteristics.

Experiment 10: Determination of common base & common emitter characteristics of a transistor.

Experiment 11: Study of various logic gates.

Experiment 12: To study a half wave and full wave rectifier circuits with and without capacitor filter and determination of ripple factor.

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AUTOMATIC CONTROL (ME-1401)

UNIT 1:Introduction-Introduction to control, open-loop control, feedback control. System modeling: Modeling of electromechanical systems, Modeling of dynamic systems, State-space modeling, Modeling and simulation of dynamic systems in Matlab/Simulink. Laplace transform: Properties of Laplace transform, Laplace transforms of electromechanical systems, Laplace transform of state equations, Transfer functions, Poles, zeros. Representation of multiple subsystems: Block diagrams, Signal flow graphs. 8(L)

UNIT2:Sensors and Transducers-Characteristics, contact and non-contact type, pressure switches, proximity and position sensors. Actuators: solenoids, hydraulic and pneumatic actuators, valves and circuits. 4(L)

UNIT 3: Time response patterns-Response of first and second order systems, System response versus pole and zero location, approximation of high order system by low order system. Stability analysis: Stability analysis using the Routh-Hurwitz test. Feedback systems: Steady state and tracking analysis, The PID compensator, Tuning rules of PID compensator. 8(L)

UNIT 4:Root locus analysis-Sketching a root locus, Selection of gain from the root locus, Controller design using the root locus: Lead compensation, Lag compensation. 6(L)

UNIT5: Frequency response of linear systems- Frequency response analysis, Bode plot techniques, Stability Analysis: The Nyquist theorem, Stability Margins, Closed loop frequency response, Frequency domain compensation techniques: Lead and lag compensators. 6(L)

UNIT6:Linear discrete time systems-Z-transform, mathematical modeling, stability analysis, steady-state error, dynamic performance of discrete time systems 8(L)

Text/Reference Books

- Ogata, K., Modern Control Engineering, Pearson Education.
- Gopal, M., Control Systems: Principles and Design, Tata McGraw-Hill.
- Raven, F. H., Automatic Control Engineering, McGraw-Hill.
- Nagrath, I. J. and Gopal, M., Control Systems Engineering, New Age International.
- Kuo, B. C. and Golnaraghi, F., Automatic Control Systems, Wiley.
- Franklin, G F., Powell, J. D., and Emami-Naeini, A., Feedback Control of Dynamic Systems, Prentice-Hall.

INDUSTRIAL ENGINEERING (ME-1402)

UNIT 1:Introduction, Engineering Economy and Costing-Cost Analysis, Break-even Analysis, Methods of Depreciation, Productivity Concepts and Measurements. 8(L)

UNIT 2:Job evaluation, Benefits of Job evaluation, Methods of Job evaluation, Merit Rating, Methods of Merit Rating, Requirements for success of Merit Rating System, Objectives of a Good Wage-Incentive Plan, Basis of a Good Wage-Incentive Plan, Types of Wage-Incentive Plans. 10(L)

UNIT 3:Work Measurement, Time Study, PMTS, Work Sampling, Method Study, Micro Motion Study, Principles of Motion Economy. 10(L)

UNIT 4:Material Handling System- principles, types, and devices. 7(L)

UNIT 5:Maintenance Management- Probabilistic Failure and Repair Times, Preventive Maintenance and Replacement, Total Preventive Maintenance, Concurrent Engineering- steps and CE Environment. 10(L)

Text/Reference Books

- Turner, W.C., et. Al, 1993, "Introduction to Industrial and System Engineering", Prentice Hall.
- Del Mar, Donald, "Operations and industrial management: designing and managing for productivity", McGraw-Hill, 2007
- Ralph M. Barnes, "Motion and Time Study: Design and Measurement of Work", Wiley Publishers
- Chandler Allen Phillips, "Human Factors Engineering", John Wiley and Sons, New York,
- S.K. HajraChoudhary, Nirjhar Roy, and A. K. HajraChoudhary, "Production Management: An integrated approach to Industrial Engineering", Media Promoters and Publishers.

MEASUREMENT & METROLOGY (ME-1403)

UNIT1:Introduction to measurement and measuring instrument, generalized measuring system and functional elements, static and dynamic performance, characteristics of measurement devices, concept of error, sources of error, statistical analysis of errors. 6(L)

UNIT2:Sensors and transducers- types and their characteristics, measurement of pressure, direct acting and elastic pressure transducers, measurement of very low pressures. Strain measurement- types of strain gauges and their working, strain gauge circuits, temperature strain rosettes. 5(L)

UNIT3:Measurement of force and torque, temperature measurement by thermometers, bimetallic thermocouples, thermistors and pyrometers. Measurement of flow, vibration and noise measurement, seismic instruments. Data acquisition system. 5(L)

UNIT 4:Standards of liner measurement, line and end standards, system of limits and fits, linear and angular measurement devices and systems, limit gauges and their design. 6(L)

UNIT5:Measurements of geometric forms like straightness, flatness, roughness and circularity, optical projectors, tool microscope, autocollimators, principle and use of interferometry, optical flat interferometers, laser interferometers. Comparators- types, working principles and magnification range, measurement of screw threads and gears. 6(L)

UNIT6:Surface texture-quantitative evaluation of surface roughness and its measurement, introduction to CMM, in-process gauging systems, inspection- in-process and final inspection, sampling and 100% inspection, sampling plans. 6(L)

Text/Reference Books

- Beckwith Thomas G., Mechanical Measurement, Narosa Publishing House.
- Doeblein, E.O., Measurement Systems: Application and Design, McGraw Hill.
- Hume, K.J., Engineering Metrology, MacDonal and Co.

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- Gupta, I.C., Engineering Metrology, DhanpatRai & Sons.
- Bewoor, A.K. and Kulkarni, V. A., Metrology & Measurement, Tata McGraw-Hill Education Pvt. Ltd.
- Sawhney, A.K. and Mahajan, M., A text book of measurement and metrology, DhanpatRai & Co.

FLUID MECHANICS (AM-1401)

UNIT 1: Introduction to Fluid Mechanics- Statics and Kinematics Fluid and continuum, Physical properties of fluids, Types of fluid flows, Rheology of fluids. Manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, fluid masses subjected to linear acceleration and uniform rotation about an axis. Kinematics of Fluid flow: steadiness, uniformity, rotational and irrotational flows, streamline, streakline, pathline, continuity equation, stream function and velocity potential, applications of potential flow. 8(L)

UNIT 2: Dynamics Of Fluid Flow and Dimensional Analysis Euler's Equation of motion along a streamline and its integration, Bernoulli's equation and its applications, momentum equation and its application to pipe bends. Dimensional Analysis, Buckingham's Pi theorem, important dimensionless numbers and their physical significance, geometric, kinematic and dynamic similarity, model studies, Hydraulic similitude. 8(L)

UNIT 3: Laminar and Turbulent Flows- Equation of motion for laminar flow through pipes, Stokes law, transition from laminar to turbulent flow, types of turbulent flow, isotropic and homogenous turbulence, scale and intensity of turbulence, eddy viscosity, Prandtl's mixing length theory, velocity distribution in turbulent flow over smooth and rough surfaces, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, three reservoir problems and pipe network. 10(L)

UNIT 4: Hydrodynamic Boundary Layer-Introduction with a historical background, boundary layer, displacement and momentum thickness, boundary layer over a flat plate, Prandtl boundary layer equation, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub-layer, separation and its control, drag and lift, drag on a sphere, 2D cylinder and airfoil, Magnus effect. 8(L)

UNIT 5: Measurement Techniques-Flow measurement by Pitot tube, orifice, Venturi, nozzle, and bend meter, rotameter, notches and weirs, hot-wire anemometer, LDV and PIV, Turbine flowmeter, Vortex shedding flowmeter, magnetic flowmeter, Doppler Ultrasonic flowmeter, Coriolis flowmeter etc. 4(L)

UNIT 6: Introduction to Hydraulic Machines-Introduction to Hydroelectric power station and its components, Classification of turbines and pumps, similarity laws and specific speed, efficiency, cavitation. 4(L)

Text/Reference Books

- Fox, R.W., McDonald, A.T., Introduction to Fluid Mechanics, 7th edition, Wiley India.
- Ojha, C.S.P., Berndtsson, R., Chandramouli, P.N., Fluid Mechanics and Machinery, Oxford University Press, New Delhi.
- Majumdar, B., Fluid Mechanics with Laboratory Manual, PHI Learning, New Delhi.
- Som, S.K. and Biswas G, Introduction of Fluid Mechanics & Fluid Machines, TMH, New Delhi.
- Mohanty, A.K., Fluid Mechanics, PHI Learning, New Delhi.
- Shames, I.H., Mechanics of Fluids, McGraw Hill, International Students Edition.
- Agarwal, S.K., Fluid through Problems, New Age International Pvt. Ltd, New Delhi.
- Lal, J., Hydraulic Machines, Metropolitan Book Co. Pvt. Ltd., Delhi.

THERMAL ENGINEERING (ME-1407)

UNIT 1: Overview and Basics of Engine Operation, Engine Geometry, Performance Parameters, Ideal Cycle Analysis, Combustion Stoichiometry, Fuel-air Cycle Model 6(L)

UNIT 2: Gas Exchange: 4-Stroke, Gas Exchange: 2-Stroke, Turbocharging, Mixture Preparation 6(L)

UNIT 3: Ignition System, Spark-ignition Engine Combustion, Knock, Diesel Combustion 7(L)

UNIT 4: Refrigeration: Simple Vapour compression Systems, Psychrometry, Air-conditioning Systems 7(L)

UNIT 5: Steam Flow Through Nozzles: Types, Nozzle efficiency, energy equation, critical pressure. Overview and Basics of Steam Turbines: Working principle, Types, Velocity diagrams 7(L)

UNIT 6: Overview and Basics of dynamic Compressors: Working principle, Types, Velocity diagrams Steam Turbine Plants, Rankine cycle, Regenerative feed heating, Reheating 7(L)

Text/Reference Books

- Internal Combustion Engine Fundamentals. New York: McGraw-Hill, 1988. ISBN: 9780070286375 by Heywood, John B
- I.C. Engines by V. Ganeshan
- Refrigeration and Airconditioning by C. P. Arora
- Refrigeration and Airconditioning by Manohar Prasad
- Turbines Compressors and Fans by S M Yahya
- Thermodynamics and Heat Engines, Vol. II by R. Yadav

KINEMATICS AND DYNAMICS OF MACHINE (AM-1403)

UNIT 1: Basic Kinematic Concepts-Links, Kinematic Pairs, Kinematic Chains, Mechanism, Inversion of Mechanism. 4(L)

Velocity and Acceleration in Mechanism Relative Velocity Method, Instantaneous Centre Method, Kennedy's Theorem for Three Centers, Acceleration Diagram, Coriolis Component of Acceleration, Klein's Construction. 4(L)

UNIT 2: Force Analysis and Flywheel Static Force Analysis in Mechanism, Inertia Force Analysis in Mechanism, Turning Moment Diagram for Engines, Flywheels. 4(L)

Friction (Belts, Ropes & Clutches) Types of Friction, Frictional Clutches, Single Disc or Plate Clutch, Multi Plate Disc Clutch, Introduction to Cone Clutch and Centrifugal Clutches. Types of Belt Drive, Types of Belts, Materials Used for Belts, Velocity Ratio of Belt Drive, Slip in Belt, Creep in Belt, Condition for Maximum Power Transmission, V-Belt Drive, Fiber Ropes, Rope Drives. 4(L)

Cams-Classification of Cams and Followers, Nomenclature, Types of Follower Motion, Generation of Cam Profile with Uniform Velocity, SHM, Uniform Acceleration and Retardation, Cycloidal Motion of The Follower. 4(L)

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UNIT 3: Gears and Gear trains Basic Terminology, Different Types of Gears, Simple, Compound, Reverted and Epicyclic Gear Train, Gear Box, Overdrives in Gear Box. 3(L)

Governor Function of Governor, Watt, Porter, Proell, Hartnell, Characteristics of Governor, Governor Efforts and Power, Controlling Force Diagram. 4(L)

UNIT 4: Balancing Dynamic Balancing of Rotating Masses in Same Plane and Different Planes, Balancing of Reciprocating Parts, Partial Balancing. 4(L)

Brakes and Dynamometer Internal and External Shoe Brakes, Disc Brake, Power Brake, Transmission and Absorption Type Dynamometer. 3(L)

UNIT 5: Mechanical Vibration Longitudinal Vibration, Transverse Vibration of Beams, Torsional Vibration of Shaft, Approximate Methods - Rayleigh's Method And Rayleigh-Ritz Method, Single Degree Free and Forced Undamped and Damped Vibrations, Critical Speed of Shaft. 6(L)

Text/Reference Books

- The Theory of Machines by Thomas Bevan, CBS Publishers & Distributors.
- Theory of Machines and Mechanisms by John J. Uicker, Jr. Gordon R. Pennock & Joseph E. Shigley, Oxford University Press, New York.
- Theory of Mechanisms and Machines by Dr. Jagdish Lal, Metropolitan Book Co. Pvt. Ltd.
- Theory of Machines by S. S. Ratan, Tata McGraw-Hill

MEASUREMENT AND METROLOGY LAB (ME-1451)

Measurement lab

Experiment 1: Study of displacement and current characteristics in Linear variable differential transformer (LVDT)

Experiment 2: Find the relationship between displacement and change in signal generated due to Capacitive type transducer (Proximity tutor)

Experiment 3: To draw the calibration graph for the Bimetallic transducer using a thermometer as standard and determine the time constant for the transducer

Experiment 4: Find the relationship between displacement and change in signal generated due to Strain gauge

Experiment 5: To calibrate the given force measuring elastic transducer for compression and tensile loads

Experiment 6: To plot the calibration graph between the temperature and RTD readings

Experiment 7: To study the variation of light intensity with distance from source with a luxmeter

Experiment 8: Calibration of Bourdon pressure gauge for (i) above atmospheric pressure conditions, and (ii) below atmospheric pressure conditions.

Metrology Lab

Experiment 1: To measure the screw parameters i.e. external diameter, pitch, flank angle by using Tool Makers Microscope

Experiment 2: To make the study and use of micrometer and depth gauge

Experiment 3: To measure the angle of a given taper specimen with the help of a clinometers first and then calculate the accurate value using a Sine bar.

Experiment 4: To determine the outside and core diameter of a given specimen with the help of Floating carriage micrometer.

Experiment 5: To determine the diameter of a specimen and the error in given specimen with the help of passameter and slip gauges.

