INDIAN INSTITUTE OF TECHNOLOGY (ISM), DHANBAD 826004

DEPARTMENT OF PETROLEUM ENGINEERING

COURSE STRUCTURE AND SYLLABUS

(Finalized by Senate 2020)

B.TECH PETROLEUM ENGINEERING

(To be implemented from session 2020-21)

Course Structure

Semester III

(Implemented from Session 2020-21)

Course type	Subject ID	Subject Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit Hours	Contact Hours
DC1	PEC 201	Drilling Technology	3	0	0	9	3
DC2	PEC 202	Elements of Reservoir Engineering	3	0	0	9	3
DC3	PEC 203	Drilling Fluids and Cements	3	0	0	9	3
ESO1	GLE 201	Geology for Engineering and Sciences	3	0	0	9	3
ESO2	GPE 202	Geophysical Prospecting	3	0	0	9	3
DP1	PEC 204	Reservoir Engineering Lab	0	0	2	2	2
DP2	PEC 205	Drilling Fluids and Cementing Lab	0	0	2	2	2
ESO 1	GLE 201	Geology for Engineering and Sciences practical		0	2	2	2
		Total Credit	15	0	6	51	21

Semester IV

Course Type	Subject ID	Subject Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit Hours	Contact Hours
DC4	PEC 206	Elements of Petroleum Production Engineering	3	0	0	9	3
DC5	PEC 207	Petroleum Formation Evaluation	3	0	0	9	3
DC6	PEC 208	Reservoir Fluid Thermodynamics	3	0	0	9	3
DC7	GLC 512	Petroleum Geology	3	0	0	9	3
ESO3		Open	3	0	0	9	3
DP3	PEC 209	Petroleum Product Testing Lab	0	0	2	2	2
DP4	PEC 210	Drilling Simulation Lab	0	0	2	2	2
		Total Credit	15	0	4	49	19

Semester V

(Implemented from Session 2021-22)

Course type	Subject ID	Subject Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit Hours	Contact Hours
DC8	PEC 301	Applied Petroleum Reservoir Engineering and Management	3	0	0	9	3
DC9	PEC 302	Petroleum Production Operations	3	0	0	9	3
DC10	PEC 303	Natural Gas Engineering	3	0	0	9	3
HSS	HSS01/MS	HSS/MS	3	0	0	9	3
ESO4		Open	3	0	0	9	3
DP5	PEC 304	Petroleum Production Engineering Lab	0	0	2	2	2
DP6	PEC 305	Process Engineering Lab	0	0	2	2	2
		Total Credit	15	0	4	49	19

Semester VI

(Implemented from Session 2021-22)

Course type	Subject ID	Subject Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit Hours	Contact Hours
DC11	PEC 306	Directional Drilling	3	0	0	9	3
DC12	PEC 307	Oil and Gas Well Testing	3	0	0	9	3
OE1			3	0	0	9	3
OE2			3	0	0	9	3
HSS/ MS	MS01/HSS	MS/HSS	3	0	0	9	3
DP7	PEC 308	Enhanced Oil Recovery Lab	0	0	2	2	2
DP8	PEC 309	Reservoir Characterization Lab	0	0	2	2	2
		Total Credit	15	0	4	49	19

Semester VII

(Implemented from Session 2022-23)

S. No.	Subject ID	Subject Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit Hours	Contact Hours
DE1			3	0	0	9	3
DE2			3	0	0	9	3
OE3			3	0	0	9	3
OE4			3	0	0	9	3
OE5			3	0	0	9	3
DC13	PEC 402	UGP-1	0	0	6	6	6
DC 14	PES 401	Internship/Training/Seminar/ Field-Excursion	0	0	0	S/X	0
		Total Credit	15	0	6	51	21

Semester VIII

(Implemented from Session 2022-23)

S. No.	Subject ID	Subject Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit Hours	Contact Hours
DE3			3	0	0	9	3
DE4			3	0	0	9	3
OE6			3	0	0	9	3
OE7			3	0	0	9	3
DC15	PEC 402	UGP-2	0	0	6	6	6
		Total Credit	12	0	6	**42**	18

ESO Course Offered by PE Department (for Non PE students)

Course Type	Course Code	Name of Course	L	T	P	Credit
ESO/3	PEE 201	Introduction to Petroleum Engineering	3	0	0	9
ESO/4	PEE 202	Petroleum Environmental Management	3	0	0	9

Course Syllabus

THIRD SEMESTER

B.TECH PE

(Implemented from session 2020-21)

Course type	Subject ID	Subject Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit Hours	Contact Hours
DC1	PEC 201	Drilling Technology	3	0	0	9	3
DC2	PEC 202	Elements of Reservoir Engineering	3	0	0	9	3
DC3	PEC 203	Drilling Fluids and Cements	3	0	0	9	3
ESO1	GLE 201	Geology for Engineering and Sciences	3	0	0	9	3
ESO2	GPE 202	Geophysical Prospecting	3	0	0	9	3
DP1	PEC 204	Reservoir Engineering Lab	0	0	2	2	2
DP2	PEC 205	Drilling Fluids and Cementing Lab	0	0	2	2	2
ESO 1	GLE 201	Geology for Engineering and Sciences practical		0	2	2	2
		Total Credit	15	0	6	51	21

Course Type	Course Code	Name of Course	L	T	P	Credit
DC1	PEC 201	Drilling Technology	3	0	0	9

Course Objective
The objective of the course is to provide basic knowledge related to drilling of oil and gas wells.
Learning Outcomes
Upon successful completion of this course, students will: • have a broad understanding of well planning, drilling rig and its operating systems. • have a conceptual knowledge of different types of well tubular and their specific uses in the system • have analytical capability of problems to be encountered during drilling of the well and to take corrective measures.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Well Planning:** Introduction to oil well drilling, Drilling planning approaches.	5	Ability of proper planning of the well
2	**Rotary Drilling Method:** Rig parts, selection and general layout.	6	Knowledge of different operating system of drilling rig
3	**Drilling Operations & Practices:** Hoisting, circulation, Rotation, power plants and Power transmission, Rig wire line system handling & storage. **Coring:** Different methods of coring	6	Knowledge of different operating system of drilling rig
4	**Well tubular:** Casing String and casing seat selection, Drill String.	6	Familiarity of different well tubular and their utility
5	**Drill Bits:** Classification and design criteria of drag, rotary, roller, diamond and PDC bits. **Bit Selection:** Conventional and Log based. Introduction to tri-axial loading, Well Head Equipment.	5	Ability of selection of proper bit compatible to the well
6	**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.	6	Ability to handle different type of drilling problems
7	**Well Kick, Blow out and Well Control methods**	5	Ability to handle the unbalanced pressure and to control the Blowout
	Total contact hours:	**39**	

Text Books:

i. Petroleum Engineering: Drilling and Well Completion: Carl Gatlin
ii. Applied Drilling Engineering: Adams T Bourgoyane
iii. Drilling Engineering: A complete Well Planning and approach.: Neal J.Adams

Reference Books:

i. Well Control Problems Solutions : Neal A J.dams
ii. Oil Well Drilling : H Rabia
iii. Oil Well Drilling Technology : Mc. Gray& Cole

Course Type	Course Code	Name of Course	L	T	P	Credit
DC2	PEC202	Elements of Petroleum Reservoir Engineering	3	0	0	9

Course Objective
The objective of the course is to present an introduction to Petroleum Reservoir Engineering, with an emphasis on how to provide basic knowledge of Reservoir Engineering.
Learning Outcomes
Upon successful completion of this course, students will: have a broad understanding of concepts of Petroleum Reservoir Engineering, oil and gas properties, reservoir rock and fluid properties. be able to understand the concepts of relative permeability, capillary pressure, phase behaviour of hydrocarbon fluids and principles of fluid flow, pressure measurement and reserve estimation.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	**Introduction to reservoir engineering.** Characteristics of crude oil and natural gas, classification of crude and its physicochemical properties	4	To learn about scope of reservoir engineering, characteristics, classifications and properties of oil and gas
2.	**Reservoir Rock Properties :** Porosity and permeability determination, combination of permeability in parallel & series beds, porosity permeability relationship, fluid saturation determination and significance	5	To know about definitions and their determination of reservoir rock properties, series and parallel combination of beds, fluid saturation, etc.
3.	**Effective and relative permeability**, wettability, capillary pressure characteristics, measurements and uses	5	To understand the concept of effective and relative permeability, capillary pressure
4.	**Reservoir Fluids:** Phase behaviour 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	5	To understand the phase behaviour of hydrocarbon, equilibrium ratio, fluid sampling, PVT properties determination, and their measurement, correlations, data reduction and applications,
5.	**Flow of Fluids through Porous Media:** Darcy's law, single and multiphase flow, linear, radial & spherical flow, steady state, semi steady state & unsteady state flow, GOR, WOR equations	5	To understand the principle of fluid flow in the porous media, linear, radial and spherical flow, steady and unsteady state flow
6.	**Special type of flow:** flow through fractures, Water and gas coning	5	To analyze flow through fractures and coning problems in wells
7.	**Reservoir Pressure Measurements and Significance:** Techniques of pressure measurement	5	To know the techniques of pressure measurements in the oil and gas wells
8.	**Reserve estimation:** Reservoir drives**,** resource & reserve concept, Different reserve estimation techniques: Volumetric, MBE, decline curve analysis;, latest SPE/ WPC/ IS classification	5	To understand the drive mechanisms, methods of oil and gas reserve estimation, latest reserve classification
	Total contact hours:	**39**	

Text Books:

1. Reservoir Engineering Handbook: Tarek Ahmed
2. Petroleum reservoir engineering: Petrophysical properties J. W Amyx; D. M. Bass Jr. and R L. Whiting

Reference Books:

1. Oil Reservoir Engineering S. J. Pirson

Course Type	Course Code	Name of Course	L	T	P	Credit
DC3	PEC 203	Drilling Fluids and Cements	3	0	0	9

Course Objective
To provide basic knowledge about different types of drilling fluids and their applications. To provide the basic knowledge of oil and gas well cementing procedure.
Learning Outcomes
Ability to select the proper drilling fluid compatible to the well. Ability to design and selection of proper cement slurry compatible to an oil and gas well.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
	Drilling Fluids:		
1	Overview of Drilling Fluids: Drilling Fluid Characteristics: Basic functions, properties, maintenance, additives and treatments of drilling fluids	4	Students will be able to understand the basic functions of drilling fluids, which properties are responsible to achieve these functions and how to get that that properties of mud.
2	Classification, Types and applications of Drilling Fluids: Water based, oil based, emulsion based, polymer based, Surfactant based, Foam based and Aerated drilling fluids. Synthetic oil based drilling fluid (SOBM). Non damaging drilling fluids	5	Students will understand about different types of drilling fluids, there advantages and disadvantages and different key factors that drive decisions about the selecting types of drilling fluids for a specific well.
3	Clay chemistry and its application to drilling fluids, types of clays, hydration, flocculation, aggregation and dispersion.	5	Students will be able to understand the phisico-chemical behavior of clay minerals, from which drilling fluid is made up of.
4	Rheology of drilling fluids. Drilling fluid calculations: Slip Velocity, mud weight, additives.	5	The aspects of drilling fluid rheology and its role in drilling will be explained to the students.
5	Advancement in drilling fluid technology- New generation drilling fluids.	3	Modern drilling fluid and advancement in drilling will be explained to the students.
	Cements:		
6	**Cementing, Cements & cement slurry:** Objectives of cementing, oil well cements, Classification of cement, Slurry design, Slurry additives, Factors influencing cement slurry design, Cementing equipment.	5	The student will learn about different well cementing practices and their role in oil and gas well.
7	**Cementing Methods**: Primary cementing, Stage cementing, Liner cementing, Plugging, Squeeze Cementing techniques in practice. Deep well cementing, Characteristics of good quality cementation. HPHT and Deep water Cementing.	5	The detail mechanism of well cementing and design procedure will be explained to the students.
8	**Cementing Calculations**	5	The student will be able to calculate cement slurry, surface power and other requirements.
	Total contact hours:	**39**	

Text Books:

i. Petroleum Engineering: Drilling and Well Completion: Carl Gatlin
ii. Oil Well Drilling Technology : Mc. Gray& Cole
iii. Composition and Properties of Drilling and completion fluid: H. C. H. Darley and G. R. Gray, 5th Edition, Gulf professional Publishing.

Reference Books:

i. Applied Drilling Engineering: A. T. Bourgoyne Jr., K. K. Millheim, M. E. Chenvert and F. S. Yong Jr. Society of Petroleum Engineers.

Course Type	Course Code	Name of Course	L	T	P	Credit
ESO1	GLE 201	Geology for Engineering and Science	3	0	0	9

Course Objectives

The primary objective of the course is to introduce fundamental concepts, ideas and materials in geology to students of science and engineering.

Learning Outcomes:

Upon completion of the course, students will be able to:

i. Understand the basics of mineralogy and petrology and learn identification of some minerals and rocks.

ii. Learn about the fundamentals of palaeontology and stratigraphy.

iii. Understand physical and structural geology and solve some structural geological problems.

