Major (Core) Courses (MCC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CH01	Engineering Chemistry	FC	2		1	3	50	50	100	-
2501MA01	Linear Algebra & Calculus	FC	2	1		3	50	50	100	-
2501PH01	Solid State Physics	FC	2		1	3	50	50	100	-
2501PT06	Geology & Sedimentology for Petroleum Engineers	FC	1	1	2	4	50	50	100	-
2501PT10	Petroleum Geology & Exploration Techniques	FC	1	1	2	4	50	50	100	-
2501MA02	Differential Equations & Vector Calculus	FC	2		1	3	50	50	100	LA&C
2501MA05	Numerical Methods & Integral Transforms	IC	2	1		3	50	50	100	-
2501MA06	Complex Variables & Statistical Methods	IC	2	1		3	50	50	100	-
2501IT01	Business Intelligence Lab	FC			2	2	50	50	100	-
2501CS01	Programming for Problem Solving Using C	FC	2		2	4	50	50	100	BIL
2501ME01	Engineering Graphics	FC	1		2	3	50	50	100	-
2501ME03	Engineering Workshop	FC			1	1	100	-	100	-
2501PT01	Drilling Engineering	IC	2		2	4	50	50	100	GSPE & PGET
2501PT04	Fluid Mechanics for Petroleum Engineers	IC	1	1	2	4	50	50	100	-
2501PT09	Petroleum Formation Evaluation	IC	1	1		2	50	50	100	PGET
2501PT08	Instrumentation & Process Control	IC	2		2	4	50	50	100	-

2501PT05	Fundamentals of Liquefied Natural Gas	IC	3			3	50	50	100	FMPE
2501PT02	Elements of Reservoir Engineering	IC	2		2	4	50	50	100	GSPE
2501PT11	Petroleum Production Engineering	IC	1	1		2	50	50	100	ERE
2501PT12	Petroleum Refinery Engineering	IC	3			3	50	50	100	PPE
2501PT07	Heat Transfer in Petroleum Operations	IC	1	1	2	4	50	50	100	FMPE
2501PT14	Safety & Environmental Engineering Practices in Petroleum Industry	IC	2			2	50	50	100	-
2501PT17	Well Workover & Stimulation	AC	1	1		2	50	50	100	ERE
2501PT13	Reservoir Modelling & Simulation	AC	1	1	2	4	50	50	100	ERE
2501PT15	Surface Production Operations	IC	2			2	50	50	100	-
2501PT16	Unconventional Hydrocarbon Resources	AC	1	1		2	50	50	100	ERE
2501PT03	Enhanced Oil Recovery	AC	2	1		3	50	50	100	PPE
Total			**42**	**13**	**26**	**81**				

Engineering Chemistry

(Common to CE, ME, PT & Min. E)

Course Code: 2501CH01

L	T	P	C
2	0	1	3

Course Outcomes:

At the end of the course, the students will be able to:

- **CO 1** Apply the knowledge of water treatment and specifications of potable water
- **CO 2** Exemplify the principles of electrochemical cells and apply this knowledge to control corrosion
- **CO 3** Summarize the essence of polymers and fuels – for sustainable energy solutions
- **CO 4** Infer the preliminaries of engineering materials for industrial applications
- **CO 5** Explore the fundamentals of Nano materials and integrate Green Chemistry for promoting sustainability

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	1	-	-	1	-	1	1	-	-
CO2	3	-	-	-	-	-	-	1	1	-	-
CO3	3	-	1	-	-	1	-	1	1	-	-
CO4	3	-	-	-	-	1	-	1	1	-	-
CO5	3	1	-	-	-	2	-	1	1	-	-

UNIT I:

Water Technology

Soft and hard water, Boiler troubles –Priming, foaming, scale and sludge, Caustic embrittlement, Industrial water treatment method (Zeolite and Ion-Exchange Process) – Internal treatment of water: Carbonate conditioning, Phosphate conditioning, Colloidal conditioning, Calgon conditioning.

Specifications of water for domestic use (ICMR and WHO); Domestic water purification – Candle filtration- activated carbon filtration; Disinfection methods- Ultra filtration, UV treatment, Ozonolysis, desalination of brackish water, reverse osmosis(RO)and electro dialysis.

Practice:

1. Determination of Hardness of a ground water sample
2. Determination of Chloride content in given water sample
3. Estimation of dissolved oxygen in given water sample

UNIT II:

Electrochemistry and Corrosion

Electrodes– electrochemical cell, Nernst equation, cell potential calculations.

Primary cells – Zinc-air battery, Secondary cells: Nickel-Cadmium (Ni-Cad), and lithium-ion batteries- Working principle of the batteries including cell reactions; Fuel Cells: Principle and working of hydrogen-oxygen Fuel cell.

Corrosion: Introduction to corrosion, Dry corrosion (Pilling Bed worth rule) electro chemical theory of corrosion (Mechanism), differential aeration cell corrosion, galvanic corrosion, Factors affecting the corrosion**,** cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

Practice

1. Conductometric titration of strong acid vs weak base
2. Potentiometric titration of red-ox
3. P^H-metric titration of Acid-Base

UNIT III:

Polymers and Fuel Chemistry

Introduction to polymers, functionality of monomers, Thermo plastics and Thermo setting plastics-: Preparation, properties, and applications of PVC, and Bakelite.

Compounding of plastics: Injection molding, and Extrusion molding.

Biodegradable polymers: Introduction and their requirements.

Fuels – Types of fuels, calorific value of fuels, numerical problems based on calorific value; Analysis of coal (Proximate and Ultimate analysis), Liquid Fuels: Refining of petroleum, Octane and Cetane number, Alternative fuels: CNG, Ethanol and biodiesel.

Practice

1. Calorific value determination by Bomb Calorimeter.
2. Preparation of a Polymer (Bakelite)

UNIT IV:

Engineering Materials

Composites-Definition, Constituents, Fiber reinforced composites, properties, and Engineering applications

Refractories-Classification, Properties, Failures of Refractories and Applications.

Lubricants-Classification,Functionsoflubricants,Propertiesoflubricating oils (Definition): Viscosity, Viscosity Index, Flash point& Fire point, Cloud point &Pour point and Applications of lubricants.

Building materials- Portland cement, constituents, Setting and Hardening of cement.

Practice

1. Determination of total acid number by potentiometric titration
2. Estimation of Calcium in port land Cement
3. Estimation of Saponification value of Fats/Oils

UNIT V:

Nano materials and Green Chemistry

Nano Materials: Introduction to Nano materials, chemical synthesis of Nano materials: Sol-gel method, characterization of Nano materials by SEM and TEM (includes basic principle of SEM and TEM), Applications of Nano materials (waste water treatment, lubricants and engines).

Green Chemistry: Principles of Green Chemistry and applications of green chemistry.

Various green chemical approaches – Microwave synthesis, Bio catalyzed reaction (only explanation with examples).

Practice

1. Preparation of Nano particle by Green Synthesis method.

Text Books:

1. Prasanta Rath, S. Aruna Kumari Engineering Chemistry, CENGAGE Learning, 2024. (ISBN 978-93-5350-651-3)(ISBN 93-5350-651-4).
2. Shikha Agarwal , Engineering Chemistry Fundamentals and Applications, Cambridge 2nd Edition(ISBN 978-1-108-72444-9).

Reference Books:

1. H.F.W. Taylor, Cement Chemistry, ,Thomas Telford Publications, 2nd edition. (978-072-772-5929).
2. Dr S.S. Dara, Dr S.S. Umare, A Textbook of Engineering Chemistry, S. Chand Publication, 2022.(978-935-2-836-068).

Web Links:

1. https://nptel.ac.in/courses/105107207
2. https://nptel.ac.in/courses/113104082
3. https://nptel.ac.in/courses/113108051
4. https://archive.nptel.ac.in/courses/104/105/104105039/
5. https://nptel.ac.in/courses/118102003

Linear Algebra & Calculus

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

	L	T	P	C
Course Code: 2501MA01	**2**	**1**	**0**	**3**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Solve the system of Linear equations
CO2: Calculate Eigen values and Eigen vectors
CO3: Apply differential calculus for one and several variable functions
CO4: Calculate the Maximum value and Minimum value of a function of several variables
CO5: Compute areas and volumes using multiple integrals

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

UNIT – I

System of linear equations: Vector Space,Linear Independence,Rank of a matrix by echelon form, normal form, Inverse of Non-singular matrices by Gauss-Jordan method, Solutions of Linear Systems: Existence, Uniqueness,Solving the system by Gauss elimination method.

Practice(Using any computational tool)

1. Variables, arithmetic operations, elementary mathematical functions.
2. Defining row vector, column vector, Arithmetic operations on matrices
3. finding transpose of a matrix, inverse of a matrix, determinant of a matrix
4. rank of a matrix, solving system of linear equations.

UNIT – II

Eigenvalues, Eigenvectors : Eigenvalues and properties(without proof), Eigenvectors, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), Quadratic forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation,Nature of Quadratic forms.

Practice(Using any computational tool):
Computing eigen values and eigen vectors, matrix diagonalization.

UNIT – III

One Variable Calculus:Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems.

Several Variable Calculus: Limit, Continuity, partial derivatives and their geometrical interpretation.

Practice(Using any computational tool): Basics of plotting, Plot graphs of single variable functions

UNIT – IV

Functions of several variables: Total differential and differentiability, derivatives of composite and implicit functions, derivatives of higher order and their commutativity,Euler's theorem on homogeneous functions , Taylor's and Maclaurin's expansion of functions of two variables. Jacobians, maxima and minima, constrained maxima/minima problems using Lagrange's method of multipliers.

Practice(Using any computational tool): Plot graphs of various multi variable functions

UNIT – V

Multiple Integrals: Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Practice(Using any computational tool): Plotting the region of Integration

Students are advised to use any computational / AI Tool like Wolfrum Alpha, Symbolab, Mathway, Desmos, Geogebra etc., for the practice

Text Books:

1. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 5th Edition (9th reprint), 2021· ISBN 978-8184875607
2. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 5th Edition, 2018. ISBN-13. 978-1292174341

Reference Books:

1. Advanced Engineering Mathematics, Michael Greenberg, Pearson publishers, 9th edition. ISBN-13. 9788177585469
2. Higher Engineering Mathematics, H. K. Dass, Er. R. Verma, S-Chand publishers, 3rd edition 2023.ISBN 9788121938907

Web Links:

1. https://archive.nptel.ac.in/courses/111/104/111104137/
2. https://archive.nptel.ac.in/courses/111/107/111107108/
3. https://www.khanacademy.org/math/linear-algebra/
4. https://www.khanacademy.org/math/multivariable-calculus

Solid State Physics

(Common to CE, ME, PT & Min. E)

	L	T	P	C
Course Code:2501PH01	**2**	**0**	**1**	**3**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1 Extend basic concepts of Elastic properties and bending of beams.
CO2 Understand the basics of crystals and their structures
CO3 Explain the basic concepts of Semiconductors and identify the type semiconductors using Hall effect.
CO4 Classify the magnetic materials based on behavior of substances
CO5 Summarize various types of electrical polarizations of dielectrics.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	-	-	-	-	-	1	1	-	-
CO2	2	1	-	-	-	-	-	1	1	-	-
CO3	2	1	-	-	-	-	-	1	1	-	-
CO4	2	1	-	-	-	-	-	1	1	-	-
CO5	2	1	-	-	-	-	-	1	1	-	-

Unit–I
Elasticity of Materials: Stress – strain - Hooke's law – stress - strain curve – generalized Hooke's law with and without thermal strains for isotropic materials – different types of moduli and their relations – bending of beams – Bending moment of a beam – Depression of cantilever.
Practice:
1. Determination of rigidity modulus of a material by using Torsional Pendulum.
2. Determination of Young's Modulus of the material by method of single cantilever beam.
3. Determination of Moment of Inertia of a Fly Wheel.
4. Determination of Acceleration due to Gravity by using Compound Pendulum.

Unit–II
Crystal Structure and X-ray diffraction
Crystal Structure: Lattice and Basis – Crystal Systems – Bravais Lattice - Unit cell – Packing fraction – coordination number- Miller indices – Separation between successive (h k l) planes- Applications.
X-ray Diffraction: Bragg's law-Bragg's x-ray spectrometer – crystal structure determination by Laue's and powder method- Applications.
Practice:
1. Determine the crystal structure of the sample using data.

Unit–III

Semi-conductor Physics

Origin of resistivity - Formation of energy bands in crystalline solids - classification of crystalline solids - Intrinsic semiconductors - Fermi level – extrinsic semiconductors - P-type and N-type -Dependence of Fermi energy on carrier concentration and temperature - Hall effect - Hall coefficient -Applications of Hall effect –Drift and Diffusion currents– Einstein's equation. – P-N junction diode -Zener Diode - Applications

Practice:

1. Study the relation between Temperature and resistance and finding the constants A & B of a thermistor.
2. Determine the resistivity of a semiconductor by four probe method.
3. Determination of V-I characteristics and Breakdown voltage of a Zener diode.
4. Determination of Energy band gap of a semiconductor by using P-N junction diode.
5. Determination of Frequency of electrically maintained tuning fork by Melde's apparatus.

Unit–IV

Magnetic materials: Introduction –Magnetic dipole moment– Magnetization– Magnetic susceptibility and permeability – Origin of permanent magnetic moment – Bohr magneton –Classification of magnetic materials: Dia, para & Ferro–Domain concept of Ferro magnetism Hysteresis–soft and hard magnetic materials–applications of Ferromagnetic material.

Practice:

1. Study the variation of magnetic field along the axis of a circular coil carrying current by using Stewart and Gee's apparatus.

Unit – V

Dielectric Materials: Introduction – Dielectric polarization–Dielectric polarizability, Susceptibility, Dielectric constant - Relation between D, E, P- Types of polarizations – Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) – Ferro electric materials - Frequency dependence of polarization - Applications.