AUTOMATIC CONTROL (ME-1452)

Experiment 1: Dynamic response of systems using transfer-function approach in MATLAB®

Experiment 2: Dynamic response of systems using transfer-function approach in Simulink®

Experiment 3: Dynamic response of systems using State-Space approach in MATLAB®

Experiment 4: Dynamic response of systems using State-Space approach in Simulink®

Experiment 5: Closed-loop control of systems with PID controller using transfer-function and State-Space approaches in MATLAB®

Experiment 6: Closed-loop control of systems with PID controller using transfer-function and State-Space approaches approach in Simulink®

Experiment 7: Closed-loop control of systems using Root-Locus design in MATLAB®

Experiment 8: Frequency response of systems in MATLAB®

Experiment 9: Dynamic response of systems with digital control in MATLAB®

Experiment 10: Dynamic response of systems with digital control in Simulink®

THERMAL ENGINEERING LAB-1 (ME-1453)

Experiment 1: Study of the heat transfer in pin fin apparatus

Experiment 2: Study of the heat transfer in natural convection apparatus

Experiment 3: Study of the heat transfer in the forced convection apparatus

Experiment 4: Study of the Stefan Boltzman apparatus and estimation of Stefan Boltzman's constant

Experiment 5: Study of the heat transfer in drop-wise and film wise condensation.

Experiment 6: To estimate the thermal conductivity of metal bar

Experiment 7: Study of the heat transfer through composite wall

Experiment 8: Study of heat transfer behaviour in Heat pipe apparatus

Experiment 9: Study of the emissivity measurement apparatus

Experiment 10: To estimate the thermal conductivity of insulating powder

Experiment 11: To study the Heat transfer in lagged pipe apparatus

Experiment 12: To estimate effectiveness in Shell-and-Tube Heat Exchanger

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Experiment 13: To estimate effectiveness in double pipe heat exchangers

FLUID MECHANICS & HYDRAULIC LAB (AM-1451)

Experiment 1: To verify the momentum equation using the experimental set-up on diffusion of submerged air jet.

Experiment 2: To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.

Experiment 3: To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.

Experiment 4: To study the variation of friction factor ' f ' for turbulent flow in commercial pipes.

Experiment 5: To calibrate an orifice meter, venturimeter, and bend meter and study the variation of the co-efficient of discharge with the Reynolds number.

Experiment 6: To study the impact of jets in a flat plate.

Experiment 7: To study performance of a Pelton wheel/ Francis turbine/ Kaplan Turbine.

Experiment 8: To study performance of two Centrifugal pumps connected in series and parallel.

Experiment 9: To study performance of a Reciprocating pump.

Text/Reference Books

- Singh, S. Experiments in Fluid Mechanics, PHI Learning, New Delhi.
- Prakash, M. N. S., Experiments in Hydraulics and Hydraulic Machines: Theory and Procedures, PHI Learning, New Delhi.
- Majumdar, B., Fluid Mechanics with Laboratory Manual, PHI Learning, New Delhi.

PNM

COMPUTER AIDED DESIGN (ME-1501)

UNIT 1: Definitions, Historical Development. Nameable and Unnameable shapes, Explicit and Implicit Equations, Intrinsic Equations, Parametric Equations, Coordinate Systems. Design of Curves: Algebraic and Geometric Forms, Parametric space of a curve, Blending functions, Reparametrization, Truncating, Extending and subdividing, Space curve, Four point form, Straight lines, Spline Curves, Bezier Curves, B-spline Curves, Rational Polynomials, introduction to NURBS. 12(L)

UNIT 2: Geometric Transformation and Projection: Transformations: Translation, Rotation, Scaling Symmetry and Reflection, Homogeneous Transformations. Orthographic Projections, Axonometric Projections, Oblique Projections, Perspective Transformation. 6(L)

UNIT 3: Design of Surfaces: Algebraic and Geometric form, Tangent and Twist Vectors, Normal, Parametric space of a surface, Blending Functions, Reparametrization of a surface patch, subdividing, Sixteen Point form, Four Curve Form, Plane surface, Cylindrical Surface, Ruled surface, Surface of Revolution. Bezier Surface, B-Spline Surface. 8(L)

UNIT 4: Design of Solids and Solid modeling schemes. Solid Modelling Fundamentals: Topology of Closed Paths, Piecewise flat surfaces, topology of closed curved surfaces, Generalized Concept of boundary, Set theory, Boolean operators, Set-membership Classification, Euler operators, Formal Modelling Criteria. Solid Model Construction: Graph Based methods, Boolean models, Instances and Parameterized Shapes, Cell Decomposition and spatial-Occupancy Enumeration, Sweep Representation, Constructive Solid Geometry, Boundary Representation. Assemble Modelling. 12(L)

UNIT 5: Data transfer formats: Neutral data format, IGES, STEP and XML. Applications of Solid Models: Rapid Prototyping, FEM, Medical Applications. 4(L)

Text/Reference Books

- Geometric Modelling: Michael E. Mortenson, John Wiley, 2006
- Mathematical Elements of Computer Graphics: Roger and Adams, McGraw Hill, 1994.
- CAD CAM Theory and Practice: I. Zeid, McGraw Hill, 1994.

MACHINE DESIGN-I (ME-1502)

UNIT 1: General Introduction and Selection of Materials-Definition, Methods, Standards in Design and Selection of Preferred Size, BIS system of Designation of Steels, Steels and Alloys, Plastics and Rubbers. 5(L)

UNIT 2: Design against Static and Fluctuating Load-Concept of Three Dimensional State of Stress and Strain, Stress-Strain Relationship, Principle Stresses, Stress Concentration, Stress Concentration Factor and Notch Sensitivity Factor, Factor of Safety, Theories of Failure, Fluctuating Stress, Fatigue Failure, Endurance Limit, Design for Finite and Infinite Life, Soderberg and Goodman Criteria. 9(L)

UNIT 3: Shafts, keys and coupling-Design of Shafts against Static and Fluctuating Load, Strength and Rigidity Design, Design of Square and Flat Keys and Splines, Rigid and Flexible Couplings. 5(L)

UNIT 4: Power Screws and Joints-Form of Threads, Square Threads, Trapezoidal Threads, Stresses in Screw, Design of Screw Jack, Screwed Joints, Riveted Joints, Welded Joint and Eccentric Loading of above Joints, Design for Fatigue Loading. 9(L)

UNIT 5: Mechanical Springs-Helical Springs, Stress Equations, Deflection Equation, Design against Static and Fatigue Loading, Multi Leaf Springs, Spiral Springs. 7(L)

UNIT 6: Belts, Brakes and Clutches-Flat Belts, V Belts, Static Analysis of Brakes and Clutches, Internal Expanding and External Contracting Rim Brakes and Clutches, Band type Brakes and Clutches, Frictional contact Axial Clutches, Disc Brakes, Cone Clutches and Brakes 7(L)

Text/Reference Books:

- Machine Design An Integrated Approach by R. L. Norton, Pearson Prentice Hall
- Mechanical Engineering Design by J. E. Shigley, McGraw-Hill
- Design of Machine Element by V. B. Bhandari, Tata McGraw-Hill
- Design Data – PSG College of Technology

MANUFACTURING SCIENCE AND TECHNOLOGY-I (ME-1503)

UNIT 1: Metal Casting Science and Technology- Need and Classification; Expendable Green Sand Mould Metal Casting: Preparation, Composition, Properties and Testing of Green Sand; Function, Materials, Allowances and Types of Patterns; Function and Types of Cores; Core prints and Chaplets; Molding Methods; Gating Design; Cooling and Solidification-Mechanism and Rate; Riser Design and Placement; Expendable Precision Sand Mould Metal Castings: Shell Mould Casting, Vacuum Mould Casting and CO₂Mould Casting; Investment Casting (Lost Wax) and Evaporative Casting (Lost Foam); Expendable Plaster Mould (Antioch process) and Ceramic Mould (Shaw process) Casting; Permanent Metal Mould Metal Casting: Gravity Die and Pressure Die Casting, Vacuum Die and Slush Die Casting; Special Metal Casting Processes: Centrifugal, Continuous, Squeeze and Chilled Metal Casting; Casting Defects and Inspection of Casting; 9(L)

UNIT 2: Plastic Moulding Science and Technology: Classification of Moulding Processes, Extrusion and Injection Moulding, Compression and Transfer Moulding, Blow and Rotational Moulding; Glass-working Science and Technology:Raw material preparation; shaping of Piece Ware and Flat and Tubular glass; Powder Metallurgy Science and Technology: Powder preparation; Blending and/or Mixing of Powders, Compacting and Sintering of powders; Hot Isostatic Pressing (HIP), Powder Injection Moulding (PIM), and Electro-Spark Pressing (ESP) 6(L)

UNIT 3: Massive Metal Forming Science and Technology- Need and Classification, Elastic and Plastic deformation-Yield and Flow; Rolling: Classification of Rolling, Process geometry and Analysis of Plate rolling for Rolling load and power calculations; Rolling mills and Roll pass design; Defects in Rolled Products; Forging: Classification of Forging, Process Geometry and Analysis of Strip and Disc forging for Forging Load and Power calculations; Defects in Forged Products; Drawing: Process Geometry and Analysis of Wire and Sheet Drawing for Load and Power calculations, Maximum Reduction Possible. Extrusion: Classification, *form*

Process Geometry and Analysis of Rod and Sheet Extrusion for Load and Power calculations, Maximum Reduction Possible; Defects in Extruded Product. 12(L)

UNIT 4: Sheet Metal Forming Science and Technology- Need and classification; Blank preparation by sheet cutting; Press Forming: Bending and Drawing- Process Geometry and Calculation for Force and Power; Impulse Forming: Explosive forming, Electro-hydraulic forming and Electro-magnetic forming; Laser Forming: Laser Bending and Laser Drawing 6(L)

UNIT 5: Rapid Prototyping Science and Technology: Need and Classification of Rapid Prototyping Processes; Process Principle, Equipments and Applications of Stereo Lithography(SLA), Solid Ground Curing (SGC), Selective Laser Sintering (SLS) and Three Dimensional Printing (TDP), Fused Deposition Modelling (FDM) and Laminated Object Manufacturing (LOM).**Surface Coating Science and Technology:** Need and Classification; Process Principle, Equipments and Applications of Physical Vapour Deposition (PVD), Chemical Vapour Deposition (CVD), Electro-Plating, Electroless-Plating, Powder Coatings, Thermal Coating and Chemical Coating; Choice of coating materials and processes; Testing of surface coatings 6(L)

Text/Reference Books:

- Manufacturing Science by **Ghosh and Mallik**, East West Press Pvt. Ltd., New Delhi
- Fundamentals of Modern Manufacturing by **M. P. Groover**, John Wiley and Sons, New Delhi
- Fundamentals of Metal Forming Processes by **B. L. Juneja**, New Age International Ltd., New Delhi
- Manufacturing Engineering and Technology by **Kalpakkjian and Schmid**, Pearson Education Pvt. Ltd. New Delhi

OPERATIONS RESEARCH (ME-1505)

UNIT 1: BASICS OF OPERATIONS RESEARCH-Development of Operations Research, Definition of Operations Research, Characteristics of Operations Research, Scope of Operations Research, Operations Research and Decision-Making, Scope of Operations Research in Management, Scope of OR in Financial Management ,Application of various OR Techniques, Objective of Operations Research 6(L)

UNIT 2: INVENTORY CONTROL-Necessity for Maintaining Inventory, Inventory Costs, Inventory Control Problem, Classification of Fixed Order Quality Inventory Models, Inventory Models with Deterministic Demand, Model 1(a).Classical EOQ Model(Demand Rate Uniform, Replenishment Rate Infinite),Model 1(b).(Demand Rate Non-Uniform, Replenishment Rate Infinite),Model 1(c).(Demand Rate Uniform, Replenishment Rate finite),Model 2(a).(Demand Rate Uniform, Replenishment Rate infinite, shortage allowed),Model 2(b). (Demand Rate Uniform, Production Rate finite, shortage allowed),Inventory Models with Probabilistic Demand, Inventory 12(L)

UNIT 3: LINEAR PROGRAMMING-Introduction, Formulation of Linear Programming problems, Graphical Method of Solution, The General Linear Programming problem, Canonical and Standard Forms of Linear Programming Problem, Theory of Simplex Method, Analytical Method or Trial and Error Method, The Simplex Method (Technique or Algorithm),Artificial Variables Techniques, The Big-M Method, The Two-Phase Method 12(L)

UNIT 4: TRANSPORTATION MODEL-Introduction to the Model, Definition of the Transportation Model, Matrix Terminology, Formulation and solution of Transportation Models, Variants in Transportation Problems, Additional Problems

ASSIGNMENT MODEL-Definition of the Assignment Model, Mathematical Representation of the Assignment Model, Comparison with the Assignment Model, The Hungarian Method for Solution of the Assignment Problems, Formulation and solution of the Assignment Models, Variations of the Assignment Problem, The Travelling Salesman Problem.