COURSE CONTENT:

Unit No.	Topic	Contact Hrs	Learning outcome
1	**Mineralogy:** General properties; Bowen's Reaction Series, Classification of minerals and properties of common rock-forming minerals; Megascopic identification of some rock-forming minerals	8	Concept about general properties of rock forming minerals and their identification
2	**Petrology***:* Rock cycle, Rock types, Classification and description of some common rocks; Megascopic identification of igneous, sedimentary and metamorphic rocks	8	Developing knowledge about classification of rock and its identification
3	**Stratigraphy and Palaeontology:** Principles of stratigraphy; Geologic Time Scale; Broad stratigraphic subdivisions and associated rock types of important coal belts and oil fields of India; Concepts of palaeontology; Fossils and their mode of preservation; Concept of index fossils	4	Understanding of rock deposition and stratification
4	**Mineral and Energy Resources:** Introduction and scope of economic geology (including coal and hydrocarbon resources); Ore and gangue minerals; Resource, reserve and grade; Distribution and mode of occurrence of some mineral deposits, coal and petroleum deposits; Megascopic identification of some ore-forming minerals	7	Knowing about mineral & energy resources and their evaluation
5	**Physical Geology:** Evolution of the earth; Exogenous and endogenous processes shaping the earth; Important geomorphological features	4	Understanding about earth's evolution over time
6	**Structural Geology:** Interpretation of topographic and geological maps; Attitude of planar and linear structures; Effects of topography on outcrops; Unconformities, folds, faults and joints – their nomenclature, classification and recognition; Some structural geological problems and their solutions	8	Knowledge about various geological structure and their recognition
	Total contact hours	**39**	

Text Books:

Hefferan, K. and O'Brien, J., 2010. Earth Materials, Wiley-Blackwell, Sussex; 670 p.

Reference Books:

Jain, S., 2014. Fundamentals of Physical Geology, Springer, New Delhi; 494 p.

Van der Pluijm, B.A., Marshak, S., 2004. Earth Structure – An Introduction to Structural Geology and Tectonics, W.W. Norton & Company, New York; 656 p.

Course Type	Course Code	Name of Course	L	T	P	Credit
E/SO3	**GPE 202**	**Geophysical Prospecting**	3	0	0	9

Course Objective
The primary objective of the course is to introduce fundamental aspects of Earth and Planetary system and its related changes with time. This course will emphasize the knowledge on the branches of geophysics, solar system, planets, climates, ocean, carbon cycle, and transitions of Earth's structure through different geological ages. The underlying physics of the various Earth and planets related changes and its creation are presented through theory classes.
Learning Outcomes
Knowledge on the history of Earth's development, the solar system; climate and its changes; Earth's interior; plate tectonics; the physical property of ocean water; changes of ocean climates; global carbon cycle; depositional events and environments with geological ages and glaciations are the goal of the.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	Introduction to Geophysics, different branches of Geophysics and relationship with other sciences	4	Presentation of geophysics and its branches
2.	Solar System formation, meteorites, planet formation, Asteroid belt, Nebula Hypothesis, Kepler's Law, Bode's law	4	Knowledge of the solar system
3.	Isotopes and Minerals	2	Fundamentals of minerals
4.	Geomorphology and Geophysical Signature observed by various missions	3	Study of comparative planetology
5.	Plate tectonics, physical geology systems explaining the interior of the Earth	6	Study on Earth's tectonic system
6.	Blackbody radiation, energy balance, greenhouse effect, climate forcings, climate sensitivity, the role of sun/volcanoes/greenhouse gasses/aerosols, climate feedbacks	4	Overview and fundamental concept on Earth's climates system
7.	Structure and circulation of the atmosphere, Coriolis effect, Geostrophic balance, Wind-driven circulation, Thermo-Haline circulation, Upwelling, El Nino-Southern Oscillation, Monsoons	5	Knowledge of ocean-atmospheric circulation
8.	Carbon reservoir and fluxes, long-term carbon cycle and plate tectonics, Volcanic outgassing and silicate weathering, glacial-interglacial CO_2 cycles, and role of the Ocean, the anthropogenic perturbation, Keeling curve, Carbon uptake by Ocean and the terrestrial biosphere	4	Fundamental study on the global carbon cycle
9.	Major climate events and trends during the Cenozoic last 65 Million	4	Knowledge of climate changes during Cenozoic
10.	Late Paleocene Thermal Maximum, Eocene climate optimum, Antarctic glaciation, Northern Hemisphere glaciation, Plio-Pleistocene Cooling	3	Glaciation and physical property changes of Earth during different geological age
	Total Class	**39**	

Text Book:

1. Fowler, C.M.R., Solid Earth: An Introduction to Global Geophysics

2. Howell, B.F., An Introduction to Geophysics, Mc-Graw Hill
3. Lowrie, W., Fundamentals of Geophysics, Cambridge University Press

Reference Book:

4. Jacobs, J.A., A Text Book of Geonomy, Adam-Hilger
5. Tucker, R.H., Cook, A.H., Iyer, H.M. and Stacey, F.D., Global Geophysics, English Univ. Press
6. Donald, L., Turcotte& Gerald Schubert : Geodynamics (Second Edition)

Course Type	Course Code	Name of Course	L	T	P	Credit
DP1	PEC 204	Reservoir Engineering Lab	0	0	2	2

Course Objectives:
On hand training to test the reservoir rock properties as per standard practices.
Learning Outcomes:
Ability to design and develop the compatible fluid equilibrium system compatible to the reservoir rock.
COURSE CONTENT:

Exp. No.	Name of the Experiment	Contact Hrs
1.	Determination of porosity by saturation Method.	2
2.	Formation Resistivity factor.	2
3.	Calibration of Dead Weight Tester.	2
4.	Resistivity Log Simulator.	2
5.	Ternary Phase Diagram.	2
6.	Determination of Metacentric Height.	2
7.	Determination of Permeability by Gas Permeameter.	2
8.	Determination of Liquid Permeability by Liquid Permeameter.	2
9.	BHP Chart Analysis.	2
10.	Determination of Permeability by Hesseler core Holder	2
11.	Determination of Permeability by Bench Top Liquid Permeameter	2

Course Type	Course Code	Name of Course	L	T	P	Credit
DP2	PEC 205	Drilling Fluid & Cements Lab	0	0	2	2

Course Objectives:
i. On hand training to handle the equipment related to testing the drilling fluid an cement slurry.

Learning Outcomes:
i. Ability to design and develop the compatible drilling fluid and cement slurry as per requirement.

COURSE CONTENT:

Exp. No.	Name of the Experiment	Contact Hrs
1.	Determination of apparent viscosity, Plastic viscosity, Yield Point, Initial Gel Strength by Fann V-G meter	2
2.	To Study the effect of time on gel strength by Fann V-G meter	2
3.	Determination of viscosity by Marsh Funnel viscometer	2
4.	Determination of Viscosity, Initial Gel strength and 10 minutes Gel Strength by Rotatory Viscometer	2

5.	Determination of shear strength by shearometer.	2
6.	Determination of sand content by Baroid Sand Content Set.	2
7.	Determination of Hydrostatic gradient, mud weight and specific gravity using Mud Balance	2
8.	Determination of API Filtration Loss using Standard Filter Press.	2
9.	To study for effect of CMC on filtration loss	2
10.	Determination of Chloride ion concentration& filtrate alkalinity (e.g. hydroxyl alkalinity, carbonate alkalinity and bicarbonate alkalinity)	2
11.	Determination of cation exchange capacity and bentonite content.	2
12.	To study the effect sodium chloride concentration on the resistivity by Fann-Resistivity meter.	2
13.	Determination of initial and final setting time by Vicat Needle Apparatus	2

FOURTH SEMESTER

B.TECH PE

(Implemented from session 2020-21)

Course Type	Subject ID	Subject Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit Hours	Contact Hours
DC4	PEC 206	Elements of Petroleum Production Engineering	3	0	0	9	3
DC5	PEC 207	Petroleum Formation Evaluation	3	0	0	9	3
DC6	PEC 208	Reservoir Fluid Thermodynamics	3	0	0	9	3
DC7	GLC 512	Petroleum Geology	3	0	0	9	3
ESO3		Open	3	0	0	9	3
DP3	PEC 209	Petroleum Product Testing Lab	0	0	2	2	2
DP4	PEC 210	Drilling Simulation Lab	0	0	2	2	2
		Total Credit	15	0	4	49	19

Course Type	Course Code	Name of Course	L	T	P	Credit
DC4	PEC 206	Elements of Petroleum Production Engineering	3	0	0	9

Course Objectives
The objective of this course is to give an Introduction to Petroleum Production Operations with an emphasis on the basic knowledge of petroleum production systems and operations.
Learning Outcomes
Exposure of the oil field equipment related to the surface production systems. Exposure to the well completion, activation and ability to handle the production problems.

COURSE CONTENT:

Unit No.	Topic	Contact Hrs	Learning Outcome
1.	**Introduction to Petroleum Production System**	**3**	To learn about the basics of Petroleum Production systems, Operations and related factors
2.	**Well Equipment:** Christmas tree, valves, hangers, flow control	**5**	To know about the equipment related to

	devices, packers, tubular and flow lines. Surface and subsurface chokes.		petroleum production systems. Learn about the role of different valves and control systems including flow lines for production of crude oil and gas
3.	**Well Completion:** Well completion Methods, Perforating Oil & Gas Wells - Conventional and Unconventional techniques viz. through tubing and tubing conveyed underbalanced perforating techniques, type size and orientation of perforation holes. Smart wells- intelligent completions.	**7**	Able to know the basics of well completion design and related influential parameters. Understand the modern well completions techniques for hassle free production operations.
4.	**Well Activation and Self flow potential:** Well activation methods, use of compressed air & liquid Nitrogen.	**3**	Able to know about the different techniques and their comparative effectiveness for activation of well before starting the production.
5.	**Production System Analysis:** PI & IPR of self-flowing wells. Single and Multiphase flow in tubing and flow-lines. Sizing, selection and performance of Tubing, chokes and surface flow lines. Production Optimization – Nodal System analysis.	**7**	Know about the influential parameters for production of oil & gas. Able to analyses optimum production rate, flow line size, choke size though nodal analysis
6.	**Gathering and collection of oil and gas:** GGS, CTF and GCS - layout, sequential treatment, and safety features.	**5**	Understand how crude oil and gas are to be collected, What are the different processing to be performed before sending crude to the refinery.
7.	**Storage of Petroleum and Petroleum Products:** Types of storage system, Storage tanks and their API & ASTM codes, Specification, maintenance and operation of tank batteries. Vapour recovery system.	**3**	Able to learn about how petroleum and petroleum products should be stored. Know to design storage tanks for Petroleum and its products
8.	Surface Facilities for Water handling and injection system, Gas compression and injection system.	**3**	Know how water/gas to be processed, stored and utilized for injection purpose.
9.	Metering and measurements of oil and gas.	**3**	Able to know the methods of measuring the quantity of oil and gas specially during storage and before dispatch.
	Total contact hours	**39**	

Text Books:

Production Engineering: Drilling and well completion : Carl Gatlin
Principle of Oil well Production : T. F. W. Nind
Production Operation Vol 1 and 2 : Allen Rebort

Reference Books:

Petroleum Production Handbook : Bardly
Petroleum Production Handbook, Vol 1 : T. C. Frick
Petroleum Production Engineering, A Computer Assisted Approach – Guo, Lyons & Ghalambor
Production Optimization using Nodal Analysis : H. Dale Beggs
Petroleum Production Systems : Economides et al.

Course Type	Course Code	Name of Course	L	T	P	Credit
DC5	PEC 207	**Petroleum Formation Evaluation**	3	0	0	9

Course Objective
The objective of the course is to provide the basic knowledge of well logging and its requirement.
Learning Outcomes
Proficiency in well logging tools and interpretation of well log data.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	**Formation Evaluation Overview:** Direct and Indirect Methods, classification and logging tools. Mud Logging and cutting analysis log, Coring and Core analysis log.	4	Student will be explained about different well logging method and role of mud logging in formation evaluation
2.	**Petrophysical Measurements**: Rock-Fluid interaction, Bore hole environment and basic concepts of well log analysis and application	2	The borehole environment and their effect on log measurement will be explained to student.
3.	**Openhole Well Logging**: Principle, Logging tools, application & Limitations Spontaneous Potential Log, Gamma Ray Log, Resistivity Measurement: Electrical, induction logging and micro-resistivity log Porosity Logs: Density & Litho-density log, neutron log, sonic (acoustic) log, Electromagnetic Propagation tools**.** Nuclear Magnetic Resonance log	10	The different openhole well log and their principle, and application in reservoir characterization will be explained to student.
4.	**Cased Hole Logging**: introduction, objectives and methods Well Integrity evaluation: CBL and VDL logs, Ultrasonic Imaging tools Casing inspection tools: Electromagnetic and acoustic CIT log Reservoir fluid Saturation Determination: tool principle and application	5	The different openhole well log and their principle, and application various capacity will be explained to student.
5.	**Production Logging**: Introduction, type of tools, principles, limitations and applications	6	Different production logging tool and their application will be explained to student.
6.	**Log Interpretation and Analysis Techniques:** Standard log interpretation methods. Quick-Look Interpretation: Crossplots, and Overlays Lithology/ Minerology Identification Porosity Determination Water saturation and Resistivity Determination Clean sand & Shaly sand interpretation	6	Student will learn how to interpretate openhole well log to get the desired information
7.	**Bore hole Imaging Devices:** Tool type and principle: Ultrasonic, Electrical & Optical scanning. Formation micro scanner (FMS)Dip hole Shear Sonic Imager(DSI)	4	Different imaging technique of well bore and their application will be explained to student
8.	Advancements in Formation Evaluation, new logging devices.	2	Advanced logging method will be explained to student.
	Total contact hours	**39**	

Text Books:

Formation Evaluation: Edward Lynch

Fundamental of Formation Evaluation: Donald P Helander

Reference Books:

Theory Measurement & Interpretation of Well Logs: ZakiBassiouni

Cased-Hole Log Analysis & Reservoir: Richard M Bateman

Course Type	Course Code	Name of Course	L	T	P	Credit
DC6	PEC 208	Reservoir Fluid Thermodynamics	3	0	0	9

Course Objectives
The objective of this course is to give fundamental concepts which will form the foundation on which art of Petroleum Engineering is based. Describe the basic concepts in so far as reservoir fluids are concerned.
Learning Outcomes
• Basic concepts of Petroleum Reservoir and its fluids and the treatment of more complex systems. • Exposure to the fundamentals of operations of different types of compressor used the field of Petroleum Engineering.

