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Quarterly Newsletter of Department Of Applied Geophysics

IIT ISM INDIAN INSTITUTE OF TECHNOLOGY INDIAN SCHOOL OF MINES DHANBAD

GEOSPECTRUM

INSIDE THIS ISSUE

RESEARCH ACHIEVEMENTS:

TOTAL PUBLICATIONS 31

05 NEW INSTRUMENTS ADDED

TOTAL NO. OF PROJECTS 14

SPOTLIGHT ON RESEARCH EXCELLENCE

From the HoD's desk

Welcome to the 1st edition of our Department of Applied Geophysics newsletter. Since our inception in 1957, we have developed into a pioneering department dedicated to advancing knowledge and expertise in geophysical sciences inside country as well as in global space. With programs at the undergraduate, postgraduate, and doctoral levels, we prepare our students to address complex geophysical challenges, contributing significantly to the fields of energy, resource management, geohazards and sustainability. Our curriculum emphasizes both foundational knowledge and cutting-edge advancements, enabling our graduates to excel globally.

Our research focus encompasses seismology, near surface geophysics, seismic studies, rock and fluid physics, remote sensing, formation evaluation, potential fields, ground water and environmental geophysics, with an increasing integration of artificial intelligence, machine learning, and sustainable resource management. Equipped with advanced laboratories and facilities, including a Seismological Observatory and specialized labs for seismic data processing, mining geophysics, global optimization, and rock physics, we are at the forefront of research and development in applied geophysics. Oiur department has storng expertise in Near Surface Geophysics; Environmental Geophysics; Mining Geophysics; Archaeological Geophysics, Engineering Geophysics and Geotechnical Modelling

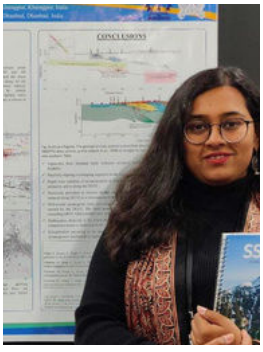
A cornerstone of our department is collaboration. Through strategic partnerships with industry leaders and research institutions, we provide our students with real-world experience and access to state-of-the-art technologies. The Subsurface Resource Characterization Group (sRCg), for instance, is a recent initiative dedicated to exploring innovative solutions for subsurface exploration and environmental sustainability. This group develops software tools and methodologies that enhance subsurface analysis and resource estimation.

Our department's outreach efforts and workshops are designed to strengthen our engagement with the geoscience community and to foster knowledge sharing and skill development among students and professionals. Through our continuous work in early warning systems for geohazards, we are dedicated to creating safer, more resilient communities.

As we look to the future, our commitment remains to excellence in education, impactful research, and meaningful contributions to the geoscience sector. Thank you for supporting the Department of Applied Geophysics at IIT (ISM) Dhanbad as we strive to lead in geophysical innovation and knowledge.

Warm regards,
Prof. Sanjit Kumar Pal
Head of the Department
Department of Applied Geophysics, IIT (ISM) Dhanbad

WOMEN FACULTY ACHIEVERS:



Prof. Niptika Jana

Assistant Professor

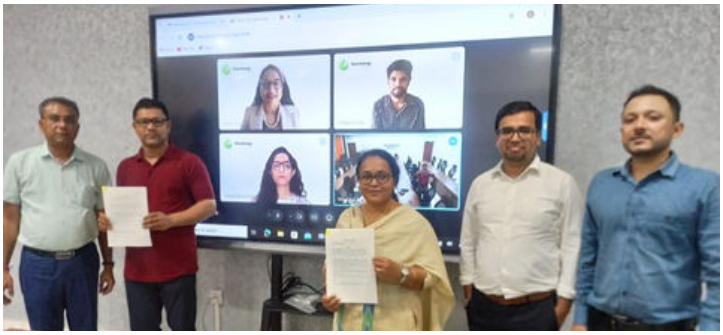
We feel proud that Prof. Niptika Jana, a distinguished faculty member from our Department of Applied Geophysics, recently represented IIT (ISM) Dhanbad on an international platform at the Seismological Society of America's Annual Conference held in Anchorage, Alaska, from April 29 to May 4, 2024. She presented her research on the "Seismic structure, lithospheric deformation, and seismicity of the Indian plate in Sikkim Himalaya," showcasing her contributions to understanding regional tectonics and seismic hazards.

