Shodh

MNNIT RESEARCH BULLETIN

मोतीलाल नेहरू राष्ट्रीय प्रौद्योगिकी संस्थान
इलाहाबाद

Motilal Nehru National Institute of Technology
Allahabad

MOTILAL NEHRU NATIONAL INSTITUTE OF TECHNOLOGY ALLAHABAD
PRAYAGRAJ-211004

Dean (Research & Consultancy)

Motilal Nehru National Institute of Technology Allahabad
Prayagraj - 211 004 [India]

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Message from Patron

Prof. Rajeev Tripathi, Director MNNIT Allahabad

It is imperative that, academicians work in the lines of a diverse, interconnected, globally competitive world to push the boundaries of research innovation, while training new generation of students. Interconnection is the key concept for academic institutions and industry to forge new partnerships and create new interactive dynamics.

In fact, an academic institution and industry shape one another's mission and jointly transform the regional techno-economic mix. Over the years, we have some outstanding research successes to celebrate and we need to move on further in same spirit- perhaps more to achieve big !

Within this domain, Research & Consultancy cell, MNNIT Allahabad offers an extraordinary platform for research interactions, support to academic training, social and technological innovation. I am glad that Office of Dean (Research & Consultancy) is bringing out this Newsletter "Shodh" as a step towards facilitating the interconnectivity with industry and other research collaborators.

Message from Dean, Research & Consultancy

The Office of Research & Consultancy, MNNIT Allahabad is committed to deliver administrative facilitation to faculty members in order to successfully complete the research projects and consultancy.

The newsletter "Shodh" seeks to showcase the ideas, research achievements, including scholarly awards and research grant highlights of faculty members that form the research enterprise at MNNIT Allahabad. These activities reflect the vibrancy of our research community, a hard earned feature which we are committed to reinforce through the administrative support provided from Research & Consultancy Cell. There are many more spectrum of research and innovation and I look forward to work with you and include them in future release of Shodh.

The release of Shodh is aimed to promote our academic and consultancy research.

The Shodh release and its distribution may also form one of the important channel for communication between our research stakeholder and the Institute.

Foreword

This newsletter "Shodh" is aimed to endorse the research activities and the highlights of academic research projects carried out by the faculty members of the Institute. It has been prepared with the information provided by the faculty members to the Office, Dean (Research & Consultancy). It is planned to publish the said newsletter on quarterly basis depending upon the mass of related information provided by faculty members of the Institute.

Its distribution to various academic institutions, research project funding agencies, and other stakeholders should serve primarily to promote awareness about the available research expertise, which can be extended outside. Also, aspires to create a network of relationships of substance that span not only in the country but even across the globe.

Finally, "Many Thanks" to faculty members who have contributed to get their significant research results published in this issue of newsletter "Shodh".

Editor

MNNIT Allahabad - A Glance

Motilal Nehru National Institute of Technology (MNNIT) Allahabad (formerly Motilal Nehru Regional Engineering College MNREC, Allahabad) is an institute with total commitment to quality and excellence in academic pursuits, and is among one of the leading institutes in India. It was established in the year 1961 as a joint enterprise of Central Govt. of India and State Govt. of Uttar Pradesh in accordance with the scheme of establishment of REC's. However, with effect from 26th June, 2002 the Institute became a deemed university and an Institute of national importance, now known as Motilal Nehru National Institute of Technology. The institute offers B. Tech. programmes in nine areas of technology, M. Tech. programmes in more than twenty disciplines, MCA, MBA, 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.
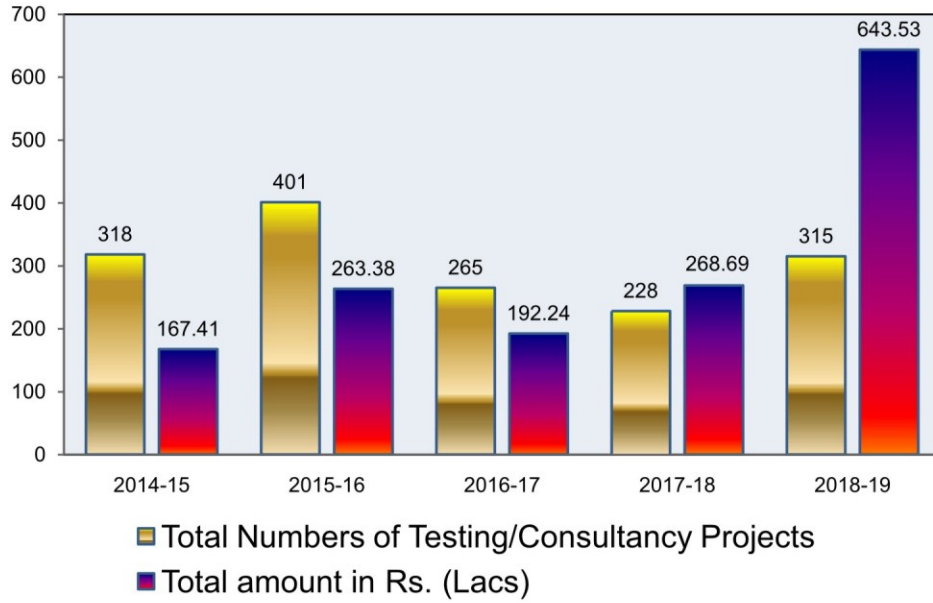
The entire campus, including hostels, executive development centre and residential area is connected with 1.25 Gbps internet connectivity.