COURSE CONTENT:

Unit No.	Topic	Contact Hrs	Learning Outcome
1.	Introduction to Reservoir fluid thermodynamics and PVT behavior of oil and gas.	**4**	Basics of Reservoir Fluids and its related properties including PVT as wells as the concept of gas evolved from oil when pressure falls below bubble point
2.	**Work Calculations:** Types of compressors, selection, Thermodynamics of compressors, compressor calculation for compression/ expansion of ideal and non-ideal gases, compression cycles and horse power calculations - single, double and multistage with and without clearance.	**8**	Knowledge about the different types of compressors used in the petroleum Industry and to calculate the energy required to drive the compressor to transport and store Natural gas and other produced gas.
3.	**Thermodynamics of Gases and Liquid Hydrocarbons:** Free energy & work function, Mollier diagrams, perfect & imperfect gaseous mixtures, Equation of state, Law of corresponding states, Joule Thompson effect, Arrhineous equation and activation energy. Fugacity and fugacity coefficient of gases and gaseous mixtures, Lewis fugacity rules and Third law of thermodynamics.	**8**	Thermodynamic properties related to reservoir fluids and to calculate enthalpy change during production and transportation of reservoir fluid by using Mollier Diagram.
4.	**Solution Thermodynamics:** Vapour liquid equilibria, equilibrium constant, partial molar properties, chemical potential, Raoult's law and Henry's law, ideal and non ideal solutions, Activity and activity coefficients, Gibb's Duhem equation, Gibb's adsorption equation.	**9**	Knowledge of variation of reservoir fluid properties with respect to the variation of components.
5.	**Phase Rule:** Phase rule of single, two, three, multi component and multi phase systems, phase behaviour in different conditions, Thermodynamic aspects of phase equilibria. Calculation of phase equilibria. Ternary and pseudo ternary phase diagrams.	**5**	To know about the phase behaviour in different conditions during production of oil & gas. Able to calculate amount of Liquid and gas and its composition at separator condition
6.	**Fluid Flow Thermodynamics:** Single phase flow & multiphase flow through vertical, incline and horizontal conduits. Pressure traverse curves and their applications. Venturi flow, nozzle flow, pipe internal flow, annular flow and nozzle flow thermodynamics of multiphase & multicomponent system.	**5**	Able to calculate pressure drop and other related properties during flow of oil and Gas through different configured pipelines
	Total contact hours	**39**	

Text Books:

i. Thermodynamics of Hydrocarbon Reservoirs – Abbas Firoozabadi
ii. Properties of Petroleum Reservoir Fluids – Emil J. Burcik
iii. Applied Hydrocarbon Thermodynamics – Vol. 1 – Wayne C. Edmister, Byuang IK Lee

iv. Applied Hydrocarbon Thermodynamics – Vol. 2 – Wayne C. Edmister

Reference Books

i. Engineering Thermodynamics – P K Nag
ii. Introduction to Chemical Engineering Thermodynamics – Smith, Van Ness and Abbott
iii. Introduction to Chemical Engineering Thermodynamics – G. Halder
iv. Chemical Engineering Thermodynamics – Y V C Rao
v. Chemical and Engineering Thermodynamics – Stanley I. Sandler

Course Type	Course Code	Name of Course	L	T	P	Credit
DC7	GLC 512	Petroleum Geology	3	0	0	9

Course Objective

The primary objective of the course is to introduce the students with the geochemical, origin and accumulation aspects of hydrocarbons. Depositional environment of sediments, their stratigraphic positions, exploration using microfossils also included in this course for better understanding. Also student will gain knowledge about some hydrocarbon fields in India.

Learning Outcomes

Upon completion of the course, students will be able to:

- Brief idea about the hydrocarbon system.
- Chemical and physical properties of hydrocarbons
- Hydrocarbon basins in India
- Support of microfossils for hydrocarbon exploration.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Petroleum: its different states of natural occurrence. Basic concepts of organic geochemistry. Origin of petroleum, Geochemistry and maturation of kerogen; Biogenic and Thermal effect. Distribution of Petroleum in space and time.	7	Basic idea of origin of petroleum.
2	Introduction to migration of oil and gas: geologic framework of migration; short and long distance migration, primary and secondary migration; geologic factors controlling hydrocarbon migration; forces responsible for migration, migration routes and barriers. Oil field water- characters and classifications	9	Basic idea of migration of petroleum
3	Reservoir rocks: general attributes and petrophysical properties. Classification of reservoir rocks - Clastic and Carbonate reservoirs. A brief account on Reservoir Characterization. Blowout problem.	7	Exposure of petrophysical properties and different type of rocks
4	Hydrocarbon traps: definition; classification of hydrocarbon traps - structural, stratigraphic and combination; time of trap formation and time of hydrocarbon accumulation. Cap rocks - definition and general properties.	6	Knowledge of hydrocarbon traps and geological structures.
5	Petroleum Geology of important Indian basins (offshore and onshore).	7	Idea of Indian basins
6	Introduction to oil and gas exploration with reserve estimation.	3	Basics of oil and as exploration
	Total contact hours	39	

Recommended Books:

1. Tissot, B. P., and Welte, D. H., Petroleum Formation and Occurrence. Springer-Verlag, Germany.
2. North F. K., Petroleum Geology. Allen & Unwin Inc., London.

Other References:

1. Selley, R. C.,Elements of Petroleum Geology. Academic Press, USA.
2. Selly, R. C. and Sonnenberg, S. A., Elements of Petroleum Geology, Elsiver-Academic Press
3. Slatt, R. M., Stratigraphic Reservoir Characterization for Petroleum Geologists, Geophysicists, and Engineers. Elsevier, Hungary

Course Type	Course Code	Name of Course	L	T	P	Credit
DP3	PEC 209	Petroleum Product Testing Lab	0	0	2	2

Course Objectives:

On hand training of Testing of Petroleum Products and their applications in quality control

Learning Outcomes:

Proper utilization of Petroleum Products

COURSE CONTENT:

Exp. No.	Name of the Experiment	Contact Hrs
1.	Determine surface tension of the supplied oil sample.	2
2.	Determine smoke point, flash point and fire point of the supplied oil sample.	2
3.	Determine aniline point, diesel index and cetane number of the supplied oil sample.	2
4.	Determine cloud and pour point of the supplied oil sample.	2
5.	Determine viscosity index of the supplied oil sample by redwood viscometer.	2
6.	Determine kinematic viscosity of the supplied oil sample by Saybolt viscometer.	2
7.	Determine kinematic viscosity of the supplied oil sample by Cannon Fenske viscometer.	2
8.	Determine water content of the supplied oil sample.	2
9.	Determine initial and final boiling point, evaporation loss and condensate recovered of the supplied oil sample by ASTM distillation apparatus. Draw temperature versus cumulative condensate recovered curve.	2
10.	Determine Reid vapour pressure of the supplied oil sample.	2

Course Type	Course Code	Name of Course	L	T	P	Credit
DP4	PEC 210	Drilling Simulation Lab	0	0	2	2

Course Objectives:
Exposure of different aspects of Drilling system and their laboratory scale simulation.
Learning Outcomes:
Ability to handle critical situation of drilling problems in Oil and gas fields.

COURSE CONTENT:

Exp. No.	Name of the Experiment	Contact Hrs
1.	Drilling a vertical well up to a certain depth using the various drilling systems such as the hoisting system and the rotary system.	2
2.	Calculation and monitoring of all the drilling parameters such as the drilling rate (rate of penetration, ROP), rotary speed, drill pipe pressure, casing pressure, mud weight etc.	2
3.	Setting up of a situation where a kick is induced into a well and fixing it using the driller's method (two circulation method). Preparation of a kill sheet.	2
4.	Resolving a kick using the wait of weight method (Engineer's method, one circulation method). Preparation of a kill sheet.	2
5.	Resolving a kick using the volumetric method. Preparation of a kill sheet.	2
6.	Resolving a kick using the concurrent method. Preparation of a kill sheet.	2
7.	Resolving the drilling problem when a choke is plugged.	2
8.	Resolving a drilling problem when a choke is washout out.	2
9.	Resolving a drilling problem when a bit nozzle is plugged.	2
10.	Resolving a drilling problem when the well is packed-off.	2
11.	Evaluate the effect of surge and swabbing on drilling.	2
12.	Evaluate the effect of differential sticking on drilling.	2
13.	Resolve all the remaining IADC (International Association of Drilling Contractors) and IWCF (International Well Control Forum) malfunctions.	2

FIFTH SEMESTER

B.TECH PE

(Implemented from session 2021-22)

Course type	Subject ID	Subject Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit Hours	Contact Hours
DC8	PEC 301	Applied Petroleum Reservoir Engineering and Management	3	0	0	9	3
DC9	PEC 302	Petroleum Production Operations	3	0	0	9	3
DC10	PEC 303	Natural Gas Engineering	3	0	0	9	3
HSS	HSS01/MS	HSS/ MS	3	0	0	9	3
ESO4		Open	3	0	0	9	3
DP5	PEC 304	Petroleum Production Engineering Lab	0	0	2	2	2
DP6	PEC 305	Process Engineering Lab	0	0	2	2	2
		Total Credit	15	0	4	49	19

Course Type	Course Code	Name of Course	L	T	P	Credit
DC8	PEC301	Applied Reservoir Engineering and Management	3	0	0	9

Course Objective

The objective of the course is to present the advanced knowledge of Petroleum Reservoir Engineering, with an emphasis on how to apply the acquired knowledge in the oilfield

Learning Outcomes

Upon successful completion of this course, students will:

have an overview and scope of the subject, the application of forms of MBE, the drive mechanisms and related production behaviour of the reservoir, various techniques of performance prediction.

to be able to learn the principle of pressure maintenance, theory of immiscible displacement and application to water flooding operations, learn to calculate water flooding performance, principle and applications of integrated reservoir management.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	**Overview:** Scope of applied reservoir engineering and reservoir management	1	To understand the overview and scope of the subject
2.	**Generalized Oil & Gas MBE:** Derivation, its Havlena and Odeh modification and application	4	To learn the use of MBE to understand reservoir behaviour
3.	**Drive Mechanism and recovery factors:** production behaviour of oil and gas reservoirs, gas reservoir MBE – p/z analysis	4	To understand the drive mechanisms and production behaviour of oil and gas reservoirs
4.	**Performance prediction of oil reservoirs:** Depletion drive, Gas cap drive, Water drive and Combination drive	4	To learn various techniques of performance prediction for various types of reservoirs
5.	**Water influx:** steady and unsteady state models – estimation of water influx	4	To learn to evaluate the water influx into the reservoir
6.	**Reservoir pressure maintenance techniques:** advantages and limitations	4	To learn application of pressure maintenance in the reservoir
7.	**Flow of immiscible fluids through porous media:** Continuity equation, equation of motion, solution methods. Displacement processes.	4	To understand the theory of immiscible displacement in the reservoir
8.	**Water flooding Theory & practices:** Buckley Leverette treatment of fractional flow and frontal advance equations - Recovery efficiency, permeability heterogeneity, Water for water flooding	5	To learn about immiscible fluid flow, various principles and equations applicable to water flooding operations
9.	**Water flooding performance calculations:** Frontal advance method, viscous fingering method, Stiles method, Dykstra-Parsons Method	5	To learn about calculations on water flooding performance by different methods
10.	**Integrated Reservoir Management:** applications and case studies	4	To learn principles of integrated reservoir management
	Total contact hours:	**39**	

Text Books:

1. Reservoir Engineering Manual — F. W. Cole
2. Reservoir Engineering Handbook — Tarek Ahmed

Reference Books:

1. Fundamentals of Reservoir Engineering — L. P. Dake
2. Applied Petroleum Reservoir Engineering: — Crafts and Howkins
3. Integrated Reservoir Management — A. Satter and G. C. Thakur

Course Type	Course Code	Name of Course	L	T	P	Credit
DC9	PEC 302	Petroleum Production Operations	3	1	0	11

Course Objective
The objective of the course is to familiarize the students with field processing of crude oil and gas, develop PI and IPR of wells, diagnose & solve well problems, design sand control, learn well servicing and stimulation techniques and finally learn about the digital oil fields.
Learning Outcomes
Upon successful completion of this course, students will have the ability to : -design basic field processing systems of crude oil and natural gas. -design tests for calculating PI and IPR of wells -diagnose and solve production problems and to design simple gravel pack operations -have the basic knowledge of well servicing, well stimulation, digital oil fields and SCADA

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Introduction to Field Processing of Oil & Gas**: Flash and stage separation of oil & gas, oil & gas, Demulsification, dehydration, stabilization and desalting of crude oil. Dehydration and desalting of gas. Special problems in oil and gas separation. Removal of suspended solid & water from oil & gas. Scrubbers and wash tank. Safety features in oil and gas separation system.	6	Knowledge of field processing of crude oil and natural gas and the ability to design basic equipments such as separators, dehydration units, heater treaters, desalters etc.
2	**Production Testing**: PI & IPR of artificial lift wells, production testing - back pressure test, flow after flow test & isochronal test, surface layout, test design & analysis of test data. Production characteristics of Horizontal and multilateral wells.	6	Ability to do production testing of oil and gas wells for constructing IPR for both horizontal wells and vertical wells with or without lift assistance.
3	**Well Production Problems, Diagnosis and mitigation**: Scale formation, paraffin deposition, formation damage, water production, gas production, sand deposition, corrosion problem etc.	6	Ability to understand, diagnose and fix various production problems.
4	**Sand Control**: Sand control techniques, Formation Sand Size analysis, optimum gravel - sand ratio, gravel pack thickness, gravel selection, gravel packing fluid & gravel pack techniques.	6	Ability to design basic gravel packing parameters and get familiar with the operations.
5	**Well Servicing & Workover**: Workover system, workover rigs and selection, rig less workover including Endless/ Coiled tubing unit, minor & major workover jobs-diagnosis & remedial measures water shut off and gas shut off- Chemical treatment and conformance control. Wire-line operations, Workover & completion fluids - types & selection, Formation damage, Workover planning & economics.	6	Learn various workover rigs, and methods for various solving various production issues.
6	**Well Stimulation Techniques**: Type & description of stimulation techniques, Matrix acidizing, Acid fracturing. Hydraulic fracturing, Multistage Fracturing. Wave technology & microbial stimulation.	6	Understand and design basic stimulation techniques such as acidizing, and fracking.
7	Introduction to Digital oil field, Satellite oil fields and SCADA.	3	Understand digital oil fields and SCADA systems.
	Total contact hours:	**39**	

