24CP101P					Computer Programming – I Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To implement basic programming concepts.
2. To create different types of data collections.
3. To implement user defined function.
4. To perform different file handling operations.

List of Experiments:

1. **Introduction to Computer Programming**: Understanding compilation process through a simple C program, program execution flow, C Tokens, variables and keywords and identifiers, types of C constants and variables.

2. **Simple and formatted Input Output Operations:** Data types, Operators, Input /output statements in C, Formatted I/O, format specifiers, escaper sequences
3. **Decision making and branching:** if, if-else, if-else ladder, switch, go to statement, conditional operator statement

4. **Looping control structures:** while, do-while, for loop, Break statement, Continue statement
5. **Derived Data Type: Array and Strings:** One dimensional and multidimensional array, Declaration, initialization, Array Manipulations. Matrix operations, Basic Concepts, Inbuilt String manipulation with and without using inbuilt functions.
6. **Derived Data Type: Structure and Union:** structure, arrays and structures, structures and functions, pointer to structure, typedef, unions
7. **Functions:** Introduction to user defined functions, Types of Functions, Call by value-call by reference, header file creation, recursion, pointers to functions, arrays and functions
8. **Pointers:** Pointer's basics, use of &, * operator in context to pointers, Pointer arithmetic, Array and String processing using pointer, pointer to pointer, Array of Pointers
9. **File Handling in C:** File handling in C, Different types of files, Operations on Files, File handling functions.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Identify the use of appropriate naming conventions and programming style including appropriate comment density.
CO2: Implement a basic C program using appropriate control structure.
CO3: Apply appropriate derived data types based on data attributes.
CO4: Develop solutions with pointers and utilize them to access strings and structures.
CO5: Design user defined functions for problem solving and reuse them across different programs.
CO6: Apply suitable file handling functions and operations.

TEXT/REFERENCE BOOKS

1. Kernighan & Ritchie, C Programming Language, PHI.
2. K. N. King , C Programming: A Modern Approach, W.W. Norton.
3. E. Balaguruswamy, Programming in ANSI C, McGraw-Hill.
4. Y.P. Kanetkar,Let us C, BPB Publication.
5. Y.P. Kanetkar, Pointers in C, BPB Publication.

24CP101T					Computer Programming – I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
1	0	0	1	1	25	50	25	-	-	100

COURSE OBJECTIVES

1. To understand the usage of operators and data types.
2. To apply different types of Conditional and looping statement.
3. To create different types of data collections.
4. To implement user defined function.
5. To perform different operations upon files.

UNIT 1: Basics of Programming **3 Hrs.**

Introduction to Computer Programming, Features of C language, Structure of C program, program execution flow, C Tokens, variables, Data types, Operators, Decision control statements-if, switch, go to statement. Loop control structures- while, do-while, for loop, Break statement, Continue statement

UNIT 2: Derived Data types **4 Hrs.**

Array: one dimensional and multidimensional array, Declaration, initialization, Array Manipulations. Matrix operations, String-Basic Concepts, Inbuilt String manipulation Functions, Pointer, Pointer arithmetic, Pointer to pointer, Array of Pointers

UNIT 3: Functions and Structures **4 Hrs.**

Introduction to user defined functions, Types of Functions, Call by value-call by reference, recursion, pointers to functions, Structures, Array of Structure, Union

UNIT 4: Files Handling **3 Hrs.**

File handling in C, Different types of files, Operations on Files such as File creation, File deletion, File access modes such as read, write, append, File concatenation, File handling using seek function.

Total: 14 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Understand basics of programming.
CO2: Identify different programming constructs for a problem.
CO3: Apply appropriate derived data type for data storage.
CO4: Prepare a user defined data type based on data attributes.
CO5: Construct user defined functions for problem solving.
CO6: Analyse different data structure based on application requirement.

TEXT/REFERENCE BOOKS

1. Kernighan & Ritchie, C Programming Language, PHI
2. K. N. King , C Programming: A Modern Approach, W.W. Nortorn
3. David Griffiths and Dawn Griffiths, Head First C: A Brain-Friendly Guide, O'Reilly
4. E.Balaguruswamy, Programming in ANSI C, McGraw-Hill
5. Y.P. Kanetkar, Let us C, BPB Publication
6. Y.P. Kanetkar , Pointers in C, BPB Publications

24ME102P					Engineering Graphics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
0	0	4	2	4	--	--	--	50	50	100

COURSE OBJECTIVES

1. To cover the fundamental of engineering drawing and standards used in drawing.
2. To explain the students to communicate ideas using orthographic and isometric projection methods.
3. To help students to use CAD software to prepare drawings.
4. To demonstrate the presentation of drawing using sketching and 3D modelling in CAD tool.

LIST OF EXPERIMENTS

1 Introduction to Engineering Graphics: Principles of engineering graphics and their significance, drawing instruments & accessories, lettering and numbering, types of lines, dimensioning methods, basic geometric drawing, reading a drawing.

2 Orthographic Projection: Introduction to projection, types of projection, 1st angle and 3rd angle projection

3 Isometric Projection: Principles of isometric projection – isometric scale, isometric views, conventions, conversion of isometric views to orthographic views and vice-versa

4 Projection of Solids and Development of Surface: Classification of solids, projections of solids like cylinder, cone, pyramid, and prism with its inclination to reference plane, development of surfaces of right regular solids - prism, pyramid, cylinder and cone.

5 Introduction of Computer Aided Engineering Drawing: Demonstrating knowledge of the theory of CAD software, use of software in drawing, CAD software user interface, commands, Coordinate System, menus and toolbars, planes, dimensioning, saving of files, Select and erase objects, zoom tools, and others

6 Basic sketching using CAD tool: Sketch entities using tools – origin, points, lines, circle, arcs, polygons, fillets and chamfer, trim, extend and offset, copy, cut, delete and others

7 Advanced sketching using CAD tool: Sketching entities using relation constrains, Mirror, Patterning, full definition of drawing and others

8 Basic 3D modelling using CAD tool: Extrude, cut, drawing on different planes, editing, symmetric, revolving, and others

9 Computer aided drawing sheets: Preparing drawing sheets, creating different views, section view, drawing templates, and others

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Recalling the fundamentals of engineering graphics by considering basic rules of drawing, dimensioning, and labelling.
CO2 : Explain the principle of projection using orthographic and isometric projection.
CO3 : Represent the 2-dimensional drawing using CAD tool.
CO4 : Construct the 3-dimensional geometries using CAD tool.
CO5 : Apply the concept of engineering drawing by organizing drawing views and applying necessary dimensions by preparing drawing sheets
CO6 : Analyse the intricate details of solid using projection of solid, sectioning of solid and development of lateral surfaces.

TEXT/REFERENCE BOOKS

1. Bhatt N.D., Panchal V.M. & Ingle P.R., Engineering Drawing, Charotar Publishing.
2. Shah P.J., Engineering Graphics, S. Chand Publishing.
3. Agrawal, B. & Agrawal C. M., Engineering Drawing, Tata McGraw Hill Publishers.
4. Hanifan R, Perfecting Engineering and Technical Drawing, Springer International Publishing Switzerland.
5. Corresponding Set of CAD Software Theory and User Manuals.

24CV101T					Environmental Science					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

1. To develop a comprehensive perspective of environment and sustainable development
2. To understand the causes and effects of various types of pollution
3. To develop an understanding of the various strategies for controlling the pollution
4. To introduce the emerging environmental domains

UNIT I : INTRODUCTION TO ENVIRONMENT **05 Hrs.**

Sustainable Development; Sustainable Development Goals; Environmental Studies – Its importance and Multidisciplinary nature, Introduction to Environmental Parameters and their standards (air, water, soil, noise, etc.); Ecosystem and its types, Ideal ecosystem, Biodiversity : Its importance and conservation.

UNIT II : MULTI-SCALE ENVIRONMENTAL POLLUTION (GLOBAL, REGIONAL AND LOCAL) **06 Hrs.**

Pollution, Causes and Effects of different types of pollution : Air Pollution, Water Pollution, Soil Pollution, Solid Waste (organic and Inorganic) Pollution, Hazardous Waste Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Radioactive Pollution; Introduction to man-made disasters like floods, heat waves, landslides, etc., Introduction to the various instruments for measuring air pollution, water pollution, noise, etc.

UNIT III : ENVIRONMENTAL POLLUTION CONTROL STRATEGIES **09 Hrs.**

Multi-approaches for reducing various types of pollution: Introduction to Water and Wastewater treatment technologies, Air and Noise pollution control techniques, Introduction to different environmental management concepts like Swachh Bharat Mission, Mission LiFE (Lifestyle For Environment), etc. Indian Culture and Traditional Wisdom for managing environment

UNIT IV: EMERGING ENVIRONMENTAL MANAGEMENTS DOMAINS **08 Hrs.**

Concept of Zero Liquid Discharge (ZLD) and the reuse of the treated wastewater, Green Credit Rules - 2023, Clean Development Mechanisms (CDM) and Carbon Credits, Green Buildings, Carbon Footprint and Water Footprint, Green Business, International Environmental Laws, Environmental Auditing

TOTAL: 28 Hrs.

COURSE OUTCOMES:

On completion of the course, student will be able to:

CO-1: Demonstrate comprehension of sustainable development and environmental aspects.
CO-2: Recognize the interdisciplinary characteristics inherent in Environmental studies.
CO-3: Evaluate the impact of various pollutants on the environment.
CO-4: Assess the efficacy of different technologies for environmental pollution control.
CO-5: Analyze different environmental management policies and their implications.
CO-6: Synthesize knowledge about emerging environmental management paradigms.

TEXT-BOOK AND REFERENCE BOOKS:

1. Bharucha Erach, Textbook for Environmental Studies, UGC New Delhi.
2. Daniel B. Botkin & Edwards A. Keller, Environmental Science, Wiley India edition.
3. Miller T. G. Jr., 2006. Environmental Science, Clengage Learning.
4. R. Rajagopalan, Environmental Studies, Oxford University Press.
5. Gilbert Masters and Wendell P. Ela, Introduction to Environmental Engineering and Science, PHI.

24PE101P					Geology for Petroleum Engineers Laboratory					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs./Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE**	
0	**0**	**2**	**1**	**2**	**--**	**--**	**--**	**50**	**50**	**100**

COURSE OBJECTIVES

1. Demonstrate the unique characteristics of various rocks.
2. Develop analytical skills to identify various rock specimens.
3. Imbibe skills to prepare geological maps.
4. Enhance the ability to perform geological studies before reservoir modelling.

LIST OF EXPERIMENTS

1 Study of crystal: clinographic projection of cube
2 Study of common silicates in hand specimens: quartz, feldspar, mica, garnet, kyanite, sillimanite
3 Study of other minerals in hand specimen: graphite, gypsum, barite, calcite, aragonite, corundum, haematite
4 Study of common igneous rocks in hand specimens: granite, basalt, rhyolite, syenite, dolerite, gabbro
5 Study of common metamorphic rock in hand specimen: slate, phyllite, schist (mica, talc, chlorite), gneiss, marble, quartzite
6 Study of common sedimentary rock in hand specimen: shale, siltstone, sandstone, conglomerate, breccia, limestone
7 Study of thin sections of minerals: quartz, feldspar, mica, pyroxene & amphiboles
8 Study of thin sections of igneous rocks: granite, gabbro, diabase, diorite, pegmatite, and peridotite.
Study of thin sections of volcanic rocks: basalt, obsidian, pumice, tuff, rhyolite, scoria, dacite, and andesite
9 Study of thin sections of metamorphic rocks: schist, gneiss, quartzite, Novaculite or Arkansas Stone & Lapis Lazuli
10 Study of thin sections of sedimentary rocks: shale, sandstone & limestone
11 Study of selected fossils in hand specimen
12 Study of topographic maps
13 Study of geological maps

COURSE OUTCOMES

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

CO1 : Identify and classify different rock-forming minerals
CO2 : Identify and classify various igneous, sedimentary and metamorphic rocks.
CO3 : Interpret and differentiate between different fossil groups for reconstructing the paleoenvironment of the studied rocks.
CO4 : Analyse the structural maps.
CO5 : Evaluate the structural deformation in the map area
CO6 : Correlate the rock types and geological structures with some aspects of petroleum systems

TEXT/REFERENCE BOOKS

1. Siobhan Mcgoldrick (2021), **A Practical Guide to Introductory Geology**
2. Dougal Dixon (1992), **The Practical Geologist: The Introductory Guide to The Basics of Geology and to Collecting and Identifying Rocks**

24PE101T					Geology for Petroleum Engineers					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Demonstrate the fundamentals of the origin of the earth.
2. Enhance skill to perform study of rocks.
3. Improve skills in interpreting geological activities.
4. Develop skills to identify the petroleum potential of an area.

UNIT I: PHYSICAL GEOLOGY **10 Hrs.**

Origin of the solar system with earth formation - stellar nucleosynthesis. The Earth's structure - crust, mantle and core; Plate tectonics and basin formation. Geological time scale; radioactive dating. Sea level change.

UNIT II: WEATHERING AND STRUCTURAL GEOLOGY **10 Hrs.**

Weathering - Goldich stability series; Physical or mechanical weathering; Chemical weathering; Biological weathering. Stress and strain in rocks; Strike and Dip; Fold nomenclature; Fault nomenclature; Types of joints in geology

UNIT III: MINERALOGY AND PETROLOGY **10 Hrs.**

Crystallography – Crystal structure and unit cell types; chemical mineralogy, Bio mineralogy, Optical mineralogy; silicate mineralogy, Igneous Petrology – rock cycle, Classification of rocks; Bowen's reaction series, Formation of igneous rocks, Classification of igneous rocks, Texture of igneous rocks, Sedimentary rocks formation; structure and texture of sedimentary rocks; classification of sandstone, Folk's textural classification of carbonate sediments; Dunham's limestone classification. Formation of metamorphic rocks, Foliated rocks, and Non-foliated rocks.

UNIT IV: PALEONTOLOGY AND STRATIGRAPHY **10 Hrs.**

Palaeontology - body fossils and trace fossils; Types of fossils; benthic fossils; pelagic fossils; Uses of fossils; Index fossils, importance of fossils in petroleum geology, Stratigraphy - Types of Stratigraphy; Laws of Stratigraphy; Unconformities; importance of stratigraphy in oil and gas traps.

TOTAL: 40 Hrs.

COURSE OUTCOMES

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

CO1 : Understand and correlate the different earth processes;
CO2 : Differentiate and classify the other minerals and rocks;
CO3 : Estimate the bearing of various physicochemical and mineralogical parameters on the geo-mechanical properties of the rocks;
CO4 : Evaluate the petroleum potential of an area based on the different geological structures;
CO5 : Analyze the different strata based on their fossil assemblage and evaluate the petroleum potential based on the physiography and stratigraphy;
CO6 : Understand and correlate the different earth processes;

TEXT/REFERENCE BOOKS

1. Sengupta S.M., **Introduction to Sedimentology**
2. Mukherjee P.K., **A Textbook of Geology**
3. G.B. Mahapatra, **A Textbook of Geology**

24MA101T					Mathematics – I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. To be able to evaluate problems related to differential and integral calculus of complex functions.
2. To be able to obtain area, volume using integral calculus.
3. To be able to formulate and solve various engineering problems using the calculus.
4. To study the properties of sequence and series and to check the convergence and divergence.

UNIT I: DIFFERENTIAL CALCULUS AND ITS APPLICATIONS **08 Hrs.**

Partial derivative and its application - Euler's theorem - Total derivatives - Jacobians – Maxima and Minima of two variables using Lagrange's multipliers. Taylor's series, Convergence of power series.

UNIT II: INTEGRAL CALCULUS AND ITS APPLICATIONS **12 Hrs.**

Definition and evaluation of double integral (Cartesian – Polar form) – Change of orders - Change of variables – Evaluation of triple integral, change of variables (Cartesian to spherical – and cylindrical) – Applications, area – volume – center of mass – center of gravity by double and triple integral.

UNIT III: VECTOR CALCULUS **10 Hrs.**

Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector Integration – Simple problems on line, surface and volume integrals – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (without proofs) – Simple application involving cubes and rectangular parallelepipeds.

UNIT IV: SEQUENCE AND SERIES **12 Hrs.**

Definition. Convergent, divergent, bounded & monotone sequences. Infinite sums: Basics Taylor series, Convergence and divergence, Tests for convergence for positive term series, Alternating series – Leibnitz test, Absolute convergence, conditional convergence.

TOTAL: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Identify the use of convergence of infinite series in engineering aspects.
CO2 : Understand the concept of Directional derivative, Irrotational and Solenoidal vector fields.
CO3 : Apply the concept of differential and integral calculus in engineering problems.
CO4 : Analyze the obtained solution in linear and non-linear domains.
CO5 : Appraise mathematical problems from complex domain.
CO6 : Evaluate problems on Green's, Stokes' and Divergence theorems.

TEXT/REFERENCE BOOKS

1. B. S Grewal, Higher Engineering Mathematics, Khanna Pub.
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Alpha Science.
3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley.
4. G. Strang, Linear Algebra and its Applications, Cengage Learning.
5. K. Hoffman and R. A. Kunze, Linear Algebra, Prentice Hall of India.

