Semester III

Basics of Geological Science

1.1 Course Number: PE201
1.2 Contact Hours: 3-0-0 Credits:9
1.3 Semester-offered: 2nd Year –Odd
1.4 Prerequisite: NA
1.5 Syllabus Committee Members: Dr. Chinmoy Jit Sarma, Dr. Satyajit Chowdhury, Dr. Sekhar Gogoi & Dr. Srawanti Medhi

2. Objective:

The objective of this course is to help participants attain the aspects of geology. It will cover the fundamentals involved in understanding the rock formations and minerals. It will also cover structures and features of rock formations that may be favourable for hydrocarbon storage in the form of crude oil and gas. Also, information about sedimentary basins and plate movements of earth will be presented. A brief introduction to basics of Geophysics will be covered in the subject.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction**	Introduction, parts of earth- Atmosphere, lithosphere, Hydrosphere; subdivisions of geology, Introduction to petroleum geology	3
2	**Geological process works and rock formation**	Introduction, geological works of atmosphere (rock formation- rock weathering: physical and chemical), water (streams/rivers, sea, groundwater), glaciers	3
3	**Mineralogy**	Introduction, Properties- Physical and optical, Formation of minerals from magma, gases, recrystallization, solution; Common rock forming minerals.	4
4	**Structural features of Rocks**	Basics: Introduction, Primary and secondary structures, basic terms, stratigraphy and sequence stratigraphy; Folds and folding: Introduction, parts of fold, causes, classifications; Faults and faulting: Introduction, Classification, effects, recognition and causes, fault analysis; Joints and jointing: Introduction, Classification, Occurrences, Origins; Unconformity: Introduction, origin and types	5
5	**Study of Rocks Part A**	Introduction, Igneous rocks: definition, forms of igneous rocks -Concordant, disconcordant, igneous extrusions; Classification of igneous rocks, important igneous rocks	3
6	**Study of Rocks Part B**	Sedimentary rocks: Introduction, Formation of sedimentary rocks – mechanical, chemical, organic; classification of sedimentary rocks – clastic, non-clastic; important sedimentary rocks	6

7	**Study of Rocks Part C**	Metamorphic rocks: Introduction, classification of metamorphic rocks, important metamorphic rocks.	3
8	**Sedimentary basins and Plate tectonics**	Sedimentary basins: Introduction, Types of sedimentary basins, petroleum systems; Plate Tectonics: Introduction, Plate boundaries- transform, divergent, convergent; current plates of the earth.	3
9	**Introduction to Geophysics**	Introduction, Gravity surveys: gravity measuring instruments, gravity survey, gravity anomalies, Gravity corrections, applications, Magnetic survey - Geo-magne, magnetic field, field method of magnetic surveys, application of magnetic survey; Seismic survey: Seismic sources, receivers, Seismic reflection and refraction survey, applications	6
Total			**36**

4. Readings

4.1 Suggested Books:

1. Geology of Petroleum, A.I. Levorsen, CBS Publishers
2. Elements of Petroleum Geology, R.C. Shelly, Elsevier Science Publishing Co.
3. Engineering and General Geology, Parvin Singh, Katson Books
4. Textbook of Geology, P.K. Mukherjee, World Press Private Limited
5. Textbook of Physical Geology, G.B. Mahapatra, CBS Publishers
6. Textbook of Geology, G.B. Mahapatra, CBS Publishers
7. Principles of Engineering Geology, K.M.Bangar, Standard Publishers

5. Outcome of the Course:

The students will be able to:

1) Understand the basics of geology and its importance in oil and gas exploration.
2) Get an idea of the different rock minerals and rock types.
3) Understand about basins and plate tectonics.

Reservoir Engineering-I

1.1 Course Number: PE202
1.2 Contact Hours: 3-1-0 Credits: 11
1.3 Semester-offered: 2nd Year –Odd
1.4 Prerequisite: Concepts of Physics and Mathematics
1.5 Syllabus Committee Members: Dr. Chinmoy Jit Sarma, Dr. Satyajit Chowdhury, Dr. Sekhar Gogoi & Dr. Srawanti Medhi

2. Objective:

i) To help the students understand the fundamentals and relevance of reservoir engineering in the broader context of Oil/Gas Field Exploitation, and have in-depth knowledge of vital aspects of elements of reservoir engineering in particular-

ii) To enable students to understand fluid properties existing in hydrocarbon reservoir and apply laws of fluid flow through porous media and their applicability under various field conditions.