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

As per National Institutional Ranking Framework (NIRF), Ministry of Human Resource and Development, Government of India, the Institute stood at 42nd rank in Engineering stream in the country in 2019.
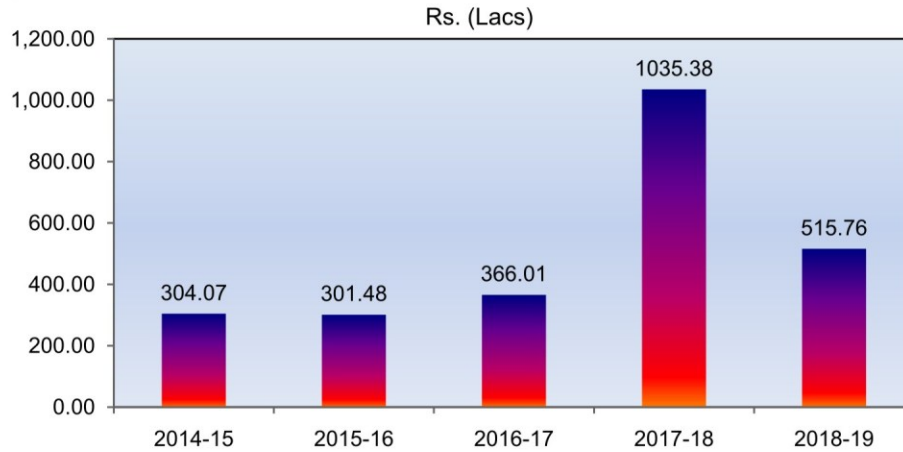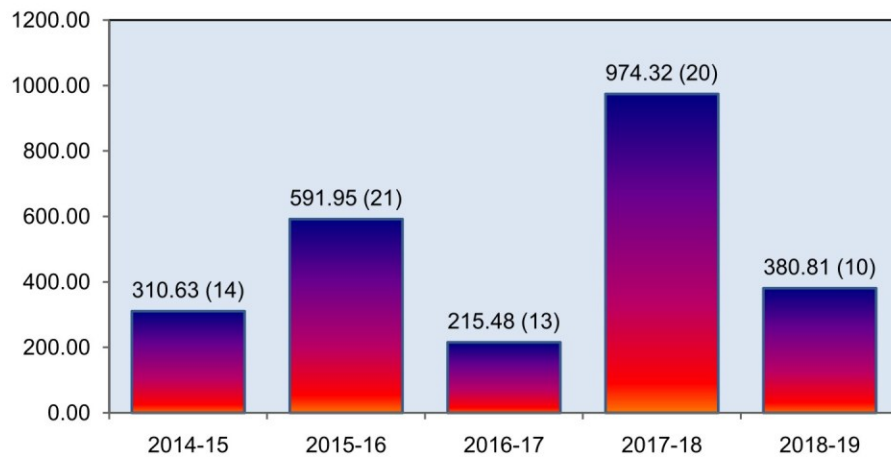
Testing and Consultancy Funding Statistics :

Legend:
- Total Numbers of Testing/Consultancy Projects
- Total amount in Rs. (Lacs)

Data points:
Year	Total Numbers of Testing/Consultancy Projects	Total amount in Rs. (Lacs)
2014-15	318	167.41
2015-16	401	263.38
2016-17	265	192.24
2017-18	228	268.69
2018-19	315	643.53

Research Project Funding Statistics :

Total grant received

Rs. (Lacs)

Year	Rs. (Lacs)
2014-15	304.07
2015-16	301.48
2016-17	366.01
2017-18	1035.38
2018-19	515.76

(i)   Total amount in Rs. (Lacs for sanctioned research projects)
(ii)   Total number of sanctioned research projects (shown in parentheses)

Year	Total amount in Rs. (Lacs) (number of projects)
2014-15	310.63 (14)
2015-16	591.95 (21)
2016-17	215.48 (13)
2017-18	974.32 (20)
2018-19	380.81 (10)

