Annexure-I

RGIPT Jais Campus, UP

S.No	Topic(s)	Departments
I.	1. CO_2 sequestration in geological formations 2. CO_2 monitoring techniques and geophysical characterization 3. Green solvents for carbon capture 4. CCUS technologies 5. Greenhouse mitigation technologies 6. Energy extraction from unconventional resources 7. Geothermal resource exploration and production 8. Wellbore instabilities and its mitigation 9. AI/ML technology for seismic data processing and interpretation 10. Exploration and Development of Hydrocarbon Resources 11. Unconventional Hydrocarbon Resources: Shale Gas, Tight Oil, Coalbed Methane, and Gas Hydrates 12. Coal Geochemistry, Characterization, and Utilization in Energy Production 13. Integrating Digital Rock Physics (DRP) with traditional rock physics and its applications. 14. Reservoir Characterization and Monitoring using geophysical and core data. 15. Reservoir Geomechanics and Porous Media Characterization. 16. Under-balance drilling fluid design for mature well 17. Flow Assurance in tubing and pipelines 18. Mitigation of Asphaltene and Wax deposition 19. Prevention of hydrate deposition in flowlines 20. Sand control 21. Water shut off 22. Drilling/ Completion/Workover/Fracturing Fluid design 23. Advance cement design with reduced WOC 24. Spacer fluid design to prevent cement and mud contamination 25. Logging techniques in sub-hydrostatic zones, Cement squeeze zones 26. Treatment of effluent water 27. Spotting fluid for pipe stuck up 28. EOR Solutions in mature and depleting reservoir 29. Digitalization / AI / ML for Oil and Gas industry 30. Loss circulation mitigation 31. Advance seismic data acquisition and processing 32. Gas hydrate recovery 33. Gas hydrate applications for CCUS 34. Development of intelligent nanoparticle-enhanced fluids for optimized oil recovery and improving CO2 sequestration Potential 35. Advanced cement formulations for high-temperature and high-pressure challenging downhole conditions 36. Development of responsive drilling fluids for improved drilling and wellbore stability	**Petroleum Engineering and Geo-Engineering**

	37. Advanced solutions for flow assurance challenges in oil and gas production systems 38. Subsurface characterization of geothermal reservoirs 39. Hydrate formation modeling in gas pipelines 40. Predictive maintenance of rigs and pipelines	
II.	1. Process Safety in Hydrogen Systems 2. Fire/explosion modeling in refineries 3. Environmental Monitoring Technologies 4. Life Cycle Analysis of Energy Systems 5. Low-cost Biogas Upgradation by removal of CO_2/H_2S to meet grid standards 6. Low-cost Catalytic pyrolysis of plastic waste into fuels 7. Crude Oil Pre-Heat Train Exchangers Fouling Model. 8. Hexene-1 production through controlled trimerization approach 9. Safe handling and disposal of spent catalyst 10. Enhancement of polymer (PE/PP) mechanical properties 11. Advanced inner coating for CS pipes 12. Pre-treatment system for Py-Oil Stripping of NH3 from ETP treated water 13. Reducing MDEA loss in Hydrogen unit 14. AI based corrosion models for refineries 15. Metallurgical failure analysis for refineries 16. Material selection guidance for non-standard feeds used in refineries 17. High value additives for Petchem Polymer units 18. Pre-treatment of hydrotreatment for controlling catalyst bed pressure drop issue 19. Improving color & yield of DAO produced from VR 20. Solvent dewaxing: AI/ML based model for Prediction of time for the Filter cloth washing 21. Development of Anti-Static Additives 22. Catalyst for Mercaptan to Disulfides Conversion 23. Green Hydrogen Generation 24. Redox Fow Battery 25. Sodium-ion Battey 26. CO_2 capture using Ionics liquids 27. CO_2 to Chemicals 28. C_3 separation using membrane matrix 29. Hydrogen Storage for Mobil Application	**Chemical & Biochemical Engineering**
III.	1. Small-Scale Pyrolysis Reactor Design 2. Sustainable Utilization of Waste Plastics for Construction Materials, Printer filament and Alternate Fuels. 3. Graphite-based Perovskite Solar Cells for Photovoltaic Applications 4. Lab-Scale Set-Up to Simulate Tribo-Corrosion of Drilling Tool 5. Multiphase Flow Pipeline Design 6. Wear-Corrosion Device Design with Load, Speed-Regulating, Corrosion Chamber, and Control System. 7. CO_2 Sequestration in Saline Aquifer 8. Green Solvents for Carbon Capture	**Mechanical Engineering**

