Minutes of Meeting

12th Meeting *of the* Senate

Venue of the Meeting

Conference Hall, IIPE, Visakhapatnam &
Virtually through CISCO Webex

Date & Time of the Meeting

07th March, 2025 at 10:30 AM

INDIAN INSTITUTE OF PETROLEUM AND ENERGY
VISAKHAPATNAM – 530003

भारतीय पेट्रोलियम और ऊर्जा संस्थान विशाखापत्तनम

INDIAN INSTITUTE OF PETROLEUM AND ENERGY
VISAKHAPATNAM – 530 003

MINUTES OF THE 12th MEETING OF THE SENATE OF IIPE VISAKHAPATNAM

Date & Time: 7th March, 2025 (Friday) from 10:30 hrs;

Venue: Conference Hall (Room No. 301), IIPE Campus, Visakhapatnam & virtually through CISCO Webex.

Members Present:

1	Prof. Shalivahan, Director	**Chairperson**	Attended physically
2	Prof. Arvind Kumar Mishra, Director, CSIR-CIMFR Dhanbad	Member	Attended virtually
3	Prof. K. Srinivas Reddy, IIT Madras	Member	Attended virtually
4	Prof. A. Seshagiri Rao, Assoc. Dean (Faculty Affairs)	Member	Attended physically
5	Prof. Himangshu Kakati, Assoc. Dean (Academic Affairs) & HoD (PE&ES)	Member	Attended physically
6	Prof. C.V. Rao, Assoc. Dean (Students' Affairs)	Member	Attended virtually
7	Prof. Rajat Jain, Assoc. Dean (IRAA)	Member	Attended physically
8	Prof. Ranjan Pramanik, Assoc. Dean (IIE)	Member	Attended virtually
9	Prof. Arun Kumar Pujari, HoD, Mechanical Engineering	Member	Attended physically
10	Prof. P. Venkata Reddy, HoD, Chemical Engineering	Member	Attended physically
11	Prof. R. Ramunaidu, Dept. Humanities & Sciences	Member	Attended virtually
12	Prof. T. Hemanth Kumar, Dept. Chemical Engineering	Member	Attended virtually
13	Prof. Raka Mondal, Dept. Chemical Engineering	Member	Attended virtually
14	Prof. Dipankar Pal, Dept. Chemical Engineering	Member	Attended virtually
15	Shri Ram Phal Dwivedi, Registrar	Ex-officio Secretary	Attended physically

Leave of Absence

16	*Prof. K. Vijaya Kumar, Dean (Research & Development)*	Member
17	Prof. Somnath Ghosh, HoD, Humanities & Sciences	Member
18	Prof. P. Aparoy, Assoc. Dean (Research & Development)	Member
19	Prof. Sivasankar P., Assoc. Dean (Planning)	Member

At the outset, the Chairman welcomed the members of the Senate. He thanked and expressed his gratitude for their valuable contributions for academic endeavours and research excellence at IIPE.

After ascertaining the quorum, the Chairman declared the meeting open. The following agenda was transacted.

Senate/12/01	**Confirmation of Minutes of the 11th Meeting of the Senate and submission of Action Taken Report.**

The Minutes of the 11th meeting of the Senate of IIPE held on 13.12.2024 were circulated to all the learned members of the Senate through email on 24.01.2025. There were no comments/ remarks received from the members either by email or on the floor. The Senate was requested to confirm the minutes of the 11th meeting.

Resolution: The Senate resolved to confirm the Minutes of the 11th meeting of the Senate, held on 13.12.2024.

Senate/12/02	**Submission of the Action Taken Report on the resolutions of the 11th meeting of the Senate held on 13.12.2024.**

The Action Taken Report (ATR) on the Minutes of the 11th meeting of the Senate was presented before the members. The Senate noted the same with satisfaction.