Major Research Fields in the Departments

Name of the Department	Research fields
Applied Mechanics	Computational solid mechanics, Composite structures, Finite element analysis, Advanced Structural Systems, Kinematic and Dynamic analysis of musculoskeletal system, Damage mechanics, Sound, noise and vibration, Thermo-Fluids Engineering, Solid mechanics, Characterization of smart materials, Bone Adaptation.
Biotechnology	Agricultural biotechnology, Bioinformatics, Bioprocess development, Bio-energy, Environmental biotechnology, Genetics & Genetic engineering, Immunology, Medical biotechnology, Microbiology, Nanoparticle based diagnostic.
Chemical Engineering	Membrane and Reactive Separation, Convective heat transfer, Chemical reaction engineering, Process Modeling and Simulation, CFD, Environmental science & engineering, Industrial hazard, Process Safety & Hazards management, Advanced distillation technology
Chemistry	Inorganic nano-chemistry, Sensor analyte, Metal organic frameworks, Nano-biotechnology, Polymers
Civil Engineering	Structural engineering, Geotechnical engineering, Environmental engineering, Transportation engineering, GIS and remote sensing, Environmental Geo-technology, Water Resources Engineering, Construction engineering and Management.
Computer Science & Engineering	Software engineering, Mobile computing, Knowledge based system, Real time system, Distributed computing, Soft Computing and Machine learning, Image processing, biometrics, Pattern recognition, Data mining, Network security.
Electrical Engineering	Power electronics, Electrical drives, Power system operation, control and protection, Smart grid challenges, Renewable energy systems, Non-linear control theories and its applications.
Electronics and Communication Engineering	Data Communication and networking, Optical communication, Digital signal processing, Image processing, Pattern recognition, Biometrics, Mobile and ATM network, Wireless sensor network, Analog and Digital circuits, VLSI design, Characterization of semiconductor devices.
GIS Cell	GIS applications; GNSS and InSAR technology (core and application),Natural hazard monitoring, Machine learning applications in geoinformatics, WebGIS, LiDAR technology, Satelite image processing.
Humanities and Social Sciences	English psychology Human resource management, Accounting & Finance, English psychology.
Mathematics	Commutative algebra, Basic hypergeometric functions, Numerical analysis, Operation research, Soft computing, Cryptography, Fluid dynamics, Heat & mass transfer, Bio-fluid mechanics, General topology, Nearness-like structures & Near set theory.
Mechanical Engineering	CAD/CAM, Manufacturing processes, Chain management, Composite materialsand its characterization, Fracture and fatigue, Multi-scale machining processes, Mechanical system design, Nanocomposites characterization, Refrigeration, Cyrogenics, Heat transfer, CFD, Air-conditioning, Passive cooling.
Physics	Experimental condensed matter physics, Theoretical physics, Nano structured thin films, Functional oxide nano-materials, Synthesis and optical, Magnetic and Electric properties of 2D systems
School of Management Studies	International finance, Marketing management, Financial management, Human resource management, Management information systems, Entrepreneurship, Strategic management.

Highlights of Major Research Output

Research Project Title: **In Situ Biodiesel Production From Microalgae using Ultrasonic Assisted Reactor**

Funding agency: SERB, DST, New Delhi

Name of PI: Dr. Dipesh Shikchand Patle, Department of Chemical Engineering,

Email: dipesh-patle@mnnit.ac.in

Abstract of research with results:

Environmental pollution and diminishing supply of fossil fuels are the key factors leading to search for the alternative sources of energy. Therefore, production of eco-friendly biofuels (e.g. biodiesel) from renewable sources is one among most potential alternatives. This research aims to address the challenges we face today with respect to the fuel. First, this work embarks on finding an efficient method to synthesize biodiesel from microalgae using IL catalyst, where an ultrasonication will be used. It is proposed to conduct oil extraction from microalgal biomass and biodiesel synthesis in a single unit that will reduce the capital cost. This study is crucial as it focuses on experimental as well as process design/operational aspects. Fig 1 presents ^{1}H NMR spectrum of the produced biodiesel from castor oil (test feedstock), which denotes that the developed IL catalyst and ultrasonication are effective tools in synthesizing biodiesel.
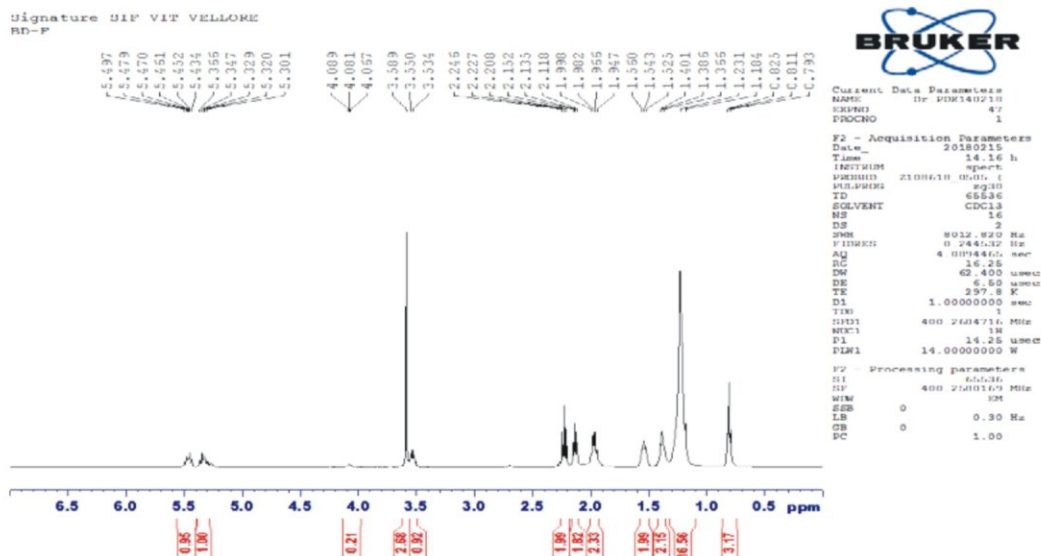
Fig.1: ^{1}H NMR spectrum of the produced biodiesel.

Impact of research works: Following research papers are published:

1. D. S. Patle, S. Sharma, A. P. Gadhamsetti, K. R. Balinge, P. R. Bhagat, S. Pandit, S. Kumar, Ultrasonication-assisted and benzimidazolium-based brønsted acid ionic liquid-catalyzedtransesterification of castor oil, *ACS Omega*, Vol. 3, Issue 11, pp. 15455-15463, 2018.

