SYLLABUS

OF

M.TECH. PROGRAMME

(PETROLEUM EXPLORATION& PRODUCTION)

2023 - 24

Department of Petroleum Technology
Faculty of Earth Sciences and Energy
Dibrugarh University

CONTENTS

1. COURSE STRUCTURE

1st Semester M.Tech. (Petroleum Exploration & Production) Programme [Total Credits: 26, Total marks: 750]

Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
Core Courses								
PT-101 (T)	Petroleum Geology	2	1	0	3	45	30	75
PT-101 (P)		0	0	2	1	15	10	25
PT-102 (T)	Petroleum Exploration Geophysics	3	0	0	3	45	30	75
PT-102 (P)		0	0	2	1	15	10	25
PT-103 (T)	Drilling Technology- I	3	0	0	3	45	30	75
PT-103 (P)		0	0	2	1	15	10	25
PT-104	Fundamentals of Reservoir Engineering	3	1	0	4	60	40	100
PT-105 (T)	Flow through Porous media	2	1	0	3	45	30	75
PT-105 (P)		0	0	2	1	15	10	25
PT-106	Production Technology	3	1	0	4	60	40	100
Ability Enhancement Courses (AEC) [Any one course]								
PT-1A1	Technical English & Professional Communication	Offered by the Department of English			2	30	20	50
	Application of Remote Sensing UAV	Offered by the Centre for Studies in Geography			2	30	20	50
	Industrial Visit/Research Lab Visit/ Geological Field Work				2	30	20	50
	Any other inter-disciplinary Courses							

2nd Semester M.Tech. (Petroleum Exploration & Production) Programme [Total Credits: 26, Total marks: 750]

Course No.	Course Name	Teaching Scheme (Hours)			Credits	Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
Core Courses								
PT-201(T)	Exploration & Development of Oil & Gas fields	2	1	0	3	45	30	75
PT-201 (P)		0	0	2	1	15	10	25
PT-202 (T)	Seismic Prospecting in Petroleum Exploration	3	0	0	3	45	30	75
PT-202 (P)		0	0	2	1	15	10	25
PT-203 (T)	Drilling Technology-II	3	0	0	3	45	30	75
PT-203 (P)		0	0	2	1	15	10	25
PT-204	Applied Reservoir Engineering	3	1	0	4	60	40	100
PT-205	Surface Production Operations	3	1	0	4	60	40	100
PT-206	Enhanced Oil Recovery	3	1	0	4	60	40	100

Ability Enhancement Compulsory Courses (AECC)						
PT-2A1	Industrial Visit	Visit in Oil industries (OIL,ONGC etc.)	2	30	20	50

3rd Semester M.Tech. (Petroleum Exploration & Production) Programme [Total Credits: 24, Total marks: 650]

Course No.	Course Name	Teaching Scheme (Hours)			Credits	Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
Core Courses								
PT-301	Natural Gas Engineering	3	1	0	4	60	40	100
PT-302	HSE & PE	2	1	2	4	60	40	100
PT-303 (T)	Well Servicing	2	1	0	3	45	30	75
PT-303 (P)		0	0	2	1	15	10	25
Discipline Specific Elective (DSE)								
PT-3D1	Project Work	Intra-Departmental			4	60	40	100
Generic Elective (GE) [Offered by the Department of Petroleum Technology]								
PT-3G1	Oil Well Production Technology	3	1	0	4	60	40	100
PT-3G2	Petroleum Geoscience	3	1	0	4	60	40	100
PT-3G3	Carbon Capture Utilization and Storage(CCUS)	3	1	0	4	60	40	100
PT-3G4	Fundamentals of Oil Well Drilling	3	1	0	4	60	40	100

Generic Elective (GE, offered by other Departments) [anyone]						
AG3G1	Water Science, Policy & Governance	Offered by the Department of Applied Geology	4	60	40	100
AG3G2T	Standard Field & Laboratory Techniques		4	60	40	100
AG3G2P						
AG3G3T	Geoscientific Data Analysis withMatLab & Petrel (LabBased)		4	60	40	100
AG3G3P						
GG3G1	Hydrology	Offered by the Centre for Studies in Geography	4	60	40	100
GG3G2	Application of Geoinformatics in Petroleum Exploration		4	60	40	100
GG3G3	Geography of Tribal Studies		4	60	40	100

Ability Enhancement Compulsory Courses (AECC)						
PT-3A1	Industrial Training	Training for one month duration in Oil Industries	4	60	40	100

4th Semester M.Tech. (Petroleum Exploration & Production) Programme [Total Credits: 20, Total Marks: 300]

Course No.	Course Name	Teaching Scheme (Hours)			Credits	Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
Core Course								
PT-401	Dissertation	Dissertation in Oil industries or in the Department (One semester)			20	180	120	300

The CBCS Board of the Department may change the mode of examination and evaluation of the Dissertation from time to time as and when required.

2. COURSE CONTENT

1st SEMESTER

<table>
<tr><th colspan="8">Course Teacher: Dr. Pradip Borgohain</th></tr>
<tr><td rowspan="2">Course No.</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hours)</td><td rowspan="2">Credits</td><td colspan="2">Course Marks</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>In Sem</td></tr>
<tr><td>PT-101</td><td>Petroleum Geology</td><td>2</td><td>1</td><td>2</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td></td><td colspan="8">Introduction: The course is design to impart knowledge on the origin, occurrence, movement and accumulation of hydrocarbons within the earth’s crust. It covers nearly all types of insight of geological disciplines, especially sedimentology, stratigraphy, paleontology and structural geology that are applied to the search for hydrocarbon deposits.</td></tr>
<tr><td>Course Content</td><td colspan="8">1. Geology of Petroleum–An Overview: Petroleum System; Petroleum types, occurrences and properties; Origin, migration and accumulation; Reservoir traps-types and genesis

2. Rocks & Minerals: Common rock forming minerals; Rock types- Igneous, Sedimentary and metamorphic; Sedimentary rocks: processes of formation, depositional environment, texture and structure. Genesis of sediments (clastic & nonclastic), classification and characteristics of clastic, non-clastic and evaporate rocks as reservoir. Grain size analysis.

3. Stratigraphy & micro-paleontology: Concept of lithostratigraphy, biostratigraphy & chronostratigraphy; Geologic timescale; Depositional environments; Application of micro fossil in hydrocarbon exploration with emphasison palynology.

4. Structure, tectonics and basin evolution: Types and causes of folds, faults & unconformity; Basin evolution processes and classification of basins on the basis of Plate Tectonics; Plate tectonics and oil prospecting

5. Source Rock: Source rock types; Kerogen types, maturation & significance; Source rock analysis: TOC, Rock-eval analysis; Role of time and temperature in petroleum generation. Bio-marker studies.

6. Reservoir rock: Types of reservoir rocks; Diagenesis and its impact on reservoir rock; Clay minerals type and its role in reservoir rock; Classification of carbonate rocks; Porosity types in carbonatereservoir rock.

7. Petroleum Province: Geographic and geologic distribution of oil and gas field in India withspecial reference to northeast India.</td></tr>
</table>

Practical	1. Reservoir rock thin-section study under Microscope. Measurement of porosity by porosimeter and under rock thin-section study. Study on diagenetic alterations in reservoir rock. 2. Hydrocarbon source potential analysis 3. Grain size analysis and its interpretations with reference to reservoir characteristics 4. Measurement of Dip & Strike using Brunton Compass 5. Preparation profile & cross-sections from geological map 6. SEM analysis related reservoir properties

Books Recommended:

1. Petroleum Geology by F.K. North, Publisher: Allen & Unwin
2. Elements of Petroleum Geology by R. C Selly. Publisher: Academic Press
3. Basic Petroleum Geology by P. K. Lint. Publisher: OGCI
4. Geology of Petroleum by A.I. Levorsen, Publisher: W.H. Freeman & co.
5. Petroleum Formation & Occurrence By- Tissot, B.P. & Welte,
6. D.H. Publisher: Springer
7. Petroleum (Indian context) by D. Chandra & R.M. Singh. Publisher: Tara Book Agency, Varanasi
8. Introduction to Sedimentology by S.M. Sengupta, Publisher: Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
9. Principles of Sedimentology & Stratigraphy by Sam Bogs, Publisher: Pearson Education Ltd., London
10. Sandstone Reservoir by John H. Barwis, et.al. Publisher: Spinger –Verlag
11. Sedimentary structures by J.D. Collinson & D.B. Thompson Publisher: CBS Publisher & Distributors, New Delhi.

