



Legacy that Inspires the Future

R&D Newsletter

Quarterly Newsletter of the Office of the Dean (R&D), IIT(ISM) Dhanbad

Vol. 2, July-September, 2024



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About R&D Newsletter

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Dear Reader,

This issue of "*R&D Newsletter*" is to showcase our excellence in academic and research activities. With our ever expanding academic network and research base, we are able to show our strength as an Institute of National Importance.



Dean (R&D)

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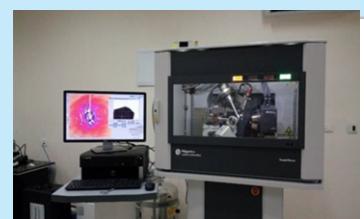
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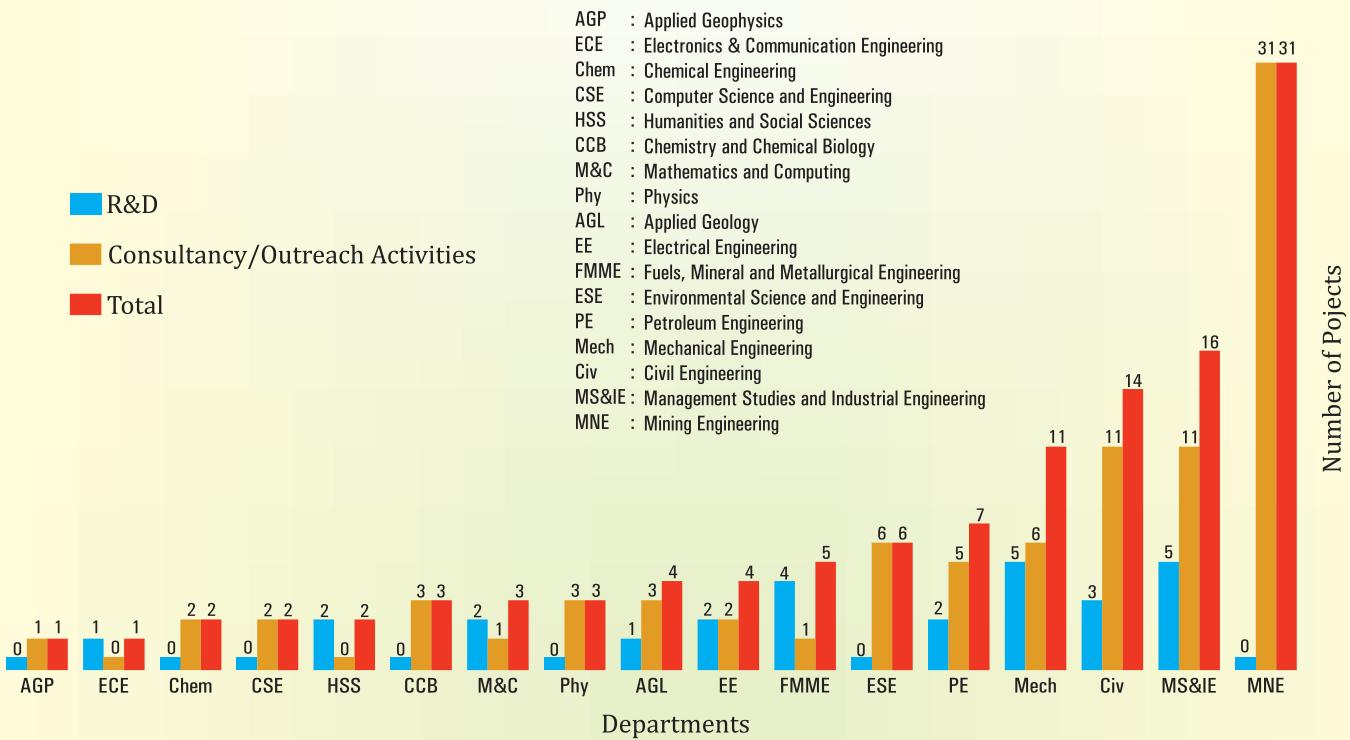


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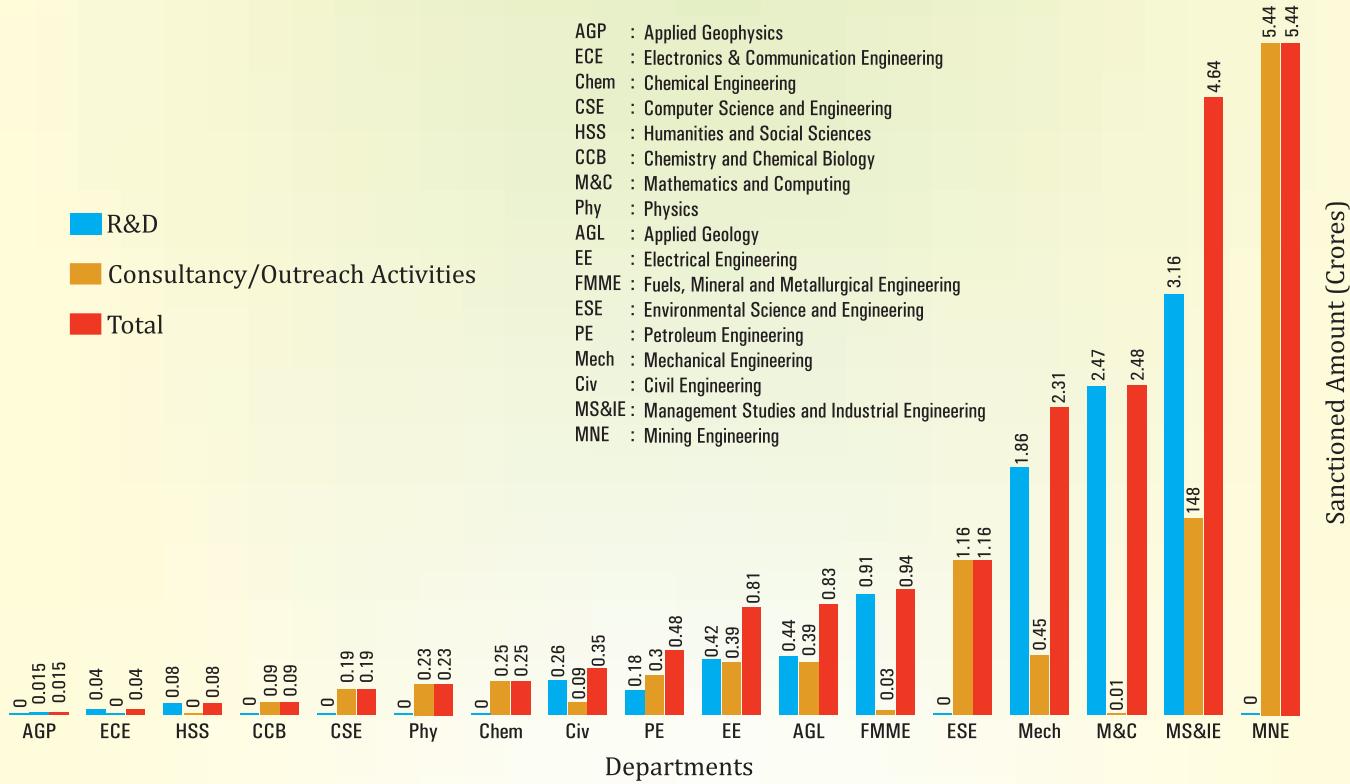