2. A. G. Khiratkar, K. R. Balinge, M. Krishnamurthy, K. K. Cheralathan, D. S. Patle, V. Singh, A. Arora, P. R. Bhagat, Sulphonic Acid-Functionalized Benzimidazolium based Poly ionic liquid Catalyzed Esterification of Levulinic Acid, *Catalysis Letters*, Vol. 148, pp. 680–690, 2018 [IF: 2.91].

3. A. G. Khiratkar, K. R. Balinge, D. S. Patle, M. Krishnamurthy, K. K. Cheralathan, P. R. Bhaga, Transesterification of Castor Oil using Benzimidazolium based Brönsted acidic Ionic Liquid Catalyst, *Fuel*, Vol. 231, pp. 458–467, 2018 [IF: 5.03].

Abstract of research with results:

The research work is aimed to recover nicotinic- and isonicotinic acid from aqueous/fermentation broth in different diluents including biocompatible extraction system using intensified approach, reactive extraction. The experimental and theoretical results can be utilized to design a continuous downstream process for microbial production of nicotinic- and isonicotinic acids. In this project, best extraction systems including biocompatible systems are investigated for the recovery of nicotinic- and isonicotinic acids from aqueous solution. Process parameters such as initial acid concentration, extractant compositions, temperature, pH, etc., are optimized for the recovery of acids. Feasibility of ionic liquids for the extraction is also checked. Theoretical studies are also carried out to get insights of extraction mechanisms and screening of diluents using thermodynamic models (COSMO-RS, UNIFAC, UNIQUAC, etc.,) on Aspen Plus and COSMOtherm. Regeneration of organic phase/solvents is carried out using NaOH solution.

Impact of research works: *Following research papers are published*:

1. A. Kumari, A. Gaur, K. L. Wasewar, S. *Kumar, Modeling and Optimization of Reactive Extraction of Isonicotinic Acid Using Tri-n-octylamine in Biocompatible Diluents Mixture: Response Surface Methodology and Regeneration of Solvents, Industrial and Engineering Chemistry Research, Vol. 57 Issue, PP(37): 12485–12493, 2018.*

2. S. Pandey, N. Chomal, S. Kamsonlian, S. Kumar, Theoretical and experimental studies on extraction of carboxylic acids from aqueous solution using ionic liquids, *International Journal of Chemical Engineering and Applications, Vol.* 9(1), Issue PP 20-25, 2018.

3. *D. Datta, B. V. Babu, S. Kumar,* Equilibrium and thermodynamic studies on reactive extraction of nicotinic acid using a biocompatible extraction system, *Journal of Chemical & Engineering Data Vol. 62 Issue PP (10): 3431–3436*, 2017.

4. D. Datta, S. Kumar, *Equilibrium and kinetic on reactive extraction of nicotinic acid with tri-n-octylamine dissolved in MIBK.Industrial and Engineering Chemistry Research, Vol. 52, Issue PP (41), 14680–14686*, 2013.

5. Kumar, S.Kamsonlian, N. Chomal, Equilibrium Study on Reactive Extraction of Nicotinic Acid from Aqueous Solution, *International Journal of Chemical Engineering and Applications*, Vol. 5 (6), Issue PP 506-510, 2014.

Research Project Title: **The Effect of Micro Level Progressive Matrix Plasticity on the Macro Level Response of Unidirectional Composites: Micromechanics Based Study**

Name of PI: Dr. V. Murari, Department of Applied Mechanics
Email Id: vmurari@mnnit.ac.in

Abstract of research with results:

A mathematically correct scenario for modeling the damage response of the composite materials at the macro level requires non-local, nonlinear, multi-scale analysis. The present work proposes to create a simple model imbibing the mathematical features which are desired but a model which can be derived out of single and multi-cell computations at the level of the constituents. To this end, the present work is focused on understanding the influence of the progressive plasticity in the matrix on the macroscopic response, by conducting a series of numerical experiments on certain selected single and multi-cell Representative Volume Elements (RVE). Most of the damage models that address nonlocal influence of damage, assumes an arbitrary nonlocal length scale parameter. However, the present work can provide the actual length scale of nonlocal influence for different micromechanical events. Damage initiation zones under different fundamental loading, in case of undamaged and damaged RVE are identified. The plastic growth scenario, observed for different state of damage in the unit-cell RVE, strongly support the simplified assumptions made in the PI's previous research work (especially in the case of fiber-matrix debond). Further, the state of damage/plastic growth that affect the coefficients of mutual influence and Chentsov's coefficients are identified, along with the magnitude of influence for different cases of fundamental loading.
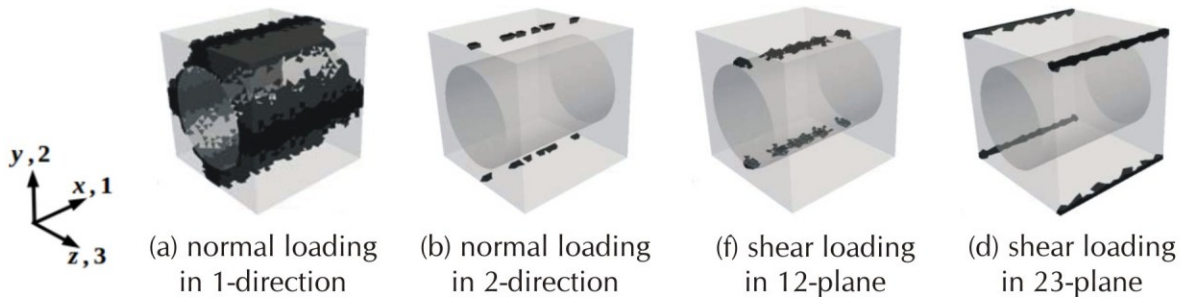
(a) normal loading in 1-direction   (b) normal loading in 2-direction   (f) shear loading in 12-plane   (d) shear loading in 23-plane

