Minor Stream Course: Pipeline and Petroleum Transport Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
241PT027	Introduction To Petroleum Engineering	FC	2			2	50	50	100	-
241PT035	Unit Operations in Petroleum Industry	FC	3			3	50	50	100	-
241PT034	Transportation of Petroleum Products	FC	3			3	50	50	100	-
241PT031	Pipeline Engineering	FC	3			3	50	50	100	-
241PT029	Operational & Maintenance of Pipelines	IC	3			3	50	50	100	PE
241PT026	Flow Assurance	IC	3			3	50	50	100	IPE
241PT028	Midstream Project Economic Analysis	IC	3			3	50	50	100	TPP
241PT033	Storage & Transportation of Crude oil & Natural Gas	IC	3			3	50	50	100	TPP & UOPI
241PT025	Data Analytics & AI For Process Industry	IC	3			3	50	50	100	UOPI
241PT030	Petroleum Economics Polices & Regulations	AC	3			3	50	50	100	MPEA
241PT032	Pipeline Project Management	AC	3			3	50	50	100	OMP
Total			**32**			**32**				

Introduction To Petroleum Engineering

Course Code: 241PT027	L	T	P	C
	2	0	0	2

Course Outcomes:

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

CO 1: Identify the various streams in the petroleum industry.
CO 2: Outline the onshore and offshore reservoirs.
CO 3: List out the various artificial lift techniques.
CO 4: Illustrate various attributes in mid-stream processing and storage.
CO 5: Describe the crude oil products and their specifications.

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	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

What is Petroleum Engineering & Significance? Introduction Petroleum Industry- Upstream Sector- Midstream Processing-Downstream Processing-Indian and World Scenario of Petroleum and Natural Gas- Petroleum Trade- Geopolitics.

UNIT II

Exploration & Production-Indian and World Scenario of Petroleum and Natural Gas Resources- The Reservoir-Reservoir fluids- Hydrocarbon Phase diagrams- Onshore and Offshore Reservoirs
Reservoir Drives. Exploration and Drilling Rigs- Rig Components-Drill and drill bits-Drilling fluids.

UNIT III

Well Completions Production System: Sketches of Well - Well head- Christmas tree and Casing and various other parts- Cementing-Safety Systems.

Artificial Lift: Principles and operation of Rod Pumps Down Hole Pumps - Gas Lift - Plunger Lift- Electrical submersible pumps.

UNIT IV

Separation of Reservoir Fluids- Manifolds and Gathering - Production Separators - Gas Treatment and Compression - Oil & Gas Storage.

Midstream processing: Transportation of Crude Oil & its Products and Natural Gas- World and Indian pipeline scenario- Design of Oil and Gas pipelines Safety aspects of pipelines- Environmental issues.

UNIT V

Crude Oil Refining: Classification and Composition - Constituents - Products and their specifications- Pre-treatment of crude oil- Refinery distillation- Safety in refinery operations.

Text Books:

1. Havard Devold, Oil and Gas Production Handbook: An Introduction to Oil & Gas Production, ABB ATPA Oil and Gas. eISBN: 978-1329783454
2. John R. Fanchi and Christiansen, R.L. Introduction to Petroleum Engineering, John Wiley & Sons. eISBN:9781119193463

Reference Books:

1. Production and transport of oil and gas (part B: gathering and transport); Szilas A.P; Elsevier publications, 2nd Edition. eISBN: 0-444-99564-1
2. Subsea Engineering Handbook; Yong Bai., QiangBai; Gulf Professional Publishing; Elsevier eISBN: 978-1-85617-689-7

Web Links:

1. https://www.studentenergy.org
2. https://petrowiki.org/Hydrate_problems_in_production
3. https://en.wikipedia.org/wiki/Pipeline_transport
4. https://petrowiki.org/Production_system

Unit Operations in Petroleum Industry

L	T	P	C
3	0	0	3

Course Code: 241PT035

Course Outcomes:

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

CO1: Understand the Heat and Mass Transfer Principles
CO2: Prioritize Proficiency in Conduction Mechanisms
CO3: Explain Mastery of Convective Heat Transfer
CO4: Apply Knowledge of Heat Exchange Equipment and Evaporation
CO5: Distinguish Mass Transfer and Distillation 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	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: Objective, scope and outcome of the course.