24PH103P					Modern Physics Laboratory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. Understand the characteristics of waves, semiconductor, heat pump, LASER.
2. Enhance knowledge on application of physics in engineering
3. To develop intellectual communication skills and discuss the basic understanding of various experimental principles involved
4. Demonstrate practical knowledge by applying experimental methods to correlate with the theory.
5. Apply the analytical techniques and graphical analysis to the experimental data

LIST OF EXPERIMENTS

1 Determining Plank's constant and inverse square law
2 Study of Photoconductivity
3 Study of Bio-Savart's Law
4 Determining e/m by Thomson's method
5 Study of Hall Effect.
6 Experiments on single and double slit diffraction and interference with He-Ne Laser
7 Study of I-V characteristics of p-n diode.
8 Determination of thermal conductivity of different solids
9 To measure resistivity of semiconductor by Four Probe method and determination of band gap.
10 Study of Interference using Newton's Ring experiment.
11 To study G.M. tube characteristics and to calculate the dead time.
12 Energy calibration of CsI:Tl radiation detector and energy analysis of an unknown gamma source
13 To determine the numerical aperture of a given fibre optics cable using the far field measurements.
14 Experiments with heat pump
15 Study of Polarization of light using LASER

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Analysis the engineering problems and design the components for the solution
CO2 : Developing skills to utilize the different tools for engineering problems
CO3 : Analyse the results and correlate with theory and its application in industries
CO4 : Design the set-up and utilize for component analysis
CO5 : Identifying the problem and creating the solutions for research and development
CO6 : Analyse the scientific data and learn to be efficient as individual and a team member

TEXT/REFERENCE BOOKS

1. W.R. Runyan , Semiconductor Measurements and Instrumentation, McGraw Hill.
2. Sayer M. & Mansingh A., Measurement, Instrumentation & Experiment Design in Physics and Engineering, Prentice Hall India.
3. Melissinos A.C. and Napolitano J, Experiments in Modern Physics, Academic Press.
4. Nakra B.C. &. Chaudhery K.K , Instrumentation Measurements & Analysis, Tata McGraw Hill.
5. ORTEC Lab Manual, Experiments in Nuclear Science, ORTEC.

24PH103T					Modern Physics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding concepts of modern physics.
2. Explaining the physics of EM waves and its propagation.
3. Applying the Acquired basic knowledge of solid state physics.
4. Analyze the Concepts of nuclear radiation physics.
5. Estimate and correlate the concepts learned so far for various engineering applications.
6. Apply the fundamentals designs of modern physics to solve complex physical problems.

UNIT I: MODERN PHYSICS **09 Hrs.**

Review of quantum concepts: particle nature of light, photoelectric effect, Compton effect, matter waves, wave packets, phase and group velocity, Interference, Diffraction and Polarization, Engineering Physics related applications. Davisson Germer experiment, Heisenberg uncertainty principle.

UNIT II: ELECTROMAGNETIC WAVES **12 Hrs.**

Physical and mathematical concepts of gradient, divergence and curl, Gauss theorem, applications in gravitation and electrostatics. Stokes' theorem and engineering Physics related applications. Equation of continuity, Biot Savart law – Ampere's law – magnetization and magnetic intensity, Faraday's law of Maxwell's equations, wave equation for electromagnetic radiation, applications of optical fibers in communication.

UNIT III: SOLID STATE PHYSICS **12 Hrs.**

Crystalline and Amorphous Solids, Ionic Crystals, Covalent Crystals, Van der Waals Bond, Band Theory of Solids, Semiconductor Devices, Electrical conductivity, Resistivity, Magnetism, Superconductivity, Introduction to BCS Theory.
Concepts of LASER, Interaction of radiation of matter-quantum mechanical view, characteristics and Types of laser, Engineering Physics related application of lasers.

UNIT IV: NUCLEAR RADIATION PHYSICS **09 Hrs.**

Mass defect, binding energy, Radioactivity, Types of Radiation, Interaction of Radiation with matter, Radiation detector, nuclear reactions, elements of nuclear reactors, fission and fusion, Engineering Physics related problems.

TOTAL: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : To relate to shape the engineering perspective in the student mind.
CO2 : Aims to provide an understanding to analyse the physical phenomena of various physics concepts.
CO3 : To develop an analytical perspective in the student.
CO4 : To enable understanding in the students the importance of application of already studied topics.
CO5 : To explain and relate the importance of interdisciplinary problems.
CO6 : To strengthen problem solving attitude in physics using mathematical tools.

TEXT/REFERENCE BOOKS

1. Resnick, Halliday and Krane, Physics part I and II, John Wiely
2. Ghatak, Optics, Tata McGraw Hill
3. Purcell E.M. Electricity and Magnetism - Berkeley Physics Course, Vol.2, Tata McGraw-Hill.
4. Kittel C., Knight W.O. and Ruderman M.A., Mechanics - Berkeley Physics Course, Tata McGraw-Hill.
5. Griffith D.J.H., Introduction to Electrodynamics - Prentice Hall, India.
6. M. N. Avadhanulu, A text book of engineering Physics, S. Chand & Company, Ltd.
7. Feyman R.P., Leighton R.B. and Sands M. The Feyman Lectures on Physics, Vol. 1., Narosa Publication.

24HS102T					Universal Human Values					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
1	0	0	1	1	25	50	25	--	--	100

COURSE OBJECTIVES

1. To understand the need of nurturing human values through the process in value-based education system.
2. To understand and develop a holistic perspective on self-exploration and being in harmony with family, society and nature.
3. To facilitate the students in understanding harmony at all the levels and applying in their profession and work place to lead an ethical life.

UNIT I: HUMAN VALUES AND PROCESS OF VALUE EDUCATION **04 Hrs.**

Human values, human aspirations and the ultimate goal, understanding happiness and prosperity, appraise the meaning of satisfaction and happiness in current scenario, harmony and compatibility, values imbibed education system and process

UNIT II: KNOWING SELF - HARMONY WITH SELF **04 Hrs.**

Understanding self, capabilities and challenges, understanding material (physical facilities) and spiritual needs - need of mind and body, understanding body as an instrument, harmony between mind and body, synchronizing physical health and mental health, practicing healthy habits for healthier me

UNIT III: HARMONY IN RELATIONSHIP – FAMILY, SOCIETY AND NATURE **03 Hrs.**

Harmony in relationships, values for harmony in any human-human interaction, harmony in family, and society, trust and respect for others, self esteem and ego, equality, equity, inclusion and liberation, concept of '*Vasudhaiva Kutumbakam',* understanding co-existence and sync with nature

UNIT IV: HARMONY IN PROFESSION AND ETHICAL BEHAVIOR **03 Hrs.**

Ethical human conduct, acceptance and respect, appraising the qualities of others, professional competence for enabling harmony in system and enabling universal human order, scope of eco-friendly systems, strategies to reach the harmonious ecosystem to reach Universal Human Order '*Sarvabhauma Vyavastha'*

TOTAL : 14 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 - Understand the significance of human values, its need, and process of value education.

CO2 - Appraise the meaning of happiness and prosperity as short- and long-term goal of life. Understand them and in context of the current scenario

CO3 - Distinguish between the mind and body, physical and spiritual wellbeing for harmony within self

CO4 - Assess the value of harmonious relationship based on trust, respect and enduring its role in all human-human relationships to build harmonious society

CO5 - Understand the importance of harmony with nature and appreciate co-existence for harmonious ecosystem.

CO6 - Create the perfect professional place and work environment following the ethical practices and strategize to uphold the human values at all the levels and interactions.

TEXT/REFERENCE BOOKS

1. R. R. Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and Professional Ethics, Excel books.
2. A. Nagraj, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
3. A. N. Tripathi, Human Values, New Age Intl. Publishers.
4. M. K. Gandhi. The Story of My Experiments with Truth, Fingerprint Publishing.
5. Ivan Illich, Energy & Equity, The Trinity Press, Worcester, and Harper Collins.
6. E. F. Schumacher, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
7. Sussan George, How the Other Half Dies, Penguin Press.

24ME101P					Workshop Practices					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To understand safety in various manufacturing processes.
2. Learn how to use various measuring tools for engineering applications.
3. Hands on training and preparation of job using wood, metal and sheet as per drawing.
4. Understand various manufacturing processes like machining, welding, soldering and 3D printing for prototypes.

LIST OF EXPERIMENTS

1 Introduction to Workshop safety, layout and identification of various materials- plastic, wood, metals-ferrous and nonferrous, rubber, glass etc.
2 Use of measuring tools for engineering applications
3 Fitting job: Detailed drawing of work piece, use of fitting tools and job preparation.
4 Carpentry job: Detailed drawing of work piece, use of carpentry tools and job preparation.
5 Sheet metal job: Detailed drawing of work piece, use of sheet metal working tools and job preparation.
6 Plumbing job: Internal/External threading, piping network using Tees, Elbows, Reducer, Bends etc
7 Hands on training on mini lathe and milling machine
8 Demonstration of welding, brazing and soldering
9 Soldering and desoldering for PCB
10 3D printing using polymer and metal.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Define workshop safety and various engineering materials
CO2 : Understand various measuring equipment
CO3 : Apply various workshop tools in preparing job for carpentry, fitting, sheet metal and plumbing
CO4 : Examine various manufacturing operations like welding and machining
CO5 : Evaluate soldering operation for PCB
CO6 : Create prototype using 3D printing

TEXT/REFERENCE BOOKS

1. S. K. Hajra Choudhury, Elements of Workshop Technology, Vol. I & II, Media Promoters and Publishers.
2. H. S. Bawa, Workshop Practice, Tata-McGraw Hill.
3. Kalpakjian S. And Steven S. Schmid, Manufacturing Engineering and Technology, Pearson Education India Edition.
4. Rao P.N., Manufacturing Technology, Vol. I and Vol. II, Tata McGraw Hill House.

24PE102P					Sedimentary and Petroleum Geology Practical					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. Demonstrate the need for studying reservoir rocks and maps
2. Demonstration the way to prepare various maps
3. Improve skills to study subsurface structure
4. Support in opting for more advanced study of reservoir modelling and basement mapping

LIST OF EXPERIMENTS

1 Study of Sedimentary rocks in Hand Specimen: Sandstone- Detailed study of Different types of Sandstone, Ex. Arkose, Wacke with respect to texture (grain size, shape, and angularity/roundness), sorting, presence/absence of cement/matrix), porosity, permeability, and their depositional environment.

2 Shale- Detailed study of different types of shales (glauconitic, fossiliferous, and carbonaceous) & their depositional environment

3 Limestone-Detailed study of different types of Limestone and their depositional environment

4 Study of Shape of pebbles

5 Grain size of analysis of sediment (Mean, Median, Standard deviation, Skewness, Kurtisis)

6 Study of thin sections of sedimentary rocks (Shale, Sandstones, limestones) vis-à-vis their porosity and permeability.

7 Study of Isochore maps and construction of sections

8 Study of Isopach maps and construction of sections

9 Construction of panel and fence diagrams

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 : Understand different minerals in hand specimen

CO2 : Analyze silicates in hand specimen

CO3 : Analyze fossils in hand specimen

CO4 : Understand different types of rocks in hand specimen

CO5 : Study clinographic projection of cube

CO6 : Interprate topographic and geological maps

TEXT/REFERENCE BOOKS

1. Sengupta S.M, **Introduction to Sedimentology**.
2. Kunt Bjorlykke, **Sedimentology and Petroleum Geology**.
3. F.j. Pettijohn, **Sedimentary Rocks**.
4. Sam Boggs Jr., **Principals of Sedimentology and Stratigraphy**.
5. Reineck H.E. and Singh I.B., **Depositional Sedimentary Environments**; Springer.

24PE102T					Sedimentary and Petroleum Geology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Demonstrate the fundamentals of Sedimentology in Reservoir characterization
2. Understand the geological process involved in formation of Hydrocarbons
3. Imbibe the knowledge of petroliferous basins of India
4. Improve analytical skills to interpret the geological history of a Petroliferous basin.

UNIT I **10 Hrs.**

Basins and formation of sediments, Grain transportation and its deposition, Hjoulstorm curve, Sediment texture (Size, Shape, sorting); Control of grains size on Porosity and permeability; Carbonate rock and its porosity; Paleocurrent analysis, diagenesis, fundamentals of fluid flow (Reynolds no; Froude no.); Flow Regimes (Upper flow regime; Lower flow regime); Introduction to Unidirectional flows and oscillatory flows.

UNIT II **11 Hrs.**

Bedforms formed under unidirectional flow; Bedforms formed under Oscillatory flow; Sediment stability diagram; Interpreting Depositional environment from outcrops and cores. Interpretation of Sedimentary environment especially, Sedimentology (Grain size, sorting), Sand distribution, Sand geometry, Porosity-permeability trends in reservoirs formed in Continental (Alluvial Fan, Fluvial System-Meandering and Braided); Delta and Estuary System; Shallow marine (Shoreface); Shelf and Deep and Ultra deep sedimentary environments. Selected case studies of each environment.

UNIT III **10 Hrs.**

Theory of Petroleum formation; Organic matter and its composition; Kerogen and its types, Maturation of Kerogene, Thermal maturity indicators, Migration of Hydrocarbons; Primary migration-Theories and reasons; Secondary migration; Tertiary migration; Migration under hydrostatic and hydrodynamic conditions; effect of isopotential surfaces, identifying migration pathways.

UNIT IV **11 Hrs.**

Distinction between reservoir and source rock; Source rock characterization; Seal and Cap rock characterization; Traps (Structural; Stratigraphic and combined traps); Total petroleum System; Evaluation of a petroliferous sedimentary basin; Petroleum Geology of India; Selected Case study on (a) Carbonate Reservoir/field –Ghawar; Mumbai-High (b) Clastic reservoir: Assam, Cambay (c) Evaporitic reservoir: Bikaner-Nagur Basin.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 : Recognize, describe and classify the different types of sediments and sedimentary rocks and petroleum components.
CO2 : Comprehend the various types of reservoir sedimentology and sand geometry for hydrocarbon system.
CO3 : Evaluate the petrophysical properties of the sedimentary rocks, and estimate the reservoir potential and evaluate the seal integrity.
CO4 : Evaluate the petroleum source rocks, and estimate the petroleum potential of the petroleum system(s) in a sedimentary basin.
CO5 : Analyze, source rocks, reservoir rocks, migration paths, and traps in petroliferous basins.
CO6 : Analyze and comprehend different components of the Total petroleum system.

TEXT / REFERENCE BOOKS

1. Slatt, Roger (2006), **Stratigraphic Reservoir Characterization For Petroleum Geologists, geophysicists, and engineers**, Elsevier (second Edition).
2. Shelly, R. C. & Sonnenberg, S. A. (2014), **Elements of Petroleum Geology**, 3rd Edition, Academic Press

3. Sam Boggs Jr: (1987) **Principles of Sedimentology and Stratigraphy**
4. Reineck H.E. and Singh I.B. (1980) **Depositional Sedimentary Environments**; Springer.
5. B.P. Tissot and D.H. Welte (1984) **Petroleum Formation and Occurrence: A New Approach to Oil and Gas Exploration**, Springer.
6. F.K. North (1985) **Petroleum Geology**, Unwin Hyman (2nd Ed).

Beaumond, E. A., and Foster, N. H (1999) **Treatise of Petroleum Geology/Handbook of Petroleum Geology: Exploring for Oil and Gas Traps** AAPG.

24INT152					Rural Internship					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	0	1	Internship	--	--	--	50	50	100

COURSE OBJECTIVES

1. The Internship aims at exploring the students to the life, culture and issues of rural India.
2. The Internship exposes students to the socio-economic aspects of Rural India

RURAL INTERNSHIP

During the Internship student will be associated with rural India, exploring

a) Rural Society
b) Rural Life
c) Rural Culture
d) Rural Development Issues
e) Rural Economy

Additionally, it also develops inter-personal skills and allied aspect.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Summarize Rural Life of India for creating sense of belongingness for the community
CO2 : Demonstrate leadership qualities and societal responsibility
CO3 : Appraise concepts of rural life and rural society for sustainable development
CO4 : Evaluate skills on participatory methodologies and tools used in rural development
CO5 : Discover cross-cultural learning on rural and development issues for inter-personal growth
CO6 : Enable the students to appreciate the importance of agriculture, artisans and rural entrepreneurs in Rural India

24MA201T					Mathematics – III					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. The primary objective of this course is to provide students with a comprehensive understanding of advanced mathematical transforms and their applications in engineering.
2. To use the concept of Laplace transform and its significance in solving differential equations.
3. Understand the fundamental concepts of difference equation and Z-transform.
4. To use this basic course in upcoming courses in respective specializations in higher classes.

UNIT I LAPLACE TRANSFORM **10 Hrs.**

Piecewise continuous functions and exponential functions, Definition, Existence and Properties of Laplace transforms, Heaviside function, Impulse function, Inverse Laplace transform, Properties of inverse Laplace transforms, Convolution theorem, Applications of Laplace Transforms in solving differential equations.

UNIT II DIFFERENCE EQUATION AND Z-TRANSFORM **10 Hrs.**

First and second order difference equation with constant coefficient, Solution of difference equation-complementary function-Particular integral, Z - transform, Properties of Z-transforms, Convolution of two sequences, inverse Z-transform, Solution of Difference equations using Z-transform.

UNIT III FOURIER TRANSFORM **10 Hrs.**

Fourier Integral, Fourier Cosine and Sine transform, Discrete Fourier Transform, Continuous Fourier Transform, Linearity, time shifting, frequency shifting, and convolution properties, Applications in image processing, communication systems, and quantum mechanics.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS **10 Hrs.**

Formation of Partial Differential Equations (PDEs), Solutions of PDEs of the first order, Cauchy problem for first-order PDEs, Lagrange's method, Charpit and Jacobi methods for solving first-order nonlinear PDEs. Classification of second order PDEs, one-dimensional heat equation, wave equation, and Laplace equation, Applications of PDE's to wave analysis.

TOTAL HOURS : 40 Hrs.

COURSE OUTCOMES:

On completion of the course, student will be able to:

CO1 : Define the partial differential equations of first and second order in order to model or understand the Engineering applications

CO2 : Understand the techniques of Laplace transforms, Z-transforms, and Fourier Transform to solve critical mathematical problems.

CO3 : Apply the methods of Transform techniques to solve differential equations involving piecewise continuous and exponential function.