Fig.1 Damage Initiation zones identified on an undamaged Single-cell RVE subjected to different fundamental loading

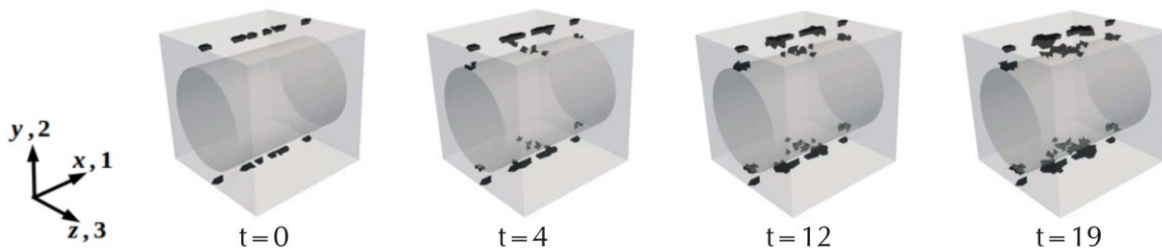t = 0   t = 4   t = 12   t = 19

Fig.2 Growth of plastic zone in the matrix at different time steps.

CASE: Undamaged; Glass/epoxy; v_f = 0.407; Normal loading in transverse direction (2-direction)

Research Project Title:	**Generation of Improved Photovoltaic Devices for Making Efficient Dye Sensitized Solar Cells.**
Funding Agency:	DST, New Delhi
Name of PI:	Dr. Ashutosh Pandey, Chemistry Department
Email ID:	apandey@mnnit.ac.in

Abstract of research with results:

Dye sensitization of wide band gap n-type semiconductors (TiO_2, SnO_2 etc.) is a rapidly expanding field with a new realization of their potential application in solar cell technology. DSSCs promise to offer a solution to low-cost, large-area photovoltaic applications. They are fabricated from cheap, easily processable materials, deriving their competitive performance from judicious molecular design and control of nanoarchitecture rather than particular impressive electronic characteristics of the individual materials. In the present work organotin compounds have been prepared in which three hydrolyzable groups are attached with each tin atom while the fourth position is occupied by a perylene or perylenebisimide (PBI) substituted group. Since the corresponding organotin compounds can be reacted with water to give oxides, this approach will ultimately lead to generation of a "single source precursor" wherein photosensitizer organic dye i.e. perylene and PBI are directly attached with semiconductor metal oxide, SnO_2 and there will be no need of absorption of dye on semiconductor metal oxide thin films. This will eventually lead to systems where the dye molecule will be covalently linked with the metal of the nanocrystalline dye, thereby providing greater stability to the cell, which has to operate in an ionic media for a longer duration of time.
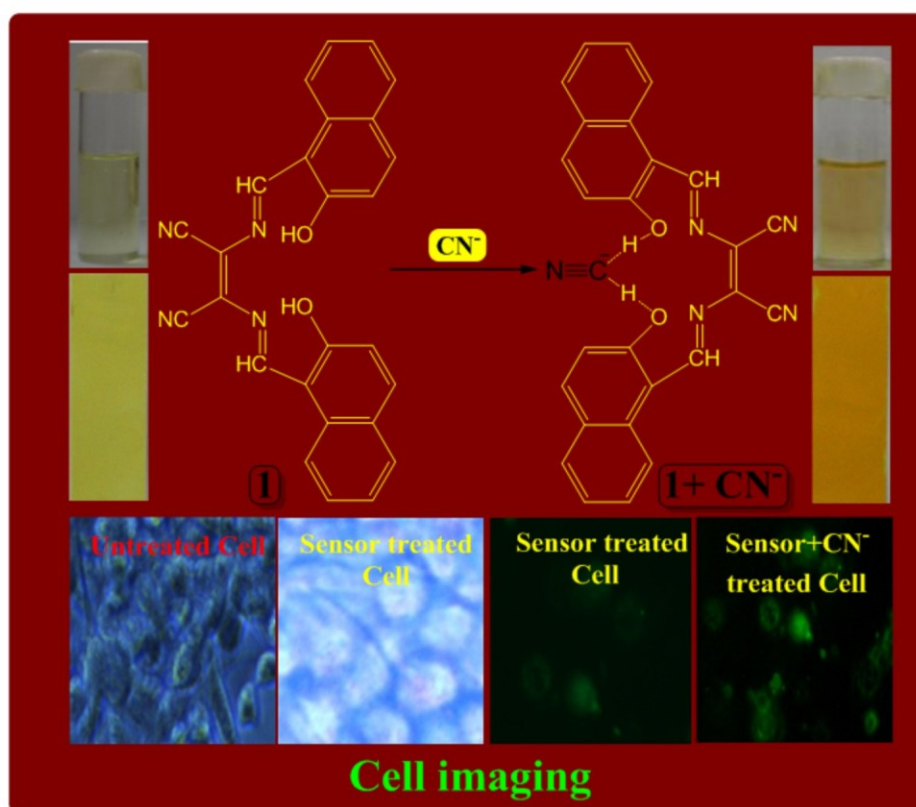
Impact of research works: *Following research papers are published:*

1. Subia Ambreen, Kiran Gupta, Sadhana Singh, D. K. Gupta, Stephane Daniele, N. D. Pandey, Ashutosh Pandey, Synthesis and structural characterization of some titanium butoxides modified with chloroacetic acids, *Transition Metal Chemistry*, Vol. 38, Issue 8, pp. 835–841, 2013.