Her participation was made possible by a prestigious travel grant from the Science and Engineering Research Board (SERB) International Travel Scheme, funded by the Department of Science and Technology, Government of India. We take immense joy in her accomplishments and her role in bringing international recognition to our department.

GLOBAL COLLABORATIONS & KNOWLEDGE EXCHANGE

MOUS SIGNED:

MOU between Rara Energy Consulting & Indian Institute of Technology (Indian School of Mines), Dhanbad.

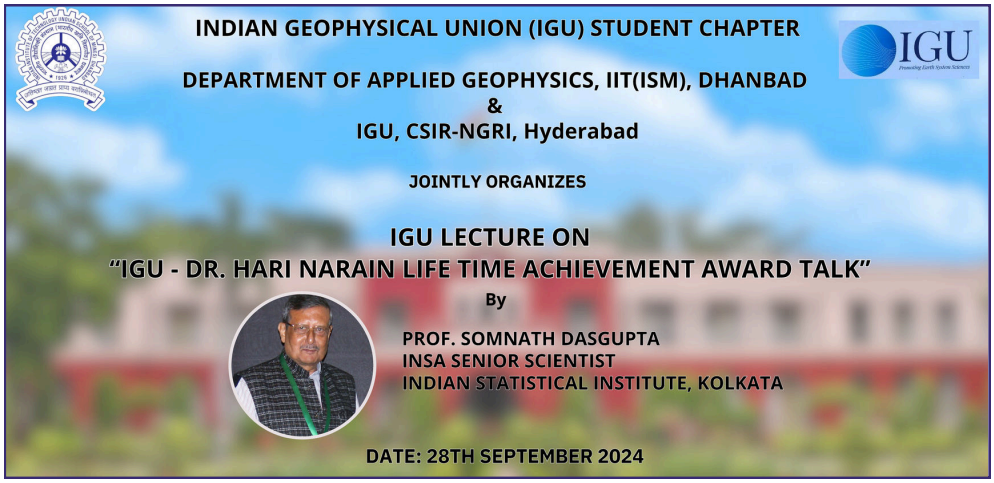


This collaborative agreement aims to explore the futuristic opportunities on CCUS and Hydrogen Storage focussing on Subsurface, Reservoir engineering and Geomechanics. We are excited to work together and work on emerging avenues of research in energy transition through sustainable practices.

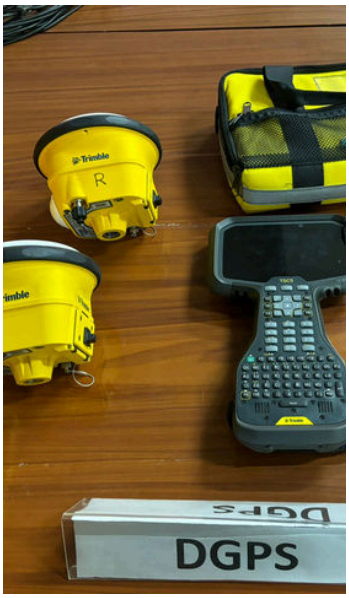
MOU between ATIIT & Indian Institute of Technology (Indian School of Mines), Dhanbad.

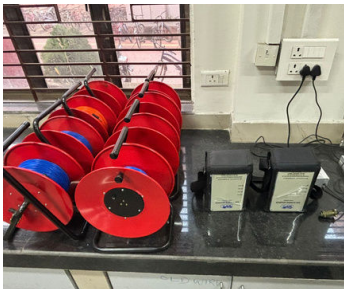
ATIIT Bhubaneswar signed an MoU with IIT (ISM) Dhanbad on August 12, 2024, to launch online certification courses in areas like Space Science, CFD, and Energy Resources, with plans to expand into Aeronautics, Climate Science, and more. These courses aim to upskill learners with industry-focused expertise.