SEQUENCING MODELS-Sequencing problems, Assumptions in Sequencing Problems, Processing n Jobs through one Machine, Processing n Jobs through two Machines, Processing n Jobs through three Machines, Processing two Jobs through m Machines, Processing n Jobs through m Machines, Problems related to Sequencing(Routing Problems in Networks),Minimal Path Problem. 6(L)

UNIT 5: GAME THEORY-Game theory, Formulate two-person zero-sum game, Solve a simple game, Solve mixed strategy games using graphical method and LP ,Describe reduction using dominated strategy, Introduce saddle point condition, Formulation of Two-person Zero-sum game., Solution of simple games, Mixed strategy games, Solving using Graphical Method, Solving Using LP, Reduction using Dominated Strategies, Saddle point Condition, Examples. 6(L)

UNIT 6: NETWORK ANALYSIS-Network models, Identify the situation in which minimum spanning tree algorithm can be used, Identify the situation in which shortest path algorithm can be used, Identify the situation in which maximal flow algorithm can be used, Draw network diagram Analyze the network using Earliest Start Time(ES) Latest Start Time (LS) , Earliest Event Time(ET), Latest Event Time(LT), Identify critical path by calculating Total Float (TF) of each activity. Apply PERT using Optimistic, Most likely, pessimistic times of activities, Find the probability of completing the project, Identify the simple rules of crashing the projects with cost consideration., Minimal spanning tree problem, Shortest route problem, Maximal flow problem, Critical Path Method (CPM), Program Evaluation and Review Technique(PERT), Network representation of simple projects.. Critical path computation., Construction of time schedule., Crashing of project duration. 6(L)

Text/Reference Books:

- Operations Research An Introduction by H.Taha
- Introduction to Operations Research by Hillier & Lieberman
- Operations Research by Heera and Gupta
- Operations Research by S D Sharma
- Operations Research by V K Kapur

PRINCIPLES OF MANAGEMENT (HS-1501)

UNIT 1: Introduction to Management-Definition of Management – Science or Art – Management and Administration, Functions of Management – Types of Business Organization. Levels of management and Managerial skills 5(L)

UNIT 2: School of Management Thoughts: Evolution of Management thoughts, classical approach, neo- classical approach, contribution of Taylor, Weber and Fayol, modern approach. 6(L)

UNIT 3: Planning Nature & Purpose – Steps involved in Planning ,Objectives, Setting Objectives, Process of Managing by Objectives ,Strategies, Policies & Planning Premises Forecasting Decision-making. 8(L)

UNIT 4: Organizing Nature and Purpose – Formal and informal organization – Organization Chart – Structure and Process – Departmentation by difference strategies – Line and Staff authority – Benefits and Limitations – De-Centralization and Delegation of Authority – Staffing – Selection Process-Techniques-HRD-Managerial-Effectiveness. **Directing:** Scope – Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation –

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Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment – Communication – Process of Communication – Barriers and Breakdown – Effective Communication – Electronic media in Communication. 11(L)

UNIT 5: Controlling-System and process of Controlling – Requirements for effective control – The Budget as Control Technique – Information Technology in Controlling – Use of computers in handling the information – Productivity – Problems and Management – Control of Overall Performance.Coordination. 5(L)

UNIT 6: Organisational Behaviour- Organisational change, Conflict Management and Stress Management **Functional management:** Human Resource Management, Financial management, Marketing Management. 5(L)

Text/Reference Books:

- Tripathy PC and Reddy PN, “Principles of Management”, Tata McGraw-Hill, 1999.
- Decenzo David, Robbin Stephen A, “Personnel and Human Reasons Management”, Prentice Hall of India, 1996
- JAF Stomer, Freeman R. E and Daniel R Gilbert, “Management”, Pearson Education, Sixth Edition, 2004.
- Fraidoon Mazda, “Engineering Management”, Addison Wesley, 2000.
- Harold Kooritz& Heinz Weihrich “Essentials of Management”, Tata McGraw-Hill, 1998
- Joseph L Massie “Essentials of Management”, Prentice Hall of India, (Pearson) Fourth Edition, 2003

COMPUTER AIDED DESIGN LABORATORY (ME-1551)

Experiment 1: Design of Hermite curves

Experiment 2: Design of Bezier curves

Experiment 3: Design of B-Spline curves

Experiment 4: Geometric transformation on curves.

Experiment 5: Design of Bi-cubic Surfaces :

Experiment 6: Design of Bezier surfaces

Experiment 7: Design of B-Spline Surfaces of surfaces.

Experiment 8: Transformations and projection

Experiment 9: Solid Modeling of few objects

Text/Reference Books:

- RudraPratap , Getting started with MATLAB: A quick introduction for scientists and engineers. Oxford Series.

MACHINE DESIGN LAB –I (ME-1552)

Assembly drawing of machine elements using AutoCAD/Solid works

- a) Threaded joints.
- b) Cotter and Knuckle joint.
- c) Couplings.
- d) Screw Jack.
- e) Tailstock.
- f) Plummer block.
- g) Rams bottom safety valve.
- h) Cylinder relief valve.
- i) Blow-off cock.
- j) Tool post.
- k) Gear box.

MANUFACTURING TECHNOLOGY LAB-I (ME-1553)

Experiment 1: Design and Preparation of a wooden pattern for the given dimensions of a casting of V- block made of Cast Iron/Steel

Experiment 2: Preparation of machine mould as per the dimensions of a given part and study of moulding methods used in Foundry Shop.

Experiment 3: To find green compression and shear strength of a given sample of green sand.

Experiment 4: To find shatter index of a given sample of green sand.

Experiment 5: To find the moisture content in a given sample of green sand.

Experiment 6: Study of Sieve Shaker and to find Grain Fineness Number for a given sample of foundry sand.

Experiment 7: Study of Permeability Tester and to find Permeability Number for a given sample of foundry sand.

Experiment 8: Determination of sheet length and bending force required for forming the given ‘Z’ section.

Experiment 9: Study of Power Press and Power Hammer

Experiment 10: Study of Laser Beam Machine.

ME-1554: Thermal Engineering Laboratory-II

Experiment 1: Study and performance of Nestler Boiler (To find the equivalent evaporation, Boiler efficiency and prepare the heat balance).

Experiment 2: Study and performance of Steam Turbine

Experiment 3: Study and performance of surface condenser

Experiment 4: Study and performance of complete steam power plant

Experiment 5: To find the dryness fraction of wet steam using separation throttling calorimeter.

Experiment 6: Study and performance of vertical steam engine

Experiment 7: Study of 60° Rovers Gas Turbine and to draw the air fuel, lubrication and power cycles.

Experiment 8: Study and performance of two stage reciprocating air compressor.

Experiment 9: Study of steam boiler models of Lancashire, locomotive and Babcock & Wilcox.

Experiment 10: Study of simple Impulse turbine and Parson’s reaction turbine models.

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MANUFACTURING SCIENCE AND TECHNOLOGY-II (ME-1603)

UNIT 1: Metal Cutting Principle-Mechanism of Chip Formation; Types of Chips; Orthogonal and Oblique cutting, Cutting Forces and Merchant Circle Diagram, Shear angle and Friction angle, Shear Velocity and Chip Velocity, Length of shear and friction plane, Stresses in shear and friction plane, Energy in shear and friction plane, Strains in shear and friction plane, Temperature in shear and friction plane; **Cutting Tools and Fluids:** Cutting Tool Materials, Cutting Tool Life, Cutting Tool Geometries, and Cutting Fluid Applications 6(L)

UNIT 2: Cutting Machining Operations-Cutting Tool Technology, Machine Tool Technology and Holding Tool Technology, Process Geometry, Cutting Conditions, Calculation of Material Removal Rate (MRR), Surface Roughness (Ra), Cutting Forces and Power for Turning and related operations; Drilling and related operations; Milling and Gear Cutting, Shaping and Planning; Broaching and Sawing operations; Economics of Machining by Cutting 12(L)

UNIT 3: Abrasive Machining Operations-Features, Need and Classifications of Abrasive Machining; Abrasive Grinding- Wheel Specification, Wheel Life; Balancing, Truing and Dressing of Wheels; Classifications of Abrasive Grinding Processes; Chipping action in grinding, Calculation of Grinding Time and Material Removal Rate, Forces and Power, Heat and Temperature; Working Principle and Applications of grinding processes for prismatic and rotational surfaces; Abrasive Finishing-Conventional abrasive finishing-Honing, Lapping, Polishing and Buffing; Modern Abrasive Finishing - Abrasive Flow Finishing and Magnetic Abrasive Finishing 12(L)

UNIT 4: Advanced Machining Operations-Need and Classification of Erosion based Machining Processes; Process Principle, Equipments and Applications of Electro-Discharge Machining (EDM) and Beam Machining Processes (e.g. LBM, EBM, IBM,); Electro-Chemical Machining (ECM) and Chemical Machining Processes (e.g. CHM, PCM, BCM), Ultra-Sonic Machining (USM) and Jet Machining Processes (AJM, WJM, AWJM), Introduction to Hybrid Machining Processes 6(L)

UNIT 5: Welding Science and Technology: Need and Classifications of Joining Processes; Solid Welding-Diffusion, Friction, Forge and Roll Welding; Explosive and Ultra-sonic Welding; Fusion Resistance Welding- Spot, Projection and Seam welding, Resistant Butt and Flash Butt welding; High Frequency Resistance and High Frequency Induction welding; Fusion Arc Welding-Non consumable electrode arc welding- CAW, GTAW, PAW and Consumable electrode arc welding-SMAW and GMAW, SAW and ESW; Twin electrode arc welding-twin carbon and tungsten; Fusion Gas Welding: Oxy Acetylene and Oxy Hydrogen; Thermit Welding; Fusion Beam Welding: LBW and EBW; Welding Defects and Inspection; Characteristics and applications of Brazing and Soldering 6(L)

Text/Reference Books:

- Manufacturing Science by Ghosh and Mallik, East West Press Pvt. Ltd., New Delhi
- Fundamentals of Modern Manufacturing by M. P. Groover, John Wiley and Sons, New Delhi
- Introduction to Machining Science by G. K. Lal, New Age International Ltd., New Delhi
- Manufacturing Engineering and Technology by Kalpakjian and Schmid, Pearson Education Pvt. Ltd. New Delhi

PRODUCTION AND OPERATIONS MANAGEMENT(ME-1607)

UNIT 1: Aggregate Production Planning-Master scheduling, Bills of materials and MRP, Purpose and scope, Basic strategies, Disaggregating methods, Order control and flow control, Routing, Scheduling and priority dispatching, Operations scheduling, Forecasting, Causal and time series models, moving average, exponential smoothening, trend and seasonality 8(L)

UNIT 2: Capacity Planning and Facility Design: Importance of Capacity and Location decisions, Measuring Capacity, Capacity Strategy, Capacity Planning and Evaluation Methods. Facility location factors, evaluation of alternatives, Types of plant layout, evaluation, Computer aided layout, Assembly line balancing. 7(L)

UNIT 3: Simulation Analysis for Operation Management-Types of Simulation Models, Steps in Simulation Modelling and Analysis, Sample Simulation, Evaluation Simulation Output 5(L)

UNIT 4: Selection of Process Structure and Technology-Classification of Production Processes: Flow Processes, Job-shop Processes, Cellular Processes, and Project Processes. Modern Production Technologies: Group Technology, Process Automation, and CAD/CAM. Methods for evaluating Process and Technology 10(L)

UNIT 5:Lean Production System: Kanban and Pull system, implementation of JIT Production, JIT Scheduling, Benefits of JIT, Evaluation of JIT Production, Bottleneck scheduling and theory of constraints, 5(L)

UNIT 6: Supply Chain Management-Introduction and overview of supply chain management, Inbound and outbound logistics, Supply chain as a source of competitive advantage. Customer service, physical distribution planning, channel considerations, inventory strategies and management, transportation infrastructure and management, Industry analysis and value-chain models, the concept of total cost of ownership, supply stream strategies, classification and development guidelines, measuring effectiveness of supply management, The Bullwhip Effect and supply-chain management game. Performance of Supply Chain 10(L)

Text/Reference Books:

- Production and Operations Management by Hamid Noori and Russell Radford
- Production and Operations Management by Joseph S. Martinich
- Production and Operations Management by Everett E. Adam, Jr. Ronald J. Ebert
- Production and Operations Management by S. N. Chary
- Modern Production/Operations Management by Elwood S. Buffa and Rakesh K. Sarin
- Operations Management For Competitive Advantage by Chase – Jacobs-Aquilano

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TOOL ENGINEERING (ME-1608)

UNIT 1: Cutting Tools-Classification of Cutting Tools; Single Point Cutting Tools- Classification, Nomenclature, and Specifications; design of single point tools for lathes, shapers and planers; Design of Inserts, Chip breakers and their design; Form Tools-Flat and circular form tools, their design and applications; Multi Point Cutting Tools- Classification, Nomenclature, and Specifications; Design of drills, milling cutters, broaches, and taps 12(L)

UNIT 2: Forming Dies-Classification of forming dies and presses; Construction, working and design of bulk metal deformation dies such as wire drawing dies, Extrusion dies, Forging dies and Rolling dies; Construction, working and design of sheet metal working dies such as Blanking dies, Piercing dies, bending and deep drawing dies; Construction, working and design of Dies used for Casting, Plastic Moulding, and Powder Metallurgy 12(L)

UNIT 3: Jigs and Fixtures-Classification of Jigs and Fixtures, Fundamental Principles of design of Jigs and Fixtures, Location and Clamping in Jigs and fixtures, Simple design for drilling Jigs, Milling fixtures, Indexing Jigs and fixtures, etc 6(L)

UNIT 4: Gauges-Classification and Selection of materials for gauges; Construction, working and design of Limit Gauges, Plug gauges, Snap gauges, and Screw gauges 3(L)

UNIT 5: Machine Tools: Classification and Components of Machine Tools, Classification and Specification of Machine Tools; Analysis and design of machine tool structure; Design of Drives and Transmission, Stepped Regulation of Speed, Design of Speed Box and Feed Box, Special Gear Boxes, Classification of Speed and Feed Boxes, Design of Guideways and Slideways 6(L)

Text/Reference Books:

- Fundamentals of Tool Design by ASTME, Prentice Hall of India Pvt. Ltd.
- Tool Design by Donaldson, Tata-McGraw Hill
- Tool Design by H.W. Pollack, Reston Publishing Company, Inc.
- Principles of Jig and Tool Design by MHA Kempster, English University Press Ltd.
- Jigs and Fixtures by P. H. Joshi, Tata-McGraw Hill
- Principles of Machine Tools by Senand Bhattacharya, New Central Book Agency Kolkata.
- Machine Tool Design by N. K. Mehta, Tata McGraw Hill
- Machine tool Design by CMTI, Tata McGraw Hill
- Machine Tool Structures by Koenigsberger and Tlusty, Pergamon Press
- Production Engineering Sciences, Pandey and Singh, Standard Publishers, Delhi
- A Textbook of Production Engineering, P.C. Sharma, S. Chand & Company Ltd.

COMMUNICATION SKILL WORKSHOP (HS-1601)

Experiment 1: Art of communication: What is communication, good communication and effective communication, barriers and filters, activity on barriers and filters.

Experiment 2: Body language: verbal and non-verbal behavior interpretation, activity on non-verbal communication.

Experiment 3: Active listening. Active listening quiz.

Experiment 4: Feedback: How to give and receive feedback, Activity on feedback.

Experiment 5: Hidden date of communication: Feelings. Activity on how to handle feelings.

Experiment 6: Practical skills: assertiveness, activity on assertiveness, self-confidence, activity.

Experiment 7: In the world of teams: the team concept, element of teamwork. Team formation, effective team, exercise on team, Team players, activity.

Experiment 8: Discussions, decisions and presentations: Structured and un-structured group discussions. Activity on each.

Experiment 9: Adapting to Corporate life: exercise on grooming and dressing, getting ready for interview.

Experiment 10: Business Etiquette/Dining etiquette.

COMPUTER AIDED MANUFACTURING LAB (ME-1651)

Experiment 1: Study of CNC Lathe and prepare a Part programming using GM codes for a given part drawing and verify it on computer.

Experiment 2: Study of CNC Drilling and prepare a Part programming using GM codes for a given part drawing and verify it on computer.

Experiment 3: Study of CNC Milling and prepare a Part programming using GM codes for a given part drawing and verify it on computer.

Experiment 4: Prepare a Part programming Manuscript using GM codes for a given part drawing and verify it.

Experiment 5: Write a program for a given part drawing using "APT" language.