2. Mridula Tripathi, Ruby Upadhyaya, Ashutosh Pandey, Novel dye Based photoelectrode for improvement of solar cell conversion efficiency, *Applied Solar Energy*, Vol. 49, Issue 1, pp. 54–57, 2013.

3. Ruby Upadhyay, Mridula Tripathi, Ashutosh Pandey, Surface modification of semiconductor photoelectrodes for better photoelectrochemical performance, *High Energy Chemistry*, Vol. 47, Issue 6, pp. 308–314, 2013.

4. Ruby Upadhyay , Mridula Tripathi, Priyanka Chawla, AshutoshPandey, Performance of CeO2–TiO2-admixed photoelectrode for natural dye-sensitized solar cell, *Journal of Solid State Electrochemistry*, Vol.18, Issue 7, pp.1889-1892, 2014.

5. Kiran Gupta, Peter Mayer, Ashutosh Pandey, Synthesis and structure of an Aluminum Bis(3-chloropentanedionate) Isopropoxide: [Al(mu-OiPr)(3-Clacac)2]2, *Zeitschrift fur Naturforschung B*, Vol. 69b, pp. 799 – 803, 2014.

Research Project Title: **Chemosensor for Anions: Synthesis, Optical andElectrochemical Sensing**

Funding agency: DST, New Delhi

Name of PI: Dr. TamalGhosh, ChemistryDepartment

Email ID: tamalghosh@mnnit.ac.in

Abstractof research with results:

In this project, we have synthesized molecules those are capable of detecting anions/ cations with visual colour change or fluorescence change. Environmentally or biologically hazardous anions/ cations may be detected and removed by this method.Recently, we have synthesized molecule 1 which can detect cyanide ion in DMSO/H2O (7:3 v/v) solvent mixture and on silica gel TLC strip with visible colour change from yellow to orange. Sensor 1 is used as an imaging reagent for detection of the cellular uptake of CN ion in Baby Hamster Kidney (BHK-21) cells.

Impact of research work:

The above molecule may be used as test strip to detect cyanide ion.

Following research paper is published:

Yadvendra Singh, TamalGhosh, Highly selective colorimetric and fluorometricchemosensor for cyanide on silica gel and DMSO/H$_2$O (7:3 v/v) mixed solvent and its imaging in living cells, *Talanta*, vol. 148, pp. 257-263, 2016.

Research Project Title:	**Embedded Disturbance Detection and Classification of Distributed Generation Unit Connected to the Grid**
Funding agency:	SERB, DST, New Delhi
Name of PI:	Dr. Soumya Ranjan Mohanty, Department of Electrical Engineering
Email ID:	soumya.eee@iitbhu.ac.in

Abstract of research with results:

The real-time analysis of power quality (PQ) disturbances and islanding detection for distributed generation (DG) system using signal processing algorithms are still at a premature stage. An implementation of advanced signal processing techniques in field-programmable gate array (FPGA) to identify PQ and islanding events in real time is carried out in study. The proposed scheme is based on orthogonal empirical mode decomposition (OEMD) implemented in FPGA. This technique does not suffer from the loss of signal characteristics with successive decomposition levels. The detection ability has been compared with discrete wavelet transform (DWT) and basic empirical mode decomposition (EMD). The OEMD reliably and accurately detects the disturbances conducted in the study, both simulated and experimental.
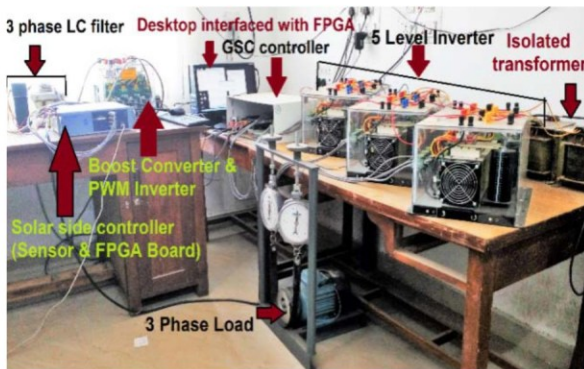
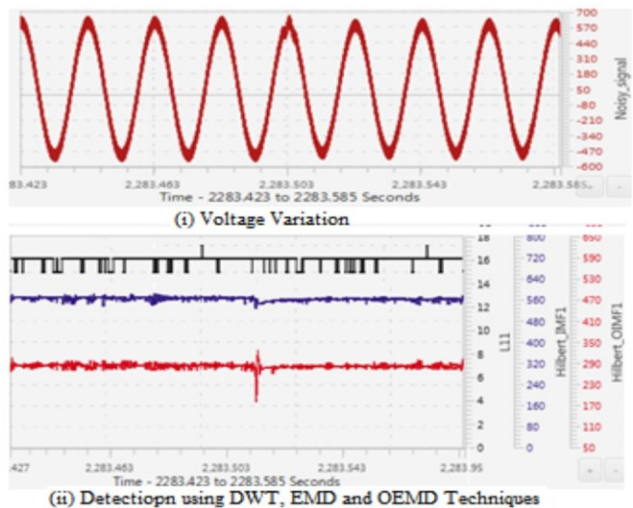Fig. 1 Hardware set up of grid emulator connected PV system