CO4 : Classify the partial differential equations of different orders and solve them using different techniques

CO5 : Appraise engineering or scientific problems that can be addressed using transform techniques

CO6 : Formulate and create various application problems in engineering using series and Transform techniques.

TEXT/REFERENCE BOOKS:

1. R.K. Jain & S.R.K. Iyengar, **Advanced Engineering Mathematics**, 3rd ed., Narosa Publishing House, 2002.
2. E. Kreyszig, **Advanced Engineering Mathematics**, 10th ed., John Wiley & Sons, 2016.
3. Peter V. O'Neil, **Advanced Engineering Mathematics**, 8th ed., Cengage Learning, 2017.
4. K. Sankara Rao, **Introduction to Partial Differential Equations**, 3rd ed., PHI Learning, 2011.
5. T. Amaranth, **An Elementary Course in Partial Differential Equations**, 2nd ed., Narosa Publishing House, New Delhi, 2003.Glynn James, **Advanced Modern Engineering Mathematics**, 4th edition, Pearson, 2016.

24PE201T					Introduction to Artificial Intelligence					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understand the core principles of AI and its various subfields.
2. Identify the potential of AI for solving complex problems in petroleum engineering.
3. Explore how AI techniques can be applied for data analysis and building basic AI models.
4. Develop basic skills in utilizing AI tools for data analysis and decision-making.

UNIT I FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE **11 Hrs.**

Introduction to AI, Machine Learning (ML) vs. Deep Learning (DL), Bridging Python Programming, **Supervised Learning:** Algorithms (linear regression, decision trees), **Unsupervised Learning:** Techniques (clustering, dimensionality reduction), Reinforcement Learning, **Data Preprocessing:** Techniques for cleaning, transforming, and preparing data for AI models.

UNIT II AI MODEL EVALUATION **10 Hrs.**

Accuracy, Precision, Recall, F1-Score, Confusion Matrix, Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), R-Squared (Coefficient of Determination), Area Under the ROC Curve (AUC-ROC). **Examples:** water-cut prediction accuracy, Net Present Value (NPV) improvement from reservoir management strategies, or drilling cost reduction achieved through AI-powered optimization.

UNIT III INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS (ANN) **10 Hrs.**

Biological Inspiration, Artificial Neurons, Network Architectures, Activation Functions, Learning Processes, Loss Functions, Overfitting and Underfitting, Deep Learning Architectures, and Optimization Algorithms. **ANN applications in Petroleum Engineering:** Reservoir property prediction using CNNs, production forecasting with RNNs, or wellbore stability analysis with MLPs.

UNIT IV TIME SERIES ANALYSIS AND ETHICS **11 Hrs.**

Artificial time series analysis, Application of time series prediction in oil and gas industry, Ethical considerations of AI, Explainability and Transparency, Environmental Impact, Data Privacy and Security, Long-term Sustainability, The Future of AI Ethics.

TOTAL HOURS : 42 Hrs.

COURSE OUTCOMES:

On completion of the course, student will be able to:

CO1 : Define key terms and concepts related to Artificial Intelligence (AI), machine learning (ML), and deep learning (DL)

CO2 : Understand the fundamental differences between supervised, unsupervised, and reinforcement learning techniques, and identify their potential applications

CO3 : Apply basic machine learning algorithms (e.g., linear regression, decision trees)

CO4 : Evaluate the performance of different AI models

CO5 : Assess the limitations and ethical considerations associated with utilizing AI models in the oil and gas industry

CO6 : Design a simple AI workflow for a specific petroleum engineering problem

TEXT/REFERENCE BOOKS:

1. Abdolhossein Hemmati-Sarapardeh, et al., **"Applications of Artificial Intelligence Techniques in the Petroleum Industry"**, 2020, Gulf Professional Publishing.
2. Yogendra Narayan Pandey, Ayush Rastogi, Sribharath Kainkaryam, Srimoyee Bhattacharya, Luigi Saputelli, **"Machine Learning in the Oil and Gas Industry-Including Geosciences, Reservoir Engineering, and Production Engineering with Python**", 2020, Apress.
3. Vishwas B. V., Ashish Patel, **"Hands-on Time Series Analysis with Python: From Basics to Bleeding Edge Techniques",** 2020, Apress.

24PE202T					Heat and Mass Transfer					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To understand the different mode of heat transfer and its Industrial applications.
2. To provide the importance of various modes of heat and mass transfer to solve variousengineering problems.
3. To explain the significance of mass transfer operations in various industries.
4. To design the various mass transfer equipments.

UNIT I: CONDUCTION AND CONVECTION **12 Hrs.**

Conduction: Steady-state and transient flow through various geometries, Convection: LMTD and NTU, overall heat transfer coefficient. Application of dimensional analysis to convection. Heat transfer rate and Heat transfer coefficient calculations. Double pipe parallel and counter flow heat exchangers, natural and forced convection through tubes and outside tubes, Shell and tube heat exchanger, and finned tube heat exchanger. Boiling of liquids and condensation of vapors.

UNIT II: RADIATION **12 Hrs.**

Introduction, theories of radiation, electromagnetic spectrum, spectral emissive power, surface emission, total emissive power, emissivity; Radiative properties, emission, irradiation, absorptivity, reflectivity and transmissivity; Concept of black and grey body, radiation intensity, laws of black body radiation, non-black surfaces, radiation between black and grey surfaces.

UNIT III: DIFFUSION **10 Hrs.**

Diffusion in gases: Fick's law, determination and estimation of diffusion coefficient; diffusion through stagnant gas and equimolecular counter-diffusion. Diffusion in liquids: Mass transfer across phase boundaries, two-film theory and mass transfer coefficient.

UNIT IV: MASS TRANSFER OPERATIONS **10 Hrs.**

Gas Absorption, Adsorption, Extraction and Distillation (flash and differential): Basic principles, laws, and calculations. Equilibrium, co-current and counter-current operations. Ideal stage concept and calculation of number of ideal stages. Efficiency of Packed bed and tray columns.

TOTAL HOURS: 44 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 : Understand conduction and convection heat transfer equations to various geometry and solve complex engineering problems.
CO2 : Analyze the phenomena of boiling and condensation and determine the thermal coefficient of various heat exchanger configurations.
CO3 : Comprehend and analyze the radiation heat transfer.
CO4 : Study the application of diffusional mass transfer in the reservoir field.
CO5 : Understand and design the various mass transfer operations in the oil and gas processing.
CO6 : Design the packed bed and tray column

TEXT/REFERENCE BOOKS

1. Coulson and Richardson's **Chemical Engineering Vol-1**, 6th Ed, Elsevier, 2020.
2. Donald Q. Kern, **Process Heat Transfer**, 2nd Edition, Tata-McGraw-Hill, 2019.
3. Holman.J.P., **Heat Transfer**, 10th Edition,Tata Mc Graw Hill, 2017.
4. Yunus A.Cengal., **Heat and Mass Transfer – A practical Approach**, 5th edition, Tata McGraw -Hill, 2013.
5. Incropera F.P. and DeWitt. D.P., **Fundamentals of Heat & Mass Transfer**, 5th Edition, John Wiley& Sons, 2007.
6. Yadav, R., **Heat and Mass Transfer**, 5th Edition, Central Publishing House, 2004.

24PE204T					Geomechanics and Strength of Materials					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To learn stress and strain concept with numerical problems and mechanical properties of material and learn the concept of material failure
2. To study strength of geological material such as rock and soil filled with or without pore fluid and applicable failure theories
3. To understand the tectonic stress field and stress classification in subsurface
4. To understand the effect of pore pressure at depth and various laws governing strength of rock in the presence or absence of pore fluid

UNIT I: BASICS OF MECHANICS **7 Hrs.**

Fundamental assumptions in elementary mechanics of materials; viscoelasticity or rheology; mechanical properties of metals – concepts of stress and strain; stress-strain behavior; inelasticity; elastic properties of materials; tensile properties; elastic recovery during plastic deformation; compressive, shear, and torsional deformation; hardness; variability of material properties; design/safety factors. Testing of material properties. Thermal stresses – bars subjected to tension, asymmetric loading, and stress calculation of cylindrical bodies. Scalar, vector, tensor; composition and resolution of stresses; stress vector acting on a surface; analysis of stress; stress field acting at a point – derivation of equations for σ_n and τ_n. Mohr's circle; deviatoric and mean stress; special states of stresses by Mohr's circle; Mohr-Coulomb failure envelope.

UNIT II: INTRODUCTION TO ROCK MECHANICS **7 Hrs.**

Structural rock mechanics; strength of geological materials; influence of geological history (burial and uplift) on rocks – normally consolidated and over consolidated rocks; effective stress, undrained modulus of elasticity, coefficient of compressibility, coefficient of consolidation, significance of drainage path length and the rate of consolidation; stress and strain in geological materials and their measurements; cohesion, friction, and failure; influence of fabric; drained and undrained strength; Atterberg limits

UNIT III: INTRODUCTION TO RESERVOIR GEOMECHANICS **7 Hrs.**

Tectonic stress field; pore pressure at depth in sedimentary basins; basic constitutive laws; rock failure in compression; tension and shear; faults and fractures at depth; compressive and tensile failures in vertical wells; determination of S_3 from mini-fracs and extended leak-off tests and constraining the magnitude of S_H from wellbore failures in vertical wells; wellbore failure and stress determination in deviated wells; stress fields – from tectonic plates to reservoirs around the world; wellbore stability; critically stressed faults and fluid flow; effects of reservoir depletion

UNIT IV: APPLICATION OF GEOMECHANICS **5 Hrs.**

Hydraulic Fracturing: Process, geomechanical factors effecting fracture development and simple calculations; Application of Geomechanics in Subsurface Energy – Oil and Gas, Geothermal Energy, Carbon Capture and Storage, and Hydrogen Storage

TOTAL HOURS: 26 Hrs.
TUTORIAL: 13 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 : Understand the structure and mechanical properties of different materials viz., metals, soil, minerals and rocks
CO2 : Determine the geomechanical properties of materials and predicting the failure based on the various failure theories
CO3 : Estimate the changes in shear strength of reservoir rocks vis-à-vis reservoir production, and its effect on the petrophysical properties
CO4 : Apply the understanding of stress-field to optimize production
CO5 : Evaluate the failure of the wall of the wellbore during drilling activities
CO6 : Analyze stress-field around boreholes using laboratory data and extending it to field situations

TEXT/REFERENCE BOOKS

1. Zobak, M. D. **Reservoir Geomechanics**

2. Longuemare, P. **Geomechanics in Reservoir Simulation**
3. Nauroy, J. F. **Geomechanics Applied to Petroleum Engineering**
4. Bansal R. K. **A Textbook of Strength of Materials**

24PE203T					Thermodynamics of Petroleum Reservoir Fluids					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	0	3	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. To provide the understanding of fundamentals of thermodynamics of reservoir fluids and their phase behaviour.
2. To provide the concept and understanding of fluid sampling and PVT study.
3. To provide the understanding of compositional characterization and application of various correlations in real field and simulation application.

UNIT I: RESERVOIR FLUIDS AND HYDROCARBON PHASE BEHAVIOUR **10 Hrs.**

Reservoir and reservoir fluids, Hydrocarbon-formation in source rock and crude oil in reservoirs, Thermodynamic behaviour –single, two, three and multicomponent system. Physical properties of petroleum reservoir fluids (Oil and water), classification of reservoirs and reservoir fluids, Compositional analysis of crude oil, Assignments and tutorials.

UNIT II: PROPERTIES HYDROCARBON COMPONENTS, CHARACTERIZATION AND CORRELATION **11 Hrs.**

Natural gas properties, behavior of ideal and real gases. Characterizing Hydrocarbon-plus fractions: generalized correlations, PNA determination, splitting and lumping scheme including various correlation methods, Assignments and tutorials

UNIT III: SAMPLING, PVT PROPERTIES AND LABORATORY STUDY OF PVT **10 Hrs.**

Collection of reservoir fluid samples for PVT study, PVT analysis: Constant composition expansion, flash liberation, differential liberation, separator test for PVT data of hydrocarbon fluids. Evaluation and correlation of physical and chemical properties of reservoir fluids including laboratory and empirical methods, Assignments and tutorials.

UNIT IV: SELECTION OF PVT CORRELATIONS **11 Hrs.**

Vapor-liquid equilibrium calculation, Selection of PVT oil properties correlations, Correlation selection based on geographical location, type of fluid, PVT model, data range and ranking and expert system or set of rules, Applications for PVT correlation selection.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Understand the compositional range of hydrocarbon components present in reservoir fluids with crude typing.
CO2 : Understand hydrocarbon phase behaviour in dynamic reservoir conditions.
CO3 : Apply knowledge for chemical characterization of hydrocarbon reservoir fluids and available correlations.
CO4 : Design sample collection for various purposed and understand PVT study and analysis
CO5 : Analyse situation dependent applicability of different correlation of vapor liquid equilibrium calculation.
CO6 : Apply the knowledge for selection of PVT correlations.

TEXT/REFERENCE BOOKS

1. Tarek Ahmed, "**Equation of state and PVT analysis: Applications for improved Reservoir Modelling**", Gulf Publishing Company.
2. Abbas Firoozabadi, Ramachandran Venkatesan, "**Thermodynamics of Hydrocarbon Reservoirs**", McGraw-Hill Publications.
3. Ali Danesh, "**PVT and Phase behavior of Petroleum Reservoir Fluids**", Elsevier.
4. Abhijeet Dandekar, "**Petroleum Rocks and Fluids Properties**", Taylor & Francis.
5. Ahmed El-Banbvi, Ahmed Alzahabi, Ahmed El-Maraghi, "**PVT Property Correlations: Selection and estimation**", Gulf Publishing Company.

24PE205T					Petroleum Exploration					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To provide the fundamental of petroleum exploration, different methods of geophysical surveys and instruments used for it.
2. To provide the understanding of geophysical data interpretation and analysis
3. To provide how to examine the acquired data to understand the position and extent of subsurface prospects in terms of depth and aerial

UNIT I: FUNDAMENTALS OF PETROLEUM EXPLORATION **10 Hrs**

Ingredients of Petroleum Exploration, Concept of source, reservoir, migration, trap and seal, Concept of Play, Lead, Prospect and Drillable Prospect, Types of Petroleum Traps-Structural, Stratigraphic and Combinational traps, Primary and Secondary Migration, E&P Life Cycle, Concept of Reserve, Lease and Reservoir, Techniques of Petroleum Exploration, Geochemical, Gravity, Magnetic, Electrical and seismic method of hydrocarbon exploration, Palaeontology & Palynology in Exploration

UNIT II: GEOCHEMICAL ANALYSIS **10 Hrs**

Petroleum geochemistry in exploration, Burial history curve with oil and gas window. Seeps and surface geochemicalexploration, Rock eval pyrolysis and maturity assessment, Fluid inclusion studies, Radiometric age dating, Geochemical well
logs for exploration, Molecular approach for petroleum exploration.

UNIT III: G AND M METHODS **9 Hrs**

Gravity and magnetic prospecting, Instruments of G&M survey, Gravity and magnetic data correction, Interpretation of G&M anomaly, Correlation of Gravity anomaly with seismic anomaly. SP, Telluric and Magnetotelluric data interpretation, Electrical properties of hydrocarbon, Electrical conductivities, Resistivity's of various lithologies, Dielectric constants, Land airborne EM, Interpretation and Modeling of data, Potential estimation for various buried bodies, Anomaly and well placement based on electrical data. Basic well logs, GR

UNIT IV: FUNDAMENTALS OF SEISMIC PROCESSING, INTERPRETATION AND ATTRIBUTE **10 Hrs**

Body waves and surface waves, Rayleigh, Love, P and S wave, Seismic acquisition principle, Seismic refraction and reflection surveys, Land and marine sources, Geophone, Hydrophone and Vibrose is survey, Seismic Fold, Signal and Noise, Seismic Processing, SEG D and SEG Y format, CDP/CMP and NMO, DMO, Seismic migration, Base map, Strike Line and Dip Line, 2D and 3D seismic, inline and cross line, 3D fold, time slice and its importance. Horizon and Fault mapping, Seismic impedance and reflection coefficient, convolution and autocorrelation, Fault skeleton preparation, wrench system Structural and Stratigraphic interpretation, Synthetic generation, Time and depth map, VSP survey, Attributes: Amplitude, Frequency and Sweetness, AVO analysis, Classification of sands, Rock solid attributes, Hydrocarbon Resource Reserve Estimation.

TOTAL HOURS: 39 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 : Evaluate prospects and drillable prospects.

CO2 : Understand the petroleum system along with the source analysis

CO3 : Examine the Process of gravity, magnetic, seismic and resistivity data acquisition, processing and interpretation will help students to handle instruments like gravimeter, magnetometer, seismometer, seismometer andresistivity meter.

CO4 : Integrate gravity and magnetic data to understand the density and magnetic susceptibility of the subsurface.

CO5 : Integrate seismic, well log and other geophysical data for volume estimation.

CO6 : Examine the structural and stratigraphic data to understand the position and extent of subsurface prospects in terms of depth and aerial extent. Determine in stochastic sense hydrocarbon resource reserve estimation.

TEXT/REFERENCE BOOKS

1. Supriya Mohan Sengupta, **Introduction to Sedimentology**, A. A. Balkema Publication.

2. Mamdough, R. Gadallah, **Reservoir Seismology**, Pennwell Books, Pennwell Publishing Company, Tusa, Oklahoma.
3. Telford, W M, Geldart, L.P., Sheriff, R.E. and Keys, D.E., **Applied Geophysics**, Oxford and IBH Publishing Co Pvt Ltd.

24PE205P					Petroleum Exploration Practical					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To provide the fundamental of petroleum exploration, different methods of geophysical surveys and instruments used for it.
2. To provide an understanding of geophysical data interpretation and analysis.