Course Teacher: Dr.Himanta Borgohain								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
PT-102 (T)	**Petroleum Exploration Geophysics**	**3**	**0**	**2**	**4**	**60**	**40**	**100**

Course Content

Introduction: The study of Physics of the Earth and its environment in spaceis collectively known as Geophysics. The potential field theory- based methods (Gravity, Magnetic, Electrical and electromagnetic techniques) play vital role in gathering information for mineral, hydrocarbon and groundwater exploration.

1. **Physics Essential for Potential Field Theory:** Field concept, The coordinate systems, Scalar and Vector fields, Differential elements of length, surface and volume, Line, surface and volume integrals, The gradient of a scalar function, Divergence of a vector field, The Laplacian operator, Some fundamental theorems and field classifications, Vector identities

2. **Gravity methods of prospecting:** Salient features of Earth's gravitational field in relation to gravity exploration, Gravitational effects over subsurface causative bodies having discrete shapes, Different types of gravimeters, Gravity Data Processing & Interpretation.

3. **Magnetic methods of prospecting:** Earth's magnetism, Types of magnetism, Magnetic susceptibility, Magnetic effects from buried magnetic bodies, Instruments used for magnetic survey, Magnetic Data Processing & Interpretation.

4. **Electrical and Electromagnetic methods of prospecting:** Self- potential method, Electrical resistivity surveying (Vertical ElectricalSounding and profiling, Different types of array designs), Principle of Anisotropy and Dar Zarrouk parameters, Basic laws of electrodynamics, Principle of electromagnetic induction survey, Electromagnetic field equations, Transverse nature of electromagnetic wave, Elliptical polarization, Plane of polarization, Propagation of electromagnetic waves through different media,Induced Polarization, GPR and its applications.

PT102 (P)

Practical: The practicals will be based on interpretation of gravity and magnetic data, SP method, Electrical Resistivity survey & IP method

Books Recommended:

1. Dobrin, M.B., Savit, C.H., 1988. Introduction to Geophysical Prospecting, 4th Ed. McGraw Hill.
2. Kearey, P., Brooks, M., Hill, I., 2002. An Introduction to Geophysical Exploration, 3rd Ed.Blackwell.
3. Lowrie,W., 2007. Fundamentals of Geophysics, 2ndedition, Cambridge University Press.
4. Milsom, J.,Eriksen, A., 2011. Field Geophysics, John Wiley&Sons.
5. Mussett, A. E., Khan, M.A., 2000. Looking into the earth: An introduction to geological geophysics, 1st Published,Cambridge University Press.
6. Robinson, E.S., Coruh,C., 1988. Basic Exploration Geophysics, 1sted., Wiley.
7. Roy,K.K., 2008. Potential Theory in Applied Geophysics, Springer.
8. Bhattacharya, B.B., Shalivahan, 2016. Geoelectric Methods, Theory and Applications, McGraw Hill Education (India) Private Limited, NewDelhi.
9. Telford,W.M., Geldart,L.P., Sheriff, R.E.,1990. Applied Geophysics, Second Edition, Cambridge University Press.
10. Reynolds,J.M., 2011. An Introduction to Applied and Environmental Geophysics, 2ndedition, Wiley-Blackwell.
11. Nabighian, M.N.,1991. Electromagnetic Methods in Geophysics, Volume2, Parts A and B, SEG Publication
12. Prytz, K., 2015. Electrodynamics: The Field-Free Approach: Electrostatics, Magnetism, Induction, Relativity and Field Theory, Springer.
13. Becherrawy, T., 2012. Electromagnetism: Maxwell Equations, Wave Propagation and Emission, Wiley.
14. Zhdanov, M.S., 2017. Foundations of Geophysical Electromagnetic Theory and Methods, Elsevier.
15. Everett, M.E., 2013. Near-surface Applied Geophysics, Cambridge University Press.
16. Hinze, P.W.J., Von Frese, R.R.B. and Saad, A.H., 2013. Gravity and Magnetic Exploration: Principles, Practices, and Applications, Cambridge University Press.

<table>
<tr><th colspan="8">Course Teacher: Dr. M.A. Chowdhury and Dr Borkha Mech</th></tr>
<tr><td rowspan="2">Course No.</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hours)</td><td>Credits</td><td colspan="2">Course Marks</td><td>Total Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td></td><td>End Sem</td><td>In Sem</td><td></td></tr>
<tr><td>PT 103</td><td>Drilling Technology I</td><td>3</td><td>0</td><td>2</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Course Content</td><td colspan="8">Introduction: This course provides a broad understanding of the essential principles of Oil Well Drilling. It presents a systematic approach to the equipment, process and design of major systems required for drilling an oil well. Subsurface and wellbore pressure relations are highlighted throughout the course for safe planning and design.</td></tr>
<tr><td>Theory</td><td colspan="8">1. Introduction to oil well drilling, drilling process, directional wells. Drilling rigs, onshore/offshore, rig components and arrangement, Hoisting, rotation, circulation system
2. Subsurface conditions, pressure relations with information and wellbore, geomechanics, and fracture pressure, well control fundamentals.
3. Drilling fluids – functions, types, composition, and properties, drilling fluid additives and treatment.
4. Drill string, components, design factors, drill bit, types/classification & selection.
5. Casing, types and functions, components and accessories, casing policy.
6. Cementing, types of cement, cement slurry, additives, equipment, cementing operation, design of cement job.
7. Drilling math: Load calculations, casing load analysis and design, drilling fluid calculations.</td></tr>
<tr><td>Practical</td><td colspan="8">1. Drilling fluid preparation
2. Density analysis
3. Determination of Marsh funnel viscosity, Plastic viscosity, yield point and gel strength.
4. Determination of Filtrate loss and mud cake thickness.</td></tr>
</table>

Suggested Books:

1. Working Guide to Drilling Equipment and Operations, William C. Lyons, 1st Edition - September 16, 2009
2. Oilwell Drilling Engineering, H.L. Rabia, 1st May 1986
3. IADC Drilling Manual, 12th Edition 2015
4. Formulas and Calculating for Drilling, Production, and Workover, N.L. Lapeyrouse 4th Edition - November 2, 2015.
5. Casing Design – Theory and Practice, S.S. Rahman, G.V. Chilingarian. 1st Edition - August 1, 1995
6. Practical Well Planning and Drilling Manual, Steve Deveraux, 1st January 1998.
7. Composition and Properties of Drilling and Completion Fluids by H. C. H, 5th Edition 1988.
8. Composition and Properties of Drilling and Completion Fluids by H. C. H, 6th Edition 2011.
9. Drilling Fluid Engineering by Pal Skalle, September 2015.
10. Drilling and drilling fluids by G.V Chilingarian, P.Vorabutr, 1981.

<table>
<tr><th colspan="8">Course Teacher: Dr. Ranjan Phukan</th></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Title</td><td colspan="3">Contact Hours</td><td rowspan="2">Credits</td><td colspan="3">Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>In Sem</td><td>Total</td></tr>
<tr><td>PT 104</td><td>Fundamentals of Reservoir Engineering</td><td>3</td><td>1</td><td>0</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Course Objective</td><td colspan="7">The course aims to help students develop a complete understanding of the characteristics of petroleum reservoirs. This course covers an introduction to petroleum reservoirs, reservoir fluid and rock properties used in reservoir engineering applications, fundamentals of fluid flow in a reservoir under steady, unsteady, semi-steady state flow conditions, and special type of reservoir fluid flow like gas and water coning. Students will also learn about the reservoir drive mechanisms and their influence on oil reservoir performances, together with an introduction to reserves classification and the different reserve estimation methods. The course also aims to help students in developing their skills in analysing, interpreting, and presenting experimental findings.</td></tr>
<tr><td>Course Content</td><td colspan="7">Introduction to Petroleum Reservoirs
Reservoir Fluids and Phase Behavior: Phase behavior and phase diagrams; Fluid composition and fluid types classification; Natural gas properties; Crude oil properties; Formation water properties; Introduction of the cubic equation of state.
Reservoir Rock Properties: Porosity; Permeability; Fluid saturations; Wettability; Surface forces and Capillary pressure; Rock Compressibility; Reservoir Heterogeneity; Core analysis.
Fluid Flow in Reservoirs: Darcy’s law; Classification of reservoir flow systems; Steady-state flow equations for the flow of incompressible, compressible, and slightly compressible fluids.
Reservoir Drive Mechanisms: Primary recovery mechanisms and their effects on the performances of oil reservoirs.
Estimation of Petroleum Reserves: Classification of reserves as per PRMS; Reserve estimation methods: Volumetric, Material balance equations, Decline curve analysis, Reservoir simulation.
Reservoir fluid sampling and PVT analysis.</td></tr>
</table>