(i) Voltage Variation

(ii) Detectiopn using DWT, EMD and OEMD Techniques

Fig. 2. Islanding detection for 'zero power' mismatch with 28 dB SNR

(i) Voltage Signal

(ii) EEMD-IMF classification under noisy scenario

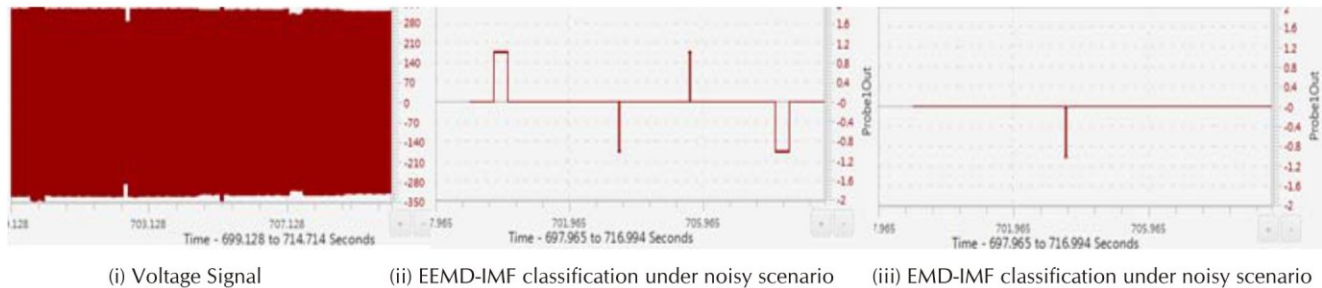(iii) EMD-IMF classification under noisy scenario

Fig. 3 Real-time classification of voltage sag, swell events

Impact of research works: *Following research paper is published:*

Rupal S. Hukumpal, S. R. Mohanty, Nand Kishor, Ankit Thakur, Real-Time implementation of signal processing techniques for disturbances detection, *IEEE Transactions on Industrial Electronics, vol. 66, Issue 5, pp. 3550-3560, 2019, IE : 7.05.*

|	
Research Project Topic:	**Design and Study of Sensitivity of Optical Biosensors having Metamaterials**
Funding agency:	SERB, DST, New Delhi
Name of PI:	Dr. Yogendra Kumar Prajapati, Department of Electronics and Communication Engineering
Email ID:	yogendrapra@mnnit.ac.in

Abstract of research with results:

Today, it needs to develop a device which offers a rapid diagnosis of infectious diseases with minimum time and high accuracy for common people. The aim of the research project to design and fabricate optical waveguide-based sensor having metamaterial for sensing applications. Along with the analytical study, fabrication of the sensor is done and the sensing experiments are performed for sucrose detection. It is observed that metamaterial provides good sensing ability to the SPR waveguide sensor in spite of the high absorption properties and the sensing ability of the SPR sensor greatly depends on the surface characteristics of the sensor.
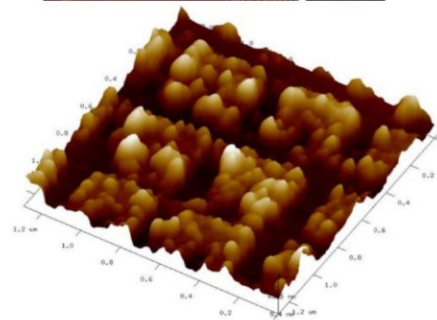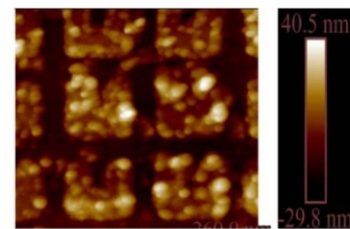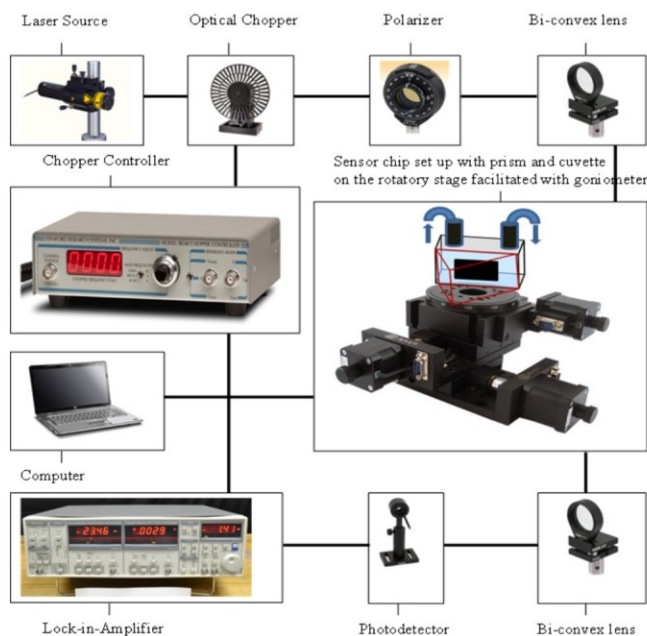
AFM images for the synthesized sample at 2-D view and 3-D view

Impact of research works:

It is observed that the developed sensor provides better sensitivity in comparison to the existing conventional biosensors. The sensitivity of the pre-existing sensors is limited due to the lack of attachment of these biomolecules on the top surfaces of the sensor chip.