Experiment 6: Study of HMT CNC TRAIN MASTER Lathe.

Experiment 7: Study of HMT CNC TRAIN MASTER Machining Centre.

Experiment 8: Study of PMT CNC Lathe.

Experiment 9: Study of various types of Automatic Tool changers.

Experiment 10: Study of different components of robot.

Experiment 11: Programming on HMT Trainer Lathe.

Experiment 12: Programming on HMT milling machine.

MACHINE DESIGN LAB II (ME-1652)

- Experiment 1:** Development of algorithm and program for design of shaft, keys and coupling.
- Experiment 2:** Development of algorithm and program for design of Power screw/bolt nut.
- Experiment 3:** Development of algorithm and program for design of springs.
- Experiment 4:** Two dimensional computer drafting of single gear set with involute tooth profile in meshing condition: Knowledge of computer graphics facility on C/C+ development of algorithm.
- Experiment 5:** Development of algorithm and program for design of spur/spiral/helical gear set. Design problem of spur gear on solid works.
- Experiment 6:** Development of algorithm and program for design of bevel gear set. Design Problem of bevel gear on solid works.
- Experiment 7:** Development of algorithm and program for design of hydrodynamic bearing. Design problem of hydrodynamic bearing on solid works.
- Experiment 8:** Development of algorithm and program for selection design of ball bearing.
- Experiment 9:** Some case studies on Axiomatic Design of Suh.
- Experiment 10:** Two dimensional computer drafting of a single gear set with involute tooth profile in meshing condition: Knowledge of computer graphics facility on C/C+, Development of algorithm and program.
- Experiment 11:** Development of algorithm and program for design of spur/spiral/helical gear set. Design problem of spur gear on solidworks.
- Experiment 12:** Development of algorithm and program for design of bevel gear set. Design problem of bevel gear on solidworks.
- Experiment 13:** Development of algorithm and program for design of hydrodynamic bearing. Design problem of hydrodynamic bearing on solidworks.
- Experiment 14:** Development of algorithm and program for selection design of ball bearing.
- Experiment 15:** Drafting assembly drawing of: Tail Stock, Ramsbottom safety valve and Blow-off Cock on AutoCAD. Use of layers to show assembly.
- Experiment 16:** Some case studies on Axiomatic Design of Suh.

MANUFACTURING TECHNOLOGY LAB II (ME-1653)

- Experiment 1:** Preparation of a SINGLE POINT CUTTING TOOL as per the given tool specification. Also write the process sheet for the same.
- Experiment 2:** To make a job as per drawing on the CAPSTAN LATHE. Write the process sheet and draw the sketches of the machine tool and tools used.
- Experiment 3:** To make a job as per drawing using RADIAL DRILLING MACHINE. Write the process sheet and draw the sketches of the machine tool and tools used.
- Experiment 4:** Study of Indexing Mechanism for Gear Cutting and to cut gear on a gear blank using Indexing Mechanism on HORIZONTAL MILLING MACHINE. Write the process sheet and draw the sketches of the machine tool and tools used.
- Experiment 5:** To make a slot as per drawing using VERTICAL MILLING MACHINE. Write the process sheet and draw the sketches of the machine tool and tools used.
- Experiment 6:** To make a job as per drawing using CYLINDRICAL GRINDING MACHINE. Write the process sheet and draw the Sketches of the machine tool and tools used.
- Experiment 7:** To make a job as per drawing using SURFACE GRINDING MACHINE. Write the process sheet and draw the Sketches of the machine tool and tools used.
- Experiment 8:** Study of SHAPER, PLANER and SLOTTER
- Experiment 9:** Study of MIG WELDING MACHINE and preparation of T-joint. Study the welding defects induced. Also draw the sketches of the tools used.
- Experiment 10:** Demonstration and study about CUTTING, DRILLING AND WELDING operation on LASER BEAM MACHINE
- Experiment 11:** Study of ELECTRICAL DISCHARGE MACHINE

TOOL ENGINEERING LAB (ME-1655)

- Experiment 1:** Study of Box type Jig.
- Experiment 2:** Study of Indexing Fixture.
- Experiment 3:** Study of Twist Drill.
- Experiment 4:** Study of Guide ways of Lathe, Milling, Drill machines.
- Experiment 5:** Study of Indexing Jig.
- Experiment 6:** Study of Form tools.
- Experiment 7:** Study of Locating Devices.
- Experiment 8:** Study of Clamping Devices.
- Experiment 9:** Design of tool for drilling using CAD software.
- Experiment 10:** Design of tool for milling using CAD software.
- Experiment 11:** Design of tool for grinding using CAD software.

PDMS

ADVANCED MANUFACTURING PROCESSES (ME-1703)

UNIT 1: Advanced Machining Processes-Process Principle, Analysis and Applications of Electric Discharge Machining, Laser Beam Machining, Electron Beam Machining, Ion Beam Machining, Plasma Beam Machining, Ultra-Sonic Machining, Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Electrochemical Machining, Chemical Machining; Hybrid Machining Processes: Electro-Chemical Discharge Machining, Electro-Chemical Abrasive Grinding, Electro-Discharge Abrasive Grinding. 15(L)

UNIT 2: Advanced Finishing Processes-Need, classification, process principle and applications of Abrasive Flow Finishing, Magnetic Abrasive Flow Finishing, Magnetic Abrasive Finishing, Electroglue Magnetic Abrasive Finishing, Magneto-Rheological Finishing and Elastic Emission Finishing 6(L)

UNIT 3: Advanced Welding Processes- Laser Beam Welding, Electron Beam Welding, Ultra-Sonic Welding, Plasma Arc Welding, Explosive Welding, Under Water Welding, Welding in Space, Micro Welding Processes. 6(L)

UNIT 4: Generative Manufacturing Processes-Concept of generative manufacturing, need and Classification, Process principle and Applications of Selective Laser Sintering, Fused Deposition Manufacturing, Stereolithography, Ballistic Particle Manufacturing, Three Dimensional Printing, Laminated Object Manufacturing. 9(L)

UNIT 5: Advanced Forming Processes: Explosive forming, Electro hydraulic forming, Electro magnetic forming, Laser Bending, Powder rolling, Spray rolling, Hydro forming, Hydrostatic and Powder extrusion, powder, rotary and isothermal forming. 6(L)

Text/Reference Books:

- Non Traditional Manufacturing Processes by G F. Benedict, Marcel Dekker Inc, New York
- Advanced Machining Processes by V. K. Jain, Allied Publisher Bombay
- Advanced Machining Methods by J. A. McGough, Chapman and Hall, London
- New technology by Bhattacharaya
- Modern Machining Process by Aditham
- Manufacturing Science by Ghosh and Malik, EWP Private Ltd.
- Modern Machining Processes by Pandey and Shan, TMH Publication, New Delhi
- Solid Freeform Manufacturing by D. Kochan,

ECONOMICS (HS-1701)

UNIT 1: Introduction to Economics; Nature and Scope of Economics, Significance, Branches of Economics, Micro and Macro, fundamental concepts. Objectives of a firm. 6(L)

UNIT 2: Utility Analysis: cardinal and ordinal view, laws. Demand Analysis; Law of Demand, Exceptions to the law of Demand, Determinants of Demand. Elasticity of Demand- Price, Income, Cross and Advertising Elasticity; Uses of Elasticity of Demand for managerial decision making, measurement of Elasticity of Demand. Demand forecasting meaning, significance and methods. 8(L)

UNIT 3: Supply Analysis; Law of Supply, Supply Elasticity; Analysis and its uses for managerial decision making. Production concepts & analysis; Production function, single variable-law of variable proportion, two variable-Law of returns to scale. Cost concept and analysis, short-run and long-run cost curves and its managerial use. 8(L)

UNIT 4: Market Equilibrium and Average Revenue Concept. Market Structure: Perfect Competition, features, determination of price under perfect competition. Monopoly: Feature, pricing under monopoly, Price Discrimination. Monopolistic: Features, pricing under monopolistic competition, product differentiation. Oligopoly: Features, kinked demand curve, cartels, price leadership. 8(L)

UNIT 5: Pricing Strategies; Price determination, full cost pricing, product line pricing, price skimming, penetration pricing. 4(L)

UNIT 6: Indian Economy: National Income; Concepts and various methods of its measurement, Inflation, types and causes, Business Cycle. 6(L)

Text/Reference Books:

- Damodaran Suma – Managerial Economics (Oxford 2006)
- Hirschey Mark – Economics for Managers (Thomson, India Edition, 2007)
- Dominick Salvatore - Managerial Economics (Oxford, 2007)
- Mithani D.M. - Principles of Economics (Himalaya Publishing House, 2005).
- Dwivedi D.N. - Managerial Economics (Vikas Publication, 7th Edition)

Professional Elective – I

OPTIMIZATION METHODS IN ENGINEERING (ME-1731)

UNIT 1: Introduction-Optimization Problem Formulation, Design Variables, Constraints, Objective Function, Variable Bounds, Engineering Optimization Problems, Optimization Algorithms.

UNIT 2: Single Variable Optimization Problems-Optimality Criterion, Bracketing Methods: Exhaustive Search Method, Bounding Phase Method.

UNIT 3: Region Elimination Methods-Interval Halving Method, Fibonacci Search Method, Golden Section Search Method.

UNIT 4: Point Estimation Method-Successive Quadratic Estimation Method.

UNIT 5: Gradient Based Methods-One of the followings-Newton-Raphson Method, Bisection Method, Secant Method, Cubic Search Method.

UNIT 6: Multivariable Optimization Algorithms-Optimality Criteria, Unidirectional Search, Direct Search Methods: Any two of the followings-Evolutionary optimization method, Simplex Search Method, Hooke-Jeeves pattern search method, Powell's Conjugate Direction Method.

UNIT 7: Gradient Based Methods-Cauchy's Steepest Descent Method, Newton's method, Marquardt's Method, Conjugate Gradient Method, Variable-metric Method.

UNIT 8: Constrained Optimization Algorithms, Kuhn Tucker Conditions, Transformation Methods-Penalty Function Method, Method of Multipliers. Sensitivity analysis

UNIT 9: Specialized Algorithms, Integer Programming-Penalty Function Method, Branch and Bound Method., Geometric Programming

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UNIT 10: Non-Traditional Optimization Algorithms- Genetic Algorithms: Working Principle, Differences between Genetic and traditional methods, GA for constrained optimization. Other GA operators.

UNIT 11: Simulated Annealing-Analogy, Algorithm, Application.

DYNAMIC DESIGN OF MECHANICAL SYSTEMS (ME-1732)

UNIT 1: Introduction to modal testing-Overview of dynamic design and modal analysis. Use of MATLAB for solving vibration engineering problems. Basics of modal analysis and presentation and properties of FRF data for SDOF system, undamped multi-degrees-of-freedom systems(MDOF), proportional damping, hysteretic damping, viscous damping, characteristics and presentation of MDOF FRF data.

UNIT 2: Mobility measurement techniques-Basic measurement system, structure preparation, excitation of the structure, transducers and amplifiers, analyzers, digital signal processing, use of different excitation types, calibration, mass cancellation.

UNIT 3: Modal parameter extraction methods-System identification techniques (SDOF and MDOF), Preliminary checks of FRF data, SDOF modal analysis – Peak amplitude, circle-fit method, inverse method, residuals, introduction to MDOF curve-fitting procedure – extension of SDOF method.

UNIT 4: Derivation of Mathematical models: Modal models, display of modal model, response models, spatial models, mobility skeletons and system models.

UNIT 5: Application: comparison of experiment and predication, correction or adjustment of models. Structural modifications and its optimization. Response predication and force determination. Application of modal analysis to real structures. Case studies.

Text/Reference Books:

- Modal Analysis: by Jimin He and Zhi-Fang Fu, 2001, Butterworth-Heinemann, Woburn, MA, USA.
- Modal testing; Theory, Practice and application, second edition, D J Ewins, research studies Press Ltd., Baldock Hertfordshire, England.
- Fundamental of mechanical Vibration, 1993, S grahm Kelly, McGraw-Hill Intl. Editions.
- Mechanical Vibration, 1990, S S Rao, Addition-Wesley publishing company.

MACHINE TOOL DESIGN (ME-1733)

UNIT 1: Broad Classification of Tools-Cutting tools, Dies , Holding and Measuring tools. 2(L)

UNIT 2: Design of Jigs and Fixtures-Classification of Jigs and Fixtures, Fundamental Principles of design of Jigs and Fixtures, Location and Clamping in Jigs and fixtures, Simple design for drilling Jigs, Milling fixtures etc. Indexing Jigs and fixtures.6(L)

UNIT 3: Design of limit Gauges- Classification, Selection of materials for gauges, Design of Plug gauges, Snap gauges, Screw gauges, etc. 2(L)

UNIT 4: Design of Cutting Tools- Single Point Cutting Tools: Classification, Nomenclature, geometry, design of single point tools for lathes, shapers, planers etc. Chip breakers and their design. 8(L)

UNIT 5: Design of Cutting Tools-Multipoint Cutting Tools: Classification and specification, nomenclature, Design of drills, milling cutters, broaches, taps etc. 10(L)

UNIT 6: Design of Form Tools-Flat and circular form tools, their design and application. 2(L)

UNIT 7: Design of Dies-Classification of dies, Design of Dies for Bulk metal Deformation-Wire Drawing, Extrusion, Forging and Rolling. 4(L)

UNIT 8: Design of Dies for Sheet metal-Blanking and Piercing, Bending and Deep-drawing. 4(L)

UNIT 9: Design of Dies used for Casting and Moulding, Powder Metallurgy die design. 2(L)

Text/Reference Books:

- Donaldson, C., LeCain, G.H., Goold, V.C., 'Tool Design', Tata McGraw Hill, 1980.
- Pollack, H.W. Tool Design, Reston Publishing Company, Inc. 1966
- Kempster, M.H.A. Principles of Jig and Tool Design, English University Press Ltd.
- Pandey, P.C., Singh, C.K., Production Engineering Sciences, Standard Publishers, Delhi, 2001.

ADVANCED MANUFACTURING PROCESSES (ME-1734)

UNIT 1: Introduction- Need and classification of unconventional manufacturing processes, brief overview.

UNIT 2: Unconventional Machining Processes-Process Principle, Analysis and Applications of Electric Discharge Machining, Laser Beam Machining, Electron Beam Machining, Ion Beam Machining, Plasma Beam Machining, Ultra-Sonic Machining, Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ice Jet Machining, Electrochemical Machining, Chemical Machining, Bio Chemical Machining. Hybrid Machining Processes: Electrochemical Discharge Machining, Electro-Chemical Abrasive Grinding, Electro Discharge Abrasive Grinding.