References and Resources:

1. Fundamentals of Reservoir Engineering, 1983 - L.P.Dake
2. Reservoir Engineering Handbook, 3rd Edition 2006 – T. Ahmed
3. Petroleum Reservoir Engineering, 1960 – J.W.Amyx, D.M.Bass, and R.L.Whiting
4. Applied Petroleum Reservoir Engineering, 2nd Edition 1990 – B.C.Craft and M.F. Hawkins
5. Fundamental Principles of Reservoir Engineering, 2002 – B.F.Towler
6. PVT and Phase Behavior of Petroleum Reservoir Fluids, 1998 – A.Danesh
7. Phase Behavior of Petroleum Reservoir Fluids, 2007 – K.S.Pedersen and P.L.Christensen
8. Equation of State and PVT Analysis, 2007 – T.Ahmed
9. Petrophysics – Theory and Practice of Measuring Reservoir Rock and Fluid Transport Properties, 2011, D.Tiab and E.C.Donaldson
10. Essentials of Multiphase Flow and Transport in Porous Media, 2008 – G.F.Pinder andW.G.Gray
11. Books and Journals of Society of Petroleum Engineers (SPE)

<table>
<tr><th colspan="8">Course Teacher: Dr (Mrs) Subrata Borgohain Gogoi</th></tr>
<tr><td rowspan="2">Course No.</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hours)</td><td rowspan="2">Credits</td><td colspan="2">Course Marks</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>InSem</td></tr>
<tr><td>PT 105</td><td>Flow through porous media</td><td>2</td><td>1</td><td>2</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td rowspan="2">Course Content</td><td colspan="8">Introduction: A porous medium is a solid containing void space (pores), either connected or unconnected, dispersed within it in either a regular or random manner. Fluid flow through porous media is the way fluids behave when flowing through a porous medium, for example in the underground oil and gas reservoir rocks. The basic law governing the flow of fluids through porous media is Darcy's Law, which was formulated by the French civil engineer Henry Darcy in 1856 since his experiments on vertical water filtration through sandbeds.</td></tr>
<tr><td colspan="8">Introduction: Importance of fluid flow through porous medium, influence in reservoir characteristics, influence of fluid characteristics, capture mechanisms.
Factors effecting flow in porous media: Influence of reservoir characteristics, influence of fluid characteristics.
Linear displacement: Frontal displacement, piston like displacement, two-three-dimensional displacement.
Injection well location: Central and peripheral flooding, pattern flooding.
Areal sweep Efficiency for pattern flood: Unit mobility ratio, non-unit mobility ratio.
Displacement mechanisms: Homogeneous reservoirs, heterogeneous reservoirs.
Water injection performance calculations: Analytical methods, homogeneous reservoirs, layered reservoirs (Stiles’s method, Dykstra-Parsons and Johnson methods).
Modeling & Simulation: 2D and 3D displacement using different software.
Micro fluidics: Tracer analysis</td></tr>
<tr><td>Practical</td><td colspan="8">Reservoir fluids analyses
Reservoir rock analyses
Flooding experiments in Core flood apparatus
Flooding experiments in Microfluidics</td></tr>
</table>

Books Recommended:

1. Flow through Porous Media, Hendrik Pieter, Eindhoven University of Technology, The Netherlands, 2022.
2. "Transport Phenomena in Porous Media" (2020) by Jacob Bear, Alexander H.-D. Cheng, and Ming Ye
3. "Flow and Transport in Porous Media and Fractured Rock: From Classical Methods to Modern Approaches" (2018) by Muhammad Sahimi

4. "Multiphase Flow in Porous Media" (2017) by Martin J. Blunt, Branko Bijeljic, and Harvey R. Stephen
5. Bear, J., Dynamics of Fluids in Porous Media, Dover, 1989
6. Gogoi SB, “Petroleum Technology –Enhanced Oil Recovery Techniques”, pub. Oxford 3. & IBH, 2014.
7. Craft, B.C. and Hawkins, M.F.:” Applied Petroleum Reservoir Engineering,” Prentice Hall, November 1964.

<table>
<tr><th colspan="8">Course Teacher: Dr. Dhrubajyoti Neog</th></tr>
<tr><td rowspan="2">Course No.</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hours)</td><td rowspan="2">Credits</td><td colspan="2">Course Marks</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>InSem</td></tr>
<tr><td>PT 106</td><td>Production Technology</td><td>3</td><td>1</td><td>0</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td rowspan="2">Course Content</td><td colspan="8">Introduction: The course is designed to impart knowledge of crude oil recovery methods and the multiplicity of problems involved in the extraction of crude oil from sub-surface reservoirs. The course provides a comprehensive and systematic discussion of a variety of oil field practices and well performance evaluation techniques employed in the oil industry. By the completion of the course, learners will be able to apply their knowledge to identify and analyze oil well concerns in order to develop an appropriate solution to oil field production challenges.</td></tr>
<tr><td colspan="8">1. Introduction to Oil Recovery methods:
Primary recovery, Secondary recovery, Improved Oil Recovery, Enhanced Oil Recovery, Recovery factor
2. Well Completion Design:
Well completion, types of well completion, Down-hole completion and tools, wellhead equipment, multi-zone completion
3. Well Activation methods:
Displacement, Compressor application, Application of Nitrogen, Aeration, Swabbing, Coiled Tubing unit, Use of artificial lifts
4. Performance Evaluation:
Drawdown and Productivity Index (PI), Specific Productivity Index (SPI), Inflow performance relationship (IPR), GOR, WOR, GLR
5. Flowing well performance:
Determination of inflow performance, vertical lift performance-flow regime in vertical two-phase flow, stable and unstable flowing conditions, choke performance, Nodal analysis
6. Well stimulation Techniques:
Well stimulation, well acidizing treatment, hydraulic formation fracturing, thermal stimulation, surfactant treatment, Microbial treatment
7. Artificial Lift methods:
Gas lift- Continuous and intermittent gas lift, unloading operations, gas lift valve components and mechanics, Plunger lift, Chamber lift Mechanical Pumping-Sucker Rod Pumping, components and operation, SRP installation, ESP-components and operation, Jet pump, Progressive Cavity Pump.</td></tr>
</table>

Books Recommended:

1. Introduction to Petroleum Production Vol. I & II, 1981, by D.R. Skinner
2. Principles of Oil Well Production, 1964, by T.E.W. Nind
3. Production Operations Vol. I & II, 1982, by Thomas & Roberts
4. Petroleum Engineering by Archer, & C.G. Wall, 1986
5. Petroleum Engineering, 1960, by Carl Gatlin
6. Applied Petroleum Reservoir Engineering, 1959, by Crafts & Hawkins
7. Fundamentals of Reservoir Engineering, 1978, by L.P Drake
8. Integrated Petroleum reservoir Management,1996, by Abdus Sattar and Ganesh C. Thakur
9. Technical manual for Production Operations, 2004, by R.K. Mukherjee. Institute of Oil &Gas Production Technology, ONGC Ltd., Panvel
10. Well completion and Servicing, Oil & gas Field Development Techniques, 1999, EditionsTechnip, D. Perrin
11. Enhanced Oil Recovery, Don W Green, G. Paul Willhite, 1998, SPE Textbook Series Vol 6.
12. Waterflooding, G. Paul Willhite, 1986, SPE Textbook Series, Vol. 3
13. Petroleum Production Handbook, 1962, Vol. I, Thomas C. Frick, Editor-in-Chief, R.William Taylor, Associate Editor, Journal of Petroleum Technology
14. Thermal Methods of Oil Recovery, 1985, J. Burger P. Sourieau, M. Combarnous, EditionsTechnip
15. Petroleum Exploration & Exploitation Practices, 2001, Dr. Bhagwan Sahay
16. Gas Lift Manual, Gabor Takacs, 2005, Ph.D. Petroleum Engineering Department,University of Miskolc, Hungary
17. Modern Petroleum Technology, 2001, Volume I, Upstream, Edited by Richard A. Dawe, 6th Edition
18. The Technology of Artificial Lift Methods, 1980, Kermit E. Brown, Vol 2, PennWell Publishing Company