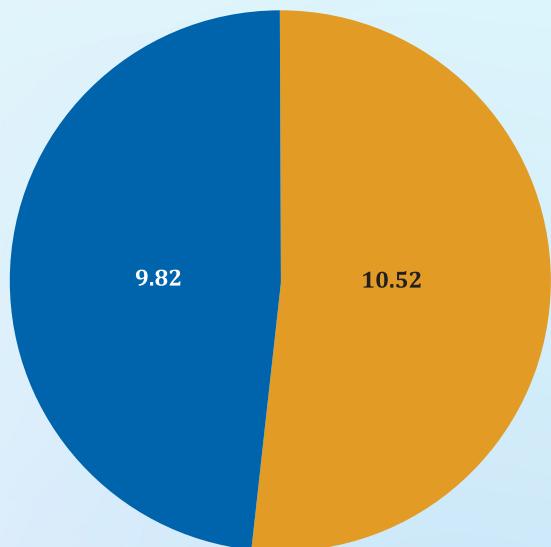
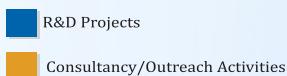
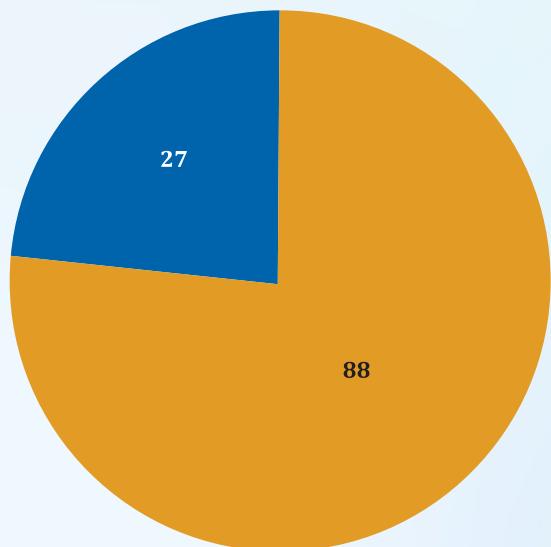
R&D Funding of the Institute

No. of R&D Projects, Consultancy/Outreach Activities (July-Sept. 2024)



Sanctioned Amount (in Crore) of R&D Projects, Consultancy/Outreach Activities (July-Sept. 2024)





R&D Projects (No)	Consultancy/Outreach Activities (No)
27	88

Sanctioned amount of R&D Projects (Crores)	Sanctioned amount of Consultancy/Outreach Activities(Crores)
9.82	10.52

Major R&D Projects/Consultancy / EDP/CoEs

- **Prof. Ajit Kumar**, Department of Mechanical Engineering and his team (Prof. Niranjan Kumar, Department of Mechanical Engineering) have received a R&D Project (**Rs. 53.95 Lakhs**) titled "*Development of Energy Efficient Ergonomically Designed (EEED) Chair Lift Man Riding System*" funded by Coal India Limited (Central Mine Planning & Design Institute Limited), Ranchi, Jharkhand.
- **Prof. Shikha Singh** and her team (Prof. Mrinalini Pandey), Department of Management Studies & Industrial Engineering have received an Outreach project (**244.5 Lakhs**) titled "*Capacity Building of Faculty and Institutions towards Design & Entrepreneurship Development*" funded by Ministry of Education, Department of Higher Education, New Delhi.
- **Prof. S. Pasupuleti** and his team (Prof. Vishwas N. Khatri) from Department of Civil Engg. have received a Consultancy Project (**Rs. 1.77 Crore**) titled "*Comprehensive*
- **Hydrological Study to Assess the Impact of Nalas and Damodar River on Kalyaneswari Tasra Mining Pvt. Ltd. (KTMPL) Mining Area, Tasra, Sindri**" funded by M/s Kalyaneswari Tasra Mining Pvt. Ltd. (KTMPL), Dhanbad.
- **Prof. B. K. Mishra** and his team (Prof. Anshumali) from Department of Env. Sc. Engg. have received a Consultancy Project (**Rs. 1.12 Crore**) titled "*Scientific Study for investigation of mine-wise water availability and potential for community use in ECL*" funded by M/s ECL, Sitarampur.
- **Prof. B. K. Mishra** received a Consultancy Project (**Rs. 53.10 Lakhs**) titled "*Scientific Study for Environmental Impact Assessment & Risk Analysis for Utilization of Red Mud for NHAI Road Project in Jharkhand*" funded by Hindalco, Muri.
- **Department of Mathematics & Computing** has received a **FIST Grant of Rs. 2.23 Crore**.

Research achievements (July - September, 2024)

Publications

Total No. of Publications : 350

Selected Publications

- K. Manna, A. Dolai, S. Ghosh, S. Samanta, S. Dey, **Sagar Pal**. *Macromolecules*, 57, 8445, **2024**.
- K. Singha, G. Kumari, S. Jagadevan, A. N. Sarkar, **Sagar Pal**. *Langmuir*, 40, 16208, **2024**.
- U. Hoque, A. Samanta, S. Pramanik, S. R. Chowdhury, R. Lo, **Soumitra Maity**. *Nature Communications*, 15, 5739, **2024**.
- G. Thirumal, **C. Kumar**, P. K. Donta. *Internet of Things*, 26, 101165, **2024**.
- **A. S. V. Rao**, S. Kainth, **A. Bhattacharya**, T. **Amgoth**. *Expert Systems with Applications*, 255, 124800, **2024**.
- P. Priya, **M. Firdaus**, A. Ekbal. *IEEE Transactions on Computational Social Systems*, 11(5), 6662, **2024**.
- P. Priya, **M. Firdaus**, A. Ekbal. *Computer Speech & Language*, 88, 101661, **2024**.
- N. C. Dhibar, **R. R. Busigari**, **Madhumita Patel**. *Environmental Science and Pollution Research*, 31, 56091, **2024**.
- P. Kumari, **S. R. Samadder**. *Journal of Energy Storage*, 102, 113873, **2024**.
- A. Rani, A. S.Lal, **P. Saravanan**. *Chemosphere*, 364, 143198, **2024**.
- A. Singh, **V. Kumar**, S. Anand, D. Phukan, N. Pandey. *International Journal of Biological Macromolecules*, 280, 136113, **2024**.
- S. Anand, **V. Kumar**, A. Singh, D. Phukan, N. Pandey. *Environmental Pollution*, 348, 123880, **2024**.
- R. K. Jain, **Anshumali**, P. Sherekar, A. Nayak, S. Jaiswal, K. Pimpalghare, R. Tumane, A. Jawade, S. K. Pingle, S. G. Suke, S. R. Kashyap, B. B. Mandal. *PLOS One*, 19(9), e0309237, **2024**.
- S. Kumar, **Anshumali**. *Geoderma Regional*, 38, e00851, **2024**.
- D. Phukan, **V. Kumar**, A. Singh, S. Anand. *International Biodegradation & Biodegradation*, 193, 105841, **2024**.
- A. Singh, S. K. Durbha, A. Sinha, **S. Pasupuleti**. *Water Supply*, 24(9), 2969, **2024**.
- A. Singh, **V. Kumar**, Sarika. *IOP Publishing Ltd., Bristol, UK*, **2024**.
- Isha Burman, **Alok Sinha**, *Environmental Science and Pollution Research*, 31 (33), 45808, **2024**.
- Vinod, A. K. **Prasad**, S. **Mishra**, B. Purkait, M. **Mukherjee**, A. Shukla, N. Desinayak, B. C. **Sarkar**, A. K. **Varma**, *Scientific Reports*, 14, 13785, **2024**.
- M. Devi, V. Gupta, **K. Sarkar**, *Journal of Earth System Science*, 133(131), 1, **2024**.
- R. C. Arasad, S. Kumar, G. S. Rao, A. Biswas, P. R. **Sahoo**, S. **Singh**. *Eastern India. Acta Geophysica*, **2024**.
- M. Mazumder, A. Bal, **A. Tripathy**, Liu Shiqi, T.N. Singh, *Energy & Fuels*, 38, 17510, **2024**.
- Srishti, **A. Kumar**. *Food Chemistry*, 460, 140595, **2024**.
- M. Hazarika, D. N. V. V. L. Konda, **V. K. Rai**. *Journal of Alloys and Compounds*, 1002, 175453, **2024**.
- S. Yadav, A. Pandey, D. Halari, S. Sharma, A. Saxena, **K. Ojha**, S. J. Joshi. *Petroleum Science and Technology*, 1-18, **2024**.
- L. Jangid, S. Dey, D. Joshi, N. Saxena, **K. Ojha**, A. **Mandal**. *Journal of Molecular Liquids*, 408, 125326, **2024**.
- R. Dutta, G. Kundu, S. M. Mousavi Mirkalaei, R. Chakraborty, S. Yomdo, **A. Mandal**. *Energy & Fuels*, 38(15), 14096, **2024**.
- V. Kumar, **S. Ghosh**. *Arabian Journal for Science and Engineering*, 1, **2024**.
- P. **Gupta**, S. Krishna, N. K. **Maurya**. *Energy & Fuels*, 38(16), 15284, **2024**.
- M. I. Ansari, S. F. Anwer, **M. H. Siddique**, T. Alam. *Part G: Journal of Aerospace Engineering*, p.09544100241283365. **2024**.
- Y. K. Pandit, A. Kumar, **V. Mahato**, U. **Gopalakrishnan Nair**, S. Matey, M. Dhandi. *Industrial & Engineering Chemistry Research*, 63, 15665, **2024**.
- M. Mandal, R. Prasanth Kumar, **Keka Ojha**. *Journal of Molecular Liquids*, 411, 125746, **2024**.
- A. Raj, Varun Chaudhary, **R. K. Gangwar**, and R. K. Chaudhary, *IEEE Transactions on Nanotechnology*, 30, 673, **2024**.
- P. Kumar, **R. K. Ranjan**, and S. M. Kang, *IEEE Transactions on Circuits and Systems II: Express Briefs*, September **2024**.
- **R. K. Upadhyay**, D. Barman. *Physica D-Nonlinear Phenomena* 468, 1, 134293, **2024**.
- J. Jia, D. Hu, **R. K. Upadhyay**, Z. Zheng, N. Zhu, Ming Liu. *Communications in Nonlinear Science and Numerical Simulation* 140, 1, Article No. 108360. **2024**.

