SYLLABUS

OF

M.TECH. PROGRAMME

(PETROLEUM EXPLORATION

& PRODUCTION)

2021-22

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								
PT101 (T)	Petroleum Geology	2	1	0	3	45	30	75
PT101 (P)		0	0	2	1	15	10	25
PT102 (T)	Geophysical Exploration and Prospecting	2	1	0	3	45	30	75
PT102 (P)		0	0	2	1	15	10	25
PT103	Drilling Technology - I	3	1	0	4	60	40	100
PT104 (T)	Fundamentals of Reservoir Engineering	2	1	0	3	45	30	75
PT104 (P)		0	0	2	1	15	10	25
PT105 (T)	Flow through Porousmedia	2	1	0	3	45	30	75
PT105 (P)		0	0	2	1	15	10	25
PT106	Production Technology	3	1	0	4	60	40	100
Ability Enhancement Courses (AEC)[Any one course]								
PT1A1	Technical English& Professional Communication	Offered by the Department of English			2			50
	Application of Remote Sensing UAV	Offered by the Centre for Studies in Geography			2	30	20	50

	Industrial visit / Geological Fieldwork		2	30	20	50
	Any other inter-disciplinary Courses					

2nd Semester M.Tech. (Petroleum Exploration & Production) Programme [TotalCredits:26,Totalmarks:750]

Course No.	Course Name	Teaching Scheme(Hours)			Credits	Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
Core Courses								
PT201(T)	Exploration & Development of Oil & Gas fields	2	1	0	3	45	30	75
PT201 (P)		0	0	2	1	15	10	25
PT202 (T)	Geophysical Exploration and Data Processing	2	1	0	3	45	30	75
PT202 (P)		0	0	2	1	15	10	25
PT203	Drilling Technology-II	3	1	0	4	60	40	100
PT204	Applied Reservoir Engineering	3	1	0	4	60	40	100
PT205	Surface Production Operations	3	1	0	4	60	40	100
PT206	Enhanced Oil Recovery	3	1	0	4	60	40	100

Ability Enhancement Compulsory Courses(AECC)						
PT2A1	Industrial Visit	Visit in Oil industries (OIL, ONGC etc.)	2	30	20	50

3rd Semester M.Tech. (Petroleum Exploration & Production) Programme [TotalCredits:24,Totalmarks:650]

Course No.	Course Name	Teaching Scheme(Hours)			Credits	Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
Core Courses								
PT301	HSE and Risk Management	3	1	0	4	60	40	100
PT302(T)	Drilling Fluid Technology and Cementation	3	0	0	3	45	30	75
PT302 (P)		0	0	2	1	15	10	25
PT303(T)	Well Servicing	2	1	0	3	45	30	75
PT303 (P)		0	0	2	1	15	10	25

Discipline Specific Elective(DSE)								
PT3D1	Minor Project	**Intra-departmental**			4	60	40	100
Generic Elective(GE) [Offered by the Department of Petroleum Technology]								
PT3G1	Oil Well Production Technology	3	1	0	4	60	40	100
PT3G2	Petroleum Geo science	3	1	0	4	60	40	100
PT3G3	Reservoir Rock and Fluid Properties	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			100
AG3G2T	Standard Field & Laboratory Techniques				4			100
AG3G2P								
AG3G3T	Geo scientific Data Analysis with Mat Lab &Petrel (Lab Based)				4			100
AG3G3P								
GG3G1	Hydrology	Offered by the Centre for Studies in Geography			4			100
GG3G2	Application of Geo informatics in Petroleum Exploration				4			100
GG3G3	Geography of Tribal Studies				4			100

Ability Enhancement Compulsory Courses (AECC)						
PT3A1	Industrial Training	Training for minimum 3weeks duration in Oil Industries	4	60	40	100

4th Semester M.Tech. (Petroleum Exploration & Production) Programme [TotalCredits:20,Totalmarks:300]

Course No.	Course Name	Teaching Scheme(Hours)			Credits	Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
Core Course								
PT401	Dissertation	Dissertation in Oil industries (One semester)			20	180	120	300

TheCBCSBoardoftheDepartmentmaychangethemodeofexaminationandevaluationoftheDissertationfromtimetotimeasandwhenrequired.

2. COURSE CONTENT

2.1. 1st SEMESTER

<table>
<tr><td colspan="8">Course Teacher: Dr. Pradip Borgohain</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 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 & non clastic), classification and characteristics of clastic, non- clastic and evaporate rocks as reservoir. Grain size analysis

3. Stratigraphy & micro- paleontology:
➢ Concept of lithostratigraphy, biostratigraphy & chrono stratigraphy.
➢ Geologic timescale
➢ Depositional environments
➢ Application of micro fossil in hydrocarbon exploration with emphasis on 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</td></tr>
</table>

	➢Role of time and temperature in petroleum generation 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 carbonate reservoir rock 7. **Petroleum Province**: Geographic and geologic distribution of oil and gas field in India with special reference to northeast India
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 to 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, D.H. Publisher: Springer
6. Petroleum (Indian context) by D. Chandra & R.M. Singh. Publisher: Tara Book Agency,Varanasi
7. Introduction to Sedimentology by S.M. Sengupta, Publisher: Oxford & IBH Publishing Co. Pvt. Ltd., NewDelhi
8. Principles of Sedimentology & Stratigraphy by Sam Bogs, Publisher: Pearson Education Ltd.,London
9. Sandstone Reservoir by John H. Barwis, et.al. Publisher: Spinger–Verlag
10. Sedimentary structures by J.D. Collinson & D.B. Thompson Publisher:CBS Publisher & Distributors, NewDelhi.