Conduction: Introduction to unit operation and its application in petroleum engineering. Heat Transfer and its application, Modes of heat transfer one dimensional and two-dimensional, heat rate equations, Theory of insulation, critical radius calculations, types of insulation material, conduction through slab, cylinder and sphere.

Unit – II

Convection: Convective heat transfer, natural and forced convection, co/counter/cross current contacting for heat transfer, individual and overall heat transfer coefficient, Fouling factor, Heat transfer with and without phase change conditions**.**

Unit – III

Heat Exchange equipment: Introduction to double pipe, shell and tube exchangers, condensers, extended surface equipment.

Evaporation- Type of evaporators and their applications single and multiple effect evaporators, operation of forward– backward and mixed feed operations.

Unit – IV

Mass transfer and its application: Analogies in transfer process, basic concept of diffusion and interphase mass transfer. Mass transfer theory film theory Penetration and surface renewal theory.

Unit – V

Distillation: Rectification, reflux ratio, calculation of numbers of plates by McCabe Thiele method, optimum reflux ratio

Basic introduction to absorption, liquid liquid extraction, leaching

Drying: Equilibrium mechanism theory of drying, drying rate curve

Text Books:

1. Heat and Mass Transfer: Fundamentals and Applications by Yunus A. Çengel and Afshin J. Ghajar. eISBN: 978-9339223199
2. Introduction to Chemical Engineering Thermodynamics" by J.M. Smith, H.C. Van Ness, and M.M. Abbott. eISBN: 978-0070145870

Reference Books:

1. Transport Processes and Separation Process Principles" by Christie John Geankoplis. eISBN: 9789332549432
2. Process Heat Transfer" by Donald Q. Kern. eISBN: 978-0074632178

Weblinks:

1. https://onlinecourses.nptel.ac.in/noc22_me139/preview
2. https://www.engineeringtoolbox.com/convective-heat-transfer-d_430.html
3. https://www.thomasnet.com/articles/process-equipment/double-pipe-heat-exchangers/
4. https://pages.mtu.edu/~fmorriso/cm3120/lectures/2020%20CM3120%20First%20Diffusion%20Lecture%209.pdf
5. http://www.dempt.co.za/mso2015/handout4.pdf

Transportation of Petroleum Products

	L	T	P	C
Course Code: 241PT034	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO1: Understand the Pipeline Construction and Operation.
CO2: Prioritize Proficiency in Instrumentation and Control.
CO3: Apply Knowledge of Safety, Traffic Management, and Supply Scenarios.
CO4: Understand the Product Quality Control and Bulk Distribution.
CO5: Make Awareness of Pricing Mechanisms and Conservation Efforts.

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: Objective, scope and outcome of the course.
Basics of Pipeline construction: operation and protection. Pump and compressor.

Unit – II
Instrumentation and Control: Metering and measurements of oil and gas.
Traffic management, Fire and safety rules. Indian and Global supply scenario of petroleum and petroleum products.

Unit – III
Product quality control. Bulk distribution and handling-domestic, commercial and industrial. Storage of petroleum products in fixed installations. Standards and regulations.

Unit – IV
Role of International oil companies and OPEC pricing mechanism. Administered and market determined, pricing mechanism in India.

Unit – V

Conservation of petroleum & its products. Spot and other market control mechanism.

Text Books:

1. Petroleum Transportation and Production: Oil Spill and Pollution Control by Marshall Sittig, Noyes Publications.eISBN: 9780815507017
2. Petroleum Storage & Transportation: Petroleum liquids transportation, William E. Swales, National Petroleum Council. Committee on Petroleum Storage & Transportation. eISBN: 9780686292821.

Reference Books:

1. Petroleum Transportation Handbook, Harold Sill Bell, McGraw-Hill. eISBN: 9780070049336
2. Green Gasoline: A Green Spark Transportation Fuel, Mohammad Aslam; Shrikant Maktedar; Anil Kumar Sarma, Green Chemistry Series, 2023. eISBN: 9781837670843.