Senate/12/03	**Director's Report on the progress of various activities of the Institute.**

At the outset, the Director conveyed his gratitude to the Members of the Senate for their continued support towards the Institute's growth. He made a special mention of the Board's commendation for initiating the unique **Global Internship Programme** at IIPE. The Director further presented the following updates on the progress of various activities of the Institute:

(i) Energy Excellence Award 2025:

The Director informed that IIPE has been honoured with the **Energy Excellence Award-2025** for **Outstanding Achievement in Education** by the **CHEMTECH Foundation**. This prestigious recognition marks a significant milestone for the Institute, reflecting the remarkable progress made in education, research, and academic excellence within a short span.

(ii) Gratitude to HPCL:

The Institute thanks HPCL for funding the 'Makerspace' initiative and sponsoring 20 students for India Energy Week (IEW)-2025. HPCL approved ₹ 39.5 lakh as the first instalment out of the ₹5 crore grant, supporting academic and research opportunities, especially for underprivileged students.

(iii) Publications:

The faculty of the Institute published 44 research and review papers in reputed journals during the year 2024.

(iv) Patents:

02 patents were filed during the year 2024, of which 01 design patent was granted to Prof. Santosh Kumar Senapati (IIPE), Prof. Arun Kumar Pujari (IIPE), and Dr. A. Mohanty (VSSUT, Burla, Odisha).

(v) Seminars, Workshops, and Conferences conducted:

- Certification course on **'Carbon Capture and Utilization'** for 12 weeks from 02.11.2024, with 81 participants, including 18 industrial professionals (16 from HPCL, 1 from Bloom Energy, USA, and 1 from Kuwait Oil), 3 PDFs from USA, Canada, and Saudi Arabia, and 1 Ph.D. Scholar from Nepal.

- **Industry-Academia Conclave 2024**: Connecting Academia and Industry for a Sustainable World on 28th November 2024.

- Workshop on **'Corrosion Prevention and Remediation Strategies'** from 11th to 13th December 2024.

- Workshop on **'Numerical Methods for Partial Differential Equations'** from 16th to 27th December 2024.

- **Local College and Schools - Students Fellowship Program (LCS-SFP)** & **College and School Teachers' Education and Academic Mentoring (CS-TEAM)** programs were organized during December 2025, in line with the JIGYASA scheme launched by the Government of India, providing training to school children and teachers.

- Workshop on **'Immersion Program on Recent Advances in Petroleum Engineering'** from 20th December 2024 to 2nd January 2025.

- Workshop on **'Harnessing Computational Fluid Dynamics in the Energy Sector: Techniques and Applications (H-CFD-2025)'** from 23rd to 25th January 2025.

- One-day workshop **'Samavesha (Episode-10)'** on 11th February 2025 in collaboration with I-STEM, familiarizing scholars and faculty members from colleges and universities in Visakhapatnam and surrounding districts with the I-STEM portal. IIPE will act as the Satellite Campus of I-STEM.

- Workshop on **'Crystallization Systems Engineering'** from 18th to 20th February 2025.

- A GIAN Course with International Coordinator Prof. Vahid Vatanpour, Istanbul Technical Institute, on **'Next generation Composite Membranes for Hydrogen Energy and Environmental Application'** during 03rd to 08th March, 2025.

- A GIAN Course on **'Absorption Techniques for CO2 Capture : Modeling and Simulation Insights'** with International Coordinator Prof. Debangsu Bhattacharyya of West Virginia University, USA is scheduled from 24th to 28th March, 2025.

(vi) Outreach Programs:

The Institute organized various outreach activities, including Swachhata Hi Sewa, Janjatiya Gaurav Diwas & Varsh, Fit India Freedom Run, and Intra Sports Meet.

(vii) Ph.D. Degrees:

04 Ph.D. Scholars are likely to be awarded their degrees in the forthcoming Convocation of the Institute this year.

The Senate noted the same and appreciated the efforts made by the Institute.

Senate/12/04	Four-year curriculum for the new B.Tech. program in Mathematics and Computing.

During the 10th meeting of the Senate held on 24.04.2024, the Senate recommended the proposal for commencement of a new **B.Tech. Program in Mathematics and Computing** from the academic year **2025-26,** for approval of the Board. During the 11th Senate meeting held on 13.12.2024, the Senate approved the Course Structure for 1st & 2nd Semesters of the First Year for the said Course.