Practice:

1. Determine dielectric constant of dielectric material using charge-discharge method.

Text Books:

1. "AText book of Engineering Physics" by M N Avadhanulu, P G Kshirsagar & T.V.S.Arun Murthy S Chand &Company Ltd, 11th edition. **ISBN**: 81-219-0817-5
2. "Engineering Physics" by R K Gaur and S L Gupta, Dhanpat Rai Publications. **ISBN:** 978-8189928223
3. "Physics for Engineers" by T.Vijaya Krishna, Cengage publications.**ISBN:** 978-93-5350-755-8

Reference Books:

1. "Engineering Physics" by M.R.Srinivasan, New Age international publishers (2009). **ISBN**: 978-1848290501
2. "Text book of Engineering Physics" by S. O. Pillai, New Age international publishers (2012). **ISBN**: 9788122420753
3. "Introduction to Solid State Physics" by Charles Kittel, Wiley publications 8th edition (2012) **ISBN**: 978-1-119-45416-8

Web Links:

1. http://nptel.ac.in/courses/122107035/11
2. http://nptel.ac.in/courses/115102023/
3. https://phet.colorado.edu/en/simulations/category/physics
4. http://physicsgecg.blogspot.in/p/reading-materials.html

Geology & Sedementology for Petroleum Engineers

	L	T	P	C
Course Code: 2501PT6	**1**	**1**	**2**	**4**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Explain the general facts of the earth.
CO2: Explain the formation of different structures.
CO3: Describe the origin of rocks, especially sedimentalogy.
CO4: Describe the different depositional environments and basins.
CO5: Apply the uses of micro fossils in oil exploration.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	3
CO2	-	2
CO3	-	3
CO4	-	3
CO5	-	2

UNIT – I
The Earth: Introduction to origin, age, internal structure, and constitution of earth; Introduction to earth's lithosphere, atmosphere, hydrosphere, and biosphere. Plate tectonic theory, tectonic elements of continents and oceans; continental drift.

UNIT – II
Domain of Structural Geology: Concepts of strike and dip; parameters controlling deformation of rocks; deformation in rocks – descriptions of folds, joints, faults and their classifications; unconformity; geological maps and sections; map symbols.

UNIT – III
Origin of igneous, sedimentary, and metamorphic rocks
Sedimentology: Subaerial weathering processes: physical and chemical weathering; distinction between soil, alluvium, and sediments;

Sedimentary textures: grain size, particle shape,sorting and fabric and their effect on porosity and permeability of sedimentary rocks;
Sedimentary structures: stratification and bedforms, bedding planemarkings; paleocurrent analysis.

UNIT – IV

Sedimentary Rocks and Depositional Environments: Diagenesis of siliciclastic sedments. Classification of siliciclastic sedimentary rocks: rudaceous, aranaceous, and luteceous sedimentary rocks; carbonate sedimentary rocks: classification, diagenesis.
Introduction to different types of sedimentary basins, and depositional environments: Eh-pH fence diagram; continental (fluvial, lake, aeolian), marginal marine (estuarine, lacustrine), shallow marine (tidal flat, beach, deltaic), shelf and deep marine environments.

UNIT – V

Concepts of palaeontology: Fossils, their mode of preservation and significance as indices of age and climate; Concept of index fossils and their uses in oil exploration.

Integrated Lab With 2 Credits

Practices:

1. Study of Sedimentary rocks in Hand Specimen: Sandstone – Detailed study of Different types of Sandstone, Ex. Arkose, Arenite, Wacke with respect to texture (grain size, shape and angularity/roundness),
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 shapes of pebbles.
5. Grain size analysis of sediment (Mean, Median, Standard deviation, Skewness, Kurtosis).
6. Measurement of the strike.and dip.
7. Location of observed outcrops on the Toposheet and Preparation of geological map of the area.
8. Study of Isopach maps and construction of sections.
9. Construction of panel and fence diagrams
10. Study of porosity and permeability from samples

Additional Practices:

1. Identification of minerals
2. Measurement of thickness of beds.
3. Field trips to the different deltaic environments of Godavari delta.

Textbooks:

1 Introduction to Sedimentology , Sengupta S.M.eISBN: 978-93-883-2799-2

2 Depositional Sedimentary Environments, Reineck H.E. and Singh I.B, Springer eISBN: 978-3-642-81498

Reference Books:

1. Elements of Mineralogy, Gribble, C. D., Rutley's, 27th Edition. CBS Publishers. eISBN: 978-94-011-6832-8
2. Principles of Physical Geology, David Duff, Homes, Nelson Thornes Ltd; 4th Revised edition. eISBN: 041240320X
3. Textbook of Physical Geology, Mahapatra, G.B., CBS Publishers. eISBN: 9788123901107

Web Links:

1. web.crc.losrios.edu/~jacksoh/classes/earthscience/Chapter1.pdf
2. science.jrank.org/pages/3820/Landform.html
3. www.manitoba.ca/iem/min-ed/kidsrock/origins/index.html
4. https://ocw.mit.edu/courses/earth-atmospheric-and.../12...sedimentary .../ch11.pdf
5. www.ucmp.berkeley.edu/fosrec/ONeill.html

Petroleum Geology & Exploration Techniques

	L	T	P	C
Course Code: 2501PT10	**1**	**1**	**2**	**4**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Explain its properties, origin and migration of petroleum in different rocks.
CO2: Explain the entrapment of oil and gas.
CO3: Apply the different geological approaches for exploration of oil and gas deposits.
CO4: Utilize the principles of gravity and magnetic prospecting to explore the subsurface rocks favorable for hydrocarbon deposits.
CO5: Apply different seismic refraction and reflection techniques in selected areas of structural interest revealed by the gravity and magnetic methods to locate oil bearing structures.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	-	2
CO3	2	-
CO4	-	2
CO5	-	2

UNIT – I
Physical and chemical characteristics of crude oil, Origin of petroleum: diagenesis, catagenesis and metagenesis. Source rock and maturation, Reservoir rocks and cap rocks. Migration of hydrocarbons: mechanism, pattern, and barriers.

Unit-II
Entrapment of oil and gas: types and mechanism.
Geology of sedimentary basins of India –producing and prospective basins, KG basin Mumbai Offshore and Cambay Basin

UNIT – III

Exploration Philosophy and Principles. Stages and norms of exploration.Geological techniques and procedures of petroleum exploration. Geological mapping.
Geochemical methods of prospecting: Soil geochemical surveys; Hydro-geochemistry as a tool for oil exploration

UNIT – IV

G and M Methods:Gravity and magnetic prospecting, Instruments of G&M survey, Gravity and magnetic data correction, Interpretation of G&M anomaly, Correlation of Gravityanomaly with seismic anomaly and applications in oil exploration.

UNIT – V

Body waves and surface waves, Rayleigh, Love, P and S wave, Seismic acquisition principle, Seismic refraction and reflection surveys and their applications in oil exploration, Land and marine sources, Geophone, Hydrophone and Vibrioses survey, Seismic Fold, Signal andNoise, Seismic Processing, CDP/CMP and NMO, DMO, 2D and 3D seismicsurveys.

Integrated Lab With 2 Credits

Practices:

1. Megascophic identification of source, reservoir, and cap rocks
2. Preparation of litho stratigraphic columns, litho stratigraphic correlation.
3. Identification of differences between clastic and carbonate reservoir rocks
4. Measurement of porosity of reservoir rocks
5. Measurement of permeability of reservoir rocks
6. Preparation of structural contour map and location of Oil Water Contact (OWC)
7. Basics of Contouring (Hand Drawn and Computerised)
8. Gravity Data Processing and Interpretation
9. Magnetic Processing and Interpretation
10. Seismic data interpretation (Shallow seismic-Hammer source)

Additional Practices:

1. Identifying Play, Lead and Drillable prospects from seismic data.
2. Identifying Play, Lead and Drillable prospects from gravity data.
3. Identifying Play, Lead and Drillable prospects from magnetic data.

Textbooks:

1 Reservoir Seismology , Mamdough, R. Gadallah, Pennwell Books, Pennwell Publishing Company, Tusa, Oklahoma.eISBN: 0-87814-411-0
2 Applied Geophysics, Telford, W M, Geldart, L.P., Sheriff, R.E. and Keys, D.E., Oxford and IBH Publishing Co Pvt Ltd. eISBN:0-521-32693-1

Reference Books:

1 Elements of Geology: Oil and Gas Exploration Techniques, J. Guillemot, Technip. eISBN: 978-2710806998
2 Applied Geophysics, W. M. Telford, L.P. Geldart, R.E.Shariff, Cambridge University Press.eISBN: 9780521339384

3 Exploration Geophysics: An Introduction, M.Gadallah, R.Fisher, Springer Publications. eISBN: 978-3-540-85160-8

Web Links:

1 https://link.springer.com/article/10.1007/s13369-019-03778-x
2 www.os.is/gogn/unu-gtp-sc/UNU-GTP-SC-09-13a.pdf
3 www.geol-amu.org/notes/b8-4-4.htm
4 https://www.eoas.ubc.ca/courses/eosc350/content/methods/meth_6/raypaths.html

Differential Equations and Vector Calculus

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

	L	T	P	C
Course Code: 2501MA02	**2**	**1**	**0**	**3**

Course Outcomes:

At the end of the Course, Student will be able to:

CO1: Solve the linear differential equations of first order and apply in various engineering problems.

CO2: Solve the linear differential equations of higher order and apply in various engineering problems.

CO3: Solve the linear partial differential equations

CO4: Calculate the gradient, divergence and curl.

CO5: Compute work done, flux using vector integration

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

UNIT – I

Ordinary Differential Equations of First Order and First Degree:

Solution of first order linear differential equations, exact differential equations and equations reducible to exact differential equations, Orthogonal Trajectories, Modelling of RL- circuit.

Practice(Using any computational tool): Solving the first order initial value problems using **odesolver** and plot the solution curves.

UNIT – II

Linear Differential Equations of Higher Order:

Solution of linear differential equations with constant coefficients, method of variation of parameters, solution of simultaneous linear differential equations.

Equations reducible to Linear differential equations with constant coefficients: Cauchy's homogeneous Linear Equations, Legendre's Linear Equations. Study of oscillations arising in LCR circuit (free oscillations and forced oscillations).

Practice(Using any computational tool): Solving the second order initial value problems using **odesolver** and plot the solution curves

UNIT – III

Partial Differential Equations:

Solution of linear PDE of first order by Lagrange's method, solution of homogeneous linear PDE of higher order with constant coefficients.

UNIT – IV

Vector Differentiation:

Gradient of a scalar field, finding angle between two surfaces, directional derivative. Divergence and solenoidal fields. Curl and irrotational fields, Finding Scalar Potential.

Practice(Using any computational tool): Plotting of surfaces, 3D-plots, plotting vector fields

UNIT – V

Vector Integration:

Line integrals, work done by a force, conservative force field, surface integral, flux, volume integral. Green's theorem, Stoke's theorem and Gauss divergence theorem.

Students are advised to use any computational / AI Tool like Wolfrum Alpha, Symbolab, Mathway, Desmos, Geogebra etc., for the practice.

Text Books:

1. Advanced Engineering Mathematics, E. Kreyszig, John Willey & Sons,10th Ed., 2018. ISBN 978-0470458365
2. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 44'th Edition (2021). ISBN 978-9383214204

Reference Books:

1. Advanced Engineering Mathematics, Dennis G. Zill, Jones & Bartlett Learning, 2018, 6th Edition.ISBN 978-1284105902.
2. Higher Engineering Mathematics, B.V. Ramana, McGraw-Hill Education, 11'th Ed., 2017. ISBN 978-9339216016.

Web Links:

1. https://www.classcentral.com/course/differential-equations-engineers-13258
2. https://archive.nptel.ac.in/courses/111/106/111106100/
3. https://www.khanacademy.org/math/differential-equations
4. https://archive.nptel.ac.in/courses/111/101/111101153/
5. https://archive.nptel.ac.in/courses/111/105/111105122/

Numerical Methods & Integral Transforms

(Common to EEE, PT & Min. E)

	L	T	P	C
Course Code: 2501MA05	**2**	**1**	**0**	**3**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Apply numerical methods to solve the solution of equations and interpolation of polynomials.
CO2: Apply numerical methods to solve problems involving differentiation, integration and initial value problems.
CO3: Compute Fourier series of a function.
CO4: Compute the Fourier transform of a function.
CO5: Apply Laplace transform to solve initial value problems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

UNIT – I
Solution of Algebraic and Transcendental Equations and Interpolation:
Solution of Algebraic and Transcendental Equations: Errors in Numerical Computation, Bisection method, Method of false position, Secant method and Newton - Raphson method.
Interpolation: Unequal Intervals- Lagrange's interpolation, Newton's divided difference formulae, Equal Intervals-Newton's Forward and Backward difference formlae, Central difference, Relation between operators.
Practice(Using any computational tool): Find solution of equations and Newton's forward interpolation.

UNIT – II
Numerical Differentiation, Integration and Solutions of Ordinary Differential Equations:
Numerical Differentiation: Numerical differentiation using Newton's Forward, Backward and Newton's divided difference formula.
Numerical Integration: Simpson's 1/3rd and 3/8th rule.
Numerical solution of ordinary differential equations: Taylor's series method, Euler's method and Runge-Kutta method (second and fourth order).
Practice(Using any computational tool):Solving problems on above methods.

UNIT – III
Fourier Series: Fourier series of periodic functions, Half-range series, Change of interval and Fourier series in complex form, Parseval's formula and R.M.S Value.
Practice(Using any computational tool): Generating Fourier Series of functions .

UNIT – IV

Fourier Transforms: Fourier integral theorem (without proof), Fourier sine and cosine integral, Fourier Transform, Properties, Fourier sine and cosine transforms and Finite Fourier transforms.

UNIT – V

Laplace Transforms : Laplace Transform of Standard functions, Properties, Inverse Laplace transform, Properties, Convolution theorem, Solving ordinary differential equations and Simultaneous equations with constant coefficients by using Laplace Transforms.

Practice(Using any computational tool): Finding Laplace Transform of functions.

Students are advised to use any computational / AI Tool like Wolfrum Alpha, Symbolab, Mathway, Desmos, Geogebra etc., for the practice

Text Books:

1. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 5th Edition (9th reprint), 2021· ISBN 978-8184875607
2. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 44'th Edition (2021). ISBN 978-9383214204

Reference Books:

1. Advanced Engineering Mathematics with MATLAB, Dean G. Duffy, CRC Press. ISBN 978-1498739641
2. Higher Engineering Mathematics, H. K. Dass, Er. R. Verma, S-Chand publishers, 3rd edition 2023.ISBN 9788121938907

Web Links:

1. https://swayam.gov.in/nd1_noc19_ma21/preview
2. https://onlinecourses.nptel.ac.in/noc20_ge20/preview
3. https://onlinecourses.nptel.ac.in/noc23_ma43/preview
4. https://onlinecourses.nptel.ac.in/noc22_ma62/preview

Complex Variables& Statistical Methods

(Common to EEE, PT & Min.E)

	L	T	P	C
Course Code:2501MA06	**2**	**1**	**0**	**3**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Examine the continuity and analyticity of functions of complex variables and Evaluate different types of complex integrals
CO2: Expand a function of complex variable as Taylor and Laurent series and evaluate residues.
CO3: Apply various Probability distributions for both discrete and continuous random variables.
CO4: Compute mean and variance of sample means with replacement and without replacement and estimating maximum errors
CO5: Apply various tests to test the hypothesis concerning mean, Proportion, variance.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

UNIT – I
Functions of a complex variable and Complex integration:
Introduction – Continuity – Differentiability – Analyticity –Cauchy-Riemann equations in Cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne – Thompson method.
Complex integration: Line integral –Cauchy's integral theorem–Cauchy's integral formula (without proofs)

UNIT – II
Series expansions and Residue Theorem:
Radius of convergence–Expansion in Taylor's series,Maclaurin's series and Laurent series.
Types of Singularities:Isolated–Essential–Pole of order m–Residues–Residue theorem (without proof)

UNIT – III
Random variables and Distributions:
Random variables – Discrete and Continuous random variables – Distribution functions – Probability mass function, Probability density function and Cumulative distribution functions – Mathematical Expectation and Variance –Binomial, Poisson and Normal distributions.
Practice(Using any computational tool): Fitting Binomial and Poisson distributions

UNIT – IV

SamplingTheory:

Introduction –Population and Samples–Sampling distribution of Means and Variance – Central limit theorem (without proof) –Point and Interval estimations –Maximum error of estimate.