<table>
<tr><th colspan="8">Course Teacher: 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-102</td><td>Geophysical Exploration & Prospecting</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: The study of Physics of the Earth and its environment in space is collectively known as Geophysics. The potential field theory-based methods (Gravity, Magnetic, Electrical techniques) and well logging methods of geophysical prospecting play vital role in gathering information for mineral and hydrocarbon exploration. Well logging, also known as borehole geophysical prospecting is the practice of making a detailed record (a well log) of the geologic formations penetrated by a borehole. The log may be based either on visual inspection of samples brought to the surface (geological logs) or on physical measurements made by instruments lowered into the hole (geophysical logs). Well logging can be done during any phase of a well's history; drilling, completing, producing and abandoning. Well logging is done in boreholes drilled for the oil and gas, groundwater, minerals, geothermal, and for environmental and geotechnical studies.</td></tr>
<tr><td></td><td colspan="8">1. An overview of Exploration Geophysics: Geophysics as an exploration tool, brief accounts of different fields of exploration geophysics, exploration strategies for the virgin areas and those having inadequate data.

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, Basics on gravity data processing and interpretation, Airborne gravity survey.

3. Magnetic methods of prospecting: Earth’s magnetism, Types of magnetism, Magnetic susceptibility, Magnetic effects from buried magnetic bodies, Instruments used for magnetic survey, Brief introduction to Magnetic data processing and interpretation. Airborne magnetic survey.

4. Electrical methods of prospecting: Basics of methods in Electrical prospecting and recent applications.

5.Well logging: basic principles, objective, classifications, equipment</td></tr>
</table>

	(sondes /tools used in well logging including their basic principles, logging environment, calibration and quality control). 6. **Techniques of well logging (Types & Basic Principles):** a) Conventional Open Hole Log Suite: SP logs, Caliper log, Resistivity logs, Natural Gamma ray (GR) log & Spectral Gamma ray log, Azimuthal Gamma ray log, Sonic logs, Neutron log, Formation Density log, Photoelectric log & Azimuthal density images. b) Additional/Advanced Open Hole Log Suite: Dipmeter log, NMR, Formation Pressure test & Sampling. c) Cement Evaluation Tools d) Production Logging tools. 7. **Log Interpretation** - Quick look method of log interpretation - Qualitative interpretation - Quantitative interpretation 8. **Introduction to VSP and its principle and geo scientific advantages**. 9. **Advances in Logging tools**
Practical	1. Analysis of log to determine lithology, shaliness etc. 2. Calculation of formation water resistivity. 3. Calculation of water saturation (Sw). 4. Calculation of Porosity. 5. Calculation of Shale volume.
Books Recommended:	1. Introduction to Geophysical Prospecting by Milton B. Dobrin 2. Roy, K.K., Potential Theory in Applied geophysics, Springer, 2008. 3. Basic Exploration Geophysics by Edwin S. Robinson and Cahit Coruh 4. Outlines of Geophysical Prospecting by M.B. Ramachandra Rao. 5. Nettleton, L.L., Elementary Gravity and Magnetics for Geologists and Seismologists, SEG, 1971, https://doi.org/10.1190/1.9781560802433. 6. Geophysical Well-logging, Principles and Practices by J.P. Vaish 7. Well Logging in Nontechnical Language by David E. Johnson & Kathryne E. Pile

Course Teacher: Dr M.A. Chowdhury								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
PT 103	**Drilling Technology I**	**3**	**1**	**0**	**4**	**60**	**40**	**100**

	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. Degree-level background in physics, chemistry & mathematics is required to undertake this course.
Course Content	1. Introduction to oil well drilling, drilling process, directional wells. Oil well drilling rigs, onshore/offshore, rig components and arrangement. 2. Subsurface conditions, pressure relations within formation and well bore, geomechanics, and fracture pressure. Drilling fluids and well control fundamentals. 3. Drill string, components, basic load analysis. Drill bit, types/classification, design factors, selection. 4. Casing, types and functions, components and accessories, casing policy, casing load analysis and design. 5. Cementing, types of cement, cement slurry, additives, equipment, cementing operation, design of cement job. 6. Drilling process analysis: hoisting, rotation, pumping, hydraulics. Basic well planning: data acquisition and analysis, drilling program

Suggested Books:

1. Working Guide to Drilling Equipment and Operations, William C. Lyons
2. Oilwell Drilling Engineering, H.L. Rabia
3. IADC Drilling Manual
4. Formulas and Calculating for Drilling, Production, and Workover, N.L. Lapeyrouse
5. Casing Design – Theory and Practice, S.S. Rahman, G.V. Chilingarian.
6. Practical Well Planning and Drilling Manual, Steve Deveraux.