LIST OF EXPERIMENTS

1 Basics of Contouring (Hand Drawn and Computerised)

2 Seismic Data Acquistion, Processing

3 Seismic Data Interpretation

4 Horizon and Fault Mapping of processed 2D line

5 Identification of Prospects and Drillable Prospects on a Seismic Section

6 Gravity data Acquisition

7 Gravity Data Processing and Interpretation

8 Magnetic Data Acquisition

9 Magnetic Processing and Interpretation

10 Resistivity Data Acquistion

11 Resistivity Data Processing and Interpretation

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 : Understand the basics of contouring

CO2 : Understand the petroleum system along with the source analysis

CO3 : Examine the Process of gravity, magnetic, seismic and resistivity data acquisition, processing and interpretation will help students to handle instruments like gravimeter, magnetometer, seismometer, seismometer and resistivity meter

CO4 : Integrate gravity and magnetic data to understand the density and magnetic susceptibility of the subsurface.

CO5 : Integrate seismic, well log and other geophysical data for volume estimation

CO6 : Evaluate prospects and drillable prospects..

TEXT/REFERENCE BOOKS

1. Mamdough, R. Gadallah, **Reservoir Seismology**, Pennwell Books, Pennwell Publishing Company, Tulsa, Oklahoma.
2. Telford, W M, Geldart, L.P., Sheriff, R.E. and Keys, D.E., **Applied Geophysics**, Oxford and IBH Publishing Co Pvt Ltd.

24PE204P					Geomechanics and Strength of Materials Practical					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hours / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	25	50	25	--	--	100

COURSE OBJECTIVES

1. To understand geomechanical properties of the reservoir/seal rocks
2. Differentiate between strain energy and strain energy density
3. To understand failure planes in different rocks

LIST OF EXPERIMENTS

1 To perform the hardness test on the test specimen by Rockwell and Brinell methods
2 To perform the impact test on the test specimen by Izod and Charpy methods
3 To perform the tension test on the test specimen
4 To perform the torsion test on the test specimen
5 To perform the bending test on the test specimen
6 To perform the shear test on the test specimen
7 To perform the compression test on the test specimen
8 To perform the fatigue test on the test specimen
9 To understand the triaxial test of reservoir rocks on the test specimen

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 : Understand the structure and mechanical properties of different materials viz., metals, soil, minerals and rocks
CO2 : Determine the geomechanical properties of materials and predicting the failure based on the various failure theories
CO3 : Estimate the changes in shear strength of reservoir rocks vis-à-vis reservoir production, and its effect on the petrophysical properties
CO4 : Apply the understanding of stress-field to optimize production
CO5 : Evaluate the failure of the wall of the wellbore during drilling activities
CO6 : Analyze stress-field around boreholes using laboratory data and extending it to field situations

TEXT/REFERENCE BOOKS

Zoback, M. D. (2010) **Reservoir Geomechanics**

24PE206T					Industry 4.0					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

1. To understand the core technologies powering Industry 4.0.
2. To analyze applications of Industry 4.0 technologies to improve the efficiency, safety, and sustainability of oil and gas operations.
3. To develop strategies for Industry 4.0 implementation in oil and gas companies.

UNIT I: INTRODUCTION AND BASIC CONCEPTS OF INDUSTRY 4.0 **10 Hrs.**

Introduction to Industry 4.0, Definition, General framework, Application areas, Introduction to the Evolution of Industrial revolutions, Key features, Need and benefits, **Introduction to Industry 4.0 core technologies:** Big data, Advanced Robotics, Simulation, Integration, Internet of Things (IoT), Artificial Intelligence (AI), Cybersecurity, Cloud computing, Additive manufacturing and Augmented Reality. Overview of machine learning for Industry 4.0. Transformation of industrial processes through the integration of modern technologies such as sensing and actuation, communication, and computational processing.

UNIT II: INDUSTRY 4.0 TECHNOLOGIES IN THE OILFIELD LANDSCAPE **6 Hrs.**

Digital Oilfield Transformation, Digital Oilfield concept (DOF), **Sensors and the Internet of Things (IoT):** Types of sensors used in oilfields (temperature, pressure, flow, seismic), IoT network architectures, Connected Oilfield: Integration of sensors, actuators, and communication networks across oilfield operations.

UNIT III: INTELLIGENT OPERATIONS AND AUTOMATION **6 Hrs.**

Drilling Optimisation, Smart Reservoir management, Automation of Well operations, Greenfield and brownfield automation, Process Control and Safety

UNIT IV: DIGITAL TWINS FOR ENHANCED OPERATIONS **6 Hrs.**

Concept of digital twins, Simulation and prediction of performance, optimization of maintenance schedules, risk mitigation, Integration of sensor data, physics-based models for real-time updates on the digital twin

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

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

CO1 : Understand the core elements and basic technologies for Industry 4.0
CO2 : Apply the different computational techniques and algorithms for realizing Industry 4.0
CO3 : Transform the traditional business approach by integrating data and intelligence
CO4 : Develop the traditional industries with intelligent and automated machines
CO5 : Utilize data and intelligence for the development of a Smart World
CO6 : Understand the concept, significance and means to achieve sustainable development

TEXT/REFERENCE BOOKS

1. Vikram Bali, et al., **"Industry 4.0, AI, and Data Science Research Trends and Challenges"**, CRC Press
2. Patrick Bangert, **"Machine Learning and Data Science in the Oil and Gas Industry"**, Gulf Professional Publishing
3. Abdolhossein Hemmati-Sarapardeh, et al., **"Applications of Artificial Intelligence Techniques in the Petroleum Industry"**, Gulf Professional Publishing

24PE206P					Industry 4.0 Practical					
Teaching Scheme					Examination Scheme					
					Theory			Practical		Total
L	T	P	C	Hrs/Week	MS	ES	IA	LW	LE/Viva	Marks
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To provide a strong foundation in Industry 4.0 concepts as they apply to the petroleum industry.
2. To develop proficiency in utilizing Industry 4.0 technologies for process optimization, predictive maintenance, and reservoir management.
3. To encourage critical thinking and problem-solving skills in the context of digital transformation in the petroleum sector.

LIST OF EXPERIMENTS

1 To analyze Data Analytics for Reservoir Management – part A
2 To analyze Data Analytics for Reservoir Management – part B
3 To develop a simplified digital twin model for production optimisation – part A
4 To develop a simplified digital twin model for production optimisation – part B
5 To explore historical pipeline sensor data and use Machine Learning (ML) for Pipeline Integrity Prediction
6 To design a basic Internet of Things (IoT) system for well-monitoring
7 To apply 3D printing in creating customized downhole tools – part A
8 To apply 3D printing in creating customized downhole tools – part B
9 To explore the Augmented Reality (AR) in oil and gas operations for Remote Assistance – part A
10 To explore the Augmented Reality (AR) in oil and gas operations for Remote Assistance – part B
11 To research Oil and Gas robots for well inspection and maintenance tasks in hazardous environments
12 To use big data analytics in processing and interpreting large seismic datasets – part A
13 To use big data analytics in processing and interpreting large seismic datasets – part B

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Understand the concept of Industry 4.0 and its significance
CO2 : Understand the resource requirements for the implementation of Industry 4.0
CO3 : Learn the Simulation Packages for Industry 4.0
CO4 : Explore the concept of Smart Infrastructure through simulation studies
CO5 : Inspect embedded platform applications for Industry 4.0
CO6 : Synthesise the solution for the given Industry 4.0 related problem

TEXT/REFERENCE BOOKS

1. Vikram Bali, et al., **"Industry 4.0, AI, and Data Science Research Trends and Challenges"**, CRC Press
2. Patrick Bangert, **"Machine Learning and Data Science in the Oil and Gas Industry"**, Gulf Professional Publishing
3. Abdolhossein Hemmati-Sarapardeh, et al., **"Applications of Artificial Intelligence Techniques in the Petroleum Industry"**, Gulf Professional Publishing

24PE207T					Drilling Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. Demonstrate the equipment and practices of oil well drilling
2. Illustrate the Casing practices and Cementing techniques
3. Imbibe skills to prepare a Geo-Technical order
4. Develop skills to address problems in drilling oil wells

UNIT I: DRILLING RIG AND DRILLING FLUIDS **17 Hrs.**

Evolution of Well Drilling Processes; Drilling Operations; Drilling Rig Components/Systems: Power, Derrick & Sub-structure, Hoisting System, Rotary systems, Circulation & Mud treatment, Rig control system; Drilling Fluids: Basics, Functions, Properties and Nature; Classification of drilling fluids viz. Pneumatic drilling fluid, Water-based drilling fluids, Oil-based drilling fluids; Latest advances and emerging trends in drilling fluids viz. use of NDDF, Inhibitive, and Non-inhibitive; Balanced/Underbalanced drilling; Rheological models of drilling fluids: Bingham Plastic Model, Power law model, Herschel-Buckley model, Mud weight Calculations; Well Planning and Geo-Technical Order (GTO); Pore Pressure prediction, Fracture pressure, Overburden Pressure, and Abnormal pressure.

UNIT II: DRILL STRING, CASING, AND BIT DESIGN **16 Hrs.**

Drill String: Components and functions; Drill String design; Drill String fatigue failure; Drill Bits: Types, Performance and Criteria for design, Bit Nozzle size selection, Rig Hydraulics; Bit failure; Casing: Functions, Configuration, Types, Properties, Casing setting depth and hole sizes, Casing handling practices; Casing design criteria; Casing and Liner design.

UNIT III: CEMENTING TECHNIQUES **11 Hrs.**

Introduction to Cementing, Cement and Cement Slurry: Objectives of cementing, Classification of cement, Slurry design, Slurry additives, Factors influencing cement slurry design; Cementing equipment; Cementing Methods: Primary cementing, Stage cementing, Liner cementing, Plug Cementing, Squeeze Cementing techniques in practice; Deep well cementing; Characteristics of good quality cementation using CBL/VDL. Cementing calculations.

UNIT IV: DRILLING PROBLEMS AND RIG SITE HSE **12 Hrs.**

Pipe sticking and Calculations, Pipe failure, Lost circulation, Hole Deviation, Sloughing shale, Formation damage, Borehole Instability; Fishing and coring operations; Hole Cleaning; General equipment and personnel safety; Environmental Impact of Drilling fluid; Drilling waste management: Classification of drilling waste, Approaches of Drilling waste minimization.

TOTAL HOURS: 56 Hrs.

COURSE OUTCOMES

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

CO1 : Recognize the drilling practices on drill site.
CO2 : Express information with increased technical clarity.
CO3 : Relate changes with changes in drilling parameters.
CO4 : Investigate drilling bottlenecks during drilling.
CO5 : Plan a drilling program.
CO6 : Recommend optimum conditions to drill a well.

TEXT/REFERENCE BOOKS

1. H. Rabia (1986), **Oil Well Drilling Engineering: Principles and Practices**, Graham &Trotman
2. Bourgoyne, Adam T. Jr., Martin E. Chenevert, Keith K. Millheim and F.S. Young Jr. Richardson, TX (1991), **Applied Drilling Engineering**, Society of Petroleum Engineers
3. J.J. Azar, G. Robello Samuel, **Drilling Engineering**, PennWell Books (19 March 2007)
4. **IADC Drilling Manual**, International Association of Drilling Contractors (2000)
5. Neal J.Adams (1985), **Drilling Engineering: A Complete Well Planning and Approach**, PennWell Books
6. Carl Gatlin (1960), **Petroleum Engineering: Drilling and Well Completion**, Prentice Hall; 1st Ed.
7. Gray and Darley (1988), **Composition and properties of drilling and completion fluids**, Gulf Professional publishing.

24PE208T					Reservoir Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. To explain the basic concepts of reservoir media, fluid flow and its behaviour.
2. To provide the difference between single and multiphase flow for reservoir flow system.
3. To acquire and analyse the data of reservoir.
4. To develop the reservoir performance evaluation.

UNIT I: ROCK PROPERTIES **14 Hrs.**

Introduction to reservoir media–porous and fracture medium, concept of porosity fluid saturation, wettability, capillary pressure and relative permeability for understanding multiphase flow behavior in reservoir system, Salient features of Gas-Oil and Water-Oil relative permeability Curves, Factors affecting relative permeability, Three phase relative permeability, basic laboratory core data analysis for understanding petrophysical parameters.

UNIT II: FLOW THROUGH POROUS MEDIA **14 Hrs.**

Fundamentals of flow in porous media, Classification of flow system in porous media, Single phase and multiphase fluid flow in different state (steady and unsteady) and different systems (linear, radial, turbulent, spherical) considering compressible, slightly compressible and incompressible fluid, Diffusivity equation and its application for reservoir flow system

UNIT III: RESERVOIR DRIVE MECHANISM AND RESERVES ESTIMATION **14 Hrs.**

Reservoir Field operation data acquisition, Basic data of reservoir engineering; PVT data, Core data, Well logging and transient well testing information. Reservoir Drive Mechanism, Application of reservoir engineering principles: volumetric, material balance and decline curve analysis.

UNIT IV: : INTRODUCTION TO WATER INJECTION AND PERFORMANCE ANALYSIS **14 Hrs.**

Water injection concept, Fractional flow equation, Buckley Leverett equation, Pattern flooding, Reservoir performance analysis, Preparation of developmentschemes, IOR/EOR and workover jobs for reservoir.

TOTAL HOURS: 56 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO 1 : Know the basics of fluid properties and petrophysical parameters of the petroleum reservoir system.

CO 2 : Assess the importance of various petrophysical parameters for flow behaviour of fluids in multiphase petroleum reservoir system.

CO 3 : Understand the different types of flow system existing in a petroleum system in terms of rock, fluid and drive system.

CO 4 : Analyse the importance of reservoir data acquisition activities in different stages of reservoir Analyse the importance of reservoir data acquisition activities in different stages of reservoir life

CO 5 : Conceptualize sequential reservoir engineering activities.

CO 6 : Design water injection strategy and analyse reservoir performance in conjunction with reservoir management concepts.

TEXT/REFERENCE BOOKS

1. L. P. Dake, "**Fundamentals of Reservoir Engineering**" Elsevier.

2. B. C. Craft, M. F. Hawkins, Ronald E. Terry, "**Applied Petroleum Reservoir Engineering (Second Edition)**", Prentice Hall.
3. H. C. Slip Slider, "**Worldwide Practical Petroleum Reservoir Engineering Methods**", Pennwell Publishing Company.
4. Tarek Ahmed, Paul D. McKinney, "**Advance Reservoir Engineering**", Gulf Professional Publishing- Elsevier.
5. C. R. Smith, G. W. Tracy, R. L. Farrar, "**Applied Reservoir Engineering (Vol – I & II)**", OGCI Publications.
6. Abhijit Y. Dandekar, "**Petroleum Reservoir Rock and Fluid Properties**", Taylor and Francis.

24PE209T					Well Log and Formation Evaluation					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. To provide the concept of various direct and indirect logging techniques.
2. To identify geology and mineralogy of formations and determine its petrophysical properties.
3. To estimate reservoir potential and production capacity and designing strategy for efficient exploitation.

UNIT I: INTRODUCTION TO FORMATION EVALUATION AND WELL LOGS **10 Hrs.**

Introduction to petroleum formation evaluation methods; Introduction to well logs; LWD (Instruments and data recording); Well log tracks and their presentation; Types of cores, Routine and special core analysis techniques; Mud logging introduction; Description of cutting and oil shows in the log and Gas detection. Basic principle, data acquisition and interpretation of Temperature and Calliper Logs. Assignment on relevant topics.

UNIT II: SP, GR AND RESISTIVITY LOGS **16 Hrs.**

SP log: Basic principle and log interpretation; GR lags: Basic principle, data acquisition and interpretation of gamma ray and spectral gamma ray logs; Resistivity Logs: tools, data acquisition and interpretation. Electrical image logs. Assignment on SP, GR, and Resistivity logs, Shale volume calculation and identification of gross sand and net sand, Rw calculation and its use in determining S_W.

UNIT III: POROSITY LOGS – DENSITY, NEUTRON, SONIC AND NMR **18 Hrs.**

Data acquisition and interpretation of Density porosity, Neutron porosity and Sonic logs; Porosity and lithology estimations (Neutron-Density, Sonic-Density, Sonic Neutron, MN and MID cross plots); Acoustic image logs and their applications; Nuclear Magnetic Resonance Log (Principles, Porosity and permeability estimation, type of fluid identification); Assignments to determine porosity, lithology and mineralogy from logs and their cross plots.

UNIT IV: SUMMARY OF INTERPRETATION AFTER INTEGRATING ALL WELL LOGS **10 Hrs.**

Integration of different log data to determine lithology, shale volume, minerology, porosity, and net pay thickness; Evaluate reservoir potential and its production capability. Assignment or case studies on different formation types for evaluating the reservoir potential.

TOTAL HOURS: 56 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Describe the benefits and limitations of various direct and indirect formation evaluation techniques.
CO2 : Understand the basic principles, data acquisition, and interpretations of different well logging techniques.
CO3 : Distinguish the sub surface formation by predicting porosity, permeability and type of fluids from various well logs
CO4 : Estimate different reservoir properties (rocks and fluid properties) from individual logs.
CO5 : Integrate different log data and cross-plot to determine lithology, minerology, porosity and net pay thickness
CO6 : Evaluate reservoir potential and its production capability for efficient exploitation.

TEXT/REFERENCE BOOKS

1. Malcom Rider **"The Geological Interpretation Of Well Logs"**, Second Edition, 2002, Rider French Consulting limited
2. Oeberto Serra and Lorenzo Serra, "**Well Logging - Data Acquisition And Applications**", Edition Serralog, France, 2004
3. Jorden J R and Campbell F. L., **"Well Logging Vol. 1 and 2"** SPE, New York, 1986:
4. Ellis, D. V. and Singer, J. M., **"Well Logging For Earth Scientist"**, 2nd edition, Springer, 2007
5. Toby Darling, **"Well logging and Formation Evaluation"**, Gulf Professional Publishing, Elsevier Science
6. Darwin V. Ellis and Julian M. Singer, "**Well Logging for Earth Scientist"**, 2nd Edition, Springer.