	9. CCUS Technologies for Carbon Assessment and Removal 10. Industrial CO_2 Capturing and Conversion 11. Mechanical Issues of Wellbore Instabilities 12. AI/ML Techniques for Casting, Welding, and Industrial Manufacturing 13. Tribo-Corrosion Performance Assessment of Drill Bit Material 14. Wellbore Chips Removal Performance for Drilling Process 15. Cement Slurry Design using Nanomaterial at HPHT Conditions 16. Design of Metal Oxide Semiconductor (MOS) using Indigenous Nanomaterial 17. MOS based Sensing Device for Sub-ppm levels of Methane detection 18. Lab based set-up for Conversion of waste plastic into plastic beads 19. Lab based set-up for Bio-Mass Gasification for H_2 development and CO_2 Capturing 20. Injection Moulding Set-up design for Plastic Beads Conversion into Bricks 21. Unit Design for Solid Waste (SW) Segregation and its Utilization 22. Pressure Calculations for Gravity Falling of SW Segregation Unit 23. ASPEN PLUS Simulation of SW Segregation Unit for RGIPT Hostel and Housing area 24. Digitalization/Automation for Oil and Gas industry Processes.	
IV.	**A. AI/ML for Process Optimization & Asset Integrity** 1. **AI-Based Corrosion Prediction Models** Predictive AI/ML models for corrosion in refinery and petrochemical units using plant operating and lab data. 2. **AI-Driven Metallurgical Failure Analysis** Vision-based analysis of corroded/failed samples for root cause detection and preventive maintenance suggestions. 3. **Material Compatibility Prediction for New Feedstocks** AI-based decision support for material selection when processing non-standard feeds (corn oil, pyrolysis oil, etc.). 4. **ML Models for MDEA Loss Monitoring and Prevention** Data-driven monitoring and anomaly detection for MDEA losses in hydrotreaters. **B. Digitalization, Digital Twins & Intelligent Agents** 5. **Digital Agent for Process Engineering Expertise** AI/ML-powered agent for engineering calculations, literature search, test run analysis, and KPI dashboards. 6. **Digital Twin-Based Expert System for Process Control** DT models for process optimization, including: o Cooling Tower performance optimization o Biogas plant yield improvement o Enhanced Oil Recovery (EOR) process control o Oil rig/drilling operations o Pumping stations and gas gathering stations	**CSE/IT**

7. **Upstream Cloud-Based Intelligent Data Analytics**
   Cloud-integrated multi-sensor, multi-temporal data analytics platform for exploration and prospecting, combining seismic, satellite, UAV, and IoT data with specialized SW/HW tools.
8. **Refinery Digitalization Value Mapping**
   Identification and deployment of high-value digitalization use cases for refining and petrochemical processes.

C. IoT, Sensor Integration & Structural Health Monitoring

9. **IoT-Based Asset Integrity Monitoring**
   Real-time monitoring of vibration, temperature, corrosion rates, and operational parameters using sensor networks.
10. **Digital Twin for Structural Health Monitoring**
    Integration of 3D scanners and AI defect detection to monitor tanks, pipelines, and pressure vessels.
11. **Smart Limestone Quality Monitoring for CFBC Boilers**
    IoT + vision analytics for particle size distribution monitoring to prevent high bed temperatures.

D. Cybersecurity & Secure Data Exchange

12. **Cybersecurity Solutions for Refinery OT/IT Systems**
    AI-driven intrusion detection and anomaly detection for industrial control systems.
13. **Secure Data Exchange Framework for Energy Operations**
    Blockchain-enabled and encrypted data communication between IT and OT networks.

E. Vision-Based & Image Processing Applications

14. **AI/ML Image Analysis for Corrosion & Crack Detection**
    Drone/robotics-enabled automated visual inspection for critical plant structures.
15. **Feature Extraction for Process Anomalies**
    Vision and sensor data analytics to detect process deviations, leaks, or abnormal emissions.