Course outcome of Drilling Technology I

1. Understand key aspects of drilling operations and the major equipment, drill rig types and fundamental differences between onshore and offshore drilling. Differentiate different well types such as vertical, directional and horizontal.

2. Analysis of critical underground parameters associated with drilling, such as overburden pressure, pore pressure, fracture pressure, pressure and temperature gradients and the basics of geomechanics and its applications.

3. Understand the drill string and the loads on it. Explain the mechanics and design of drill bits, and key issues associated with drill bit selection.

4. Functions of drilling fluids and its importance for well control. Understand the concepts of well kicks and well control and utilise knowledge of key safety features in well control procedures.

5. Explain the process and importance of casing and cementing, including casing design and cement job calculations.
6. Understand the concepts of power required in various drilling operations such as hoisting, rotation, pumping, as well as the pressure balance in the hydraulic system.
7. Understand the well planning process, preparation of a drilling plan and equipment specifications.

<table>
<tr><th colspan="9">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>2</td><td>1</td><td>2</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td>Course Objective</td><td colspan="8">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="8">1. Introduction to Petroleum Reservoirs
2. Reservoir Fluids and Phase Behaviour: Phase behaviour 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.
3. Reservoir Rock Properties: Porosity; Permeability; Fluid saturations; Wettability; Surface forces and Capillary pressure; Rock Compressibility; Net Pay Thickness; Reservoir Heterogeneity; Core analysis.
4. 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.
5. Gas and Water Coning: Coning; Coning in vertical and horizontal wells; Breakthrough times and after breakthrough performances.
6. Reservoir Drive Mechanisms: Primary recovery mechanisms and their effects on the performances of oil reservoirs.</td></tr>
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	7. Estimation of Petroleum Reserves: Classification of reserves; Reserve estimation methods: Volumetric, Material balance equations, Decline curve analysis, Reservoir simulation. 8. Core analysis: Core preparation; Routine core analysis for the determination of porosity and permeability of reservoir cores; Special core analysis like IOR/EOR studies, wet ability determination, and reservoir condition core floods. 9. Crude oil and formation water analysis: Practical related to the determination of physicochemical properties of crude oil and formation water using standard (ASTM/IP) methods.

References and Resources:

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

Course Teacher: Dr (Mrs) Subrata Borgohain Gogoi								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
PT 105	**Flow through porous media**	**2**	**1**	**2**	**4**	**60**	**40**	**100**
Course Content	**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. These so-called pores may contain a variety of fluids such as air, water, oil etc. If the pores represent a certain portion of the bulk volume, a complex network can be formed which is able to carry fluids. Only these permeable and porous media are taken into consideration in this volume. 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. As observed, some fluid flows through the media while some mass of the fluid is stored in the pores present in the media. 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 sand beds.
	1. **Introduction**: Importance of fluid flow through porous medium, influence in reservoir characteristics, influence of fluid characteristics, capture mechanisms. 2. **Single-phase flow in porous media:** flow potential, incompressible and compressible flow in porous media, Darcy's law and non-Darcy effects, mass, determination of the parameters and viscous dissipation in porous media flow. 3. **Multi-phase flow in porous media:** wet ability, capillary pressure and its estimation, capillary pressure function, permeability dependence of capillary pressure and Leverett scaling, relative permeability, numerical models, solution and verification, steady-state and unsteady-state relative permeability measurements and data interpretation. 4. **Effective properties of porous media:** effective medium, determination of effective properties through Monte-Carlo simulations, effective properties of anisotropic porous media, pore connectivity and disorder, introduction to percolation theory. 5. **Injection well location:** Central and peripheral flooding, pattern flooding. 6. **Areal sweep Efficiency for pattern flood:** unit mobility ratio, non-unit mobility ratio. 7. **Displacement mechanisms:** Frontal advance theory, Piston-like movement. 8. **Fluid flow in reservoirs:** Homogeneous reservoirs, heterogeneous reservoirs 9. **Theories:** Buckley-Leverette theory, viscous fingering theory, Stile's methods, Dykstra Parsons, Lorentz co-efficient and Johnson methods. 10. **Modelling & Simulation:** 2D and 3D displacement using MRST and Ansys fluent.
Practical	1. Reservoir fluidsanalyses 2. Reservoirrockanalyses 3. Flooding experiments in Core flood apparatus 4. Flooding experiments in Microfluidics

Books Recommended:

Text:

1.Civan, F.A, Porous Media Transport Phenomena, Wiley, 2011. 2. Dullien, F.A.L,Porous Media 2nd Edition
2. Fluid Transport and Pore Structure, Elsevier, 1991.
3. Latil, M.:"Enhanced Oil Recovery," Techniq, 1980.

Reference:

1. Bear, J., Dynamics of Fluids in Porous Media, Dover, 1989

2. Gogoi SB, “Petroleum Technology –Enhanced Oil Recovery Techniques”, pub. Oxford & IBH, 2014.
3. Craft, B.C. and Hawkins, M.F.:”Applied Petroleum Reservoir Engineering,” Prentice Hall, November 1964.
4. Roger J M De Wiest and Jacob Bear, Flow through porous media, New York.