The course structure and syllabus for the 3rd to 8th Semesters of the B.Tech. Program in Mathematics and Computing was now placed before the Senate for approval.

Resolution: After detailed deliberations, the Senate suggested the following modifications curriculum:

- Introduction of **Industrial Training** in the 7th Semester;
- Inclusion of an **Open Elective** in the 6th Semester;
- Addition of specific electives, including Reinforcement Learning;
- Reconsideration for having five theory courses and redistributing courses from the 3rd Semester due to a higher academic load.

The Senate recommended that the revised syllabus for the 3rd to 8th Semesters, aligned with the Institute's academic framework, be resubmitted for approval in the subsequent meeting.

The Senate approved the intake for **22 seats** starting from the **academic year 2025–26,** considering the ongoing transition from the temporary campus to the permanent campus.

Senate/12/05	New course proposed for the PG and Ph.D. programs.

The Institute proposed a new course titled **"Renewable Energy Systems"** for PG and Ph.D. programs. *The detailed syllabus of the proposed course placed before the Senate for consideration* and approval.

Resolution: After detailed deliberations, the Senate recommended renaming the course **'Renewable Energy System'** (4 credits) to **'Renewable Energy Technology'** (3 credits), considering its proposed offering for both PG and Ph.D. programs. The Senate also advised the inclusion of **Ocean and Tidal Energy** under the unit **'Other Energy Sources'** and emphasized that case studies should be integrated as a core component within each unit of the course.

Senate/12/06	Ph.D. admission for candidates with a M.Tech. degree without GATE.

The Institute proposed to allow Ph.D. admissions for M.Tech. degree holders without GATE score through a written test and/or interview. This proposal was submitted for the Senate's discussion and consideration.

Resolution: After detailed deliberations, the Senate recommended the following guidelines **for approval of the Board**, for Ph.D. admissions for candidates possessing an M.Tech. degree without a GATE qualification from the academic year 2025-26:

(i) Shortlisting Criteria: Candidates shall be shortlisted based on their UG and M.Tech. academic performance. The Institute should define normalized evaluation parameters applicable to graduates from CFTIs and private institutions.

(ii) Interview Process: Shortlisted candidates will be required to appear for an interview as part of the selection process.

(iii) Additional Assessment: Candidates who completed their M.Tech. degree more than 10 years prior to the application date, must undergo a written examination in addition to the interview.

Senate/12/07	Detailed syllabus of M.Tech. program in Petroleum Engineering starting from 2025-26

The detailed syllabus of M.Tech. program in Petroleum Engineering starting from the academic year 2025–26, was placed before the Senate for consideration and approval.

Resolution: After thorough deliberations, the Senate resolved to approve the syllabus of M.Tech. program in Petroleum Engineering as placed at **Annexure-1.**

Senate/12/08	Design approval for PC and Transcript for all programs.

Approval was sought for the design of the Provisional Certificate (PC) and Transcript Certificate for all *UG and PG programmes of IIPE.*

Resolution: The Senate approved the design of the **Provisional Certificate** and **Transcript Certificate** for all UG and PG programs of IIPE, as placed at **Annexure-2.**

Senate/12/09	Foreign Examiner for Ph.D. Defence Viva-voce Seminar.

Approval was requested for the appointment of a Foreign Examiner, alongside an Indian Examiner, as an external expert for the Ph.D. Defence Seminar.

Resolution: The Senate approved the appointment of a Foreign Examiner for the Ph.D. Viva-Voce Defense Seminar through online mode, with an honorarium of **125 USD**.

RATIFIED AGENDA

Senate/12/10	Conversion from Project to Institute Assistantship.

The Senate was apprised that the Chairman Senate approved the conversion of the assistantship of Ms. Sudipta Sahu (Roll No: 24RS9P04), a Ph.D. student, from Project Assistantship to Institute Assistantship based on the recommendation of the DSC, following the completion of the project period.