iii) To empower students with the resource analysis expertise through extensive evaluation of hydrocarbon reservoir with respect to reserve estimations, recovery factors and ensure a positive economic gain.

iv) To enable students to emulate and simulate the reservoir parameters and use the same in futuristic R&D of their respective research areas and concerns in and around fluid mechanics such as energy, health etc. across multidisciplinary domains.

v) To equip students with multidisciplinary approach of problem-solving professional way by using commercial software packages, data analysis and presentation, numerical simulations etc.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction**	Introduction to reservoir engineering	5
2	**Characteristics**	Characteristics of crude oil and natural gas, classification of crude and its physicochemical properties.	6
3	**Reservoir Rock Properties**	Porosity and permeability determination, combination of permeability in parallel & series beds, porosity permeability relationship, fluid saturation determination and significance, effective and relative permeability, wettability, capillary pressure characteristics, measurements and uses. Coring and Core Analysis.	8

4	**Reservoir Fluids**	Phase behavior of hydrocarbon system, ideal & non-ideal system, equilibrium ratios, reservoir fluid sampling, PVT properties determination, different correlations and laboratory measurements, data reduction, evaluation and application.	7
5	**Flow of Fluids through Porous Media**	Darcy's law, single and multiphase flow, linear, radial & spherical flow, steady state & unsteady state flow, GOR, WOR equations.	8
6	**Reservoir Drives**	Reservoir drive mechanics and recovery factors.	4
Total			**38**

4. Readings

4.1 Textbooks:

1. Tarek Ahmed, "Reservoir Engineering Handbook", Gulf Professional Publishing, 4th ed, (2010).
2. NnaemekaEzekwe, "Petroleum Reservoir Engineering Practice", Pearson Education, Inc, (2010).

4.2 Reference Books:

1. Benjamin Cole Craft, Murray Free Hawkins, and Ronald E. Terry, "Applied Petroleum Reservoir Engineering" by Prentice Hall, (1991).
2. LP Dake, "Fundamentals of Reservoir Engineering" shell learning and development, (1998).
3. Tarek Ahmed, Paul D. McKinney, "Advanced Reservoir Engineering" Gulf Professional Publishing, 4th ed, (2005).
4. BF Towler, "Fundamental Principles of Reservoir Engineering", SPE, (2002).
5. Heriot Watt, "Reservoir Engineering Handbook".
6. Abhijit Y. Dandekar, "Petroleum Reservoir Rock and Fluid Properties", CRC Press, (2013).

5. Outcome of the Course:

1) Gain the knowledge of reservoir properties of rocks
2) Calculate the properties of reservoir fluid.
3) Gain insight into vapor – liquid, liquid – solid phase equilibrium during oil & gas production.
4) Understand the phenomenon of multiphase flow system in porous media and Equations for the calculation of required parameters applied in Reservoir Engineering.
5) Understand and explain different drive mechanisms and recovery factor of a Reservoir.
6) Calculate reserves of oil and gas by volumetric and material balance and acquire the Basics knowledge of Reservoir Modeling Software's

Production Engineering-I

1.1 Course Number: PE203
1.2 Contact Hours: 3-0-0 Credits: 9
1.3 Semester-offered: 2nd Year –Odd
1.4 Prerequisite: NA
1.5 Syllabus Committee Members: Dr. Chinmoy Jit Sarma, Dr. Satyajit Chowdhury, Dr. Sekhar Gogoi & Dr. Srawanti Medhi

2. **Objective:**

i) Gain the fundamental concepts in petroleum production engineering.
ii) Understand crude oil recovery methods from subsurface reservoirs
iii) Understand application of artificial lift methods on production depletion.
iv) Identify sand problem and its control

3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction to Oil Recovery methods**	Recovery Techniques: Primary recovery, Secondary recovery, Improved Oil Recovery, Enhanced Oil Recovery, Recovery factor.	4
2	**Well Completion and Equipment**	Wellhead Equipment, Christmas tree, valves, hangers, flow control devices, packers, tubular and flow lines. Perforating Oil & Gas Wells - Conventional and Unconventional techniques viz. Through tubing and tubing conveyed underbalanced perforating techniques, type size and orientation of perforation holes.	8
3	**Well Activation Methods**	Well Activation methods, Coiled Tubing unit, Down-hole equipment selection, servicing, installation & testing, smart wells- intelligent completions.	6
4	**Artificial Lift Completion**	Gas lift- Continuous and intermittent gas lift, unloading operations, gas lift valve components and mechanics, Plunger lift, chamber lift Mechanical pumping-Sucker Rod Pumping, components and operation, SRP installation, ESP-components and operation, Jet pump, Hydraulic pump-operation and components, Progressive Cavity Pump.	12
5	**Sand Control**	Introduction, Types of formation sand, effects of excess sand production, causes, Sand Control Mechanism, Gravel Pack: size, requirement, carrier fluid, hardware, gravel placement.	6
Total			**36**