<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 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="7">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 analyse oil well concerns in order to develop an appropriate solution to oil field production challenges.</td></tr>
<tr><td colspan="7">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 by D.R. Skinner
2. Principles of Oil Well Production by T.E.W. Nind
3. Production Operations Vol. I & II by Thomas & Roberts
4. Petroleum Engineering by Archer & C.G. Wall
5. Petroleum Engineering by Carl Gatlin
6. Applied Petroleum Reservoir Engineering by Crafts & Hawkins
7. Fundamentals of Reservoir Engineering by L.P Drake
8. Integrated Petroleum reservoir Management by Abdus Sattar and Ganesh C. Thakur
9. Technical manual for Production Operations by R.K. Mukherjee. Institute of Oil & Gas Production Technology, ONGC Ltd., Panvel
10. Well completion and Servicing, Oil & gas Field Development Techniques, Editions Technip, D. Perrin
11. Enhanced Oil Recovery, Don W Green, G. Paul Willhite, SPE Textbook Series Vol 6.
12. Waterflooding, G. Paul Willhite, SPE Textbook Series, Vol. 3
13. Petroleum Production Handbook, Vol. I, Thomas C. Frick, Editor-in-Chief, R. William Taylor, Associate Editor, Journal of Petroleum Technology
14. Thermal Methods of Oil Recovery, J. Burger P. Sourieau, M. Combarnous, Editions Technip
15. Petroleum Exploration & Exploitation Practices, Dr. Bhagwan Sahay
16. Gas Lift Manual, Gabor Takacs, Ph.D. Petroleum Engineering Department, University of Miskolc, Hungary
17. Modern Petroleum Technology, Volume I, Upstream, Edited by Richard A. Dawe, 6th Edition

AEC (Inter-Departmental)								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
PT 1A1	**Geological/Industrial Field work**				**2**	**30**	**20**	**50**
	The students will undergo Geological field work including mapping and sampling in the outcropped sections of Assam and Fold -Thrust belt areas of northeast India. The field work may include the laboratory visits in petroleum related industries/institutions.							

1.2. 2nd SEMESTER

<table>
<tr><td colspan="8">Course Teacher: Dr Pradip Borgohain</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 201</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="7">Introduction: The course includes the different Exploration techniques for search of underground oil and gas deposits, and evaluation in the case of discovery. Once the presence of commercially viable oil and/or gas deposit is confirmed, certain steps need to be followed to develop the oilfield scientifically for production. The course is also designed to throw knowledge on the Unconventional hydrocarbon resources and their exploration methods and application of sequence stratigraphy in hydrocarbon exploration.</td></tr>
<tr><td>Course content</td><td colspan="7">1. Petroleum exploration methods:
➢ Geological exploration methods
➢ Geophysical exploration methods
➢ Geochemical exploration methods with overview on seismic acquisition, processing and interpretation
➢ Microbialand other techniques.

2. Well prognosis and economic analysis:
➢ Prognostication, prospect identification and location identification for drilling
➢ Classification and categorization of reserves with overview on PRMS
➢ Classification of drilling location
➢ 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 (Preparation of exploratory plan and drilling first exploratory well, collection and analysis of information during exploratory drilling, drilling of out step wells, preparation of a development plan and field development period, overview on Field Development Plan)
➢ Rational development system
➢ Basic geologic data for development planning
➢ Brief overview on Static and Dynamic Modeling
➢ Well completion and its effects of reservoir characteristics</td></tr>
</table>

	➢ Perforation and well activation **4. Processing and integration of geological and geophysicaldata:** ➢ Preparation of different types of subsurface maps – structure contour, isopach, isopay, lithofacies mapetc. and their application ➢ Application of electro-logs ➢ Correlation of well sections ➢ Preparation of geological and seismo-geological sections ➢ Estimation of reserves ➢ Techno-economic evaluation **5. Concept of sequence stratigraphy and its application in Petroleum Exploration** **6. Unconventional hydrocarbon system**: ➢ Types, Occurrence & Distribution ➢ Production Technologies ➢ Environmental Impact **7. Future hydrocarbon exploration in India with special reference to Assam-Arakan Basin/ / NE India**

Books Recommended:

1. Theoretical Principles of Exploration and Development of Oil & Gas Accumulation by Bakirov,A.D
2. Geophysical Prospecting by Dobrin MiltonB.
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 NelsonJr.
11. Formation Evaluation and Wellsite Geological Techniques byBhagwan Sahay
12. Petroleum Exploration and Exploitation Practices byBhagwan Sahay
13. Outlines of Geophysical prospecting by RamchandraRao
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 BarryKatz
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: TBA</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</td><td>Geophysical Exploration and Data Processing</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 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.Electromagnetic methods of prospecting: Principle of electromagnetic induction, Magnetic field due to a current carrying loop, Elliptical polarization, Plane of polarization, Brief introductions to VLF, AFMAG and TURAM, GPR and its applications.
2. Elasticity and seismic waves: Elasticity of materials, the elastic constants, Hooke’s law, Different types of elastic waves and their propagation characteristics, Equations of motion of seismic body waves, Attenuation and dispersion of seismic waves.
3. 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 at an interface, Distinguishing features of seismic events, Types of seismic noise and their attenuation.
4. Seismic data acquisition: Different aspects of reflection and refraction seismic survey, Spread types, Selection of field parameters, Basics of 2D & 3D seismic data acquisition, Uphole survey, Vertical Seismic Profiling (VSP), 4-D Seismic, General discussion on seismic instruments and different energy sources</td></tr>
</table>

