शोध Shodh

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मोतीलाल नेहरू राष्ट्रीय प्रौद्योगिकी संस्थान इलाहाबाद
प्रयागराज–211004

Editorial Board

Message from the Patron

Prof. Rajeev Tripathi, Director, MNNIT Allahabad

MNNIT Allahabad is an Institute which consistently drives to attain new heights in research and innovation. I am pleased to see that an other issue of the Research Bulletin 'Shodh' has been published to share the achievements of faculty and research scholars.

It is noteworthy that despite the ongoing challenges, various restriction and limitation due to emerging Covid variants, the innovation and research in the Institute is thriving. Filing of new patents, transfer of technology, among other ongoing sponsored research projects reflect the self-motivated dedication of our faculty and research scholars towards innovation and research. MNNIT Allahabad has featured among top 10 Institutes in ARIIA Ranking and has received 4 Star rating for innovation activities by the Ministry of Education, Government of India. This has been possible due to the zeal and creativity of MNNITians.

I am happy to share with peers in academics and industry the research achievements of the Institute. As they say, 'knowledge grows when shared'.

Wishing everyone a healthy, happy and fruitful New Year 2022.

Prof. Rajeev Tripathi
Director

मुख्य सम्पादक की लेखनी से.....

अनुसंधान और नवाचार एक सतत प्रक्रिया है। तकनीकी शोध, नवाचार, अभिकल्प एवं परामर्श, आदि मानव कल्याण, समाज उत्थान, तथा राष्ट्र प्रगति के मार्ग में मूलभूत अवयव है। एम.एन.एन.आई.टी. इलाहाबाद पिछले साठ वर्षों से राष्ट्र और मानवता की सेवा में अनुसंधान और नवाचार में महत्वपूर्ण योगदान दे रहा है। पूरी दुनिया एक अज्ञात दुश्मन कोविड 19 के खिलाफ लड़ाई लड़ रही है। हमारे निदेशक प्रो. राजीव त्रिपाठी के दूरदर्शी नेतृत्व में संस्थान के संकाय सदस्य एवं छात्र निरंतर शोध कार्य में लगे रहे। कुछ नवाचार उत्पादों को कोरोना योद्धाओं की मदद के लिए मुफ्त में वितरित भी किया गया है तथा कुछ अन्य को व्यावसायीकरण के लिए स्थानांतरित किया गया है। शोध का यह खंड विद्वान पाठकों और हितधारकों के लाभ के लिए संस्थान में किए गए शोध और नवाचार का एक संक्षिप्त विवरण प्रस्तुत करता है।

हमें विश्वास है कि आपकी प्रतिक्रिया से हमारा मनोबल बढ़ाने और सपनों को साकार करने के लिए प्रोत्साहन मिलेगा।

इस क्रम में शोध का नया अंक प्रस्तुत है।

रमा शंकर यादव
अधिष्ठाता शोध एवं परामर्श

Foreword

It has been sometime since the Dean R&C office of MNNIT Allahabad has come out with the idea of a research bulletin to showcase and highlight the research activities and achievements of the students and faculty. This new edition of SHODH grabs the opportunity to present all the exciting stuff happening in research & consultancy domain at MNNIT Allahabad. It is proud moment for me to present all the news and thereby attempting to enthuse more vigour and motivation among its readers. It is a challenging time for all of us. It gives me immense pleasure to see that our faculty and students have made untiring efforts to strive for academic excellence in research and other academic activities.

It gives me great pleasure to announce that MNNIT Allahabad has commissioned a high performance compute cluster of 18 nodes with theoretical peak performance of 47.2 teraflops. This will serve the high performance computing needs of the researchers.

I look forward to welcome and highlight the opportune news related to your achievements in research endeavours in the next version of SHODH.

A. K. Singh
Associate Dean (R&C)
Editor: Shodh

MNNIT Allahabad - A Glance

Celebrating Diamond Jubilee of its establishment, Motilal Nehru National Institute of Technology (MNNIT) Allahabad, is among one of the leading institutions in the country. Established in the year 1961 as a joint enterprise of Govt. of India and Govt. of Uttar Pradesh in accordance with the scheme of establishment of Regional Engineering Colleges, the Institute became a deemed University with effect from 26th June, 2002 and an Institute of National Importance in 2007. The Institute offers B. Tech. programmes in nine areas of technology, M. Tech. programmes in twenty for disciplines, alongwith MCA, MBA, MSc. and PhD. programmes in all branches of Engineering, Science and Management.

The infrastructure of the Institute is at par with the best institutions in the country, the Computer Centre has state-of-the-art computing facilities, departments have modern laboratories and the library houses print as well digital learning resources.

The entire campus, including hostels, executive development centre and residential area is connected with wired and wireless both. High speed internet service is available to all with 10 GBPs NKN Railtel and 500 MBPs BSNL fibre leased lines.