4. Readings

4.1 Textbooks:

1. Petroleum Production Engineering: A computer Assisted Approach, BoyunGuo, William C. Lyons, Ali Ghalambor, Elsevier Science & Technology Books, 2007.
2. Production Operations, (2-Volume Set: Volume I & Volume II), Thomas O. Allen and Alan P. Roberts.
3. Well Completion Design, Jonathan Bellarby.
4. Technical Manual on Work-over Operation by IOGPT, ONGC

4.2 Reference Books:

1. Production Technology I-II, Institute of Petroleum Engineering, Herriot Watt University.
2. Petroleum Engineering Handbook by Howard B. Bradley
3. Non-Technical guide to Petroleum Geology, Exploration, Drilling and Production - Norman J Hyne
4. Dictionary of Petroleum Exploration, Drilling & Production by Norman J, Hyne
5. Petroleum Production Systems, M. J. Economides, A. Daniel Hill & C. E. Economides, Prentice- Hall, N. J – 07488, 1994.

5. Outcome of the Course:

After the course, the students will be able to:

1) Determine the well head pressure, down-hole pressure and operating oil/ gas flow rates of the reservoir.
2) Identify formation damage and find remedial methods to bring the well back into production.
3) Screen, design and operate artificial lifts on reservoir pressure depletions.
4) Handle in case of any crisis at drilling/production installations.
5) Contribute to reservoir management as production engineers to prolong the reservoir life with optimum production.

Drilling Engineering-I

1.1 Course Number: PE204
1.2 Contact Hours: 3-0-0 Credits:9
1.3 Semester-offered: 2nd Year –Odd
1.4 Prerequisite: NA
1.5 Syllabus Committee Members: Dr. Chinmoy Jit Sarma, Dr. Satyajit Chowdhury, Dr. Sekhar Gogoi & Dr. Srawanti Medhi

2. Objective:

The objectives of this course are to give an overview of the role of drilling engineers in oil and gas industries. It will help to understand the plan of drilling a well, the process of drilling and various equipment used for drilling as well the drill string. It will focus on the importance of drilling fluid and its properties. Also, the course will shed light on understanding casing and cementing operations and a brief introduction to different borehole problems.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Overview of drilling**	Drilling planning approaches, drilling team, types of drilling, power systems	5
2	**Hoisting system**	Derrick & substructure, steel derricks, making a connection, tripping operation, draw-works, travelling assembly: crown block, travelling block & hook, drilling line, static crown load.	6
3	**Drill String**	Drill string, drill string components, and design, stretch of drilling pipe, drill pipe maintenance.	4
4	**Drill Bits**	Types of bits, standard classification of bits, bit selection methods	5
5	**Drilling Mud Engineering**	Introduction, functions, types of mud, fundamental properties of mud, mud circulation, mud conditioning system.	5
6	**Casing & Cementing**	Casing, functions, types, casing sequence, cementing, functions of cement, cement classes, casing accessories, setting casing, single stage and two stage cementing.	6
7	**Borehole Problems**	Introduction, pipe sticking differential sticking, mechanical sticking, and key seating; sloughing shale, lost circulation zones.	6
Total			**37**

4. Readings

4.1 Suggested Books:

1. Oil well Drilling Engineering, H Rabia
2. Well Construction and Engineering, H. Rabia
3. Composition and Properties of Drilling and Completion Fluid, H.C.H Darley and George R. Grey
4. Drilling Engineering- A complete Well Planning Approach, Neal J. Adams
5. Drilling Operation Practices Manual, IDT, ONGC

5. Outcome of the Course:

1) The drilling concepts of a well from planning to rig mobilization to the location.
2) The concept of a drill string design for drilling.
3) The suitable drilling fluids during drilling.
4) The concept of Casing and Cementation installation.
5) To troubleshoot well borehole problems.