WEBINARS & GUEST TALKS



INSTRUMENTS AT A GLANCE

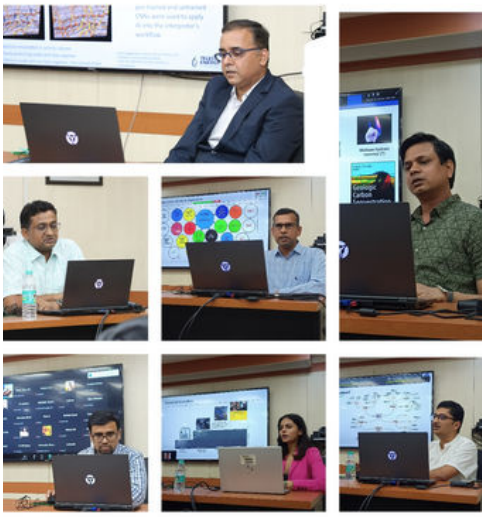




The Department of Applied Geophysics at IIT (ISM) Dhanbad has bolstered its resources for advanced geophysical research and hands-on work with a range of specialized instruments. Among the department's latest additions are the Geode 24 Channel Seismograph, DGPS, AUTO-Grav Gravity Meter (CG-6), Water level indicator, Spectral radiometer and a cutting-edge resistivity meter. These new tools will surely enhance the department's capabilities in conducting precise and extensive geophysical investigations.

The expanded inventory of state-of-the-art equipment supports students and researchers in exploring diverse aspects of Earth sciences, from gravity and magnetic surveys to seismic, resistivity, and spontaneous potential studies. These resources empower our community to pursue innovative research and contribute meaningfully to advancements in geophysical methods and applications, strengthening the department's role in shaping the future of Earth science and technology.

EDP COURSE



Five days Executive Development Program on "Resource Parameter Estimation and Forecasting Using Skillful and Interpretable AI/ML of Geoscience Data" was conducted by the Department of Applied Geophysics, IIT(ISM) Dhanbad

Around 50 delegates from organizations like ONGC, OIL, IOCL, Reliance, Halliburton, Oilmax, CDAC-Pune, CSIR-NGRI, IITs, and other universities participated in person and online. They explored advanced AI/ML techniques for Earth resource estimation and forecasting. A total of 17 technical talks and 4 tutorials were presented by experts from ONGC, Telesto Energy, Halliburton, Roy Hill Holdings, Rezlytix, Querent AI, and notable academics from institutions such as The University of Texas at Austin, Stanford, Sorbonne Abu Dhabi, CSIR-NGRI, and IITs, focusing on the role of interpretable AI/ML in resource estimation, energy security, and sustainability.

NATIONAL CONFERENCE
EMERGING TREND IN EARTH SCIENCES (ETES): GEOHAZARDS AND RESOURCE MANAGEMENT

ETES-2024
Sept. 27-29, 2024

The Department of Applied Geophysics at IIT (ISM) Dhanbad recently **hosted the National Conference on Emerging Trends in Earth Sciences (ETES-2024) from September 27-29, 2024.** This event, a precursor to the institute's upcoming centenary celebrations, brought together an impressive gathering of over 200 delegates from institutions such as IITs, IISERs, CSIR labs, ISRO, and industry leaders, marking it as a landmark platform for advancing Earth sciences.

NATIONAL CONFERENCE
EMERGING TREND IN EARTH SCIENCES (ETES): GEOHAZARDS AND RESOURCE MANAGEMENT

Distinguished Guests and Inaugural Highlights:

The conference was organized under the leadership of **Prof. Sanjit Kumar Pal (Convener)** and **Prof. Saumen Maiti** and **Prof. Saurabh Datta Gupta (Co-Conveners)**, supported by an esteemed organizing committee, including **Prof. Anil Kumar Chaubey, Dr. Partha Pratim Mandal,** and **Dr. Niptika Jana.** It brought together **over 200 participants** from **20 institutions** across India, including IITs, IISERs, CSIR Labs, ISRO Centers, public and private industries.