International Bilateral Research Projects

Research Project Title:	**Operation of the Smart Grid with Wide Area Information (OperaGRID)**
Funding agency:	DST-RCN (Department of Science &Technology-Research Council of Norway)- 2015
Name of Indian PI:	Dr. Nand Kishor, Department of Electrical Engineering
Email Id:	nandkishor@mnnit.ac.in
Name of Norwegian PI:	Dr. Kjetil Uhlen, Norwegian University of Science and Technology (NTNU) Trondheim, Norway

Abstract of research with results:

The project had performed research into operation and control of power grids with the objective to meet the future challenges in realizing sustainable energy systems. More specifically, the project has analyzed and developed new methods for wide area monitoring, protection and control. The motivation behind this is that power systems are becoming more and more complex. Higher variability and uncertainty in power flows make it increasingly challenging for operators to manage the power balance and consequently the security and quality of supply. The project was carried out with six work-packages (WP), with Dissemination as WP6. On Indian side, following methods were developed:

- Wide area monitoring of sustained power oscillations using two stage mode decomposition
- Determination of mode shapes in PMU signals using two stage mode decomposition and spectral analysis
- Power system event detection utilizing time-frequency representation of synchrophasor data
- Real-time coherency detection among the generators in the network.

Several of the developed methods for power system monitoring have been tested with real system data and reached a state where they are ready to be implemented as prototype tools.

Impact of research works: *Following research papers are published:*

1. Lalit Kumar, Nand Kishor, Wide area monitoring of sustained oscillations using double stage mode decomposition, *International Transactions on Electrical Energy Systems*, vol. 28, Issue 6, pp.1-18, e2553, 2018, IF : 1.619.

2. Lalit Kumar, Nand Kishor, Determination of mode shapes in PMU signals using two stage mode decomposition and spectral analysis, *IET Generation, Transmission and Distribution*, vol. 11, pp. 4422-4429, 2017, 2017, IF : 2.213.

3. Shweta, Nand Kishor, Kjetil Uhlen, S. R. Mohanty, Identification of coherency and critical generators set in real time signal, *IET Generation, Transmission and Distribution*, vol. 11, pp. 4456-4464, 2017, IF : 2.213.

4. Sanjay Singh Negi, Nand Kishor, Kjetil Uhlen, RichaNegi, Event detection and its signal characterization in PMU data stream, *IEEE Transactions on Industrial Informatics*, vol. 13, pp. 3108-3118, 2017, IF: 6.764.

5. Sanjay Singh Negi, Nand Kishor, Avinash Kumar, Kjetil Uhlen, Signal processing for TFR of synchro-phasor data, *IET Generation, Transmission and Distribution*, vol. 11, pp. 3881-3891, 2017, IF: 2.213.

Research Project Title:	**Integrated Renewable Resources and Storage: Operation and Management [IReSOpM]**
Funding agency:	DST-RCN (Department of Science &Technology-Research Council of Norway)- Call on Renewable Energy 2018
Duration of the project:	3 years (2019-2022)

Project Summary:

A smart grid is a networked group of distributed energy sources with the goal of generating, converting and storing energy, delivering the energy to end users efficiently. The full advantage of smart-grid technologies can be achieved only with smart control mechanisms, capable to manage andcoordinate distributed energy systems so as to minimize the costs of energy production, conversion and storage.

The main research problem are in the lines to address the issues that includes; (i) how to provide security on information flow in ICT enabled interconnected energy resources, (ii) how one should have resilient strategy using available signals, (iii) how to apply optimal energy management with distribution network operational flexibility (including those from consumers) and constraints, (iv) how to establish interaction dynamics between interconnected energy resources under cyber layer environment, (v) how a situation of several interconnected energy resources be coordinated at distribution network level.

The project consists of five work packages (WP), out of which three WPs are being led by Indian Institutions.

Name of Indian PI:	Dr. (Mrs) RichaNegi, Department of Electrical Engineering
Email Id:	richa@mnnit.ac.in

Name of Norwegian PI:	Dr. Van Khang Huynh, University of Agder (UiA), Grimstad
Other Project participants:	

Indian side:	Dr. Asheesh K. Singh (MNNIT)
	Dr. S. N. Singh (lITKanpur/MMMUT Gorakhpur)
	Dr. A. S.Raghuvanshi (NIT Raipur)

Norway side:	Dr. Nils Ulltveit-Moe (UiA, Grimstad)
	Dr. Timothy C. Lommasson (NORCE)
	Dr. Kirsti Midtt∅mme (NORCE)

Research Recognition Award

Prof. P. K. Dutta is honoured with Best Faculty Researcher (Marshall) Award with a cash prize of Rs.10,000 and citation by Indian Chitin & Chitosan Society (ICCS), Erode (Tamil Nadu) in its 7th Annual Meeting held at CSIR-National Chemical Laboratory Pune (CSIR-NCL) from October, 11-13, 2018 for his untiring 25 years of research work on Chitin & Chitosan field and widespread expansion of Chitin Science.