AEC (Inter-Departmental)								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
PT 1A1	**Industrial Visit/Research Lab Visit/ Geological Field work**				**2**	**30**	**20**	**50**
	The students will undergo training in petroleum related industries/institutions including drilling site, OCS/GGS, research laboratory, and geological field visit. The research laboratory visit will comprise of visiting reservoir rock and fluid analyses lab, EOR lab, reservoir simulation labs, and refinery/petrochemical labs. Geological field work including mapping and sampling inthe outcropped sections of Assam and Fold -Thrust belt areas of northeast India. Marks distribution: Report submission (End sem): 30 Viva voce (In Sem): 20							

2nd SEMESTER

<table>
<tr><th colspan="8">Course Teacher: Dr. Pradip Borgohain</th></tr>
<tr><td rowspan="2">Course No.</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hours)</td><td rowspan="2">Credits</td><td colspan="2">Course Marks</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>In Sem</td></tr>
<tr><td>PT 201(T)</td><td>Exploration and Development of Oil & Gas Fields</td><td>2</td><td>1</td><td>2</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td></td><td colspan="8">Introduction: The course includes the different Exploration techniques of underground oil and gas deposits, and evaluation in the case of discovery. It covers the various steps to be followed during development of Oil & Gas fields. It discusses the principles of various well logging techniques and their application in hydrocarbon exploration, the mode of occurrence and distribution of unconventional hydrocarbon resources, overview on the application of sequence stratigraphy in hydrocarbon exploration and the role of regulatory bodies on E&P business in India.</td></tr>
<tr><td>Course content</td><td colspan="8">1. Petroleum exploration methods: Geological exploration methods; Geophysical exploration methods; Geochemical exploration methods; Microbial and other techniques
2. Well prognosis and economic analysis: Prognostication, prospect identification and location identification fordrilling; Classification and categorization of reserves; Economic analysis of the project; Well programme (GTO); Basics of geologging
3. Principles of development of oil & gas fields: Concept of development of oil & gas fields. Steps followed during development of oil & gas fields; Rational development system; Basic geologic data for development planning; Overview on Static and Dynamic Modelling; Well completion and its effects of reservoir characteristics; Perforation and well activation.
4. Well logging: Logging environment. Basic principles of operation of different types of open hole and cased hole logs. Qualitative and quantitative interpretation of well logs. Formation evaluation and lithology reconstruction from well logs. Well log correlation.
5. Preparation & interpretation of subsurface maps:Principles & methods of contouring. Construction of structure contour map,isopach map, isopay map, lithofacies map etc. and their applications in oil exploration & production
6. Concept of sequence stratigraphy and its application in Petroleum Exploration
7. Unconventional hydrocarbon system: Types, Occurrence & Distribution, Production Technologies & Environmental Impact
8. Overview on role of regulatory bodies on E&P business in India: Nomination/ NELP/DSF/HELP/OALP/Statutory Clearance and Processes.
9. Future hydrocarbon exploration in India with special reference to Assam-Arakan Basin/ NE India.</td></tr>
</table>

PT-201 (P):

1. Methods of contouring, Construction of structure contour map, sand –shale ratio map, isopach map, isopay map, reservoir thickness map and their interpretation from hydrocarbon exploration perspective
2. Preparation of geological cross sections and interpretation. Preparation of geological map and profile sections using DEM data
3. Lithofacies analysis from wire-line logs. Well log correlation & sections. Shale volume determination, measurement of porosity and lithology by using wireline logs. Formation evaluation

Books Recommended:

1. Theoretical Principles of Exploration and Development of Oil & Gas Accumulation by Bakirov, A.D
2. Geophysical Prospecting by Dobrin Milton B.
3. Handbook for Prospectors by Richard M. Peaut
4. Petroleum Exploration Handbook by Moody, GB.
5. Handbook of Subsurface Geology by Moore, C.A
6. Electrical methods in Geophysical Prospecting by George V. Keller
7. Development and Exploration of Oil and Gas Fields by Peace Publishers, Moscow
8. Geophysical Exploration by Heiland, C.A
9. New technologies for Exploration & Development of Oil and Gas Resources by Graham & Trotman
10. New Technology in Exploration Geophysics, by H. Roices Nelson Jr.
11. Formation Evaluation and Wellsite Geological Techniques by Bhagwan Sahay
12. Petroleum Exploration and Exploitation Practices by Bhagwan Sahay
13. Outlines of Geophysical prospecting by Ramchandra Rao
14. Seismic Stratigraphy by Robert E. Sherif
15. Applied Hydrodynamics in Petroleum Exploration by Eric C. Dahlbery
16. Oil and Gas Traps by Melkom K. Jenyon
17. Petroleum Source Rocks by Barry Katz
18. Geology for Petroleum Exploration, Drilling and Production by Norman J. Hyne
19. New Technologies for the Exploration and Exploitation of Oil and Gas resources by Miller, Joulia Asselt & Angyris.

<table>
<tr><th colspan="8">Course Teacher: Dr. Himanta Borgohain</th></tr>
<tr><td rowspan="2">Course No.</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hours)</td><td rowspan="2">Credits</td><td colspan="2">Course Marks</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>In Sem</td></tr>
<tr><td>PT-202 (T)</td><td>Seismic Prospecting in Petroleum Exploration</td><td>3</td><td>0</td><td>2</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td rowspan="2">Course Contents</td><td colspan="7">Introduction: Seismic method of prospecting is one of the major disciplines of Geophysics that depends upon velocities of acoustic energy in earth materials. The need of understanding the elastic properties of earth materials is very important while dealing with seismic survey. Seismic surveys involve in generation of short pulse of seismic energy by either natural or artificial source that propagates through different parts of earth’s crust to yield information on velocity contrast among different subsurface layers. Seismic methods are broadly classified into Reflection and Refraction seismic. Seismic methods of prospecting play the most important role in hydrocarbon exploration.</td></tr>
<tr><td colspan="7">1. Elasticity and seismic waves: Elasticity of materials, the elastic constants,Hooke’s law, Different types of elastic waves and the its propagation characteristics.

2. Basic concepts of seismic methods: Reflection, Refraction and Diffraction of seismic waves and the associated laws, Reflection and Transmission co- efficient, Effects of the medium on wave propagation, Partitioning of energy atan interface, Types of seismic noise.

3. Seismic data acquisition: Different aspects of reflection and refraction seismic survey, General discussion on seismic instruments and different energy sources, Spread types, Selection of field parameters, Up-hole survey, Basics of 2D &3Dseismicdataacquisition, A brief account of passive seismic.

4. Basics of seismic data processing: Different aspects of Geophysical signal theory, Filter Design, Fourier Transform, Z-transform, Convolution, Cross- correlation and Auto-correlation, Steps involved in seismic data processing (viz., Geometrical merging, Amplitude correction, Deconvolution, Static Correction, CMP Sorting, Velocity Analysis, NMO Correction, DMO Correction, Residual Static Correction, CMP Stacking, Migration).</td></tr>
</table>

PT-202 (P)

Practical: The practicals will be based on seismic reflection and refraction methods of prospecting and interpretation of seismic sections.

Books Recommended:

1. Lowrie,W.,2007.Fundamentals of Geophysics,2nd edition,Cambridge University Press.
2. Telford,W.M.,Geldart,L.P.,Sheriff,R.E.,1990.Applied Geophysics, Second Edition, Cambridge University Press.
3. Dobrin,M.B.,Savit,C.H.,1988.Introduction to Geophysical Prospecting, 4thEd., McGrawHill.
4. Sheriff, R.E., & Geldart, L.P., 1986 & 1987. Exploration Seismology Vol. 1 & 2, Reprinted. Cambridge.
5. Robinson,E.S.,Coruh,C., 1988. Basic Exploration Geophysics,1sted.,Wiley.
6. Yilmaz öz, 2000. Seismic Data Analysis: Processing, Inversion and Interpretation of Seismic Data, Society of Exploration Geophysics.
7. Kearey,P.,Brooks,M.,Hill,I., 2002. An Introduction to Geophysical Exploration, 3rdEd., Blackwell.
8. Milsom, J.,Eriksen, A., 2011. Field Geophysics, John Wiley&Sons.
9. Reynolds,J.M., 2011. An Introduction to Applied and Environmental Geophysics, 2nd edition,Wiley-Blackwell.
10. Gadallah, M. and Fisher, R., 2009. Exploration Geophysics-An Introduction, Springer.