The Institute makes all efforts to strengthen collaborative research programmes in emerging areas of science and technology. Motilal Nehru National Institute of Technology Allahabad promotes advanced research via (i) joint thesis and research projects with industry participation, (ii) institutional assistantship to promote PG and Doctoral programmes, (iii) administrative support to faculty members to conduct consultancy and research projects, funded by external agencies.

Our alumni have headed top most public and private companies in India and abroad. They have also made a mark in Civil Services. The illustrious alumni have started connecting with their alma mater by giving back in various forms, such as sports and other student amenities.

MNNIT Allahabad is set to adopt the guidelines of National Education Policy 2020, for future batches of students.

Signing of MoU between MNNIT Allahabad and RGIPT Amethi

Motilal Nehru National Institute of Technology Allahabad, Prayagraj and Rajiv Gandhi Institute of Petroleum Technology, Amethi entered into a academic Memorandum of Understanding (MoU) to give pace to academic and research activities. The MoU signed by Prof. Rajeev Tripathi, Director, MNNIT Allahabad and Prof. A.S.K. Sinha, Director RGIPT Amethi is aimed towards development of research, academic courses, joint operation of research and technology development. On this occasion Prof. Tripathi highlighted the significant role of both Institutes in bringing academic excellence and wished to move towards the holistic development of all the students and faculty of the two Institutes. He further mentioned that this MoU will be start of new journey that will support faculty, researchers and students for exchange of knowledge, joint projects and technologies for mutual interest. Prof. A.S.K. Sinha, Director RGIPT also mentioned that MoU will facilitate exchange of faculty and administrative staff, exchange of scholars, graduate and undergraduate students, conduct lectures and organising symposia and exchange of academic information and materials.

The event was attended by Prof. Geetika Dean Resource Generation and International Affairs. Prof. R.K. Singh Dean Academics, Dr. Sarvesh Kumar Tiwari Registrar MNNIT Allahabad and other distinguished dignitaries.

Signing of MoU between MNNIT Allahabad and IIIT Allahabad

An MoU was signed between MNNIT Allahabad and IIIT Allahabad under which the students of one institution can take advantage of the expertise of faculty members of other institution. Director of IIIT Allahabad, Prof. P. Nagabhushan said on this occasion, that this MoU would be a milestone to achieve the goals of new education policy. He also said that it would extend great opportunities to young faculty members of both institutions to develop their capabilities and expertise, by doing joint research or joint academic program dedicated to the country.

On this occasion Prof. Rajeev Tripathi, Director MNNIT Allahabad expressed his feelings, that MNNIT Allahabad had strong collaborations since inception of IIIT Allahabad. Now this MoU is a transformation and extension to that collaborative approach for making it exemplary at the national level. He also said that, after this MoU both the Institute will not only have academic interchange program but it will also be a potentially beneficial for research. It paves the way for a healthy communication between the two institutes which will prove beneficial to realizing the goals of NEP. A student at MNNIT can take any elective course at IIIT Allahabad and vice versa. The compering of the program was done by Dr. Madhvendra Mishra. In this program Prof. G. C. Nandi, Prof. U. S. Tewari, Prof. Geetika, Dr. Shivesh Sharma, Prof. Tapovrat Lahri, Prof. Shekher Verma were present.

अब बीटेक के वैकल्पिक विषय की पढ़ाई एक-दूसरे के परिसर में कर सकेंगे छात्र

एमएनएनआईटी-ट्रिपलआईटी ने एक-दूसरे के लिए खोले द्वार

समझौता

प्रयागराज | निज संवाददाता

देश के दो नामचीन तकनीकी संस्थानों ने एक-दूसरे के छात्रों के लिए अपनी-अपनी कक्षाओं के द्वार खोल दिए हैं। एमएनएनआईटी और ट्रिपलआईटी के बीटेक व शोध छात्र संबंधित विषयों के अध्ययन के लिए एक-दूसरे के अध्यापकों के अनुभवों का लाभ उठा सकेंगे। दोनों संस्थान के निदेशकों के बीच ट्रिपलआईटी में मंगलवार को एमओयू पर हस्ताक्षर किए।

ट्रिपलआईटी के निदेशक प्रो. पी. नागभूषण ने इस अवसर पर इस समझौते (एमओयू) को नई राष्ट्रीय शिक्षा नीति के उद्देश्यों को पूरा करने की तरफ बड़ा कदम करार दिया। उन्होंने कहा कि समझौता पत्र नए शिक्षकों विशेषतः सहायक एवं एसोसिएट प्रोफेसर को अपनी क्षमता और प्रतिभा

ट्रिपलआईटी के निदेशक प्रो. पी. नागभूषण और एमएनएनआईटी के निदेशक प्रो. राजीव त्रिपाठी ने शैक्षिक एवं शोध के क्षेत्र में आदान-प्रदान करने के समझौते पर हस्ताक्षर किए।

विकसित करने का अवसर देगा। दोनों संस्थान अपनी चहारदीवारी से बाहर आकर संयुक्त रूप से किसी शोध या शैक्षिक कार्यक्रम को राष्ट्र के नाम समर्पित कर सकते हैं।