Books Recommended:

1. Robinson, E.S., Coruh, C., Basic Exploration Geophysics, 1st ed., Wiley, 1988.
2. Milsom, J., Eriksen, A., Field Geophysics, John Wiley & Sons, 2011.
3. Kearey, P., Brooks, M., Hill, I., An Introduction to Geophysical Exploration, 3rd Ed. Blackwell, 2002.
4. Dobrin, M.B., Savit, C.H., Introduction to Geophysical Prospecting, 4th Ed. McGraw Hill, 1988
5. Lowrie, W., Fundamentals of Geophysics, 2nd edition, Cambridge University Press, 2007.

<table>
<tr><th colspan="8">Course Teacher: Dr M.A. Chowdhury</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- 203</td><td>Drilling Technology II</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: 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. Completion of PT-103 Drilling Technology I course or equivalent is a prerequisite to undertake this course.</td></tr>
<tr><td colspan="7">1. Drilling optimization: deviation control, well path analysis, survey tools and methods, cuttings transport, torque and drag, rig hydraulics.
2. Directional drilling, applications, steering tools and BHA design, MWD. Horizontal drilling, multilateral drilling, extended reach drilling.
3. Drilling complications, formation problems, stuck pipe, fishing. Remedial and preventive measures.
4. Air and gas drilling: basic principles, aerated drilling, foam drilling, special equipment.
Drilling Services: Mud logging, LWD, MWD, Coring.
5. Innovative drilling techniques: coil tubing drilling (CTD), underbalanced drilling (UBD), managed pressure drilling (MPD) and controlled mud level (CML drilling).
6. Drilling automation, applied cybernetics, optimizing rate of penetration.</td></tr>
</table>

Books Recommended:

1. Horizontal and Directional Drilling, Richard S. Carden, Robert D. Grace.
2. Well Engineering and Construction, H.L. Rabia
3. Drilling Engineering, J.J. Azar
4. Applied Drilling Engineering, A.T. Bourgoyne, K.K. Millheim, M.E. Chenevert.
5. Practical Well Planning and Drilling Manual, Steve Deveraux
6. Formulas and Calculating for Drilling, Production and Workover, N.L. Lapeyrouse
7. Measurement while drilling (MWD), losing-while-drilling and geosteering – I. Do Well and A.A. Mells.
8. Mud Logging: Principles & Interpretations – Alum Whittaker.

Course outcome of Drilling Technology II

1. Describe equipment and processes associated with directional drilling and its uses in exploration and production. Explain key aspects of horizontal drilling, and related technologies like multi-lateral and extended reach drilling.
2. Explain the mechanics of important drilling aspects such as the well path, deviation and survey, cuttings transport, hydraulics of mud flow through the circulating system, as well as torque and drag.

3. Understanding the basics and importance of drilling services such as mud logging, LWD, MWD, coring.
3. Explain the causes of drilling complications, problem mitigation, fishing tools.
4. Key aspects of new and advanced drilling technologies, such as air/gas drilling, UBD, MPD, CTD, etc.
5. Understand drilling automation, application of feedback control systems, artificial intelligence, robotics, etc., for drilling automation, Key factors affecting the rate of penetration, and modelling for optimization.

<table>
<tr><th colspan="9">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- 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="8">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="8">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 build-up analysis techniques; Type curve matching methods; Drill stem testing; Interference and pulse test analysis methods.
3. Gas Well Testing: Applications of gas flow equations; Deliverability testing and well production potential analysis methods.
4. Water Influx: Classification of aquifers; Recognition of natural water influx, Water influx models.
5. Immiscible Displacement: Fractional flow equation; Buckley-Leverett frontal advance equation; Oil recovery calculations; Principles of water flooding and other improved oil recovery methods</td></tr>
</table>

	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.

References and Resources:

1. Fundamentals of Reservoir Engineering - L.P.Dake
2. Reservoir Engineering Handbook – T. Ahmed
3. Advanced Reservoir Engineering – T.Ahmed and P.D.McKinney
4. Applied Petroleum Reservoir Engineering – B.C.Craft and M.F. Hawkins
5. Oil Well Testing Handbook - A.U.Chaudhry
6. Gas Well Testing Handbook - A.U.Chaudhry
7. Well Testing - J.Lee
8. Petroleum Reservoir Simulation – J.H.Abou-Kassem, S.M.F. Ali, and M.R.Islam
9. Integrated Petroleum Reservoir Management: A Team Approach - by A.S. Satter and G.C. Thakur
10. Books and Journals of Society of Petroleum Engineers (SPE)

Course Teacher: Dr Dhrubajyoti Neog								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
PT- 205	**Surface Production Operations**	**3**	**1**	**0**	**4**	**60**	**40**	**100**
Course Content	**Introduction:** The course provides a systematic and organised 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.							
	1. **Surface gathering system** Types of gathering systems, fluid flow behaviour, flow lines, headers, valves, flow behaviour in gathering systems 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 5. **Flow assurance** Scales, Hydrate, Paraffin chemistry- methods of removal, preventing deposition and its control, Corrosion control 6. **Sand control** Mechanism, mechanical method- Gravel pack, Chemical method-Resin Consolidation