Practice(Using any computational tool): Plotting of confidence intervals

UNIT – V

Tests of Hypothesis:

Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors –Level of significance – One tail and two-tail tests – tests for large samples (Z - test for single mean, difference of means, single proportion, difference of proportions) – tests for small samples (t-test for single mean and difference of means)– F-test for comparison of variances-Chi Square test for attributes.

Practice(Using any computational tool): F- test and t- test.

Students are advised to use any computational / AI Tool like Wolfrum Alpha, Symbolab, Mathway, Desmos, Geogebra etc., for the practice

Text Books:

1	Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 44'th Edition (2021).ISBN 978-9383214204
2	Miller and Freund's, Probability and Statistics for Engineers, 9/e, Pearson, 2020.ISBN978-9353945237

Reference Books:

1	Complex Variables and Applications, J.W.Brown and R.V.Churchill, 9th edition , Mc-Graw Hill, 2021 .ISBN 9789354600364.
2	Fundamentals of Mathematical Statistics, S.C. Gupta and V.K.Kapoor, 12th edition, Sultan Chand & Sons Publications, 2020.ISBN 978-9351611738

Web Links:

1	https://archive.nptel.ac.in/courses/111/103/111103070/
2	https://onlinecourses.nptel.ac.in/noc20_ma50/preview
3	https://onlinecourses.nptel.ac.in/noc21_ma74/preview
4	http://mathworld.wolfram.com/topics/ProbabilityandStatistics.html
5	https://www.khanacademy.org/math/statistics-probability

Business Intelligence Lab

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

	L	T	P	C
Course Code: 2501IT01	**0**	**0**	**2**	**2**

Course Outcomes:

At the end of the course, student will be able to:

- **CO1:** Utilize Excel and Power BI for data analysis, visualization, and reporting.
- **CO2:** Apply various data analysis techniques in Excel and Power BI to extract meaningful insights from datasets
- **CO3:** Create clear and compelling visualizations using Excel and Power BI to communicate data-driven insights.
- **CO4:** Develop data models in Power BI to organize and analyze data efficiently.
- **CO5:** Design interactive dashboards in Power BI to facilitate data exploration and decision-making.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	-	-	2	-	-	-	1	1	1
CO2	2	3	-	-	2	-	-	-	1	1	2
CO3	2	2	-	-	2	-	-	-	1	1	2
CO4	1	2	1	-	2	-	-	-	1	1	2
CO5	1	2	1	-	2	-	-	-	1	1	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	2
CO2	2	1
CO3	2	2
CO4	1	2
CO5	2	2

Practice

1. Introduction to Excel

a. Overview of Excel and its capabilities for data analysis
b. Basics of Excel: Navigating the interface, entering data, formatting cells
c. Introduction to functions and formulas: SUM, AVERAGE, IF, VLOOKUP, etc.
d. Importing data into Excel from different sources: CSV, text files.

2. Data Analysis with Excel

a. Data manipulation techniques: Sorting, filtering, and grouping data
b. Advanced functions and formulas: INDEX/MATCH, SUMIFS, COUNTIFS, etc.
c. Data visualization with Excel: Creating charts and graphs
d. Using PivotTables for data summarization and analysis

3.Advanced Excel Features

a. Introduction to Excel tables and structured references
b. Working with named ranges and dynamic ranges
c. Excel data validation techniques

4. Introduction to Power BI

a. Overview of Power BI and its advantages over Excel for large datasets
b. Installing Power BI Desktop
c. Understanding the Power BI interface: Navigation, ribbons, and panes
d. Importing data into Power BI Desktop from various sources

5. Data Preparation in Power BI

a. Introduction to Power Query for data transformation
b. Cleaning, shaping, and filtering data in Power Query Editor

6. Data Preparation in Power BI

a. Combining data from different sources
b. Loading data into Power BI model.

7. Data Modeling in Power BI

a. Understanding relationships between tables
b. Creating calculated columns and measures using DAX

8. Data Modeling in Power BI

a. Introduction to DAX functions: CALCULATE, FILTER, RELATED, etc.
b. Working with date and time functions in DAX

9. Visualization Basics in Power BI

a. Creating basic visualizations: Bar charts, line charts, pie charts, etc.
b. Customizing visualizations: Formatting, titles, legends, etc.

10. Visualization Basics in Power BI

a. Using slicers and filters to interact with visualizations
b. Adding drill-down capabilities to visualizations

11. Advanced Visualizations and Dashboards in Power BI

a. Exploring advanced visualizations: TreeMap, Waterfall chart, KPIs, etc.
b. Creating custom visuals from the marketplace

12. Advanced Visualizations and Dashboards in Power BI

a. Designing effective dashboards: Layout, arrangement, and organization
b. Adding interactivity with bookmarks and drill-through

Additional Practice:

1. **Basic Data Analysis:** Import a dataset into Excel and perform basic data analysis tasks such as sorting, filtering, and creating simple charts to visualize the data.

2. **Expense Tracker:** Create a spreadsheet to track your expenses. You can have columns for date, item description, category, and amount. Use formulas to calculate totals and analyze your spending habits.

3. **Data modeling and extracting statistics from dataset:** Connecting Power BI to local data files and cloud servers (COVID19 dataset will be imported into the Power BI for visualization).

Text Books:

1. Learn Power BI - Second Edition: A comprehensive, step-by-step guide for beginners to learn real-world business intelligence 2nd Edition, ISBN: 9781801811958.
2. Power BI Beginner: Zero to Hero in Power BI Desktop by Philip Seamark, ISBN 1691641227.

Reference Books:

1. Power BI Quick Start Guide: Build dashboards and visualizations to make your data come to life by Devin Knight and Siddharth Mehta.
2. Learn Power BI: A Beginner's Guide to Analyzing Data and Creating Reports with Power BI by Murilo Miranda.

Web Links:

1. https://learn.microsoft.com/en-us/power-bi/
2. https://support.microsoft.com/en-us/excel
3. https://cce.sydney.edu.au/course/MSE1
4. https://cce.sydney.edu.au/course/PBBA

Programming for Problem Solving using C
(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

	L	T	P	C
Course Code: 2501CS01	**2**	**0**	**2**	**4**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Demonstrate basics of computer, algorithm and flow chart for problem solving.
CO2: Make use of an appropriate control structures to solve given problems.
CO3: Solve complex problems using arrays and strings.
CO4: Develop modular programming using functions.
CO5: Demonstrate dynamic memory allocations and file handling using file operations.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	3	2	1	3	-	-	2	-	-	1
CO2	2	3	2	1	3	-	-	2	-	-	1
CO3	2	3	2	1	3	-	1	2	-	-	1
CO4	2	3	2	1	3	-	1	2	-	-	1
CO5	2	3	2	1	3	-	1	2	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2

UNIT – I

Introduction to Programming and Problem Solving

Introduction to Programming Languages, Basics of a Computer Program- Algorithms, Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms, flowcharts (Using Dia Tool), pseudo code. Structure of C Program, Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, operators, keywords, identifiers, Type Conversion, and Casting.

Practice 1:

1. Explore different platforms
   a. Basic linux environment and its editors like Vi, Vim & Emacs etc.
   b. Exposure to turbo C, gcc.
   c. Explore to hacker rank or any other Online coding platform and compiler environment.
   d. "Hello world" in C.
      https://www.codechef.com/learn/course/c/CDEVINTRO/problems/CDEV004B
   e. Objective: Learn about the syntax of reading from stdin and writing to stdout.
      https://www.hackerrank.com/challenges/hello-world-c/problem?isFullScreen=true

f. Write a simple program to read int, float, char and string using scanf() and display using printf() in all the above given platforms.

2. Basics and Operators
   a. Sum and Difference of 2 numbers.
      Objective: Learn int and float data types.
      https://www.hackerrank.com/challenges/sum-numbers-c/problem?isFullScreen=true
      https://maya.technicalhub.io/owl-program-details/668b9ec2e069313510b0235a
   b. Playing with Characters.
      Objective: Learn how to take a character, a string and a sentence as input in C.
      https://www.hackerrank.com/challenges/playing-with-characters/problem?isFullScreen=true

   c. Bitwise Operators
      Objective: Learn how to work with bits (0,1) and bitwise operators.
      https://www.hackerrank.com/challenges/bitwise-operators-in-c/problem?isFullScreen=true

   d. Conversion of Fahrenheit to Celsius and vice versa.
      https://www.codechef.com/practice/course/c/LPCAS03/problems/LCAS30
      https://maya.technicalhub.io/owl-program-details/66a0c0dda7d31805366af641

   e. Distance travelled by an object.
      https://maya.technicalhub.io/owl-program-details/6687c4e9fd042085d9ec254a

   f. Calculate Simple interest and compound interest.
      https://maya.technicalhub.io/owl-program-details/6687b498dfe02cea4b53e0ab

3. Operators and Expressions, Variables and Type conversions.
   a. Evaluate the following expressions
      i. a/b*c-b+a*d/3
      ii. j = (i++) + (++i)
   b. Square root of a given number.
   c. Find the area of circle, square, rectangle and triangle.
      https://maya.technicalhub.io/owl-program-details/6686546930bfbd35127c869c
      https://maya.technicalhub.io/owl-program-details/6688cf91e467bfe336f8352f
      https://www.hackerrank.com/challenges/rectangle-area/problem?utm_source=chatgpt.com

      https://maya.technicalhub.io/owl-program-details/6688ea3ce467bfe336f8ab9d
   d. Find the maximum of three numbers using conditional operator.
      https://maya.technicalhub.io/owl-program-details/668690d230bfbd35127c9bf5

   e. Take marks of 5 subjects in integers, find the total in integer and average in float.

UNIT – II
Control Structures
Simple sequential programs, Conditional Statements (if, if-else, else if ladder, switch), Loops (for, nested for loop, while, do-while), break and continue, goto statement.

Practice:

1. Conditional Statements
   a. Objective: Understand if and else Conditional statements in C.
      https://www.hackerrank.com/challenges/conditional-statements-in-c/problem?isFullScreen=true
   b. Roots of a Quadratic Equation.
   c. Generate electricity bill.
      https://maya.technicalhub.io/owl-program-details/66868f6730bfbd35127c9ba7
   d. Simulate a calculator using switch case.
   e. Find the given year is a leap year or not.
2. Loops
   a. Objective: Learn the usage of the for loop in C.
      https://www.hackerrank.com/challenges/for-loop-in-c/problem?isFullScreen=true
   b. Sum of the digits of a 5-digit number.
      Objective: Learn the usage of while loop and usage of operators - % and /.
      https://www.hackerrank.com/challenges/sum-of-digits-of-a-five-digit-number/problem?isFullScreen=true
      https://maya.technicalhub.io/owl-program-details/66864717f56afec5c0c917e1
   c. Given number is a prime or not. (Also Prime numbers between a given range.)
      https://maya.technicalhub.io/owl-program-details/6687b69ddfe02cea4b5404a3
   d. Armstrong Number or not.
   e. Palindrome or not.
      https://maya.technicalhub.io/owl-program-details/6687af17dfe02cea4b5376ae
   f. Objective: Print a pattern of numbers using Loops.
      https://www.hackerrank.com/challenges/printing-pattern-2/problem?isFullScreen=true
   g. Construct a Pyramid pattern.
      https://www.codechef.com/practice/course/c/LPCAS02/problems/LCAS20

UNIT – III

Arrays: Arrays indexing, Accessing programs with array of integers, two dimensional arrays, Introduction to Strings, string handling functions.
Sorting Techniques: bubble sort, selection sort.
Searching Techniques: linear, Binary search.

Practice:

1. 1-Dimensional Arrays
   a. Objective: Print the sum and free the memory where the array is stored.
      https://www.hackerrank.com/challenges/1d-arrays-in-c/problem?isFullScreen=true
   b. Objective: Working with indices in array.
   c. Search an element in array (Linear Search).
      https://maya.technicalhub.io/owl-program-details/6687c40ffd042085d9ec15d6
   d. Find min and max elements in array.
      https://maya.technicalhub.io/owl-program-details/66879493dfe02cea4b529041

e. Insert an element into array.
f. Eliminate duplicate elements from array.
https://maya.technicalhub.io/owl-program-details/66e920a1aca93b27f3364b57
g. Sorting of elements in an array using Bubble sort.

2. 2-Demensional Arrays
   a) Sum of two 2-D arrays.
   https://maya.technicalhub.io/owl-program-details/66864fa9f56afec5c0c924f6
   b) Multiplication of two 2-D arrays.
   c) Transpose of a Matrix.
   d) Trace of a Matrix.
   e) Lower Triangular Matrix.
3. Hacker Rank
   a) Objective: print each word of the sentence in a new line.
   b) Count number of alphabets (lowercase, uppercase, consonants, vowels) and digits
   Lowercase to Uppercase, Uppercase to Lowercase, Toggle case, Sentential case
   https://maya.technicalhub.io/owl-program-details/6698e2fbcb6bd470f35b73d8
   https://maya.technicalhub.io/owl-program-details/6698ef03cb6bd470f35b7c3e
   c) find the frequency of each digit in the given string.
   https://www.hackerrank.com/challenges/frequency-of-digits-1/problem?isFullScreen=true
   d) Find string length, concatenate 2 strings, reverse a string using built-in and without built-in string functions.
   https://maya.technicalhub.io/owl-program-details/6698ed2dcb6bd470f35b7ae7

UNIT – IV

Functions: Introduction to Functions, Function Declaration and Definition, Function call Return **Types and Arguments**, arrays as parameters, Scope and Lifetime of Variables, **storage classes**, **recursion**, functions and arrays.