F. Operational & Supply Chain Optimization

16. **AI-Enhanced Additive Development for Petchem Units**
    ML models to predict additive performance for polymers and optimize formulations.
17. **Supply Chain Management Dashboard for Renewable Hydrogen**
    SW suite/dashboard for end-to-end hydrogen production, storage, and distribution management.
18. **Gamified Simulation for Oil Price, Quality & Cost Prediction**
    Serious game design for forecasting crude oil prices, quality impacts, and supply chain risks — extending to other energy economics simulations.

	G. Surveillance & Disaster Monitoring 19. **UAV, CCTV, IoT, and Balloon-Based Surveillance Systems** Development of multi-platform aerial and ground surveillance systems for refinery perimeter security, pipeline monitoring, and restricted zone access control. 20. **Disaster Monitoring & Prediction Systems** AI/ML-based multi-sensor platform integrating UAVs, CCTVs, balloons, and IoT sensors for early detection and prediction of industrial disasters (fire, gas leaks, structural failures) and environmental hazards. **H. Language Modelling Based AI Solutions for Oil and Gas** 21. **Corrosion & Failure Report Generator** Multimodal AI creates instant reports from logs, images, and sensor data. 22. **LLM Digital Process Engineer** A conversational assistant for real-time troubleshooting and optimization. 23. **Predictive Maintenance Planner** Generates schedules using past failures, visuals, and sensor trends. 24. **Multilingual Safety Agent** Guides operators during emergencies via text, voice, and visuals. 25. **Regulatory Compliance Checker** Uses NLP algorithms to scan documents and flag compliance gaps while providing explanations.	
V.	**AI/ML in Energy and Financial Modelling:** AI/ML Based solutions for Predictive maintenance. Big Data Analysis to extract features and provide solutions for various challenges. AI/ML applications in Finance. 1. **Digital Twin** Monitor and simulate wells, pipelines, rigs, refineries. Predict failures, optimize performance, reduce downtime. 2. **Energy Forecasting and Demand Prediction:** Time-series models (ARIMA, state-space models). ML/DL methods for sequence forecasting. Uncertainty quantification (Bayesian models) 3. **Energy Trading and Market Analytics** Financial mathematics for derivatives in energy trading. Machine learning for price forecasting. Risk management using stochastic optimization. 4. **Fault Detection and Predictive Maintenance** Anomaly detection in sensor data Signal processing and ML for vibration, temperature data.	**Mathematical Sciences**

	Graph-based ML for network-level fault localization. 5. **Data Assimilation for Real-Time Reservoir Management** To update reservoir models continuously using real-time production and sensor data using: Ensemble Kalman Filter, Particle filters. Hybrid data assimilation with ML. 6. **Algorithmic & High-Frequency Trading (HFT)** Industry problem: Design trading algorithms that execute buy/sell orders at optimal times, reacting to market movements in milliseconds. AI/ML approaches: Supervised learning: Predict short-term price moves from order book data. Reinforcement learning: Develop agents to optimize execution strategies. Deep learning: LSTMs, Transformers for tick-level time series.	
VI.	1. Sensor design for physical and byproduct monitoring from Energy industry 2. Energy storing/converting materials 3. Robust and adaptive control for nonlinear, multivariable oil and gas industry applications 4. Lifecycle and degradation modelling of energy storage systems 5. Decentralized and distributed control design for petrochemical processes 6. Design and Stability Analysis of Event-Triggered Controllers for Energy Systems 7. Prediction of energy storage capability for energy storage devices by Machine learning based approach 8. Data driven classification approach for specific capacitance prediction of energy storage materials for energy devices (supercapacitor, Battery, etc) 9. Flexible Display for better system control in energy sector 10. Prediction and monitoring of health conditions of workers in energy units 11. IoT-Enabled Sensor Data Analytics for Real-Time Pipeline Monitoring and Leak Detection 12. Anomaly Detection in Oil and Gas Process Control Systems Using IoT and Signal Processing 13. IoT-Based Environmental Monitoring for Climate Change Mitigation in Oil and Gas Operations 14. Healthcare Monitoring for Worker Safety in Oil and Gas Environments Using Wearable and Non-wearable IoT Devices 15. Multilevel converters for renewable integration in oil & gas operations 16. Modular power converters for scalable backup and hybrid energy systems 17. Model Predictive Control (MPC) for refining and drilling processes 18. High-efficiency wide band gap SiC rectifiers for electrolyzers and energy conversion 19. EV Charging Infrastructure & Grid Integration 20. Descaling and cleaning of pipeline sections.	**Electrical and Electronics Engineering**