Distinguished guests included **Padmashree Prof. Harsh K. Gupta (Former Secretary, Ministry of Earth Sciences, Govt. of India) as the Chief Guest** and **Prof. J. R. Kayal (Former Deputy Director, GSI) as the Guest of Honour**, along with several esteemed speakers and delegates. **Prof. Dheeraj Kumar, Deputy Director, IIT(ISM) Dhanbad** presided over the function.

The conference featured 12 technical sessions addressing a diverse range of topics, including AI/ML in geosciences, energy security, nearsu rface exploration, mine safety, and geophysical techniques for archaeological studies. The event also emphasized emerging fields like geospatial advances and continental margin studies.

NATIONAL CONFERENCE
EMERGING TREND IN EARTH SCIENCES (ETES): GEOHAZARDS AND RESOURCE MANAGEMENT

Thematic Sessions and Expert Talks

ETES-2024 covered an extensive range of themes across its eight sessions, catering to current geoscientific interests. Highlights included discussions on:

- Mine Safety and geoscientific challenges of the mining industry : Advanced techniques for slope stability, coal fire monitoring, and early warning systems were discussed to improve mining practices and safety.
- Physics of Earth's Interior and planetary system: Talks covered geodynamic modeling and crustal studies, focusing on tectonic evolution and seismic activity.
- Energy Security and Storage and carbon sequestration : In this session, experts addressed carbon sequestration, geothermal energy, and innovations in enhanced oil recovery.
- Geological Hazards : risk assessment and mitigation: Assessments and mitigation strategies for landslides, seismic hazards, and subsurface dynamics were discussed to reduce risk in vulnerable areas.
- Applications of AI/ML in Geosciences: Innovative uses of deep learning in seismic and geophysical data processing highlighted the technological advancements shaping the field.
- Geospatial Technologies and Groundwater Management: Insights into flood mapping, mineral exploration, and groundwater potential assessment demonstrated the role of remote sensing in Earth sciences.
- Climate Change and Atmospheric Sciences: Experts discussed climate extremes and land atmosphere interactions, crucial for understanding climate resilience.
- Geoscientific Techniques in delineating archaeological heritages : The conference closed with sessions on using geophysical methods to explore archaeological sites, including case studies from ancient Indian locations.
- Continental Margins and Ocean Basins:This delved into the complexities of continental margins and ocean basins, with particular emphasis on recent research in the Indian Ocean.
- Geology and Geodynamics of the Eastern Himalayas and Foreland Basins:Enlightenment on the geology and tectonic dynamics of the eastern Himalayas and adjacent foreland basins, focusing on the intricate processes shaping this region were covered.

NATIONAL CONFERENCE EMERGING TREND IN EARTH SCIENCES (ETES): GEOHAZARDS AND RESOURCE MANAGEMENT

MORE IMAGES FROM THE EVENT:

NATIONAL CONFERENCE
EMERGING TREND IN EARTH SCIENCES (ETES): GEOHAZARDS AND RESOURCE MANAGEMENT

CULTURAL NIGHT:

Sponsors and Collaborative Support

ETES 2024 was made possible through generous support from both diamond and silver sponsors, reflecting a strong commitment to advancing research and sustainable solutions in Earth sciences.

Diamond Sponsors included the Ministry of Earth Sciences, Government of India, South Eastern Coalfields Ltd. (SECL), Northern Coalfields Limited (NCL), and Oil and Natural Gas Corporation (ONGC). Their contributions underscore the importance of industry government collaboration in fostering innovation and knowledge exchange.