<table>
<tr><th colspan="8">Course Teacher: Dr. M.A. Chowdhury and Dr Borkha Mech</th></tr>
<tr><td rowspan="2">Course No.</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hours)</td><td rowspan="2">Credits</td><td colspan="2">Course Marks</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>InSem</td></tr>
<tr><td>PT-203</td><td>Drilling Technology II</td><td>3</td><td>0</td><td>2</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Course Contents</td><td colspan="8">Introduction: This course aims to develop an understanding of the drilling practices, tools and methods that are conductive for fast and cost-effective drilling of an oil well. It provides an introduction to the basic methods, concepts and technology that can be applied for problem-free drilling</td></tr>
<tr><td>Theory</td><td colspan="8">1. Drilling optimization: deviation control, well path analysis, survey tools and methods, cuttings transport, torque and drag, rig hydraulics. Optimizing rate of penetration.
2. Directional drilling, applications, steering tools and BHA design, Horizontal drilling, multilateral drilling, extended reach drilling.
3. Clay mineralogy and chemistry of drilling fluids, rheology, and filtration property of drilling fluids, Air and gas drilling: basic principles, aerated drilling, foam drilling, innovations in drilling fluids.
4. Drilling complications, formation problems, stuckpipe, fishing, drilling fluids complicacy, Remedial and preventive measures.
5. Drilling services: Mud logging, LWD, MWD, RSS, Coring.
6. Innovative drilling techniques: coil tubing drilling (CTD), underbalanced drilling (UBD), managed pressure drilling (MPD), casing while drilling.</td></tr>
<tr><td>Practical</td><td colspan="8">1. Mud weight analysis: Comparison of theoretical and experimental values.
2. Chemical Analysis.
3. Rheological and Filtration behaviour study and comparative analysis with different additives.
4. Software tools.</td></tr>
</table>

Books Recommended:

1. Horizontal and Directional Drilling, Richard S. Carden, Robert D. Grace. 2007.
2. Well Engineering and Construction, H.L. Rabia, 2002.
3. Drilling Engineering, J.J. Azar, 2007.
4. Applied Drilling Engineering, A.T. Bourgoyne, K.K. Millheim, M.E. Chenevert, August 2016.
5. Practical Well Planning and Drilling Manual, Steve Deveraux, 1st January 1998.
6. Formulas and Calculating for Drilling, Production and Workover, N.L. Lapeyrouse, 4th Edition - November 2, 2015.
7. Composition and Properties of Drilling and Completion Fluids by H. C. H, 5th Edition 1988.
8. Composition and Properties of Drilling and Completion Fluids by H. C. H, 6th Edition 2011.
9. Drilling Fluid Engineering by Pal Skalle, September 2015.
10. Drilling and drilling fluids by G.V Chilingarian, P.Vorabutr, 1981.
11. Underbalanced Drilling: Limits and Extremes, Bill Rehm, Arash Haghshenas, Amir Saman Paknejad, 2013.
12. Measurement while drilling: Signal analysis, Optimization & Design, Wilson Chin 2018.

<table>
<tr><th colspan="8">Course Teacher: Dr Ranjan Phukan</th></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hours)</td><td rowspan="2">Credits</td><td colspan="2">Course Marks</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>InSem</td></tr>
<tr><td>PT-204</td><td>Applied Reservoir Engineering</td><td>3</td><td>1</td><td>0</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Course Description</td><td colspan="7">In this course, the students will learn about the practical application of reservoir engineering concepts. Starting with the transient flow equation, the focus will be on the CTR and CTP solutions to the diffusivity equation as an application for well test analysis and water influx calculations. This course also covers the transient well testing methods including pressure build-up analysis and drawdown testing of oil wells. In addition, the deliverability test of gas wells will also be addressed along with their production potential analysis. During this course, the students will also gain an understanding of the water influx models, immiscible displacement process, integrated reservoir management, and basics of reservoir simulation.</td></tr>
<tr><td>Course Content</td><td colspan="7">1. Flow Equations: Unsteady-state flow and derivation of radial diffusivity equation CTR solutions to diffusivity equations; Pseudosteady-state flow equations; Principle of superposition, Transient well testing.
2. Oil well Testing: Transient well testing methods; Pressure drawdown testing techniques; Pressure buildup analysis techniques; Type curve matchingmethods; Drill stem testing; Interference and pulse test analysis methods, Multi-flow.
3. Gas Well Testing: Applications of gas flow equations; Deliverability testingand well production potential analysis methods.
4. Water Influx: Classification of aquifers; Recognition of natural water influx,Water influx models, Reasons of water influx.
5. Immiscible Displacement: Fractional flow equation; Buckley-Leverett frontal advance equation; Principles of water flooding and other improved oil recovery methods
6. Integrated Reservoir Management: Fundamentals of reservoir management;Synergy and integration process.
7. Reservoir Simulation: Basic principles of reservoir simulation, its applications, and steps involved in the development of reservoir simulator, Monte-Carlo Simulation.</td></tr>
</table>

References and Resources:

1. Fundamentals of Reservoir Engineering, 1983 - L.P.Dake
2. Reservoir Engineering Handbook, 3rd Edition 2006 – T. Ahmed
3. Advanced Reservoir Engineering , 2005, Elsevier Inc. – T.Ahmed and P.D.McKinney
4. Applied Petroleum Reservoir Engineering, 2nd Edition 1990 – B.C.Craft and M.F. Hawkins
5. Oil Well Testing Handbook, 2004, Elsevier Inc. - A.U.Chaudhry
6. Gas Well Testing Handbook, 2003 by Elsevier Science - A.U.Chaudhry
7. Well Testing, 1982 SPE – John Lee
8. Petroleum Reservoir Simulation, 2nd Edition 2020 Elsevier Inc.– J.H.Abou-Kassem, S.M.F. Ali, and M.R.Islam.
9. Integrated Petroleum Reservoir Management: A Team Approach, 1996 PennWell Corp. - A.S. Satter and G.C. Thakur.
10. Books and Journals of Society of Petroleum Engineers (SPE)

<table>
<tr><th colspan="8">Course Teacher: Dr Dhrubajyoti Neog</th></tr>
<tr><td rowspan="2">Course No.</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hours)</td><td rowspan="2">Credits</td><td colspan="2">Course Marks</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>In Sem</td></tr>
<tr><td>PT-205</td><td>Surface Production Operations</td><td>3</td><td>1</td><td>0</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td rowspan="2">Course Content</td><td colspan="7">Introduction: The course provides a systematic and organized study of surface handling techniques of crude oil at processing facilities. The course discusses flow assurance measures as well as concerns related to crude oil processing at surface facilities. By completing the course, learners will be able to identify the specific needs of an installation and design a model with appropriate inclusion of process components.</td></tr>
<tr><td colspan="7">1. Surface gathering system
Types of gathering systems, fluid flow behavior, flow lines, headers, valves, flow behavior in gathering systems, crude oil measurement system for wellhead installations (WHI)/EPS/GGS. Mass flow meters, real time monitoring.
2. Gas processing
Two-phase separators, test separators, different separator types, stage separators, Dehydrators, Gas sweetening process, Sulphur recovery process, condensate separation
3. Liquid processing
Oil-water emulsions, free-water knockout, Treating emulsions-gravity separation, heating separation, Thermo-chemical treating, Treaters-Vertical and horizontal, Electrostatic separation-electrostatic treaters, Safety precautions with treaters
4. Surface handling of gas, oil and water
Underground storage of natural gas, liquid storage tanks, vapour recovery from storage tanks, equipment associated with liquid storage tanks, effluent water treatment, salt water disposal, standard operating procedures for crude oil measurement at central tank farm (CTF) to custody transfer points.
5. Flow assurance
Scales, Hydrate, Paraffin chemistry- methods of removal, preventing deposition and its control, Corrosion control – Lyntex modeling
6. Sand control
Mechanism, mechanical method- Gravel pack, Chemical method-Resin Consolidation.</td></tr>
</table>

Books Recommended:

