

**SYLLABUS FOR  
ONE YEAR DIPLOMA PROGRAMME  
IN  
OIL WELL DRILLING TECHNOLOGY  
(OWDT)  
2023-24**



**DEPARTMENT OF PETROLEUM TECHNOLOGY  
FACULTY OF EARTH SCIENCES AND ENERGY  
DIBRUGARH UNIVERSITY**

**Programme Coordinators:**

Dr. Dhrubajyoti Neog

Dr. Borkha Mech

**Programme Advisors:**

Prof. Subrata Borgohain Gogoi

Prof. Pradip Borgohain

## **Eligibility Criteria**

Candidates seeking admission to the Diploma in Oil Well Drilling Technology should possess either of the following requisite qualifications:

- (a) B.Sc. degree in Physics, Chemistry, Geology and Mathematics.  
Candidates with B.Sc. degree in Physics, Chemistry and Geology must have cleared mathematics paper in their B.Sc. course.
- (b) Diploma in Petroleum, Mechanical, Chemical and Electrical engineering.
- (c) Candidates already employed in oil industries and having any of the above qualifications (a) & (b) may also apply through proper channel.
- (d) Sponsored candidates from oil industries for supernumerary seats.

**Proposed date of implementation of the Programme: 1<sup>st</sup> Aug'23**

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## 1. COURSE STRUCTURE

1<sup>st</sup> Semester OWDT Course [Total Credits: 22, Total marks: 550]

Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
<b>Core Courses</b>								
OW-101	Fundamentals of Petroleum Geology & Hydrocarbon Exploration	3	1	0	4	60	40	100
OW-102	Drilling Rig Technology	3	1	0	4	60	40	100
OW-103	Petroleum Reservoir Fundamentals	3	1	0	4	60	40	100
OW-104	Fundamentals of Production Technology	3	1	0	4	60	40	100
OW-105	Oil Well Technology	3	1	0	4	60	40	100
<b>Ability Enhancement Courses (AEC)</b>								
OW-1A1	Drilling wellsite visit				2	30	20	50

**2<sup>nd</sup> Semester OWDT Programme [Total Credits: 20, Total marks: 500]**

CourseNo.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
<b>Core Courses</b>								
OW-201	Drilling Operations	3	1	0	4	60	40	100
OW-202	Health Safety & Environment	3	1	0	4	60	40	100
OW-203	Workover Technology	2	1	2	4	60	40	100
OW-204	Drilling Practical	0	0	8	4	60	40	100
<b>Ability Enhancement Courses (AEC)</b>								
OW-2A1	Industrial Training / Project Work/ Field work				4	60	40	100

# 1. COURSE CONTENT

## 1.1. 1<sup>st</sup> SEMESTER

Course Teacher: Dr. Pradip Borgohain								
Course No.	Course Name	Teaching Scheme (credits)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
OW- 101	<b>Fundamentals of Petroleum Geology &amp; Hydrocarbon Exploration</b>	3	1	-	4	60	40	100
	<b>Introduction:</b> The course is designed to impart knowledge on the origin, occurrence, movement and accumulation of hydrocarbons within the earth's crust. It also covers the basics of petroleum exploration & development methods and distribution of oil & gas fields in India							
Course Content	<ol style="list-style-type: none"> <li>1. Petroleum System: [Origin, migration and accumulation of petroleum, Reservoir rock, source rock and cap rock. Reservoir traps]</li> <li>2. Basics of Igneous, Sedimentary and Metamorphic rocks</li> <li>3. Concept on Geologic Time Scale &amp; stratigraphic units</li> <li>4. Types of fold, fault &amp; unconformity</li> <li>5. Petroleum exploration methods: Geological, Geophysical, Geochemical &amp; Microbial exploration methods. Well programme (GTO)</li> <li>6. Steps followed during development of oil &amp; gas fields. Application of wireline logs</li> <li>7. Distribution of oil and gas fields in India with special reference to northeast India</li> </ol>							