एमएनएनआईटी के निदेशक प्रो. राजीव त्रिपाठी ने कहा कि ट्रिपलआईटी की स्थापना से ही एमएनएनआईटी मिलकर सहयोग करता आया है। इसे अब एक समझौते का स्वरूप देकर राष्ट्रीय स्तर पर एक उदाहरण बनाना है। दोनों संस्थान शैक्षिक आदान-प्रदान के अलावा प्रौद्योगिकी के क्षेत्र में कुछ नए शोध कार्य करेंगे। दोनों संस्थानों के मध्य इस समझौते के बाद एक स्वस्थ संवाद संभव होगा। जिससे भविष्य की नई राहों में मिलकर नई शिक्षा नीति की सार्थकता सिद्ध होगी। दोनों संस्थानों के संकाय सदस्यों के बीच एक क्रिकेट मैच का प्रस्ताव दिया। ट्रिपलआईटी की कुलसचिव डॉ. विजयश्री तिवारी एवं एमएनएनआईटी के कुलसचिव डॉ. सर्वेश तिवारी ने दोनों संस्थानों के निदेशक की उपस्थिति में हस्ताक्षर किए। डॉ. सर्वेश तिवारी ने बताया कि बीटेक तृतीय एवं चतुर्थ वर्ष में छात्रों को कुछ वैकल्पिक विषय लेने होते हैं। ऐसे में यदि एमएनएनआईटी का छात्र जो वैकल्पिक विषय लेना चाहता है, उसकी पढ़ाई संस्थान में नहीं हो रही है तो वह उस विषय की कक्षा ट्रिपलआईटी में कर सकता है। इसी प्रकार ट्रिपलआईटी का छात्र एमएनएनआईटी में वैकल्पिक विषय की कक्षा ले सकता है।

संचालन डॉ. माधवेन्द्र मिश्र ने किया। प्रो. जीसी नंदी, प्रो. यूएस तिवारी, प्रो. गीतिका अग्रवाल, डॉ. शिवम, प्रो. तपोव्रत लहरी, प्रो. शेखर वर्मा आदि मौजूद रहे।

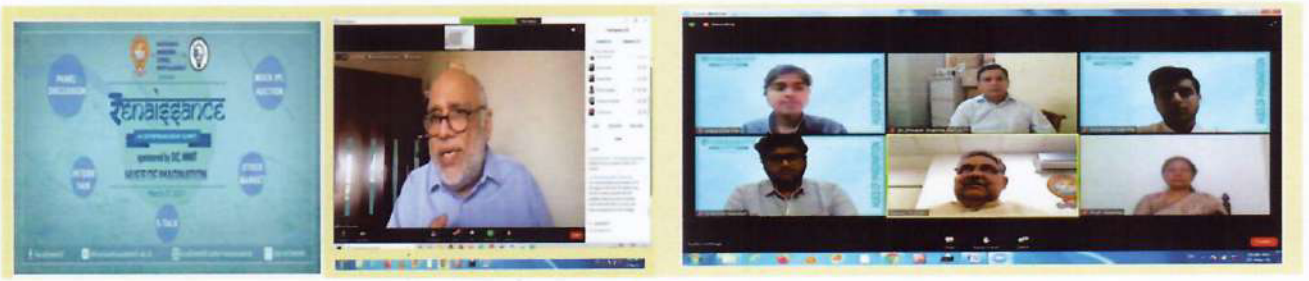
E-SUMMIT 2021

The 6th version of MNNIT's annual entrepreneurship summit, RENAISSANCE 2k21, has been successfully organized and was conducted virtually in light of the prevailing COVID 19 situation. Organized by the Institute Innovation Council(IIC) MNNIT, sponsored by Design Innovation Centre (DIC), Renaissance 6.0 witnessed humongous participation, with the students filled in with anticipation and eagerness to learn, compete and excel on sharpening and nurturing their entrepreneurial spirits, taking the event to an even higher note.

The chief guest of the event Prof. Rajeev Tripathi, Director MNNIT Allahabad, motivated the young minds regarding the need for an entrepreneurial approach in the modern world. He also highlighted that there is a need to have critically thinking, problem-solving entrepreneurs who are ready to positively change the world for the betterment.

President IIC - Prof Geetika also highlighted the need of innovation and startup and emphasized the need of entrepreneurship mindset. Convener IIC - Prof Shivesh Sharma welcomed all the guests and gave an overview of the entire event.

The E Summit came up to conclusion on a high note leaving students pumped to follow their passions by planning ahead to be job-creators and not job-seekers to make India Atmanirbhar.



How to plan for startups- legal & ethical steps

The event was conducted with the aim to make students aware of the ethical and legal ways of a startup. The event was held before the conduction of the event Plan- B under the Renaissance. The platform used for the interaction was MS Teams.

The session was addressed by TSS(The Startup Scholar). TSS provides students the knowledge, ideas, career counseling, financial aid, etc for the budding entrepreneurs and their startups.