1. Introduction to Petroleum Production Vol. I & II, 1981, by D.R. Skinner
2. Production Operations Vol. I & II, 1982, by Thomas & Roberts
3. Surface Operations in Petroleum Production, 1987, Vol. I, II & III by Chilingarian,Robertson A.R., Sanjay Kumar
4. Integrated Petroleum reservoir Management,1996, by Abdus Sattar and Ganesh C. Thakur
5. Principles of Petroleum Reservoir Engineering, 1991, Vol. II by Gian Luigi Chierici &translated from the Italian by Peter J. Westaway
6. Petroleum Engineering-Principles and Practices, 1986, by J.S. Archer & C.G Wall
7. Handbook of Natural Gas Engineering, 1959, by Katz
8. Enhanced Oil Recovery Processes & Operations, 1989, by Donaldson
9. Production & Transportation of Oil & Gas, 1975, by Szilas, Development in PetroleumScience, Vol. 3
10. Oilfield Processing, Vol. II: Crude Oil, 1995, Francis S. Manning, Ph.D. P.E & Richard E.Thompson Ph.D. P.E
11. Surface Production Operations, Design of Gas Handling Systems and Facilities, 2014, Vol.I, Vol. II, Ken Arnold Maurie Stewar
12. Petroleum Production Handbook, 1962, Vol. I, Thomas C. Frick, Editor-in-Chief, R.William Taylor, Associate Editor, Journal of Petroleum Technology.

Course Teacher: Dr. (Mrs) Subrata Borgohain Gogoi								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	InSem	
PT-206	**Enhanced Oil Recovery**	**3**	**1**	**0**	**4**	**60**	**40**	**100**
Course Content	**Introduction:** Enhanced oil recovery (abbreviated EOR), also called tertiary recovery, is the extraction of crude oil from an oil field that cannot be extracted during primary and secondary recovery mechanisms. EOR can extract 30% to 60% or more of a reservoir's oil, compared to 20% to 40% using primary and secondary recovery mechanisms.							
	1. **Introduction:** Principles of enhanced oil and gas recovery methods. IOR, EOR. Screening criteria for EOR methods. 2. **Water injection:** Displacement mechanisms, Performance calculations, Mathematical models, Practical interpretation of pressure fall off curves. 3. **Immiscible displacement:** Injection well location, production well completion, surface installation. 4. **Miscible displacement:** Principles of miscible displacement**,** ternary diagrams, Enriched gas injection (Condensing gas drive), HP natural gas injection (Vaporizing gas drive), LPG slug injection, Alcohol slug injection, physical and mathematical modelling. 5. **Thermal recovery methods:** Hot fluid displacement, in-situ combustion, numerical simulation models. 6. **Chemical recovery methods:** Principles of chemical displacement, Alkaline flooding, Surfactant/micellar flooding, polymer flooding (inverted pattern) and their combinations, modelling and simulation. 7. **Other methods:** Foam injection, CO_2 flooding, microbial flooding. 8. **Development of images:** Velocity vectors and pressure contours in ANSYSFLUENT. 9. **Designing flow parameters:** Design Expert, GrapherandCalcPlot3D. 10. **Carbonated water injection (CWI);** Produced water injection.							

Books Recommended:

1. Latil,M. Enhanced Oil Recovery,Techniq,1980.
2. James J Sheng, "Enhanced Oil Recovery Field Case Studies",2013
3. James J Sheng, "Enhanced Oil Recovery in shale and tight reservoir", 2019
4. Marcin Kremieniewski, "Fundamentals of Enhanced Oil Recovery" , 2022
5. Larry W. Lake," Enhanced Oil recovery", 1989
6. Advances in Petroleum Technology – Enhanced Oil Recovery Techniques, Gogoi SB, Pub. Jenny Stanford Publishing, New York, 2020. eBook ISBN: 9781003049937,https://doi.org/10.1201/9781003049937

AECC (Intra-Departmental)								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	InSem	
PT-2A1	**Industrial Visit**				**2**	**30**	**20**	**50**
	The visit will be in the nearby oil industries. The evaluation of the visit will be based on the submission of the report followed by viva-voce and performance of the student during the visit. The report will be examined internally by the concerned Teacher(s) in – charge of the visit End Sem: 30 marks (Seminar + Viva-voce + performance during field) In Sem: 20 marks (Report)							

3rd SEMESTER

<table>
<tr><td colspan="8">Course Teacher: Dr. (Mrs.) Subrata Borgohain Gogoi & Guest Lecturer</td></tr>
<tr><td rowspan="2">Course No.</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hours)</td><td rowspan="2">Credits</td><td colspan="2">Course Marks</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>In Sem</td></tr>
<tr><td>PT- 301</td><td>Natural Gas Engineering</td><td>3</td><td>1</td><td>0</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td></td><td colspan="7">Introduction: The purpose of the course is to understand the natural gas reservoirs and their production. This gives insight about the natural gas properties, utilization of natural gas, natural gas industry (World and India) and natural gas reserves. It covers Wellbore and Choke performances for gas wells, Gas processing methods at the surface, Gas flow measurement and fundamentals, Gas Reservoir Performance, Volumetric measurement and Transportation. Importance of Unconventional Gas Reservoirs such as Gas Hydrates and Shale Gas.</td></tr>
<tr><td>Course Content</td><td colspan="7">1. Introduction:
Properties: Specific gravity, Pseudo critical properties, Viscosity, Compressibility factor, Gas density, Formation volume factor and expansion factor, Compressibility of natural gas, Real gas pseudo pressure and real gas normalized pressure. Drilling for Gas Reservoir (Conventional and Unconventional): Rig components and structure, Mechanism, Offshore and Onshore, Underbalanced Drilling Technology. Gas reservoir deliverability: Introduction, Analytical methods, Empirical methods and Construction of inflow performance relation curve.
2. Wellbore and Choke performance:
Introduction, Single phase gas well, Mist flow in gas wells. Choke performance: Introduction, Sonic and subsonic flow, Dry gas flow through chokes, Wet gas flow through chokes. Well deliverability: Introduction, Nodal analysis, Analysis with wellhead node.
3. Gas flow measurement and fundamentals:
Steady State Flow of Gas in Production Tubing, Temperatures profiling in flowing gas systems. Volumetric measurement: Measurement with orifice meters, Displacement metering, Turbine meter, Elbow meter, Natural gas liquid measurement.
4. Importance of Unconventional Gas Reservoirs:
Gas Hydrates: Phase stability, Kinetics, Prevention for flow assurance, Storage and Transportation, Roles and Applications. Shale Gas: Properties, Exploration Technique, Fracking, Roles and Applications.
5. Natural Gas as an Alternative Fuel:
Methanol, ethanol, dimethyl ether production and compatibility with fossil fuel.</td></tr>
</table>

Books Recommended:

1. Boyan Guo Ali Ghalambor, "Natural Gas Engineering Handbook", Gulf publishing company. 2012.
2. Elbashir, etc 2019. "Natural Gas Processing from Midstream to Downstream", Willey 2019.
3. Anurodh Dayal, Devleena Mani Shale Gas- Exploration and Environmental and Economic Impacts 1st Edition - January 23, 2017.
4. Renewable Hydrogen Production by Haris Ishaq and İbrahim Dinçer, 2022

<table>
<tr><th colspan="8">Course Teacher: Dr (Mrs) Subrata Borgohain Gogoi & Guest Lecturer</th></tr>
<tr><td rowspan="2">Course No.</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hours)</td><td rowspan="2">Credits</td><td colspan="2">Course Marks</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>In Sem</td></tr>
<tr><td>PT- 302</td><td>Health, Safety & Environment (HSE) and Petroleum Economics (PE)</td><td>2</td><td>1</td><td>2</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td></td><td colspan="7">Introduction: HSE is one of the vital constituents of oil industry activities because most of the operational conditions, chemicals and end products (hydrocarbons and other compounds) associated with Oil and Gas production are well-known to pose serious safety and health threats to the workers.
PE is petroleum business dealing with strategic issues such as dynamics of petroleum pricing; the risk, uncertainty, and decision analysis. Implications of fiscal and trade policies will also be covered.</td></tr>
<tr><td rowspan="2">Course Content</td><td>Part 1- HSE</td><td colspan="6">1. Introduction
2. Health hazards in Petroleum Industry: Toxicity, Physiological, Asphyxiation, respiratory and skin effect of petroleum hydrocarbons, sour gases.
3. Safety: Manual & automatic shutdown system, blow down systems. Gas detection system. Fire detection and suppression systems. Personal protection system & measures. HSE Policies. Disaster & crisis management in Petroleum Industry.
4. Environment: Environment concepts, impact on eco-system, air, water and soil. The impact of drilling & production operations on the environment, Environmental transport of petroleum wastes.
5. Geopolitical issues like the impact of the Covid-19 pandemic and the Russia-Ukraine war on the global oil market.</td></tr>
<tr><td>Part 11- PE</td><td colspan="6">1. Introduction
2. Structure of OPEC, Cartel, Role of OPEC in explaining oil price, Role of Saudi Arabia
3. Petroleum as a depleting resource; Can depletion and rising costs explain price development, Cost performance of global oil industry and Oil Spills.
4. Exchange Rate, Determination of Exchange Rate, Oil Price</td></tr>
</table>