UNIT 3: Unconventional Finishing Processes- Need, classification, process principle and applications of Abrasive Flow Finishing, Magnetic Abrasive Flow Finishing, Magnetic Abrasive Finishing, Electrogel Magnetic Abrasive Finishing, Magneto-Rheological Finishing.

UNIT 4: Unconventional Welding Processes-Laser Beam Welding, Electron Beam Welding, Ultra-Sonic Welding, Plasma Arc Welding, Explosive Welding, Under Water Welding, Welding in Space, Micro Welding Processes.

UNIT 5: Generative Manufacturing Processes- Concept of generative manufacturing, need and Classification, Process principle and Applications of Selective Laser Sintering, Fused Deposition Manufacturing, SterioLithography, Ballistic Particle Manufacturing, Three Dimensional Printing, Laminated Object Manufacturing.

UNIT 6: Unconventional Forming Processes-Explosive forming, Electro hydraulic forming, Electro- magnetic forming, Laser Bending, Powder rolling, Spray rolling, Hydro forming, Hydrostatic and Powder extrusion, powder, rotary and isothermal forming.

KNOWLEDGE MANAGEMENT (ME-1735)

UNIT 1: Define Data, Information, and knowledge. Study the different methods for conversion of data into information. Difference between data, information and knowledge. Different methods for conversion of data into information. Types of knowledge. Define knowledge management. Knowledge management framework and value propositions for knowledge management implementation. Knowledge management Enablers for implementation, knowledge management barriers for implementation. Knowledge management processes and knowledge management technologies. Selection criteria for knowledge management team members. Knowledge management is an essential survival imperative. Knowledge sharing enablers and knowledge sharing barriers. Categorization of knowledge sharing barriers: group/individual, organizational, and technological. Application of ISM methodology, Similarity coefficient methodology, AHP methodology for the categorization, similarity and quantify. the critical variables.

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REFRIGERATION AND AIR CONDITIONING (ME-1736)

UNIT 1: Refrigeration-Introduction to refrigeration system: Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration capacity, C.O.P., applications. Air refrigeration cycle, Bell Coleman air refrigeration cycle, Brayton refrigeration cycle, optimum C.O.P. & pressure ratio, air craft refrigeration system, classification of air craft refrigeration system, Actual power for refrigeration system, Dry Air Rated Temperature [DART]

UNIT 2: Refrigerants-Classification, Nomenclature, Desirable properties of refrigerants, common refrigerants secondary refrigerants and CFC free refrigerants.

UNIT 3: Vapor Compression System- Single stage system, Analysis of vapor compression cycle, Effect of pressure change on C.O.P. use of T-S and p-h chart, Effect of subcooling of condensate on C.O.P. and capacity, effect of super heating of vapor-compression constructional details of Refrigerator and Air conditioners. Multi stage compression.

UNIT 4: Vapor-Absorption System-Working Principle of continuous Absorption System, compression between Absorption & compression system. Theory of mixtures, Temp-concentration Diagram, Enthalpy concentration diagram. Adiabatic mixing of two systems, Lithium-Bromide water-vapor absorption system. Working principle, compression with Ammonia-water system.

UNIT 5: Air Conditioning-Introduction to air-conditioning, psychrometric terms, Definitions, Adiabatic saturation & Thermodynamic, wet-bulb temperature, psychrometers use of psychrometric chart, Air conditioning requirement for comfort and industrial processes, comfort chart & comfort zones, cooling towers, cooling & heating load calculations.

UNIT 6: Refrigeration Equipment & Application-Expansion device, Duct design. Food preservation cold storage, refrigerators, freezers, ice plant, water coolers, thermal analysis for human body. Automotive air conditioning-brief overview. Introduction to solar radiation distributions. Empirical methods to evaluate heat transfer through walls & roofs, infiltration, passive heating & cooling of buildings.

REVERSE ENGINEERING (ME-1738)

UNIT 1: Introduction of Reverse and concurrent engineering-Elements of concurrent engineering. Advantage and applications.

UNIT 2: Theory of measurements-Linear, angular, curved surfaces, methods of advanced Measuring devices, Coordinate Measuring machine. Elements to CMM. Data accumulation, retrieval.

UNIT 3: Geometric Modeling-2D and 3D Graphics, concepts of various transformation of Geometric Models, Wireframe surface and solid modeling techniques, representation of parametric and non-parametric curves and surfaces, Mathematical representation of solid and solid modeling- based applications. CAD/CAM data exchanges. Visual realism and Graphics Tools, Applications, AutoCAD, Auto surf, Auto Mil., and UNIGRAPHICS. CAD/CAM interfaces, process planning, computer aided production planning systems. Capacity planning. Part Programming. APT, CAPPS programming, Geometry definition, Tool Path generation.

UNIT 4: Rapid Prototyping- Concurrent Engineering, Need of Rapid Prototyping. Techniques, Resins, (Laser engines) Laser, Laser production and control. Post curing, Data retrieval from CAD, MIC codes generation, Apparatus for quality measurement. (CMM)

MODELING AND SIMULATION IN ENGINEERING (ME-1739)

UNIT 1: Fundamental aspect of modeling-Technical and Commercial aspects, types of modeling- Analytical, experimental, mechanistic, numerical, AI based and stochastic. Model testing, Principles of simulation, Discrete event simulation. Applications in design and manufacturing.

PRESSURE VESSEL DESIGN (ME-1739)

UNIT 1: Basic principles-Elastic analysis of shells of revolution, membrane solutions, spherical and cylindrical shells, Junctions of shells of different geometry, Limit analysis, Shakedown.

UNIT 2: Pressure vessel branches- Radial nozzle in spherical shell, stress concentration factors due to combined loadings, design methods to reduce SCF, nonradial nozzles in spherical shells, Junction analysis of radial and non-radial nozzles in cylindrical shells.

UNIT 3: Pressure vessel ends-different design forms.

UNIT 4: Flanges-Stress analysis and design methods.

UNIT 5: Local loading and local attachments-Supports design. Creep and fatigue in thin pressure vessels and its components. Pressure vessel design codes.

UNIT 6: Thickwall design-monoblock cylinders and spheres, multiplayer constructions. Pre-stressing of thick shells, shrink fit construction, wire and ribbon wound cylinders, Plastic radial expansion autofretting. Thermal stress, creep and stress rupture; Dynamic and fatigue behaviour.

UNIT 7: Case studies-Vessels for special purposes. Computer aided design of pressure vessels

Text/Reference Books:

- Harvey J F, 'Pressure vessel design' CBS publication
- Brownell. L. E & Young. E. D, 'Process equipment design', Wiley Eastern Ltd., India
- ASME Pressure Vessel and Boiler code, Section VIII Div 1 & 2, 2003
- American standard code for pressure piping , B 31.1
- Henry H Bednar, Pressure vessel Design Hand book, CBS publishers and distributors
- Stanley M Wales, Chemical Process equipment, selection and design, Butterworths, series in Chemical Engineering, 1988
- William.j.,Bees,"Approximate methods in the Design and Analysis of pressure vessels and piping", ASME Pressure vessels and piping conference,1997

Professional Elective-II

FINITE ELEMENT METHODS IN ENGINEERING (ME-1741)

UNIT 1: Approaches of FEM-Discrete, Variational and Weighted Residual; Direct Problems- Spring, Hydraulic Network; Resistance Network and Truss Systems; 1-D Field and Beam Bending Problems; 2-D and Axisymmetric Field and Stress Problems; Plate Bending; 3-D Stress Analysis; Solutions of Unsteady Problems related to Stress Analysis, Heat Conduction, Fluid flow and Vibration. Solutions of Plane Stress, Plane Strain and Axisymmetric Plasticity Problems.

FUELS COMBUSTION AND POLLUTION (ME-1742)

Unit 1: Chemistry of Combustion-Combustion and its Chemistry, Heat, Types of Fuel, Molecularity and order of reaction, Rates of reaction, Arrhenius equation. Conservation equations of mass, momentum, energy and species for a multicomponent system.

Unit 2: Combustion of gaseous fuel jets-Premixed and diffusion flames, Laminar and turbulent flames. Concepts of kinetically controlled and diffusion controlled reactions, Flammability limits, Ignition, Burning velocity, Flame structure and Stability for laminar flames.

Unit 3: Liquid Fuel combustion-Atomization of liquid, Various atomizers and their performances Evaporation of droplets in high temperature gas streams. Simple model of droplet burning. Physical and mathematical models of spray flames.

Wms

Unit 4: Combustion of Solids-Description of carbon sphere combustion, Diffusional theory of carbon combustion of pulverized coal.

Unit 5: Pollution-Pollutant formation in various combustion processes and their controlling measures.

Text/Reference Books:

- An Introduction to Combustion: Concepts and Applications by *Stephen R. Turns*
- Combustion Engineering by G. L. Borman, K. W. Ragland

ROBOTICS (ME-1743)

Unit 1: Introduction-Past, Present & Future; Robot Terminology; Applications, Components and Subsystems; Classification of Robot, End Effectors, Different types of grippers and design concepts.

Unit 2: Robot Kinematics-Object location; Homogenous, Transformations, Direct and Inverse Kinematics, Manipulator motion,

Unit 3: Robot Drives, Actuators and Control-Drive systems Hydraulic, Pneumatic and Electrical : DC Motor, Stepper Motor, Robot Motion and Path control, controller.

Unit 4: Sensors and Perception-Types of sensors, vision system. Computer Interfaces.

ADVANCED WELDING TECHNOLOGY (ME-1744)

Unit 1: Introduction-A review of various metal joining techniques such as welding, brazing, soldering and adhesive bonding, welding compared with other processes of fabrication. Classification of welding processes. Application of welding processes.

Unit 2: Fusion Welding-Mechanism of arc initiation and maintenance, Temperature distribution. Techniques, scope and limitations of manual metal arc. TIG, MIG, submerged arc. Electroslag welding. Plasma Arc and Electro gas welding. Various gas welding processes e.g. oxyacetylene oxy-hydrogen welding processes.

Unit 3: Resistance welding, Modern welding processes-viz. Electron Beam, Ultrasonic; Explosive, laser beam processes and their applications. Solid state welding processes viz. Friction, Diffusion, cold pressure process and their applications.

Unit 4: Oxygen cutting Plasma Arc cutting-laser cutting processes etc.

Unit 5: Brazing, soldering and adhesive bonding-Scope and application.

Unit 6: Welding defects and remedies-Weld cracking and prevention. Testing and inspection of welds.

RELIABILITY ENGINEERING (ME-1745)

Unit 1: Elements of probability theory-Elements of statistical theory. Some general stochastic processes. Statistical failure models. System reliability. reliability improvement. Maintainability and availability. fault tree analysis, Failure mode effect analysis. Reliability physics models.

Unit 2: Optimization techniques for systems reliability with redundancy. Heuristic methods applied to optimal system reliability. Dynamic programming applied to optimal system reliability. Discrete maximum principle applied to optimal; system reliability. Sequential unconstrained minimization techniques. Generalised reduced gradient method. Method of Lagrangian multiplier and Kuhn-Tucjer conditions applied to optimal system reliability. Generalized Lagrangian function. Geometric and integer programming methods applied to optimal system reliability. Other methods to system reliability optimization problems. Determination of component reliability and redundancy for optimum system reliability.

Unit 3: Point and interval estimation procedure for life time distributions. Testing reliability hypotheses. Bayes methods in reliability. Design and analysis of life test experiments. Accelerated life testing. Non-parametric methods.

Unit 4: Introduction to engineering design - design morphology - production process & material selection. Concept of load, strength optimization and safety. Reliability principles. product life cycle, design and development, risk reliability, product liability. Failure analysis techniques, Case histories of failures. Quality Control. Design for maintenance. Ergonomics in design, Probabilistic concept in design. Cost evaluation and economic decision making. Case studies of reliability design process in allied engineering systems (Electrical, Aeronautical, Mechanical, Civil etc.)

Unit 5: Detail Part Consideration :- Component reliability, derating, failure analysis of passive components and integrated circuits, Accelerated testing, Electrostatic Discharge, VLSI reliability issues.

NON-CONVENTIONAL ENERGY RESOURCES (ME-1746)

Unit 1: Introduction-the energy crisis – causes and options, renewable and non-renewable forms of energy and their characteristics, availability of renewable energy and land area requirements.

Unit 2: Biomass energy-thermo-chemical and biological conversion to solid, liquid and gaseous fuels; production of bioethanol, biogas and producer gas.

Unit 3: Ocean, wave and tidal energy-Ocean thermal energy conversion – closed and open cycles and their limitations, Wave energy and its conversion through oscillating water column, Tidal energy – nature of the tides and tidal barrages for power generation.

Unit 4: Wind energy-power in the wind, site selection, maximum power coefficient, wind turbine types – horizontal axis and vertical axis machines, performance of wind machines.

Unit 5: Geothermal energy-hot aquifers and hot dry rock systems.

Unit 6: Solar energy-(i) solar radiation at the earth's surface, flat-plate and concentrating collectors, solar ponds and energy storage, solar thermal power generation. (ii) Solar photovoltaic power generation: monocrystalline, polycrystalline and amorphous silicon modules and their production technology.

CAD OF THERMAL SYSTEMS (ME-1747)

Unit 1: Study of the design aspects. Fluid flow and heat transfer characteristics and materials requirements of at least two of the following types of heat exchange equipment: Liquid-to-liquid. Liquid -to-gas and gas-to-gas heat exchangers. Cooling tower, Familiarity with the use of the design related international/national and other codes. Preparation of necessary computer programs for designing the thermal system. Learning of the techniques for presenting design features of the thermal equipment.

ADVANCED AUTOMOBILE ENGINEERING (ME-1748)

Unit 1: Introduction and overview –Beginnings Growth and refinement. 3(L)

Unit 2: Prime movers–types-advantages & limitations of different fuel based prime movers - alternative technologies. Comparison on Well to wheel basis. 4(L)

Unit 3: Types of suspension & Drive- front mounted engines- rear mounted drive- advantages and limitations, rear and mid mounted engines drive, front wheel drive- types of design- advantages and disadvantages, four wheel drive advantages and disadvantages 6(L)

Unit 4: Automotive vehicle safety, basic concepts of vehicle safety, fail safe, alternative designs, safety factors, designs for uncertainty, crash testing 4(L)

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- Unit 5:** Introduction to Traffic Engineering -Highway Engineering- geometric design of highways – Accident causes. 4(L)
- Unit 6:** Tyres & Wheels requirements, Wheel travel & Elastokinematics 6(L)
- Unit 7:** Steering- systems -types-limitations. Hydraulic, electro hydraulic and electrical power steering, steering column, steering damper. 4(L)
- Unit 8:** Springing- comfort requirements- weights and axle loads, Shock absorbers, spring damper units 4(L)
- Unit 9:** Chassis – Vehicle and body centre of gravity and handling properties, axle weight and axle centre of gravity, body weight and body centre of gravity, Braking behavior –stability, anti dive control, traction behavior. 6(L)
- Unit 10:** Future -vehicle safety, techno legal issues- ethics, testing of automotive components, failure investigations- (to be continued with topic. 4(L)

Text/Reference Books:

- The Automotive Chassis by J. Reimpell, H Stoll- SAE International
- The Motor Vehicle: by- Newton and Steed
- Automotive vehicle safety – George A Peters & Barbara J Peters
- Automotive Engineering Fundamentals – Richard Stone and J K Ball
- Chassis design – Principles and Analysis
- Electric Vehicle Technology Explained – James Larminie, John Lowry
- Highway Design & Traffic Safety Engineering Handbook Ruediger Lamm
- The handbook of road safety measures- Rune Elvik, Alena Hoye

Along with the above following is also desired to follow:

Various trade magazines on automobile published nationally and internationally.