Web Links:

1. https://www.eit.edu.au/resources/pipeline-systems-designing-construction-maintenance-and-asset-management/
2. https://blog.epcland.com/instrumentation-and-control-engineering/
3. https://archive.org/download/za.sans.10087.3.2008/za.sans.10087.3.2008.pdf
4. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/WPM31-OPECPricingPowerTheNeedForANewPerspective-BassamFattouh-2007.pdf
5. https://ongcindia.com/documents/77751/2593733/syllabus222_20.pdf

Pipeline Engineering

Course Code: 241PT031	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO1: Illustrate pipeline route selection and survey operations.
CO2: Apply the pipeline mechanical design and pipeline protection.
CO3: Summarize the natural gas transmission in pipelines.
CO4: Explain the performance of compressors and coolers
CO5: Facilitate the fundamentals of transient 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	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

Elements of pipeline design: Fluid properties – Environment - Effects of pressure and temperature - Supply / Demand scenario - Route selection for onshore and offshore - Codes and standards - Environmental and hydrological considerations – Economics - Materials / Construction – Operation - Pipeline protection - Pipeline integrity monitoring.
Pipeline route selection, survey, geotechnical guidelines, construction and commissioning:Introduction - Preliminary routeselection - Key factors for route selection - Engineering survey - Legal survey - Construction / As-built survey - Geotechnical design

Unit – II

Materials selection: Elements of design – Materials designation standards.
Pipeline mechanical design: Codes and standards – Location classification – Pipeline design formula – Expansion and flexibility – Joint design for pipes of unequal wall thickness –

Value assemblies – Scraper traps – Buoyancy control – Crossings – Depth of cover – Aerial markings – Warning signs.
Pipeline construction: Construction – Commissioning.
Pipeline protection, Instrumentation, and Pigging: Pipeline coating – Cathodic protection – Cathodic protection calculations for land pipelines – Internal corrosion – Flow meters and their calibration – Sensors – Pigs.

Unit – III

Natural gas transmission: General flow equation – Steady state - Impact of gas molecular weight and compressibility factor on flow capacity - Flow regimes - Widely used steady-state flow equations – Summary of the impact of different gas and pipeline parameters on the gas flow efficiency – Pressure drop calculation for pipeline in series and parallel – Pipeline gas velocity – Erosional velocity – Optimum pressure drop for design purposes – Pipeline packing – Determining gas leakage using pressure drop method – Wall thickness / pipe grade – Temperature profile – Optimization process – Gas transmission solved problems.

Unit – IV

Gas compression:Types of compressors – Compressor drivers – Compressor station configuration – Thermodynamics of isothermal and adiabatic gas compression – Temperature change in adiabatic gas compression – Thermodynamics of poly-tropic gas compression – Gas compressors in series – Centrifugal compressor horsepower – Enthalpy / Entropy charts (Mollier diagram) – Centrifugal compressor performance curve-Reciprocation compressors.
Coolers: Gas coolers – Air-cooled heat exchangers –Heat transfer equations for coolers – Fanair mass flow rate – Required fan power – Gas pressure drop-in coolers – Iterative procedure for calculations based on unknown T2.

Unit – V

Liquid flow and pumps:Fully developed laminar flow in a pipe – Turbulent flow – Multiphase flow - Centrifugal pumps – Retrofitting for centrifugal pumps (Radial-flow) – Pump station control – Pump station piping design.
Transient flow in liquid and gas pipelines:Purpose of transient analysis – Theoretical fundamentals and transient solution technique – Applications – Computer applications – Corrosion, Safety and Maintenance Considerations.

Text Books:

1. Pipeline Design and Construction: A Practical Approach, M. Mohitpour, H. Golshan and M.A. Murray, 2ndEdition, ASME Press. eISBN: 9780791802037
2. Pipeline Engineering, Henry Liu, Lewis Publishers (CRC Press). eISBN: 9781420041429

Reference Books:

1. Outlines of Chemicals Technology, Dryden, C.E., Edited and Revised by Gopala Rao, M. and M.Sittig, 2nd Edition, Affiliated East-West press eISBN: 9788185336601
2. Piping and Pipeline Engineering: Design, Construction, Maintenance Integrity and Repair, George A. Antaki, CRC Press. eISBN: 9780824707128

Web Links:

1. http://petrowiki.org/Pipelines
2. http://www.pipingguide.net/2008/01/piping-codes-standards.html
3. http://naturalgas.org/naturalgas/transport/
4. http://physics.bu.edu/~duffy/py105/Firstlaw.html
5. http://petrowiki.org/Centrifugal_pumps