		Shock, Implications of fiscal and trade policies (with special attention to exchange rate policies, BOP crisis and Indian economy)

Books Recommended:

1. Process Safety in Upstream Oil and Gas 1st Edition, Publisher Wiley- AICHE, 2021
2. Online HSE Manual, https://pdfgoal.com/downloads/hse_manual_for_oil_and_gas_suppliers, 2022
3. Risk Management in the Oil and Gas Industry, publisher MIT Energy Initiative by Nancy Leveson,2011.

<table>
<tr><th colspan="8">Course Teacher: Dr. Dhrubajyoti Neog</th></tr>
<tr><td rowspan="2">Course No.</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hours)</td><td rowspan="2">Credits</td><td colspan="2">Course Marks</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>InSem</td></tr>
<tr><td>PT-303</td><td>Well Servicing</td><td>2</td><td>1</td><td>2</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td rowspan="2">Course Content</td><td colspan="7">Introduction: The course discusses different aspects of oil well workover operations associated with the upstream petroleum industry, which aids in understanding the diverse types of sick well issues. Its practical component is designed to help acquire skills for problem analysis in order to develop solutions to oil well challenges.</td></tr>
<tr><td colspan="7">1. Sickwell:
Sick well, problem analysis, identification and diagnosis of well problems, re-completing a new zone/reservoir, completing in multiple reservoirs, techniques of perforation, perforation guns
2. Workover operations & equipment:
Workover, need for workover operations, workover procedure, well killing methods, work string, casing scraper, Junk and Boot baskets, cement retainer, casing roller, bridge plug, cement plug, milling and fishing tools for workover operations.
3. Workover fluids:
Completion and workover fluids-Types, packer fluids
4. Well Intervention:
Mechanical wireline and its operations, wireline unit, wireline tools, Coiled Tubing Operations, production logging tools.
5. Problems associated with WO operations"
6. Lab-work/Practical:
1. Characterisation of formation water with water analyser, flame photometer and atomic absorption spectrophotometer
2. Rheological behaviour study
3. Reservoir rock/outcrop analysis
4. Workover fluid formulation
5. Production well problem study
6. Wettability study</td></tr>
</table>

Books Recommended:

1. Technical manual for Production, 2004, by R.K. Mukherjee. Institute of Oil & Gas Production Technology, ONGC Ltd., Panvel.
2. Well completion and Servicing, Oil & gas Field Development Techniques, 1999, Editions Technip, D.Perrin
3. Modern Petroleum Technology, 2001, Volume I, Upstream, Edited by Richard A. Dawe, 6thEdition
4. Production Operation, 1982, Vol. I, II by Thomas & Roberts
5. Petroleum Production Handbook, 1962, Vol. I, Thomas C. Frick, Editor-in-Chief, R. William Taylor,Associate Editor, Journal of Petroleum Technology
6. Petroleum Exploration & Exploitation Practices, 2001, Dr. Bhagwan Sahay
7. Petroleum Production Engineering, 2017, 2nd Edition, by Xuehao Tan, Xinghui Liu, Boyun Guo,ISBN: 9780128096123
8. Waterflooding, 1986, G Paul Willhite, SPE Textbook Series, Vol.3

Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	InSem	
PT-3D1	**Project Work**				**4**	**60**	**40**	**100**
Course Contents	The students will undertake projects individually or as a team in consultation with the course teacher(s).							

In Sem	**Progress seminar(2nos.): 20+20= 40 marks**
End Sem	**A. Project Report**: **60marks** **B. Seminar & viva-voce**: **60marks**

Generic Elective Course (For students of other Departments)

<table>
<tr><th colspan="8">Course Teacher: Dr. Dhrubajyoti Neog</th></tr>
<tr><td rowspan="2">Course No.</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hours)</td><td rowspan="2">Credits</td><td colspan="2">Course Marks</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>InSem</td></tr>
<tr><td>PT-3G1</td><td>Oil Well Production Technology</td><td>3</td><td>1</td><td>0</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td rowspan="2">Course Contents</td><td colspan="7">Introduction: The course provides an overview of petroleum production technologies and crude oil field handling methods at processing plants. Its contents are intended to impart knowledge about crude oil production systems.</td></tr>
<tr><td colspan="7">1. Basics of Petroleum Geology:
Basics of origin, occurrence, movement, accumulation and exploration of hydrocarbons.
2. Well Completion Design:
Oil well production mechanisms, well completion-types, Down-hole completion and tools, wellhead equipment, multi-zone completion, well activation
3. Well performance:
Drawdown and Productivity Index (PI), Inflow performance relationship (IPR), vertical lift performance- flow regime in vertical two-phase flow, stable and unstable flowing conditions, choke performance, Nodal analysis
4. Artificial Lift methods:
Gas lift- Continuous and intermittent gas lift, unloading operations, Plunger lift, chamber lift, Mechanical Pumping- Sucker Rod Pumping, components and operation
5. Surface production operations:
Surface gathering system-types, headers, two & three phase separators, Oil-water emulsions, free-water knockout, Treaters-vertical and horizontal, electrostatic separation-electrostatic treaters, safety precautions with treaters</td></tr>
</table>

Books Recommended:

1. Introduction to Petroleum Production Vol. I & II, 1981, by D.R. Skinner
2. Principles of Oil Well Production, 1964, by T.E.W. Nind
3. Petroleum Engineering by Archer, & C.G. Wall, 1986
4. Petroleum Engineering, 1960, by Carl Gatlin
5. Fundamentals of Reservoir Engineering, 1978, by L.P Drake
6. Well completion and Servicing, Oil & gas Field Development Techniques, 1999, EditionsTechnip, D. Perrin
7. Enhanced Oil Recovery, Don W Green, G. Paul Willhite, 1998, SPE Textbook Series Vol 6.
8. Waterflooding, G. Paul Willhite, 1986, SPE Textbook Series, Vol. 3
9. Thermal Methods of Oil Recovery, 1985, J. Burger P. Sourieau, M. Combarnous, EditionsTechnip
10. Petroleum Exploration & Exploitation Practices, 2001, Dr. Bhagwan Sahay
11. Gas Lift Manual, Gabor Takacs, 2005, Ph.D. Petroleum Engineering Department, University ofMiskolc, Hungary

12. Oilfield Processing, Vol. II: Crude Oil, 1995, Francis S. Manning, Ph.D. P.E & Richard E. Thompson Ph.D. P.E
13. Surface Production Operations, Design of Gas Handling Systems and Facilities, 2014, Vol I,Vol. II, Ken Arnold Maurie Stewar
14. Petroleum Production Handbook, Vol. I, 2006, Thomas C. Frick, Editor-in-Chief, R. WilliamTaylor, Associate Editor, Journal of Petroleum Technology