### Books Recommended:

1. Petroleum Geology by F. K. North, Publisher: Allen & Unwin
2. Petroleum (Indian context) by D. Chandra & R. M. Singh. Publisher: Tara Book Agency, Varanasi
3. Principles of Sedimentology & Stratigraphy by Sam Bogs, Publisher: Pearson Education Ltd., London
4. Sandstone Reservoir by John H. Barwis, et.al. Publisher: Springer-Verlag
5. Petroleum Exploration and Exploitation Practices by Bhagwan Sahay
6. Theoretical Principles of Exploration and Development of Oil & Gas Accumulation by Bakirov, A. D

### 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.

<b>Course Teacher: Dr Borkha Mech</b>								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
<b>OW-102</b>	<b>Drilling Rig Technology</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>	<b>60</b>	<b>40</b>	<b>100</b>
Course Content	<p><b>Introduction:</b> This course provides a broad understanding of the Drilling rig for drilling an oil well. It will develop an understanding of various drilling rig components and the process involved. Drilling fluid, a key component of drilling a well will also be highlighted in the course.</p>							
	<ol style="list-style-type: none"> <li>1. Introduction to oil well drilling: drilling terminology and abbreviations, drilling process, process flow, oil well drilling rigs, onshore/offshore, Subsurface conditions</li> <li>2. Drilling equipment, Rig components, and rig instrumentation</li> <li>3. Drill string: components and its functions, concept of neutral point and weight on bit</li> <li>4. Drill bit: classification, grading of used bit.</li> <li>5. Casing, types and functions, components and accessories.</li> <li>6. Drilling process analysis: tripping/reaming practices, hoisting, rotation, pumping, hydraulics &amp; hole cleaning.</li> <li>7. LOT, CIT &amp; PIT</li> <li>8. Well Head and BOP fitting and testing.</li> <li>9. Wire rope</li> <li>10. Drilling fluids: functions, types, composition, and properties, drilling fluid additives and treatment, drilling fluid calculations</li> <li>11. Cementing and types of cement slurry</li> <li>12. Care and Maintenance of Rig equipment</li> </ol>							

**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.
7. Composition and Properties of Drilling and Completion Fluids by H. C. H.

<b>Course Teacher: Dr. Ranjan Phukan</b>							
<b>Course Code</b>	<b>Course Title</b>	<b>Contact Hours</b>		<b>Credits</b>	<b>Marks</b>		
		Theory	Tutorial		End Sem	In Sem	Total
<b>OW-103</b>	<b>Petroleum Reservoir Fundamentals</b>	3	1	4	60	40	100
<b>Course Objective</b>	The course aims to help students develop a complete understanding of the characteristics of petroleum reservoirs including reservoir fluid and rock properties, fundamentals of fluid flow in a reservoir, reservoir drive mechanisms, reserves classification, and reserve estimation methods.						
<b>Course Content</b>	<ol style="list-style-type: none"> <li>1. Introduction to Petroleum Reservoirs</li> <li>2. Properties of reservoir fluids and phase behavior: Natural gas properties; Crude oil properties; Formation water properties.</li> <li>3. Properties of reservoir rocks: Porosity; Permeability; Fluid saturations; Wettability; Surface forces and Capillary pressure; Rock Compressibility; Reservoir Heterogeneity.</li> <li>4. Fluid flow equations: Darcy’s law; Classification of reservoir flow systems; Steady-state flow equations for the flow of incompressible, compressible, and slightly compressible fluids.</li> <li>5. Reservoir drive mechanisms: Primary recovery mechanisms and their effects on the performances of oil reservoirs.</li> <li>6. Classification and estimation of petroleum reserves as per PRMS Guidelines</li> </ol>						
<b>References and Resources:</b>							
<ol style="list-style-type: none"> <li>1. Fundamentals of Reservoir Engineering - L.P.Dake</li> <li>2. Reservoir Engineering Handbook – T. Ahmed</li> <li>3. Petroleum Reservoir Engineering – J.W.Amyx, D.M.Bass, and R.L.Whiting</li> <li>4. Applied Petroleum Reservoir Engineering – B.C.Craft and M.F. Hawkins</li> <li>5. Fundamental Principles of Reservoir Engineering – B.F.Towler</li> <li>6. PVT and Phase Behavior of Petroleum Reservoir Fluids – A.Danesh</li> <li>7. Phase Behavior of Petroleum Reservoir Fluids – K.S.Pedersen and P.L.Christensen</li> <li>8. Equation of State and PVT Analysis – T.Ahmed</li> <li>9. Petrophysics – D.Tiab and E.C.Donaldson</li> <li>10. Essentials of Multiphase Flow and Transport in Porous Media – G.F.Pinder and W.G.Gray</li> <li>11. Books and Journals of Society of Petroleum Engineers (SPE)</li> </ol>							