Text Books:

1. Petroleum Production Handbook : Bardly
2. Petroleum Production Handbook, Vol. 1 : T. C. Frick
3. Production Operations Vol. 1 and 2 : Allen Roberts
4. Principle of Oil well Production : T. F. W. Nind

Reference Books:

1. Production Optimization using Nodal Analysis : H. Dale Beggs
2. Petroleum Production Systems : Economides et al.
3. Production and Transport of Oil & Gas : Szilas

Course Type	Course Code	Name of Course	L	T	P	Credit
DC10	PEC 303	Natural Gas Engineering	3	0	0	9

Course Objective
The objective of the course is to provide the basic knowledge of natural gas and its utilization
Learning Outcomes
Upon successful completion of this course, students will have the exposure of the natural gas processing, handling and utilization.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Introduction:** Composition of Natural Gas, Utilization of Natural Gas, Natural Gas Industry, Natural Gas Reserves, Types of Natural Gas Resources, Future of the Natural Gas Industry.	5	This will help students to learn about formation, composition and utilization of natural gas.
2	**Properties of Natural Gas:** Physical properties of natural gas and hydrocarbon liquids associated with natural gas. Reservoir aspects of natural gas. Calorific value of gas and measurement.	5	This unit will help students to learn the different properties of natural gas.
3	**Gas Compression:** Heat and Mass Transfer Principles and Applications in Natural Gas Engineering, Use of Mollier Diagrams.	5	This unit will help student to learn the importance of compression in gas industry. This unit give detailed idea of reciprocating and centrifugal compression processes.
4	**Gas Flow Measurement:** Process control and instrumentation in natural gas processing plants.	5	This unit will help students to get the exposure of different flow measurement devices. And also its utilization in gas industry.
5	**Natural Gas Processing:** Field separation and oil absorption process, Refrigeration and low temperature processing, Liquefaction Process, Dehydration of Natural Gas, Sweetening of Natural gas and sulphur recovery. Processing for LPG, CNG, system, Conversion of gas to liquid. Custody transfer- principles and measurements.	5	This unit will help students to understand different natural gas processing processes.
6	**Gas Gathering, Transport and Storage:** Gas Gathering System. Steady Flow in Simple Pipeline System, Steady State and non Steady State Flow in Pipelines, Solution for Transient Flow. Transmission of Natural Gas, Specifications. Underground Storage and Conservation of Natural Gas. LPG, NGL & LNG storage.	5	This unit will help students to get the natural gas flow concept in pipeline. Also this unit deals with understanding the natural gas underground storage and converting the natural gas in different valuable products.
7	LNG: Production and Utilization.	5	This unit will help students to learn the production of LNG using different processes.
8	Issue and Challenges to Enhance Supply of Natural Gas	4	This unit will help student to learn the issues and challenges faced by industry while enhancing the supply of natural gas.
	Total contact hours	**39**	

Text Books:

- Gas Production Engineering : Sanjay Kumar
- Natural Gas Production Engineering : Mohan Kelkar
- Handbook of Natural Gas Engineering : Doland L. Katz

Reference Books:

- Practical Natural Gas Engineering : R. V. Smith
- Natural Gas : E. N. Tiratsoo
- Fundamentals of Gas Reservoir Engineering : Jacques Hogoort

Course Type	Course Code	Name of Course	L	T	P	Credit
DP5	PEC 304	Petroleum Production Engineering Lab	0	0	2	2

Course Objectives:

On hand training to test the properties of petroleum and petroleum products as per standard practices.

Learning Outcomes:

Ability to design and develop the compatible additives to the produced oil.

COURSE CONTENT:

Exp. No.	Name of the Experiment	Contact Hrs
1.	Demulsification for separation of oil-water emulsion	2
2.	Operation of continuous distillation column	2
3.	Calibration of pressure gauge by dead-weight tester	2
4.	Stability analysis of offshore platform using metacentric height apparatus	2
5.	Process control for unit operations	2
6.	Screening analysis for gravel packing using sieve analyzer	2
7.	Study of Centrifugal pump Characteristics and to determine; Power Input, Shaft Output, Discharge, Total Head, Pump Output, Overall Efficiency and Pump Efficiency	2
8.	Studies of pour point depression by pour point depressant	2
9.	Determination of terminal velocity at different proppant loading	2
10.	Cleaning characteristics of different fracturing fluids	

Course Type	Course Code	Name of Course	L	T	P	Credit
DP6	PEC 304	Process Engineering Lab	0	0	2	2

Course Objectives:
To provide on-hand training of different control process required in oil and gas filed operations.

Learning Outcomes:
Exposure of different equipment.

COURSE CONTENT:

Exp. No.	Name of the Experiment	Contact Hrs
1.	Determination of Power Input, Heat Output and Coefficient of Performance of Mechanical Heat Pump.	2
2.	To investigate and measure the Heat Flux and Surface Heat Transfer coefficient during Film wise and Drop wise Condensation at atmospheric pressure.	2
3.	To investigate the stability limit of gaseous fuel and compare the limits of stable operation of various burners operating on gaseous fuel by plotting test results on a 'Fuidge' diagram. Measure the Flame speed of air/gas mixture	2
4.	To show that ON/OFF control produces oscillations of the controlled variable at the set point, and the magnitude and period of such oscillations are related to the process delay time.	2
5.	Determine the Surface Heat Transfer Coefficient inside & outside the tube, overall heat transfer coefficient and the effect of fluid velocity on these and show it graphically.	2
6.	Study of Centrifugal pump Characteristics and to determine; Power Input, Shaft Output, Discharge, Total Head, Pump Output, Overall Efficiency and Pump Efficiency	2
7.	Study of heat transfer in natural convection process, and determination of the Heat transfer coefficient of heated vertical cylinder, which is exposed to atmosphere.	2
8.	To investigate the flow round a 90^{o} bend in a duct of rectangular section using pressure tapings along the walls to establish pressure Co-efficient.	2
9.	To investigate- Fourier's law for linear conduction of heat along a simple bar. Effect of Surface contact on thermal conduction. The rate of heat transfer from radial steady conduction through a wall of cylinder.	2
10.	Inverse Square Law: To Show that the luminance of a surface is inversely proportional to the square of the distance of the surface from the light source.	2
11.	Lambert's Cosine Law: To show that the energy radiated in any direction at an angle with a surface is equal to the normal radiation multiplied by the cosine of the angle between the direction of the radiation and the normal to the surface.	2

SIXTH SEMESTER

B.TECH PE

(Implemented from session 2021-22)

Course type	Subject ID	Subject Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit Hours	Contact Hours
DC11	PEC 306	Directional Drilling	3	0	0	9	3
DC12	PEC 307	Oil and Gas Well Testing	3	0	0	9	3
OE1			3	0	0	9	3
OE2			3	0	0	9	3
HSS/ MS	MS01/ MS	MS/ HSS	3	0	0	9	3
DP7	PEC 308	Enhanced Oil Recovery Lab	0	0	2	2	2
DP8	PEC 309	Reservoir Characterization Lab	0	0	2	2	2
		Total Credit	15	0	4	49	19

Course Type	Course Code	Name of Course	L	T	P	Credit
DC11	PEC 306	Directional Drilling	3	0	0	9

Course Objective

The objective of the course is to provide detailed knowledge of directional drilling, directional well profile, monitoring of the progressing well path and corrective measures for deflected well trajectory.

Learning Outcomes

Upon successful completion of this course, students will:

- have a broad understanding of different type of well profiles.
- Ability to monitor the progressing well path.
- Expertise to correct the deflected well path.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Introduction to Directional drilling, its objectives, deflection tools and tool orientation	4	Understanding of directional coordinates and techniques
2	**Directional Drilling:** Directional well profiles. **Slant Hole Drilling**: Objectives and selections, Well profiles and applications.	5	Understanding of Three dimensional geometry of directional well profiles
3	**Well Monitoring:** Well path deflection & correction. Down the hole surveying methods, Surveying Analysis Methods and Calculations of Three-Dimensional well coordinates.	5	Ability to check the profile of the progressive well and to correct the deflected well path
4	**Measurements and Logging While Drilling**: Objectives of MWD/ LWD, SWD, MWD tools, Telemetry system.	5	knowledge of well monitoring without interrupting the drilling progress
5	**Down Hole Motors:** Positive displacement motors and Turbo-drills - motor description, Power calculation and applications. Auto-track and verti-track system. Rotary Steerable system, Geo-steering tools.	5	Awareness of different bottom drive drilling systems and their applications
6	**Horizontal Well Drilling:** Horizontal well objectives and selection, Different profiles, Drilling techniques, Mud requirements & characteristics, casing and drill string requirements and completion programs. Hole cleaning in high angled wells.	5	Exposure of Horizontal well drilling technology and its applications
7	**Special Methods of Directional Drilling:** Extended reach drilling, Multilateral drilling, coil tubing drilling and Geo-steering.	5	Exposure of technology for exploration of multi seam and multi layered formation profiles
8	Directional drilling problems and their remedies, torque and drag, stress-strain analysis.	5	Ability to handle the directional well problems properly
	Total contact hours:	**39**	

Text Books:

i. Oil Well Drilling : H Rabia
ii. Applied Drilling Engineering : Adam T.Bourgoyne Jr. et. al

References:

i. Advanced Drilling Techniques : William C. Maurer
ii. Horizontal Well Technology : SD Joshi
iii. Horizontal Wells : R. Aguilera et. Al

Course Type	Course Code	Name of Course	L	T	P	Credit
DC12	PEC 307	Oil & Gas Well Testing	3	0	0	9

Course Objective
Basic well testing techniques for reservoir characterization Diagnosis of productivity problems and evaluation of stimulation treatment effectiveness
Learning Outcomes
Understanding different interpretation methodology of various types of well testing Skills for performing diagnostic analysis, history matching, and characterization.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Introduction to well testing:** Objectives and requirements. Diffusivity Equation Derivation & Solutions, Radius of investigation, principle of superposition. DST chart observation and preliminary interpretation, RFT, MDT	**3**	Objectives of oil and gas Well Testing
2	**Pressure Transient Tests:** Drawdown and build-up-test analysis, Reservoir limit test, Horner's approximation, determination of permeability and skin factor, Analysis of pressure build-up tests distorted by phase redistribution,	**5**	Measurement of Reservoir Properties by Pressure Transient Tests
3	**Well Test Interpretation:** Well-test interpretation in hydraulically fractured wells, Interpretation of well-test data in naturally fractured reservoirs, Wellbore storage effects, Multilayer reservoirs, Injection well testing, Multiple well testing, Wireline formation testing. Interference testing, Pulse testing.	**5**	Interpretation of well test data for complicated
4	**Type curves:** Fundamentals of type curves, Ramey's type curve, McKinley's and Gringarten, Bourdet type curves.	**3**	Important of Type Curves in interpretation of Well test data
5	**Gas well testing:** Basic theory of gas flow in reservoir, Flow-after-flow test, Isochronal test, etc.	**4**	Special consideration of well test analysis for gas reservoirs
6	**Well Test Analysis Part A:** Well testing tools and techniques, Variable-rate convolution: Single-rate pressure build-up case, Conventional analysis of pressure drawdown/build-up test data.	**5**	Details of well testing tools
7	**Well Test Analysis Part B:** Analysis of gas well tests, Un-fractured and fractured wells, and dual porosity reservoirs, Design of well tests, Software for the analysis of well test data.	**5**	Well test for fractured wells and analysis of test data using software
8	**Applications of well testing:** Well testing in horizontal wells, Extended Reach wells & multi-laterals wells, tests with and without flow measurement.	**5**	Special consideration of well test analysis for horizontal and multilateral wells
9	**Computer–aided well test analysis:** Derivative plot, diagnostic plot evaluation, data preparation, nonlinear regression, Introduction to well testing software.	**4**	Analysis of well test data by software with real time data
	Total contact hours:	**39**	

Text Book:

i. Pressure Transient Testing, SPE Textbook Series Vol. 9, (2003): John Lee, John Rollins, and John Spivey,

Reference Books:

i. Gas Well Testing Handbook, Elsevier Science, ISBN 0-7506-7705-8 (2003): Amanat U. Chaudhry
Oil Well Testing Handbook, Elsevier Science & Technology, ISBN 978-0-75067706-6 & electronic ISBN 978-0-0805- 7979-8 (2004): Amanat U. Chaudhry

Course Type	Course Code	Name of Course	L	T	P	Credit
OE1	PEO502	Flow Assurance	3	0	0	9

Course Objective
• Understanding flow assurance challenges in hydrocarbon production • Diagnosis of flow assurance problems and possible solutions
Learning Outcomes
• Apply fluid hydraulics and fluid characterization for addressing flow assurance challenges. • Understand and apply advanced techniques for smooth flow operations

Unit No.	Topic	Contact Hours	**Learning Outcome**
1	Flow assurance: definition, flow assurance in project life cycle, flow assurance in offshore developments, role of flow assurance, fluid related issues, and pipeline/flowline/tubing design related issues.	4	Idea of basic concept of Flow assurance
2	Application of fluid hydraulics and fluid characterization for addressing flow assurance problems, phase behavior, and operating regions for smooth operations (wax deposition, hydrate formation, and scaling).	5	Knowledge of fluid hydraulic behavior during different regime of fluid flow
3	Flow assurance challenges for gas hydrates, thermodynamics and kinetics of gas hydrates formation and dissociation, prevention and remedies for hydrate formation and agglomeration.	5	Specific behavior of fluid flow during hydrate formation.
4	Modelling of hydrate formation/inhibition, industry practice: rules of thumb – for hydrate management.	5	Knowledge of hydrate formation modeling
5	Wax and asphaltene as flow assurance problems, determination of wax appearance temperature, impact on production, wax and asphaltenes management, downhole deposition of wax and asphaltenes and their assessment, inhibition and remediation.	5	Ability to know different type of flow interfering product and their treatment
6	Modelling and optimization of flow in onshore and offshore pipelines.	5	Ability to understand the pipe line specific modeling
7	Scale: mechanism of scale formation, common scaling minerals, scale mitigation and remediation, and scale management.	5	Knowledge of scale formation the its impact on fluid flow
8	Corrosion : pipeline corrosion examples, corrosion predictions, reducing corrosion, and corrosion monitoring.	5	Understanding of corrosion and its treatment in oil and gas field
	Total	**39**	

Text Books:

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.