- **S. Mandal**, S. Samanta, P. K. Tiwari, **R. K. Upadhyay**. *Mathematics and Computers in Simulation* 228, 313, **2024**.
- A. Tripathi, **S. P. Tiwari**, K. Jacob, **S. Mahato**. *Soft Computing*, 28, 10781, **2024**.
- M. Kumari, V. K. Yadav, S. Ruhela, **S. P. Tiwari**. *Soft Computing*, 28, 9233, **2024**.
- **S. Chatterjee**, D. Saha. *Annals of Operations Research*, 340(1), 83, **2024**.
- **M. K. Singh**, B. Nithin, **Kesavan Ravi, Rahul M. R.** *Intermetallics* 175, 108501, **2024**
- N. C. Dhibar, **R. R. Busigari, M. Patel**. *Environ Sci Pollut Res*, 31, 56091, **2024**.
- S. Azam, S. Liu, S. Bhattacharyya, **D. P. Mishra**. *Journal of Hazardous Materials*, 476, 135226, **2024**.
- S. Roy, **D. P. Mishra**, H. Agrawal, **R. M. Bhattacharjee**. *Measurement*, 239, 115516, **2024**.
- K. Raj, **B. S. Choudhary**, G. W. Deressa. *J. Inst. Eng. India Ser. D*, **2024**.
- A. Singh, **S. Agarwal**, A. Prabhat. *Frontiers in Earth Science* 12, 1330217, **2024**.
- **S. Mishra**, A. Mishra, **K. S. Rao**. *Indian Geo-tech J*, **2024**.
- P. K. Gautam, R. Dwivedi, P. Garg, D. Majumder, **S. Agarwal**, M. McSaveney, T. N. Singh. *International Journal of Damage Mechanics*: 10567895241253727, **2024**.
- **S. Mishra**, A. Kumar, **K. S. Rao**, N. K. Gupta, R. Velmurugan, G. Balaganesan, N. Kakur, K. Kanny, (eds) *Dynamic Behavior of Soft and Hard Materials 01. IMPLAST 2022*. Springer Proceedings in Materials, 34. Springer, Singapore. **2024**.

Patents

Granted:

- **Sagar Pal**, Priyapratim Patra, Abhay Shankar Patra, Biswajit Saha, Asim Kumar Mukherjee, "Alginic acid/sodium alginate based polymer as an organic binder in iron ore pelletization", Patent No: 548923, Date of grant: 28.08.2024.

Published:

- **Vivek Bajpai**, Rajesh Sahoo, Prakhar Shukla, "Adaptive pulse width control system by actuating tool position for electro-discharge", Patent Application Number: 202431055777, dated 22.07.2024.
- **Vivek Bajpai, Rabindra Kumar Sinha**, Dhiraj Bajpai, Prince Anand, "A rock drilling equipment

for transverse drilling in a tunnel", Patent Application Number: 202431058252, dated 31.07.2024.

- **Rajeev Upadhyay**, Yash Gupta, Shashank Suman, "A method of Coalbed Methane (CBM) reservoir simulation for characterizing CBM reservoirs at individual well level", Patent Application Number: 202431058525, dated 01.08.2024.
- **S. Narayanan, Swagata Bhaumik**, Manish Kant, Sushil Kumar Singh, Aadit Narayananmurthy, "Design and development of a low noise next generation air-foil with conventional wavy leading edge and curved wavy trailing edge tubercles for enhancing the mitigation of broadband noise", Patent Application Number: 202431058901, dated 03.08.2024.
- **Arun Dayal Udai, Ajay Bhandari**, Ashish Siddharth, "An equipment and method for ocular surgery and drug delivery with needle with robotic-assisted techniques", Patent Application Number: 202431060703, dated 09.08.2024.
- **Vivek Bajpai**, Prince Anand, Abhipsa Kar, "A system of hybrid reverse osmosis", Patent Application Number: 202431060704, dated 09.08.2024.
- **Anup Krishna Prasad**, Sameeksha Mishra, Arya Vinod, Anubhav Shukla, Shailayee Mukherjee, Bitan Purkait, Atul Kumar Varma, Bhabesh Chandra Sarkar, "Multi-model method and system of estimation of ash yield in coal using mid-infrared Fourier transform infrared spectroscopy", Patent Application Number: 202431065336, dated 29.08.2024.
- **Ashis Mallick**, Vivek Sharma, "A hydraulic back pressure attachment for equal channel angular pressing (ECAP) for magnesium and its alloys and the method of working", Patent Application Number: 202431066132, dated 31.08.2024.
- **Prashant Kumar Sharma**, Priyanshu Chaubey, "A multi-interface heterostructure $\text{SnO}_2\text{-Co}_3\text{O}_4\text{-Mo}_2\text{S}_3$ nanocomposite for water splitting application and a process for the preparation thereof", Patent Application Number: 202431066933, dated 04.09.2024.
- **Alok Kumar Das**, Kumar Ujjwal, Mukul Anand, Robin Singh, "A laser-based process for topography correction of Wire-Arc Additive Manufactured components", Patent Application Number: 202431067209, dated 05.09.2024.
- **Amit Rai Dixit**, Mahip Singh, Anuj Kumar Sharma, "Dynamic cutting fluid supply system and method to maintain a constant cutting zone

temperature during a workpiece operation", Patent Application Number: 202431068865, dated 11.09.2024.

- **Aditya Kumar**, Sristhi, "A water-repellent and biodegradable-polymer enhanced stiff jute-cotton blended (Juco) fabric and a process for the preparation thereof", Patent Application Number: 202431069395, dated 13.09.2024.
- **Aditya Kumar**, Sapan Kumar Pandit, 'A Biodegradable Water-Repellent Coating for Paperboard Packaging Materials and a process for the preparation thereof", Patent Application Number: 202431069866, dated 16.09.2024.
- **Sumanta Kumar Padhi**, Thillai Natarajan. M, "A catalyst for green hydrogen generation, a process for the preparation thereof and the use thereof for green hydrogen generation from ammonia", Patent Application Number: 202431070872, dated 19.09.2024.
- **Vivek Bajpai**, Dhiraj Bajpai, Rajesh, "A robotic vacuum cleaner with an integrated exhaust air guidance system to enhance drying of mopped area", Patent Application Number: 202431070877, dated 19.09.2024.
- **Vivek Bajpai**, Abhipsa Kar, "A Fall arrester system with shock absorption to prevent accidental falls from the ladder", Patent Application Number: 202431071314, dated 20.09.2024.
- **Avinash Kumar Singh**, "An equipment with advanced testing facility for precise characterization of pavement materials under repeated longitudinal wheel movement", Patent Application Number: 202431071315, dated 20.09.2024.
- **Kaushik Mazumdar**, Chumki Das, "In_{0.22}Al_{0.2}Ga_{0.58}As/In_{0.63}Ga_{0.37}As metal-oxide-semiconductor high-electron-mobility transistor (HEMT) with TiO₂ passivation for RF application", Patent Application Number: 202431071797, dated 23.09.2024.
- **Amit Rai Dixit**, Annada Prasad Moharana, Ratnesh Raj, "System and method of automatic fibre placement during vat photopolymerization additive manufacturing for composite material fabrication", Patent Application Number: 202431071798, dated 23.09.2024.
- **Gauri Shankar, Vedantham Lakshmi Srinivas, Kartick Chandra Jana**, Suryakant Kumar, Khalid Raza Khan, Ram Khelawan Saket, "A System for

Voltage Stabilization Control with Hybrid Renewable Power Sources in DC Microgrid", Patent Application Number: 202431073196, dated 27.09.2024.