Practice: Functions in C

1. Objective: Learn simple usage of functions.
   https://www.hackerrank.com/challenges/functions-in-c/problem?isFullScreen=true
2. Objective: Fibonacci Numbers using recursive function.
   https://www.hackerrank.com/challenges/ctci-fibonacci-numbers/problem
3. Objective: N^{th} factorial using recursion.
4. Objective: Find the super digit of the integer.
5. Implement LCM
6. Objective: Calculate the Nth term of series.
   https://www.hackerrank.com/challenges/recursion-in-c/problem?isFullScreen=true

UNIT – V

Pointer: Introduction to Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, **functions & pointers** modifying parameters inside functions using pointers, Command line Arguments, Dynamic memory allocation, Null Pointer, generic pointer, dangling pointer.

File Handling:-Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, Random File Access.

Practice:

1. Pointers

a. Objective: learn to implement the basic functionalities of pointers in C. https://www.hackerrank.com/challenges/pointer-in-c/problem?isFullScreen=true
b. Objective: Learn using Pointers with Arrays and Functions. https://www.hackerrank.com/challenges/students-marks-sum/problem?isFullScreen=true
c. Objective: sort a given array of strings into lexicographically increasing order or into an order in which the string with the lowest length appears first. https://www.hackerrank.com/challenges/sorting-array-of-strings/problem?isFullScreen=true
d. Find the sum of a 1D array using malloc().
e. Swap two numbers using functions and pointers - call by value and reference.
f. Objective: Dynamic Handling requests by a Librarian to place the books in the shelves. https://www.hackerrank.com/challenges/dynamic-array-in-c/problem?isFullScreen=true

2. File handling concepts
   a) Write text into and read text from a file.
   b) Write text into and read text from a binary file using fread() and fwrite().
   c) Copy the contents of one file to another file.
   d) Merge two files into the third file using command-line arguments
   e) Find no. of lines, words and characters in a file.

Text Books:

1 Programming in C, Rema Theraja, Oxford, 2nd edition. ISBN 93-5497-9
2 "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall. ISBN 13: 9780131103627

Reference Books:

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education. ISBN.No: 9352604172
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill. ISBN No. 0071367993
3. Let Us C Yashwanth,Kanetkar, Eighth edition, BPB Publications.ISBN No. 1934015253
4. Programming in C A-Practical Approach, Ajay Mittal. Pearson Education.ISBN No. 9788131729342
5. R G Dromey How to Solve It by Computer (Prentice-Hall International Series in Computer Science.ISBN-13 : 978-0134340012

Web Links:

1 https://www.hackerrank.com/
2 https://onlinecourses.nptel.ac.in/noc22_cs40/preview
3 https://archive.nptel.ac.in/courses/106/104/106104128/

Additional Practice:

S.No.	Difficulty	Problem Name	Link
1	Easy	Add Two Numbers	https://www.codechef.com/practice/course/cpp/PCPP05/problems/FLOW001
2	Easy	Enormous Input Test	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/INTEST
3	Easy	ATM	https://www.codechef.com/practice/course/1-star-difficulty-problems/DIFF1200/problems/ATM2
4	Easy	Number Mirror	https://www.codechef.com/practice/course/python/PPY01/problems/START01
5	Easy	Sum of Digits	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW006
6	Easy	Remainder	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW002
7	Easy	First and Last Digit	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/FLOW004
8	Easy	Reverse The Number	https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/FLOW007
9	Easy	Life, the Universe, and Everything	https://staging.codechef.com/practice/course/cpp/PRACTICECPP2/problems/TEST
10	Easy	Chef and Operators	https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/CHOPRT
11	Easy	Difference and Sum	https://www.codechef.com/problems/DIFFSUM
12	Easy	Second Largest	https://www.codechef.com/practice/course/arrays/ARRAYS/problems/LARGESECOND
13	Easy	Two Sum	https://leetcode.com/problems/two-sum/
14	Easy	Reverse Integer	https://leetcode.com/problems/reverse-integer/
15	Easy	Palindrome Number	https://leetcode.com/problems/palindrome-number/
16	Easy	Roman to Integer	https://leetcode.com/problems/roman-to-integer/
17	Easy	Remove Duplicates from Sorted Array	https://leetcode.com/problems/remove-duplicates-from-sorted-array/
18	Easy	Remove Element	https://leetcode.com/problems/remove-element/
19	Easy	Find the Index of the First Occurrence in a String	https://leetcode.com/problems/find-the-index-of-the-first-occurrence-in-a-string/
20	Easy	Length of Last Word	https://leetcode.com/problems/length-of-last-word/
21	Easy	Plus One	https://leetcode.com/problems/plus-one/
22	Easy	Merge Sorted Array	https://leetcode.com/problems/merge-sorted-array/
23	Easy	Majority Element	https://leetcode.com/problems/majority-element/
24	Easy	Single Number	https://leetcode.com/problems/single-number/
25	Easy	Move Zeroes	https://leetcode.com/problems/move-zeroes/

26	Easy	Missing Number	https://leetcode.com/problems/missing-number/
27	Easy	Contains Duplicate	https://leetcode.com/problems/contains-duplicate/
28	Easy	Valid Anagram	https://leetcode.com/problems/valid-anagram/
29	Easy	Valid Parentheses	https://leetcode.com/problems/valid-parentheses/
30	Easy	Fibonacci Number	https://leetcode.com/problems/fibonacci-number/
31	Easy	Climbing Stairs	https://leetcode.com/problems/climbing-stairs/
32	Easy	Binary Search	https://leetcode.com/problems/binary-search/
33	Easy	Number of 1 Bits	https://leetcode.com/problems/number-of-1-bits/
34	Easy	Hamming Weight	https://leetcode.com/problems/number-of-1-bits/description/
35	Easy	Power of Two	https://leetcode.com/problems/power-of-two/
36	Easy	Power of Three	https://leetcode.com/problems/power-of-three/
37	Easy	Same Tree	https://leetcode.com/problems/same-tree/
38	Easy	Maximum Subarray	https://leetcode.com/problems/maximum-subarray/
39	Medium	Chef and Notebooks	https://www.codechef.com/problems/CNOTE
40	Medium	Chef and Wildcard Matching	https://www.codechef.com/search?q=TWOSTR
41	Medium	Minimum Moves	https://www.codechef.com/search?q=SALARY
42	Medium	Lucky Four	https://www.codechef.com/search?q=LUCKFOUR
43	Medium	Maximum Difference	https://www.codechef.com/search?q=MAXDIFF
44	Medium	Uncle Johny	https://www.codechef.com/search?q=JOHNY
45	Medium	Chef and Strings	https://www.codechef.com/search?q=CHEFSTLT
46	Medium	Two vs Rib	https://www.codechef.com/search?q=TWOVRIB
47	Medium	Chef and Array	https://www.codechef.com/search?q=CHEFARRP
48	Medium	Add Two Numbers	https://leetcode.com/problems/add-two-numbers/
49	Medium	Longest Substring Without Repeating Characters	https://leetcode.com/problems/longest-substring-without-repeating-characters/
50	Medium	Longest Palindromic Substring	https://leetcode.com/problems/longest-palindromic-substring/
51	Medium	3Sum	https://leetcode.com/problems/3sum/
52	Medium	Container With Most Water	https://leetcode.com/problems/container-with-most-water/

53	Medium	Integer to Roman	https://leetcode.com/problems/integer-to-roman/
54	Medium	String to Integer (atoi)	https://leetcode.com/problems/string-to-integer-atoi/
55	Medium	Divide Two Integers	https://leetcode.com/problems/divide-two-integers/
56	Medium	Rotate Image	https://leetcode.com/problems/rotate-image/
57	Medium	Set Matrix Zeroes	https://leetcode.com/problems/set-matrix-zeroes/
58	Medium	Spiral Matrix	https://leetcode.com/problems/spiral-matrix/
59	Medium	Jump Game	https://leetcode.com/problems/jump-game/
60	Medium	Permutations	https://leetcode.com/problems/permutations/
61	Medium	Combination Sum	https://leetcode.com/problems/combination-sum/
62	Medium	Search in Rotated Sorted Array	https://leetcode.com/problems/search-in-rotated-sorted-array/
63	Medium	Group Anagrams	https://leetcode.com/problems/group-anagrams/
64	Medium	Sort Colors	https://leetcode.com/problems/sort-colors/
65	Medium	Subsets	https://leetcode.com/problems/subsets/
66	Medium	Reverse Linked List II	https://leetcode.com/problems/reverse-linked-list-ii/
67	Medium	Add Two Numbers II	https://leetcode.com/problems/add-two-numbers-ii/
68	Medium	Reorder List	https://leetcode.com/problems/reorder-list/
69	Medium	Linked List Cycle II	https://leetcode.com/problems/linked-list-cycle-ii/
70	Medium	K-th Largest Element in an Array	https://leetcode.com/problems/kth-largest-element-in-an-array/
71	Medium	Product of Array Except Self	https://leetcode.com/problems/product-of-array-except-self/
72	Medium	Word Search	https://leetcode.com/problems/word-search/
73	Medium	Unique Paths	https://leetcode.com/problems/unique-paths/
74	Medium	Minimum Path Sum	https://leetcode.com/problems/minimum-path-sum/
75	Medium	Temperature Converter - II	https://www.codechef.com/practice/course/c/LPCAS03/problems/LCAS30B
76	Medium	Reverse	https://www.hackerrank.com/challenges/reverse-array-c/problem?isFullScreen=true

77	Medium	Sentence in a new line	https://www.hackerrank.com/challenges/printing-tokens-/problem?isFullScreen=true
78	Hard	Median of Two Sorted Arrays	https://leetcode.com/problems/median-of-two-sorted-arrays/
79	Hard	Regular Expression Matching	https://leetcode.com/problems/regular-expression-matching/
80	Hard	Wildcard Matching	https://leetcode.com/problems/wildcard-matching/
81	Hard	Trapping Rain Water	https://leetcode.com/problems/trapping-rain-water/
82	Hard	First Missing Positive	https://leetcode.com/problems/first-missing-positive/
83	Hard	Longest Valid Parentheses	https://leetcode.com/problems/longest-valid-parentheses/
84	Hard	Merge k Sorted Lists	https://leetcode.com/problems/merge-k-sorted-lists/
85	Hard	Reverse Nodes in k-Group	https://leetcode.com/problems/reverse-nodes-in-k-group/description/
86	Hard	Sudoku Solver	https://leetcode.com/problems/sudoku-solver/
87	Hard	N-Queens	https://leetcode.com/problems/n-queens/description/
88	Hard	Edit Distance	https://leetcode.com/problems/edit-distance/
89	Hard	Word Ladder II	https://leetcode.com/problems/word-ladder-ii/
90	Hard	Maximal Rectangle	https://leetcode.com/problems/maximal-rectangle/
91	Hard	Binary Tree Maximum Path Sum	https://leetcode.com/problems/binary-tree-maximum-path-sum/
92	Hard	Serialize and Deserialize Binary Tree	https://leetcode.com/problems/serialize-and-deserialize-binary-tree/
93	Hard	Variadic functions in C	https://www.hackerrank.com/challenges/variadic-functions-in-c/problem?isFullScreen=true
94	Hard	Small Triangles, Large Triangles	https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem?isFullScreen=true
95	Hard	Permutations of Strings	https://www.hackerrank.com/challenges/permutations-of-strings/problem?isFullScreen=true

Maya Programs

S.No.	Problem Name	Maya Program Link
1	Can Cross the Bridge	https://maya.technicalhub.io/owl-program-details/6686308df56afec5c0c8e2dd
2	Hypotenuse	https://maya.technicalhub.io/owl-program-details/6686404ef56afec5c0c90135
3	Heron's Formula	https://maya.technicalhub.io/owl-program-details/66864474f56afec5c0c911f5
4	Loss Percentage	https://maya.technicalhub.io/owl-program-details/66864868f56afec5c0c91a4a
5	King Tours	https://maya.technicalhub.io/owl-program-details/66864c96f56afec5c0c921f1

6	Profit Percentage	https://maya.technicalhub.io/owl-program-details/66865237f56afec5c0c92694
7	Area and Perimeter of Square	https://maya.technicalhub.io/owl-program-details/6686546930bfbd35127c869c
8	Volume of Sphere	https://maya.technicalhub.io/owl-program-details/6686565530bfbd35127c8818
9	Required Points	https://maya.technicalhub.io/owl-program-details/66865b1130bfbd35127c8a04
10	Instant Noodles	https://maya.technicalhub.io/owl-program-details/66865ddb30bfbd35127c8c0a
11	Find Second Number	https://maya.technicalhub.io/owl-program-details/668660a530bfbd35127c8cde
12	Kmph to Mps	https://maya.technicalhub.io/owl-program-details/668663ce30bfbd35127c8dfb
13	Inches to Centimeters	https://maya.technicalhub.io/owl-program-details/6686665e30bfbd35127c8f3a
14	Capacity	https://maya.technicalhub.io/owl-program-details/668678aa30bfbd35127c95b9
15	Average of Two Numbers	https://maya.technicalhub.io/owl-program-details/6687b002dfe02cea4b5389d6
16	Compound Interest	https://maya.technicalhub.io/owl-program-details/6687b498dfe02cea4b53e0ab
17	Average Weight	https://maya.technicalhub.io/owl-program-details/6687b93edfe02cea4b54367a
18	Arithmetic Operations	https://maya.technicalhub.io/owl-program-details/6687bda0dfe02cea4b5488a1
19	Distance Between Two Points	https://maya.technicalhub.io/owl-program-details/6687c4e9fd042085d9ec254a
20	Days into Years, Weeks	https://maya.technicalhub.io/owl-program-details/6687cad1fd042085d9ec95a8
21	Convert Seconds to Hours, Minutes and Seconds	https://maya.technicalhub.io/owl-program-details/6688c926e467bfe336f8007b
22	Hours and Minutes	https://maya.technicalhub.io/owl-program-details/6688e4f0e467bfe336f89673
23	Romeo and Juliet	https://maya.technicalhub.io/owl-program-details/6688e068e467bfe336f87a8b
24	Gross Salary of an Employee	https://maya.technicalhub.io/owl-program-details/6688dd95e467bfe336f87682
25	Surface Area and Volume of a Cube	https://maya.technicalhub.io/owl-program-details/6688d909e467bfe336f872ca
26	Area of Trapezium	https://maya.technicalhub.io/owl-program-details/6688d637e467bfe336f86c5e
27	Swap Two Numbers	https://maya.technicalhub.io/owl-program-details/6688d2d0e467bfe336f84f55
28	Last Two Digits of a Given Year	https://maya.technicalhub.io/owl-program-details/6688ccfae467bfe336f81f90
29	Arithmetic Operations	https://maya.technicalhub.io/owl-program-details/6687bda0dfe02cea4b5488a1
30	Uppercase Letters in a String	https://maya.technicalhub.io/owl-program-details/669a2453c03fc56b320b215c
31	Factors Finding	https://maya.technicalhub.io/owl-program-details/66866c4a30bfbd35127c90b4

32	String Copy	https://maya.technicalhub.io/owl-program-details/669a03ded62716a9c6d4fa9a
33	Recursive Digit Sum	https://www.hackerrank.com/challenges/recursive-digit-sum/problem

	Basic Programs	Aditya's Internal Coding Platform (Maya)	Code chef	Hacker rank	Leet code	Total
Unit-1	4	8	2	5	0	**19**
Unit-2	4	4	1	4	0	**13**
Unit-3	8	7	0	2	0	**17**
Unit-4	3	0	0	3	0	**6**
Unit-5	7	0	4	4	0	**15**
Additional Practice	0	33	22	5	68	**128**
Total	**26**	**52**	**29**	**23**	**68**	**198**

Engineering Graphics

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501ME01	L	T	P	C
	1	0	2	3

Course Outcomes:
At the end of the course, student will be able to:

- **CO1:** Apply the principles of engineering drawing to construct Engineering curves
- **CO2:** Construct projections of points and lines.
- **CO3:** Demonstrate visualization skills of projections of planes.
- **CO4:** Demonstrate visualization skills of projections of solids and development of surfaces
- **CO5:** Construct isometric and orthographic views of simple solids.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	1	-	2	-	-	1	1	-	-
CO2	3	2	1	-	2	-	-	1	1	-	-
CO3	3	2	1	-	2	-	-	1	1	-	-
CO4	3	2	1	-	2	-	-	1	1	-	-
CO5	3	2	1	-	2	-	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

Practice:

1. **Introduction to Engineering Graphics**
   Introduction to AutoCAD, Dimensioning, elements of dimensioning, system of dimensioning, and Conventions in Drawing.