Books Recommended:

1. Introduction to Petroleum Production Vol. II & III by D.R. Skinner
2. Production Operation Vol. II by Thomas & Roberts
3. Surface Operations in Petroleum Production Vol. I, II & III by Chilingarian, Robertson A.R., Sanjay Kumar
4. Integrated Petroleum Reservoir Management by Abdus Sattar and Ganesh C. Thakur
5. Principles of Petroleum Reservoir Engineering Vol. II by Gian Luigi Chierici & translated from the Italian by Peter J. Westaway
6. Petroleum Engineering-Principles and Practices by J.S. Archer & C.G Wall
7. Handbook of Natural Gas Engineering by Katz
8. Enhanced Oil Recovery Processes & Operations by Donaldson
9. Production & Transportation of Oil & Gas by Szilas, Development in Petroleum Science, Vol. 3
10. Oilfield Processing, Vol. II: Crude Oil, 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, Vol. I, Vol. II, Ken Arnold Maurie Stewar
12. Petroleum Production Handbook, Vol. I, Thomas C. Frick, Editor-in-Chief, R. William Taylor, Associate Editor, Journal of Petroleum Technology.

<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>In Sem</td></tr>
<tr><td>PT- 206</td><td>Enhanced oil recovery</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: Enhanced oil recovery (abbreviated EOR), also called tertiary recovery, is the extraction of crude oil from an oil field that cannot be extracted otherwise. EOR can extract 30% to 60% or more of a reservoir's oil, compared to 20% to 40% using primary and secondary recovery. There are three primary techniques of EOR: gas injection, thermal injection, and chemical injection. Gas injection, which uses gases such as natural gas, nitrogen, or carbon dioxide (CO_2), accounts for nearly 60 percent of EOR production in the United States. Thermal injection, which involves the introduction of heat, accounts for 40 percent of EOR production in the United States, with most of it occurring in California. Chemical injection, which can involve the use of long-chained molecules called polymers to increase the effectiveness of water floods, accounts for about one percent of EOR production in the United States.</td></tr>
<tr><td colspan="8">
Introduction: Principles of enhanced oil and gas recovery methods. IOR, EOR. Screening criteria for EOR methods.
Water injection: Displacement mechanisms, Performance calculations, Mathematical models, Practical interpretation of pressure fall off curves.
Immiscible displacement: Injection well location, production well completion, surface installation.
Miscible drive: Miscible slug flooding, thermodynamic miscibility, ternary diagrams, methods of miscible drive. Benham’s correlations, physical and mathematical modelling.
Thermal recovery methods: Hot fluid displacement, in-situ combustion, numerical simulation models.
Chemical recovery methods: Alkaline flooding, Surfactant/micellar flooding, polymer flooding,
Other methods: Foam injection, CO_2 flooding, microbial flooding.
Development of images: Velocity vectors and pressure contours in ANSYS FLUENT.
Designing flow parameters: Design Expert, Grapher and CalcPlot3D
Practical: Surface tension and Interfacial tension, measurements of surfactants and alkalis Crude oil analysis Determination of resins, waxes and asphaltenes Reservoir produced water characterization by Water Analyser and Flame photometer Rheological behaviour study porous media analysis Determination of adsorption Isotherm of Chemicals on porous media
</td></tr>
</table>

Books Recommended:

Text

1. Enhanced Oil Recovery, Don W. Green and G. Paul Willhite, SPE Text Book Series, 1998.
2. Fluid Transport and Pore Structure, Elsevier, 1991.
3. Latil, M.:"Enhanced Oil Recovery," Techniq, 1980.

Text:

1. Enhanced Oil Recovery: Field Planning and Development Strategies, Vladimir Alvarado and Eduardo Manrique, Gulf Publishing, 2010.
2. 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 (Inter-Departmental)								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
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)							

1.3.3rd SEMESTER

<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- 301</td><td>Health, Safety & Environment (HSE) and Risk Management (RM)</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: HSE is one of the vital constituents of Upstream 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. The latest focus on upstream oil industry is on how to manage all kinds of risk in order to rein in costs. This task is more daunting than ever before for this industry.</td></tr>
<tr><td rowspan="2">Course Content</td><td>Part 1- HSE</td><td colspan="7">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. Offshore environmental studies. Offshore oil spill and oil spill control. Waste treatment methods.</td></tr>
<tr><td>Part 11- RM</td><td colspan="7">1. Introduction
2. Principles of risk management: Identify Risk, Risk Quantification, Consolidation and Initiate agreed response
3. Application of risk management: Inventorying the risk issues, Quantifying risk severity, definitions, Developing Risk Matrix, Assessment of Impact and Risk Classification: low, Medium.
4. Application of risk management in Upstream Oil Industry: Role of Risk Management, Evaluating Risk, Mitigation Plan, Control Measures and residual risk</td></tr>
</table>