- **S. R. Samadder**, Rima Kumari, "An integrated process for copper extraction from waste printed circuit boards", Patent Application Number: 202431072102, dated 24.09.2024.
- **Anup Krishna Prasad**, Sameeksha Mishra, Arya Vinod, Anubhav Shukla, Shailayee Mukherjee, Bitan Purkait, Atul Kumar Varma, Bhabesh Chandra Sarkar, "Multi-model method and system of estimation of ash yield in coal using mid-infrared Fourier transform infrared spectroscopy", Patent Application Number: 202431065336, dated 29.09.2024.

Individual faculty achievements

- **Prof. Ajay Mandal**, Dept. of Petroleum Engineering conferred IOGCA 2024 Awards in "*Excellence in Chemistry and Chemical Engineering in Oil & Gas Industry and Petrochemical*" in upstream oil and gas sector.
- **Prof. Ravi Kumar Gangwar**, Dept. of Electronics Engineering has received the prestigious "*IEI Young Engineer of the Year award*" from the IEI JH section at Ranchi IEI headquarters.
- **Prof. Anindya Sinha**, Professor of Practice, Dept. of Mining Engineering has been conferred with the MGMI Award for Coal Mining for 2023-24 for his outstanding contribution to the Coal Mining Industry.



- **Prof. Jeevesh Kumar**, Dept. of Electronics Engineering has been awarded with the prestigious "*Tag Corporation Medal*" for best Ph.D. Thesis (2022-2023) in the Department of Electronics Systems Engineering, Indian Institute of Science, Bangalore.
- **Prof. Subramanian Narayanan**, Dept. of Mechanical Engineering was appointed as Associate Editor for the ASME Journal of Engineering and Science in Medical Diagnostics

and Therapy.

- **Prof. Somnath Chattopadhyaya**, Dept. of Mechanical Engineering became a member of the Editorial Board of a Polish Journal "Advances in Science and Technology Research Journal" (SCOPUS Indexed).
- **Prof. Ajay Mandal**, Dept. of Petroleum Engineering has been selected Guest Editor in "Petroleum Exploration and Production Technology" Journal.
- **Prof. Ajay Mandal**, Dept. of Petroleum Engineering received the Energy & Fuels 2024 Excellence in Review Award.
- **Prof. Ajit Kumar**, Dept. of Mechanical Engineering was inducted as an executive member of the National Academic Council of the Fluid Power Society of India (FPSI) for 2024-26.
- **Prof. R. B. Reddy**, Dept. of FMME has received the 2nd Runner Up and won Rs. 2 Lakh Cash Prize in Coal gasification Hackathon-2024 (In July 2024) jointly with CSIR – NCL and IIT(ISM) Dhanbad for providing conceptual solution on Technology Advancement for Efficiency Enhancement in Coal Gasification.
- **Prof. A. Samanta**, Department of Chemical Engineering was awarded the 2nd Runner up and won Rs. 2 Lakh Cash Prize under the category "PS4: Emission Reduction in coal gasification" in "Hackathon on Coal Gasification", organized by Central Mine Planning & Design Institute Limited (CMPDIL), Ranchi in association with the Ministry of Coal, Govt. of India.

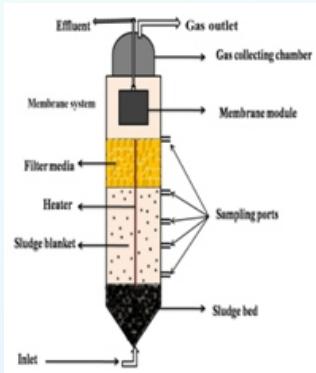


Major Research output

- **Prof. Sagar Pal and his team (Dept. of Chemistry and Chemical Biology)**
A new biopolymeric reagent was developed (**TRL Level: 7**) by the research group of Prof. Sagar Pal [*through joint collaborative research project between Tata Steel Raw Materials Division and his research group at IIT(ISM) Dhanbad*] that has been found efficient as organic binder in iron ore pelletization at plant trial. Also, the patent has recently been granted (Patent No: 548923, Date of Grant: 28.08.2024).
- **Prof. Soumitra Maity and his team (Dept. of Chemistry and Chemical Biology)**
Taming two-headed nucleophiles by light! Thiocyanate, an integral component in the defense mechanisms of the human body, is a two-headed nucleophile. Controlling this dual nucleophilicity has been a long-standing challenge to chemists. My research group has developed a green catalytic tool, harnessing the power of light and photosensitizers to bend its reactivity to their will, synthesizing small cyclic molecules containing sulfur and nitrogen that can assist in future drug discovery crusades.
- **Prof. Isha Burman and Prof. Alok Sinha (Dept. of Env. Sci. & Engg.)**
Economic evaluation of submerged anaerobic hybrid membrane bioreactor was carried out operating at mesophilic temperature, by Dr Isha Burman and Prof Alok Sinha. A laboratory-scale mesophilic submerged anaerobic hybrid membrane bioreactor (An-HMBR) was operated for 270 day for the treatment of high-strength synthetic wastewater at different hydraulic retention times (HRTs) (3 days, 2 days, 1 day, and 0.5 days). Chemical oxygen demand (COD) removal efficiency of 92% was obtained with methane yield rate of 0.18 LCH₄/g COD removal at 1-day HRT. The results of lab scale reactor at 1-day HRT were utilized for upscaling and cost analysis. Cost analysis revealed that the total capital cost comprised tank system (48%), membrane cost (32%), screen and PUF sponge (5% each), PLCs (4%), liquid pumps (3%), and others (2%). The operational cost comprised chemical cost (46%), pumping energy (42%), and sludge disposal (12%). The results revealed that the tank and heating costs accounted for the largest fraction of the total life cycle cost for full-scale An-HMBR. The heating cost can be

- **Prof. Kripamoy Sarkar** Dept. of Applied Geology became the Life Member (LM-11234) of the Mining, Geological & Metallurgical Institute of India on 21.09.24.

compensated by gas recovery. Sensitivity analysis revealed that the interest rates, influent flow, and membrane flux were the most crucial parameters which affected the total cost of An-HMBR.