The Senate was requested to ratify the decision of the Chairman, Senate.

Resolution: The Senate resolved to ratify the decision of the Chairman, Senate.

Senate/12/11	Review of the Ph.D. Fee Structure for the QIP Admission Category.

In accordance with the recommendation made during the 11th meeting of the Senate, the Ph.D. fee structure for the QIP Admission Category was reviewed in comparison with those of other IITs. Based on this review, a revised fee structure was implemented at IIPE, as detailed in **Annexure-3**.

Resolution: The Senate noted the same.

Senate/12/12	Any other item with the permission of the chair

The Chairman, Senate announced that the 5th Convocation of IIPE is planned to be held on 15th May 2025, following the declaration of results on 12th May 2025 He also extended an invitation to the external members to attend the 13th Senate meeting in-person.

Resolution: The Senate accepted and noted the announcement.

The meeting ended with thanks to the Chair.

APPROVED

(Prof. Shalivahan)
Director &
Chairman, Senate, IIPE

(R.P. Dwivedi)
Registrar &
Secretary, Senate, IIPE

Annexure - 1

Petroleum Geology	3-0-0	3 CH

Introduction to Petroleum Geology; Origin, Migration, and Accumulation of Hydrocarbons; Sedimentology and stratigraphy; Subsurface Environments; Petroleum Systems and Basin Analysis; Reservoir Rocks and Cap Rocks; Structural and Stratigraphic Traps; Environmental and Economic Aspects of Petroleum Geology.

References:

1. Selley, R.C. – **Elements of Petroleum Geology**
2. Tissot, B.P. & Welte, D.H. – **Petroleum Formation and Occurrence**
3. North, F.K. – **Petroleum Geology**
4. Levorsen, A.I. – **Geology of Petroleum**
5. Allen & Allen – **Basin Analysis: Principles and Application to Petroleum Play Assessment**

Formation Evaluation	3-0-0	3 CH

Introduction to formation evaluation; Core analysis and petrophysical properties; Well logging fundamentals and borehole environments; Resistivity logging and saturation analysis; Porosity and lithology logging; nuclear magnetic resonance (NMR) and dielectric logging; Formation pressure and production logging; Integrated formation evaluation (Log-Derived Permeability Estimation Methods, Water Saturation Models in Carbonates and Clastics, Well Log Interpretation for Pay Zone Identification, Integration of Log, Core, and Seismic Data for Reservoir Characterization)

References:

1. "Well Logging and Formation Evaluation" – Toby Darling
2. "Petrophysics: Theory and Practice of Measuring Reservoir Rock and Fluid Transport Properties" – Djebbar Tiab & Erle C. Donaldson
3. "Fundamentals of Well Log Interpretation" – Oberto Serra

Drilling Technology	3-0-0	3 CH

Well Planning and Well design
Objective, Drilling programme preparation, Type of well, Prospect, Geotechnical Order GTO, Introduction to wellbore pressures.
Rig Components and Drilling Systems
Rotary / top drive drilling, Types of onshore/offshore rigs, Rig Components, power generation system, Hoisting, Rotary system, Drilling Fluid circulation system, mud pumps, Well control system, Rig selection criteria, well tubular, drill string design
Drilling Bits and Mechanics
Drill bits and bit mechanics, Classification and design criteria; rock- tool interaction, methods of coring.
Drilling fluids and Mud Hydraulics
Drilling fluids functions and classifications, additives, hydraulic models, mud flow rate and pressure calculations.
Cements and Casing Design
Cements classifications, cementing methods and calculations, casing design practices, casing seat selection, casing while drilling.
Well Problems and Solutions
Fatigue failure, Pipe sticking, Lost-circulation, Sloughing shale, Swabbing, surge, gas cap drilling. Oil Well Fishing: Fish classification, tools and techniques.

Well Kick, Blow out and Well Control method
Causes of well kicks and early detection; Blowout prevention methods, Well control techniques (driller's method, wait-and-weight, volumetric method), well control calculations, kill sheet

References:
Text Books:
1. Petroleum Engineering: Drilling and Well Completion: Carl Gatlin.
2. Applied Drilling Engineering: Adams T Bourgoyane.
3. Drilling Engineering: A complete Well Planning and approach.