Reference:

1. Natural Gas Hydrates, John Carroll, Elsevier, 2014

	Course Code	Name of Course	L	T	P	Credit
OE1	PEO 301	Heat and Mass Transfer in Petroleum Operations	3	0	0	9

Course Objective
To provide the basic knowledge of heat transfer phenomena relevant to petroleum operations.
Learning Outcomes
• Understanding different interpretation methodology of various types of well testing • Skills for performing diagnostic analysis, history matching, and characterization.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Introduction to heat transfer: Typical heat transfer situations, Modes of heat transfer, Introduction to laws, some heat transfer parameters	4	To understand the concept of heat transfer mechanisms
2	Conduction – Fourier's law and thermal conductivity, Differential equation of heat conduction, boundary conditions and initial conditions, concept of thermal resistance, critical radius. variable thermal conductivity	5	An insight heat transfer by conduction
3	NATURAL CONVECTION Introduction, governing equations, Vertical plate – Pohlhausen solution, horizontal cylinder, horizontal plate, enclosed spaces FORCED CONVECTION Concepts of fluid mechanics, Differential equation of heat convection, Laminar flow heat transfer in circular pipe – constant heat flux and constant wall temperature, thermal entrance region, Turbulent flow heat transfer in circular pipe, pipes of other cross sections, Reynolds analogy	5	To understand the concept of heat transfer by convection
4	HEAT EXCHANGERS Types of heat exchangers, LMTD approach – parallel, counter-flow, multi-pass and cross flow heat exchanger, NTU approach – parallel, counterflow, shell and tube, cross flow heat exchanger	5	To learn the principle and design of different types of heat exchangers
5	Mass Transfer: Introduction; Diffusion mass transfer, Fick's Law of diffusion; steady state molecular diffusion, Convective mass transfer	5	To understand the concept of mass transfer mechanisms
6	Characterization of separation processes: Equilibrium and rate governed process; Cascading and interstage flow; Vapour-liquid equilibrium and enthalpy concentration diagrams.	5	An insight to mass transfer phenomena during separation processes
7	Principles of distillation; Batch distillation with and without reflux; Steam distillation; Fractionating columns; Calculation of number of plates by McCabe-Thiele and Ponchon-Savarit methods.	5	Principle and design of distillation column
8	Adsorption: Adsorption equilibria; Batch, stagewise and continuous adsorption; Industrial adsorbers; Elution; Ion-exchange. Momentum, heat and Mass Transfer Analogy.	5	The concept of adsorption phenomena and Momentum, heat and Mass Transfer Analogy.
	Total contact hours:	**39**	

Text Books:

- Fundamentals of Heat and Mass Transfer- Frank P. Incropera
- Heat and Mass Transfer- Rudramoorthy and Mayilsami
- Process Heat Transfer D. Q. Kern

Course Type	Course Code	Name of Course	L	T	P	Credit
OE2	PEO505	Oil and Gas Processing Plant Design	3	0	0	9

Course Objective
The objective of the course is to provide the basic knowledge of oil and gas processing system involving process flow diagram and process instrumentation diagram including the process design of key equipment involved
Learning Outcomes
Upon successful completion of this course, students will: have a detailed understanding of the purification/treatment techniques of contaminated oil and gas before marketing. be able to develop the skill to design major oil and gas processing units.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	**Overview of field processing of oil and gas**	3	To learn about the scope of oil & gas processing at the surface
2.	**Petroleum Processing and Treatment:** Theory and practice, Emulsifiers & Demulsifiers, Gravity Separation, coalescence, coalescing media, electrostatic coalescers.	3	To know about the treatment process specifically using crude oil involving water.
3.	**Petroleum Processing Equipment:** Vertical, horizontal & Electrostatic Vessels, Process heat duty, Sensible heat of natural gas, Water, Heat transfer from fire-tube. Heat exchangers- types, fluid placement, sizing, number of tubes. Oil desalter, emulsion treatment, Heater treater, Chemical Treater	8	To know about the process equipment design procedure of different vessels, heat exchangers and heater treater.
4.	**Effluent Treatment Plant and Design**	3	To know about the different oil & gas process plant effluents, their treatment and designing of key equipment associated with it.
5.	**Crude Oil & Condensate Stabilization:** Multistage Separation, Hengsteback's Flash calculation, stabilizer design.	4	To understand the principle of crude oil & condensate stabilization and flash vaporization and the process & equipment design of stabilizers
6.	**Natural Gas Dehydration:** (a) Glycol Process: operation, effect of variables, dew point depression, stage calculation. NTU - graphical and analytical methods, Absorber sizing. Lean oil absorption. (b) Solid-bed process: design & operation, effect of process variables, Regeneration and cooling calculations. Hydrocarbon recovery.	8	To understand the principle and process conditions of natural gas purification by dehydration using absorption and adsorption technique and process design
7.	**Natural Gas Sweetening:** Acid gases, Toxicity, Pipeline specification. Solid-bed Process: Design, operation & effect of variables. Adsorbent selection. Amine and other absorptive process details.	8	To know the principle, process conditions of gas sweetening by absorption and adsorption technique and process design
8	**Gas hydrate formation & inhibition**	3	To understand the principle of gas hydrate formation and its inhibition
	Total contact hours:	**39**	

Text Books:

1. Surface Productions Operations Volume 1 & 2 Ken Arnold and Maurice Stewart

Reference Books:

1. Surface Production Operations, Volumes 1&2, Maurice Stewart and Ken Arnold, Elsevier,2007
2. Technology of Artificial Lift Methods, Kermit E. Brown, PennWell Books,1980

Course Type	Course Code	Name of Course	L	T	P	Credit
OE2	PEO 302	Oil & Gas Field Development and Planning	3	0	0	9

Course Objective
To provide basic knowledge of Reservoir Engineering.
Learning Outcomes
Exposure of reservoir rock properties, reservoir fluids and behavior of oil and gas in reservoir. Proficiency in reserve estimation and prediction of reservoir fluid flow characteristics.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Brief overview on field development, Difference between oil and gas field development,	**4**	• Recognition of the process to start field development and briefly about the variants on which field development depends
2	The Field Life Cycle: Gaining Access, Exploration Phase, Appraisal Phase, Development Phase, Production Phase, Decommissioning.	**4**	• To recognize the different stages of a petroleum field and the activities carried out during the life of a field.
3	Petroleum Agreements & Bidding: Invitations to bid, Motivations and form of bid, Block Award, Fiscal System, Farm-in & Farm-out, Unitisation and Equity determination. NELP & OALP, PSC.	**5**	• Development of the knowledge of various petroleum exploration and production licensing policies practiced throughout the globe, with their merits and demerits, with emphasis on Indian policy
4	Field Appraisal: Importance of Appraisal, Identifying and quantifying sources of Uncertainty, Cost benefit calculations for Appraisal.	**4**	• The activities carried out during the appraisal stage to be elaborated with classification of resource and reserve
5	Reservoir Dynamic Behaviour: Fluid Flow studies, PVT data, Drive Mechanisms. Gas Reservoirs: Gas sales profiles; Influence of Contracts; movement of GWC during production, Pressure response, Fluid displacement in the Reservoir, Estimation of Reserves, Reservoir Simulation, Estimating the Recovery Factor, Estimating the Production Profile.	**5**	• Basic understanding of drive mechanism and its effect on the field development decisions in well planning, completion strategy and recovery techniques
6	Well Dynamic behavior in Vertical and Horizontal Wells: Estimating the number of Development Wells, Fluid flow near the wellbore.	**4**	• Understanding of fluid flow behaviour through the well depending on the type of well i.e. horizontal and vertical, and determination of numbers of wells to be drilled based on the criteria .
7	Petroleum Economics: Basic principles of Development Economics, Project Cash flow, Revenue & expenditure items, CAPEX-OPEX, Sensitivity Analysis,	**4**	• Understanding the economic parameters in field development decisions • Constructing cash flow for a project
8	Project & Contract Management: Phasing & Organization, Planning & Control, Cost Estimation & Budgets, Types of Contracts.	**4**	• Basic knowledge how to phase out a project, and its control.
9	Managing the Producing Field: Subsurface, surface facilities, Internal & External factors	**5**	• Development of idea about the various facilities required at subsurface and surface to produce and treat petroleum for maximizing the recovery
	Total contact hours:	**39**	

Text Books:

1. Hydrocarbon Exploration and Production by Frank John, Mark Cook and Mark Graham (Elsevier Publications)
2. Integrated Petroleum Reservoir Management A Satter and G C Thakur
3. Fundamentals of Reservoir Engineering L P Dake
4. Petroleum Production System : M. J. Economides, A. D. Hill and C. E. Economides

Course Type	Course Code	Name of Course	L	T	P	Credit
OE2	PEO 303	Coal bed Methane, Gas Hydrates & Shale Gas / Oil	3	0	0	9

Course Objective
Introducing students to newer hydrocarbon resources including coalbed methane, methane hydrates, and shale oil/gas Teaching exploitation strategies for these emerging energy resources
Learning Outcomes
Familiar with newer resources for fossil fuel Exposure to contemporary energy recovery processes.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
	Coal Bed Methane		
1	Present status of coalbed methane- Global and Indian Scenario, Difference from conventional gas reservoirs in terms of gas storage, drilling & production	**2**	Knowledge of CBM and its current status at the world and Indian level
2	Coal formation and deposition, Coal properties, Generation of coalbed methane gas & its properties, properties of coal as reservoir rock	**3**	Knowledge on CBM source, i.e. coal and its properties
3	Gas content, adsorption isotherm, reserve estimation	**3**	Knowledge of estimating CBM content in coal and estimating total CBM reserves
4	CBM drilling, dewatering, gas rate, variation in coal porosity & permeability, coal shrinkage, water treatment and disposal	**4**	Knowledge on drilling, reservoir and production performance of CBM reservoirs
5	CO2 sequestration for enhanced CBM recovery	**1**	EOR in CBM reservoirs
	Gas Hydrates		
6	Present status of gas hydrates, formation, accumulation and properties of gas hydrates.	**4**	Knowledge of gas hydrates and its current status at the world and Indian level
7	Thermodynamics, kinetics and phase behavior of gas hydrates	**4**	Knowledge on gas hydrates thermodynamics
8	Prevention & control of gas hydrates during drilling and production	**3**	Knowledge on gas hydrates problems in drilling and production
9	Uses of gas hydrates	**2**	Other uses of gas hydrates
	Shale Gas/Oil		
10	Global Scenario of shale gas/oil production.	**2**	Knowledge of shale gas/oil and its current status at the world and Indian level
11	Nature, origin and maturation, reserve estimation	**3**	Characterization of shale and shale gas, reserve estimation
12	Development of current practices, hydraulic fracturing, Environmental issues in shale gas exploration.	**4**	Knowledge on production practices in shale gas reservoirs
13	Markets and Globus impact on energy scenario.	**2**	Knowledge on shale gas market
14	Introduction to oil shale and oil sand	**2**	Knowledge on oil shale and sand
	Total contact hours:	**39**	

Text Books:

i. Coalbed methane principles & practices — Rogers
ii. Natural Gas Hydrates A guide for Engineers — John J. Carrol
iii. Shale Oil Production Processes — James G. Speight

Reference Books:

i. Fundamentals of Coalbed Methane Reservoir Engineering: — John Seidle
ii. Coal & Coalbed Gas by Romeo: — M. Flores
iii. Clathrate Hydrates of Natural Gases: — Sloan
iv. Shale Gas Production Processes: — James G. Speight

Course Type	Course Code	Name of Course	L	T	P	Credit
DP7	PEC 308	Enhanced Oil Recovery Lab	0	0	2	2

Course Objective
Exposure of Effect of different treatments in the oil fields to enhance the oil production.
Learning Outcomes
Understanding different experimentation and their suitability to increase the mobility of the oil in the reservoir.

COURSE CONTENT:

Exp. No.	Name of the Experiment	Contact Hrs
1.	Experimental study on Ternary phase diagram	2
2.	Measurement of oil recovery by water flooding	2
3.	Measurement of interfacial tension between oil and water by pendant drop method	2
4.	Measurement of dynamic surface tension: Effect of temperature and salinity	2
5.	Wettability alteration study of oil saturated rock in presence of surfactant	2
6.	Unsteady/Steady state porosity and permeability measurement	2
7.	Salinity scan studies on relative phase volumes of oil/brine/surfactant system	2
8.	Rheology study of polymer using brookfield viscometer	2
9.	Foam stability analysis by Bartsch (Shaking) method	2
10.	Determination of thermodynamic parameters by conductometric analysis of aqueous surfactant solutions	2

Course Type	Course Code	Name of Course	L	T	P	Credit
DP8	PEC 309	Reservoir Characterization Lab	0	0	2	2

Course Objectives:

i. To provide on-hand training of different oil and gas filed operations.

ii. To provide the basic knowledge of different oil and gas field simulators.