- **Prof. A. K. Prasad and his team (Dept. of Applied Geology)**

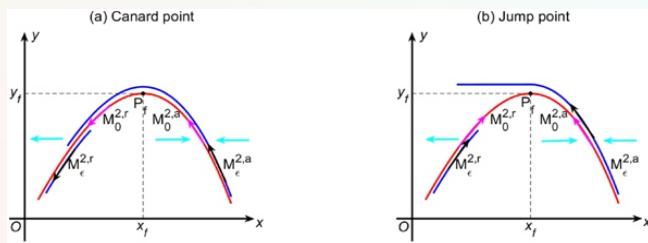
A novel multi-model estimation of phosphorus in coal and its ash using FTIR spectroscopy was done by Prof. A. K. Prasad and his team. The level of phosphorus must be carefully monitored for proper and effective utilization of coal and coal ash. The phosphorus content needs to be assessed to optimize combustion efficiency and maintenance costs of power plants, ensure quality, and minimize the environmental impact of coal and coal ash. The detection of low levels of phosphorus in coal and coal ash is a significant challenge due to its complex chemical composition and low concentration levels. Effective monitoring requires accurate and sensitive equipment for the detection of phosphorus in coal and coal ash. X-ray fluorescence (XRF) is a commonly used analytical technique for the determination of phosphorus content in coal and coal ash samples but proves challenging due to their comparatively weak fluorescence intensity. Fourier Transform Infrared spectroscopy (FTIR) emerges as a promising alternative that is simple, rapid, and cost-effective. However, research in this area has been limited. Until now, only a limited number of research studies have outlined the estimation of major elements in coal, predominantly relying on FTIR spectroscopy. In this article, we explore the potential of FTIR spectroscopy combined with machine learning models (piecewise linear regression—PLR, partial least square regression—PLSR, random forest—RF, and support vector regression—SVR) for quantifying the phosphorus content in coal and coal ash. For model development, the

methodology employs the mid-infrared absorption peak intensity levels of phosphorus-specific functional groups and anionic groups of phosphate minerals at various working concentration ranges of coal and coal ash. This paper proposes a multi-model estimation (using PLR, PLSR, and RF) approach based on FTIR spectral data to detect and rapidly estimate low levels of phosphorus in coal and its ash (R² of 0.836, RMSE of 0.735 ppm, RMSE (%) of 34.801, MBE of - 0.077 ppm, MBE (%) of 5.499, and MAE of 0.528 ppm in coal samples and R² of 0.803, RMSE of 0.676 ppm, RMSE (%) of 38.050, MBE of - 0.118 ppm, MBE (%) of 4.501, and MAE of 0.474 ppm in coal ash samples). Our findings suggest that FTIR combined with the multi-model approach combining PLR, PLSR, and RF regression models is a reliable tool for rapid and near-real-time measurement of phosphorus in coal and coal ash and can be suitably modified to model phosphorus content in other natural samples such as soil, shale, etc.

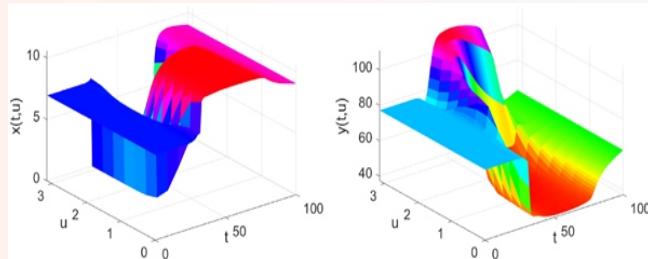
- **Prof. R. K. Upadhyay and his team (Dept. of Mathematics & Computing)**

A model has been considered with a Holling type IV functional response that describes a situation in which the predator's per capita rate of predation decreases at sufficiently high prey density. Meanwhile it can be transformed into a Holling type II functional response in the limiting sense where predator's attack rate increases at a decreasing rate with prey density until it becomes satiated. To explore the different dynamics of these two functional responses, we consider the slow-fast dynamic behavior of predator-prey system with Holling type IV and II functional responses, respectively, and make some simple comparisons of the dynamics of the system with these two functional responses. Specifically speaking, in the non-spatial case, firstly, the system with Holling type II functional response does not undergo a higher-codimension Hopf bifurcation. Then, the system with Holling type IV is extensively proved the existence of canard cycles and relaxation oscillations by using a range of analytical methods such as geometric singular perturbation technique, normal form of the slow-fast system, and the way in-way out function. In the spatial case, the temporal systems are extended to reaction-diffusion predator-prey systems. For the reaction-diffusion system with Holling IV, the

different types of traveling wave are observed. Moreover, for the reaction-diffusion predator-prey system with Holling II, it is demonstrated that Turing instability occurs, which induces spatial heterogeneity patterns. Finally, the comparisons of the above dynamics of Holling Type IV and II functional responses in the non-spatial and spatial cases, respectively, are presented. From these comparisons, different Holling functional responses may be adopted for species at different stages or states, which is more conducive to maintaining species diversity and coexistence.



The critical manifold $\mathbb{0}2$ (red curve) can be split into two parts $\mathbb{0}2,a$ (attracting) and $\mathbb{0}2,r$ (repelling) at point \mathbb{P} (black dot). Black and magenta arrows represent slow flow, and cyan arrows represent fast flow. (a) The slow submanifolds $\mathbb{0}2, 2,$ and $\mathbb{0}2, r$ (blue curves) near the canard point. (b) The slow submanifolds $\mathbb{0}2, 2,$ and $\mathbb{0}2, r$ (blue curves) near the jump point.



Turing instability of the model system.

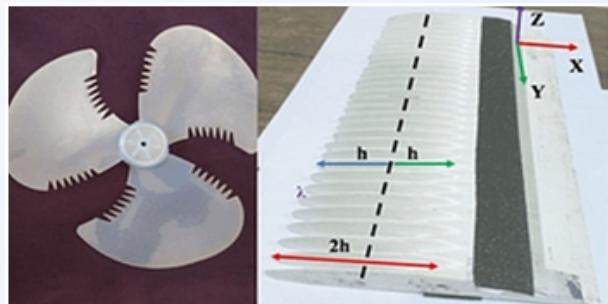
- **Prof. Antarip Poddar and his team (Dept. of Mechanical Engineering)**

A study led by Prof. Antarip Poddar finds that higher hematocrit (Hct) levels shorten recirculation zones behind stenoses, stabilize vortices, and increase wall shear stress (WSS), raising the risk of plaque rupture in diabetes but reducing oscillatory shear index (OSI) and plaque formation potential. In contrast, lower hematocrit (Hct) level promotes vortex instability, increases OSI, and expands regions prone to plaque formation. Eccentric stenosis further amplifies flow disturbances, with diabetes suppressing jet instability while anemia increases vortex shedding. Higher Hct levels reduce flow fluctuations over the cardiac cycle, shorten jet length, and promote flow symmetry, indicating that blood viscosity plays

a critical role in altering flow dynamics and disease progression.

- **Prof. Subramanian Narayanan and his team (Dept. of Mechanical Engineering)**

Researchers from IIT (ISM), led by Prof. Subramanian Narayanan, have designed an advanced airfoil inspired by barn owl wings to reduce aircraft noise significantly. The DST supports the team's innovative design incorporating wavy serrations at the leading and trailing edges, unlike traditional serrated airfoils. This unique structure has demonstrated notable noise reduction across various frequencies, with potential applications in aircraft wings, wind turbines, and fan blades. The leading edge serrations reduce turbulence interaction noise, while the trailing edge serrations target self-noise emissions. Early tests indicate up to a 4-decibel noise reduction, offering a breakthrough in aerodynamic noise control. The team has effectively minimized broadband noise through extensive theoretical and experimental work, promising substantial advancements in quiet aerodynamic design.

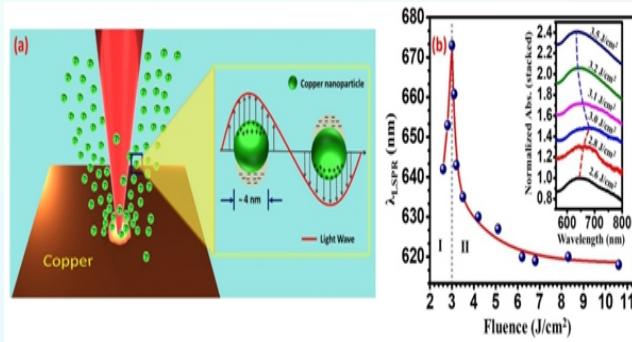


- **Prof. A. Adak and his team (Dept. of Physics)**

Nonclassical plasmonic response of laser-plasma-engineered ultrasmall nearly-monodispersed clean copper nanoparticles

Prof. Adak and his team conducted a systematic study on nonclassical behaviour of the localized surface plasmon resonance (LSPR) response on the size of ultrasmall copper nanoparticles nanoengineered by pulsed laser ablation (PLA) in deionized water. We obtained, for the first time, laser-engineered record-small (4 nm) nearly monodispersed Cu nanoparticles by PLA method. (see: J. Patra, P. Das, S. Nanda, M. Dandapat, U. Tripathy, A. Adak Optics& Laser Technology, 180, 111444, 2025. [published online on 24 July 2024]). These nanoparticles have shown the ability to exhibit antimicrobial properties. Our present work offers a method for controlled clean nanofabrication of

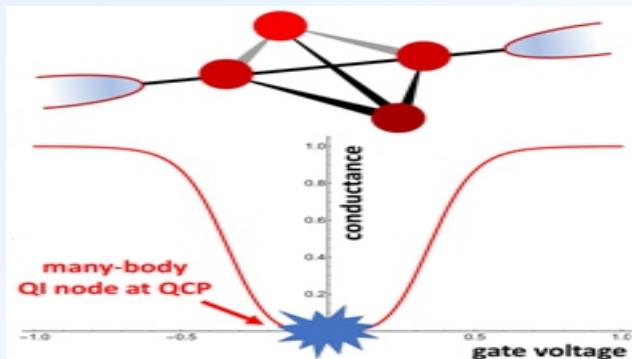
ultrasmall near monodispersed copper nanoparticles with a clear understanding of their plasmonic response.