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
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. Borkha Mech Das</th></tr>
<tr><td rowspan="2">Semester</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>Drilling Fluid technology</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 description</td><td colspan="8">Introduction: Drilling fluids are used in rotary drilling method which generally consists of an aqueous clay suspension, containing weighting agents to increase the hydrostatic head and frequently also contains concentrated colloidal suspending and conditioning agents. Drilling fluids play a vital role in hole cleaning, suspension of cuttings, prevent caving, and ensure the tightness of the well wall, cooling and lubricating the drilling tool, transfer the hydraulic power and carry information about the nature of the drilled formation by raising the cuttings from the bottom to the surface, using a simple mixture of water and clays, to complex mixtures of various specific organic and inorganic products as additive. The successful completion of an oil well and its cost depend to a considerable extent on the properties of the drilling fluid. The cost of the drilling fluid itself is relatively small, but the choice of the right fluid and maintenance of the right properties while drilling profoundly influence total well costs.</td></tr>
<tr><td>Course content</td><td colspan="8">1. Drilling Fluids: Types, functions and properties
Water based, oil based, emulsion based, polymer based, Surfactant based, Foam based and Aerated drilling fluids. Synthetic oil-based drilling fluid (SOBM). HPHT Drilling fluids. Basic functions, compositions, properties, maintenance and treatments of drilling fluids.
2. Clay Mineralogy and the Chemistry of Drilling Fluids.
Origin and occurrence of Clay minerals, Ion exchange, Clay swelling mechanism, The electrostatic double layer, colloid & surface chemistry.
3. The Rheology of Drilling Fluids
Laminar Flow Regime, Turbulent Flow Regime, Flow models,</td></tr>
</table>

	Influence of Temperature and Pressure on the Rheology of Drilling Fluids, Rheological Properties Required for Optimum Performance. 4. **The Filtration properties of Drilling Fluids** Static Filtration, The Filter Cake, Dynamic Filtration, Filtration in the Borehole, Concept of AV, PV, YP, Gel strength, Filtration loss (Dynamic and static) Mud cake thickness, Salinity, lubricity coefficient, Basic hydraulic parameters. 5. **Drilling fluid calculations** 6. **Practical Implementations and innovations in drilling fluids.** a. Nanotechnology in drilling fluids b. Drilling complicacy 7. **Cement Slurry** Types, Composition, properties, preparation, rheology, testing.
Practical	5. Drilling fluid preparation 6. Cement slurry preparation, property measurement. 7. Mud weight analysis: Comparison of theoretical and experimental values. 8. Rheological and Filtration behaviour study. 9. Chemical Analysis.

Books Recommended:

1. Composition and Properties of Drilling and Completion Fluids by H. C. H. Darley and George R. Gray
2. Drilling Fluid Engineering by Pal Skalle.
3. Drilling and drilling fluids by G.V Chilingarian, P. Vorabutr.

Course Teacher: Dr. Dhrubajyoti Neog								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
PT- 303	**Well Servicing**	**2**	**1**	**2**	**4**	**60**	**40**	**100**
Course Content	**Introduction:** The course discusses different aspects of oil well work over 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.							
	1. Sick well: 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. Work over operations &equipment:** Work over, need for work over operations, work over procedure, well killing methods, work string, casing scraper, Junk and Boot baskets, cement retainer,							

	casing roller, bridge plug **2. Work over fluids:** Completion and work over fluids-Types, packer fluids **3. Well Intervention**: Wire line and its operations, wire line unit, wire line tools, Coiled Tubing Operations 5. **Lab work/Practical:** ➢ Characterisation of formation water with water analyser, flame photometer and atomic absorption spectrophotometer ➢ Rheological behaviour study ➢ Reservoir rock/outcrop analysis ➢ Work over fluid formulation ➢ Production well problem study ➢ Wet ability study

Books Recommended:

1. Technical manual for Production Operations by R.K. Mukherjee. Institute of Oil & Gas Production Technology, ONGC Ltd., Panvel.
2. Well completion and Servicing, Oil & gas Field Development Techniques, Editions Technip, D. Perrin
3. Modern Petroleum Technology, Volume I, Upstream, Edited by Richard A. Dawe, 6th Edition
4. Production Operation Vol. I, II by Thomas & Roberts
5. Petroleum Production Handbook, Vol. I, Thomas C. Frick, Editor-in-Chief, R. William Taylor, Associate Editor, Journal of Petroleum Technology
6. Petroleum Exploration & Exploitation Practices, Dr. Bhagwan Sahay
7. Petroleum Production Engineering, 2nd Edition, by Xuehao Tan, Xinghui Liu, Boyun Guo, ISBN: 9780128096123
8. Water flooding, 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	In Sem	
PT- 3D1	**Minor Project**				**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 (40 marks)	**Progress seminar (2nos.): 20+20= 40 marks**
End Sem (60 marks)	**A. Project Report**: **30 marks** **B**. **Seminar & viva- voce on Minor Project**: **30 marks**

1.1 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>In Sem</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.
(The course is designed for the students of other departments as a generic Elective Course)</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 by D.R. Skinner
2. Principles of Oil Well Production by T.E.W. Nind
3. Petroleum Engineering by Archer & C.G. Wall
4. Petroleum Engineering by Carl Gatlin
5. Fundamentals of Reservoir Engineering by L.P Drake
6. Well completion and Servicing, Oil & gas Field Development Techniques, Editions Technip, D. Perrin
7. Enhanced Oil Recovery, Don W Green, G. Paul Willhite, SPE Textbook Series Vol 6.
8. Waterflooding, G. Paul Willhite, SPE Textbook Series, Vol. 3