A watchful eye on news paper reports on automobile related accidents for the purpose of analyzing the cause of accident such that the accident can be reduced in the society.

Visit to automobile repair shops for the feel of Engineering.

Motor vehicle acts and rules being enforced from time to time available from law book stores.

Production catalogue from various automobile manufactures and if possible the service manual of the vehicles.

During the course students are required to work on projects allotted to them.

CONCURRENT ENGINEERING (ME-1749)

Unit 1: Meaning and Purpose of Concurrent Engineering, Techniques of Concurrent Engineering - Quality Function Deployment (QFD), Design for manufacture (DFM), Design for assembly (DFA), Taguchi method for Robust design (TMRD), Failure mode and effect analysis (FMEA), Design for reliability, maintainability and serviceability, Implementation

NOISE AND VIBRATION (ME-1750)

UNIT 1: Noise-Random aspects of noise, traffic noise community noise, automobile noise, jet noise, aircraft noise. Sonic bang, acoustic fatigue. Industrial noise, noise in piping system. Noise in machines and components of reciprocating and rotating machines.

UNIT 2: Noise control systems-types and design of exhaust mufflers, sound absorbing materials.

UNIT 3: Noise measurement and instrumentation-Effect of noise on human beings.

UNIT 4: Vibration-Systems with one degree of freedom, Free and forced vibration, torsional vibration. Analysis by Rayleigh's method. Stodola method and iterative method of Holtzer. Analysis and application of forced vibration in steady state as well as transient state, self excited vibrations. Free vibrations of systems with several degrees of freedom. Free vibration of elastic bodies, Free longitudinal vibrations of Prismatic bar, orthogonality principle.

Open Electives

ENERGY MANAGEMENT

Unit 1: Introduction-the energy-economy link, patterns of energy use in developing countries, the electricity-economy link for developing economies, options to overcome the energy crisis, characteristics of conventional and non-conventional energy resources. Conventional energy resources and their utilization; thermal, nuclear and hydro-electric power plants, use of diesel engines and gas turbines for power generation, combined cycles for efficient power generation.

Unit 2: Non-conventional energy resources and their utilization-solar, geothermal, wind, wave, biomass and ocean-thermal energy conversion and their limitations. Energy storage techniques.

Unit 3: Energy conservation-energy auditing, process energy and gross energy requirements, energy recovery: insulation, heat recovery heat exchangers, heat-pumps, combined heat and power plants (cogeneration), efficient lighting and energy conservation in buildings.

Unit 4: Environmental aspects of energy resource utilization-combustion generated air pollution, global warming, acid rain, fly ash disposal, radioactive pollution and nuclear waste disposal.

NON-CONVENTIONAL ENERGY RESOURCES

Unit 1: Introduction-the energy crisis – causes and options, renewable and non-renewable forms of energy and their characteristics, availability of renewable energy and land area requirements.

Unit 2: Biomass energy-thermo-chemical and biological conversion to solid, liquid and gaseous fuels; production of bioethanol, biogas and producer gas.

Unit 3: Ocean, wave and tidal energy-Ocean thermal energy conversion – closed and open cycles and their limitations, Wave energy and its conversion through oscillating water column, Tidal energy – nature of the tides and tidal barrages for power generation.

Unit 4: Wind energy-power in the wind, site selection, maximum power coefficient, wind turbine types – horizontal axis and vertical axis machines, performance of wind machines.

Unit 5: Geothermal energy-hot aquifers and hot dry rock systems.

Unit 6: Solar energy-(i) solar radiation at the earth's surface, flat-plate and concentrating collectors, solar ponds and energy storage, solar thermal power generation.(ii) Solar photovoltaic power generation: monocrystalline, polycrystalline and amorphous silicon modules and their production technology.

OPERATIONS RESEARCH

Unit 1: Introduction-History of operations research. Nature & Scope of Operations Research. Allocation, assignment and transportation models, construction and Solution of these models.

Unit 2: Linear Programming-Introduction, Mathematical formulation of the problem. Graphical solution methods. Mathematical solution of linear programming problem, Slack, and surplus variables. Matrix formulation of General linear Programming Problem.

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Unit 3: The Simplex Method-Fundamental properties of solution corroboration of extreme points. Simplex algorithm, computational procedures. Artificial variables. Two phase simplex method. Formulation of linear Programming Problems and its solution by simplex method. Unrestricted variables, problems of degeneracy. Principle of duality in Simplex method. Formation of dual with mixed type of constraints. Solution of primal and dual (solution of dual contains solution of Primal also) Sensitivity analysis.

Unit 4: Integer Programming-Formulation and solution of Integer Programming problem.

Unit 5: Game Theory-Introduction. Two persons zero sum games. The Maxxmini and Minimax principles.

Unit 6: Graphical Solution-Reduction of Game problem to L.P.P. The transportation problem Matrix form of transportation problem, initial basic feasible solution. Selecting the entering variable. Selecting the leaving variable. Transportation algorithm. Degeneracy in transportation problem. Inventory Control.

ME-1751: Thermal Engineering Laboratory-IV

Experiment 1: Study of vapour compression refrigeration tutor

Experiment 2: Study and performance of air refrigeration system

Experiment 3: Study of air conditioner tutor and window air conditioner.

Experiment 4: Study of vapour absorption system

Experiment 5: Study and performance of desert cooler

Experiment 6: Study and performance of vortex tube refrigerator tutor

Experiment 7: Study and performance of steam jet refrigeration system

MAJOR PROJECT (STAGE 1) (ME-1791)

ADVANCED MANUFACTURING LAB (1755)

Experiment 1: Determination of Material Removal Rate (MRR) during Sinking-Electro-Discharge Machining (Sinking-EDM).

Experiment 2: Determination of material Removal Rate (MRR) during Drilling-Electro-Discharge Machining (Drilling-EDM).

Experiment 3: Determination of material Removal Rate (MRR) during Electro-Discharge Diamond Grinding (EDDG).

Experiment 4: Cutting of curved profile as per drawing on Mild Steel Sheet using Nd-YAG Pulsed Laser Beam Machine.

Experiment 5: Drilling of holes on Mild Steel Sheet using Nd-YAG Pulsed Laser Beam Machine.

Experiment 6: Welding of Mild Steel Sheets using Nd-YAG Pulser Laser Beam Machine.

Experiment 7: Study of Fused Deposition Modeling (FDM) Rapid Prototyping Machine.

PRODUCT DESIGN AND DEVELOPMENT (ME-1801)

UNIT 1: Introduction-Introduction to product design, Significance of product design, product design and development process, sequential Engineering design method, the challenges of product development,

Development Process and Organizations-Generic Development Process, Concept Development, Adapting the generic PD process flows, AMF development Process, Product Development Organizations, The AMF Organization.

UNIT 2: Product Planning and Identifying Customer Needs-Product Planning process, Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs, review of the process.

Product Specifications:-Establish target specifications, setting final specifications,

UNIT 3: Concept Generation-Activities of concept generation, clarifying problem, search both internally and externally, explore the output,

Concept Selection:-Overview, concept screening and concept scoring, methods of selection.

Concept Testing-Elements of testing: qualitative and quantitative methods including survey, measurement of customers' response.

Product Architecture-Modular and Integral architecture, implications, establishing the architecture, Delayed differentiation, Platform Planning.

Industrial Design-Assessing need for industrial design, Impact of industrial Design, industrial design process, management of industrial design process, assessing quality of industrial design.

UNIT 4: Embodiment Design: Design for Manufacturing, prototyping. Robust Design

Intellectual Property and Environmental Guidelines-Intellectual Property: Elements and outline, patenting procedures, claim procedure, Environmental regulations from government, ISO system.

Text/Reference Books:

- Ulrich K. T, and Eppinger S. D, Product Design and Development, Tata McGraw Hill
- Otto K, and Wood K, Product Design, Pearson
- Engineering of creativity: introduction to TRIZ methodology of inventive Problem Solving, By Semyon D. Savransky, CRC Press.

ENERGY CONSERVATION (ME-1802)

UNIT 1: Introduction – the energy crisis, options to ameliorate the energy crisis and their impact, the energy conservation option, energy auditing – scope and purpose, process energy and gross energy requirements. 6(L)

UNIT 2: Efficient energy conversion, combined cycles, combined heat and power plants, combined cooling and power plants (Goswami cycle), tri-generation and multi-generation systems. 9(L)

UNIT 3: Energy recovery in refrigeration and air conditioning systems, desiccant cooling, heat pumps; mechanical vapour recompression systems applied to evaporation, distillation and drying processes; energy efficiency through cascade refrigeration with V-C and V-A systems; double-effect V-A systems for COP improvement. 9(L)

UNIT 4: Energy conservation in buildings, thermal load reduction through insulation and solar passive techniques. 6(L)

UNIT 5: Case studies from industrial and commercial sectors. 6(L)

Text/Reference Books:

- “Energy Efficiency” by Eastop and Croft; Longman Scientific and Technical
- “Managing energy in commerce industry” by Gordon A. Payne; Butterworth
- www.bee-india.nic.in (Bureau of Energy Efficiency, Ministry of Power, GOI.
- “Energy: Management, Supply and Conservation” by Clive Beggs, Butterworth-Heinemann

PROFESSIONAL ELECTIVE – III

DESIGN AGAINST FATIGUE AND FRACTURE (ME-1831)

Fracture of Cracked Members

Unit 1: Introduction-cracks as stress raisers, behavior at crack tips in real materials, effects of cracks on strength, effect of cracks on brittle versus ductile behaviors.

Unit 2: Mathematics concepts of-strain energy release rate, G_c , stress intensity factor K .

Unit 3: Application of K to design & analysis-mathematical form used to express K , cases of special interest for practical applications, discussion.

Unit 4: Fracture toughness values and trends-trends of K_{IC} with material, effects of temperature and loading rate, micro structural influences on K_{IC} .

Unit 5: Plastic zone size and plasticity limitation on LEFM-plastic zone size for plane stress, plastic zone size for plane strain, plasticity limitation on LEFM.

Unit 6: Standard test methods for-fracture toughness testing, effect of thickness on fracture behavior

SOLAR ENERGY AND ITS APPLICATIONS (ME-1833)

Unit 1: The energy crisis: causes and options, renewable and non-renewable forms of energy and their characteristics, solar energy option – availability and land area requirements. Solar radiation outside the earth's atmosphere and at the earth's surface, instruments for measuring solar radiation, solar radiation geometry, basic earth-sun angles, flux on tilted surfaces.

Unit 2: Liquid flat-plate collectors-design and performance parameters, solar air heaters, concentrating collectors, solar ponds and energy storage.

Unit 3: Solar thermal power generation-low, medium and high temperature cycles, solar cooling, drying and desalination, solar air and water heating, solar passive architecture.

Unit 4: Solar photovoltaic power generation-monocrystalline, polycrystalline and amorphous cells, Fabrication and performance of SPV modules.

Unit 5: Indirect methods of solar energy utilization-biomass, wind, wave and ocean thermal energy conversion technologies. Economic considerations.

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MECHATRONICS (ME-1834)

Unit 1: Fundamentals of Mechatronics, definitions and Concepts; Conventional vs. Mechatronics Systems; Need of Mechatronics in Mechanical Engineering; Sensors and Transducers with Special reference to Mechatronics. Signals System and actuating devices; real time interfacing. Applications of Mechatronics in Manufacturing and Automation Case Studies.

METAL FORMING (ME-1837)

Fundamentals of Elasticity, Plasticity and Viscoplasticity, Stress and strain invariant

Unit 1: Elasticity-State of stress and strain, stress-strain relations, strain-displacement relations.

Unit 2: Plasticity and Viscoplasticity-Yield criterion, effective stress and strain, state of plastic strain, Plastic strain rate, Flow rule, Effective strain rate, plastic anisotropy and viscoplasticity (determination of load and power) concept of solid and flow formulations.

Analysis of Deformation Processes using SSM, UBM & SLM

Unit 3: Plain strain Problems-Drawing and Extrusion of sheet, Rolling and forging of strips.

Unit 4: Axisymmetric Problems-Drawing and Extrusion of bar and tube, forging of solid and Hollow disc.

Unit 5: Sheet metal problems-Axisymmetric deep drawing and stretching.

MECHANICAL SYSTEM DESIGN (ME-1839)

Unit 1: Engineering Process and systems Approach-Application of Systems concepts in Engineering, Identification of Engineering functions, Systems approach, Engineering Activity Matrix, Defining the proposed effort, Role of Engineer, Engineering Problem Solving, Concurrent Engineering. A case study.

Unit 2: Problem Formulation-Nature of Engineering Problems, Needs Statement, Hierarchical Nature of Systems, Hierarchical nature of problem environment, Problem scope and constraints. Case study.

Unit 3: System Theories-System analysis view points, black box approach, state theory approach, component integration approach, Decision Process Approach, Case study.

Unit 4: System Modelling-Need for modelling, Modelling types and purposes, Linear graph modelling concepts, Mathematical Modelling Concepts. Case Study.

Unit 5: Linear Graph Analysis-Graph Modelling and Analysis Process, Path problem, Network flow problem. Case Study.

Unit 6: Optimisation Concepts-Optimisation process, Motivation and freedom of Choice, goals and objectives- Criteria, methods of optimisation-analytical, combinatorial, subjective. Case Study.

Unit 7: System Evaluation-Feasibility Assessment, planning horizon, time value of money, financial analysis. A case study.

Unit 8: Calculus Methods for Optimization-Model with one or more decision variables, model equality and/ or inequality constraint, Case study.

Unit 9: Decision Analysis-Elements of a decision problem, Decision model probability, Expected monetary value, Utility value, Baye's theorem. Case Study.