24PE210T					Earth Science and Hydrocarbon Exploration Field Work					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	6	3	--	--	--	--	50	50	100

COURSE OBJECTIVES

1. To prepare students for the field of Petroleum Exploration
2. To imply ability of reading maps, planning exploration and taking risk and decision
3. To help students in identifying sedimentary rocks and its relation to petroleum system
4. To able to help students in identifying and interpreting structural aspects in field.

LABORATORY COURSES

Practical classes/Field trips shall be based on theory course content of Earth science, Sedimentary geology, Petroleum Geology and Petroleum Exploration courses

Aim: Field familiarization of exploration in sedimentary basin and petroleum System

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 : Analyse, Identify and sample different minerals, rocks and fossils for detailed study
CO2 : Evaluate the structural aspects of an area
CO3 : Differentiate between Source, Reservoir and Trap rocks
CO4 : Perform the geological/Geophysical Mapping of a petroliferous basin
CO5 : Construct the geological and Geophysical maps of the area for exploration and exploitation
CO6 : Integrate and Evaluate the G&G data for predicting hydrocarbon resources.

TEXT/REFERENCE BOOKS

1. Coe, A. L. (2011) **Geological field techniques**, Wiley Blackwell Publication,
2. Compton, R. R. (1962) **Manual of Field Geology**.

24PE207P					Drilling Engineering Practical					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To provide the concept of measuring different properties of drilling fluid and cement slurry
2. Explain the importance and limitations of all parameters of drilling fluid and cement slurry
3. Provide the experimental procedure and data analysis of performed experiments
4. To evaluate the drilling fluid and cement slurry properties as per standards

LIST OF EXPERIMENTS

1 Preparation of WBM and determination of pH of drilling fluid.
2 Determination of the mud weight and viscosity of the given mud.
3 Determination of the Rheology of the drilling fluid.
4 Determination of the Fluid loss, Mud cake thickness, and Sand content of a WBM.
5 Determination of the Total hardness in drilling fluid by titration.
6 Determination of the alkalinity in Drilling fluid and in filtrate of drilling fluid by titration.
7 Determination of the cation exchange capacity using field procedure.
8 Preparation of OBM and measuring the gel or shear strength of OBM.
9 Determination of the volumes of Water, Oil and Solids in OBM
10 Preparation of homogeneous cement slurry and determination of slurry density.
11 Demonstration of Atmospheric and HPHT Consistometer.
12 Estimation of the volume of cement filtrate loss to the formation.
13 Determination of the rheological properties and the behavior of cement slurries.
14 Determination of the stability of Cement Slurry under static Conditions.

COURSE OUTCOMES

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

CO1 : Decide the sequence for adding the additives to formulate mud.
CO2 : Determine the drilling fluid properties as per API standard.
CO3 : Validate the experimental rheological properties with statistical models.
CO4 : Understand the interaction of drilling fluid with the subsurface formation.
CO5 : Formulation of Cement Slurry.
CO6 : Determine the cement slurry properties for a given slurry.

TEXT/REFERENCE BOOKS

1. API RP 13B, **Recommended Practice for Laboratory Testing of Drilling Fluids**, 8th Edition, March 2009
2. Bourgoyne, Adam T. Jr., Martin E. Chenevert, Keith K. Millheim and F.S. Young Jr. Richardson, TX (1991), **Applied Drilling Engineering**, Society of Petroleum Engineers

Mitchell, R.F. and Miska, S.Z. (2011), **Fundamentals of Drilling Engineering**, Society of Petroleum Engineers

24PE331T					Health Safety and Environment					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To understand various hazards associated with the oil and gas industry.
2. Discuss various case studies on hazards and risk analysis.
3. To study and demonstrate the requirements for safety.
4. To develop the skills to address the Safety issue.

UNIT I: INTRODUCTION **6 Hrs.**

Introduction to Physical, Chemical, Biological, Environmental, Ergonomical etc. Hazards and their remediations. Environmental issues and management, Environmental impact and management Impact of oil and gas industry in the marine environment, Oil hydrocarbons in marine environment, Chemical disposal of the offshore industry and environmental management, Dispersion models and atmospheric pollution Dispersion models continued, Hazard assessment

UNIT II: HAZARD AND RISK ANALYSIS **8 Hrs.**

Operational Safety, Introduction to HSE Safety assurance, Safety in design and operations, Organizing for safety Hazard, classification and assessment, Hazard evaluation and control, Hazop, FMEA, Risk Matrix, HAZID, HAZOP, QRA (API 14 J, OISD), Safe Work Practices: PTW, MOC, SIMOPS etc. (ref API RP 75, OISD, OMR), Electrical Safety; Classification of Hazardous locations, Hazardous area (Ref IER, OISD, OMR, API RP 500 & 14 F) Accident Investigations: Study of major Accidents like Piper Alpha, Flixborough, Bhopal etc., Investigation techniques Emergency Response planning Audits & Inspection. Audit methodology, protocol, typical checklists for Drilling rigs, Work over activities, logging, etc.

UNIT III: HSE MANAGEMENT SYSTEM **8 Hrs.**

Accident modeling, risk assessment & management, Dose assessment, safety regulations, Toxic releases-models and methods Chemical risk analysis Quantitative risk assessment, Fire Risk and Control, Flammability diagrams, Fire and explosion: prevention methods, Event tree and fault tree analyses, Process safety management, Software used in HSE, OISD, API RP 75, ISO, OSHAS Standards, OMR and Petroleum Rules.

UNIT IV: ENVIRONMENTAL POLLUTION AND CONTROL **4 Hrs.**

Environment Concepts: Effect on eco-system; Air, Water, & Soil of HCs, Environmental Impact Assessment, Oil Spills Control and their Management. Maritime Environmental Rules & Regulations. Drilling / Oil Storage / Effluent water / waste (solid & sludge) treatments their disposal and remediation of soil etc. Directorate of Mine Safety, DGMS. Downstream Safety: Implementing Agency PNGRB; Safety Regulations (Technical Standard, Specification and Safety Standards T4S), Emergencies, Mutual Aida; Emergency Response and Disaster Management Plan ERDMP)

TOTAL HOURS: 26 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Understand the various hazard associated with oil and gas industry
CO2 : Apply the control methods & safety measures for preventing hazards and risk
CO3 : Analyse the various risk matrixes, safe work practices and accident investigations
CO4 : Implement the standards of HSE management systems
CO5 : Evaluate the various environmental issues in oil and gas industry and safety regulations
CO6 : Demonstrate the various safety issues during drilling and refinery operations

TEXT/REFERENCE BOOKS

1. Less, F. P., **Loss Prevention in the Process Industries**, 2nd ed., Butterworth Heinemann, UK.
2. Peavy, H. S., Rowe, D. R. and Tchobanoglous, G., **Environmental Engineering**, McGraw Hill, New York.
3. Sanders, R. E., **Chemical Process Safety**, Butterworth Heinemann, UK, Year.
4. NFPA, **API 14 G & OISD Standards**.
5. Marchell, V. and Ruchemann, S., **Fundamentals of Process Safety**, Institution of Chemical Engineers, Warwickshire, UK

24PE332T					Petroleum Refinery Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To provide the concept of petroleum refining and explain the different methods of petrochemical reactions and their applications
2. To provide the importance of various refining processes and their applications
3. To explain the significance petrochemicals productions

UNIT I: PETROLEUM CRUDE AND PRODUCTS CHARACTERIZATION **7 Hrs.**

Types of crudes, crude composition Characteristics and classification–Crude oil properties. IS 1448: Standard – Testing of Petroleum crude Products: Specifications and their Significance.

UNIT II: PROCESSING OF PETROLEUM AND TREATMENT TECHNIQUES **6 Hrs.**

Pre-treatment of crude for Refining–Dehydration and desalting–Atmospheric distillation, Vacuum distillation of residue products–Treatment techniques for vacuum distillates with different processes like solvent extraction –DE asphalting, dewaxing, hydro fining, catalytic dewaxing and clay contact process– Production of lubricating oils. Hydro cracking, principles, process requirements, product yields and qualities and reside-cracking – Hydrotreating –Sulphur removal, hydro finishing.

UNIT III: THERMAL AND CATALYTIC CRACKING **6 Hrs.**

Thermal cracking – Processes, operating parameters, feed stock selection and product yields, Advantages –Types and functions of secondary processing – Visbreaking – Processes, operating parameters and advantages–Coking –Operating parameters and advantages. Fluid catalytic cracking –processes, operating parameters, feed stock selection and product yields –Advantages.

UNIT IV: UPGRADATION OF REFINING PRODUCTS **7 Hrs.**

Principle, Processes, Operating Parameter and advantages of Reforming – Isomerisation – Alkylation – Polymerization. Asphalt manufacture, Air blowing technology, Bitumen Types and their properties, Acid gas removal and sulphur removal techniques.

Max. 30 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 : Introductory information about origin, exploration and production of petroleum crude and understand their properties with the help of standard testing protocols

CO2 : Recognize various primary crude processing techniques like distillation, de-asphalting, hydrocracking, hydrotreating, and their supporting processes.

CO3 : Recognize various secondary thermal cracking, catalytic cracking and reforming and coking and their supporting processes.

CO4 : Understanding the process technologies for reforming, isomerization, alkylation and polymerization unit process.

CO5 : To understand and evaluate various residue processing schemes.

CO6 : To apply the finishing processes to petroleum products for meeting the market specifications in view of fuel quality and environmental regulations.

TEXT/REFERENCE BOOKS

1. Dr. B.K. Bhaskara Rao, Modern Petroleum Refining Processes (5th Edition)
2. Dr. B.K. Bhaskara Rao, A Text Book on Petrochemicals.

Marshall Sitting, Dryden's Outlines of Chemical Technology

24PE301T					Well Completion and Fundamentals of Production Engineering					
Teaching Scheme					Examination Scheme					
					Theory			Practical		Total
L	T	P	C	Hrs/Week	MS	ES	IA	LW	LE/Viva	Marks
2	1	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To provide an Introduction to Petroleum Production Operations with an emphasis on the basic knowledge of petroleum production systems and operations.
2. To provide the concepts of different well problems and well intervention methods used.

UNIT I: INTRODUCTION TO PETROLEUM PRODUCTION SYSTEM **13 Hrs.**

Petroleum Production System, Equipment of naturally flowing well: Christmas tree, valves, hangers, flow control devices, packers, tubular and flow lines. Surface and subsurface chokes. Fundamentals of Well Testing, Well Completion: Well-completion Methods, Perforating Oil & Gas Wells - Conventional and Unconventional techniques viz. through tubing and tubing conveyed underbalanced perforating techniques, type size and orientation of perforation holes. Smart wells- intelligent completions.Bean size selection, Principle and application of workover methods/ReCompletion, Workover fluids,- Well Perforations instruments and techniques, Connecting the payzone and bore hole: Well activation methods, use of compressed air & liquid Nitrogen.

UNIT II: COMPONENTS OF PRODUCTION SYSTEM **10 Hrs.**

Reservoir performance, Supplementing reservoir energy: Fluid Injection and Artificial lift methods, Introduction to inflow performance, Productivity index. Formation damage diagnosis, Skin effect, IPR in case of different drive mechanism. Vogel IPR equation. Composite production system: Completion pressure drop, Pressure drop in tubing, multiphase flow regimes. Choke performance, types of chokes. Overall production system pressure losses.

UNIT III: WELL PRODUCTIVITY EVALUATION **9 Hrs.**

Production logging and its application, Problems during logging in deviated and horizontal wells, Spinner Flow meters and spinner crossplots, Fluid identification tools (Temperature log, Nuclear fluid density, GHOST, and DEFT) Advanced logging tools (Flow Scan Imager Tool and Multiple Array Production Suit, and Noise logs).

UNIT IV: PRODUCTION SYSTEM ANALYSIS AND OPTIMIZATION **10 Hrs.**

Production System Analysis: PI & IPR of self-flowing wells. Single and Multiphase flow in tubing and flow-lines. Sizing, selection and performance of Tubing, chokes and surface flow lines. Production Optimization – Nodal System analysis.

TOTAL HOURS : 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 : Explain about the basics of Petroleum Production systems, Operations and related factors
CO2 : Analyze the fundamentals of productivity index and future IPR and understand the principles of production optimization.
CO3 : Understand the performance of flowing wells.
CO4 : Study the application of diffusional mass transfer in the reservoir field.
CO5 : Determine the bottom-hole pressure, well head pressure, and handling oil and gas flow rates of the reservoir.
CO6 : Evaluate the understanding of water control and sand control.

TEXT/REFERENCE BOOKS

1. Dr. Guo Boyun, **Computer Aided Petroleum Production Engineering**
2. **Drilling and Well Completion**: Carl Gatlin
3. **Principle of Oil Well Production**: T.E.W. Nind
4. **Production Operation Vol 1 and 2**: Allen & Roberts.
5. **Fundamentals of Production Logging** by Schlumberger.

24PE302T					Well Test Analysis					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To Understand the various transient well tests conducted during the various stages of life of a producing field.
2. To have a broad knowledge regarding the well-test data acquisition.
3. To Interpret the Hydrocarbon properties therein and Reservoir characteristics from the test results.

UNIT I: INTRODUCTION TO THE WELL TEST ANALYSIS **12 Hrs.**

Purpose and objectives of well testing, Types of well tests: drawdown, buildup, injectivity, falloff, multi-rate, Basic reservoir flow models: radial, linear, boundary-dominated, Data acquisition and quality control

UNIT II: PRESSURE TRANSIENT ANALYSIS FOR SINGLE-PHASE FLOW **16 Hrs.**

Concept of pressure diffusivity, Analysis of drawdown and buildup tests in infinite-acting radial flow, Type curve analysis, Effects of skin and wellbore storage, Specialized plots: Horner, MDH, derivative analysis, Introduction to well-test analysis software

UNIT III: WELL TEST ANALYSIS IN COMPLEX SYSTEMS **15 Hrs.**

Partially completed and limited entry wells, naturally fractured reservoirs (dual porosity models), Layered reservoirs, Horizontal wells, Interference testing

UNIT IV: ADVANCED CONCEPTS AND APPLICATIONS **13 Hrs.**

Well testing in gas reservoirs (pseudo pressure, pseudo time), Multiphase Flow Considerations, Integration of well test data with other reservoir data (seismic, well logs, production data), Case Studies and real-world examples.

TOTAL HOURS: 56 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Identify the principle governing equations of transient well testing and their solutions.
CO2 : Understand the various transient well-testing methods and their requirement for petroleum exploitation activities.
CO3 : Apply the methods to interpret well test data to determine petrophysical parameters in dynamic flow conditions around a well.
CO4 : Classify the standard procedure to control the well.
CO5 : Appraise the Petrophysical properties from the well-bore vicinity to the extent of the reservoir.
CO6 : Formulate an appropriate well-testing program for the formation.

TEXT/REFERENCE BOOKS

1. Dominique Bourdet**, "Well Test Analysis: The use of Advanced Interpretation Models"**, ELSEVIER.
2. John Lee**, "Well Test Analysis",** Society of Petroleum Engineers (SPE)
3. Robert C. Earlougher**, "Advances in well test analysis",** Henry L. Dougherty Memorial Fund of AIME, Society of Petroleum Engineers of AIME
4. LP. Dake, **"Fundamental of Reservoir Engineering",** ELSEVIER, Shell Learning and Development.

24PE303T					Advanced Drilling Technology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding of directional and horizontal drilling, well profile monitoring of the progressing well path and corrective measures for deflected well trajectory.
2. Comprehensive knowledge on the emerging trends in drilling technology.
3. Comprehend the well-control methods and its procedures.

UNIT I: DIRECTIONAL DRILLING **15 Hrs.**

Introduction to directional drilling technology; Objectives of directional drilling; Directional well profiles and well path calculations; Tools for deflection & orientation; Downhole mud motors: Dynadrill and Turbodrill; Power calculations and applications of mud motors; Directional drilling problems & their remedies; Well surveying objectives, & tools for surveying/methods; Well path correction methods and its execution in drilling.

UNIT II: HORIZONTAL WELL DRILLING **15 Hrs.**

Introduction to horizontal well drilling; Horizontal well drilling objectives; Horizontal drilling techniques; Horizontal well profiles; Extended reach drilling, Special mud requirements and their characteristics for horizontal drilling; Objectives of MWD / LWD tools; Telemetry system and data interpretation; Geo steering: Auto and Verti-track systems; Surveying analysis and calculations for well coordinates; Horizontal drilling problems and their remedies.

UNIT III: EMERGING TRENDS IN DRILLING **13 Hrs.**

Coil tubing drilling technique and application, Slant drilling techniques and the specialized tools, Introduction to multilateral drilling, Technology advancement of multilaterals, Slim hole drilling, Casing While Drilling, Prospects of big data analytics in drilling: Automation and robotics in drilling operations.

UNIT IV: WELL CONTROL PRINCIPLES & PROCEDURES **13 Hrs.**

The anatomy of a well kick and blowouts: Problem, symptoms and controlling measures; Kick control methods: Dynamic kick control, Driller method & Engineer methods, Well killing calculations.

TOTAL HOURS: 56 Hrs.

COURSE OUTCOMES

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

CO 1 : Demonstrate the different methods of directional drilling.

CO 2 : Apply the fundamentals of Horizontal well drilling techniques.

CO 3 : Execute surveying tools and MWD/LWD for monitoring the bottom hole condition.

CO 4 : Analyse the well profile and survey the well trajectory

CO 5 : Defend the requirement for the implementation of emerging technologies in the conventional directional drilling process.