Learning Outcomes:

i. Exposure of different field simulators.

ii. Practical aspects with hands-on working on oil field commercial simulators

COURSE CONTENT:

Exp. No.	Name of the Experiment	Contact Hrs
1.	Oil well bore performance of a vertical well.	2
2.	Gas well bore performance of a vertical well.	2
3.	Optimization of well bore performance: Tubing Size, Well head pressure etc.	2
4.	Performance prediction of a depletion drive reservoir using material balance	2
5.	Performance prediction of a water drive reservoir using material balance	2
6.	Phase behaviour of reservoir fluids: Phase envelope generation of HC mixtures and associated calculation.	2
7.	Black oil reservoir simulation in a 2-D system.	2
8.	Modelling and optimization of surfactant flooding process.	2
9.	Well test data interpretation in oil wells	2
10.	Basic well log interpretation: Identification of pay zone and calculation of saturation	2
11.	Oil well bore performance of a vertical well.	2

SEVENTH SEMESTER

B.TECH PE

(Implemented from session 2022-23)

S. No.	Subject ID	Subject Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit Hours	Contact Hours
DE1			3	0	0	9	3
DE2			3	0	0	9	3
OE3			3	0	0	9	3
OE4			3	0	0	9	3
OE5			3	0	0	9	3
DC13	PEC 402	UGP-1 (Zero-Credit Compulsory)	0	0	6	6	6
DC 14	PES 401*	Internship/Training/Seminar/ Field-Excursion	0	0	0	0	0
		Total Credit	15	0	6	54	21

Course Type	Course Code	Name of Course	L	T	P	Credit
DE1	PED 401	Offshore Drilling and Petroleum Production Practices	3	0	0	9

Course Objective
The objective of this course is to introduce the students in this new and challenging area of operation so that when they join the oil & gas industry, they are already well trained to get used to a completely new environment by not being a novice in a challenging circumstance. This will also open up many new ideas for doing further research.
Learning Outcomes
Exposure to the different offshore platforms used for drilling and production; basics of their stability criteria and station keeping methods. Exposure to the offshore drilling, completion and production operations with a clear understanding of the difference between offshore and onshore operations.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Introduction to offshore oil and gas operations**.	2	Students will get introduced to the historical development and the whole gamut of offshore activities all over the world.
2	**Sea States / Offshore Environment:** Meteorology, oceanography, ice, sea bed soil.	3	Will understand the complexity of operating in a typical offshore environment in different parts of the world.
3	**Offshore Fixed Platforms:** Types, description and operations, Includes Compliant Platforms.	6	Will learn about the use of fixed and compliant platforms in a particular situation besides their type, installation and structural differences.
4	**Offshore Mobile Units:** Types, description and installation. Station keeping methods like conventional mooring & dynamic positioning system.	6	Will get an exposure to a completely new type of offshore structure, specially floating platforms and also associated problems and solutions.
5	**Buoyancy and stability**.	3	Will learn to evaluate the stability criteria of the floating platforms.
6	**Offshore Drilling:** Difference in drilling from land, from fixed platform, Jackup, ships and semi submersibles. Use of conductors and risers. Deep sea drilling.	6	It is the core of this subject and students will learn right from the installation of conductors, risers and landing bases upto the completion of drilling from different types of platforms in or stepwise manner.
7	**Offshore Well Completion -** Platforms and subsea completions, Deep water applications of subsea technology.	3	This is equally an important chapter and knowledge of different types of well completion especially subsea completion which is completely a new innovation, will be available here.
8	**Offshore Production:** Oil processing platforms, gas processing platforms, water injection platforms, storage, SPM and SBM, transportation and utilities.	6	This is also another important operation which has a completely new set of arrangement in offshore environment, right from processing set up, types of production risers, mid-water terminal facilities like SBM etc., storage and transportation and the outcome will be to gain knowledge about all those.
9	**Deep water technology:** Introduction, definition & prospects. Deep water regions, Deep water drilling rig – selection and deployment, deep water production system, Emerging deep water technologies – special equipment and systems, Remote operation vessels (ROV).	2	Here the students will learn about the challenges in deep water and their possible solutions. Of course this is an emerging area and students have to keep them abreast with it.

10	**Divers and Safety:** Principles of diving, use of decompression chambers, life boats.	2	Divers play a very important role and students will learn about the diver's role and the complexity involved in their working condition. Knowledge of safety during all the above operations is a must for anybody working in offshore platform. So students will have that knowledge beforehand.
	Total contact hours:	39	

Text Books:

i. Offshore Petroleum Drilling and Production: Sukumar Laik
ii. Dynamics of Offshore Structures: James F. Wilson
iii. Offshore Drilling, Completion and Production: ETA Offshore Seminars Inc.
iv. Introduction to Offshore Structures: Graff
v. Deepwater Petroleum – Exploration & Production: Leffler, Pattarozzi and Sterling.

Reference Books:

i. Offshore Handbook: B. C. Malhotra
ii. Floating Drilling: Equipment and its use: Riley Sheffield.
iii. Offshore Handbook Vol.1 to 5: Gulf Pub. Co.
iv. Offshore Pipeline Design, Analysis and Methods: A. H. Mousselli.
v. Drilling and Producing Offshore: Stewart Hall

Course Type	Course Code	Name of Course	L	T	P	Credit
DE2	PED 402	Enhanced Oil Recovery Techniques	3	0	0	9

Course Objective
The objective of the course is to provide the basic knowledge of enhanced oil recovery systems.
Learning Outcomes
Upon successful completion of this course, students will: Have the ability to select and apply the compatible EIOR method to a particular oil field. Have the ability to monitor the progress of the production of oil.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Historical background and review of primary and secondary recovery, injection rates & pressures in secondary recovery. Flood patterns and coverage.	6	Strong knowledge base of primary and secondary recovery techniques.
2	Microscopic displacement of fluids in a reservoir: Capillary forces, viscous forces, phase trapping, mobilization of trapped phases.	4	Knowledge of the fundamentals on various microscopic forces acting during oil recovery.
3	Macroscopic displacement of fluids in a reservoir: Areal sweep efficiency, vertical sweep efficiency, displacement efficiency, mobility ratio, well spacing.	4	Knowledge of the fundamentals on various macroscopic effects during oil recovery, ex. various sweeps.
4	Chemical flooding: Polymer flooding and mobility control processes, micellar/ polymer flooding, phase behavior of micro-emulsions, phase behavior and IFT, wettability alterations, alkali flooding.	6	Knowledge of the fundamentals of chemical flooding, alkali and polymer flooding, with the emphasis on the phase behavior and IFT of the fluids and wettability alterations of the porous medium.
5	Miscible displacement processes: Mechanism of miscible displacement, phase behavior related to miscibility, high pressure gas injection, enriched gas injection, LPG flooding, carbon dioxide flooding, alcohol flooding.	6	Knowledge of the fundamentals of miscible flooding, i.e. phase behavior related to miscibility, high pressure and enriched gas injection, LPG, CO_2 and alcohol injection
6	Thermal recovery processes: Mechanism of thermal flooding, hot water flooding, cyclic steam injection, estimation of oil recovery from steam drive, in-situ combustion, air requirement for in-situ combustion.	6	Knowledge of the fundamentals and mechanism of thermal flooding which includes hot water, steam, and in-situ combustion drives.
7	Microbial oil recovery.	4	Fundamentals of MEOR mechanism, operation and types of microbes used in the process.
8	EOR project evaluation.	3	Ability to evaluate an EOR project.
	Total contact hours:	**39**	

Text Books:

1. Smith C.B.-"Mechanics of Secondary Oil Recovery"
2. Lake, L.W., "Enhanced Oil Recovery"
3. Chilinger, "Enhanced Oil Recovery", Vol. I & II

References:

1. Craig F.F., "The Reservoir Engineering Aspects of Water Flooding"
2. Cosse, R., "Basics of Reservoir Engineering"
3. Van Poollen H.K., "Fundamental of Enhance oil recovery" Petroleum Production Systems, Economides et al., Prentice Hall, 2012

Course Type	Course Code	Name of Course	L	T	P	Credit
DE2	PED 403	Drilling System Design	3	0	0	9

Course Objective

The objective of the course is to provide Advanced knowledge of design of different drilling systems as per requirement and field conditions.

Learning Outcomes

Upon successful completion of this course, students will:
have a capability to select proper rig suitable to for the field applications as per criteria set by the company.
Proper knowledge of well design.
Ability to handle the unbalanced hydraulic situations.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Drilling Rig Selection and Design: Environmental loading and stability of rig. Design of Block and Tackle System, Design of Draw works Drum, Top drive drilling.	5	Ability to select drilling rig suitable and compatible to the formation
2	**Casing Design:** Conventional and conditional Casing Design Practices, Deep well strings, Design practices for high inclined, Horizontal and Slanted wells. Liner design and setting.	5	knowledge of conditional casing design operation and handling
3	**Casing Buckling and Well Head Loads:** Casing landing practices, Buckling criteria and Calculation of well head loads.	5	Analytical capability of effective load on casing and its ensuring the stability
4	Drill String Design for vertical, directional and horizontal wells.	5	Understanding of conditional string design
5	**Mud Hydraulics Design:** Rheology of drilling fluids and compatibility to borehole conditions, Hydraulic horse power and Rig horse power calculations. Jet impact force, Hydraulics design in High inclines wells. Bit Hydraulics, Bottom drive hydraulics design.	5	Ability of proper hydraulics balance and well handling
6	**Rotary System Design:** Design and performance of Kelly drive, Bottom Drive and Top Drive Systems.	3	Awareness of different power drive drilling systems and their applications
7	**Special Methods of Drilling:** Aerated drilling, Under-balanced drilling, Overbalanced drilling, HPHT Drilling, Variable pressure regime, Plasma drilling, Electrical Drilling, Re-entry drilling, Jet Drilling, Drilling automation. Smart wells Design, Managed Pressure Drilling.	5	Exposure of advances in drilling technology
8	**Drilling Economics.**	3	knowledge of drilling cost and financial balance
9	**Computer Application in Drilling**	3	Development of interactive software for drilling systems
	Total contact hours:	**39**	

Text Books:

i. Applied Drilling Engineering, Adam T. Bourgoyne Jr. et al., SPE Text Book Series, 1991
ii. Drilling Engineering: A Complete Well Planning and Approach, Neal J. Adams, Pennwell, 1985.

References:

i. Well Control Problems Solutions, Neal J. Adams, Pennwell, 1980
ii. Oil Well Drilling Engineering: Principles and Practice, H Rabia, Springer, 1986

Course Type	Course Code	Name of Course	L	T	P	Credit
OE3	PEO 401	Petroleum Environment, Health and Safety Practices	3	0	0	9

Course Objective
The objective of the course is to provide operational and occupational hazards in oil and gas industry as well as awareness of safe practices and environmental sustainability
Learning Outcomes
Safety code of conduct in oil and gas operations **Environmental impact assessment and mitigation.**

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Introduction to Health, Safety and Environmental Management	3	The role of Health, Safety and Environment in Petroleum operation will be explained to the students.
2	HSE Terms and Definitions, Importance of HSE Management, HSE performance. HSE Regulations and regulatory agencies for Oil and Gas Industry	4	Basic terminology and different HSE regulations will be explained to the students.
3	Environmental issues and Management	4	How to minimize that adverse impacts of oil and gas activity to the environment will be explained to the students.
4	Air pollution- Stack emissions, Flaring and fugitive release	4	Students will learn about different harmful gases which releases during E&P activities and how to minimize that emissions.
5	Water pollution and wastewater management, Produced water management	4	Students will learn about waste water management techniques which ultimately controls the problems of water pollution.
6	Oil spill Management	4	Student will learn about methods to mitigate offshore and onshore oil spill.
7	Waste management: Drilling waste, Rock cutting, oily sludge, etc.,	4	Students will be able to understand the different process to decrease the toxicity of waste generated by oil and gas drilling and production activities.
8	Environmental Management, monitoring and Impact Assessment.	4	The students will be able to assess the environmental impacts of Petroleum operation.
9	Occupational Health and Safety Management	4	Different aspects of on-field safety requirement will be explained to students
10	Risk assessment and management: (Qualitative and quantitative)	4	We will teach to students the management to plan ahead, not necessarily to avoid the risk, but to be as prepared as possible should the risk become an issue.
	Total contact hours:	**39**	

Text Books:

i. Environmental Control in Petroleum Engineering: John C Reis
ii. Environmental Technology in the Oil Industry: Orszulik, Stefan

Reference Books:

i. Environmental management in Petroleum Industry: S. K. Wahi
ii. The prevention of Oil pollution: J. Wardley-Smith
iii. The Control of Oil Pollution: Wardley-Smith
iv. Safety and Health in the oil and gas Extractive Industries: Graham & Trotman Ltd., London for the commission of European Communities.