The speaker of this session, Mr. Aakarshan Sethi, is an entrepreneur enthusiast and has been in this domain for more than five years. He has been part of many seminars, events, and webinars as a speaker or judge, or mentor.

The speaker addressed the students and carried on the session with a friendly introduction. He explained the need and importance of proper planning before setting up a startup. Out of many points mentioned, the most important points are legal and ethical ways of setting up a startup. He elaborated both the ways in a simple and easy manner. The knowledge required for planning a startup was delivered.

HACK 36

April 9-11, 2021

Introduction

In the world of innovation that we live in today, it is imperative we train the young minds to have quick thinking skills in order to resolve the problems and challenges encountered. A hackathon is an excellent way to train the mind to come up with an excellent and innovative solution. This is why hackathons have incessantly gained importance to become a ubiquitous part of most college technical fests. They have become indispensable in the IT industry. Hacking or coding is more of an adrenaline rush than a feeling. The word is derived from words ***hack*** and ***marathon***. A **hack** is something which can be implemented within a few hours with continuous development, that adds to the performance or aesthetics of any product or service. A **marathon** is just a long distance run. Hackathons basically provide a platform where a plethora of new ideas are structured, implemented and showcased. It is a team event where the idea is to collaboratively code, and work from scratch to a working prototype.

To continue the legacy of our beloved seniors and to keep alive the spirit of innovation and development which was showcased so indisputably in Hack36 3.0, **Hack36 4.0** was organized with the same endgame in mind. However, the biggest challenge that was put forth before us was the raging pandemic. However, with the impeccable enthusiasm of the Computer Science and Engineering Department MNNIT in association with Student Activity Center and IIC of MNNIT along with support of big names like Nasscom Foundation and PrepBytes and generous sponsors, the first ever virtual hackathon took place from 9th april to 11th April. Having all these young minds full of fresh ideas on bringing about a change in the world, our themes for this year were carefully curated keeping in mind the current context of our planet. the real power of technology shines when it changes the world for the greater good. Keeping this in mind, the following themes have been crafted for this year's Hack36, namely, E-administration, Cybersecurity, Education, Women's Safety and Life in Pandemic.

Modeled on other online hackathons, all participating teams were provided with a discord server inorder facilitate teamwork and the collaborative spirit. The online platform DevFolio graciously provided us their services for the submission of the projects. Hence the ambience was set for the teams to conquer the ultimate hacking battle. Along with the aforementioned paraphernalia, some **games** and **quizzes** were also conducted, which enabled participants to have a decent enjoyable break in the middle of continuous hacking so that they could feel rejuvenated during the hackathon. A more detailed description of the activities & features of Hack36 is provided in the following sections.

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Awards & Honors

- Dr. Anjana Pandey, Department of Biotechnology, received best paper award for paper, "International Summit and Conference on Material Science Nanotechnology & Bio Manufacturing (ISCMNB) 2021", May 25th – 28th, 2021, Selangor, Malaysia
- Dr. Ruchi Chawla and Prof. P. K. Dutta, Department of Chemistry received first prize best paper award for "The 9th Indian Chitin & Chitosan Society Symposium 2021 (9th ICCSS 2021)", 26th to 28th February 2021, Online mode
- Ms. Manisha Pal Dayaram, Dr. Ruchi Chawla and Prof. P. K. Dutta, received Second prize best paper award for "The 9th Indian Chitin & Chitosan Society Symposium 2021 (9th ICCSS 2021)" 26th to 28th February 2021, Online mode
- Mr. Raju Kumar Tiwar, Dr. Ajaya Bharti, Mr. Hariom Tripathi, Mr. Naveen Kumar and Mr. Kuldeep Kumar Saxena, received best paper award for "02nd International Conference on Aspects of Materials Science and Engineering (ICAMSE2021)", 05-06 March, 2021, Panjab University Chandigar
- Dr. Anjana Pandey, Department of Biotechnology, received best paper award for paper, "Bio-hydrogen Production & Technology Development: A future renewable energy source", AICTE Training And Learning (ATAL) Academy, MNNIT Allahabad, Prayagraj

Recently Awarded Externally Funded Projects

Research Project Topic : Augmentation of fermentative biohydrogen production by using anoparticles and immobilization techniques for mitigating biowastes