CO 6 : Investigate and execute well killing operation

TEXT/REFERENCE BOOKS

1. Inglis T. A. (1987), **Petroleum Engineering and Development Studies (Vol. 2), Directional Drilling**, Graham & Trotman

2. H. Rabia (1986), **Oil Well Drilling Engineering Principles and Practices**, Graham &Trotman
3. Bourgoyne , Adam T. Jr., Martin E. Chenevert, Keith K. Millheim and F.S. Young Jr., Richardson, TX (1991) **Applied Drilling Engineering**, Society of Petroleum Engineers.
4. Joshi, S. D. (1991) **Horizontal Well Technology**, Penn Well Publishing.
5. J.J. Azar, G. Robello Samuel, **Drilling Engineering**, PennWell Books (19 March 2007)
6. **IADC Drilling Manual**, International Association of Drilling Contractors (2000)
7. Adam, N. J. (1980), **Well control Problems and Solutions**, Petroleum Publishing Company

24PE304P					Introduction to Petroleum Software Lab					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To provide an overview of the oil and gas industry software tools.
2. To provide the importance of modelling and simulations for different petroleum engineering problems.
3. To explain how to identify the best tool matching the type and scope of numerical study.

LIST OF EXPERIMENTS

1 Analytical Modelling for Buckley Leverett Solution using any programming language-Part A

2 Analytical Modelling for Buckley Leverett Solution using any programming language-Part B

3 Developing a Numerical Model for One Dimensional Flow through Porous Media Problem – Part A

4 Developing a Numerical Model for One Dimensional Flow through Porous Media Problem – Part B

5 Reservoir Modelling and Simulation Using IMEX/GEM/tNavigator – Part A

6 Reservoir Modelling and Simulation Using IMEX/GEM/tNavigator – Part B

7 History Matching Problem – Part A

8 History Matching Problem – Part B

9 Integrated Static and Dynamic Modeling using tNavigator.

10 Introduction to Well Testing using Saphire/Topaze/ Emeraude.

11 Design of Hydraulic fractures for Mini-frac and fracture applications using FracPro – Part A

12 Design of Hydraulic fractures for Mini-frac and fracture applications using FracPro – Part B

13 Introduction to Integrated Production Modeling Suite – Part A

14 Introduction to Integrated Production Modeling Suite – Part B

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Demonstrate the role of simulation software in the engineering industry and in specific to the upstream petroleum industry

CO2 : Classify the various software tools available in the individual domain of upstream petroleum industry like seismic data processing and interpretation, reservoir modelling and simulation, drilling, and production engineering.

CO3 : Build a reservoir simulation model using CMG (reservoir simulation software) and simulate the specific initial and boundary constraints defined.

CO4 : Excel the fundamental modelling workflows associated with the simulation software like conceptualizing, mathematical modelling, numerical modelling and solving the set of equations using the gauss elimination technique.

CO5 : Comprehend complex and dynamic nature of the petroleum engineering problems and formulate a solution strategy for effective management at the field scale.

CO6 : Identify the best tool matching the type and scope of the numerical study the student has been deployed to perform in the future.

TEXT/REFERENCE BOOKS

1. Donald W. Peaceman, "**Fundamentals of Numerical Reservoir Simulation"**, ELSEVIER.
2. John R. Fanchi, "**Principles of Applied Reservoir Simulation"**, Gulf Professional Publishing.

3. George F. Pinder, William G. Gray, “**Essentials of Multiphase flow and Transport in Porous Media”**, WILEY.

24PE305P					Petroleum Engineering – I Practical					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To provide basic knowledge related to petroleum engineering laboratory equipment.
2. To teach the fundamental aspects of petroleum engineering, which includes core plug making, core trimming and swabbing.
3. To determination of permeability and porosity of the core sample by the different-different method and compared with each other for the research point of view.

LIST OF EXPERIMENTS

1 To make core plug ready for experiment in Core Plugging.
2 To perform the Core Trimming and Swabbing
3 To determine the Effective porosity of given core sample by saturation method.
4 To determine the Porosity of given core sample by Helium Porosimeter.
5 To determine the Permeability of given sample by using Ruska Liquid Permeameter.
6 To determine the Permeability of the core sample by using Gas Permeameter.
7 To study the core flooding apparatus under reservoir pressure and temperature conditions.
8 To study the petrophysical properties of core in core flooding apparatus.
9 To determine the viscosity of oil by using capillary viscometer.
10 To study of the various Drilling Equipment's.
11 To study of the Sucker Rod Pumping System: A Case Study
12 To study of the working of Gas Lift system.
13 Study and understanding of Group Gathering Sation (GGS) system.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Understand and demonstrate core preparation techniques for various core flooding environments
CO2 : Determination of the petrophysical properties.
CO3 : Design of enhanced oil recovery experiment using core flooding apparatus.
CO4 : Determination of viscosity of light oil samples.
CO5 : Understand the drilling equipment and production process.
CO6 : Demonstration of artificial lift equipment.

TEXT/REFERENCE BOOKS

1. Abhijit Y. Dandekar, **"Petroleum Reservoir Rock and Fluid Properties"**, Taylor and Francis.
2. H Dale Begg, **"Production Optimization",** OGCI Publication, Tulsa.
3. L. P. Dake, "**Fundamentals of Reservoir Engineering**", Elsevier, 17th Edition.

24INT251					Industrial Orientation					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	0	0	0	--	--	--	50	50	100

COURSE OBJECTIVES

The objective of the course is to orient students towards entire spectrum of the Oil and Gas Industry best working practices.

INDUSTRIAL ORIENTATION

The students are required to visit entire value chain of the oil and Gas industry for

a) Acquaintance with the best working practices adopted in industry .
b) Understanding Industry working environment.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 : Acquire Technical skills prevailing in the industry
CO2 : Develop professional communication skills (both written and oral).
CO3 : Demonstrate capability for understanding project plan and project management technique
CO4 : Demonstrate capability for managing team and working as team leadership.
CO5 : Develop Professional vision to chart its own professional life.
CO6 : Develop skill sets of professional and ethical petroleum engineering practices

24PE333T					Data Analytics for Petroleum Engineers					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

1. To develop an understanding of the big data in the oil and gas upstream industry.
2. To improve skills for handling and processing data for various applications in upstream oil and gas industry.
3. To improve knowledge and skills to interpret data for effective engineering operations and management.
4. To develop a date based model for prediction and optimization of parameters

UNIT I: EXPLORATORY DATA ANALYSIS **7 Hrs**

Introduction to Data Analytics in oil and gas industry, Big Data types, Characteristics of Big Data, Probability and statistics, Exploratory Data Analysis: Univariate, Bivariate, and Multivariate analysis, Parametric Distribution Models.

UNIT II: PREDICTION MODELS **7 Hrs**

Regression Modeling and Analysis, Simple linear regression, multiple regression, nonparametric transformation and regression; Classification and Clustering algorithms; multi-attribute regression modeling, data driven modelling; field applications and case studies, coding assignments.

UNIT III: APPLICATIONS IN GEOSCIENTIFIC APPLICATIONS **7 Hrs**

Application of data driven models in exploration, reservoir characterization, lithofacies interpretations and classification, petrophysical investigations using well logs, reservoir engineering, reservoir simulation and prediction optimization, physics informed machine learning models.

UNIT IV APPLICATIONS IN DRILLING, PRODUCITON AND HSE OPERATIONS **7 Hrs**

Application of data science in Real-Time Monitoring, geosteering, automation, Production Engineering, Health and Safety Executive (HSE), Integrating Big Data: Simulation, Predictive Analytics, case studies to field applications.

TOTAL HOURS: 28 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Understand the data and correlate them with the oil and gas upstream industrial activities.
CO2 : Demonstrate an understanding of handling and processing big data of oil and gas upstream industry.
CO3 : Perform exploratory data analysis and provide statistical summary with parametric correlation.
CO4 : Create a statistical prediction model using multiple attributes of data.
CO5 : Demonstrate deep learning techniques and its application in optimization of prediction.
CO6 : Analyze a case study through interpretation of data for effective engineering operations and management

TEXT/REFERENCE BOOKS

1. Srikanta Mishra and Akhil Datta Gupta, **"Applied Statistical Modeling and Data Analytics: A Practical Guide for Petroleum Geosciences"**, 2017, Elsevier Publication.
2. Shahab D. Mohaghegh, Saud M. Al-Fattah, and Andrei S. Popa, **"Artificial Intelligence & Data Mining Applications in the E&P Industry"**, 2011, Society of Petroleum Engineers.
3. Shahab D. Mohaghegh, "**Data-Driven Reservoir Modeling"**, 2017, Society of Petroleum Engineers.

4. Patrick Bangert**, "Machine Learning and Data Science in the Oil and Gas Industry-Best practices, Tools, and Case Studies**", 2021, Gulf Professional Publishing.
5. Yogendra Narayan Pandey, Ayush Rastogi, Sribharath Kainkaryam, Srimoyee Bhattacharya, Luigi Saputelli, **"Machine Learning in the Oil and Gas Industry-Including Geosciences, Reservoir Engineering, and Production Engineering with Python**", 2020, Apress.
6. Keith R. Holdaway, **"Harness Oil and Gas Big Data with Analytics: Optimize Exploration and Production with DataDriven Models"**, 2014, Wiley.
7. George Mount, **"Advancing into Analytics: From Excel to Python and R"**, 2021, O'Reilly Media.

24PE335T					City Gas Distribution					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Identify the various attributes of CGD value chain.
2. Understanding the policies pertaining to CGD as prescribed by PNGRB.
3. Examine the various engineering aspects pertaining to the CGD network.
4. Analysing the components of CNG and PNG sector.
5. Assessing the responsibilities for HSE in CGD industry.
6. Simulating the optimisation of CGD network using IT.

UNIT I: INTRODUCTION OF NATURAL GAS AND ITS VALUE CHAIN **10 Hrs.**

Types of Natural Gas, Introduction to concept of Geographical Area (GA), History of CGD in India; LNG, LPG, and CGD business. Gas Value Chain**:** Gas Transmission and Distribution System; City Gate Station (CGS); Gas Filtration and Pressure reduction skids; Odorizing unit; Common pressure reduction station (CPRS)/District Regulation Station (DRS); Meters including smart meters; Pipeline for CGD; Steel and PE Pipelines; CNG infrastructure: Mother Station, Online Station, Daughter Station, Daughter Booster Station;

UNIT II: PETROLEUM AND NATURAL GAS REGULATORY BODIES **10 Hrs.**

Introduction to Ministry of Petroleum and Natural Gas (MoPNG); Upstream and downstream regulators, Powers and functions of Petroleum and Natural Gas Regulatory Board (PNGRB), Evolution of CGD bidding in India till date, Bidding attributes and Bid authorization, Natural gas trend, Technical Standards and Specifications including Safety Standards (T4S).

UNIT III: ACCESSORY EQUIPMENT'S AND ITS APPLICATIONS IN CGD VALUE CHAIN **10 Hrs.**

Annual O&M Plan; Valves, Pumps, Compressors, Welding, Cathodic Protection System, QHSE: CNG Safety; Emergency Response Plan; Disaster Management Plan; Quality assurance concepts; Inspection and Surveillance; Risk Assessment in CGD Business; Fire and Fire Protection equipment's.

UNIT IV: ADVANCE METHODS IN CGD VALUE CHAIN **09 Hrs.**

Types of Cylinders, HCNG, LCNG, Compressed Biogas, Dispenser, IT in CGD including Artificial Intelligence (AI), Machine Learning (ML), Internet of Things (IoT), Block chain and its application in centre.

TOTAL HOURS: 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 : Summarize City Gas Distribution value chain and Natural Gas system.

CO2 : Acquaint and adapt the roles, functions and objectives of PNGRB

CO3 : Explain Piped Natural Gas (PNG) distribution system.

CO4 : Classify the types of Compressed Natural Gas (CNG) Stations and explain the CNG infrastructure.

CO5 : Practice the HSE measures for safety of CGD sector.

CO6 : Assess the steps to be taken in financing the CGD measures.

TEXT/REFERENCE BOOKS

1. Natural Gas: A comprehensive study (Anirbid Sircar and Kriti Yadav).
2. City Gas Distribution: An Indian perspective (Anirbid Sircar, Shreya Sahajpal, Umang Modi).

City Gas Distribution in India: Demystifying the Opportunity, Growth and Investment Potential(Infra line Energy)

24PE336T					Pipeline Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To provide the basic knowledge of the pipeline operations required for transportation of oil and gas.
2. Comprehensive understanding of specifications, codes, and materials of oil and gas pipeline
3. Deeper insight for onshore and offshore pipeline design and fluid hydraulics
4. Fundamental knowledge and understanding of commissioning, inspection, and maintenance of pipeline.

UNIT I: INTRODUCTION TO OIL AND GAS PIPELINE **6 Hrs.**

Modes and comparison among different modes of transportation of petroleum products, Advantages and limitations of pipelines modes, Introduction to pipeline project, Economics and cost structure of Pipeline project, Economic pipe diameter.

UNIT II: PIPELINE CONSTRUCTION , PROCESSES AND DESIGN FACTORS **7 Hrs.**

Introduction to outline for Design & construction of onshore-offshore pipelines, Pipeline codes and standards, Overview of O & G field Processes, Types of Onshore/ Offshore Pipelines, Factors affecting pipeline design (External, fluid properties, pipeline parameters and Fluid flow considerations. Loop- lines

UNIT III: DESIGNING OF LIQUID & GAS PIPELINE **7 Hrs.**

Design of Liquid pipelines: Hydraulic Analysis, Relevant Pipeline Parameters, Types of fluids, Pressure Loss calculations, Maximum allowable operating Pressure, Pipeline sizing, Diameter sizing, Determination of wall Thickness, Station Spacing Pumping Power calculations, Design of Gas Pipelines: Factors affecting Gas Pipeline Design, Pressure Loss calculations, Gas pipeline Hydraulic Calculations, as Compression / Power requirement.

UNIT IV: COMMISSIONING, INSPECTION AND MAINTENANCE OF PIPELINE **6 Hrs.**

Commissioning of pipeline. Pipeline Operations, Pigging, integrity assessment by Intelligent pigging and Instrumentation, Monitoring and Control Thru SCADA application, Corrosion and control/ Cathodic Protection.

TOTAL HOURS: 26 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Understand the basics of pipeline, roles and responsibilities of a pipeline engineer in the oil and gas Industry

CO2 : Apply pipeline codes, regulations and standards in both offshore and onshore environments.

CO3 : Attribute pipeline terminology, various components and materials used and the fluid properties that affect pipeline transportation.

CO4 : Evaluate forces acting on a pipeline system in operating conditions.

CO5 : Analyse the processes involved in the prevention of corrosion and the inspection of pipeline and its components.

CO6 : Evaluate the various safety issues and practices involved in onshore and offshore pipeline operations.

TEXT/REFERENCE BOOKS

1. Alkazraji Duraid, "**A Quick Guide to Pipeline Engineering"**, Woodhead Publishing Limited.
2. Vincent, Jecqes , **"Fundamentals of Pipeline Engineering",** Gulf Publishing.
3. E Shashi Menon and Pramila S Menon, "**Liquid Pipeline Hydraulics: Second Edition"**, Trafford Publishing.
4. Antaki, G. A., **"Piping and Pipeline Engineering"** , Marcell Dekker.
5. Henry Liu, **"Pipeline Engineering",**CRC Press.
6. Mikhail V Luric, **"Modelling of Oil and Products and Gas Pipeline Transportation",** Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim.
7. H.S. Bell, "**Pipeline Transportation Handbook**", McGraw-Hill.

24PE306T					Reservoir Modelling and Simulation					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To provide an overview of reservoir simulation software to conceptualize the complex nature of the reservoirs
2. To provide the concepts on how to create an algorithm to solve the model by applying numerical methodsusing the developed mathematical model & numerical model
3. To explain how to apply the conceptual, mathematical and numerical skills attained on field-scale problems; and classify limitations of the conventional techniques

UNIT I: INTRODUCTION **11 Hrs**

Introduction to Geological Modelling, Geostatistical Modeling & Variogram correction, classification of Models, Need for reservoir simulation, Applications of reservoir simulation, Steps of reservoir simulation, Representative Elementary Volume (REV), Property upscaling, Rock and fluid properties, PVT models, Conservation of Mass and Momentum; Continuity Equation, Equation of Motion, Darcy and Non-Darcy Flow.

UNIT II: FUNDAMENTALS OF RESERVOIR SIMULATION **12Hrs**

Reservoir Discretization, Block Identification and Block Ordering, Single Phase Fluid Flow Equations in Multidimensional Domain, Flow Equations using CVFD Terminology, Various Flow Geometries, Initial and Boundary Conditions, Block-Centered and Point-Centered Grid distribution, Simulation with Block-Centered Grid, Simulation with a Point-Distributed Grid, Well Representation in Simulators, Single-Phase Flow equations for various Fluids.

UNIT III: RESERVOIR MODEL SOLUTION ALGORITHMS **11Hrs**

Linearization of Flow Equations, Immiscible two-phase fluid flow equations, Pseudo functions, Explicit & implicit grid system, Reservoir Model Solution Techniques: Implicit pressure and Explicit Saturation (IMPES); Sequential and Fully Implicit Method; Preview of Numerical Solution Methods: Direct & Iterative method, stability criteria, Well representation.

UNIT IV: HISTORY MATCHING AND STREAMLINE SIMULATION **8Hrs**

Model validation/verification: History Matching, Optimization algorithms in History Matching, performance prediction; Introduction to reactive transport modelling; Introduction to Streamline Simulation, comparison of Conventional / Streamline Simulation.

TOTAL HOURS: 42 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Apply the fundamentals of reservoir modelling and simulation
CO2 : Examine and classify various models based on its application in reservoir engineering
CO3 : Create Reservoir simulation models for various scenarios for visualization and implementation
CO4 : Analyse and assess the required reservoir data for understanding the fluid flow in the reservoir
CO5 : Validate the History matching concept for reservoir performance and production optimization.
CO6 : Examine the robustness of reservoir model for performance prediction of oil and gas field reservoirs.