- Prof. Sudeshna Sen and her team (Dept. of Physics)

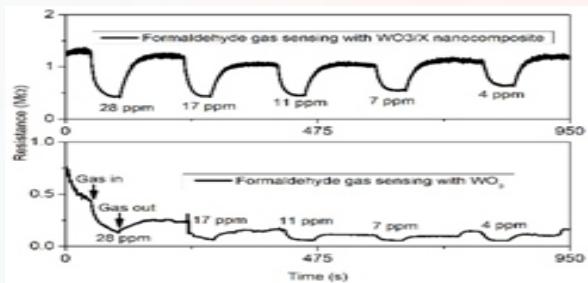
Inverse Design of Molecular Junctions

From the Quantum Materials group at IIT(ISM) Dhanbad led by Prof. Sudeshna Sen. In a recent work titled "Many-body quantum interference route to the two-channel Kondo effect: Inverse design for molecular junctions and quantum dot devices," the authors have explored the elusive two-channel Kondo physics in molecular junctions. The authors have developed an inverse design strategy for generalized quantum impurity models describing molecular junctions. They have used them to demonstrate that many-body quantum interference can be leveraged to realize the two-channel Kondo critical point in simple 4- or 5-site molecular moieties. We show that remarkably high Kondo temperatures can be achieved, meaning that entropy and transport signatures should be experimentally accessible. This work was done in collaboration with Prof. Andrew Mitchell from University College Dublin, Ireland. This work has been published in the journal Physical Review Letters (Phys. Rev. Lett., 133, 076501, 2024). The research has been supported by the Science and Engineering Research Board (SERB), India.



- Prof. Jhasaketa Nayak and his team (Dept. of Physics)

Prof. Nayak and his team have developed some novel materials for enhancement of room temperature sensitivity and stability of metal oxide semiconductor based volatile organic gas sensors. Tungsten oxide (WO_3) nanoparticles can efficiently detect trace amount of toxic volatile organic compound gases such as formaldehyde, trimethylamine, ammonia and carbon monoxide present in lower atmospheres in laboratory and industry. Some of the major drawbacks of WO_3 and other metal oxide semiconductor-based gas sensors are: (i) instability characterized by large baseline drift and (ii) poor response at room temperature, especially in humid atmosphere. During humid rainy days, WO_3 gas sensors malfunctions showing erroneous data. We have developed some oxide semiconductor nanocomposites that are resilient in highly humid atmosphere (RH=92%) can efficiently sense formaldehyde gas at room temperature. The above nanocomposite-based gas sensors have higher response compared to WO_3 sensors, they are exceptionally stable as indicated by negligible baseline resistance drift during room temperature operation in a highly humid condition. A maximum room temperature sensitivity of 0.24 ppm^{-4} towards formaldehyde gas has been recorded for the above metal oxide semiconductor nanocomposite-based gas sensor.



Dynamic responses of formaldehyde gas sensors fabricated with WO_3 nanoparticles and WO_3/X nanocomposites.

Major instrumental facilities created

Department of Computer Science and Engineering

The Department of Computer Science and Engineering has recently established a state-of-the-art facility on **Internet of Things (IoT)** aimed at fostering research and innovation in

emerging technologies. The lab is equipped with cutting-edge equipment, including NVIDIA GPU workstations for deep learning, IoT development kits, and edge computing devices. The lab is actively engaged in several externally funded projects, focusing on areas such as smart cities, AI-based predictive maintenance for mining assets, IoT-based environmental monitoring solutions, and AI-enabled autonomous drones. Students are involved in mini-projects, including smart agriculture, home automation, and AI-powered surveillance systems.



Department of Petroleum Engineering



Department of Fuel, Mineral and Metallurgical Engineering

The present depositions are carried on DYMET 420 cold spray setup. To study the effect of scan/deposition path strategy, a XY manipulator setup was built in house. Onto this manipulator the deposition gun was mounted, so that it can follow the programmed path during the experimentation at desired traverse

speed. The manipulator has two degrees of freedom with a working range $300\text{ mm} \times 250\text{ mm}$. The setup is capable of producing basic primitives shapes to complex curvatures with 0.1 mm resolution, following different scan patterns such as zigzag, raster, island and other strategies. Lead Screws are utilized for motion control in X and Y axes, further which are coupled with Stepper motors for precise movement. The stepper motors were interfaced to Arduino using stepper drivers, in order to make to Computer Numeric Control unit. Finally GRBL freeware in combination with Universal G-Code Sender (UGS) platform are utilized to execute the G-Code commands and replicate the travel path/scan strategy.



DYMET 420 Cold Spray set up

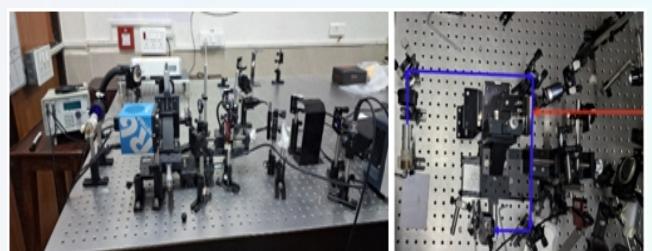
Department of Mechanical Engineering

An experimental facility with a low-speed open-circuit wind tunnel for the UG teaching lab was installed in the Department of Mechanical Engineering.

Department of Physics

Optical Probe Beam Deflection Setup for Fast Plasma Dynamics

The beam deflection is a method for detecting shock waves by measuring the deflection of probe beam caused by shock wave passage. In our present work, we have developed an advanced Optical Probe Beam Deflection Setup at LLPI, Department of Physics. In our preliminary work, we see complete absorption of probe and an evolution of shock wave as the probe moves away from interaction spot. This setup will enable us to characterize the intense nanosecond pulsed laser driven fast plasma dynamics and spatio-temporal structure of the shockwave front.



Laboratory for Laser Plasma Interaction (LLPI) Instrumental facility

Women Faculty Achievers

- **Prof. Madhulika Gupta**, Department of Chemistry and Chemical Biology was appointed as the Nodal officer of the Vigyan Jyoti program of the Department of Science and Technology (DST), Government of India. Under this initiative, she organized a special one-day program on 20th August 2024 for over 70 students from PM SHRI School Jawahar Navodaya Vidyalaya (JNV), Koderma, Jharkhand to encourage young girls to pursue careers in STEM (Science, Technology, Engineering, and Mathematics). Another event was organized for 61 girl students from JNV Dhanbad. The program seeks to break gender stereotypes, address the gender imbalance in these fields, and empower young girls with knowledge, skills, and opportunities. She was invited for interaction at JNV Koderma to inspire boys' and girls' students in STEM education on 10th September 2024. During her visit, she delivered a and shared insights into how programs like Vigyan Jyoti can help to bridge the gender gap by providing the necessary support and resources for young women to excel in these domains.



- **Prof. Sheeja Jagadevan**, Dept. of Env. Sc. & Engg. delivered a **Lecture at the Skilled Training on Quality Monitoring of Water and Wastewater: Laboratory Analysis, Data Interpretation, and Quality Assurance** held from **July 9th to 16th, 2024**, at the CSIR-Central Institute of Mining and Fuel Research (CIMFR), Barwa Road Campus, Dhanbad. The talk entitled "Technologies for treatment of arsenic and fluoride contaminated groundwater" was delivered to participants from Binod Bihari Mahto Koyalanchal University, Dhanbad on **15th July, 2024** from **2.30 PM to 3.30 PM**. The participants got to learn about advanced methodologies and best practices for dealing with arsenic and fluoride contaminated groundwater.