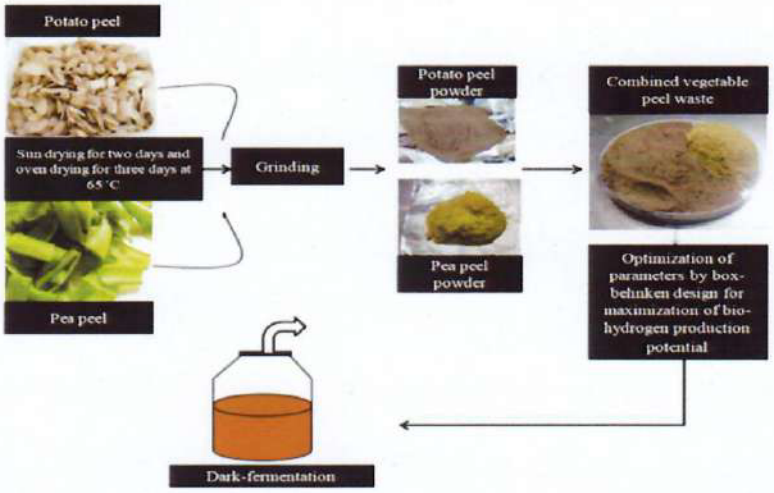
Funding agency: DST

Name of Faculty member: Prof. Anjana Pandey (Mentor), Priya Rai (PI)

Name of the Department: Biotechnology Department

Abstract of research with results:

Lignocellulosic biowastes i.e. vegetable peel waste, fruit peel waste, agricultural peel waste, and leaf waste were utilized for the selection of favorable biowaste for augmenting the biohydrogen production (potential) through the dark-fermentation process. Favorable biowaste i.e. vegetable peel biowaste was further treated as a natural feed for biohydrogen production (potential) and augmentation using multiple optimization design i.e. box-behnken design (BBD). A set of different runs were carried out using variables such as pre-treatment period (15, 30, 45, 60, and 75 min), initial substrate concentration (10 g/L, 20 g/L, 30 g/L, 40 g/L, 50 g/L, and 60 g/L), and initial pH (5.5, 6, 6.5, and 7) based on the BBD model. The ANOVA analysis has significantly justified the outputs due to R^2 (98.47%), (adj) R^2 (95.71%), and (pred) R^2 (76.48%). The validation of predicted values for biohydrogen production potential was performed through the experimental process that showed maximum biohydrogen potential (1751 mL/L of fermentation medium) which was highly near to the predicted biohydrogen potential (1726.76 mL/L of fermentation medium).



Outcome of the project: Optimization of influential parameters by box-behnken design for augmentation of bio-hydrogen production potential using vegetable peel waste is communicated in **"Environmental Chemical Engineering"** with publisher **"Elsevier".**

Research Project Topic: Visible light mediated synthetically important radical reactions of vinyl epoxides (Ref. No. SR/WOS-A/CS-54/2018)

Funding agency: Department of Science & Technology (DST)

Name of Faculty member: Prof. P. K. Dutta

Name of the Department: Department of Chemistry

Abstract of research with results:

While looking for a non-nucleophilic reagent which can furnish radicals under visible light mediation in order to be clubbed with vinyl epoxides, we came across arylazosulfones which fetched interesting results when

reacted with cinnamic acids, β-nitrostyrenes and vinyl epoxides. Cinnamic acids could be converted into a range of vinyl sulfones whereas β-nitrostyrenescould be converted intotrans-stilbenes and (E)-vinyl sulfones in CH_3CN and dioxane/H_2O 2:1, respectively.The absence of any metal, photocatalyst and additive; excellent selectivity (E- or trans- stereochemistry), solvent-switchability; and the use of visible light and ambient temperature are the prime assets of the developed methods.

Outcome of the project:

The following articles were published out of the above project work:

1. Photocatalyst-free visible light driven synthesis of (E)-vinyl sulfones from cinnamic acids and arylazo sulfones, Ruchi Chawla, Shefali Jaiswal, P.K. Dutta, Lal Dhar S. Yadav, Tetrahedron Lett. 2020, 61, 151898.
2. A photocatalyst-free visible-light mediated solvent-switchable route to stilbenes/vinyl sulfones from β-nitrostyrenes and arylazo sulfones, Ruchi Chawla,* Shefali Jaiswal, P. K. Dutta and Lal Dhar S. Yadav, Org. Biomol. Chem.2021,DOI: 10.1039/D1OB01028J.

Research Project Topic:	Development of novel protection Schemes for HYBRID Microgrid
Funding agency:	SERB, DST
Name of Faculty member:	Dr. Saumendra Sarangi
Name of the Department:	EED, MNNIT Allahabad

Abstract of research with results:

In recent times microgrids have emerged to be the main constituents of the future power grids, as distribution energy resources (DERs) are targeted to harvest the energy. With such a platform, it is forecasted that microgrid industry will grow by 3.5 times in the coming decade and this has also led to increased penetration of DERs in the existing electrical grid. Such consequent developments of the active distribution networks have prompted the exploration of power distribution in the dc microgrid paradigm, as majority of the DERs are preferred to operate on DC(i.e Photo voltaic(PV)). With the existence both DC as well AC, hybrid micro grid has formed. It is preferred to operate the lower load side on DC and upper source side on AC. The protection techniques available for the distribution system, is well defined for the AC. Generally they used the over current relays for the protection of the distribution system. Even DC is used and beneficial in operation, the breaking of fault current is a challenge because the current zero is not available as in case of the alternating Current (AC). In this protection of hybrid micro grid is targeted.