Silver Sponsors included prominent organizations such as the National Remote Sensing Centre (NRSC), ISRO, Hyderabad, ONGC Cauvery Asset, Tata Steel, Bharat Coking Coal Limited (BCCL), and Aimil Ltd. These sponsors played a vital role in supporting the event, facilitating discussions on topics like energy security, resource management, and geohazard mitigation.

The involvement of these esteemed organizations exemplified the collaborative spirit driving ETES 2024 and aligns with IIT (ISM) Dhanbad's commitment to advancing Earth sciences through interdisciplinary cooperation and shared knowledge.

Ministry of Earth Sciences
Government of India

SECL
South Eastern Coalfields Ltd.

NCL

ONGC
ENERGY: Now AND Next

nrsc
NRSC, ISRO, Hyderabad

ONGC
ONGC Cauvery Asset

TATA STEEL

BCCL

Aimil

A Legacy of Excellence and Future Vision

Since its founding in 1957, Our Department of Applied Geophysics at IIT (ISM) has established it's prominence in geophysical research and education. The ETES 2024 conference further underscored the department's commitment to advancing Earth sciences, celebrating both its rich legacy and its innovative contributions to addressing global challenges. As IIT (ISM) approaches its centenary, the department remains focused on expanding its research frontiers, driving sustainable solutions, and reinforcing its position as a hub for pioneering geophysical research.

ETES-2024
Sept. 27-29, 2024

भारतीय प्रौद्योगिकी संस्थान
भारतीय खनि विद्यापीठ
धनबाद

IIT INDIAN INSTITUTE OF TECHNOLOGY
ISM INDIAN SCHOOL OF MINES DHANBAD

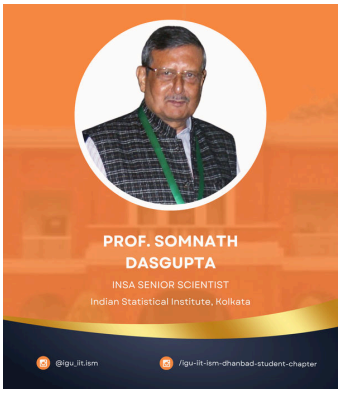
GEOCONFLUENCE '24

Annual Event by the Department of Applied Geophysics

GeoConfluence'24: An Annual Fest by our Department

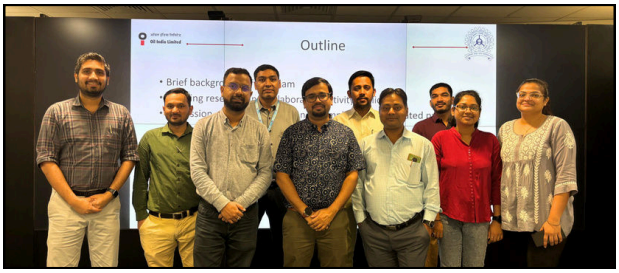
GeoConfluence'24, the annual event by the Department of Applied Geophysics, kicked off on September 27, 2024, following a series of pre events. Organized by student chapters SEG, EAGE, SPG, IGU, AEG, and SPWLA under the Geophysical Society at IIT(ISM) Dhanbad, the event was inaugurated by Co Convener Prof. Niptika Jana and featured dignitaries like Padma Shree Prof. Harsh K. Gupta. Convener Prof. Partha Pratim Mandal introduced the schedule, thanking key sponsors TexMIN, SPG, and UiT Bio AI Lab, and announced the new SPWLA chapter.

Highlights included industrial talks by ExxonMobil representatives, a Geology Museum tour, the TerraProspect Hackathon, IGU Horinaray talk ,a GeoModelling competition, and the GeoSabha debate. A Tree Plantation Drive, treasure hunt, and "3 Idiots" Movie Night capped off the final day, celebrating three days of learning and fellowship.



ACHIEVEMENTS AT THE DEPARTMENT

FACULTY ACHIEVERS:



Prof. Partha Pratim Mandal recently delivered an invited talk at the Duliajan office of Oil India Ltd. on the topic, "Role of Reservoir Geomechanics in the Life Cycle of Hydrocarbon Fields." The session highlighted the critical role geomechanics plays in ensuring the efficient development and management of hydrocarbon reservoirs.