2. **Construction of Cycloids and Involutes**
   a) Construction of Cycloid, Epicycloid and Hypocycloid
   b) Involute of a pentagon and circle

3. **Introduction to Orthographic Projection**
   a) Principles of Projection
   b) Orthographic Projection – Four Quadrants.
   c) First angle & Third angle Projection with examples, reference plane, importance of reference lines or Plane.
   d) Projections of a point situated in any one of the four quadrants.

4. **Projection of straight lines-I:**
    a) Projections of straight lines parallel to both reference planes.
    b) Projections of straight lines perpendicular to one reference plane and parallel to other reference plane
    c) Projections of straight line parallel to one plane & inclined to another plane

5. **Projection of straight lines-II:**
    a) Projections of straight line inclined to both reference planes

6. **Projection of planes:**
    a) Regular planes perpendicular to both reference planes, Parallel to one reference plane and inclined to the other reference plane

    Ex: Rectangle, Pentagon, Hexagon and Rhombus

7. **Projection of planes**
    a) Projections of Planes inclined to both reference planes Ex: Rectangle, Pentagon, Hexagon and Rhombus.

8. **Projection of solids**
    a) Axis Perpendicular to H.P and Axis Perpendicular to V.P

    Ex: Pentagonal and Hexagonal Prisms, Pyramids, Cylinder and Cone
    b) Axis Parallel to H.P and V.P

    Pentagonal and Hexagonal Prisms, Pyramids, Cylinder and Cone

9. **Projection of solids**
    a) Projection of Solids with axis inclined to one reference plane and parallel to another plane

    Ex: Pentagonal and Hexagonal Prisms, Pyramids, Cylinder and Cone

10. **Development of Surfaces**
    a) Development of Prisms and Cylinder simple cases

11. **Development of Surfaces**
    a) Development of Pyramids and Cone simple cases

12. **Conversion of Isometric views to Orthographic views**
    a) Practice figure - 1
    b) Practice figure - 2

Additional Practice:

1. **Conversion of Isometric views to Orthographic views**
    a) Practice figure - 3
    b) Practice figure - 4
2. **Conversion of Orthographic views to Isometric views**
    a) Practice figure - 1
    b) Practice figure - 2

Text Books:

1. Engineering Drawing, N. D. Bhatt, Charotar Publishing House, 54th edition, 2024, ISBN : 9789385039706.
2. Engineering Drawing and Graphics , Venugopal, New Age Publications, 2nd edition, 2019, ISBN: 9788122415452.

Reference Books:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2021, ISBN: 978-9385983177.
2. Computer Aided Engineering Graphics, T. Jeyapoovan,Vikas Publishing house, New Delhi, 1stEdition, 2023, ISBN : 9789356743199.

Web Links:

1. https://nptel.ac.in/courses/112103019/
2. https://academy.autodesk.com/authenticated-home-user
3. https://www.sciencedirect.com/book/9780080108391/engineering-drawing-from-thebeginning

Engineering Workshop

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501ME03

L	T	P	C
0	0	1	1

Course Outcomes:
At the end of the course, student will be able to:

CO1: Prepare various wooden joints.
CO2: Demonstrate various sheet metal models.
CO3: Develop the basic knowledge of house wiring.
CO4: Develop the basic knowledge of plumbing.
CO5: Practice various welded joints.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	1	1	-	-	-	1	1	2	1	-	1
CO2	1	1	-	-	-	1	1	2	1	-	1
CO3	2	2	-	-	-	1	1	2	1	-	1
CO4	1	2	-	-	-	1	1	2	1	-	1
CO5	2	2	-	-	-	1	1	2	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	1	-
CO4	2	-
CO5	2	-

Practice:

1. To make a T-Lap joint from the given wooden workpieces.
2. To make a dovetail lap joint from the given wooden workpieces.
3. To make a taper tray using the given sheet metal.
4. To make a funnel using the given sheet metal.
5. To make a square tin using the given sheet metal.
6. To connect three bulbs by using series and parallel connections.
7. To give connection to a bulb by using staircase wiring.
8. To prepare wiring for a tube light with switch control.
9. To prepare a PVC pipe joint by using the given circuit1.
10. To prepare a PVC pipe joint by using the given circuit2.
11. To make a butt joint using the given M.S pieces by arc welding.
12. To make a lap joint using given M.S pieces by arc welding

Additional Practice:

1. To make a cross-lap joint from the given wooden workpieces.
2. To make an open scoop using the given sheet metal.
3. To make a T-joint using given M.S pieces by arc welding.

Text Books:

1. Work shop Manual, P.Kannaiah & K.L.Narayana/ SciTech Publishers, 2nd edition, ISBN: 978-8183711302.
2. Elements of Workshop Technology,Vol I by S.K. Hajra Choudhury, S.K. Hajra Choudhury & Nirjhar Roy, Media Promoters and Publishers Pvt.Limited, 14th edition. ISBN: 8185099146.

Reference Books:

1. Workshop Technology, Part 1, W.A.J. Chapman, 5th edition, ISBN 9780415503020.
2. Engineering Practices Lab Manual, T. Jeyapoovan & M. Saravanapandian, Vikas Publishing House Pvt. Limited, 4th edition, ISBN: 8125929037.
3. Engineering Practices Laboratory Manual, Ramesh Babu.V., VRB Publishers Private Limited, Chennai, Revised edition, 2019-20, ISBN: 978-81-935993-8.

Web Links:

1. https://bharatskills.gov.in
2. https://www.gopracticals.com/basic-engineering/workshop/

Drilling Engineering

	L	T	P	C
Course Code: 2501PT01	**2**	**0**	**2**	**4**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Apply basic Concepts of well design
CO2: Apply basic Concepts of drilling technology
CO3: Evaluate drill mud for pressure control
CO4: Evaluate the equipments and their purpose
CO5: Apply the testing tools and analysis of well problems

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	1
CO3	3	2	-	-	-	-	-	-	-	-	1
CO4	3	2	-	-	-	-	-	-	-	-	1
CO5	3	2	-	-	-	-	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	3
CO2	-	3
CO3	-	3
CO4	-	3
CO5	-	3

UNIT – I
Well Planning and Well Design:
Drilling programme preparation, Type of well, Prospect, GTO, Introduction to wellbore pressures

UNIT – II
Introduction to drilling Technology:
Rotary / top drive drilling, Types of onshore/offshore rigs, Introduction to hardware system (Land Rig), power generation system, Hoisting, Rotary and Drilling Fluid circulation system, mud pumps, Rig selection criteria. Horsepower calculations for draw-works and rotary. Advantages and disadvantages of top drive system.

UNIT – III
Introduction, functions, types, compositions, properties of mud, Field test, Rheology, Additives and contamination, Selection of drilling fluids and mud, Conditioning equipment, Mud

calculations, Hydrostatic pressure,Volume, Weight related calculations during drilling and tripping

UNIT – IV

Well tubular: Casing String and casing seat selection, Drill String

Drill Bits: Classification and design criteria of drag, rotary, roller, diamond and PDC bits.

Bit Selection: Conventional and Log-based. Introduction to tri-axial loading, Well Head Equipment.

Cement Selection: Functions, classification of cement, Cement additives, Methods of cementation, Equipment and accessories, Field problems pertaining to cementation job, Cement slurry calculations

UNIT – V

Well Problems and Solutions: Fatigue failure, Pipe sticking, Lost-circulation, Sloughing shale, Swabbing, surge, gas cap drilling.

Oil Well Fishing: Fish classification, tools and techniques

Integrated Lab With 2 Credits

Practices:

1. Measurement of drilling fluid Equipment: The Baroid mud balance
2. Measurement of mud viscosity. Equipment: Marsh funnel
3. Measurement of pH of mud. Equipment: pH meter and hydrino pH dispenser
4. Determination of mud rheology (Viscosity, Gel strength, and Yield point). Equipment: The Baroid rheometer
5. Determination of the loss of liquid from a mud. Equipment: Standard API filter press
6. Measurement of a drilling mud cake and evaluate resistivity. Equipment: Baroid digital resistivity meter
7. Measurement of the effect of adding bentonite on mud properties.
8. Drilling fluid contamination test (Salt, Gypsum & Cement contamination) and their effect on the drilling fluid properties.
9. Measurement of solid and liquid content and emulsification characteristics of drilling fluid. Equipment: Sand content set, fann emulsion and electrical stability testers
10. Determination the amount of Calcium Carbonate ($CaCO_3$) and Magnesium Carbonate (Dolomite) in a sample of alkaline earth carbonates such as oil well cores or drilledcuttings. Equipment: Calcimeter and Procedure is as per ASTM D 4373-84
11. Measurement of Oil, water, solid and clay content. Equipment: Oil/ water retort kit

Additional Practices:

1. Measurement of water ratios for Portland cement slurry.(Effect of water ratio on free water separation normal and minimum water content and thickening time)
   Equipment: The atmospheric consistometer
2. Measurement of compressive strength of cement test moulds and effect of temperature and pressure on setting of the slurry.
   Equipment: Compressive strength testing machine
3. Measurement of compressive strength of cement test moulds and effect of chemicals on flash setting and retardation
   Equipment: Compressive strength testing machine

Textbooks:

1. Petroleum Engineering: Drilling and Well Completions c.gatlin eISBN: 978-0136621553
2. Applied Drilling Engineering A. T. Bourgoyne eISBN: 9781555630010

Reference Books:

1. Hussain Rabia, Oil Well Drilling Engineering, Principles & Practice, Graham & Trotman, eISBN: 9780860106616
2. Well Control Problems Solutions : Neal A J.dams eISBN: 9780878141241

Web Links:

1. https://www.sciencedirect.com/science/article/pii/B9780123838469000047
2. https://petroleumpdf.com/drilling-and-well-completions-by-carl-gatlin-pdf-free-download/
3. https://www.scribd.com/doc/232062873/Carl-Gatlin-Drilling-Well-Completion-pdf
4. https://www.scribd.com/document/306762429/Bit-selection-guidelines-pdf
5. https://petrowiki.spe.org/PEH:Drilling_Problems_and_Solutions

Fluid Mechanics For Petroleum Engineers

	L	T	P	C
Course Code: 2501PT04	**1**	**1**	**2**	**4**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Explain the basic fluid properties and types of fluids.
CO2: Derive the equations related to fluid statics
CO3: Classify the kinematics and dynamics of fluid flow and derive its equations
CO4: Demonstrate the concept of flow measurement and dimensional analysis
CO5: Classify the pumps and compressors and solve the energy calculations

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	3	-	2	-	-	-	-	-	-	-
CO2	2	3	-	2	-	-	-	-	-	-	-
CO3	2	3	-	2	-	-	-	-	-	-	-
CO4	2	3	-	2	-	-	-	-	-	-	-
CO5	2	3	-	2	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	1
CO2	-	3
CO3	-	1
CO4	-	1
CO5	-	2

UNIT – I
Fluid properties
Definition of fluid; Properties of fluids: Viscosity, compressibility and bulk modulus; Shear stress in a moving fluid; Difference between liquids and gases, compressible and incompressible fluids; Newtonian and non- Newtonian fluids.

UNIT – II
Fluid statics
Continuum concept of a fluid: Statics of fluid systems, pressure and the variation of pressure due to gravity in a static fluid; Manometers: U-tube, differential and inclined manometers.

UNIT – III
Kinematics and dynamics of fluid flow
Fluid kinematics: Classification and types of flow; Velocity field and acceleration; Continuity equation and its applications;

Fluid dynamics: Reynolds experiment, laminar and turbulent flows, nature of turbulence and bound- ary layer; Euler's equation of motion; Bernoulli's theorem; Momentum equations and energy losses in fluid flow.

UNIT – IV

Dimensional analysis and flow measurement

Dimensional analysis: Dimensions of physical quantities, dimensional homogeneity, Buckingham pi theorem, important dimensionless numbers.

Flow measurement: Application of Bernoulli's equation in pitot tube, venturi meter, orifice meter, rota meter, triangular and rectangular notch, mass flow meters, etc.

UNIT – V

Pumps and compressors

Classification of pumps: Characteristic curves, selection criteria; Types of compressors: COP and selec- tion criteria; Compressible fluid flow; Ideal gas relations and energy calculations.