- **Prof. U. Bansal**, invited speaker at the conference, titled “*Women in Geosciences: Opportunities, Challenges and Accomplishments*” that took place from 2nd to 4th September, 2024 at NCESS, Thiruvananthapuram.

[thehindu.com/news/national/kerala/national-seminar-on-womens-participation-in-geosciences-begins-at-ncess/article68598061.ece](https://www.thehindu.com/news/national/kerala/national-seminar-on-womens-participation-in-geosciences-begins-at-ncess/article68598061.ece)

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National seminar on ‘Women’s Participation in Geosciences’ begins at NCESS

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THE HINDU BUREAU

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M. Ravichandran, Secretary, Ministry of Earth Sciences, on Monday inaugurated a three-day national seminar on ‘Women’s Participation in Geosciences: Opportunities, Challenges, and Achievements’ at the National Centre for Earth Science Studies (NCESS), Akkulam.

Sudipta Sengupta of Jadavpur University delivered the keynote address. Prof. Sengupta’s book ‘Breaking Rocks and Barriers’ was released on the occasion. More than 65 women scientists and researchers will present papers and participate in a poster exhibition covering topics such as field geology, paleoclimate, igneous petrology and metamorphic petrology.

NCESS director N.V. Chalapati Rao and NCESS-DAC chairman Tolat Ahmad also spoke.

<https://www.thehindu.com/news/national/kerala/national-seminar-on-womens-participation-in-geosciences-begins-at-ncess/article68598061.ece>



- **Prof. Keka Ojha** presented paper on “*Development of Silica Nanoparticle-Enhanced PHPA Hydrogels for Water Shut-Off in High-Temperature and High-Salinity Reservoirs*” in IOGCA New Delhi during September 26-27, 2024 and awarded best technical paper in IOGCA New Delhi during September 26-27, 2024. Prof. Ojha is actively involved in research in the field of CBM, Shale water shut-off & hydraulic fracturing and delivered R&D and consultancy projects to different E&P companies in India.
- **Prof. Aarti Kumari** attended the first international conference on Circular Hydrometallurgy – ICHS 2024, held at Mechelen (Belgium) during 9th -11th September, 2024. Topic of presentation: Hydrometallurgy for sustainable recovery of rare earths from waste NdFeB magnets.
- **Prof. Sudeshna Sen**: Scientists have long known that electrons are indivisible fundamental particles. Yet surprising new research shows that a weird feature of quantum mechanics can be used to produce objects that behave like half of an electron. The work by Prof. Sudeshna Sen, in collaboration with Prof. Andrew Mitchell from University College Dublin, Ireland, on inverse design of molecular junctions was highlighted as the Editors' Suggestion in the prestigious journal, *Physical Review Letters*. The impact of the work was also highlighted in the phys.org magazine.

International Visits

Prof. Biswajit Chowdhury, Department of Chemistry and Chemical Biology visited UIT the Arctic University of Norway, Tromso during 10th June-10th July 2024 as a visiting researcher where Prof. Krishna Agarwal was the host faculty. During his stay, he discussed about collaborative research between IIT(ISM) and UIT, master/doctoral student exchange through **Indo-Norwegian Cooperation Programme 2024** and a proposal has been submitted.



Hege Kristin Widnes (left), International Cooperation Section, University of Tromsø - The Arctic University of Norway with Prof. Biswajit Chowdhury (Right)

Prof. P. R. Sahoo, Department of Applied Geology, participated in 37th International Geological Congress at Busan, South Korea. He presented research work and chaired a session during the event.



Prof. Aarti Kumari, Department of Fuel, Mineral and Metallurgical Engineering, attended the "First International Conference on Circular Hydrometallurgy – ICHS 2024", held at Mechelen, Belgium during 9th-11th September.



Prof. Aarti Kumari

Prof. D. P. Mishra and Prof. S. Agrawal, Department of Mining Engineering attended the 12th International Mine Ventilation Congress (IMVC2024) at Sydney, Australia during 12-16 August 2024.



Prof. D. P. Mishra submitted and presented the bid document before the IMVC Committee for hosting the 13th IMVC in India.

MoUs Signed

- **MoU between IIT(ISM) Dhanbad and ATIIT, Bhubaneswar**



ATIIT which stands for 'Advanced Trainings in Information and Intelligent Tech's Private Limited', based in Bhubaneswar, Odisha, signed an MoU (Memorandum of Understanding) with Indian Institute of Technology (Indian School of Mines) Dhanbad, Jharkhand on 12th August 2024, to promote online advanced certification courses.

The MoU was signed by Prof. Sagar Pal, Dean (Research & Development), IIT(ISM) Dhanbad and Mr. Manjil Choudhury, Director, ATIIT Private Limited, Bhubaneswar, Odisha in the presence Mr. Prabhupad Gharai, Dr. Swarandeep Sahoo, Dr. Rajeev Upadhyay, Dr. Saurabh Datta Gupta and Prof. Sanjit Pal, HOD/AGP along with other eminent dignitaries.

The scope is vast, and some of the subjects range from Space Science, Computational Fluid Dynamics (CFD), Mineral explorations and Energy Resources to start with. Other subjects that can be introduced soon are Aeronautics Engineering, Autonomous Vehicles, Material Science, Climate Science, Blue Economy, Renewable Energy etc. These will be certification courses and will benefit the learners as they will be exposed to high end, industry specific, future oriented curriculum and enhance their skills in specific time frame. The faculty members of IIT(ISM) Dhanbad will get a chance to play a key role in knowledge and technological up-gradation, innovation and competitiveness of the students and learners and also contribute to the overall branding and revenue enhancement. Learners will not only gain specialized knowledge but also have a tangible credential to showcase their expertise.

- **MoU between IIT(ISM) Dhanbad and RARA Energy Consulting**



An MoU was signed between Indian IIT(ISM) Dhanbad and Rara Energy Consulting to explore future opportunities in carbon capture, utilization, and storage (CCUS) and hydrogen storage, with a focus on subsurface, reservoir engineering, and geomechanics. We look forward to a successful academia-industry partnership on emerging

research avenues that contribute to the energy transition through sustainable practices.

The MoU was signed online and following members were present:

Ms. Swati Gupta, Ms. Zainab Rizvi, Mr. Vinod Kumar Madem from RARA Energy and Prof. Sagar Pal (Dean of R&D@IITISM), Prof. Keka Ojha (Head of the Department of Petroleum Engineering), Prof. Sayantan Ghosh, and Prof. Partha Pratim Mandal. From IIT(ISM) Dhanbad.

- **MoU between IIT(ISM) Dhanbad and L&T Institute of Project Management, Vadodara**



MoU signed between IIT(ISM) Dhanbad and L&T Institute of Project Management, Vadodara, Gujarat to undertake the activities in the field of engineering, projects and construction management, Organising joint research activity and event. Prof. Shikha Singh, Department of Management Studies and Industrial Engineering is the Faculty Coordinator from IIT(ISM) Dhanbad of this MoU.

- **MoU between IIT(ISM) Dhanbad and Shahid Nirmal Mahato Medical College, Dhanbad**

An MoU was signed between IIT(ISM) Dhanbad and Shahid Nirmal Mahato Medical College, Dhanbad (SNMMC) for undertaking activities and programmes like publishing papers, organising conference/conclave, Faculty Development and Co-Teaching. Prof. Shikha Singh, Department of Management Studies and Industrial Engineering is the Faculty Coordinator from IIT(ISM) Dhanbad of this MoU.

- **MoU between IIT(ISM) Dhanbad and NIPER, Mohali**

An MoU was signed between IIT(ISM) Dhanbad and National Institute of Pharmaceutical Education and Research, Mohali, Punjab for participation in the research and development projects pertaining to the structure-based design of small molecule for inhibiting the aggregation of amyloid beta for the treatment of Alzheimer's and non-alcoholic fatty acid disease. Prof. Swapan Dey, Department of Chemistry and Chemical Biology is the Faculty Coordinator from IIT(ISM) Dhanbad of this MoU.