Prof. Sanjit Kumar Pal has joined the Editorial Board of Pure and Applied Geophysics as well as Acta Geophysica. An expert in Solid Earth Sciences, he will review papers, identify key research, and collaborate with Editor-in-Chief Prof. Carla F. Braitenberg. His affiliation will be featured on the journal's cover and website, acknowledging his role in advancing geophysical research. Prof Pal is also become Executive Council member of IGU from 2024-2027.

Prof. Arun Singh and his team made significant contributions to the 26th Electromagnetic (EM) Induction Workshop, held from September 7-13, 2024, in Beppu, Japan. Their notable presentations included advancements in Bayesian inversion techniques and AI-driven approaches for magnetotelluric data analysis.

In addition, Prof. Singh, along with Pritam Yogeshwar, Mohammad Israil, and Bülent Tezkan, published "2-D Transdimensional Joint Inversion of Radio Magnetotelluric and Electrical Resistivity Tomography Data" in Geophysical Journal International on October 14, 2024. This groundbreaking study introduced a novel algorithm combining RMT and ERT data, significantly improving subsurface imaging methods.

Prof. Saurabh Datta Gupta from the Department of Applied Geophysics, IIT ISM, participated in the prestigious Asia Oceania Geosciences Society (AOGS) 2024 conference held in Pyeongchang, South Korea, during June. The conference, renowned for advancing geoscientific research and its applications globally, provided an excellent platform for Prof. Gupta to showcase his research on the shallow subsurface structure of the Moon.

His presentation received significant recognition for its contribution to planetary science, offering new insights into lunar exploration. This study paves the way for uncovering many unexplored aspects of the Moon and strengthens collaborative efforts with prominent scientists from PRL/ISRO. The visit marked a successful step in enhancing the department's international research footprint.

Prof. Mohit Aggarwal's 30-hour NPTEL/SWAYAM course, Earthquake Seismology, has enrolled 658 students, offering a foundational understanding of earthquake mechanisms, seismic attenuation, and waveform interpretation. Designed for geoscientists, engineers, and students of tectonics, it integrates physics, mathematics, and geology to analyze Earth's structure and assess seismic hazards.

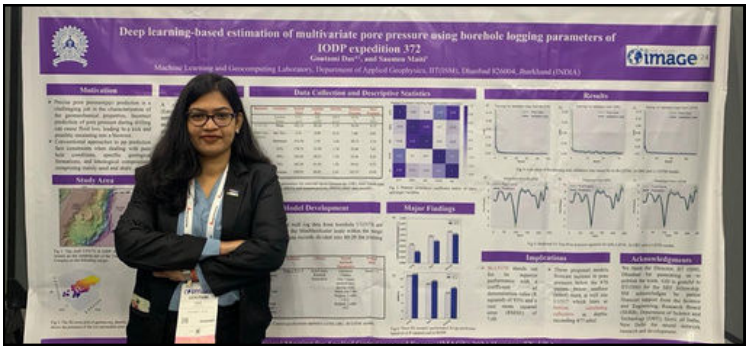
In March 2024, he presented Seismic Ambient Surface Wave Tomography for Crustal Structure in Northeastern India at the national conference Geosciences for a Sustainable World (BHU) and gave an invited lecture on Multi-objective Optimization in Seismology at the international conference at Pachhunga University College, Mizoram.

ACHIEVEMENTS AT THE DEPARTMENT

STUDENT ACHIEVERS:

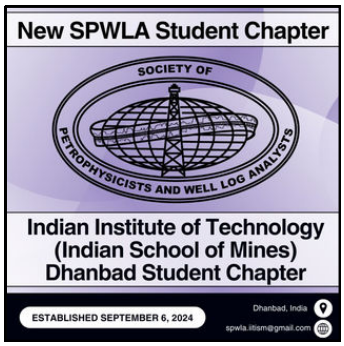
Heartfelt congratulations to **Dheeraj Kumar Sharma**, Senior Research Fellow from the Department of Applied Geophysics at IIT (ISM), for his outstanding achievement in being selected to present his abstract at the prestigious European Geosciences Union (EGU) General Assembly 2024 in Vienna, Austria. This significant recognition highlights his dedication, passion, and commitment to advancing geoscience research.