Integrated Lab With 2 Credits

Practice:

1. Identify laminar and turbulent flows
2. Measure the point velocities
3. Verify Bernoulli's equation
4. Calibrate Rotameter
5. Study the Variation of Orifice coefficient with Reynolds Number
6. Determine Venturi coefficient
7. Study Friction losses in Fluid flow in pipes
8. Study the coefficient of Discharge in a V-Notch
9. Study the coefficient of contraction for a given open orifice
10. Study the Characteristics of Centrifugal Pump

Additional Practice:

1. Study Pressure drop and void fraction in a fluidized bed
2. Study Pressure drop and void fraction in a packed bed
3. Study the Characteristics of reciprocating Pump

Textbooks:

1 Unit Operations of Chemical Engineering of, McCabe,W.L., J.C.Smith& Peter eISBN: 9780072848236

2 Transport Processes and Unit Operations,Christie J. Geankoplis, P eISBN: 9780205059393

Reference Books:

1 Introduction to Fluid Mechanics, Fox, R.W. and A.T.Mc.Donald, 5th Edition, John eISBN: 9781119721024

2 Chemical Engineering, Vol-1: Fluid flow, Heat Transfer and Mass Transfer, J.M. Coulson and J.F.Richardson, Pergamon Press, 4th Edition.eISBN: 9780750644440

3 Fluid Mechanics for Chemical Engineers, Noel De Nevers, Tata McGraw-Hill. eISBN: 9780071238243

Web Links:

1. www.mhhe.com/engcs/chemical/mccabe/graphics/toc.pdf
2. www.unimasr.net/ums/.../UniMasr.com_919e27ecea47b46d74dd7e268097b653.pdf
3. home.zcu.cz/~kovarikp/MT/freestudy/FLUID.../FLUID_MECHANICS_D203.pdf
4. https://www.coursehero.com
5. www.qzu.zj.cn/hgx/jpkc/hgyl/kj/huagongyuanli/syjx/801.html

Petroleum Formation Evaluation

	L	T	P	C
Course Code: 2501PT09	**1**	**1**	**0**	**2**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Apply the methods for core analysis and interpretation
CO2: Make use of subsurface properties of reservoir.
CO3: Interpret the different log data using different open hole interpretation techniques.
CO4: Explain the basics of casedhole logging in evaluate formation.
CO5: Apply principles of production logging techniques in production control.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	-	-	-	-	-	-	-	-	3	-
CO2	3	-	-	-	-	-	-	-	-	3	-
CO3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	-	-	-	-	-	-	-	-	3	-
CO5	3	-	-	-	-	-	-	-	-	3	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I
Formation Evaluation Overview:
Direct and Indirect Methods, classification and logging tools. Mud Logging and cutting analysis log, Coring and Core analysis.
Petrophysical Measurements: Rock-fluid interaction, Bore hole environment and basic concepts of well log analysis and application

UNIT – II
Introduction to properties measurements:
Rock-forming minerals, types of rocks, reservoirs, source rocks, migration Archie's formulation, Capillary pressure and Leverett J-function, elastic rock properties, fluid measurements, effect of clay minerals on physical properties measurements.

UNIT – III

Openhole Well Logging: Principle, Logging tools, application & Limitations Spontaneous Potential Log, Gamma Ray Log.
Resistivity Measurement: Electrical, induction logging and micro-resistivity log
Porosity Logs: Density & Litho-density log, neutron log, sonic (acoustic) log, Electromagnetic Propagation tools. Nuclear Magnetic Resonance log

UNIT – IV

Cased Hole Logging: introduction, objectives and methods
Well Integrity evaluation: CBL and VDL logs, Ultrasonic Imaging tools
Casing inspection tools: Electromagnetic and acoustic CIT
Log Reservoir fluid Saturation Determination: tool principle and application

UNIT – V

Production Logging: Introduction, type of tools, principles, limitations and applications
Log Interpretation and Analysis Techniques: Standard log interpretation methods.
Quick-Look Interpretation: Crossplots, and Overlays Lithology/ Minerology Identification
Porosity Determination Water saturation and Resistivity Determination Clean sand & Shaly sand interpretation.

Textbooks:

1. Log Interpretation Principles/Applications, Schlumberger
2. Well Logging and Formation Evaluation, Toby Darling, Elsevier, New York. eISBN: 9780080457956

Reference Books:

1. Well Logging & Reservoir Evaluation, Oberto Serra, Editions Technip. eISBN: 9782710808817
2. Formation Evaluation, Edward J. Lynch, Harper & Row.

Web Links:

1. Sample Examination Manual, R.G.Swanson, Shell Oil Company, Published by AAPG
2. https://link.springer.com/chapter/10.1007%2F978-3-319-29710-1_3
3. petrowiki.org/Types of logs
4. www.pe.tamu.edu/blasingame/data/z_zCourse_Archive/P663.../GR%20Log.PDF
5. https://www.sciencedirect.com/science/article/pii/S0376736108705788

Instrumentation & Process Control

Course Code: 2501PT08	L	T	P	C
	2	0	2	4

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Choose the instrument based on static and dynamic characteristics.
CO2: Categorize the various types of thermometers & pressure gauges
CO3: Explain the processes with appropriate instrumentation diagrams
CO4: Interpret the responses of first&second order systems with examples
CO5: Explain tuning a control loop and characteristics of control valves

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	-	3	-	-	-	-	-	-	3	-	-
CO2	-	3	-	-	-	-	-	-	3	-	-
CO3	-	3	-	-	-	-	-	-	3	-	-
CO4	-	3	-	-	-	-	-	-	3	-	-
CO5	-	3	-	-	-	-	-	-	3	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I

Fundamentals: Elements of instruments, Functions of instruments and Characteristics of an instruments.

Industrial Thermometers: Expansion thermometers and its types, Static accuracy and response of thermometry. Thermoelectricity-Industrial Thermocouples-Thermocouple wires- Thermocouple wells and response of thermocouples; Thermal coefficient of resistance- Industrial resistance-thermometer bulbs and circuits. Radiation receiving elements-Radiation pyrometers-photoelectric and optical pyrometers.

UNIT – II

Pressure and vacuum: Liquid column manometers-Measuring elements for gauge pressure and vacuum indicating elements for pressure gauges-Static accuracy and response of pressure gauges.

Composition analysis: Spectroscopic analysis by absorption, emission and mass, Gas analysis by thermal conductivity, analysis of moisture.

UNIT – III

Flow Meters: Head flow meters-Area flow meters-Viscosity measurements.
Process Instrumentation: Controls Center-Instrumentation Diagram-Process analysis-Digital instrumentation and SCADA systems

UNIT – IV

Introduction to process dynamics and control: Response of first order systems – Physical examples of first order systems. Response of first order systems in series, higher order systems: Second order and transportation lag.

UNIT – V

Control systems, controllers and final control elements, Block diagram of a Petrochemical rector control system. Closed loop transfer functions, Transient response of simple control systems.
Stability Criterion, Routh Test, Frequency control model, Controller tuning and process identification, Control valves.

Integrated Lab With 2 Credits

Practices:

1. Experiments with single capacity system.
2. Experiments with two capacity systems with interaction
3. Experiments with two capacity systems without interaction
4. Control valve characteristics
5. Calibration and determination of time lag of various first order instruments
6. Calibration and determination of time lag of various second order instruments
7. Experiments on multi process trainer set up with computer
8. Experiments on I/P and P/I converters set up
9. Level control trainer
10. Temperature control trainer

Additional Practices:

1. Experiments on proportional, reset, rate mode of controllers
2. Estimation of damping coefficient for U-tube manometer
3. Calibration of various temperature instruments like Thermocouple, RTD and Thermistor

Textbooks:

1 Process Systems Analysis and Control, Donald Coughanowr, 3rd Ed. McGraw-Hill. eISBN: 9780071121866
2 Chemical Process Control: An Introduction to Theory and Practice, George Stephanopoulos, Pearson Education India, 1st Ed. eISBN: 9780131286290

Reference Books:

1. Process Control and Instrumentation Technology, Curtis D. Johnson, 8th Edition, Pearson publisher. eISBN: 9788120330290
2. Petrochemical Instrumentation, Dr. N. Stalin, Dr. Anil Kumar Thandlam, Ch. Venkatrao, Dr. J. Samson Isaac, 1st Edition, Scientific International Publishing House, ISBN: 9789356254695

Web Links:

1. https://www.globalspec.com/learnmore/sensors_transducers_detectors/temperature_sensing/industrial_thermometers
2. https://engineerexcel.com/vacuum-pressure/
3. http://radix.co.in/families/temperature-sensors-rtd
4. http://nptel.ac.in/courses/103103037/
5. http://www.bgu.ac.il/chem_eng/pages/Courses/oren%20courses/Chapter_10

Fundamentals of Liquefied Natural Gas

Course Code: 2501PT05	L	T	P	C
	3	0	0	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Explain the LNG value chain
CO2: Classify the different liquefaction technologies of LNG
CO3: Explain the components of LNG receiving terminals
CO4: Summarize LNG storage and transportation facilities
CO5: Identify major equipment and safety aspects of LNG industry

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	2	-
CO3	3	2	-	-	-	-	-	-	-	2	-
CO4	3	2	-	-	-	-	-	-	-	2	-
CO5	3	2	-	-	-	-	-	-	-	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I
Introduction: Overview of LNG industry -History of LNG industry – Base load LNG – Development of an LNG Project – World and Indian Scenario– Properties of LNG.

UNIT – II
Propane precooled mixed refrigerant process – Description of Air products C3MR LNG process–. Description of Conoco Phillips optimized cascade (COPOC) process – Liquefaction– LNG flash and storage.
Other Liquefaction Processes: Description of Linde MFC LNG process- Precooling and Liquefied Petroleum Gas (LPG) recovery – Liquefaction and sub cooling- Trends in LNG train capacity –strategy for grassroots plant- offshore LNG production.

UNIT – III

Gas pre-treatment: Slug catcher– NGL stabilization column – Acid gas removal unit – Molecular sieve dehydrating unit Receiving terminals in India – Main components and description of marine facilities – LNG tanks– Process descriptions. –Mercury and sulphur removal unit–NGL recovery–Nitrogen rejection–Helium recovery.

UNIT – IV

LNG Shipping Industry: LNG fleet – Types of LNG ships – Moss – Membrane – prismatic; Cargo measurement and calculations,

Cryogenic heat exchangers: Spiral– Wound heat exchangers – Plate & fin heat exchangers – Cold boxes.

Centrifugal compressors –Axial compressors – Reciprocating compressors;

LNG pumps and liquid expanders –Loading Arms and gas turbines, Description of Regasification.

UNIT – V

Submerged combustion vaporizers- Open rack vaporizers–Shell and tube vaporizers: direct heating with seawater, and indirect heating with seawater.

Safety design of LNG facilities – Security issues for the LNG industry – Environmental issues– Risk-based analysis of an LNG plant.

Ambient air vaporizers: Direct heating with ambient air – Indirect heating with ambient air.

Textbooks:

1. LNG: Basics of Liquefied Natural Gas, Stanley Huang, Hwa Chiu and Doug Elliot, Ist Edition, PETEX. eISBN: 978-0886982171
2. Marine Transportation of LNG (Liquefied) and related products, Richard G. Wooler, Gornell Marine Press. eISBN: 9780608024646

Reference Books:

1. Natural Gas by Sea: The Development of a new technology, Roger Rooks, Wither by Publishers eISBN: 9780856140549
2. Marine Transportation of Liquefied Natural Gas, Robert P Curt, Timothy D. Delaney, National Maritime Research Centre.

Web Links:

1. http://folk.ntnu.no/skoge/prost/proceedings/aiche2008/data/papers/P139095.pdf
2. https://ceonline.austin.utexas.edu/petexonline/file.php/1/ebook_demos/lng/html/index.Htm
3. http://petrowiki.org/Liquified_natural_gas_(LNG
4. http://www.chebeague.org/fairwinds/risks.htm
5. http://www.beg.utexas.edu/energyecon/LNG_Safety_and_Security_Update_2012.pdf

Elements of Reservoir Engineering

Course Code: 2501PT02

L	T	P	C
2	0	2	4

Course Outcomes:
At the end of the Course, Student will be able to:

- **CO1:** Apply basic Concepts of Reservoir Engineering
- **CO2:** Evaluate the porosity and Permeability from reservoir
- **CO3:** Estimate the oil and gas properties of reservoir
- **CO4:** Apply Basic radial Flow differential equation and stabilized well inflow Estimation for Different system of equations, immiscible fluid displacement and water influx models
- **CO5:** Estimate the reserves by curve analysis.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	3	-	-	-	-	-	-	-	2	-
CO2	2	3	-	-	-	-	-	-	-		-
CO3	2	3	-	-	-	-	-	-	-	2	-
CO4	2	3	-	-	-	-	-	-	-	2	-
CO5	2	3	-	-	-	-	-	-	-	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I
Reservoir rocks and structures, Classification of sedimentary oil reservoirs
Fundamental concepts: Introduction to Hydrocarbon Reservoir, Pressure-Temperature diagram, Fluid pressure regimes.

UNIT – II
Rock properties: Porosity & Permeability, Types & Determination, Permeability in Series & parallel combination of beds Fluid saturation, Wettability, surface and interfacial tension, Capillary Pressure, Permeability- Klinkenburg effect, averaging absolute permeabilities, Rock compressibility, net pay thickness, reservoir heterogeneity.

UNIT – III
Crude oil properties: Density, gravity, viscosity, gas solubility, bubble point pressure, oil formation volume factor
Natural gas properties: Compressibility, gas formation volume factor, viscosity

UNIT – IV

Flow of Fluids through Porous Media : Fluid types, flow regimes, Darcy's law, single and multiphase flow, linear, radial & spherical flow, steady state, unsteady state and pseudosteady state flow, GOR, WOR equation

UNIT – V

Reserve Estimation: Reservoir drives, resource & reserve concept, Different reserve Estimation Techniques: Volumetric, MBE, decline curve analysis;, latest SPE/ WPC/ IS classification

Integrated Lab With 2 Credits

Practices:

1. Determination of effective porosity by gas expansion method.
2. Determination of porosity and pore size distribution by mercury injection.
3. Measurement of surface tension with the ring Tensiometer.
4. Determination of fluid density using Pycnometer and hydrometer methods.
5. Liquid viscosity measurement using capillary tube viscometer (Ostwald type).
6. Determination of capillary pressure of reservoir rock (core) using porous plate method.
7. Measurement of contact angle (between oil, water and solid surface) using imaging method.
8. Measurement of air permeability.
9. Absolute permeability measurement of water.
10. Determination of relative permeability of oil-water using unsteady state method.
11. Determination of relative permeability of gas-oil using unsteady state method.