Unit 10: System Simulation-Simulation Concepts, simulation models, Iconic, Analog, Analytical, Waiting line simulation, Simulation Process Problem definition, input model construction, solution process, limitations of simulation approach: A case study.

Unit 11: Axiomatic Approach of Suh-Problem definition and FRs, Hierarchy of FRs and DPs: decomposition of Design process, Design for manufacture.

COMPUTER-INTEGRATED MANUFACTURING (ME-1840)

Unit 1: Fundamentals of Automation in Manufacturing Systems-Manufacturing Systems: Concept Objectives, Types and Trends; Concepts of Mechanization, Automation and Integration

Unit 2: Functions and Components of CIM System-Concept of CAD/CAM and CIMS

Unit 3: Software Technology for CIM System-Business Database System: File processing, Data Processing and Database Design, File Organization and Relational Analysis; Decision Support System, Personal/Distributed Computing and Local Area Network

Unit 4: Group Technology and Cellular Manufacturing-Concept of Group Technology and its Application, classification and Coding Techniques; Clustering Techniques and Cellular Manufacturing

Unit 5: Planning and Scheduling Functions in CIM System-Aggregate Production Planning (APP), Master Production Schedule (MPS), Material Requirement Planning (MRP), Capacity Requirement Planning (CRP), Manufacturing Resource Planning (MRP-II), Just-In-time Production Systems and Concept of Enterprise Resource Planning (ERP).

Unit 6: Computer-Aided Process Planning-Approaches – Variant and Generative, Feature Classification and Recognition; Process Classifications and Selections, Machines and Tool Selection, Setting Process Parameters, Process Sheet Documentation

Unit 7: Automated Material Handling Systems-Industrial Robots, Conveyors, AGVs, Automatic Storage and Retrieval Systems

Unit 8: Advanced Manufacturing Systems-Lean Manufacturing systems, Agile Manufacturing systems, Reconfigurable Manufacturing Systems, Holonic Manufacturing Systems and Agent-Based Manufacturing Systems

Text/Reference Books:

- Nanua Singh, 1995, Systems Approach to Computer Integrated Design and manufacturing, John Wiley & Sons.
- James A. Rehg and Henry W. Kraebber, 2005. *Computer-Integrated Manufacturing*. Second Edition, Pearson Education (Singapore) private Ltd., Delhi.
- Mikell P. Groover, 2005. *Automation, Production Systems and Computer-Integrated Manufacturing*. Second Edition, Pearson Education (Singapore) private Ltd., Delhi.
- Andrew Kusiak, 1990. *Intelligent Manufacturing Systems*, Englewood Cliffs, New Jersey: Prentice Hall.

PROFESSIONAL ELECTIVE – IV

PRECISION ENGINEERING (ME-1842)

History, Basic concepts, Dynamic characteristics of device Elements like bearings, locks and stops, coupling clutches, energy storing elements etc. Gear, Wedge, Screw and linkage mechanism Instruments for displacement, velocity acceleration, force and torque. Precision systems like video discs and d rives, laser printer etc. Design considerations for environments cooling electronic equipment. Systematic approach for design.

TOTAL QUALITY MANAGEMENT (ME-1844)

Concept of quality, quality control and quality management, Science of quality, human resources and quality, Quality organization and management: Quality manual, quality cost, quality related tasks, Quality information system: Planning, hardware-software, Statistical process control and quality deployment techniques, Controlling quality through measurement and through counting, Quality system and I.S.O. 9000 series, Quality assurance, Reports on quality, quality audit, quality training, Newer quality management approaches, Quality tools.

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RAPID PROTOTYPING (ME-1845)

Unit 1: Introduction-Phases of Prototyping, Fundamentals of R.P. Classification of R.P. Processes.

Unit 2: Rapid Prototyping Process-Automated Processes, Difference between Additive and Subtractive Processes, Process Chain, steps involved in R.P.

Unit 3: Types of R.P. systems-Liquid Based, Solid Based, & Powder Based. Data Formats in R.P. Application of R.P. in Manufacturing and Rapid Tooling. Evaluation and Benchmarking Modeling practice on softwares such as IDEAS, UNIGRAPHICS, ProE, etc.

SUPPLY CHAIN MANAGEMENT (ME-1846)

Unit 1: Introduction to Logistics and Supply Chain Management, Concepts, Drivers and obstacles, Planning Demand and supply in a supply chain-Demand forecasting, Aggregate Planning, Management of Inventory in global supply Chain, Role of Information Technology in supply chain. e-Business and the supply chain, Factors influencing logistics and decision, Bench making and performance measurement.

Energy Management (ME-1850)

Unit 1: Introduction, energy crisis - causes and options, renewable and non-renewable forms of energy and their characteristics.

6(L)

Unit 2: The energy-economy link, patterns of energy use in developed and developing countries, the electricity-economy link for developing economies.

6(L)

Unit 3: Environmental aspects of energy resource utilization, combustion generated air pollution, global warming due to (a) green house effect (b) use of non-equilibrium energy sources i.e. nuclear and fossil fuels, acid rain, fly ash disposal, radioactive pollution and nuclear waste disposal.

6(L)

Unit 4: Energy conservation, Energy auditing, process energy and gross energy requirements, energy recovery: insulation, heat recovery: heat pumps, combined heat and power plants (cogeneration and tri-generation systems), Solar Passive architecture and solar water heating.

12(L)

Unit 5: Sustainable energy supply options, biofuels and solar photovoltaic power generation.

6(L)

Unit 6: Case studies in energy management.

4(L)

Text/Reference Books:

- Energy for a sustainable world, by Goldemberg et al, Wiley Eastern.
- Energy efficiency, by Eastop and Croft, Longman Scientific and Technical.
- www.bee-india.nic.in, Bureau of energy efficiency, Ministry of power, Govt. of India.
- Solar Energy, by Sukhatme, Tata McGraw Hill.

Open Electives

ENERGY MANAGEMENT

Unit 1: Introduction-the energy-economy link, patterns of energy use in developing countries, the electricity-economy link for developing economies, options to overcome the energy crisis, characteristics of conventional and non-conventional energy resources. Conventional energy resources and their utilization; thermal, nuclear and hydro-electric power plants, use of diesel engines and gas turbines for power generation, combined cycles for efficient power generation.

Unit 2: Non-conventional energy resources and their utilization-solar, geothermal, wind, wave, biomass and ocean-thermal energy conversion and their limitations. Energy storage techniques.

Unit 3: Energy conservation-energy auditing, process energy and gross energy requirements, energy recovery: insulation, heat recovery heat exchangers, heat-pumps, combined heat and power plants (cogeneration), efficient lighting and energy conservation in buildings.

Unit 4: Environmental aspects of energy resource utilization-combustion generated air pollution, global warming, acid rain, fly ash disposal, radioactive pollution and nuclear waste disposal.

NON-CONVENTIONAL ENERGY RESOURCES

Unit 1: Introduction-the energy crisis – causes and options, renewable and non-renewable forms of energy and their characteristics, availability of renewable energy and land area requirements.

Unit 2: Biomass energy-thermo-chemical and biological conversion to solid, liquid and gaseous fuels; production of bioethanol, biogas and producer gas.

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OPERATIONS RESEARCH

Unit 1: Introduction-History of operations research. Nature & Scope of Operations Research. Allocation, assignment and transportation models, construction and Solution of these models.

Unit 2: Linear Programming-Introduction, Mathematical formulation of the problem. Graphical solution methods. Mathematical solution of linear programming problem, Slack, and surplus variables. Matrix formulation of General linear Programming Problem.

Unit 3: The Simplex Method-Fundamental properties of solution corroboration of extreme points. Simplex algorithm, computational procedures. Artificial variables. Two phase simplex method. Formulation of linear Programming Problems and its solution by simplex method. Unrestricted variables, problems of degeneracy. Principle of duality in Simplex method. Formation of dual with mixed type of constraints. Solution of primal and dual (solution of dual contains solution of Primal also) Sensitivity analysis.

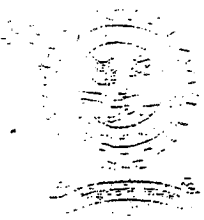
Unit 4: Integer Programming-Formulation and solution of Integer Programming problem.

Unit 5: Game Theory-Introduction. Two persons zero sum games. The Maxxmini and Minimax principles.

Unit 6: Graphical Solution-Reduction of Game problem to L.P.P. The transportation problem Matrix form of transportation problem, initial basic feasible solution. Selecting the entering variable. Selecting the leaving variable. Transportation algorithm. Degeneracy in transportation problem. Inventory Control.

MAJOR PROJECT (STAGE 2) (ME-1891)

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मोतीलाल नेहरू राष्ट्रीय प्रौद्योगिकी संस्थान इलाहाबाद

इलाहाबाद - 211004 (भारत)

Office of the Dean Academics

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Director's Office
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DOI... 2579
Date 20.10.2012

Phone: 0532-2271109, 2271110
Fax : 0532-2545341, 2545577
Website: www.mnnit.ac.in

Dated: 20.10.2012

Director

The list of Gold Medals for Ninth Annual Convocation - 2012 has been prepared by Dean (Academic) office. The above list is submitted for your perusal & necessary approval for making the medals.

[Chairman SPGC]

[Chairman SUGC]

[Dy. Dean Academic]

20/10/12

[Dy. Registrar Academic]

22-10-2012



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List of Gold Medal recipients for Ninth Convocation-2012 of the Institute.

Names of Gold Medal awardees for Convocation-2012

GOLD MEDALS FOR POST GRADUATE EXAMINATION - 2012

1. Gold Medal awarded to Pavankumar Tungala Enrollment No. 2010AM11 for standing first at M.Tech. in Applied Mechanics, Final Examination 2012. (CPI 8.43)
2. Gold Medal awarded to Neha Saxena Enrollment No. 2010BM21 for standing first at M.Tech. in Biomedical Engineering, Final Examination 2012. (CPI 9.48)
3. Gold Medal awarded to Vishnudas R Enrollment No. 2010FE02 for standing first at M.Tech. in Fluids Engineering, Final Examination 2012. (CPI 9.0)
4. Gold Medal awarded to Rahul Agarwal Enrollment No. 2010MT01 for standing first at M.Tech. in Material Science & Engineering, Final Examination 2012. (CPI 8.57)
5. Gold Medal awarded to Anuj Shukla Enrollment No. 2010BT07 for standing first at M.Tech. in Bio-Technology Final Examination 2012. (CPI 9.31)
6. Gold Medal awarded to Smita Kaloni Enrollment No. 2010ST02 for standing first at M.Tech. in Civil Engineering (Structural Engineering) Final Examination 2012. (CPI 9.0)
7. Gold Medal awarded to Amit Kumar Jha Enrollment No. 2010EN07 for standing first at M.Tech. in Environmental Engineering Final Examination 2012. (CPI 9.1)
8. Gold Medal awarded to Sonali Shrivastava Enrollment No. 2010GE05 for standing first at M.Tech. in Civil Engineering (Geo-Technology) Final Examination 2012. (CPI 8.6)
9. Gold Medal awarded to Shubhra Shivani Enrollment No. 2010CS05 for standing first at M.Tech. in Computer Science & Engineering Final Examination 2012. (CPI 10.0)
10. Gold Medal awarded to Durgesh Bajpai Enrollment No. 2010IS23 for standing first at M.Tech. in Information Security Final Examination 2012. (CPI 9.87)
11. Gold Medal awarded to Priyanka Goel Enrollment No. 2010SW26 for standing first at M.Tech. in Software Engineering Final Examination 2012. (CPI 9.75)
12. Gold Medal awarded Vipin Chandra Pal Enrollment No. 2010EE17 for standing first at M.Tech. in Electrical Engineering (Control & Instrumentation) Final Examination 2012. (CPI 8.8)
13. Gold Medal awarded to Nareshkumar Kummari Enrollment No. 2010PE34 for standing first at M.Tech. in Electrical Engineering (Power Electronics & ASIC Design) Final EXAMINATION 2012. (CPI 9.0)
14. Gold Medal awarded to Yerraguntla Shasi Kumar Enrollment No. 2010PE23 for standing first at M.Tech. in Electrical Engineering (Power Electronics & ASIC Design) Final EXAMINATION 2012. (CPI 9.0)
15. Gold Medal awarded to Anuj Kumar Varshney Enrollment No. 2010EL16 for standing first at M.Tech. in Electronics Engineering (Digital System) Final Examination 2012. (CPI 9.67)

S. B. D. Gupta

Ramesh Kumar

V. J. Singh



मोतीलाल नेहरू राष्ट्रीय प्रौद्योगिकी संस्थान
इलाहाबाद - 211004 (भारत)
MOTILAL NEHRU NATIONAL INSTITUTE OF TECHNOLOGY
Allahabad - 211004 (India)

Phone: 0532-2271109, 2271110
Fax : 0532-2545341, 2545677
Website: www.mnnit.ac.in

List of Gold Medal recipients for Ninth Convocation-2012 of the Institute. .