	21. Enhanced oil recovery (EOR) through pulse-assisted electrohydraulic shockwaves in core samples. 22. Field emission and breakdown testing in saline and crude oil environments. 23. Plasma-assisted chemical reactors for VOC degradation or wastewater treatment. 24. Pulsed spark discharge for emulsification and cavitation-driven reactions. Testing energy efficiency and process intensification metrics. 25. Energy-efficient drive systems for upstream and downstream applications. 26. Condition monitoring and predictive maintenance of drive systems in oil & gas operations. 27. High-performance motor drives for compressors, pumps, and drilling equipment.	
VII.	1. CO_2 to value added chemicals through electrolysis 2. Electrochemical ammonia synthesis 3. Electrocatalytic upcycling of plastic waste into high-value chemicals. 4. Energy conversion and storage: Materials development and device optimization 5. Photocatalytic Materials for Energy and Environmental Applications. 6. Artificial Photosynthesis & Solar Fuel Generation 7. Molecular & Hybrid Catalysts, Water Splitting, CO_2 Photoreduction, Integrated Solar Reactors 8. Biomass Conversion Technologies for CCUS and Energy (Hydrogen, Fuel) production 9. Lignocellulosic Biomass Valorization, 10. Lignin Engineering for CCUS 11. Thermo-/Photo-/Bio-Catalysis 12. Carbon-Negative Energy Systems 13. Next-Gen Energy Materials for Sensors, Storage, & Conversion 14. 2D & Quantum Materials 15. Solid-State & Flexible Batteries 16. Energy-Sensitive Smart Sensors 17. Thermoelectric materials 18. Low-cost Catalytic pyrolysis of plastic waste into fuels.	**Energy and Human Sciences**

RGIPT, Bengaluru Campus

S.No	Topic(s)	Departments
I.	1. Reliability Modeling and Life Prediction of Energy Systems/Components 2. AI for Predictive Maintenance in Energy Systems 3. Wearable and Digital Safety Technologies 4. Safety Engineering and Technology Integration 5. Occupational Health Monitoring, Chemical and Environmental Exposure Risks 6. Human Factors and Ergonomics 7. Life Cycle Analysis of Energy Systems 8. Techno-economic analysis of hybrid storage	**Robotics & Automation**

	9. AI/ML models for reservoir simulation 10. Heat Exchanger Optimization in Energy Industries 11. Predictive Analytics for Fault / Anomaly Detection and Isolation in Smart Grid 12. Predictive Energy Management Controller for Extended Range Electric Vehicles 13. AI/ ML model for reservoir characterization 14. Generative AI for Subsurface Imaging and modelling 15. Anomaly detection and explainability for enhancing grid reliability and management 16. Multimodal AI for asset health monitoring	
II.	1. Small-scale LNG logistics optimization 2. Energy Economics & Policy Modeling: Scenario modeling for Net Zero India 3. Social and Environmental Impact Assessment of Energy Systems 4. Strategic Petroleum Reserves Management 5. Blockchain for Energy Trading 6. Data-driven Asset Integrity Management 7. Techno-economic analysis of hybrid storage 8. Low-cost catalysts for hydrocracking, hydrotreating	**Sustainability Management**

RGIPT Sivasagar Campus, Assam

Topic(s)
1. CO_2 capture, utilization and sequestration
2. Utilization of Hydrogen for transportation and power generation applications
3. Green Hydrogen Production
4. Commercial production of biodiesel & biogas through cultivation of short gestation crops
5. Low cost biogas upgradation
6. Life cycle analysis of energy systems
7. Environment monitoring technologies
8. Low-cost Catalytic Pyrolysis of plastic waste into fuel
9. Utilisation of Petroleum Waste Derivatives in High-Performance Polymer Composites
10. Predictive Maintenance of Rigs and Pipelines
11. Environmental monitoring technologies or Life Cycle Analysis of Energy Systems