Additional Practices:

1. Determination of water content in a given sample.
2. Measurement of interfacial tension with the ring Tensiometer.

Textbooks:

1 Fundamentals of Reservoir Engineering, L.P.Dake, Elsevier science eISBN: 9780080568980

2 Applied Petroleum Reservoir Engineering, Third Edition, B.C Craft and M.Hawkins, Revised By Ronald E.Terry & J.Brandon Rorgers, Prentice Hall, New York. eISBN: 9780133155617

Reference Books:

1 Reservoir Engineering Handbook, Tarek Ahmed, 4th Edition, Gulf Professional Publishing. eISBN: 9781856178037

2 Basic Reservoir Engineering, Rene Cosse, Editions, Technip eISBN: 9782710806301

Weblinks:

1 https://author.energy-community.org/enc-author-prd/dam/jcr:4c5bb3db-e989-4b7d-a33e244f4a51164a/1_PetroleumResEng_Basics.pdf

2 https://petrowiki.org/Fluid_sampling

3 https://petrowiki.org/Material_balance_in_oil_reservoirs

4 https://en.wikipedia.org/wiki/Darcy%27s_law

5 https://www.researchgate.net/publication/250088881_Reserves_Estimation_The_Challenge_for_the_Industry

Petroleum Production Engineering

	L	T	P	C
Course Code: 2501PT11	**1**	**1**	**0**	**2**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Expalin the production engineers role and activities involved in the field.
CO2: Derive the equations related to well performance and optimization
CO3: Demonstrate the various types of artificial lift methods in production
CO4: Explain the different types perforation methods used in production
CO5: Outline the various types of well stimulation techniques.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	3	-	-	-	-	-	-	2	-	-
CO2	2	3	-	-	-	-	-	-	2	-	-
CO3	2	3	-	-	-	-	-	-	2	-	-
CO4	2	3	-	-	-	-	-	-	2	-	-
CO5	2	3	-	-	-	-	-	-	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I
Petroleum Production System (Surface & Subsurface Equipment)
Role of Production Engineer/activities performed at various levels of field development and its exploitation. Petroleum Production System-Well Head Equipment, Charismas tree, valves, hangers, flow control devices, packers, tubular and flow lines

UNIT – II
Well Performance analysis and Optimization
Reservoir considerations, Introduction to inflow performance, Productivity index. Formation damage diagnosis, Skin effect, IPR in case of different drive mechanism. Vogel IPR equation. Pressure loss in tubing, multiphase flow regimes. Choke performance, types of chokes. Overall production system pressure losses, Nodal system Analysis.

UNIT – III

Artificial Lift Technology

Basic principles and descriptions of Artificial Lift Methods, Continuous and Intermittent Flow Gas Lift, Design of Gas Lift System, Plunger Lift, Chamber Lift, Sucker Rod Pumping (SRP), Electrical Submersible Pumping (ESP), Hydraulic Pumping (HP).

UNIT – IV

Well Perforation

Introduction, Well Perforating Methods, Perforating Gun Types, Shaped Charge, Type, Size, Depth and Orientation of perforation holes, Shot Density, Standoff, Explosives in perforation, Explosive Train.

UNIT – V

Well Stimulation Techniques

Importance of Well Stimulation, Acid Solutions for Acidizing, Acid Additives, Matrix Acidizing, Fracture Acidizing, Hydraulic Fracturing, Wave Technology, Microbial Stimulation.

Text Books:

1. Petroleum Production Engineering: A Computer Assisted Approach, Boyun Guo, William C. Lyons, Ali Ghalambor, Elesevier Science & Technology Books, 2019 eISBN: 9780750682701
2. Petroleum Production Systems, M.J. Economides, A.Daniel Hill &C.E.Economides, Prentice Hall. eISBN: 9780137031580

Reference Books:

1. Production Technology I-II, Institute of Petroleum Engineering, Herriot Watt University.
2. The Technology of Artificial Lift Method, Vol. 1, Brown E., Pennwell Books. eISBN: 9780878140312

Web Links:

1. https://petrowiki.org/Production_system
2. https://www.globalspec.com/reference/33548/203279/chapter-3-reservoir-deliverability
3. https://www.slb.com/resource-library/oilfield-review/defining-series/defining-artificial-lift
4. https://www.drillingmanual.com/well-perforation-methods-techniques-in-oil-gas-completion/
5. https://www.petrosync.com/blog/what-is-well stimulation/

Petroleum Refinery Engineering

Course Code: 2501PT12	L	T	P	C
	3	0	0	3

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Identify the types of petroleum feed stocks and products by their properties
CO2: Make use of process knowledge to solve operational problems and increase the efficiency
CO3: Apply the knowledge of crucial processes to meet the end product demands
CO4: Prioritize the demand of various petrochemicals to optimize the processes
CO5: Classify various petrochemical products and their uses

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I
Basic of Petroleum:
Role of Crude oil in global economy, Present Scenario of Crude Oil Refinery, Importance, Occurrence, Origin(formation), Exploration, Composition, Classification and Evaluation of Crude oil, Crude Assay Analysis, Distillation Characteristics such as True Boiling (TBP), American Society for Testing Materials (ASTM).

UNIT – II
Properties of Crude and Petroleum Products:
Various types of Average Boiling Points of Crude Oil & Petroleum Fractions.
Types of Gases & their Composition, Types of Gasoline & it's Important Properties and tests such as ASTM Distillation, RVP, Octane Number, Oxidation Stability, Sulphur Content etc,
Various Types of Naphtha and their Important Properties & Applications.
Important Tests & Properties of Kerosene such as Flash& Fire Point, Smoke Point, Aniline Point etc.,

Types of Diesel & its Important Properties & Tests such as Pour Point, Diesel Index, Cetane Number etc.
Heavy Fractions like Lube Oil, Bitumen, Asphalt etc & their Important Properties such as Viscosity Index, Carbon Residue, Penetration Index, Softening Point etc.

UNIT – III
Processing of Petroleum:
Pretreatment of Crude (Dehydration & Desalting), Pumping of Waxy Crude, Heating of Crude, Distillation of Petroleum & Types of Reflux, ADU & VDU.

UNIT – IV
Thermal & Catalytic Cracking:
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 – V
Treatment Techniques:
Physical Impurities found in Crude& their Removal, Sweetening Techniques, Production and Treatment of LPG & their Methods, Dehydration and Sweetening of Gases, Gasoline Treatment such as Lead Doctoring, Merox Sweetening, Catalytic Desulphurization etc. Treatment of kerosene.
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Textbooks:

1 PetroleumRefining:Technology and Economics ,J.H.Gary and G.E.Handwerk, 5th Edition, Marcel Dekkar, Inc. eISBN: 9780203907924
2 Elements of Petroleum Processing, D S Jones, Wiley–Blackwell. eISBN: 9780471964896

Reference Books:

1 Petroleum Refining Engineering, WL Nelson, 4th Edition, McGraw Hill Company eISBN: 9780070462687
2 Fundamentals of Petroleum Chemical Technology, P Belov, Mir Publishers eISBN: 9780846404385
3 Petrochemical Processes, A. Chauvel and G.Lefebvre, Volume 1 & 2, Gulf Publishing Company eISBN: 9782710810650

Web Links:
1 https://www.scribd.com/doc/.../Surface-Production-Operations-Volume-1-Oil-System
2 www.academia.edu/.../Ken_Arnold-Surface_Production_Operations_Volume_1_3rdE
3 https://byjus.com/chemistry/petroleum/
4 https://www.slideshare.net/.../surface-production-operations-volume-iv-pumps-compr...
5 https://www.researchgate.net/publication/359449933_Petroleum_sludge_treatment_and_disposal_techniques_a_review

Heat Transfer in Petroleum Operations

	L	T	P	C
Course Code: 2501PT07	**1**	**1**	**2**	**4**

Course Outcomes:
At the end of the Course, Student will be able to:

- **CO1:** Explain the various modes of heat transfer and derive the eqautions for conduction heat transfer
- **CO2:** Classify the relation between boundary layers and estimate the convection coefficients
- **CO3:** Explain the concepts of heat transfer with phase change
- **CO4:** Demonstrate the concept of radiation heat transfer
- **CO5:** Identify the types of heat exchangers and design the double pipe heat exchanger.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	-	-	-	-	2	-	-
CO4	1	2	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	-	-	-	-	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I
Heat transfer by conduction
Importance of heat transfer in petrochemical engineering operations; Modes of heat transfer; One dimensional steady state heat conduction through plane and composite walls, hollow cylinder and spheres; Thermal conductivity measurement; Effect of temperature on thermal conductivity.

UNIT – II
Heat transfer by convection
Mechanism, thermal and velocity boundary layers, boundary layer thickness, relationship between hydrodynamic and thermal boundary layer thickness for flow over flat plates; Estimation of convection and its heat transfer coefficient; Correlation for heat transfer in laminar and turbulent flow; Natural convection under different conditions; Physical significance of Grashoff's and Rayleigh's numbers.

UNIT – III

Phase change Heat transfer

Pool boiling: Boiling curve, hysteresis in the boiling curve, nucleate boiling; Condensation: Physical mechanisms, types of condensation, factors affecting condensation.

UNIT – IV

Heat transfer by radiation

Introduction, theories of radiation, electromagnetic spectrum, emissivity; Radiative properties, absorptivity, reflec- tivity and transmissivity; Concept of black and grey body, radiation intensity, laws of black body radi- ation, non-black surfaces, radiation between black and grey surfaces.

UNIT – V

Heat exchangers

Classification of heat exchangers: Classification according to transfer processes, number of passes, surface compactness, construction features, flow arrangements, heat transfer mechanisms; Shell and tube heat exchanger, fouling, LMTD and its correction factor; Concept of effectiveness: NTU method, definition of effectiveness, effectiveness NTU relations in counter-flow and parallel flow configura- tions. Double pipe heat exchangers: Construction, various steps for the design.

Integrated Lab With 2 Credits

Practices:

1. Determine overall heat transfer coefficient of composite wall
2. Determine thermal conductivity of a metal rod
3. Determine natural convective heat transfer coefficient for a vertical tube
4. Determine forced convective heat transfer coefficient for air flowing through a pipe
5. Determine overall heat transfer coefficient in double pipe heat exchanger
6. Determine Stefan – Boltzmann constant
7. Determine emissivity of a given plate at various temperatures
8. Determine the radial distribution of heat in composite cylinder
9. Determine thermal conductivity of pipe insulation
10. Determine the thermal conductivity of insulating powder at various heat inputs
11. Determine critical heat flux point for pool boiling of water.

Additional Practices:

1. Determine the performance analysis of Shell and Tube Exchanger
2. Estimate un-steady state film heat transfer coefficient between the medium in which the body is cooled
3. Study the temperature distribution along the length of a pin-fin under natural.

Textbooks:

1 Unit Operations of Chemical Engineering, McCabe, W.L., J.C Smith and Peter Harriott, 7th Edition, McGraw-Hill. eISBN: 9780072848236

2 Heat Transfer, Holman, J.P., 9th Edition, Tata McGraw-Hill. eISBN: 9780071122306

Reference Books:

1. Heat Transfer, Y.V.C. Rao, Universities Press (India) Pvt. Ltd. eISBN: 9788173713842
2. A Text Book on Heat Transfer, Sukhatme, P., 5th Edition, Universities Press (India) Pvt. Ltd. eISBN: 9788173715440
3. Chemical Engineering: Fluid Flow, Heat Transfer and Mass Transfer,Coulson, J.M.; Richardson, J.F.; Backhurst, J.R.; Harker, J.H., Vol.1, 6th Edition, Reed Elsevier India eISBN: 9780750644440

Web Links:

1. http://nptel.ac.in/courses/103103032/9
2. http://www.srmuniv.ac.in/sites/default/files/downloads/unit_II_convective_heat_transfer.pdf
3. http://pages.mtu.edu/~fmorriso/cm310/lectures/2015heatlecture09.pdf
4. https://file.scirp.org/pdf/EPE20090200004_95602315.pdf
5. http://pages.mtu.edu/~fmorriso/cm310/lectures/2015heatlecture08.pdf

Safety & Environmental Engineering Practices In Petroleum Industry

Course Code: 2501PT14	L	T	P	C
	2	0	0	2

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Study the forms of hazards and safety Practices in petroleum industry.
CO2: Study of HSE Regulations and regulatory agencies for Oil and Gas Industry..
CO3: Explain the environmental issues in drilling and production operations.
CO4: Make use of the hazop study concepts for safe Practices in Petroleum industry.
CO5: Make use of HSE Policies. Disaster & crisis management in Petroleum Industry.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	-	-	-	-	-	-	3	-	-	-
CO2	2	-	-	-	-	-	-	3	-	-	-
CO3	2	-	-	-	-	-	-	3	-	-	-
CO4	2	-	-	-	-	-	-	3	-	-	-
CO5	2	-	-	-	-	-	-	3	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	-	2
CO3	2	-
CO4	-	-
CO5	-	-

UNIT – I
Safety in Petroleum industry; Setting & layout of petroleum plant. Forms of hazards: chemical, toxic, explosion, electrical, mechanical, radiation, noise hazards. Control and prevention of hazards.

UNIT – II
HSE: Definition and Explanations. Different HSE practises, implementation and evaluations. HSE Regulations and regulatory agencies for Oil and Gas Industry.

UNIT – III
Environmental issues, Impact during oil and gas operations and solutions.
Air Pollution in oil & gas industry: Sources, Damage and mitigation. Water Management: Pollution and pollutant, production water management.
Drilling Waste: Drilling fluid waste, Rock cutting, oily sludge, etc.
Offshore safety. Offshore oil spill and oil spill control. Safety and Environmental Management Systems, SEMS

UNIT – IV

Risk Analysis: hazard and operability (HAZOP) studies. hazard analysis (HAZAN), fault tree analysis, consequence analysis, scenario and probabilistic assessment. Onshore and Offshore Emergency Management Plans.

Safety System: Manual & automatic shutdown system, blow down systems. Gas detection system. Fire detection and suppression systems. Personal protection system & measures.

UNIT – V

HSE Policies. Disaster & crisis management in Petroleum Industry.

Environment: Environment concepts, impact on eco-system, air, water and soil. The impact of drilling & production operations on environment, Environmental transport of petroleum wastes.

Text Books:

1. Crowl, D.A., Louvar, J. F., "Chemical Process Safety – Fundamentals with Applications". Prentice-Hall, Pearson. eISBN: 9780134857848
2. Environmental Control in Petroleum Engineering: John C Reis eISBN: 9780080505756

Reference Books:

1. CCPS," Guidelines for Engineering Design for Process Safety", AIChE eISBN: 9780470938263
2. Environmental management in Petroleum Industry: S. K. Wahi eISBN: 978-8122403770
3. The prevention of Oil pollution: J. Wardley-Smith eISBN: 9789401173476

Web Links:

1. https://onlinecourses.nptel.ac.in/noc18_oe04/preview
2. https://en.wikipedia.org/wiki/Hazard_and_operability_study

Well Work Over & Stimulation

	L	T	P	C
Course Code: 2501PT17	**1**	**1**	**0**	**2**

Course Outcomes:
At the end of the Course, Student will be able to:

- **CO1:** Apply basic Concepts of effective completion types.
- **CO2:** Evaluate the reservoir problem
- **CO3:** Evaluate Operations and Tools for completions
- **CO4:** Explain about Various Completion fluids and its chemistry
- **CO5:** Apply the treatment methods for well problems

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT – I

Introduction to Completion. Well Completion design (Data gathering, well control and barriers in completion, completion types, safety and environment effect by Completion operation) Reservoir Completion (Open Hole Completion techniques, Perforating, Hydraulic Fracturing)

UNIT – II

Introduction Differentiate between reservoir problem v/s workover problem, Work-over operations, types of workover , Work over fluids. Scraping, well circulation, Shut-off, Squeeze cementing. Handling water and gas coning. Evaluation of workover jobs

UNIT – III

Specialized Components (wellheads, packers, expansion joints, safety valves, artificial lifting equipment). Completion Installation (installation types, procedures) Packers-Production packers, Packer's calculation, Well activation. Repair of wells, Paraffin and scale removal. Corrosion, Bacteria & Scale control. Sand control, Screens, Gravel packs.