Outcome of the project: Patent application/technology transfer

Research Project Title:	Developing a Model for Effective Adoption of Solar Energy Systems in India
Funding Agency:	ICSSR – IMPRESS, New Delhi
Name of the Faculty Member:	Prof. G. P. Sahu (Principal Investigator) and Prof. Asheesh Kumar Singh (Co-Investigator)
Name of the Department:	*School Management Studies*

Abstract of the research with results:

Energy plays an important role in any developing country. At present, the major portion of electrical energy is generated by non-renewable energy sources, which are very much uneconomical and bad for the environment. Besides, the fact that the Government of India and respective state governments are putting up various schemes for the implementation of Solar Energy, the usages is extremely poor. This research study using the mixed-method approach of using both qualitative and quantitative study is aiming to develop a model for effective adoption of Solar Energy systems in rural India with a primary objective to transform the livelihood of rural people with effective adoption of Solar Energy. In this study, we will identify and validate the Critical

Success Factors for the effective adoption of Solar Energy systems which will help the policymakers in framing cost-effective and easy ways of adopting the solar energy systems.

Outcome of the Project: (Patent application/technology transfer)

Research Project topic:	Design and development of dielectric resonator antenna for smart city application
Funding Agency:	UP-CST
Name of Faculty Member:	Dr.Anand Sharma and Dr. Vinay Kumar
Name of the Department:	ECE

Abstract of research with results:In smart city development, communication engineers have to use internet of things as well as GPS. In order to implement it, we require a specific antenna those having compactness, multiband characteristics, high data rate, high gain, orientation independent, nearly uniform power distribution and so on. In this project, we will develop the radiators that having aforementioned features at the frequencies used in IoT (915 MHz, 868 MHz, sub 1.0 GHz, 2.3 GHz, 2.4 GHz, 3.0 GHz, 5.0 GHz) and GPS (L1/L2/L3/L4/L5 band) applications.

Outcome of the project: Patents and product

Research Project Topic:	Intelligent Detection and Mitigation of DDoS attack in SDN
Funding agency:	Department of Science & Technology (DST) DST No: DST/ICPS/CPS - Individual/2018-490(G)
Name of Faculty member:	Dr. Shashank Srivastava, Assistant Professor
Name of the Department:	Department of Computer Science and Engineering, MNNIT Allahabad

Abstract of research with results:

The project aims to propose a detection and mitigation method which effectively stops DDoS attack by using machine learning techniques and creating a DDoS Detection and Mitigation Application in SDN (Software Defined Networking) using the ONOS (Open Networking Operating System) controller and mininet. Software Defined Networking is a promising solution to the security issue as it has the potential to mitigate DDoS attack. The application installs new flow rules in the flow tables at switches to stop the attack. Mitigation is done by tracebacking the traffic to its origin as close as possible on the basis of the flow rules installed in the switches in the network. Different machine learning algorithms such as MLP, SVM, KNN, and also ensemble learning methods such as AdaBoost, Gradient Boosting, XGBoost, Bagging and Random forest classifiers are applied on the reduced dataset and performance metrics such as accuracy, precision, recall and F-measure are calculated for all the four DDoS attack traffics (HTTP flood, TCP SYN flood, UDP flood and ICMP flood). Mitigation time analysis is done for all four DDoS attack 30 times as shown in table 1. If mitigation of DDoS attack is done by the application in a large amount of time, then the attacker may overwhelm the target with spoofed packets to a large extent till then. The App is said to work best if it detects and mitigates the DDoS attack in the least amount of time. From this table, it can be inferred that the application takes less time in mitigating the attacks. This can prove beneficial in mitigating attack traffics at a proper time, thereby reducing the impact of damage caused by attackers to legitimate users. Hence, enabling secure communication over the network.

DDoS Attack	Average time mitigation (ms)	Standard deviation (ms)	Confidence Interval (ms) [99%]
HTTP flood	3.49	0.76	(3.11 , 3.89)
ICMP flood	4.02	0.65	(3.69 , 4.35)
TCP SYN flood	3.42	0.42	(3.21 , 3.63)
UDP flood	2.39	0.72	(2.03 , 2.74)

Outcome of the project:

The output of the project would be able to provide a model for DDoS detection and mitigation. Government servers, websites, ISPs, public and private sector could deploy the product in their network infrastructure to protect themselves from miscreants who try to reduce server performance or sometimes crash the server completely. In any case, if attack has already been done then the proposed model would help to trace the locations, to find out from where the DDoS attack is being orchestrated and mitigate the attack immediately.