Course Type	Course Code	Name of Course	L	T	P	Credit
OE4	PEO 402	Well Performance	3	0	0	9

Course Objective
The objective of the course is to provide the applied knowledge to monitor the production performance of oil and gas wells.
Learning Outcomes
Upon successful completion of this course, students will: • have a broad understanding of the key drivers of the production performance of an oil & gas well • have an understanding on how to monitor the performance of the well during production and judge the improvement against the well treatment. • be able to assess the methods of reservoir management and production optimization. • be able to interpret the data gathered through production and well testing and characterize the reservoir with proper integration of data.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Introduction:** Identification of sub-surface and surface parameters that influence the well performance; Concept of continuity equation, steady state, pseudo-steady state and transient state of flow in liquid system and gas system;	6	Understanding of fluid flow through porous media. It provides idea of the equations that govern the transport phenomena within porous reservoir rocks.
2	**Multiphase Flow and IPR:** Inflow Performance Relationship (IPR) for a single phase and two-phase flow, Generalized Vogel Inflow Performance equation; Future Prediction of reservoir through IPR	8	This unit will help student in understanding the behavior of hydrocarbon liquid flow within reservoir in presence of hydrocarbon gas and water. Students will understand the impact of multiphase flow on well deliverability.
3	**Well test applications in reservoir characterization:** Plots used in well-test (Cartesian, semi-log and log-log plots); Identification of reservoir models, diagnostics on log-log plot for radial, linear, bilinear, and spherical flow; Characterization of reservoirs on properties, shape and size using modern well test methods (working equations and example problems).	9	This will help students to learn how to analyze and interpret the data gathered through pressure transient testing. Students will develop an understanding on the behavior of pressure changes within hydrocarbon reservoirs under different conditions of flow and flow regimes.
4	**FMB/DMB:** Concept of Flowing/Dynamic Material Balance (FMB/DMB) for oil and gas reservoirs.	6	Estimating reserve without shuting-in the well during production
5	**Vertical Lift Performance:** Concept of various flow regime through tubing, Homogeneous and Separated flow models and their application, Gas well deliverability, Non-Darcy flow effects, IPR and VLP in two phase reservoirs and gas reservoirs	6	Understanding about actual flow behavior; Application of various models and their applications in designing tubings. Developing the ability to select various parameters to obtain the optimum well deliverability
6	**Choke Performance:** Types of chokes, Concept of pressure losses through various chokes for multiphase flow, Sonic & Subsonic flow, Gas flow and Joule Thomson Effect	4	Students will learn to analyse the pressure loss across chokes for oil and gas at various flow rates and also temperature effect especially for gas flow.
	Total contact hours:	**39**	

Text Books:

1. Hydrocarbon Reservoir and Well Performance - T.E.W. Nind

References:

1. Advanced Reservoir Engineering - Tarek Ahmed & Paul D. McKinney

Course Type	Course Code	Name of Course	L	T	P	Credit
OE5	PEO 403	Transportation and Marketing of Petroleum and Petroleum Products	3	0	0	9

Course Objective
The objective of the course is to provide the proper knowledge of the transportation and marketing of the petroleum and petroleum products ensuring the profitability.
Learning Outcomes
Exposure of the global scenario of quality and quality control of the petroleum and petroleum products.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Indian and Global supply scenario of petroleum and petroleum products. Product quality control. Bulk distribution and handling-domestic, commercial and industrial.	3	Overall idea on supply, consumption and distribution of petroleum and petroleum products
2	Pricing Mechanisms of crude oil and natural gas. Role of International oil companies and OPEC pricing mechanism. Spot and other market control mechanism.	4	Pricing Mechanisms of crude oil and natural gas
3	Administered and market determined pricing mechanism in India. Conservation of petroleum & its products, Government & Industry regulatory norms influencing petroleum product marketing.	4	Role of Govt. on price mechanisms of petroleum products
4	Rules and Regulations for transportation of Crude oil, Natural Gas and other Petroleum products. Traffic management, Fire and safety rules.	4	Rules on safety issues of petroleum and petroleum products during storage and transportation
5	Mode of Transportation of petroleum & petroleum products.	4	Transportation of petroleum & petroleum products.
6	Pump and compressor stations. Instrumentation and control.	4	Equipment and instruments associated with the transportation
7	**Metering and Measurements:** Metering of oil & gas, Orifice and other metering devices and systems. Multiphase flow meter. Tank gauging. Sampling and Testing of crude oil. Water and sediment determination.	6	Metering of oil & gas
8	Product quality control. Marketing Organizations and Retail Infrastructure	4	Quality control of oil & gas
9	Bulk distribution and handling-domestic, commercial and industrial petroleum products, distribution network, marketing location management of petroleum products.	6	Distribution of petroleum products
	Total contact hours:	**39**	

Text Books:

i. Production and transport of oil and gas, Volume 3: A P Szilas
ii. Production and transport of oil and gas, Volume B : Gathering & Transportation (Developments in Petroleum Science) 2nd Edition: A P Szilas

Reference Books:

i. Petroleum Pipelines : A Handbook of Onshore and Gas Pipeline: Sanjoy Chanda
ii. Petroleum Marketing and Transportation : New Ideas, New Method, New Developments Gulf Publishing Company
iii. Petroleum Marketing Practices and Problems: William Henry Day

Course Type	Course Code	Name of Course	L	T	P	Credit
OE5	PEO 404	Petroleum Resource Management and Project Evaluation	3	0	0	9

Course Objective
The objective of the course is to provide the basic knowledge of the utilization of the different available resources and their management.
Learning Outcomes
Exposure to the global sharing and evaluation of projects and assets of oil and gas industry. Exposure to justify the risk and their management.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Oil and gas Reserve Classification:** Petroleum Resources Definitions, Classification, and Categorization Guidelines. Technical Assessment Principles and Applications.	4	Student will learn about resource classification method used in industry for project management
2	**Petroleum fiscal regimes**: NELP & Help – Role, history & Background, Types of Contracts and fiscal Regimes, Economic analysis of different contracts. Crude Oil and natural gas contract in India, CBM Contracts	5	What are the different rules and regulation that governs the contract between different companies and government will be explained to student
3	**Project Evaluation Introduction**: HC project lifecycle. Financial aspects of an HC field.	5	Student will learn about different oil and gas field activity and their financial impact during and oil field life cycle.
4	**Petroleum Accounting introduction**: Balance and Income sheet, Asset, liability, capital and operating expenditure, Profit and loss statement, cash flow statement	5	The basic financial terminology in petroleum economics will be explained to student.
5	**Project Evaluation method**: Time value of money in capital investment, Depreciation & depletion definition and calculation method, amortization of oil projects, Financial measures and profitability analysis, Break-even and sensitivity analysis, Optimization Techniques.	5	Different method of evaluation of oil field project on the basic of economics will be explained to student.
6	**Project Evaluation method application**: Estimation of oil reserves and evaluation of an oil property. Economic evaluation of exploration and drilling operations: Optimization of number of wells, cost etc. Economic evaluation of production operation: Tubing size optimization, optimum production rate calculation. Economic evaluation of artificial lift operation Economic evaluation of Downstream Oil Activities: Pipe size selection and other examples etc.	10	Student will learn the oil filed project evaluation in upstream and mid-stream and downstream operation with different practical examples.
7	**Uncertainty and Risk Analysis**: source of risk, managing risks by risk reduction, diversification, and uncertainty investment and decision analysis by decision tree. Risk management in energy markets	5	What are the risk and what are different risk mitigation method will be explained to students.
	Total contact hours:	**39**	

Text Books:

i. Production and transport of oil and gas, Volume 3: A P Szilas
ii. Production and transport of oil and gas, Volume B : Gathering & Transportation (Developments in Petroleum Science) 2nd Edition: A P Szilas

Reference Books:

i. Petroleum Pipelines : A Handbook of Onshore and Gas Pipeline: Sanjoy Chanda
ii. Petroleum Marketing and Transportation : New Ideas, New Method, New Developments Gulf Publishing Company

EIGHTH SEMESTER

B.TECH PE

(Implemented from session 2022-23)

S. No.	Subject ID	Subject Name	Lecture (L)	Tutorial (T)	Practical (P)	Credit Hours	Contact Hours
DE3			3	0	0	9	3
DE4			3	0	0	9	3
OE6			3	0	0	9	3
OE7			3	0	0	9	3
DC15	PEC 402	UGP-2	0	0	6	6	6
		Total Credit	12	0	6	**42**	18

Course Type	Course Code	Name of Course	L	T	P	Credit
DE3	PED 404	Petroleum Engineering Design	3	0	0	9

Course Objective
To provide the basic knowledge and skills of the oil and gas field development and economics. To provide the basic knowledge and skills in the designing of oil and gas separation system To provide the basic knowledge and skills in the designing of crude oil treatment systems To provide the basic knowledge and skills in the designing of artificial lift systems
Learning Outcomes
Upon successful completion of this course, students will: learn the different aspects of the development of oil and gas fields and have the ability to develop techno-economic oil and gas fields learn the basic fundamentals of separators, heater treaters and artificial lift techniques and have the ability to design these systems as per requirements in the oilfields.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	**Development of Oil & Gas Fields:** Selection of development scheme, economic aspect of development of oil and gas fields. Production variants, performance prediction, Recovery factor, Stages of preparation of development plans.	4	This unit help the students to acquire the knowledge and skills related to field development planning and will be able to prepare field development plans for oil and gas fields
2.	**Oil Field Economics:** Introduction to cash flow petroleum analysis Computation of economic indices viz. Capital investment, payout period, IRR, Profile, Economic life etc. Analysis of different variants based on technical and economic considerations. Economic development of Marginal fields.	4	This unit will help students to acquire the knowledge and skills for the economic development of oil and gas fields
3.	**Design of oil and gas separation system:** Design of two phase and three phase separators.	6	This unit will help students to acquire the knowledge and skills in the designing of oil and gas separation system)
4.	**Crude oil Treatment:** Heater treaters, Electrostatic heater treaters, Design of heater treaters	4	This unit will help students to acquire the knowledge and skills in crude oil treatments
5.	**Basic principles and descriptions of Artificial lift techniques:** Gas-lift - continuous and intermittent, chamber lift, plunger lift/sucker rod pumping, and hydraulic pumping - piston & jet type.	4	This unit will help students to understand basic fundamentals of Artificial lift techniques
6.	**Design of Continuous gas lift system (pressure operated valves) -** graphical and analytical methods.	5	This unit will help students to acquire the knowledge and skills in the designing of continuous gas lift system
7.	**Design of Intermittent gas lift system**; single point injection standard tubing installation (Pressure operated valves) - graphical and analytical methods.	3	This unit will help students to acquire the knowledge and skills in the designing of intermittent gas lift system
8.	**Design of Sucker rod pumping system** (Learning outcome: To acquire the knowledge and skills in the designing of sucker rod pumping system)	5	This unit will help students to acquire the knowledge and skills in the designing of sucker rod pumping system
9.	**Characteristics and Selection of electric submersible pumping/PCP systems**	4	This unit will help students to acquire the knowledge and skills

			for the selection of electric submersible pumping/PCP systems
	Total contact hours:	**39**	

Text Books:

i. Surface Production Operation , : Arnold, Ken and Stewart, Maurice
ii. Principle of Artificial Lift : N.K. Mitra

Reference Books:

i. The Artificial lift technology (All Volumes) : Brown, K.E.
ii. Well Design: Drilling & Production : Craft, Holden & Graves
iii. Development of oil and gas fields : Sant Kumar

Course Type	Course Code	Name of Course	L	T	P	Credit
DE3	PED 405	Pipeline Engineering	3	0	0	9

Course Objective
To provide the basic knowledge of the pipe line operations required for transportation of oil and gas. It also provides knowledge right from its design to construction underground and offshore along with various safety requirements and mitigating problems.
Learning Outcomes
Able to design the buried pipeline as per industry (API/ASME) specification. Able to apply this knowledge in the industry as well as in the research organization in various aspects of pipeline.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	**Introduction**: Objective and scope of pipeline as a means of fluid transportation with special reference to crude oil/gas/refined products, Economics of Pipeline transportation.	2	Will have the understanding of the use of pipeline as a means of transportation and its superiority over other methods techno-economically.
2.	**Design of Pipeline:** Factors influencing oil, gas and products pipeline design; Hydraulic surge and water hammer; river crossing; pipeline buoyancy.	6	The designing of oil & gas pipeline as per ASME/API code and the consideration of different factors in designing oil , gas and product pipeline will be learnt. A special case of river crossing and the effect of buoyancy factor will also be evaluated.
3.	**Flow of fluids through pipeline:** Basic equations for the flow of fluids through pipes; Theory and different formulae of the fluid flow for both oil and gas pipelines, pressure drop calculations, complex piping systems (series and parallel), looping of pipelines (oil & gas), Multiphase flow and its correlations, Pumps, their series and parallel connection & Pump stations, station spacing; Compressors and Compressor stations.	10	Right from basic fluid flow equations, the students will learn its application in oil & gas pipelines separately. They will also learn the advantages of connecting pipes in series or parallel and pumps in series or parallel. Application of multiphase flow calculations in the transportation of well fluid will also be learnt, knowledge of Pumps and Compressor stations in oil and gas pipeline is an integral part of this chapter.
4.	**Construction and Maintenance of pipelines;** Materials and project specifications, General equipment specifications (pipes, valves and fittings), Route location survey and laying of cross country pipelines, Installation of expansion loop and themodymetric tapping plant, Pigs, Intelligent pigs, Pigging technology, Pig launcher and receiver.	8	A complete idea right from the surveying of the pipeline route upto the laying of cross-country pipeline will be available besides the complexity in the construction in different terrain. The maintenance of pipeline by routine pigging is very important in pipeline operation which students will learn.
5.	**Corrosion protection and control;** Design of cathodic protection system, Pipeline automation.	6	Here basics of corrosion and detail design of cathodic protection of underground pipeline will be learnt.
6.	**Offshore Pipeline:** Design and control of Sag and Over bend; Description of stinger; and Riser, articulated stinger, construction of offshore pipeline, Method of underwater welding.	3	Main emphasis here will be on the various methods of laying offshore pipeline and the detail design and laying aspects of each method, specially ‘lay barge’ method will be stressed.