Unit Operations-I

1.1 Course Number- CE201
1.2 Contact Hours- 3-1-0 Credits: 11
1.3 Semester Offered- 2nd Year Odd
1.4 Prerequisite: NA
1.5 Syllabus Committee members- Dr. Abhimanyu Kar, Dr. Sanat Kumar Singha, Dr Naveen Mani Tripathi, Dr. Karthik Babu NB

2. Objective:

i) To study statics, kinematics and dynamics of fluids.
ii) To understand the characteristics associated with the fluid flow though pipeline systems.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Fluid Statics**	Brief description of various fluid properties, Pressure at a point, Compressible and Incompressible fluid, Measurement of pressure, Manometry, Buoyancy, Archimedes' principle and stability	6
2	**Fluid Kinematics**	Classification of fluid flows – viscous vs inviscid flow, internal vs external flow, compressible vs incompressible flow, laminar vs turbulent flow, natural vs forced flow, steady vs unsteady flow, uniform vs non-uniform flow; Flow patterns – timeline, streamline, path line, streamline	9
3	**Fluid Dynamics**	Fluid flow rate, Conservation of mass, Continuity equation, The Bernoulli's equation and its application	9
4	**Pipe Flow**	Flow regimes in a pipe, Energy loss in pipes through Darcy-Weisbach equation and Hagen-Poiseuille equation, Friction factor, Turbulent flow in pipes, Moody's Diagram	9
5	**Pipeline Systems**	Basic of pipe network system, Minor losses in pipes, Energy and hydraulic grade line, Valves used in pipelines – Flow control valve, Check valve, Pressure relief valve/ Safety valves	6
Total			**39**

4. Readings

4.1 Textbooks/ Reference Books:

1) Elger, Donald F., Barbara A. LeBret, Clayton T. Crowe, and John A. Roberson. Engineering fluid mechanics. John Wiley & Sons, 2020.
2) Yunus, A. Cengel. Fluid Mechanics: Fundamentals and Applications (SI Units). Tata McGraw Hill Education Private Limited, 2010.
3) Fox, Robert W., Alan T. McDonald, and John W. Mitchell. Fox and McDonald's introduction to fluid mechanics. John Wiley & Sons, 2020.
4) R.K. Bansal, A textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications.

5. Outcome of the Course:

1) Knowledge of fluid properties, stress, buoyancy and floatation.
2) Classify fluid flow and flow pattern.
3) Understand continuity and Bernoulli equations.
4) Derive Darcy-Weisbach equation and Hagen-Poiseuille equation associated with pipe flow.
5) Calculate friction factor from Moody diagram.
6) Knowledge of minor & major losses and energy & hydraulic grade lines corresponding to pipe flow.
7) Classify flow control valves and safety valves.

Engineering Thermodynamics

1.1 Course Number- ME206
1.2 Contact Hours- 3-0-0 Credits: 9
1.3 Semester Offered- 2nd Year Odd
1.4 Prerequisite: NA
1.5 Syllabus Committee members- Dr. Abhimanyu Kar, Dr. Sanat Kumar Singha, Dr Naveen Mani Tripathi, Dr. Karthik Babu NB

2. Objective:

i) To understand basic concept of thermodynamics and its properties.
ii) To generate the ability to differentiate different forms of energy i.e., heat and work.
iii) To apply first law of thermodynamics to closed and flow systems.
iv) To realize the need of second law of thermodynamics, spontaneity and irreversibility in nature.
v) To learn basic concepts of real gases and working of external and internal combustion engines.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Basic concepts and definition**	Scope and limitations of Thermodynamics, Macroscopic and Microscopic approaches; Definition of System, Surrounding, closed systems, and open system; Properties: (extensive and Intensive), Characteristics of properties (point and path function), and its representation on a property diagram; Units of measurements: Force, Pressure, and Energy.	6
2	**Equilibrium and Zeroth Law**	Equilibrium: Thermal, Mechanical, Chemical, Thermodynamic; Zeroth Law of Thermodynamics and temperature, Measurement of temperature and calibration of Thermometers, the ideal gas temperature scale.	5
3	**Processes and its representation**	Reversible and Irreversible processes; Different types of process and their representations.	2
4	**Work and Heat Transfer**	Definitions and calculations: Work Transfer, Different modes of work, Displacement Work for various processes, Heat Transfer, Specific heat, Latent heat.	4
5	**First Law of Thermodynamics**	Joule's experiment, Introduction of internal energy as a thermodynamics property, Introduction of enthalpy as a thermodynamic property; Definition of specific heats and their use in calculation of internal energy and enthalpy with emphasis on ideal gases.	5
6	**Applications of First Law of**	Application of First Law to control mass: Work done and heat transfer in various types of elementary processes;	8