<table>
<tr><th colspan="8">Course Teacher: Dr Pradip Borgohain</th></tr>
<tr><td rowspan="2">Course No.</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hours)</td><td rowspan="2">Credits</td><td colspan="2">Course Marks</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>In Sem</td></tr>
<tr><td>PT-3G2</td><td>Petroleum Geoscience</td><td>3</td><td>1</td><td>0</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td rowspan="2">Course Contents</td><td colspan="7">Introduction: The course deals with the principles of origin, migration, accumulation of petroleum in a basin. It covers in a comprehensive way the background for understanding the basic concepts and principles of petroleum geology and its applications to hydrocarbon exploration. The course is also designed to throw knowledge on the exploration & development methods of hydrocarbon deposits both conventional and unconventional.</td></tr>
<tr><td colspan="7">1. Overview on Petroleum system (Source rock, reservoir rock, caprock)
2. Origin, migration and accumulation of petroleum
3. Rock Eval Pyrolysis analysis. Maturation of source rock (Time-Temperature Index).
4. Types and distinguishing properties of reservoir rocks & fluids
5. Reservoir Trap- types and genesis
6. Concept of lifecycle of an oilfield
7. Different reservoir drive mechanisms and their effect on hydrocarbon recovery
8. Enhanced Oil Recovery (EOR) techniques
9. Sandstone diagenesis and its effects on reservoir properties
10. Clay mineral types and its impact in reservoir rock
11. Principles and application of wireline log sin reservoir studies
12. Brief overview on types and occurrence unconventional hydrocarbon resources
13. Geographic and geologic distribution of oil and gas field in India with special reference to north east India
14. Overview on role of regulatory bodies on E&P business in India (i.e. Nominated/NELP/DSF/HE LP/OALP)</td></tr>
</table>

Books Recommended:

1. Petroleum Geology by F.K. North, Publisher: Allen & Unwin
2. Elements of Petroleum Geology by R. C Selly. Publisher: Academic Press
3. Basic Petroleum Geology by P. K. Lint. Publisher: OGCI
4. Geology of Petroleum by A.I. Levorsen, Publisher: W.H. Freeman & co.
5. Petroleum Formation & Occurrence By- Tissot, B.P. & Welte, D.H. Publisher: Springer
6. Petroleum (Indian context) by D. Chandra & R.M. Singh. Publisher: Tara Book Agency, Varanasi
7. Petroleum Geochemistry and Geology - by J.M. Hunt, San Francisco: W. H. Freeman & Company
8. Petroleum Formation & Occurrence - by, B.P. Tissot&D.HWelte, Springer – Verlag
9. Advances in Petroleum Geochemistry - by J. Brooks & D. Welteed. New York: Academic Press
10. An Introduction to Organic Geochemistry - by S D Killops& V S Killops
11. Petroleum Source Rocks - by B. J. Katz (Ed.) Springer- Verlag
12. Petroleum Geochemistry – by D. Satyanarayana, Daya Publishing House, New Delhi

<table>
<tr><th colspan="8">Course Teacher: Dr. Ranjan Phukan</th></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Teaching Scheme (Hours)</td><td rowspan="2">Credits</td><td colspan="2">Course Marks</td><td rowspan="2">Total Marks</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>In Sem</td></tr>
<tr><td>PT- 3G3</td><td>Carbon Capture Utilization and Storage (CCUS)</td><td>3</td><td>1</td><td>0</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Course Descriptions</td><td colspan="7">The objective of this course is to provide the students with an understanding of CCUS technologies as a means of achieving Net Zero emissions target. The course will provide an overview of greenhouse gas (GHG) emission effects on climate change and the global Net Zero strategy. The crucial role played by CCUS technologies in meeting emission and global climate targets will be highlighted with a special focus on enhanced oil recovery implementation. The various technical features of CCUS deployment, starting from capture to storage and/or utilization will be part of this course. Additionally, anthropogenic CO_2 injection in oil reservoirs as a CCUS method will also be illustrated.</td></tr>
<tr><td>Course Contents</td><td colspan="7">1. Overview of GHG emissions and climate change: Global status of GHG emission trends and its effect on Global Warming.
2. Net Zero strategy: Intergovernmental Panel on Climate Change (IPCC) assessments, Conference of the Parties (COP), Paris Agreement, and Kyoto Protocol; Global Roadmap to Meet Emission Targets, India’s LongTerm Low Emissions Development Strategy (LTS).
3. Sustainable Solutions to Achieving Net Zero Emissions: Natural-based and Technological Approach.
4. Carbon Capture Technologies: Post-Combustion Carbon Capture, Pre- combustion Carbon Capture, Oxy-Fuel Technology, and Advanced Capture Technologies.
5. Sequestration Methods: Geological Sequestration in Oil, Gas, Saline Aquifers, and Potential Coal Fields
6. CO_2 injection as a CCUS method: Enhancing Oil Recovery and CO_2 storage by CO_2 injection in oil reservoirs; Feasibility study of CO_2-EOR for CCUS project deployment.</td></tr>
</table>

References and Resources:

1. Legal and Regulatory Frameworks for CCUS, International Energy Agency, OECD Publishing, 2022.
2. Climate Change and Greenhouse Gas Emission - Pratap Bhattacharyya, Sushmita Munda, Pradeep Kumar Dash, 2020.
3. Net Zero - How We Stop Causing Climate Change by Dieter Helm, 2021.
4. Emerging Carbon Capture Technologies Towards a Sustainable Future, Humaira Siddiqui, Mika Sillanpää, Mohammad Khalid, Swapnil A. Dharaskar, Elsevier 2022.
5. Advanced CO_2 Capture Technologies Absorption, Adsorption, and Membrane Separation Methods by Shin-ichi Nakao, KatsunoriYogo, Kazuya Goto, Teruhiko Kai, Hidetaka Yamada, 2019.
6. Carbon Capture and Sequestration Integrating Technology, Monitoring, Regulation - David Gerard, Elizabeth Wilson, Wiley 2007.
7. Carbon Capture Sequestration and Storage - Ronald E. Hester, Roy M. Harrison, Royal Society of Chemistry, 2010.
8. Carbon Capture, Utilization and Sequestration - Ramesh K. Agarwal, IntechOpen, 2018
9. Books and Journals of Society of Petroleum Engineers (SPE).

Course Teacher: Dr Borkha Mech								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
PT 3G4	**Fundamentals of Oil Well Drilling**	**3**	**1**	**0**	**4**	**60**	**40**	**100**
Course Content	***Introduction:*** This course provides an understanding of the essential principles of Oil Well Drilling. It presents a systematic approach to the equipment, process and design of major systems required for drilling an oil well. Subsurface and wellbore pressure relations are highlighted throughout the course for safe planning and design.							
	1. Introduction to oil well drilling, drilling process, Oil well drilling rigs, onshore/offshore, rig components and arrangement, hoisting, rotation, circulating system 2. Subsurface conditions, pressure relations within formation and wellbore, and fracture pressure, well control fundamentals and equipment. 3. Drill string, Drill bits, Casing: Types and functions, components and accessories. 4. Drilling fluids – functions, types, composition, and properties, drilling fluid additives and treatment. 5. Cementing, types of cement, cement slurry, additives, equipment, cementing operation. 6. Vertical and Directional drilling.							

Suggested Books:

1. Working Guide to Drilling Equipment and Operations, William C. Lyons, 1st Edition - September 16, 2009
2. Oilwell Drilling Engineering, H.L. Rabia, 1st May 1986
3. IADC Drilling Manual, 12th Edition 2015
4. Formulas and Calculating for Drilling, Production, and Workover, N.L. Lapeyrouse 4th Edition - November 2, 2015.
5. Casing Design – Theory and Practice, S.S. Rahman, G.V. Chilingarian. 1st Edition - August 1, 1995
6. Practical Well Planning and Drilling Manual, Steve Deveraux, 1st January 1998.
7. Composition and Properties of Drilling and Completion Fluids by H. C. H, 5th Edition 1988.
8. Composition and Properties of Drilling and Completion Fluids by H. C. H, 6th Edition 2011.
9. Drilling Fluid Engineering by Pal Skalle, September 2015.
10. Drilling and drilling fluids by G.V. Chilingarian, P.Vorabutr, 1981

Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
PT-3A1	**Industrial Training**				**4**	**60**	**40**	**100**
Course Contents	The period of the training, will be for one (1) month, in nearby E&P industry. The evaluation of the industrial training will be based on submission of the training report, performance of the student during training period, seminar presentation and viva-voce examination. **In Sem.:** 40 marks (Report) **End Sem:** 60 marks (Seminar and Viva-voce)							

4th SEMESTER

Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
PT-401	**Dissertation**				**20**	**180**	**120**	**300**
Course Contents	Every student will have to take up a dissertation work on a topic of practical/industrial importance during the fourth semester under supervision of a teacher in the department. There may be a co-guide for the dissertation from industrial organizations if and when required.							

In Sem	**Progress Seminar (2nos.): 60+60=120 marks**
End Sem	**A. Dissertation Report**: **120 marks** [External examiner: 60 marks +Internal examiner: 60 marks] **B. Seminar & Viva-voce on Dissertation**: **60 marks** [Examination Board including External examiner]