TEXT/REFERENCE BOOKS

1. J.H. Abou-Kassem, S.M. Farouq-Ali, M.R. Islam, "**Petroleum Reservoir Simulations**", 2006, Gulf Publishing Company.
2. Aziz. K and Sattari. A, **Petroleum Reservoir Simulation-A Basic Approach** , 1979, Applied Science Publishers.
3. Franchi. J. R., **Principles of Applied reservoir Simulation**, 2006, 3rd Edition, Gulf Professional Publication.
4. M.R. Carlson, **Practical Reservoir Simulation**, 2006, Pennwell Books.
5. Crichlow. H. B., **Modern Reservoir Engineering, A Simulation Approach**, 1977, Prentice-Hall.
6. Peaceman. D. W., **Fundamentals of numerical reservoir simulation**, 1977, Elsevier Publication.

24PE307T					Surface and Offshore Production Operations					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding the petroleum production system and its components
2. Design of equipment`s used in production operations and transportation
3. Analyse the use of various offshore technologies for development in shallow and deep water
4. Understand the operations carried out during drilling and production in offshore environment

UNIT I: SEPARATION AND TREATMENT OF PRODUCED FLUID **11 Hrs.**

Fundamentals of surface production operations, surface facilities for liquid and gas handling, classification of separators, Components of separator, Liquid level control, design of separator, Dehydration, Desalting, Demulsification, heater treater, Effluent Treatment, Group Gathering Station, Central Tank farm, Feeder and Trunk pipeline system, pumps and compressor

UNIT II: STORAGE AND TRANSPORTATION OF OIL AND GAS **10 Hrs.**

Classification of tanks: Storage tank for Oil, storage of LPG, Underground storage, Measurement-metering of Oil and Gas, Flow assurance: problems and mitigation, Flow improver (Pour point depression and Drag reducer, heat treatment), pigging in pipe lines.

UNIT III: SHALLOW AND DEEP-WATER DEVELOPMENT **11 Hrs.**

Introduction to Offshore, Environmental conditions: Wave, wind and undercurrent forces. Types and classification of Offshore Platforms. Deep water development & Flow assurance strategy, floating platforms, mooring and anchoring systems, ROV and ROT for well intervention. offshore logistics, prospective new technologies.

UNIT IV: OFFSHORE WELL COMPLETION AND PRODUCTION SYSTEM **10 Hrs.**

Techniques of drilling and completing in shallow water, Techniques of drilling and completion in deep water, subsea completion, Drilling and production risers, flexible risers: configuration and laying techniques, offshore storage, Offshore production system: Fixed, floating, subsea. Smart and intelligent well completion, Oil processing in offshore and comparison with onshore. Offshore Safety and fire protection, Safety systems for offshore operations, Case history analysis and lessons learned.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Demonstrate and apply the concept of phase separators
CO2 : Analyse oil and gas transport system and mitigation strategies for flow impediments
CO3 : Design of surface facilities like Separators, Storage tanks and accessory equipment's
CO4 : Differentiate and illustrate offshore drilling and production platforms
CO5 : Analyse offshore environment and predict techniques of various operation.
CO6 : Evaluate the feasibility of offshore operation in view with the offshore safety and environmental aspects

TEXT/REFERENCE BOOKS

1. K. Arnold and S. Maurice, "**Surface Production Operations Vol-I and II.**", Gulf Professional Publishing
2. G.V. Chilingarian, J.O. Robertson, S. Kumar, "**Surface Operations in Petroleum Production",** Elsevier
3. J.R. Hughes, N.S. Swindells, "**Storage and Handling of Petroleum Liquids: Practice and Law"**, Hodder Arnold Publisher
4. A. Marks, "**Petroleum Storage Principles"**, Penwell Corp
5. S. K. Chakrabarti., "**Handbook of Offshore Engineering", vol 1 & 2**", Penwell Corp
6. S. S. P. Singh, J. Agarwal, N. Mani., "**Handbook of Offshore Engineering**", Vol 1 & 2, CRC Press

24PE308T					Unconventional Hydrocarbon Energy Resources					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To provide basic knowledge related to unconventional energy resources, their properties, and their exploitation techniques.
2. To familiarize students with the unique aspects of unconventional gas and oil reservoirs, including their
   (a) Resources and Economic Significance
   (b) Geologic Occurrences
   (c) Controls on Production Rates
   (d) Drilling and Completion Practices
   (e) Reservoir Management
   (f) Present Activity

UNIT I: GLOBAL UNCONVENTIONAL ENERGY RESOURCES ENDOWMENT AND POTENTIAL 9 Hrs.

Background and basic science about Unconventional energy resources, Comparison between formations and mode of origin, occurrences of various conventional and unconventional energy resources, Global vis-à-vis Indian unconventional energy resources and reserves, Unconventional energy resources prospects.

UNIT II: OIL-SHALE, SHALE GAS, AND TAR SAND 12 Hrs.

Oil Shale: Geological features Oil Shale formations, Chemical composition, Components of Oil Shale: Bitumen, Kerogen, Mineral matrix, Resource recovery technologies, Commercial value and Environmental impacts.

Shale gas: Definition and prospect, geological conditions for the formation of oil shale, oil shale recovery technology, ex-situ and in-situ extraction processes of shale oil, various retorting processes, processes leading to maximization of shale oil production; Shale Gas: Definition and prospect, the conditions of formation of shale gas, debate over-extraction of shale gas from the subsurface, environmental issues, American experience, Marcellus shale gas project – an example of the success story of shale gas exploitation, methods of production, hydrofracturing, the composition of fracking fluid, water management, shale gas – Indian perspective.

Tar Sand: Definition and prospect, the distinction between heavy oil and bitumen, mineralogy and properties of oil sand, elemental composition and properties of bitumen, methods of recovery of bitumen by mining and advanced in-situ processes.

UNIT III: GAS HYDRATE 9 Hrs.

Definition, History of Hydrate R&D, prospect, types of methane hydrate deposits, chemistry and structure of natural methane hydrate, Necessary Conditions for Methane Hydrate Formation, typical conditions of methane hydrate formation in nature vis-à vis different gas hydrate stability zones, physical properties of hydrates and ice, geology of methane hydrates, exploration for methane hydrates – geological, geochemical, and geophysical, gas hydrate – Indian perspective.

UNIT IV: COAL BED METHANE 12 Hrs.

Definition and prospect, CBM, CMM, and AMM; an Overview on CBM vs. Conventional Reservoir –Gas Composition, Adsorption, Water Production, Gas Flow, Rock Physical Properties, Gas Content, Coal Rank, Gas Production. Fundamentals of Coal Geology: Genesis of Coal; Major Stratigraphic Periods of Coal Formation; Gondwana and Tertiary Coals of India; Influence of Coal Properties; Coal Chemistry – Molecular Structure, Macerals, Lithotypes, Functional Groups, Proximate Analysis, Ultimate Analysis; Significance of Rank – Definition and Measurement, Vitrinite Reflectance Measurement, Physical Properties, Volatiles Generated, Micropores; Cleat System and Natural Fracturing. Sorption: Principles of Adsorption – different types of isotherms, Langmuir Isotherm, Methane Retention; Effects of Ash and Moisture on Methane Adsorption. Decline Curves. Hydraulic Fracturing of Coal seams

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Understand the present global energy scenario, future needs and various unconventional hydrocarbon resources.
CO2 : Analyse the Geomechanical properties of unconventional reservoirs.
CO3 : Outline the fundamentals of hydraulic fracturing.
CO4 : Characterize the unconventional reservoirs and discuss available production methods.
CO5 : Apply safety and environmental features in hydraulic fracturing, gas production, and water production.
CO6 : Critical-thinking and problem-solving approach towards unconventional resources and recovery.

TEXT/REFERENCE BOOKS

1. Zou, C et al (2013) **Unconventional Petroleum Geology**, Elsevier.
2. Max, M. D. (2003) **Natural Gas Hydrate in Oceanic and Permafrost Environments**, Kluwer Academic Publication.
3. Nash, K. M. (2010) **Shale gas Development**, Nova Science Publishers, Incorporated.
4. Romeo M. Flores, Tim A. Moore. (2024) **Coal and Coalbed Gas Future Directions and Opportunities**
5. Anurodh Mohan Dayal and Devleena Mani. (2017) **Shale Gas: Exploration and Environmental and Economic Impacts**
6. Wei Yu and Kamy Sepehrnoori. (2019) **Shale Gas and Tight Oil Reservoir Simulation**.

24PE309P					Petroleum Engineering – II Practical					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To train professional candidates capable of applying engineering principles and practices for the safe and efficient
   exploration, development, production, transportation and management of petroleum resources.
2. To teach a student about rheological properties of any type of oil, slurry and chemical.
3. To give knowledge about core flooding and hydrofracturing application in oil and gas industry.

LIST OF EXPERIMENTS

1 Determine the acid value of the given oil sample.
2 Determine the Sulphur content of the given oil sample.
3 Draw a ternary phase diagram for solubility of water benzene isopropyl alcohol (IPA) solution.
4 Determine the rheological properties of a given oil sample using Rheometer.
5 Determine the rheological properties of a given oil sample using Rheometer.
6 Determine the particle size of the given oil sample using Zetasizer Particle Size analyser.
7 Determine the Formation resistivity of the saturated rock sample.
8 Water Coning using Resistance Analogy
9 Understanding of Auto-Tensiometer
10 Understanding of Proppant Conductivity System at normal temperature conditions
11 Understanding of Proppant Conductivity System at high temperature conditions
12 Understanding of Formation Damage System with temperature conditions.
13 Understanding of Formation Damage System without temperature conditions

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Determine crude oil property and its components.
CO2 : Understand rheology and determine rheological properties for sample: Oil, Slurry, and Chemicals
CO3 : Analyse the particle size distribution, interfacial tension, and solubility for any given fluid considering upstream and downstream applications.
CO4 : Determine reservoir physical property and productivity index using an electrical analogy.
CO5 : Evaluate proppant pack conductivity at different temperature conditions.
CO6 : Understanding of formation damage at different temperature conditions.

24PE310P					Petroleum Product Testing Practical					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To have the engineering knowledge of liquid petroleum products and their related repercussions.
2. To analyse the problem related to storage, transportation and use of petroleum Products.
3. To recognize the design aspects related to distillation methods.
4. Properties determination of the petroleum product properties and understanding the petroleum product aromatic properties

LIST OF EXPERIMENTS

1 Estimation of the acid number of fossil oil samples.

2 Analysis of the percentage purity of refinery product by Auto distillation apparatus.
3 Measurement of viscosity of given sample by Say Bolt viscometer.
4 Determination of viscosity of given oil sample by Red- wood Viscometer.
5 Evaluation of smoke point and Luminosity number of given kerosene sample.
6 Calculation of calorific value of coal, lignite, and oil samples by Bomb Calorimeter.
7 Determination of Flash and Fire point of refinery products by semi-automatic Prensky & Martin Apparatus.
8 Measurement of Flash and Fire point of refinery products by Cleveland open cup apparatus.
9 Evaluation of Cloud and Pour point of a given oil sample.
10 Determination of Aniline point of a given refinery products sample.
11 Estimation of Diesel Index and Cetane number of a given diesel sample.
12 Evaluation of moisture content of given liquid fuel sample using Dean and Stark apparatus.
13 Determination of Saponification value of given oil sample.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Prepare themselves to understand the experiments related to midstream sector of oil and gas refineries.
CO2 : Evaluate the caloric value of crude oil sample and other fuel samples by Bomb Calorimeter.
CO3 : Examine the flash and fire point of lighter and heavy petroleum products.
CO4 : Estimate the Aniline point of refinery products to confirm the aromaticity.
CO5 : Analyse the quality assurance issues as per requirements of the industrial practices
CO6 : Assess the distillation characteristics of refinery products such as gasoline, diesel, & kerosene by Auto distillation

24INT451					Summer Internship					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	0	2	0	--	--	--	50	50	100

COURSE OBJECTIVES

1. The objective of the course is to expose students towards specialised aspect of chosen Oil and Gas Industry working practices.

INDUSTRIAL INTERNSHIP

The students are required to perform one month internship in the specialised aspect of chosen oil and Gas Industry

a) Acquaintance with the best working practices adopted in industry
b) To understand Industry working environment

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 : Develop Technical and Professional skills for employability in Oil and Gas industry
CO2 : Develop professional communication skills (both written and oral).
CO3 : Acquire understanding of project planning management methods and techniques.
CO4 : Understand use of various artificial lift technique for various reservoir conditions
CO5 : Demonstrate capability of team leadership and Team building for solving industry problems.
CO6 : Develop skill sets for professional and ethical petroleum engineering practices.

24PE431T					Flow Assurance					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

1. To understand the concepts of flow assurance.
2. To illustrate the analytical tools for flow assurance.
3. To enhance skills to analyse and interpret basic descriptive and inferential statistics.
4. To develop skills to address flow constraints in oil fields.

UNIT I: BASICS OF FLOW ASSURANCE AND RELATED ISSUES **6 Hrs.**

Typical production system and flow assurance, Criteria of flow assurance, Resistances to the flow, various issues encountered for flow assurance in the industry, Importance of velocity profiles, temperature profiles and concentration profiles in prediction flow assurance issues, Importance of pressure drop calculations in flow assurance industry.

UNIT II: WAX DEPOSITION AND ASPHALTENE PRECIPITATION **8 Hrs.**

Wax deposition definition, Wax deposition criteria, Mechanism of wax deposition, Factors for wax deposition, Wax deposition envelop, Models used to predict wax deposition, Definition of Asphaltenes, Criteria for formation of asphaltenes, Mechanism of asphaltenes precipitation, Factors responsible for asphaltenes precipitation, Asphaltenes precipitation envelop, Models utilized for prediction of asphaltenes.

UNIT III: INORGANIC SCALE DEPOSITION AND GAS HYDRATES FORMATION **8 Hrs.**

Scale deposition definition, Scale deposition criteria, Scaling mechanism, Factors controlling scale depositions, Models used to predict scale deposition, Definition of gas hydrates, Criteria for formation of gas hydrates, Phase envelop for gas hydrate formation prediction, Models utilized for prediction of gas hydrates.

UNIT IV: MITIGATION OF FLOW ASSURANCE AND CASE STUDIES **6 Hrs.**

Need for flow assurance problem mitigation, Remedies and mitigation techniques for wax deposition, asphaltenes precipitation, scale deposition, and gas hydrates formation, Case studies on flow assurance in industry.

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Recognize a flow assurance problem and related issues.
CO2 : Illustrate the need for flow assurance problem mitigation.
CO3 : Apply knowledge to understand problems in details for wax deposition and asphaltenes precipitation.
CO4 : Analyse the problem to know the root cause of scale deposition and gas hydrate formation.
CO5 : Plan a remedial activity unique to the flow assurance problem mitigation.
CO6 : Understanding the flow assurance problems with case studies.

TEXT/REFERENCE BOOKS

1. Ovadia Shoham, "**Mechanistic Modeling of Gas-Liquid Two-Phase Flow in Pipes**", Society of Petroleum Engineers, USA.
2. E Wayne Frenier, Murtuza Ziauddin, Ramachandran Venkatesan, "**Organic Deposits in Oil and Gas production**", Society of Petroleum Engineers, USA.
3. Wayne Frenier, Murtuza Ziauddin, "**Formation, Removal, and Inhibition of Inorganic Scale in the Oilfield Environment**", Society of Petroleum Engineers, USA.

24PE432T					Corrosion Studies in Petroleum Industry					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	--	--	100

COURSE OBJECTIVES

1. To acquire the basic concept of corrosion mechanism and forms of corrosion
2. To acquire the concept of corrosion testing
3. To acquire the concept of the modern theory of corrosion
4. To understand the basic mechanism and procedure of corrosion testing and prevention

UNIT I: FUNDEMENTALS OF CORROSION **7 Hrs.**

Corrosion fundamentals, Corrosion in oil Industry, Cost of corrosion in the industry, Corrosivity of hydrocarbon fluids:- Water-oil, emulsion and multiphase flow regime, Wettability of metal surface, Corrosivity of aqueous phase in hydrocarbon fluids; Sulphur, and H_2S in hydrocarbon fluids; Influence of oil chemistry on the Corrosivity of the aqueous phase. Pipeline corrosion; Kinetics of electrochemical surface reactions; Cathodic reduction reactions; Anodic dissolution reactions; Transport of species; Transport from the bulk solution to the steel surface; Transport through the porous surface scales. Corrosion products; Kinetics of corrosion products precipitation and corrosion products growth.

UNIT II: FORMS OF CORROSION **7 Hrs.**

Modes of internal corrosion attack: -Uniform corrosion; Localized corrosion ; Pitting corrosion; Erosion corrosion; Galvanic corrosion; Intergranular corrosion; Stress corrosion cracking; Hydrogen damage; hydrogen embrittlement; Hydrogen-induced cracking; Formation of hydride. Pipeline flow Corrosivity: Effect of water wetting; Effect of multiphase flow regime; Effect of multiphase velocity ; Effect of water phase characteristics; Significance of salinity; Significance of CO2 pressure; Significance of H_2S; Significance of O_2; Significance of pH; Effect of temperature. Materials selection:-Significance of alloying composition; Significance of steel microstructure.