7.	**Hydrates, Wax & Scale:** Formation and prevention. Crude conditioning and use of additives to improve flow conditions.	2	The main problems in pipeline transportation are Wax, hydrate and scale and students will learn about the scientific theory behind these and also the different methods for combating each of these problems.
8.	**City distribution network** of oil and gas pipeline, Lease automatic custody transfer.	2	Networking of oil/gas pipeline in a specific area with Lease Automatic Custody Transfer (LACT) System will be learnt.
	Total contact hours:	**39**	

Text Books:

i. Pipeline Transportation Handbook: H.S. Bell
ii. Gas Production engineering: Sanjay Kumar
iii. Oil and Gas Pipelines and Piping Systems -- Design, Construction, Management, and Inspection: Alireza Bahadori

Reference Books:

i. Offshore Pipeline Design, analysis and Methods: A. H. Mousselli
ii. Oil and Gas Pipelines: Integrity and Safety Handbook: R. Winston Revie
iii. Pipeline Pigging Technology: J. N. H. Tiratsoo
iv. Gas Pipeline Hydraulics: E. Shashi Menon

Course Type	Course Code	Name of Course	L	T	P	Credit
DE4	PED 406	Reservoir Modeling and Simulation	3	0	0	9

Course Objective
The objective of the course is to provide the basic knowledge of reservoir modeling and simulation and its application for maximizing economic recovery of hydrocarbon from a hydrocarbon reservoir.
Learning Outcomes
Upon successful completion of this course, students will have the: Exposure of modeling and simulation concepts Ability to forecast the future production behavior of the well and field. Ability to determine the optimum conditions to maximize the economic recovery of hydrocarbon

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Introduction & Overview:** Definition, Objectives and applications of reservoir simulation with brief overview of the system, steps of the reservoir simulation.	1	This will help students understand the need for reservoir simulation.
2	**Basic Reservoir Analysis:** Volumetrics, Material Balance, Decline Curve Analysis, Reservoir Fluid and Rock Properties, Conservation of Mass and Momentum—Continuity Equation, Equation of Motion, Darcy and Non-Darcy Flow, Basic Single Phase flow equation.	6	This unit will help student in understanding the basic concepts which are essential to start reservoir simulation studies.
3	**Fundamentals of Reservoir Simulation:** Introduction to partial differential equations, Finite difference approximation to linear flow equations, Concept of Transmissibility and Geometric Factor, Discretization, Block Centred and Point Centred Grid distribution, Formulation of Flow equation for grid blocks, Boundary grid-block treatment and formulation of flow equation, Control Volume Finite Difference (CVFD) terminology for flow equation representation, Numerical solution of incompressible single phase flow equation	10	This will help students to learn how to write fluid flow equations for single phase flow through grid blocks in a discretized simulation model.
4	**Well Representation in Simulators:** Concept of equivalent radius for well block pressure, Well geometric factor, Treatment of wells in 2D areal flow, Well model, Multiblock wells, Estimation of wellbore geometric factor	5	Students will learn how to represent a well in a gridded simulation model; students will understand the basic equations that differentiate between local flow in a grid block and global flow between grid blocks.
5	**Slightly Compressible and Compressible Fluids:** Formulation of grid block flow equations and numerical solution; IMPES and AIM formulation; Concept of material balance check for validity of numerical solution	6	This unit will help students understand the impact of pressure dependent fluid density on the formulation of flow equations in a gridded simulation model.
6	**Multiphase Flow in Black Oil Simulation:** Impact of Relative Permeability and Capillary Pressure on fluid flow; Formulation of grid block flow equations and numerical solution; General Flow equations for Oil/Water, Gas/Water, Oil/Gas and Black Oil Model. Introduction to Streamline Simulation.	6	This unit will help students understand the impact of multiphase flow on the formulation of flow equations in a gridded simulation model.
7	**History Matching and Forecasting Future**	5	This will help student in developing the

	Performance: Validity of the Reservoir Model, Strategy & Plans, Adjustment of parameters, Pressures, Pressure gradients, GOR-WOR behavior Automatic History Matching. Planning prediction cases, Preparation of input data, making a smooth transition from history to predictions, Review & Analysis of predicted performance, Evaluating & Monitoring predicted performance		knowledge on how to calibrate a simulation model with the observed data and how to use the calibrated model to predict the future performance of a hydrocarbon reservoir.
	Total contact hours:	**39**	

Text Books:

1. Principles of Applied Reservoir Simulation - John R Fanchi
2. Practical Reservoir Simulation - M. R. Carlson

References:

1. Fundamentals of numerical reservoir simulation - Donald W. Peaceman

Course Type	Course Code	Name of Course	L	T	P	Credit
DE4	PED 407	Advanced Well Completion Practices	3	0	0	9

Course Objective
The objective of the course is to provide the advanced knowledge of well completion methods and their applications
Learning Outcomes
Ability of predict well life and their durability Ability to forecast the future production behavior of the well and field.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Completion Equipment:** On-land and subsea Christmas trees; Subsurface safety Valves, Packers, Expansion devices and anchor latches, Landing nipples, locks and sleeves, Mandrels and gauges, Capillary lines and cable clamps, Loss control and reservoir isolation valves, Crossovers, Flow couplings, Modules,	**5**	The different completion equipment and their role in well completion will be explained to student.
2	**Material Selection:** Down hole Corrosion, Metallurgy Selection, Corrosion Inhibition, Seals, Control Lines and encapsulation, Coatings and liners	**6**	The role of tubing metallurgy in corrosion control and different aspect of well completion damage prevention will be explained.
3	**Tubing Stress Analysis:** Stress, Strain and Grades, Axial Loads, Burst ,Collapse, Triaxial Analysis, Safety and design Factors, Load Cases, Tubing Connections	**6**	The student will learn the design of well completion string pertaining to its behavior related to changes in temperature and pressure.
4	**Life of Well Operations:** Types and methods of Intervening, Impact on Completion Design. Tubing well performance, Multiphase flow & tubing performance, Flow predictions, Temperature prediction and Control, Packer fluids, Production & Injection well sizing.	**8**	Student will learn about different instances in well during course of production and how to handle these situation with well completion design. They will learn about tubing performance prediction and means of controlling well bore environment.
5	**Well Completion Techniques:** Deep water Completions. HPHT Completions, Completions with down hole flow control, Multilateral Completions, Dual Completions, Multipurpose Completions, Underbalanced completions, Coiled tubing and insert completions, Completions for Heavy oil and steam injection, Completions for Coal Bed Methane.	**8**	The well completion design depends upon reservoir and production need. How to design a completion for a particular well bore will be explained to student.
6	**Installation of Completion systems:** Wellbore Clean-out and mud displacement, Completion fluids and filtration, Well clean-up and flow initiation.	**6**	Student will learn about installation procedure of a well completion string.
	Total contact hours:	**39**	

Text Books:

Surface Production Operation , Arnold, Ken and Stewart, Maurice

Principle of Oil Well Production- Nind, T.W.

Reference Books:

The Artificial lift technology (All Volumes) Brown, K.E.

Well Design: Drilling & Production Craft, Holden & Graves

Course Type	Course Code	Name of Course	L	T	P	Credit
OE6	PEO 405	Integrated Reservoir Management	3	0	0	9

Course Objective
The objective of the course is to provide the basic knowledge of reservoir management and integration of the well performance outcome.
Learning Outcomes
Exposure of the reservoir management concept, data acquisition, analysis and management practices. Ability of analyses to the reservoir performance and prediction of future response.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Introduction**: Scope and Objectives	**4**	Proper understanding of Reservoir management integration.
2	**Reservoir management concepts**: Definition and history, fundamentals of reservoir management, synergy and team; integration of geosciences and engineering, integration of exploration and development technology	**5**	Basic concept of Reservoir management synergy and integration.
3	**Reservoir management process**: Setting goals, developing plans and economics, surveillance and monitoring, evaluation	**6**	Ability to sequential process of Reservoir management and conceptual monitoring.
4	**Data acquisition, analysis and management:** Classification of data, acquisition, analysis and application, validation, storing and retrieval	**5**	Data management and handling ability
5	**Reservoir model**: Role of reservoir model in reservoir management, integration of G & G and reservoir model	**4**	Ability for analysis of reservoir data and development of Reservoir model
6	**Reservoir performance analysis and prediction**: Naturally producing mechanism, reserves and role of various forecasting tools- volumetric method, MBE, Decline curve and mathematical simulation	**6**	Analytical capability of Reservoir performance and forecasting of future behavior regarding productivity.
7	**Matured field reservoir Management**.	**5**	Utilization of Mature field for total field performance.
8	**Reservoir Management economics**: evaluation, risk and uncertainties	**4**	Proficiency of Reservoir economical management and risk management
	Total contact hours:	**39**	

Text Books:

1. Hydrocarbon Reservoir and Well Performance - T.E.W. Nind

References:

1. Advanced Reservoir Engineering - Tarek Ahmed & Paul D. McKinney
2. Petroleum Production Systems - Michael J Economides
3. Petroleum Production Engineering", Gulf Professional Publishing, ISBN 10: 0750682701/ ISBN 13: 9780750682701(2007): Boyun Guo, William C. Lyons, and Ali Ghalambor.

Course Type	Course Code	Name of Course	L	T	P	Credit
OE7	PEO 506	Carbon Capture And Sequestration	3	0	0	9

Course Objective
The objective of the course is To provide the basic knowledge of Carbon credit balance and the green house environment.
Learning Outcomes
The need for carbon capture and sequestration, different methods, application in Hydrocarbon industry Modelling and implementation CO_2 sequestration project

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Introduction: scope, objectives and necessity of CCUS.	4	Learning outcome: Why to go for CCUS and how to do?
2	The contribution of fossil fuels emission to climate change and global warming. Concept of carbon credit and carbon footprint.	5	Learning outcome: student shall understand how fossil fuels are responsible for climate change and its extent depending on the types of gas emission. They also shall gain the idea about carbon credit and its benefit.
3	Carbon capture techniques: CO_2 emission, scrubbing of CO_2, CO_2 re-cycling.	5	Large numbers of technologies are utilized to capture/re-utilized CO2 depending on the process by which it is emitted, its the state and the percentage present in the exit stream. Students should learn the processes and should be able to identify which technology to be used at what cases.
4	CO_2 sequestration: underground storage, potential for geologic storage, and applications in oil and gas industry.	5	What are available options for geological carbon storage and how could be used them for enhancing the hydrocarbon recovery simultaneously at the time of sequestration
5	CO_2 flooding projects and methane recovery projects.	5	Learning about the mechanism how CO2 injection can recover the stored methane in Coalbed and oil from conventional reservoirs
6	Strategy for implementing CCUS technologies.	5	Understanding about the policies taken by various industries and countries)
7	Modeling of cost and performance of CCUS plants.	5	Cash flow performance involved in CCUS plant
8	Role and function of IPCC.	5	Understanding about policies, Acts, rules and regulations of IPCC
	Total contact hours:	**39**	

Text Books:

Introduction to Carbon Capture and Sequestration, Berend Smit, Imperial college press, 2014
Carbon Capture and Storage, Stephen A. Rackley, Elsevier,2017

ESO COURSES

OFFERED BY

PETROLEUM ENGINEERING DEPARTMENT

(FOR Non-PE Students)

ESO Course Offered by PE Department (for Non PE students)

Course Type	Course Code	Name of Course	L	T	P	Credit
ESO3	PEE 201	Introduction to Petroleum Engineering	3	0	0	9

Course Objective
The objective of the course is to provide introductory knowledge related to the Indian Petroleum Energy scenario, oil and gas exploration and Oil field operations.
Learning Outcomes
Upon successful completion of this course, students will: Understanding the basics concepts of the drilling of oil and gas wells. Capabilities to have knowledge of reservoir rocks, reservoir fluids and their properties

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Introduction to petroleum exploration and Indian energy scenario	4	Understanding of national energy scenario
2	Energy security and global energy balance.	4	Knowledge of global energy balance
3	Classification of petroleum and petroleum products	4	Knowledge of petroleum and petroleum products.
4	Organization of oil filed and oil companies	4	Familiarity of oil field organizations
5	Layout of oil and gas fields.	4	Understanding of field lay out.
6	Basics of drilling systems of oil and gas wells.	4	Familiarity with the drilling system
7	Basics of reservoir rock properties	4	Elementary knowledge rock properties
8	Basics of reservoir Fluid properties	4	Basic knowledge of reservoir fluids
9	Basics of petroleum production operation	4	Elementary knowledge of oil and gas production
10	Alternate sources of energy	3	Need of alternate source of energy
	Total contact hours:	**39**	

Text Book:

i. Petroleum Engineering- Drilling and completion: Carl Gatlin **Reference Books:**
Reference Book:

ii. Petroleum Exploration and Exploitation Practices: Bhagwan Sahay

Course Type	Course Code	Name of Course	L	T	P	Credit
ESO4	PEE 202	Petroleum Environmental Management	3	0	0	9

Course Objective

The objective of the course is to provide the introductory knowledge related to the Oil and gas filed environment, standard rules and regulation necessary for field operations

Learning Outcomes

Upon successful completion of this course, students will:

Understanding the basics concepts of the personal safety issues and prevention against possible Hazards in oil and fields.

Capabilities to have basic knowledge of impact on eco-system related to the oil and gas field pollution and disposal of field wastes.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Introduction to Petroleum Oil field hazards	3	Understanding of oil hazards
2	Oil field safety rules and regulations	3	Knowledge of safety rules
3	Oil mines regulations and other environmental legislations.	3	Knowledge of operational regulations.
4	Health Hazards in Petroleum installations.	3	Familiarity of health hazards in oil field.
5	Gas detection system and fire detection system in oil field installations	3	Understanding of gas and fire detection.
6	Fire detection and suppression systems in oil fields	4	Familiarity with the firefighting systems
7	Environment concepts, impact on eco-system, air, water and soil.	4	Elementary knowledge eco balance in environment.
8	The Impact of Drilling & Production Operations on Environment, Environmental Transport of Petroleum wastes.	4	Basic knowledge of Environmental impact by oil field operations.
9	Offshore environmental studies, offshore oil spill and oil spill control,	4	Elementary knowledge offshore environments.
10	Waste treatment methods, waste Disposal method, Remediation of contaminated sites.	4	Knowledge of waste disposal in oil and gas fields.
11	Environmental impact assessment.	4	Basics of EIA
	Total contact hours:	**39**	

Text Book:

i. Environmental Control in Petroleum Engineering by John C Reis
ii. Environmental Technology in the Oil Industry by Orszulik, Stefan

Reference Book:

i. Fire Protection Manual for Hydrocarbon Processing plants by Charles H. Vervalin
ii. Environmental management in Petroleum Industry by S. K. Wahi
iii. Safety and Health in the oil and gas Extractive Industries-Graham & Trotman Ltd., London for the commission of European Communities