- **MoU between IIT(ISM) Dhanbad and ERGO Exergy Technologies INC**

An MoU was signed between IIT(ISM) Dhanbad and ERGO Exergy Technologies INC for Collaborative research and development initiative and creating a comprehensive platform for pursuing advanced research work. Prof. Keka Ojha, Department of Petroleum Engineering is the Faculty Coordinator from IIT(ISM) Dhanbad of this MoU.

- **MoU between IIT(ISM) Dhanbad and MDS IndoCan Inc., Canada**

An MoU was signed between IIT(ISM) Dhanbad and MDS IndoCan Inc., Canada to facilitate the exchanges and collaborative works including joint projects, students exchange with reputed institute in Canada and IIT(ISM) in different areas.

Workshop / Conference / Seminar

- **Department of Civil Engineering** was organized by Emerging Global Trends from 8-12 July 2024 at IIIF Kolkata. Numerous esteemed experts namely Prof. Vasant Matsagar and Prof. Tanusree Chakraborty from IIT Delhi, Prof. Guoxing Lu from Swinburne University of Technology, Australia, Dr. Anandavalli N. from SERC, Chennai, Prof. Alex Remennikov from University of Wollongong, Australia, Prof. Masuhiro Beppu from National Defense Academy, Japan, Prof. Manish Kumar from IIT Bombay, Prof. Ganesh Thiagarajan from University of Missouri, USA, Prof. Hrishikesh Sharma from IIT Guwahati, Prof. Sam Rigby from University of Sheffield, UK, Prof. M. D. Goel from VNIT Nagpur, Prof. Ricardo Castedo from Universidad Politecnica de Madrid, Spain, Prof. Rajib Sarkar and Prof. Pranesh Roy from IIT (ISM) Dhanbad, Dr. Aditya Rana from CSIR-CIMFR Dhanbad, Prof. T P Tezeswi from NIT Warangal, Prof. Hezi Grisaro from Israel Institute of Technology delivered talks during the programme.



- **Department of Computer Science and Engineering** hosted **Mr. Arunava Maity** as a distinguished speaker for a seminar aimed to spread awareness about Intellectual Property. Mr. Maity, a Registered Indian Patent Agent and Trade Mark Agent, is the co-founder of LEXECURES, a boutique law firm specializing in intellectual property law. With over 6 years of experience in patent practice and 7.5 years in software development, Mr. Maity brought invaluable insights into the critical role of intellectual property in fostering innovation and impact within academia.



- **Department of Environmental Science and Engineering** and Centre for Water Resource Management (CWRM), IIT (ISM) Dhanbad organized a four-day Programme titled, "Ecosystem Restoration, Eco-Park Development in Mined-out Areas, Carbon Sequestration, Ecosystem Goods & Services, and Application of RS, GIS & Modelling". The

training programme was held at IIT (ISM)'s Industry-Institute Interaction Facility (IIIF), New Town, Kolkata from 23rd September 2024 to 26th September 2024. The convenor of the program was Prof. S. R. Samadder – Professor/ESE and the Co-convenor was Prof. S. K. Maiti – Professor (HAG)/ESE.



- A workshop was organized by **Prof. S. Singh, Department of Applied Geology** on Critical Minerals: Nature, Recovery and Uses. The MOES funded workshop was held from July 15-19, 2024. Mr. Joshua Bamford, Head Tech and Innovation, British High Commission was the chief guest of the event. He with Ms. Chrishti Thomas and Mr. Sunil Kumar from British High Commission visited the Department.



- A six-day short-term programme on "High-efficiency, low-emissions clean coal and carbon capture, utilization, and storage technologies" was organised by the **Department of Chemical Engineering & the Department of Mechanical Engineering**, IIT (ISM) Dhanbad, under the aegis of Malaviya Mission Teacher Training Programme (MMTP), UGC, Govt. of India. It was held during 23-28 September 2024 at the OCEP Conference Hall, i2H Building, IIT (ISM) Dhanbad. The primary objective of this programme was to disseminate among the participants about the recent developments in the areas of high-efficiency, low-emissions (HELE) clean coal and Carbon Capture, Utilization and Storage (CCUS) Technologies, which are absolutely crucial to combat the biggest challenge of our time, i.e. global warming. The sessions had experts from Tata Steel, DVC, Maithon Power Limited, IIT Bombay, IIT Kharagpur, Jadavpur University, CMERI Durgapur, etc. The course witnessed participation from both academia and industries. **Prof. A. Samanta** from the Department of Chemical Engineering was the Course Coordinator for this short-term programme, while **Prof. Tanmay Dutta** (Department of Mechanical Engineering) and **Prof. Soumyajit Sen Gupta** (Department of Chemical Engineering) were the Course Co-coordinators.



- **Prof. Keka Ojha**, Department of Petroleum Engg. (Prof. M. Hamid Siddiqui, and Prof. Neetish Maurya, Co-CIs) executed Two Days Workshop on "Safety in Oil and Gas Industry" on 8-9th August in IIIF Centre, New Delhi.



- **Prof. Rajeev Upadhyay**, Dept. of Petroleum Engg, executed Two day's programme on "Coalbed methane- from prospect to pipeline" for M/s Cairn Oil & Gas (Vedanta Limited), Gurugram Office during 5th – 6th Aug 2024. The workshop was organized by Cairn India.
- **Prof. Ashutosh Kumar**, Dept. of Petroleum Engg, (Prof. Rajeev Upadhyay, Co-CI) executed Course on "Specialized Training Program on Hydrocarbon Phase Behaviour and Reservoir Rock and Fluid Properties" for Oil India Limited at Duliajan during the period 16th – 21st Sept. 2024 and 5th – 10th Oct. 2024.
- **Prof. Rajeev Upadhyay**, Dept. of Petroleum Engg, (Prof. Ashutosh Kumar, Co-CI) organized 2 days' workshop on Coalbed Methane (CBM) for executives of ONGC in P&D Directorate office, ONGC Dehradun.



- **Prof. Mohammed Hamid Siddique**, Dept. of Petroleum Engg, has coordinated the workshop "Indian Standards on Methods of sampling and Test for Petroleum and Related Products" by BIS on 28.03.2024.



- **Department of Electronics Engineering, IIT (ISM)** Dhanbad successfully organized a Drone Bootcamp at Ramgarh Engineering College (REC) Ramgarh, Jharkhand from 18-22 October 2024, under the aegis of the Ministry of Electronics and Information Technology (MeitY) funded project on "Capacity Building for Human Resource Development in Unmanned Aircraft System (Drone and related technologies)." With more than 90 students from various streams participating, the bootcamp was an incredible hands-on experience. Participants not only assembled and programmed but also flew a total of 16 drones (08 quadcopters and 08 hexacopters).



- **Department of Mechanical Engineering** organized 5-days Programme on 'Quality Engineering and Management (QEM)' at IIT (ISM) - Industry Institute Interaction Facility (IIIF), Delhi from 17-21 September 2024 in Offline mode which was coordinated by **Prof. N. K. Singh**. In this event, Prof (Retd.) S P Mukherjee, Former Centenary Professor of Statistics and Former Dean of the Faculty of Science of Calcutta University, a Legendary Statistician and International Quality and Reliability Expert, inaugurated the function in online mode as Chief Guest.



- **Prof. R. M. Bhattacharjee**, Department of Mining Engineering has conducted a Special session on "Vision Zero" in the Indian Mining Sector – Challenges ahead and path forward, for the Executives of Hindustan Copper Limited at Kolkata on 5 September 2024.
- **Prof. B. S. Choudhary**, Department of Mining Engineering has conducted a three days Professional Development Programme on "Introduction of the Latest Tunneling Technique" for the executives of NHPC Ltd.
- **Department of Mechanical Engineering** organized 5-days programme on "Condition-Based Maintenance: Integrating Oil Analysis, Vibration Analysis, and Tribology", which was coordinated by **Prof. Subrata K Ghosh** at IIT(ISM) Dhanbad during 23-27 Sept 2024.