Goutami Das, a Senior Research Fellow from the Department of Applied Geophysics, represented her work at the 4th International Meeting for Applied Geoscience and Energy (IMAGE), held from August 26–29, 2024, at the George R. Brown Convention Center in Houston, Texas, USA. Organized by SEG, AAPG, and SEPM, this prestigious event featured her technical poster presentation, showcasing advanced research in applied geophysics on an international platform.

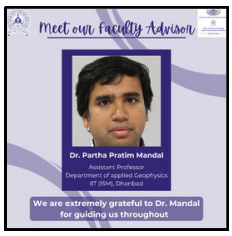


Amit Bajpai and **Koustav Ghosal**, Senior Research Fellows from the Department of Applied Geophysics at IIT ISM, have made significant contributions to the field of geophysics. They presented their cutting-edge research at the 26th EM Induction Workshop in Beppu, Japan, including work on Bayesian inversion techniques in magnetotellurics and neural network-based inversion methods. Their innovative studies continue to shape advancements in electromagnetic induction and geophysical data interpretation.

NEW STUDENT CHAPTER:

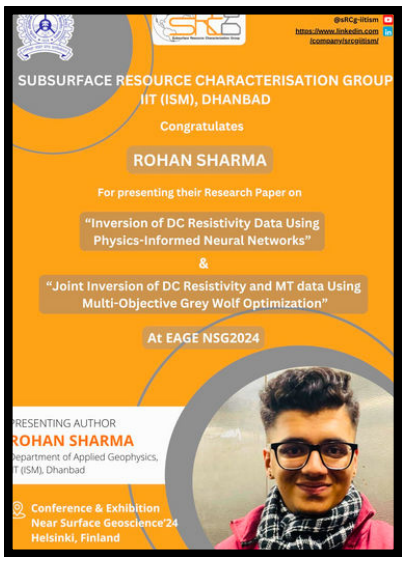


We are excited to announce the establishment of the SPWLA (Society of Petrophysicists and Well Log Analysts) - IIT ISM Dhanbad Student Chapter, officially launched on 6th September 2024 during Geoconfluence'24. Under the guidance of Prof. Partha Pratim Mandal, the chapter aims to promote learning and innovation in petrophysics and well log analysis. It will provide students with opportunities for technical workshops, industry networking, and research collaboration, shaping the future of geoscience professionals.



ACHIEVEMENTS AT THE DEPARTMENT

STUDENT ACHIEVERS:



Inversion of DC Resistivity Data using Physics-Informed Neural Networks, published by EAGE

Rohan Sharma, from the Department of Applied Geophysics, IIT (ISM) Dhanbad, presented his groundbreaking research at EAGE Near Surface Geoscience Conference 2024 (NSG2024). His work, titled "Inversion of DC Resistivity Data using Physics-Informed Neural Networks", has also been published by EAGE, showcasing his contribution to advancements in geophysical methodologies.

The study focuses on integrating physics-informed neural networks (PINNs) for inverting DC resistivity data. By addressing challenges such as limited training data, geological inconsistencies, and uncertainty quantification, Rohan's research provides a robust approach for near-surface characterization. Utilizing convolutional neural networks with Monte Carlo dropout, his method effectively estimates resistivity profiles while quantifying uncertainties, offering results comparable to existing standards.

This innovative work underscores the potential of PINNs in geophysical exploration and brings pride to IIT (ISM) on an international platform. Congratulations to Rohan for this remarkable achievement!

SLS Award

Aditya Chowdhury has been selected as a recipient of the prestigious SEG/Chevron Student Leadership Symposium (SLS) Award. This honor, supported by Chevron's generous financial sponsorship, grants Aditya the opportunity to participate in a transformative leadership development experience.