References:
1. Well Control Problems Solutions: Neal A J.dams.
2. Oil Well Drilling: H Rabia.
3. Oil Well Drilling Technology: Mc. Gray& Cole.

Hydrogen Energy	3-0-0	3 CH

Introduction to Hydrogen Energy
Basics of hydrogen as an energy carrier, Physical and chemical properties of hydrogen, Hydrogen in the global energy transition Hydrogen vs. other fuels: efficiency and sustainability

Hydrogen Production
Fossil fuel-based hydrogen production (Steam Methane Reforming, Partial Oxidation), Electrolysis: Alkaline, PEM, SOEC electrolysis, Biomass and bio-hydrogen production, Thermochemical and photochemical hydrogen production, Green hydrogen and its potential

Hydrogen Storage and Transportation
Compressed and liquefied hydrogen storage, Solid-state storage: Metal hydrides, chemical storage, Hydrogen pipelines and transport via ammonia/methanol carriers, Safety concerns in hydrogen storage and handling

Hydrogen Utilization & Applications
Fuel cells: Types, working principles, and efficiency, Hydrogen in transportation: Hydrogen vehicles, aviation, and marine applications, Hydrogen in power generation and grid balancing, Hydrogen use in industrial applications (Steel, ammonia, refineries)

Hydrogen Economy, Policies, and Safety
Hydrogen economy and global initiatives, Government policies and funding for hydrogen research, Hydrogen safety, risk assessment, and regulatory frameworks, Future challenges and prospects of hydrogen energy.

References:
1. Hydrogen and Fuel Cells: Emerging Technologies and Applications – B. Sorensen
2. Hydrogen as an Energy Carrier: Technologies, Systems, Economy – W. Hautz & J. Nitsch
3. Hydrogen Energy and Vehicle Systems – S. Basu
4. Reports & White Papers: IEA Hydrogen Report, DOE Hydrogen Program

Applied Hydrocarbon Production Engineering	3-0-0	3 CH

Reservoir Deliverability (Inflow Performance Relationship, Single phase, Multiphase flow in porous media), Well Deliverability, Nodal Analysis, Production Challenges in Unconventional Hydrocarbon Resources, Equipment selection for production operations, design of production fluids processing systems, production forecasting, surface production facilities, production optimization, Well completion, Safety Systems

References:

1. Economides M.J., Hill A.D., Economides C.E., Zhu D., Petroleum Production Systems, Prentice Hall /Pearson Education India 2012.
2. Guo B., Lyons W.C., and Ghalambor A., Petroleum Production Engineering: a Computer Assisted Approach, Gulf Professional Publishing 2011
3. Renpu Wan. Advanced Well Completion Engineering. 2011. Elsevier.

Applied Reservoir Engineering	3-0-0	3 CH

PRMS; material balance, Water influx models; Water flooding, Pressure Transient analysis, performance of unconventional reservoirs; unsteady, pseudo-steady and steady state flow, determination of well and reservoir parameters; applications to conventional and unconventional hydrocarbon producing wells.

References:

1. Ronald Terry, J. Rogers., 2007. Applied Petroleum Reservoir Engineering Pearson; 3rd edition (21 August 2014).

Flow Assurance	3-0-0	3 CH

Flow assurance in offshore, design and analysis of tubulars, flow assurance problems and solutions, phase behaviour, thermodynamics of gas hydrate formation and dissociation, inhibitors, Crude oil composition & analysis, WAT, wax and asphaltenes management, role of downhole conditions on asphaltenes & wax deposition, inhibition and remediation; Scale and corrosion problems.

References:

1. Applied Multiphase Flow in Pipes and Flow Assurance: Oil and Gas Production, Elsa M. Al-Safran and James P. Brill, SPE Text Book Series, 2017.
2. Flow Assurance Solids in Oil and Gas Production, Jon Steinar Gudmundsson, CRC Press, 2017.
3. E. Dendy Sloan, Carolyn A. Koh.,2007. Clathrate Hydrates of Natural Gases. CRC Pr I Llc; 3rd edition.