9. Thermal Methods of Oil Recovery, J. Burger P. Sourieau, M. Combarnous, Editions Technip
10. Petroleum Exploration & Exploitation Practices, Dr. Bhagwan Sahay
11. Gas Lift Manual, Gabor Takacs, Ph.D. Petroleum Engineering Department, University of Miskolc, Hungary
12. Oilfield Processing, Vol. II: Crude Oil, 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, Vol I, Vol. II, Ken Arnold Maurie Stewar
14. Petroleum Production Handbook, Vol. I, Thomas C. Frick, Editor-in-Chief, R. William Taylor, Associate Editor, Journal of Petroleum Technology

<table>
<tr><td colspan="8">Course Teacher: Dr Pradip Borgohain</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- 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.
(The course is designed for the students of other departments as a Generic Elective Course)</td></tr>
<tr><td colspan="7">➢ Overview on Petroleum system (Source rock, reservoir rock, cap rock)
➢ Origin, migration and accumulation of petroleum
➢ Rock Eval Pyrolysis analysis. Maturation of source rock (Time-Temperature Index).
➢ Types and distinguishing properties of reservoirrocks & fluids
➢ Reservoir Trap- types and genesis
➢ Concept of life cycle of an oilfield
➢ Different reservoir drive mechanisms and their effect on hydrocarbon recovery
➢ Enhanced Oil Recovery (EOR) techniques
➢ Sandstone diagenesis and its effects on reservoirproperties
➢ Clay mineral types and its impact in reservoirrock
➢ Principles and application of wireline logs in reservoir studies
➢ Brief overview on types and occurrence unconventional hydrocarbon resources
➢ Geographic and geologic distribution of oil and gas field in India with special reference to northeast India
➢ Overview on role of regulatory bodies on E&P business in India (i.e. NELP/HELP etc.)</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: AcademicPress
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 SKillops
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>Reservoir Rock and Fluid Properties</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 help students gain an understanding of the rock and fluid properties of a petroleum reservoir. In this course, students will learn about the fundamental characteristics of reservoir rock and fluids including porosity, permeability, fluid saturations, wettability, capillary pressure, core analysis, phase behavior of reservoir fluids, classification of petroleum reservoirs, natural gas properties, PVT properties of crude oils, properties of formation water, equation of state and phase equilibria, and laboratory analysis of reservoir fluids. Additionally, through the course the students will also gain an understanding of fundamentals of reservoir fluid flow.
(The course is designed for the students of other departments as a generic Elective Course)</td></tr>
</table>

Course Contents	1. Introduction to Petroleum Reservoirs 2. Reservoir Rock Properties: Porosity; Permeability; Fluid saturations; Rock Compressibility; Net Pay Thickness; Reservoir Heterogeneity; Routine and Special Core analysis. 3. Reservoir fluid properties: Natural gas properties; Crude oil properties; Formation water properties; Equation of state and phase equilibria. 4. Phase Behaviour of Reservoir Fluids: Hydrocarbon Phase behaviour; Classification of reservoirs and reservoir fluids. 5. Laboratory Analysis of Reservoir Fluids: Reservoir fluid sampling, Routine and Special laboratory PVT analysis. 6. Reservoir Rock-fluid Interactions: Phase saturations; Relative permeabilities; surface forces and capillary pressure; wettability; Impact on oil recovery. 7. Fluid Flow in Reservoirs: Darcy's law; Classification of reservoir flow systems; Flow equations for the flow of incompressible, compressible, and slightly compressible fluids under steady, semi-steady and unsteady state conditions.

References and Resources:

1. Fundamentals of Reservoir Engineering - L.P.Dake
2. Reservoir Engineering Handbook – T. Ahmed
3. Petroleum Reservoir Engineering – J.W.Amyx, D.M.Bass, and R.L.Whiting
4. Fundamental Principles of Reservoir Engineering – B.F.Towler
5. PVT and Phase Behavior of Petroleum Reservoir Fluids – A.Danesh
6. Phase Behavior of Petroleum Reservoir Fluids – K.S.Pedersen &P.L.Christensen
7. Equation of State and PVT Analysis – T.Ahmed
8. Petrophysics – D.Tiab and E.C. Donaldson
9. Books and Journals of Society of Petroleum Engineers (SPE)

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, which will not be generally less than 21 working days, will be decided in consultation with industry/institution. The evaluation of the field visit will be based on the submission of the training report, performance of the student during training and seminar and viva-voce on field training. The seminar & viva-voce will be held before a panel of internal examiners comprising of faculties of the Department. **In Sem.: 40 marks (Report)** **End Sem.: 60 marks (Seminar, Viva-voce & Performance during training)**							

2.44th 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 organisations if and when required.							

In Sem	**Progress Seminar (2nos.): 60+60= 120 marks**
End Sem	**A. Dissertation Report**: **100 marks** [External examiner 50 marks + Internal examiner 50 marks] **B**. **Seminar & viva- voce on dissertation**: **80 marks** (Examination Board including External examiner)