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.

Evaluation Criteria per Course

SN	In-Semester	End-Semester	Pass %
1	**40 %**	**60 %**	**40 % of in-semester and end-semester marks**

Proposed date of implementation of the Programme: 1st Aug'23

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1. COURSE STRUCTURE

1st Semester OWDT Course [Total Credits: 18, Total marks: 450]

Course No.	Course Name	Teaching Scheme (Hours)			Credits	Course Marks		Total Marks
		Theory	Tutorial	Practical		End Sem	In Sem	
Core Courses								
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	Oil Well Technology	3	1	0	4	60	40	100
Ability Enhancement Courses (AEC)								
OW-1A1	Drilling wellsite visit				2	30	20	50

2nd 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	
Core Courses								
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
Ability Enhancement Courses (AEC)								
OW-2A1	Industrial Training / Project Work/ Field work				4	60	40	100

1. COURSE CONTENT

1.1. 1st SEMESTER

<table>
<tr><th colspan="8">Course Teacher: Dr. Pradip Borgohain
Dr. Himanta Borgohain</th></tr>
<tr><th rowspan="2">Course No.</th><th rowspan="2">Course Name</th><th colspan="3">Teaching Scheme (credits)</th><th rowspan="2">Credits</th><th colspan="2">Course Marks</th><th rowspan="2">Total Marks</th></tr>
<tr><th>Theory</th><th>Tutorial</th><th>Practical</th><th>End Sem</th><th>In Sem</th></tr>
<tr><td>OW- 101</td><td>Fundamentals of Petroleum Geology & Hydrocarbon Exploration</td><td>3</td><td>1</td><td>-</td><td>4</td><td>60</td><td>40</td><td>100</td></tr>
<tr><td></td><td colspan="7">Introduction: 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</td></tr>
<tr><td>Course Content</td><td colspan="7">1. Petroleum System: [Origin, migration and accumulation of petroleum, Reservoir rock, source rock and cap rock. Reservoir traps]
2. Basics of Igneous, Sedimentary and Metamorphic rocks
3. Concept on Geologic Time Scale & stratigraphic units
4. Types of fold, fault & unconformity
5. Petroleum exploration methods: Geological, Geophysical (Gravity, Magnetic, Seismic, Electrical & Electromagnetic methods of prospecting), Geochemical & Microbial exploration methods. Geo Technical Order (GTO)
6. Steps followed during development of oil & gas fields.
7. Application of wireline logs-open hole & cased hole
8. Distribution of oil and gas fields in India with special reference to northeast India</td></tr>
</table>

Books Recommended:

1. North, F.K., Petroleum Geology, Allen & Unwin, 1985.
2. Chandra, D. and Singh, R.M., Petroleum Geology: Indian Context, Tara Book Agency, Varanasi, 1st Edition, 2003.
3. Boggs, S., Principles of Sedimentology and Stratigraphy, Pearson Education Ltd., London, 5th edition, 2016.
4. Barwis, J.H. *et al.*, Sandstone Petroleum Reservoirs, Spinger–Verlag, 1990.
5. Sahay, B., Petroleum Exploration and Exploitation Practices, Allied Pub., 1994.
6. Selley, R.C. and Sonnenberg, S.A., Elements of Petroleum Geology, Academic Press, Elsevier, 3rd edition, 2014.
7. Robinson, E.S., Coruh, C., Basic Exploration Geophysics, Wiley, 1st ed., 1988.
8. Lowrie, W., Fundamentals of Geophysics, Cambridge University Press,
9. 2nd edition, 2007.University Press, 2007.

Course Teacher: Dr Borkha Mech &Guest Faculty								
Course No.	**Course Name**	**Teaching Scheme (Hours)**			**Credits**	**Course Marks**		**Total Marks**
		Theory	**Tutorial**	**Practical**		**End Sem**	**In Sem**	
OW-102	**Drilling Rig Technology**	**3**	**1**	**0**	**4**	**60**	**40**	**100**

Course Content	**Introduction:** 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 awell will also be highlighted in the course.
	1. Introduction to oil well drilling: drilling terminology and abbreviations, drilling process, process flow, oil well drilling rigs, onshore/offshore, Subsurface conditions 2. Drilling equipment, Rig components, and rig instrumentation 3. Drill string: components and its functions, concept of neutral point and weight on bit 4. Drill bit: classification, grading of used bit. 5. Casing, types and functions, components and accessories. 6. Drilling process analysis: tripping/reaming practices, hoisting, rotation, pumping, hydraulics & hole cleaning. 7. Introduction to Basic Well Control and Well Control Equipment Drilling fluids: functions, types, composition, and properties, drilling fluid additives and treatment, drilling fluid calculations 8. Cementing and types of cement slurry 9. Care and Maintenance of Rig equipment

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.