	Thermodynamics	Application of First Law to control volumes; Nozzle, Diffuser, Compressor, Turbine, Throttling device, Heat Exchanger. (Only steady flow need be considered).	
7	**Second Law of Thermodynamics**	Limitations of first law of thermodynamics; Cyclic heat engine; Energy reservoirs; Refrigerator and Heat Pump; Kelvin-Plank statement and Clausius statement of second law; Reversibility and Irreversibility; Carnot Cycle and Carnot Theorems;	5
8	**Entropy**	Clausius' Theorem and Clausius' inequality; Concept of entropy; Entropy and Disorder; Entropy changes in various processes, Entropy Principle and its application,	5
	Total		**40**

4. Readings

4.1 Textbooks:

1. Engineering Thermodynamics by P.K. Nag, Publisher: TMH
2. Basic Engineering Thermodynamics by Rayner Joel, Pearson Education

4.2 Reference Books:

1. Engineering Thermodynamics by Van Wylen and Sontang, John Wiley
2. Engineering Thermodynamics by M. Achuthan, Publisher: PHI
3. Applied Thermodynamics by Eastop and McConkey, Publisher: Pearson
4. Fundamental of Engineering Thermodynamics by E. Rathakrishnan, publisher. PHI
5. Engineering Thermodynamics by Russel and Adebiyi, publisher, Oxford
6. Steam Tables in SI Units by Ramalingam, Scitech.

5. Outcome of the Course:

1) Basic understanding thermodynamics and its applications
2) Understand the basics of Engineering Materials (its applications) and Stress-Strain
3) Basic understanding of boilers, engines and latest automobile technologies.
4) Understand the basics Applied Mechanics, Simple lifting Machines & Power Transmission
5) Understand the basics of Engineering surveying and Smart Infrastructure Development.

Unit Operations Laboratory – I

1.1 Course Number: CE201L
1.2 Contact Hours: 0-0-2 Credits: 2
1.3 Semester-offered: 2nd Year –Odd
1.4 Prerequisite: Diploma level Mathematics and Physics
1.5 Syllabus Committee Members: Dr. Bhaskar Jyoti Medhi, Dr. Anil Kumar Varma, Dr. Arun Kumar

2. Objective:

i) The lab is to provide practical and theoretical experience in a number of important chemical engineering unit operations ensuring a thorough understanding of the principles of unit operation. The course includes experimental execution, data analysis and error analysis, skills development in oral presentation, technical report writing, and team-building.

ii) The experiments are designed to illustrate the principles of fluid and particle mechanics, separation processes.

3. Course Content:

Sl. No.	List of Experiments
1	To verify the Bernoulli's equation
2	To study the head losses due to various fittings in pipeline
3	To study different types of flow
4	To measure the viscosity of oil using Redwood Viscometer
5	To measure the discharge through Venturi meter, Orifice meter and Rotameter
6	To study the Reciprocating pump characteristics
7	To study the Centrifugal pump characteristics
8	To study the operation of ball mill
9	To study the operation of gyratory sieve shaker
10	To study the working principle of froth flotation cell
11	To study the operation of plate and frame filter press

4. Outcome of the Laboratory:

This lab will give the student a thorough knowledge of fluid and particle mechanics, separation processes. Understand to analyze experimental data and observed phenomena to write good technical report.

Geology Laboratory

1.1 Course Number: PE201L
1.2 Contact Hours: 0-0-2 Credits:2
1.3 Semester-offered: 2nd Year–Odd
1.4 Prerequisite: Fundamentals of Geology
1.5 Syllabus Committee Members: Dr. Satyajit Chowdhury, Dr. Chinmoy Jit Sarma, Dr. Sekhar Gogoi & Dr. Srawanti Medhi

List of Practicals:

1. Study different Physical Properties of Minerals.
2. Identification of minerals on the basis of their physical properties.

3. Study and identification of different types of Rocks. (Igneous, sedimentary & metamorphic rocks).
4. Study and sketching of various types of faults (normal, reverse, dip, shake, nonplunging and plunging faults.
5. Study and sketching of various types of structure folds (anticline, syncline, symmetrical & asymmetrical.
6. Determination of Dip and Strike of geological structures with a Clinometer Compass.
7. Geological cross sections and study of geological maps