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	
OW-104	Fundamentals of Production Technology	3	1	0	4	60	40	100
Course Content	<p><b>Introduction:</b> 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.</p>							
	<ol style="list-style-type: none"> <li><b>1. Introduction:</b> Fluid flow through porous medium, influence in reservoir characteristics, influence of fluid characteristics, capture mechanisms.</li> <li><b>2. Single-phase flow in porous media:</b> 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.</li> <li><b>3. Multi-phase flow in porous media:</b> wettability, capillary pressure, and relative permeability and their measurements and data interpretation.</li> <li><b>4. Injection well location:</b> Central and peripheral flooding, pattern flooding.</li> <li><b>5. Areal sweep Efficiency for pattern flood:</b> unit mobility ratio, non-unit mobility ratio.</li> <li><b>6. Displacement mechanisms:</b> Frontal advance theory, Piston-like movement.</li> </ol>							

### 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.

Course Teacher: Dr Dhrubajyoti Neog								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
OW-105	Oil Well Technology	3	1	0	4	60	40	100
Course Content	<p><b>Introduction:</b> 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 subsurface reservoirs. On completion of the course, learners will acquire knowledge on the functions of oil well operations and develop an understanding of oil field production challenges.</p>							
	<ol style="list-style-type: none"> <li>1. <b>Introduction to Oil Recovery methods:</b> Primary recovery, Secondary recovery, Improved Oil Recovery, Enhanced Oil Recovery, Recovery factor</li> <li>2. <b>Well Completion Design:</b> Well completion, types of well completion, Down-hole completion and tools, wellhead equipment, multi-zone completion</li> <li>3. <b>Well Activation methods:</b> Displacement, Compressor application, Application of Nitrogen, Aeration, Swabbing, Coiled Tubing unit, Use of artificial lifts</li> <li>4. <b>Well stimulation Techniques:</b> Well stimulation, well acidizing treatment, hydraulic formation fracturing, thermal stimulation, surfactant treatment, Microbial treatment</li> <li>5. <b>Artificial Lift methods:</b> 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</li> </ol>							

#### 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 Vol6.
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. Combarous, 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

<b>AEC (Inter-Departmental)</b>								
<b>Course No.</b>	<b>Course Name</b>	<b>Teaching Scheme (Hours)</b>			<b>Credits</b>	<b>Course Marks</b>		<b>Total Marks</b>
		Theory	Tutorial	Practical		End Sem	In Sem	
<b>OW-1A1</b>	<b>Industrial visit</b>				<b>2</b>	<b>30</b>	<b>20</b>	<b>50</b>
The students will undergo Industrial visit in oil industries								