CCUS	3-0-0	3 CH

CCUS requirement, carbon credits & carbon footprint, global warming, subsurface geology for CCUS, CO_2 transport in porous media, CCUS in depleted reservoir, CO_2 sequestration; infrastructure requirements,

References:

1. Eduardo G. Pereira, Alberto J. Fossa, Thomas L. Muinzer Carbon Capture Utilization and Storage. Palgrave Macmillan Cham.
2. Malti Goel, M Sudhakar and R V Shahi., Carbon Capture, Storage, and Utilization.

Applied Well Stimulation Techniques	3-0-0	3 CH
Formation damage, stimulation techniques and requirements, stimulation cycle; Matrix treatments, acidizing, fracturing, other matrix treatments (solvents, surfactants to remove wax etc), fluid selection criteria, treatment design and analysis for different rocks; Reaction kinetics, additives for stimulation fluids, other stimulation techniques, Well stimulation Economics **References:** 1. Robert Schechter. Oil well stimulation. Prentice Hall (1 December 1991) 2. A. Richard Sinclair. Well Stimulation Treatments, 2nd Ed. 2012. The University of Texas, Austin. 3. Faruk Civan.2015. Reservoir Formation Damage: Fundamentals, Modeling, Assessment, and Mitigation.		

Environmental Engineering	3-0-0	3 CH
Earth and Environment; System Analysis and Management; Computational Method and Probability Statistics; Environmental Geology; Groundwater Contamination and Remediation Industrial Waste Water Treatment; Circular Waste Management System and Greenhouse Gases Reduction; Hazardous Waste Management; Environment Quality Management; Integrated Environmental Technologies for Waste Management; Sustainable Development and Renewable Energy. **References:** 1.		

Alternate Energy Sources	3-0-0	3 CH
Introduction to Renewable Energy; Solar Energy; Wind Energy; Ocean Energy; Geothermal Energy; Hydropower; Biomass Energy; Impact of energy technologies on the environment; Energy economics, market dynamics, and sustainability considerations. **References:** 1.		

HPHT Drilling & Completion Fluids	3-0-0	3 CH
HPHT environment & classification; drilling fluid design analysis for HPHT conditions (composition & properties), selection of drilling fluids (oil based, water based, synthetic based); additives, material selection & fluid compatibility, fluid rheology & modelling, HPHT filtration characteristics, types of completion fluids, selection of additives, pressure control, Troubleshooting fluid-related problems in HPHT wells; wellbore stability, Safety & environmental concerns. **References:** 1. Ryen Caenn, HCH Darley, George R. Gray 2011. Composition and Properties of Drilling and Completion Fluids. Gulf Professional Publishing, Elsevier. 2. Bernt S. Aadnoy; Iain Cooper; Stefan Z. Miska; Robert F. Mitchell; Michael L. Payne. 2009. Advanced Drilling and Well Technology. SPE. 3. Renpu Wan. Advanced Well Completion Engineering. 2011. Elsevier.		

CourseType	Code	Name of Course	L	T	P	Credit
ELECTIVES		Data Science	*3*	*0*	*0*	*03*

Unit	Topics to be covered
	Basics of Data Science and its relevance to Petroleum Engineering; Structured and Unstructured data in Oil & Gas; Data Preprocessing and Cleaning; Data Visualization Tools; Descriptive and Inferential Statistics; Correlation and Regression Analysis; Regression Models in Reservoir Characterization; Supervised vs. Unsupervised Learning; Clustering Techniques; Time Series Analysis and Forecasting; Case Studies and Practical Applications

References:

- Sankaran, S., Matringe, S., Sidahmed, M., Saputelli, L., Wen, X. H., Popa, A., & Dursun, S. (2020). Data analytics in reservoir engineering. Richardson, Texas, USA: Society of Petroleum Engineers.
- Blum, A., Hopcroft, J., & Kannan, R. (2020). Foundations of data science. Cambridge University Press.
- Mishra, S., & Datta-Gupta, A. (2017). Applied statistical modeling and data analytics: A practical guide for the petroleum geosciences. Elsevier.
- Belyadi, H., & Haghighat, A. (2021). Machine learning guide for oil and gas using Python: A step-by-step breakdown with data, algorithms, codes, and applications. Gulf Professional Publishing.
- Khosravanian, R., & Aadnøy, B. S. (2022). Methods for petroleum well optimization.