Names of Gold Medal awardees for Convocation-2012

GOLD MEDALS FOR POST GRADUATE EXAMINATION - 2012

1. Gold Medal awarded to Pavankumar Tungala Enrollment No. 2010AM11 for standing first at M.Tech. in Applied Mechanics, Final Examination 2012. (CPI 8.43)
2. Gold Medal awarded to Neha Saxena Enrollment No. 2010BM21 for standing first at M.Tech. in Biomedical Engineering, Final Examination 2012. (CPI 9.48)
3. Gold Medal awarded to Vishnudas R Enrollment No. 2010FE02 for standing first at M.Tech. in Fluids Engineering, Final Examination 2012. (CPI 9.0)
4. Gold Medal awarded to Rahul Agarwal Enrollment No. 2010MT01 for standing first at M.Tech. in Material Science & Engineering, Final Examination 2012. (CPI 8.57)
5. Gold Medal awarded to Anuj Shukla Enrollment No. 2010BT07 for standing first at M.Tech. in Bio-Technology Final Examination 2012. (CPI 9.31)
6. Gold Medal awarded to Smita Kaloni Enrollment No. 2010ST02 for standing first at M.Tech. in Civil Engineering (Structural Engineering) Final Examination 2012. (CPI 9.0)
7. Gold Medal awarded to Amit Kumar Jha Enrollment No. 2010EN07 for standing first at M.Tech. in Environmental Engineering Final Examination 2012. (CPI 9.1)
8. Gold Medal awarded to Sonali Shrivastava Enrollment No. 2010GE05 for standing first at M.Tech. in Civil Engineering (Geo-Technology) Final Examination 2012. (CPI 8.6)
9. Gold Medal awarded to Shubhra Shivani Enrollment No. 2010CS05 for standing first at M.Tech. in Computer Science & Engineering Final Examination 2012. (CPI 10.0)
10. Gold Medal awarded to Durgesh Bajpai Enrollment No. 2010IS23 for standing first at M.Tech. in Information Security Final Examination 2012. (CPI 9.87)
11. Gold Medal awarded to Priyanka Goel Enrollment No. 2010SW26 for standing first at M.Tech. in Software Engineering Final Examination 2012. (CPI 9.75)
12. Gold Medal awarded Vipin Chandra Pal Enrollment No. 2010EE17 for standing first at M.Tech. in Electrical Engineering (Control & Instrumentation) Final Examination 2012. (CPI 8.8)
13. Gold Medal awarded to Nareshkumar Kummari Enrollment No. 2010PE34 for standing first at M.Tech. in Electrical Engineering (Power Electronics & ASIC Design) Final EXAMINATION 2012. (CPI 9.0)
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S. B. Gupta *Ravi* *Rushan* *Vijay* *M. G.*

16. Gold Medal awarded to **Sumandeep Raaj** Enrollment No. 2010VE12 for standing first at M.Tech. in Microelectronics and VLSI Design Final Examination 2012. (CPI 9.89)
17. Gold Medal awarded to **Swati Sachan** Enrollment No. 2010CC02 for standing first at M.Tech. in Mechanical Engineering (Computer Aided Design and Manufacturing) Final Examination 2012. (CPI 9.7)
18. Gold Medal awarded to **Sachin Gupta** Enrollment No. 2010DN23 for standing first at M.Tech. in Mechanical Engineering (Design) Final Examination 2012. (CPI 9.5)
19. Gold Medal awarded to **Aazad Hussain A** Enrollment No. 2010PD07 for standing first at M.Tech. in Mechanical Engineering (Product Design and Development) Final Examination 2012. (CPI 9.1)
20. Gold Medal awarded to **Dayanidhi Krishana Pathak** Enrollment No. 2010PR23 for standing first at M.Tech. in Mechanical Engineering (Production Engineering) Final Examination 2012. (CPI 9.7)
21. Gold Medal awarded to **Alka Maurya** Enrollment No. 2010GI02 for standing first at M.Tech. in GIS and Remote Sensing Final Examination 2012. (CPI 9.6)
22. Gold Medal awarded to **Dhiraj Kumar Gupta** Enrollment No. 2009CA53 for standing first at Master of Computer Applications Final Examination 2012. (CPI 9.15)
23. Gold Medal awarded to **Anamika Singh** Enrollment No. 2010MB11 for standing first at Master of Business Administration Final Examination 2012. (CPI 9.81)
24. Gold Medal awarded to **Anand Pratap Singh** Enrollment No. 2010MSC07 for standing first at Master of Science (Mathematics & Scientific Computing) Final Examination 2012. (CPI 8.8)
25. Gold Medal awarded to **Atul Sharma** Enrollment No. 2010MW14 for standing first at Master of Social Work Final Examination 2012. (CPI 9.46)

GOLD MEDALS FOR UNDER GRADUATE EXAMINATION - 2012

1. Gold Medal awarded to **Sneha Saxena** Enrollment No. 20080022 for standing first at B.Tech. (Biotechnology) Final Examination 2012. (CPI 9.43)
2. Gold Medal awarded to **Jitendra Kumar Chaurasiya** Enrollment No. 20088011 for standing first at B.Tech. (Civil Engineering) Final Examination 2012. (CPI 9.17)
3. Gold Medal awarded to **Kanupriya Sharma** Enrollment No. 20087047 for standing first at B.Tech. (Chemical Engineering) Final Examination 2012. (CPI 9.48)
4. Gold Medal awarded to **Ayush Ladia** Enrollment No. 20083012 for standing first at B.Tech. (Computer Science & Engineering) Final Examination 2012. (CPI 9.59)
5. Gold Medal awarded to **Ratnesh Thakur** Enrollment No. 20088010 for standing first at B.Tech. (Information Technology) Final Examination 2012. (CPI 9.26)
6. Gold Medal awarded to **Madhur Sarin** Enrollment No. 20088056 for standing first at B.Tech. (Electronics & Communication Engineering) Final Examination 2012. (CPI 9.37)
7. Gold Medal awarded to **Rishi Rahul** Enrollment No. 20082008 for standing first at B.Tech. (Electrical Engineering) Final Examination 2012. (CPI 9.27)
8. Gold Medal awarded to **Alok Agarwal** Enrollment No. 20081001 for standing first at B.Tech. (Mechanical Engineering) Final Examination 2012. (CPI 9.79)
9. Gold Medal awarded to **Rishabh Jain** Enrollment No. 20086030 for standing first at B.Tech. (Production & Industrial Engineering) Final Examination 2012. (CPI 9.17)

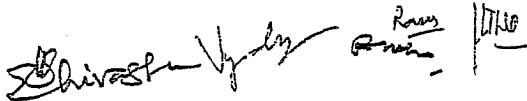
S.B.P. Jaiswal *Ravi* *Rishabh* *Vishal* *ADG*

INSTITUTE GOLD MEDAL FOR UNDER GRADUATE EXAMINATION-2012

1. Institute Gold Medal awarded to Alok Agarwal Enrollment No. 20081001 of B.Tech. (Mechanical Engineering) for standing first amongst students of all branches of the Institute Final Examination 2012. (CPI 9.79)

GOLD MEDALS – 2012 FOR UNDER GRADUATE

1. Gold Medal awarded to Shobhit Srivastava Enrollment No. 20098063 of B.Tech. (Computer Science & Engineering) for standing first at B.Tech. Third Year Examination 2012. (CPI 9.89)
2. Gold Medal awarded to Pakhi Agarwal Enrollment No. 20104095 of B.Tech (Computer Science and Engineering) for standing first at B.Tech. Second Year Examination 2012. (CPI 9.82)
3. Gold Medal awarded to Nishank Gupta Enrollment No. 20114008 of B.Tech (Computer Science and Engineering) for standing first at B.Tech. First Year Examination 2012. (CPI 9.6)



No. /Acad./Convocation-2012

(P. Chakrabarti)
Chairman Senate/Director
Dated: October 10th, 2012

Copy forwarded for information & necessary action to:

1. All Heads of the Deptt./All Deans
2. P.T.P./Chief Proctor/Chief Warden/Wardens
3. Registrar, MNNIT, Allahabad

(P. Chakrabarti)
Chairman Senate/Director

Director

The list of Sponsored Gold Medals for Ninth Annual Convocation – 2012 has been prepared by Office of Dean (Student Welfare). The above list is submitted for your perusal & necessary approval for making the medals.

Approved
[Signature]
22.10.2012

[Signature]
[Tanuj Nandan] 20/10/12
Dy. Dean [S.W]

Dated: 20.10.2012

SPONSORED GOLD MEDALS

1. RATAN PRAKASH MEMORIAL GOLD MEDAL AWARDED TO
SACHIN GUPTA (ENROLLMENT NO. 2010DN23)
FOR STANDING FIRST
AT M. TECH. (DESIGN) EXAMINATION 2012
2. RATAN PRAKASH MEMORIAL GOLD MEDAL AWARDED TO
SWATI SACHAN (ENROLLMENT NO. 2010CC02)
FOR STANDING FIRST
AT M. TECH. (COMPUTER AIDED DESIGN AND MANUFACTURING)
EXAMINATION 2012
3. RATAN PRAKASH MEMORIAL GOLD MEDAL AWARDED TO
DAYANIDHI KRISHNA PATHAK (ENROLLMENT NO. 2010PR23)
FOR STANDING FIRST
AT M. TECH. (PRODUCTION) EXAMINATION 2012
4. LAKHMIRI DEVI GOLD MEDAL AWARDED TO
NAVYA AGARWAL (ENROLLMENT NO. 20113010)
FOR STANDING FIRST IN CHEMISTRY
AT B. TECH. FIRST YEAR (ALL BRANCHES) EXAMINATION 2012
5. VISHVAMITRA DUGGAL GOLD MEDAL AWARDED TO
JAGENDRA SINGH (ENROLLMENT NO. 20101013)
FOR STANDING FIRST IN BASIC SURVEYING
AT B. TECH. II YEAR (CIVIL) EXAMINATION 2012
6. VISHVAMITRA DUGGAL GOLD MEDAL AWARDED TO
MAYANK CHATURVEDI (ENROLLMENT NO. 20109037)
FOR STANDING FIRST IN BASIC SURVEYING
AT B. TECH. II YEAR (CIVIL) EXAMINATION 2012
7. VISHVAMITRA DUGGAL GOLD MEDAL AWARDED TO
PRASHANT TRIPATHI (ENROLLMENT NO. 20106031)
FOR STANDING FIRST IN BASIC SURVEYING
AT B. TECH. II YEAR (CIVIL) EXAMINATION 2012
8. YASHI MISHRA GOLD MEDAL AWARDED TO
RAVI KUMAR GAUTAM (ENROLLMENT NO. 20101024)
FOR STANDING FIRST IN STRUCTURAL ANALYSIS
AT B. TECH. II YEAR (CIVIL) EXAMINATION 2012
9. SAROJ AGARWAL GOLD MEDAL AWARDED TO
SARTHAK GARG (ENROLLMENT NO. 20096052)
FOR STANDING FIRST
AT B. TECH. III YEAR (MECHANICAL) EXAMINATION 2012

10. KIRAN AGARWAL GOLD MEDAL AWARDED TO
SARTHAK GARG (ENROLLMENT NO. 20096052)
FOR STANDING FIRST IN MACHINE DESIGN
AT B. TECH. III YEAR (MECHANICAL) EXAMINATION 2012
11. BALBIR SINGH YADAV GOLD MEDAL AWARDED TO
AMIT SHARMA (ENROLLMENT NO. 20091044)
FOR STANDING FIRST IN TRANSPORTATION ENGINEERING
AT B. TECH. III YEAR (CIVIL) EXAMINATION 2012
12. MOHIT CHATURVEDI MEMORIAL GOLD MEDAL AWARDED TO
ALOK AGARWAL (20081001)
FOR STANDING FIRST
AT B. TECH. IV YEAR (MECHANICAL) EXAMINATION 2012
13. RAM CHARAN SINGH GOLD MEDAL AWARDED TO
MD. SHADAB IMAM (ENROLLMENT NO. 20087048)
FOR STANDING FIRST IN WATER RESOURCES
AT B. TECH. IV YEAR (CIVIL) EXAMINATION 2012
14. SUNIL CHAUDHARY GOLD MEDAL AWARDED TO
SRIJAN KUMAR (ENROLLMENT NO. 20081017)
FOR STANDING FIRST IN STEEL STRUCTURE
AT B. TECH. IV YEAR (CIVIL) EXAMINATION 2012
15. VIMAL CHANDRA AGARWAL GOLD MEDAL AWARDED TO
ALOK AGARWAL (ENROLLMENT NO. 20081001)
FOR STANDING FIRST AMONGST ALL THE
B. TECH. IV YEAR STUDENTS (ALL BRANCHES) EXAMINATION 2012
16. PROF. R. N. TIWARI GOLD MEDAL AWARDED TO
RISHI RAHUL (ENROLLMENT NO. 20082008)
FOR STANDING FIRST
AT B. TECH. IV YEAR (ELECTRICAL ENGINEERING) EXAMINATION 2012
17. T.C.S. GOLD MEDAL AWARDED TO
MANDEEP GANDHI (ENROLLMENT NO. 20089026)
FOR BEST PROJECT AMONGST ALL THE
B. TECH. IV YEAR STUDENTS (COMPUTER SCIENCE & ENGINEERING)
EXAMINATION 2012
18. T.C.S. GOLD MEDAL AWARDED TO
AYUSH LADIA (ENROLLMENT NO. 20083012)
FOR BEST STUDENT
B. TECH. IV YEAR STUDENTS (COMPUTER SCIENCE & ENGINEERING)
PASSING OUT BATCH 2012



Guidelines for institution of new Medals/Scholarships/Awards/Prizes etc.

Following are the guidelines for institution of new medals/scholarships/awards/prizes etc.:

(1) Scholarship & Medal:

A. Scholarship:

The minimum fixed amount to be deposited will be ₹ 2.00 lakh for scholarship and whatever amount is earned as annual interest on the Fixed Deposit of ₹ 2.00 lakh that will be the amount of Scholarship and that will be given to the concerned student.

B. Medal:

The minimum fixed amount to be deposited will be ₹ 0.60 lakh for scholarship and whatever amount is earned as annual interest on the Fixed Deposit of ₹ 0.60 lakh that will be used for preparation of medal and that will be given to the concerned student.

C. Awards:

- This will be cash award.
- Minimum deposit ₹ 1.00 lakh or its multiple. The interest amount will be used for wards.
- Academic requirements same as above.

D. Prizes:

- This will be in the form of cash or kind.
- It may be one time or as received from donor.
- This will applicable only for academic activities.

Following will be the conditions for institution of new medals/scholarships/awards/prizes etc.:

(i) Academic requirement for award of new medals/scholarships/awards/prizes etc. will be:

- No back paper
- CPI not less than 6.5
- No disciplinary action on record

(ii) All deposited would be valid for 10 years and after which the same will be reviewed.

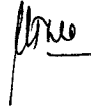
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(iii) Sponsoring person/body will be required to fill up the Application Form, placed at ANNEXURE-I for institution of new medals/scholarships/awards/prizes etc..

(iv) Institution of any new sponsored scholarship / medal / cash prize / award etc. should be only after the formal approval of the Senate in each new case.

(v) In case of institution of any new cash scholarship as mentioned above, the cash prize would be limited to ₹ 12000/- per annum or ₹ 1000/- per month in case of each newly instituted scholarship.

(vi) The weight & size of the medal to be instituted [40 gms. of silver with gold plating] will be same as that of other Institute medals. Sponsoring authority may not be allowed for suggesting any change in the medal to institute.





मोतीलाल नेहरू राष्ट्रीय प्रौद्योगिकी संस्थान इलाहाबाद
इलाहाबाद-२११००४ [भारत]

Motilal Nehru National Institute of Technology Allahabad
Allahabad-211004 [India]

APPLICATION FORM

For

Guidelines for institution of new medals/scholarships/Awards/Prizes etc.

1. Name of Sponsor :
2. Correspondence Address :
- Phone No. :
- Mobile No. :
- E-mail ID :
3. Objective of Instituting the new :
- medals/scholarships/Awards/Prizes etc.
4. Relationship with MNNIT Allahabad :
5. Minimum initial period : 10 years and the :
- reviewed
6. Suggested name after which the :
- medals/scholarships/Awards/Prizes will be :
- instituted [to be finalized by Institute :
- Committee]

[Signature of Authorized Institute signatory]

[Signature of Sponsor]