## 1.2. 2<sup>nd</sup> SEMESTER

Course Teacher: Dr Borkha Mech & Dr. Ranjan Phukan								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
OW- 201	Drilling Operations	3	1	0	4	60	40	100
Course Contents	<p><b>Introduction:</b> This course aims to develop an understanding of the drilling operations, tools and methods that are conducive 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.</p>							
	<ol style="list-style-type: none"> <li>1. Drilling optimization: deviation control, well path analysis, survey tools and methods, cuttings transport, torque and drag, rig hydraulics.</li> <li>2. Cementing operations, equipment and design of a cement job</li> <li>3. Directional drilling, applications, steering tools and BHA. Horizontal drilling, multilateral drilling, extended reach drilling, side-tracking techniques</li> <li>4. Drilling complications, formation problems, stuck pipe, fishing. Remedial and preventive measures, practices to avoid Drill string failure.</li> <li>5. Air and gas drilling: basic principles, aerated drilling, foam drilling,</li> <li>6. Drilling Services</li> <li>7. Coring and Core Analysis: Principles of conventional coring, core sampling, preparation, and core analysis.</li> <li>8. Safety in Drilling</li> </ol>							

### 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 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	
OW-202	Health, Safety & Environment (HSE)	3	0	0	3	60	40	100
	<p><b>Introduction:</b> 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.</p>							
	<p>1. Introduction            2. Health hazards in Drilling: Toxicity, Physiological, Asphyxiation, respiratory and skin effect of petroleum hydrocarbons, sour gases.            3. Safety: Manual &amp; automatic shutdown system, blow down systems. Gas detection system. Fire detection and suppression systems. Personal protection system &amp; measures. HSE Policies. Disaster &amp; crisis management in Petroleum Industry.            4. Environment: Environment concepts, impact on eco-system, air, water and soil. The impact of drilling &amp; production operations on the environment, Environmental transport of petroleum wastes. Offshore environmental studies. Offshore oil spill and oil spill control. Waste treatment methods.</p>							

### 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](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.

Course Teacher: Dr. Dhrubajyoti Neog								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
OW-203	Workover Technology	2	1	2	4	60	40	100
Course Content	<p><b>Introduction:</b> The course discusses oil well workover operations, workover equipment, workover fluids, and different types of oil well intervention operations. On completion of the course, learners will find it easier to acquire hands-on training in oil field operations.</p>							
	<p><b>1. Sick well:</b> 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</p> <p><b>2. Workover operations &amp; equipment:</b> Workover, need for workover operations, workover procedure, well killing methods, work string, casing scraper, Junk and Boot baskets, cement retainer, casing roller, bridge plug</p> <p><b>3. Workover fluids:</b> Completion and workover fluids-Types, packer fluids</p> <p><b>4. Well Intervention:</b> Wireline and its operations, wireline unit, wireline tools</p> <p><b>5. Flow assurance</b> Scales, Hydrate, Paraffin chemistry- methods of removal, preventing deposition and its control</p> <p><b>6. Practical</b></p> <ul style="list-style-type: none"> <li>• Workover fluid formulation</li> <li>• Reservoir fluid analysis</li> <li>• Introduction to workover tools</li> </ul>							

### 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. Waterflooding, G Paul Willhite, SPE Textbook Series, Vol.3
9. ONGC Manual

Ability Enhancement Course								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
OW-2A1	Industrial Training				4	60	40	100
The students will undergo a minimum of one month training program in nearby oil industries.								

Course Teacher: Dr (Mrs) Subrata Borgohain Gogoi Dr. Pradip Borgohain Dr. Ranjan Phukan Dr. Dhrubajyoti Neog Dr. Borkha Mech								
Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
OW-204	Drilling Practical	0	0	8	4	60	40	100
<b>Course Content</b>	<p><b>Introduction:</b> This course will familiarize the learners with how to evaluate a formation for crude oil production, how to analyze drilling fluids, well fluids, and workover fluids, and develop an understanding of the downhole condition of the oil wells and how to carry out drilling and workover operations.</p> <ol style="list-style-type: none"> <li>1. Drilling Simulation</li> <li>2. Designing Drilling &amp; Workover rigs</li> <li>3. Drilling fluid practical</li> <li>4. Formation evaluation</li> <li>5. Crude Oil characterization</li> <li>6. Reservoir fluids analyses</li> <li>7. Reservoir rock analyses</li> </ol>							