CourseType	Code	Name of Course	L	T	P	Credit
ELECTIVES		Big Data Management	*3*	*0*	*0*	*03*

Unit	Topics to be covered
	Characteristics of Big Data in Petroleum engineering; Data Warehousing Concepts; Distributed Storage; Databases for Big Data; Processing Technologies: Hadoop, Spark; Deep Learning with Big Data; Application: Real-time processing and monitoring; Predictive maintenance.

References:

Baesens, B. (2014). Analytics in a big data world: The essential guide to data science and its applications. John Wiley & Sons.

Leskovec, J., Rajaraman, A., & Ullman, J. D. (2020). Mining of massive data sets. Cambridge university press.

Balusamy, B., Kadry, S., & Gandomi, A. H. (2021). Big data: concepts, technology, and architecture. John Wiley & Sons.

Keith R. Holdaway, Harness Oil and Gas Big Data with Analytics: Optimize Exploration and Production with Data-Driven Models (Wiley and SAS Business Series) 1st Edition.

White, T. (2012). Hadoop: The definitive guide. " O'Reilly Media, Inc.".

Guller, M. Big Data Analytics with Spark: A Practitioners Guide to Using Spark for Large Scale Data Analysis. Apress, New York (2015).

Blum, A., Hopcroft, J., & Kannan, R. (2020). Foundations of data science. Cambridge University Press.

Mishra, S., & Datta-Gupta, A. (2017). Applied statistical modeling and data analytics: A practical guide for the petroleum geosciences. Elsevier.

Kepner, J. and H. Jananthan. Mathematics of Big Data: Spreadsheets, Databases, Matrices, and Graphs. MIT Press, 2018. ISBN: 9780262038393

CourseType	Code	Name of Course	L	T	P	Credit
ELECTIVES		Artificial Intelligence and Machine Learning	*3*	*0*	*0*	*03*

Unit	Topics to be covered
	Fundamentals of AI, ML, and Deep Learning; Linear and Non-Linear Regression Models; Decision Trees, Random Forest, and XGBoost; Predictive Modeling in Reservoir and Production Forecasting; Clustering Techniques; PCA for Dimensionality Reduction; Neural Networks: ANN, CNN and RNN; AI-Driven Optimization Techniques; AI for Predictive Maintenance and Smart Reservoir Management.

References:

Goodfellow, I., Bengio, Y., Courville, A., & Bengio, Y. (2016). Deep learning, Cambridge: MIT press.
Hemmati-Sarapardeh, A., Larestani, A., Menad, N. A., & Hajirezaie, S. (2020). Applications of artificial intelligence techniques in the petroleum industry. Gulf Professional Publishing.
Bishop, C. M., & Nasrabadi, N. M. (2006). Pattern recognition and machine learning (Vol. 4, No. 4, p. 738). New York: springer.
De Prado, M. M. L. (2020). Machine learning for asset managers. Cambridge University Press.