Research Project Topic:	Point-of-care AI Technology based XRay Imaging Device for Automated Early Diagnosis of Viral Respiratory Diseases
Funding agency:	DST TDB
Name of Faculty member:	Prof Mukul Shukla, Dr P K Agarwal, Dr B Rajitha (CSED), Dr Navjot Singh (now at IIIT Allahabad)
Name of the Department:	MED

Abstract of research with results :

Worldwide currently an alarming 4.47+ crore Covid19 cases prevail with 80+ lacs cases in India alone and nearly 11.8+ lacs people unfortunately dead. Such deadly respiratory diseases can attack any of the 130+ crore Indians. Onsite automated analysis of Chest X-Ray(CXR) can assist in population screening for early detection of pulmonary diseases like COVID19, Influenza, SARS without relying on experienced radiologists. The development of a device for mass level, point-of-care (remote villages, airports, railway stations, schools, colleges, shopping malls), testing to get an onsite, quick, inexpensive and accurate result is precisely our novelty of idea. The lower setup and operational costs, and portability and modularity of the device add to its advantage. Hence, the need of the hour is the development and nationwide setup of our portable, patient friendly and modular diagnostic device for respiratory diseases using CXR and Deep Learning AI in line with the Atmanirbhar Bharat scheme of GOI.

Outcome of the project:

Patent application/technology transfer – Just received sanction and 1st instalment of funding from the Total grant of Rs 51.59 lacs

Research Project Topic:	Prototype Development of Novel Dry Powder Inhaler (DPI) for Pulmonary Drug Delivery.
Funding agency:	Council of Science & Technology U.P.
Name of Faculty member:	Dr. Akshoy Ranjan Paul (P.I.) and Prof. Anuj Jain (Co-P.I.)
Name of the Department:	Applied Mechanics.

Abstract of research with results :

The current pharmaceutical dry powder inhalers (DPI) have poor aerosol performance with less than 30% of the dose being able to reach the lungs. The aim of the project was to develop an efficient DPI device based on the shortcomings in the design of the inhalers available in the Indian market. Both experiment and CFD based investigations were carried out to evaluate the flow field and particle trajectories in the various DPI devices at different flow conditions. The results suggest that the modified inhaler design that ensuring both swirl and axial flows are able to deliver higher amount of drug to the distal lung region

Outcome of the project:

Patent application/technology transfer

Outcome of the project:

Publications, Product development and Patent claim (due).

Research Project Topic:	Mapping ground water quality Depleted area. Potential Groundnater Recharge Zones and Exolxing the Farmer's need based Groundwater Recharge structures in District Mahoba of Bundelkhand region of UP
Funding agency:.	DST
Name of Faculty member:	Dr. Pramod Soni (Co-PI)
Name of the Department:	CED

Abstract of research with results:

Mapping of Groundwater Quality Depleted area, Potential Groundwater Recharge Zones and Evolving the Farmer's need based Groundwater Recharge structures in District Mahoba of Bundelkhand region of Uttar Pradesh. Followings are sub-objectives under the major objective.

1. To map the lineaments and topographic details including geomorphological features on 1:25000 scale.
2. To find the thickness of overburden and potential fractures.
3. To monitor the groundwater level during pre and post monsoon period alongwith their quality.
4. To integrate findings and preparation of groundwater quality map and feasible groundwater recharge area/zones and identification of feasible and farmer's need based groundwater recharge structures..

Research Project Topic:	Air Quality Monitoring at two stations of Allahabad city
Funding agency:	Uttar Pradesh Pollution Control Board (UPPCB), Lucknow
Name of Faculty member:	Prof. R. C. Vaishya (Principal Investigator)
Name of the Department:	Civil Engineering

Abstract of research with results:

The ***UPPCB, Lucknow*** initiated the program in Prayagraj city and give an opportunity to MNNIT Allahabad to monitor the air quality of the city under National Air Quality Monitoring program (NAMP).Monitoring is being performed by the Research and Field Assistant from the year 2007 to the present date at two monitoring stations viz., Commercial and residential. The criteria and primary air pollutants are monitored: Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2) at every 4 hours' interval and Respirable suspended particulate matter (PM_{10}) at every 8 hours' interval using Respirable dust sampler instrument.

Outcome of the project: Patent application/technology transfer:

Year 2021 Report

Analysis of monitored pollutants:

- Ambient air concentration of NO_2 falls under ***Good*** and ***Satisfactory*** category of air quality in year 2020-21 at both monitoring stations.
- SO_2 never crosses the permissible limit and falls under **good** category at both monitoring stations.
- At Commercial station, PM_{10} was found to violate the permissible limit prescribed by CPCB (100 $\mu g/m^3$). Approximately, 64.5% of observations falls under the ***moderate*** category and 25.0% falls under ***poor*** category with remaining varies from ***verypoor to severe***. Although the air quality is better compared to previous year.
- At Residential station, PM_{10} violates the permissible limit prescribed by CPCB (100$\mu g/m^3$) with 76.6% and 16.1% falls under ***moderate*** and ***poor*** category, respectively, except for 4% of observation falling in **good** category.
- Air Quality of the city at two monitoring stations can be said to be improving. The air quality has shifted towards moderate category with 33.3% and 13.1% at commercial and residential station compared to year 2019 (attached image).