UNIT III: TESTING OF CORROSION **7 Hrs.**

Experimental setups, methods, and standards:- Multiphase flow loop; Autoclave; Horizontal rotating cylinder; High velocity rig; Glass cell; Goniometer/Tensiometer ; Moisture content measurements ; Slow strain rate test. Corrosivity and corrosion rate determination:- Weight loss measurements; Potentiodynamic polarization and polarization resistance; Electrochemical impedance spectroscopy; Potentiostatic polarization

UNIT IV: PIPELINE CORROSION AND ITS PREVENTION **7 Hrs.**

Pipeline Corrosion control; Environment control; Gas-phase contaminants and degasification; Water presence and dehydration/dewatering; Pipe cleaning; Pigging; Internal coating/liner; Chemical treatment and corrosion inhibitors:-Corrosion control by industrial inhibitors, Application methods; Influence of operating conditions; Solubility, partitioning, and compatibility. Biocides

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

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

CO1 : Understand the basic mechanism of corrosion process
CO2 : Classify corrosion into different types and forms
CO3 : Illustrate the influencing factors of pipeline corrosion
CO4 : Demonstrate the procedure of corrosion testing
CO5 : Explain the modern theory of corrosion based on thermodynamic and kinetics study
CO6 : Interpret the preventive measures of corrosion in oil and gas industry

TEXT/REFERENCE BOOKS

1. Papavinasam, S (2013), **"Corrosion control in oil and gas industry"**, Elsevier.

2. Cicek, Volkan. **"Corrosion in Petroleum Industry."** Cathodic Protection: Industrial Solutions for Protecting Against
   Corrosion: 231-245.
3. Nathan, Charles Carb. **"Corrosion inhibitors."** C. C. Nathan, Editor, published 1973 by NACE, 260 (1973).

24PE434T					Natural Gas Engineering & LNG Value Chain					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To demonstrate the concepts of Gas Processing.
2. To demonstrate the Cryogenic processing of gases.
3. To develop skills to plan processing required to meet market specifications economically.
4. To be able to implement safe processing and handling of gases

UNIT I: INTRODUCTION **9 Hrs.**

Natural Gas Properties and Natural Gas Value chain, Natural Gas Processing: Water and Hydro Carbon Liquid Separation, Dehydration, H_2S Removal and elemental Sulfur extraction, Carbon dioxide (CO_2) removal, Mercury Removal. Gas processing for pipeline transportation (Corrosion protection, limits for water, H_2S and CO_2 contents).

UNIT II: NATURAL GAS CONDITIONING AND SEPARATION SYSTEM **10 Hrs.**

Refrigeration/ Cryogenic Process for separation/processing of Gases: Refrigeration Cycle, Cascade refrigeration processes (Multiple pure component systems and Mixed Refrigeration system), Turbo Expander and System, Advanced Refrigeration system

UNIT III: STORAGE AND EXTRACTION OF VALUE ADDED PRODUCTS FROM NG **10 Hrs.**

Storage of Natural Gas, Extraction of components in Natural gas and /or liquids: Helium Extraction, Nitrogen Removal, Propane and Butane (LPG) Extraction, Ethane Extraction, NGL component extraction from NGL liquids by Fractionation process, NGL Extraction from Gas Mix, Introduction to use of natural gas liquid (NGL), its components for manufacture of value added products: C_2, C_3 and C_4

UNIT IV: LNG **10 Hrs.**

Gas processing for LNG Production (limits of Water, CO_2, H_2S and Mercury contents etc.), LNG Production process, LNG Storage, LNG Transportation & Regasification.

TOTAL HOURS: 39 Hrs.

COURSE OUTCOMES

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

CO1 : Understand and have a comprehensive understanding and information about the Natural Gas value chain
CO2 : Understand the physical and chemical properties of Natural Gas with processing techniques
CO3 : Assess techno-commercial factors involved in the development and operation of LNG regasification terminals and liquefaction processes
CO4 : Understand Natural Gas transportation and storage.
CO5 : Enumerate global and domestic scenarios and pricing of NG
CO6 : Practice employee health and safety as well as adherence to required standards for safety and operations

TEXT/REFERENCE BOOKS

1. **Gas Production Engineering** by Sanjay Kumar
2. **Handbook of Natural Gas Transmission and Processing** by Saeid Mokhatab, William A Poe and James G. Speight

24PE401T					Well Stimulation and Artificial Lift Techniques					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. Demonstrate the concepts of Production enhancement
2. Develop Skills to design Stimulation Jobs
3. Demonstrate the use of artificial lift techniques.
4. Develop skill to analyse the best suitable artificial lift solutions for low productivity wells

UNIT I: WORKOVER AND WELL STIMULATION TECHNIQUES **18 Hrs.**

Introduction to well stimulation; Well analysis and remedial measures, Principles and application of workover methods, workover rig, Coil tubing unit, workover fluids, Water Control Techniques-Reasons, identification and control techniques, Sand Control Techniques Reasons, identification and control techniques. Well stimulation methods to mitigate formation damage problems; Acid wash; Matrix stimulation; Design of matrix acidization; Acid fracturing. Basics of hydraulic fracturing and its applications: Candidate well selection; Effect of Rock mechanical properties; Stress profile and fracture height containment, well placement; Proppants characteristics and its selection; Fracturing fluid systems and additives; Fracture pressure analysis and step-rate and leak off tests; Treatment stage design, Calculations of clean and slurry volumes for treatment designs, surface pumping pressure and no. of pumps and other relevant topics

UNIT II: MULTI-STAGE HYDRAULIC FRACTURING AND RE-FRACTURING **10 Hrs.**

Well-pad configuration; Well spacing and Fracture Driven Interactions; Multi-stage fracturing: Stage length and cluster spacing, Multistage fracturing techniques: Plug & perf, sliding sleeves, Fluid diverters; Proppants selection; Refracturing: benefits and limitations, candidate selection, procedures; Diagnostic methods: microseismic, fiber sensing-DAS and DTS, radioactive tracers, and tiltmeter. Modelling 2D, Pseudo3D, and 3D models; Flow chart of fracture simulator. Case studies on multi-stage fracturing and refracturing treatments; advanced fracturing techniques.

UNIT III: ARTIFICIAL LIFT TECHNOLOGIES **07 Hrs.**

Introduction to Artificial Lift Techniques: Artificial lift methods, Rod Pumping: Reciprocating rod lift, progressive cavity pump, Electric submersible Pump (ESP), Hydraulic lifts (Jet Pump), Gas Lift: Continuous, Intermittent, Plunger assisted lift.

UNIT IV: DESIGN, MONITORING AND OPTIMIZATION **17 Hrs.**

Sucker Rod Pump, Electric submersible pump, progressive cavity pump, Gas lift: working principles, Surface and Subsurface components, Designing, Monitoring and Optimization, Common Operating Problems and its mitigation. Digital technologies and latest developments in the artificial lift industry.

TOTAL HOURS: 52 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Understand various well stimulation techniques and its application for various reservoir conditions
CO2 : Design of hydraulic fracturing treatment stages, proppant type and fracturing fluids.
CO3 : Select the candidate and prepare the workflow for designing multi-stage fracturing and refracturing treatments
CO4 : Understand use of various artificial lift technique for various reservoir conditions
CO5 : Understand the working principle of various artificial lift used in the oil and gas industry
CO6 : Design of artificial lift technique like sucker rod pump, gas lift, electric submersible pump, progressive cavity pump

TEXT/REFERENCE BOOKS

1. B. Guo, "**Computer Aided Petroleum Production Engineering"**, Gulf Publishing.
2. J. L. Miskimins, "**Hydraulic Fracturing: Fundamentals and Advancements"**, Society of Petroleum Engineers
3. M.J. Economides, K.G. Nolte," Reservoir **Stimulation**", Wiley
4. K.E. Brown, "**Technology of Artificial Lift Methods"**, Penwell Corp

24PE402T					Integrated Reservoir Management and Enhanced Oil Recovery Methods					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. To demonstrate the concepts of Reservoir management in oil and gas exploitation.
2. To imbibe the knowledge of reservoir engineering in E & P business.
3. To develop Skills to analyse reservoir behaviour and monitoring plan for reservoir management.
4. To develop skills to implement best reservoir optimization practices for enhanced recovery.

UNIT I: CONCEPT RESERVOIR MANAGEMENT & CHARACTERIZATION **14 Hrs.**

Concept of integrated reservoir management, Evolution of reservoir management with time, Fundamentals of reservoir management, synergic team approach; Importance of reservoir management, Reservoir Data types: Geosciences, Fluid and PVT, Petrophysical properties from core, Well logs, Transient well test, and Production, Data validation and workflow development for reservoir characterization.

UNIT II: RESERVOIR PERFORMANCE ANALYSIS & DEVELOPMENT PLANS FOR TECHNO-ECONOMIC EVALUATION **16 Hrs.**

Reservoir performance analysis by various methods: Volumetric, decline curve, material balance & simulation, Concept of field development plan, Importance of EOR/IOR in reservoir management strategy, Development plans for newly explored/developed and matured fields, Scenarios for development plans & Techno-economic evaluation. Risk management, Uncertainties & economic optimization.

UNIT III: ENHANCED OIL RECOVERY METHODS **16 Hrs.**

Definition of enhanced oil recovery and improved oil recovery, Difference of IOR and EOR, Target oil resource for EOR, General Classification. Description and potential of different EOR processes, Microscopic and macroscopic displacement of fluids in a reservoir, Displacement efficiency in different system – linear, areal, volumetric, Definition and discussion of mobility ratio and mobility control processes for different types of fluids, Miscible/Immiscible displacement processes - water flooding, gas injection, micro-emulsion flooding Chemical Flooding - polymer flooding, Surfactant flooding, Micellar flooding related methods Thermal recovery processes- in situ combustion, hot-water injection, steam flooding, SAGD Microbial EOR. EOR screening criteria.

UNIT IV: : CASE STUDIES ON RESERVOIR MANAGEMENT AND ENHANCED OIL RECOVERY **10 Hrs.**

Field scale implementation and their performance of various EOR schemes of local and global context, Reservoir Management case studies for various types of clastic and non-clastic reservoirs (both onshore and offshore), Current challenges and areas of further development.

TOTAL HOURS: 56 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO 1 : Understand the integrated reservoir management concept and synergistic team approach for reservoir management and characterization.

CO 2 : Integrate the fluid, Petrophysics and production data of a reservoir for analysing its static and dynamic performance.

CO 3 : Understand the concept of field development in distinct stages in the life cycle of a reservoir with input from reservoir modelling and simulation.

CO 4 : Analyse the key issues and able to prepare field development plan for favourable risked-techno-economic scenario.

CO 5 : Understand the enhanced oil recovery methods for additional oil recovery.

CO 6 : Design and execute the enhanced oil recovery methods and reservoir management plan.

TEXT/REFERENCE BOOKS

1. Abdus Satter & Ganesh C. Thakur, "**Integrated Petroleum Reservoir Management- A team approach**" Pennwell Publishing Company, Tulsa, Oklahoma.
2. Sant Kumar, "**Development of oil and gas fields**", Allied Printers, Dehradun, India.
3. L. P. Dake, "**The practice of Reservoir engineering**", Elsevier Publisher.
4. Paul Willhite, Don Green, "**Enhanced Oil Recovery**", Society of Petroleum Engineers.

24PE403P					Reservoir Engineering Software Practical					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	50	50	100

COURSE OBJECTIVES

1. To provide a deep understanding of various Professional/Industrial software tools used in the Reservoir Engineering Domain
2. To provide the significance of Reservoir modelling and simulations for various Reservoir engineering problems.

LIST OF EXPERIMENTS

1 Seismic Data Loading, Visualization and Processing using Kingdom suite/ tNavigator – Part1.
2 Seismic Data Loading, Visualization and Processing using Kingdom suite/ tNavigator – Part2.
3 Petrophysical Investigations using Well Log Analysis.
4 Development and validation of Geo-cellular Modelling using Geostatic prediction and Variogram Modelling – Part1.
5 Development and validation of Geo-cellular Modelling using Geostatic prediction and Variogram Modelling – Part2.
6 Fluid Property (PVT) Modelling for Black Oil or Compositional Oil Simulations.
7 Simulation of SPE Comparative Solution - Model 1 (SPE-9723-PA) – Part1.
8 Simulation of SPE Comparative Solution - Model 1 (SPE-9723-PA) – Part2.
9 Assisted History Matching using an Optimization Algorithm – Part1.
10 Assisted History Matching using an Optimization Algorithm – Part2.
11 Simulation of Enhanced Oil recovery Process
12 Well Testing Studies using Kappa Engineering
13 Fracture design, analysis and optimization using FracPRO – Part1.
14 Fracture design, analysis and optimization using FracPRO – Part2.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Demonstrate the role of various software tools in reservoir engineering.

CO2 : Classify the various software tools available in the Reservoir domain for history matching Performance prediction and Risk analysis.

CO3 : Create a Static and Dynamic reservoir simulation model using simulation software's.

CO4 : Excel the fundamental modelling workflows associated with the simulation software.

CO5 : Comprehend complex and dynamic nature of the Reservoir engineering problems including Pressure transient analysis, hydro-fracturing etc. and formulate a solution strategy for effective management at the field scale.

CO6 : Identify the best tool matching the type and scope of the numerical study deployed to perform in the future.

TEXT/REFERENCE BOOKS

1. **Software Manuals**.
2. Odeh, Aziz S. "**Comparison of Solutions to a Three-Dimensional Black-Oil Reservoir Simulation Proble**." J Pet Technol (1981), 33: 13–25. DOI: 10.2118/9723-PA.

24PE404T					Hydrocarbon Contracts and Asset Management					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	-	-	100

COURSE OBJECTIVES

1. Demonstrate legal principles of oil and gas contracts
2. Illustrate Marketing strategies in Oil industry
3. Imbibe Portfolio Management skills in graduates
4. Develop skills to address dispute in oil business

UNIT I **6 Hrs.**

Life cycle of Petroleum Project, Fiscal System in hydrocarbon industry (Progressive, regressive fiscal policy tax and non-tax components of Fiscal Policy), Basic elements of Contracts, Basic terminologies of contract and legal. Basics of Upstream and Downstream regulatory Laws and Policies, Fundamentals of Oil and gas accounting: Capex, Opex, Cost classification, Depreciation depletion and amortization (DDA), Cash flow, internal rate of return, Net Present value

UNIT II **7 Hrs.**

Upstream Agreements (Concessionary, Production sharing, Risk sharing,), Indian policy on Hydrocarbon Exploration and Licensing Policy (HELP). Drilling Contracts, Farm-in and Farm-out, Joint ventures, Comingling allocation and attribution agreement, Gas sale and supply agreement. LNG Agreement

UNIT III: **6 Hrs.**

Hydrocarbon trading-Oil trading, Physical and Paper; Crude oil Markets- Spot, Barter, Future and forward. Oil pricing mechanism, short term and long term Oil Pricing..

UNIT IV **7 Hrs.**

Asset Integrity Management Introduction to concept of Asset Management& Asset Integrity Management, The Asset Management System – Asset Management Policy – Asset Management Strategy – (Strategic) Asset Management Plans – line of sight; International standard on Asset Management: ISO 55000; Risk & Risk Assessment Approaches Used for Asset Integrity Management; Identification & assessment of risk; Risk management: using the risk matrix, risk register & hazard log; Risk Based Maintenance Deterioration: the way assets could fail the seven steps of Risk Based Maintenance (RBM) / Reliability Centred Maintenance (RCM) incl. Failure Mode Effects &Criticality Analysis; Failure behaviour of onshore & offshore systems.

TOTAL HOURS: 26 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1 : Master and comprehensively understand the legal principles of oil and gas contracts
CO2 : Understanding in depth licensing, production sharing and service contracts
CO3 : Identifying the risk factors and managing those risks through effective contractual clauses
CO4 : Know the relevant legal and regulatory frameworks that are in the oil and gas industry
CO5 : Learn how to use appropriate contractual clauses in oil and gas contracts.
CO6 : Appreciate the best dispute resolution methods and how it will apply it in different scenarios.

TEXT / REFERENCE BOOKS

1. Shippey, K. C. (2009) **A short course on international Contracts**, 4 th Ed. World Trace press.
2. Tordo, S (2007) **Fiscal System in Hydrocarbons: design issues**. The World Bank
3. Ministry of P & G (Government of India) **Model Production Sharing Contracts and HELP**
4. Johnston, D (1994) **International Petroleum Fiscal System and Production Sharing Contracts**, Penn Well books
5. Wright, C. J and Gallum, R. A. (2008) **Fundamentals of Oil and Gas Accounting**, 5th Edition Pennwell

6. Millar, M. P (2015) **Asset Integrity management handbook**
7. Jennings Anthony (2002) **Oil and Gas Exploration contracts**
David M. R. (1999) **Oil and Gas infrastructure and mid-stream agreement**

24PRPE452/ 24PRPE453					Major Project/ Comprehensive Project		
Teaching Scheme					Examination Scheme		
L	T	P	C	Hrs./Week	Report Writing	V/V	Total Marks
0	0	24	12	24	--	--	--

COURSE OBJECTIVES

1. Develop skills to identify Research Gap.
2. To develop your capacity to compute, analyse and interpret basic descriptive and inferential statistics
3. Develop Team working skills and communication skills Improve writing skills in terms of technical report

COURSE CONTENT

Aim: To address specific industry and research related problems.
Unit 1: Experimentation and data analysis and Synthesis
Unit 2: Outcome, discussion conclusion
Unit 3: Report Writing, Presentation and Viva-Voce

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 : Demonstrate the capability to generate relevant information from literature surve
CO2 : Acquire research skills to identify the research problem and Knowledge Gap
CO3 : Formulate the Research methodology and design experiments for primary data generation
CO4 : Acquaint with the modern research analysis tools, software and instruments.
CO5 : Capable of working as individual and team player for designing the research project
CO6 : Develop communication skills, both written and oral.

REFERENCE BOOKS AND SOFTWARE

1. Kothari, C. P. (2008) **Research Methodology: Methods and techniques**
2. Murray, R (2002) **How to write a thesis**, McGraw Hill Publication
3. Recent **ENDNOTE** Software for referencing
4. **JABREF** for Referencing.