CourseType	Code	Name of Course	L	T	P	Credit
Core		Applied Reservoir Simulation	*3*	*0*	*0*	*03*

Unit	Topics to be covered
	Fundamentals of reservoir simulation and Numerical model; The physical laws governing fluid flow in porous media; Formulation of single-phase and multi-phase flow; Techniques to solve the governing partial differential equations using finite difference methods; Interpret the potential numerical errors; Treatment internal and external boundary conditions and initial conditions; Iterative solvers; The fully implicit and IMPES solution; Well modeling in reservoir simulation; History matching and Waterflooding concepts;

References:

- Ertekin, Turgay, Jamal H. Abou-Kassen, and Gregory R. King. Basic Applied Reservoir Simulations. Society of Petroleum Engineers, 2001.
- Aziz, Khalid, and Antonin Settari. Petroleum reservoir simulation. 2002.
- Peaceman, Donald W. Fundamentals of Numerical Reservoir Simulation. 1977
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CourseType	Code	Name of Course	L	T	P	Credit
ELECTIVES		Applied Numerical Modelling	*3*	*0*	*0*	*03*

Unit	Topics to be covered
	Solution of linear system of equations; nonlinear algebraic; linear and non-linear regression; Statistical Aspects of Least Squares Theory; Statistical Distributions; Initial and boundary value problems; Solution of partial differential equations: Parabolic, elliptic and hyperbolic partial differential equations; Taylor Series and Numerical Schemes; Finite-Volume Method Representations of Flow Equations; FVM Representations and solution techniques of Single-Phase Flow Equations, Multiphase Flow: Black-Oil Equations and Compositional Equations; Representation of Natural fractures; concept of dual porosity and dual permeability; Numerical modelling: Hydraulic Fracture initiation and Propagation, Fluid-rock-fracture interaction in deformable porous and permeable rocks.

References:

Ertekin, T., & Ayala, L. F. (2019). Reservoir Engineering Models: Analytical and Numerical Approaches. McGraw-Hill Education.

Trefethen, L. N., & Bau, D. (2022). Numerical linear algebra. Society for Industrial and Applied Mathematics.

Phillips, G. M., & Taylor, P. J. (1996). Theory and applications of numerical analysis. Elsevier.

Ertekin, Turgay, Jamal H. Abou-Kassen, and Gregory R. King. Basic Applied Reservoir Simulations. Society of Petroleum Engineers, 2001.

Shen, B., Stephansson, O., & Rinne, M. (2020). Modelling Rock Fracturing Processes: Theories, Methods, and Applications. Springer International Publishing.

Shen, X., & Standifird, W. (2017). Numerical simulation in hydraulic fracturing: multiphysics theory and applications. CRC Press.

R. P. DWIVEDI
Registrar
Indian Institute of Petroleum & Energy
Visakhapatnam

Annexure - 2

R. P. DWIVEDI
Registrar
Indian Institute of Petroleum & Energy
Visakhapatnam

R. P. DWIVEDI
Registrar
Indian Institute of Petroleum & Energy
Visakhapatnam

Annexure - 3

भारतीय पेट्रोलियम और ऊर्जा संस्थान

INDIAN INSTITUTE OF PETROLEUM AND ENERGY

VISAKHAPATNAM – 530 003

Ph.D. Fee structure of QIP Admission Category

S.No.	Particulars of Fees	Sponsored
A.	**One Time payment at the time of Admission (Non-Refundable) (Rs.)**	
1	Admission Fee	1,000
2	Identity Card	100
3	Placement Fee	0
4	Convocation Fee	2,000
5	Alumni Subscription	1,000
6	Migration fee	500
7	Thesis evaluation fee	10,000
	Total Amount	**14,600**
B.	**Caution Deposits Payable at the time of Admission# (Rs.)**	
Institute caution money		5,000
C.	**Semester Fee (Each Semester) Non-Refundable (Rs.)**	
1	Examination	500
2	Registration/Enrolment	400
3	Gymkhana Fee	1,000
4	Campus Services and Utility	0
5	Library Fee	200
6	Tuition Fee*	25,000
7	Institute Development Fund	10,000
8	Laboratory fee	800
	Total Amount	**37,900**
D.	**Annual Fees**	
1	Medical Insurance fee	0
2	Student Brotherhood Fund	500
3	Benevolent Fund	1,000
4	Modernization Fee	700
	Total Amount	**2,200**
Grand Total (A+B+C+D)		**59,700**

R. P. DWIVEDI
Registrar
Indian Institute of Petroleum & Energy
Visakhapatnam