Course Teacher: Dr. Ranjan Phukan & Guest Faculty							
Course Code	**Course Title**	**Contact Hours**		**Credits**	**Marks**		
		Theory	Tutorial		End Sem	In Sem	**Total**
OW-103	**Petroleum Reservoir Fundamentals**	3	1	4	60	40	100
Course Objective	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.						
Course Content	1. Introduction to Petroleum Reservoirs 2. Properties of reservoir fluids and phase behavior: Natural gas properties; Crude oil properties; Formation water properties. 3. Properties of reservoir rocks: Porosity; Permeability; Fluid saturations; Wettability; Surface forces and Capillary pressure; Rock Compressibility; Reservoir Heterogeneity. 4. Basics of Fluid flow equations: Darcy's law; Classification of reservoir flow systems;Steady-state flow equations. 5. Reservoir drive mechanisms: Primary recovery mechanisms and their effects on the performances of oil reservoirs. 6. Classification and estimation of petroleum reserves as per PRMS Guidelines						

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 and W.G.Gray
11. Books and Journals of Society of Petroleum Engineers (SPE)

<table>
<tr><td colspan="8">Course Teacher: Dr Dhrubajyoti Neog & Guest Faculty</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>OW-104</td><td>Oil Well 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 subsurface reservoirs. On completion of the course, learners will acquire knowledge on the functions of oil well operations and develop an understanding ofoil field production challenges.</td></tr>
<tr><td colspan="7">1. Well Completion Design:
Well completion, types of well completion, Down-hole completion and tools, wellhead equipment, multi-zone completion
2. Introduction to Oil Recovery methods:
Primary recovery, Secondary recovery, Improved Oil Recovery, Enhanced Oil Recovery, Recovery factor
3. Well Activation methods:
Displacement, Compressor application, Application of Nitrogen, Aeration, Swabbing, Coiled Tubing unit, Use of artificial lifts
4. Well stimulation Techniques:
Well stimulation, well acidizing treatment, hydraulic formation fracturing, thermal stimulation, surfactant treatment, Microbial treatment
5. 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</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

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

1.2. 2nd SEMESTER

Course Teacher: Dr Borkha Mech & Guest Faculty								
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	**Introduction:** This course aims to develop an understanding of the drilling operations, 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.							
	1. Drilling optimization: deviation control, well path analysis, survey tools and methods, cuttings transport, torque and drag, rig hydraulics. 2. Cementing operations, equipment and design of a cement job 3. Directional drilling, applications, steering tools and BHA. Horizontal drilling, multilateral drilling, extended reach drilling, side-tracking techniques 4. Drilling complications, formation problems, stuck pipe, fishing & fishing tools. Remedial and preventive measures, practices to avoid Drill string failure. 5. Coring: Principles of Conventional Coring, Core Sampling, and Preparation. 6. Introduction to UBD and MPD 7. Site selection and safety in drilling							

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. Underbalanced Drilling: Limits and Extremes, Bill Rehm, Arash Haghshenas, Amir Saman Paknejad · 2013

Course Teacher: Dr (Mrs) Subrata Borgohain Gogoi & Guest Faculty								
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**
	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.							
	1. Introduction 2. Health hazards in Drilling: 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 drilling & workover. 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.							

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>
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<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>End Sem</td><td>In Sem</td></tr>
<tr><td>OW-203</td><td>Workover Technology</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 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.</td></tr>
<tr><td colspan="7">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. Workover operations, rig & 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 tool & types, junk sub, junk basket, fish retrieval gears, overshot, male tap, wire catcher, spears
3. Workover fluid
Completion and workover fluids-Types, packer fluids
4. Well Intervention: Mechanical wireline and its operations, wireline unit, wireline tools
5. Flow assurance
Scales, Paraffin chemistry- methods of removal, sand cleaning
6. Practical
• Workover fluid design
• Reservoir fluid analysis
• Introduction to workover tools</td></tr>
</table>

Books Recommended:

1. Technical manual for Production Operations, 2004, by R.K. Mukherjee. Institute of Oil & GasProduction 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, 6th Edition
4. Production Operation, 1982, Vol. I, II by Thomas & Roberts
5. Petroleum Production Handbook, 1962, Vol. I, Thomas C. Frick, Editor-in-Chief, R. WilliamTaylor, 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

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
Dr. Himanta Borgohain
Contractual Faculty/Guest Lecturer

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**
Course Content	**Introduction:** 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. 1. Drilling Simulation-BM 2. Selection of drilling & workover rigs-BM & DN 3. Drilling fluid practical-BM 4. Formation evaluation-PBG, HB 5. Crude Oil characterization-SBG 6. Reservoir fluids analyses-DN 7. Reservoir rock analyses-RP, PBG							