UNIT – IV

Completion Fluids and Production Chemistry (types of Completion fluids, Formation compatibility, Mineral scales, Salt deposition, Waxes, Asphaltenes, Hydrates) Sand Control (rock strength and sand production prediction, mitigating sand production, formation grain size distribution, sand control methods)

UNIT – V

Well treatment; acidizing of oil & gas wells, Hydro-perforation. Hydraulic fracturing

Textbooks:

1. Well Completion Design, Jonathan Bellarby, Elsevier. eISBN: 9780080932521
2. Well Completion and Servicing, D. Perrin, Michael Caron, Georges Gaillot, Editions Technip eISBN: 9782710807650

Reference Books:

1. Production Operations: Well Completions, Workover, and Stimulation eISBN: 9780930972004
2. Well Stimulation Treatments, 2nd Ed eISBN: 9780886982096

Web Links:

1. https://www.scribd.com/document/485014588/well-completion
2. https://www.sciencedirect.com/science/article/abs/pii/S0376736108002100
3. https://www.petrosync.com/blog/well-intervention/
4. https://wiki.aapg.org/Types_of_completions
5. https://www.petrosync.com/blog/well-intervention/

Reservoir Modelling & Simulation

Course Code: 2501PT13	L	T	P	C
	1	1	2	4

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Apply basic Concepts of Reservoir modelling and simulation.
CO2: Estimate the Basic Equations for single phase flow analysis
CO3: Apply Solution techniques of single phase flow equations
CO4: Evaluate the Multiphase flow simulation
CO5: Apply Basic single and multiphase flow for History matching.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	3	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-
CO5	2	3	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I
Introduction to reservoir simulation. Concepts of modelling and simulation. Introduction to integrated reservoir modeling. Use of geophysical, geological, petro physical and engineering data with geostatistical methods to create reservoir description.

UNIT – II
Basic Equations for single phase flow. Continuity equation in various flow geometries, Derivation of Generalized flow equations, Different form of flow equations, initial and boundary conditions.
Finite Difference Approximation to linear flow equations. Method of grid constructions, Approximation of spatial and time derivatives, Implementation of initial and boundary conditions, Explicit and implicit formulations, well representation, treatment of source and sink terms; Stream tube; automatic time step control; simulation of naturally fractured reservoir.

UNIT – III

Solution techniques of single phase flow equations. Linearization techniques; incompressible, slightly compressible and compressible flow problems; Use of Balance Calculation in Reservoir Simulation.

UNIT – IV

Multiphase flow simulation. Concept of Black oil and compositional models; Conservation equations in a multiphase flow system; Flow equations; Finite difference approximation; Simultaneous Solution method, Implicit Pressure Explicit Saturation method, Sequential Solution method. Multiphase flow in two and three dimensions

UNIT – V

History matching. Inverse modeling, parameterization, objective function formation, calibration and tuning algorithm, Bayesian formulation and uncertainty quantification, optimization algorithms.

Integrated Lab With 2 Credits

Practices:

1. Reservoir simulation basics. To have basic Understanding the basic concepts of simulation and modelling.
2. Overview: Geological model and flow model and transition
3. Introduction, Historical background, application of simulator,Types of model and designing of various models depending on reservoir complexities, rock properties, fluid properties – concept of black oil model, compositional model.
4. Building, running and analyzing a “black oil” reservoir simulation model by importing contour map data. To build, run, and analyze a black oil reservoir model in IMEX by importing contour map file and reservoir properties.
5. Perform history-matching of IMEX reservoir model.
6. To analyze match between simulation and production data.
7. Streamline simulation Introduction to streamline simulation& comparison of conventional/Streamline simulation
8. Integration with Economics
9. Special Concept on Coning and Compositional Models Simulation. Optimization using Economic and Techno-economic evaluation, Computation of economic indices viz."
10. Perform history-matching of reservoir or core model.
11. To analyze match between simulation and experimental data, and determine rock-fluid parameters.
12. History matching Model calibration performance -Oil & Gas field simulation

Additional Practices:

1. Reservoir optimization Oil & Gas field simulation
2. Uncertainty quantification- Oil & Gas field simulation

Textbooks:

1 K. Aziz, A. Settari, Petroleum Reservoir Simulation. Applied Science Publisher. eISBN: 9780853347873
2 Turgay Ertekin, J.H. Abou-Kassem, and G.R. King, Basic Applied Reservoir Simulation. Society of Petroleum Engineers. eISBN: 9781555630898

Reference Books:

1 Chen, Zhangxin. Reservoir simulation: mathematical techniques in oil recovery. Society for Industrial and Applied Mathematics eISBN: 9780898717075
2 Shahab D. Mohaghegh, Data-Driven Reservoir Modeling. Society of Petroleum Engineers eISBN: 9781613995600

Web Links:

1 https://www.spe-aberdeen.org/wp-content/uploads/2018/06/Devex-2018-Introduction-to-Reservoir-Simulation.pdf
2 https://www.researchgate.net/publication/256667120_The_basic_equations_of_fluid_mechanics_in_form_characteristic_of_the_finite_volume_method
3 https://petrowiki.spe.org/PEH:Reservoir_Simulation
4 https://ntnuopen.ntnu.no/ntnu-xmlui/bitstream/handle/11250/240503/747973_FULLTEXT01.pdf?sequence=1
5 http://oaktrust.library.tamu.edu/bitstream/handle/1969.1/ETD-TAMU-3035/MA-DISSERTATION.pdf?sequence=1

Surface Production Operations

Course Code: 2501PT15	L	T	P	C
	2	0	0	2

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Explain the concept of classification and design of separators
CO2: Demonstrate the concept of surface facilities
CO3: Identify the various storage and transportation methods for oil and gas
CO4: Explain the flow assurance mitigation and pigging operations
CO5: Design principles and sizing of heat exchangers.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I
Separation and Treatment of produced fluid
Classification of separators, Components of separator, Types of separators, Liquid level control and relative advantages / disadvantages of different types of separators, Dehydration & Desalting of Oil, Demulsification, Effluent Treatment, and Design of Separator.

UNIT – II
Surface facilities for Production System Group Gathering Station, Central Tank farm, Feeder and Trunk pipeline system,

UNIT – III
Storage and Transportation of Oil and Gas
Storage tank for Oil, storage of LPG, Underground storage, Measurement-metering of Oil and Gas

UNIT – IV

Flow assurance and Mitigation Scale & Paraffin Deposition and their Mitigation, Flow improver (Pour point depression and Drag reducer, heat treatment), pigging in pipe lines

UNIT – V

Design of principles and sizing of heat exchangers: Process design of Shell &Tube heat exchangers -Double pipe heat exchangers- Plate and frame heat exchangers- Air cooled heat exchangers- Heat recovery units- Fired heaters- Materials of construction & mechanical design of heat exchangers.

Text Books:

1. Petroleum and Gas Field Processing, H.K .Abdel-Aal and Mohamed Aggour and M.A. Fahim, Marcel Dekkar Inc. eISBN: 9780203911099
2. Surface Production Operations, Ken Arnold & Maurice Stewart, Vol. 1 & 2, 3 Edition, Gulf Professional Publishing. eISBN: 9780884158219

Reference Books:

1. Surface Production Operations: Volume IV: Pumps an Compressors Authors: Maurice Steward, Gulf Professional Publishing Published Date: 1st December 2018 eISBN: 9780128098950
2. Engineering Data Book, 12th Edition (Electronic), FPS Version, Volume I & II, Gas Processers Suppliers Association (GPSA).
3. Plant Design and Operations, Ian Sutton, 2nd Edition,Gulf Professional Publishing, 2017. eISBN: 9780128128848
4. Essentials of Oil and Gas Utilities: Process Design, Equipment, and Operations, AlirezaBahadori, Gulf Professional Publishing; 1 edition, 2016. eISBN: 9780128030899

Web Links:

1. https://www.scribd.com/doc/.../Surface-Production-Operations-Volume-1-Oil System-
2. www.academia.edu/.../Ken_Arnold_Surface_Production_Operations_ Volume_1_3rdE
3. blog.agrostar.in/surface_production_operations_vol_2_design_of_gas_handling _syst...
4. http://acreditacion.uni.edu.pe/wp-content/uploads/2017/05/Design-of-OilGasSeparators-%E2%80%93-From-Hydrocarbon-Stream.pdf
5. https://pdfs.semanticscholar.org/5d3a/972503a6e99621738a67021c145fc2269ce8.pdf

Unconventional Hydrocarbon Resources

	L	T	P	C
Course Code: 2501PT16	**1**	**1**	**0**	**2**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Explain the present global energy scenario
CO2: Determine the Characteristics of a Tight Reservoir and Oil
CO3: Illustrate the origin and characterize shale gas
CO4: Demonstrate the Characteristics of Coal Bed Methane and Gas Hydrates
CO5: Explain the heavy oil reservoirs and their challenges

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I
Introduction
Introduction to Unconventional Hydrocarbon resources, Coal Bed Methane: Geological controls in CBM plays, Resource estimation, Drilling, completion and production performance of a CBM well, Indian Scenario

UNIT – II
Tight Gas and Oil
Characteristics of a Tight Reservoir; What makes them Tight; The Permeability Jail; Where to find Tight Reservoirs; Drilling Practices for Tight reservoirs; Formation Evaluation; Hydraulic Fracturing, Post Fracture Reservoir evaluation; New Technologies

UNIT – III
Shale Gas/ Oil
Introduction, geology, important occurrences, petrophysical properties, hydro fracturing, horizontal wells, production profiles.

UNIT – IV

Coal Bed Methane and Gas Hydrates

Characteristics of Coal Bed Methane Gas; Drilling Practices for Coal Beds; Workflow for Coal Bed Formation Evaluation, Cleat, Gas Content; Hydraulic Fracturing, Depressuring and Dewatering issues Success and Lessons learnt so far; Gas Hydrates: Minerology, Chemistry and physical properties, stability, challenges and pitfalls

UNIT – V

Non-Conventional Oil

Introduction to Heavy oil, extra heavy oil, Tar Sand and bituminous, oil shales; origin and occurrence worldwide, resources, reservoir characteristics, new production technologies

Textbooks:

1. Unconventional Gas Reservoirs: Evaluation, Appraisal, and Development, Islam M.R., Gulf Professional Publishing, 2014 eISBN: 978-0128017682.
2. Coal Bed Methane: From Prospects to Pipeline, Thakur P., Aminian K., Schatzel S., Elsevier Science Publishing, 2015. eISBN: 978-0128002138

Reference Books:

1. Geophysical Characterization of Gas Hydrates: 14 (Geophysical Developments), Michael Riedel, Satinder Chopra, Society of Exploration Geophysicists; 1st edition, 2010 eISBN: 978-1560802454
2. Shale Gas: Exploration and Environmental and Economic, Anurodh Mohan Dayal, Devleena Mani, Elsevier Science Publishing, 2017. eISBN: 978-0128041519.

Web Links:

1. https://link.springer.com/article/10.1007/s13202-021-01404-x
2. https://spgindia.org/10_biennial_form/P260.pdf
3. https://www.iogp.org/wp-content/uploads/2016/10/An-introduction-to-shale-oil-and-gas-Jul2015-1.pdfhttps://link.springer.com/chapter/10.1007/978-3-030-21414-2_1
4. https://link.springer.com/chapter/10.1007/978-3-030-21414-2_1
5. https://www.open.edu/openlearn/science-maths-technology/living-without-oil/content-section-1.

Enhanced Oil Recovery

	L	T	P	C
Course Code: 2501PT03	**2**	**1**	**0**	**3**

Course Outcomes:
At the end of the Course, Student will be able to:

- **CO1:** Explain the basic features and technical foundations of the most common EOR methods
- **CO2:** Explain the basic geological factors for flooding of reservoirs
- **CO3:** Apply screening criteria to a given reservoir to select an displacement method both technically and economically
- **CO4:** Make Use of rock, fluid, and reservoir data for the Displacement of fluids in the reservoir
- **CO5:** Apply screening criteria to a given reservoir to select a chemical method for flooding

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	-	-	-	-	-	-	-	-	2	-
CO2	2	-	-	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	-	-	2	-
CO4	3	-	-	-	-	-	-	-	-	2	-
CO5	2	-	-	-	-	-	-	-	-	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – I
Principles of enhanced oil and gas recovery methods. IOR, EOR& EGR. Screening criteria for EOR methods.

UNIT – II
Geological Factors in Enhanced Oil Recovery
Reservoir heterogeneities, Examples of geological factors in enhanced recovery projects Natural fractures,
Determination of Residual Oil Saturation based on Geophysical Well logging techniques, Determination of residual saturation, Well-log-derived oil saturation determination in open hole, Residual oil saturation determination in cased wellbore

UNIT – III

Immiscible displacement: Injection well location, production well completion, surface installation.Miscible drive: Miscible slug flooding, thermodynamic miscibility, ternary diagrams, methods of miscible drive. Benham's correlations, physical and mathematical modelling.

UNIT – IV

Displacement of fluids in reservoir: capillary force; viscous force; phase trapping; mobilization of trapped phases, and alteration of viscous/capillary force ratio.

UNIT – V

Design aspects of chemical flooding. Case studies of surfactant, alkali, polymer, ASP flooding. WAG process, SWAG process, and Chemical augmented WAG process. Foam flooding.

Textbooks:

1. Enhanced Oil Recovery: Mechanisms, Technology, and Feasibility" by Ajay Mandal and Keka Oja. eISBN: 978-0128200810.
2. Applied Enhanced Oil Recovery, Aural Carcoane, Prentice Hall eISBN: 9780130442727

Reference Books:

1. Basic Concepts in Enhanced Oil Recovery Processes, Marc Baviere, SCI, eISBN: 9781851666171
2. Enhanced Oil Recovery: Proceedings of the Third European Symposium on Enhanced Oil Recovery, F. John Fayers, Elsevier eISBN: 978-3-319-31421-1
3. Enhanced Oil Recovery, Larry W. Lake, Prentice Hall, eISBN: 9780132816014

Web Links:

1. https://www.ogj.com/oil-drilling-and-production/production-operations/ior-eor.html
2. http://www.ccop.or.th/ppm/document/INWS4/INWS4DOC03c_Norway_GUNNAR.pdf
3. https://petrowiki.org/Polymer_waterflooding
4. https://www.glossary.oilfield.slb.com/en/Terms/a/alkaline_flooding.aspx
5. https://petrowiki.org/Conformance_improvement