The SLS provides an exclusive chance for chapter officers and nominated members to engage in leadership coaching sessions with Chevron staff, panel discussions, and real-world problem-solving activities. It also fosters collaboration among chapters, cultural exchanges, and participation in the annual IMAGE convention.

ETH Zurich PhD Opportunity

Isha Lohan, a Master of Science and Technology student from the Department of Applied Geophysics, IIT (ISM) Dhanbad, has secured a prestigious PhD position with the Seismology and Wave Physics Group at the Institute for Geophysics, ETH Zurich.

Her research will focus on advanced techniques such as full waveform inversion, ultrasound computed tomography, and the spectral element method. This accomplishment underscores her academic excellence and passion for cutting-edge geophysical research.

SPWLA Foundation Scholarship

Three outstanding students from the Department of Applied Geophysics, IIT (ISM) Dhanbad, have been awarded the prestigious **SPWLA Foundation Scholarship**. This global recognition celebrates their academic excellence, innovative spirit, and contributions to the field of geophysics. The SPWLA Foundation Scholarship is highly competitive and acknowledges students who demonstrate exceptional potential in advancing petrophysics and related geoscience disciplines.

Aditya Chowdhury

Integrated Master of Technology in Applied Geophysics

Nandan Mukherjee

Master of Science & Technology in Applied Geophysics

Susovan Das

Master of Science & Technology in Applied Geophysics

RECENT PUBLICATIONS FROM OUR DEPARTMENT

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- Rahul Prajapati, Raj Kumar, Upendra K. Singh. "Assessment of reservoir heterogeneities and hydrocarbon potential zones using wavelet-based fractal and multifractal analysis of geophysical logs of Cambay basin, India." Science Direct, Elsevier, Published on: Feb 2024.
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- Soumyashree Debasis Sahoo, Sanjit Kumar Pal, Vivek Vikash, Satya Narayan, Rajwardhan Kumar, Saurabh Srivastava, R. M. Bhattacharjee. "Quantifying environmental impact of unplanned mining through integrated non-invasive geophysical methods: a case study from Jharia coalfield, India." Environmental Earth Science, Published on: 27th June 2024.
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- Koustav Ghosal, Arun Singh, Samir Malakar, Shalivahan Srivastava, Deepak Gupta. "Enhancing Deep Learning-based RMT Data Inversion using Gaussian Random Field." arXiv preprint arXiv:2410.19858, Published on: 22nd Oct 2024.

RECENT PUBLICATIONS FROM OUR DEPARTMENT

- Charit Tilara, Monika, Mohit Agrawal. "Seismic hazard assessment of Mathura City (India): a deterministic approach." Journal of Earth System Science, Published on: 14th Oct 2024.
- SE Sreenivasan, S Sahoo. "Oscillatory onset of rotating thermal convection subject to spatially varying magnetic fields and stable stratification." Physics of Fluids, Published on: 20th Aug 2024.
- Abhay Shukla, Swarandeep Sahoo, Piyush Sarkar. "Assessment of micro-structure and flow entrapment in Indian Gondwana shale reservoir using digital rock analysis." Marine and Petroleum Geology, Published on: 23rd Aug 2024.
- Sethulakshmy Edathara Sreenivasan, Swarandeep Sahoo. "Weak time-scale separation at the onset of oscillatory magnetoconvection in rapidly rotating fluids." Physica Scripta, Published on: 17th July 2024.
- Piyush Sarkar, Swarandeep Sahoo, Umang Nagpal, T. N. Singh. "A quantitative study of the microstructure of Indian Gondwana shale: a fractal and algebraic topology approach." Petroleum Geoscience, Published on: 15th July 2024.
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- Saumen Maiti, Surabhi Gupta, Praveen Kumar Gupta. "Prediction of Groundwater Quality Index and Identification of Key Variables Using Bayesian Neural Network." Water, Air, & Soil Pollution, Published on: 5th Sept 2024.
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