High Performance Computing Cluster [PRAYAG]

Prayag Cluster, a High-Performance Computing System installed in the Computer Center of Motilal Nehru National Institute of Technology Allahabad, comprises of multiple compute servers connected together over a high-speed interconnect. Currently, it has following configuration:

Hardware Details	Quantity
DELL PowerEdge R740 Server as Master node	1
DELL PowerEdge C6420 Server as Compute node	16
DELL PowerEdge R740 Server as GPU Node	2
DELL PowerEdge R740 Server as I/O Node	2
Dell EMC ME4084 Storage Array for PFS Storage	1
Mellanox SB7800, EDR IB2, Managed, 36 QSFP28 ports, System Interconnect Primary Switch	1
Dell Networking N1524 Switch System Interconnect Secondary Switch	1

The 16 Compute nodes are the work horses of the cluster and all the CPU intensive activities are carried on these nodes. The master node manages and monitors each of the constituent component of the cluster. The master node and each of 16 compute nodes, consists of 2 Xeon Gold 6230 Processors with 40 cores and frequency of 2.1 GHz. A total of 640 cores are available for Compute. Each node has memory of 192 GB, with a total 3072 GB memory, with Master node having 192 GB memory. The Master node has the storage capacity of 4TB x 4, whereas each Compute node has storage capacity of 480 GB. Each of the 2 GPU nodes also consist of 2 Xeon Gold 6230 Processors, thus having a total of 80 CPU cores and 384 GB memory. Each GPU node has 2 V100 32GB GPU Card. The 2 I/O nodes, each contains 2 Xeon Silver 4210 Processor with 20 cores and frequency of 2.2 GHz. Each I/O node has memory of 192 GB available as well.

The storage of the cluster is based on Lustre parallel file system, with total useable capacity of 160 TiB and throughput of 12GB/s.

Computing nodes of Prayag are interconnected by InfiniBand interconnect network owned by Mellanox.

PBS Professional is being used as job scheduler in Prayag cluster, that is well known to improve productivity, optimize resource utilization & efficiency, and simplify the process of cluster workload management. Jobs are submitted to PBS server. The job scheduler is configured in High Availability mode, such that if primary PBS server fails jobs will be moved to secondary PBS server.

Patent Applications Filed

S.No.	Title	Name of Faculty	Application No.	Date of filling
1.	A non-invasive assay and a method for early detection of ovarion cancer	Ms. Alka Singh Dr. Manisha Sachan	202111002569	19-01-2021
2.	An Anti-Biofilm and Anti-Quorum sensing formulation and a process thereof	Mr. Devendra Singh Dr. Vishnu Agarwal	202111003010	21-01-2021
3.	Assay for detecting a target analyte from biological sample and a method of detection thereof	Dr. Seema Nara Dr. Manisha Sachan Mr. Pranav Tripathi	202111005761	11-02-2021
4.	A Formulation against urinary tract and other related bacterial infections	Mr. Devendra Singh Mr. Saud Masood Siddiqui Dr. Vishnu Agarwal	202111005759	11-02-2021
5.	A tropical composition for treating fungal infections	Prof. Shivesh Sharma & Mr. Jaspreet Singh	202111009000	03-03-2021
6.	A topical composition for treating bacterial infections	Prof. Shivesh Sharma & Mr. Jaspreet Singh Dr. Durgesh Kumar Tripathi	202111009001	03-03-2021
7.	Method for preparing an animal feed and a product thereof	Dr. Nand Kumar Singh Ms. Akanksha Tripathi Ms. Preeti Sirohi Ms. Shadma Afzal	202111010394	12-03-2021
8.	A Biopolymer Coating For Implants and a Method of Preparation Thereof	Dr. Sangeeta Negi Prof. R.P. Tewari Mr. Avaneesh Pachauri Ms. Kumari Vibha	202111015120	31-03-2021
9.	A Smart Temperature Measuring System With Minimal Human Intervention	Prof. R.P. Tewari Dr. Ramesh Pandey Dr. Ashutosh Mishra Dr. Abhishek Kumar Tiwari Mr. Sajal Kumar Babu Degala`	202111020581	05-05-2021

Granted Patents

S.No.	Title	Name of Faculty	Application Status
1.	A wound care product	Dr. Archana Dr. J. Dutta Dr. P.K. Dutta	Granted Application Patent Num : 359941 Certificate Issue : 01-03-2021
2.	Method of simultaneous detection of e. coli and salmonella species by gold nanoparticle based lateral flow immunoassay	Ms. Jyoti Singh Dr. Seema Nara Dr. Shivesh Sharma	Granted Application Patent Num : 370213 Certificate Issue : 24-06-2021
3.	Gas-liquid absorption in microchannel	Dr. Sadhana Sachan Dr. Mohammad Siraj Alam Mr. Kaushal Kishor Mr. Abhishek Kumar Chandra Mr. Wasim Khan	Granted Application Patent Number :367963 Certificate Issue : 28.05.2021

Release of Shodh Vol. 4, Issue 1, 2021

अधिष्ठाता (शोध एवं परामर्श)
Dean (Research & Consultancy)
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