Operational & Maintenance of Pipelines

Course Code: 241PT029	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO1: Explain the Elements of Pipeline operation and maintenance
CO2: Explain the Operation and maintenance organization in pipeline
CO3: Explain overview of pipeline system operation
CO4: Apply pipeline system maintenance
CO5: Explain the Valves and operations in pipeline

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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

Elements of Pipeline Operation and Maintenance, Background and History, Trends in Pipeline System Development, Pipeline Transmission Systems, Operation and Maintenance Elements

Unit – II

Operation and Maintenance Organization, Introduction, General Functions in a Pipeline Organization Factors that Influence Organizational Structure, Organizational Structure of a Pipeline Codes, Policies and Procedures,Asset Management

Unit – III

Overview of Pipeline System Operation, Pipeline Operational Planning, Gas Pipeline Transportation, Liquid Transportation, Heavy oil Transportation, Special Operational Activities, Special Issues

Unit – IV

Pipeline System Maintenance, Overview of Pipeline Maintenance Activities, Right-of-way and Site Maintenance, Pipeline Pigging, Pipeline Repair, Pipeline Segment Replacement, Pipeline Protection/Corrosion Control, Pipeline Welding Techniques and Branch Connections,operation of pumps and compressors including maintenance

Unit – V

Valves & Operators, General and History, Valve Standards/Applicable Codes, Definition and Types for Pipeline Applications, Valve Operators, Automatic Line-Break Controls, Side/Takeoff Valves, Station Tie-ins, Valve Assemblies, Valve Automation For Liquid Pipelines, Valve Characteristics, Pressure Drop ,Valve Application Ranking and Identification, Valve Maintenance Requirement

Text Books:

1. Pipeline Design and Construction: A Practical Approach, M. Mohitpour, H. Golshan and M.A. Murray, 2ndEdition, ASME Press eISBN: 9780791802037
2. Pipeline Engineering, Henry Liu, Lewis Publishers (CRC Press) eISBN: 9781420041429

Reference Books:

1. Piping Calculation Manual, E. ShashiMenon, McGraw-Hill eISBN: 9780071502113.
2. Pipeline Planning and Construction Field Manual, E. ShashiMenon, Gulf Professional Publishing eISBN: 9780123858817
3. Pipeline Rules of Thumb Handbook, E. W. McAllister, 7 Edition, eISBN: 9780128018942
4. Piping and Pipeline Engineering: Design, Construction, Maintenance Integrity and Repair, George A. Antaki, CRC Press eISBN: 9780824707128.

Web Links:

1. http://petrowiki.org/Pipelines
2. http://www.pipingguide.net/2008/01/piping-codes-standards.htm
3. http://naturalgas.org/naturalgas/transport
4. http://physics.bu.edu/~duffy/py105/Firstlaw.htm
5. http://petrowiki.org/Centrifugal_pump

Flow Assurance

Course Code: 241PT026	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO1: Solve flow assurance calculations and size the piping & distribution system.
CO2: Explain the concepts of non-Newtonian fluid & friction, transient flow, transient flow and heat transfer fundamentals.
CO3: Apply the concepts of emulsion, phase behavior, hydrocarbon flow, single, two, three & four phase regimes during design
CO4: Apply three phase gas-liquid-solid flow
CO5: Explain the concepts of wax management, asphaltenes, hydrate remediation interprets phase behavior and hydrocarbon flow

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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 to flow assurance:
Pipe friction; Friction in Non-circular pipes; Friction loss in components.

UNIT-II:

Fluid Flow and Heat Transfer Fundamentals:
Non-Newtonian Fluid & Friction; Transient flow; Transient flow; Simplified liquid flow solution; Heat Transfer Fundamentals; U-Value; Steady State / Transient Heat Transfer; Thermal management strategy and Insulation; Simulation Results & Program Testing

UNIT –III:

Composition & properties of Hydrocarbons:
Emulsion, Phase Behavior, Hydrocarbon Flow; Single, two, three & four phase regimes; conservation equations; 2 & 3 fluid models; friction, deposition & entrainment, solving two-phase three fluid equations; gas & Liquid slug including boiling & condensation.

UNIT-IV:

Hydraulics:
Two Phase Liquid-Liquid Flow; Two Phase Liquid-Gas Flow, Two Phase Liquid-Solid Flow; Three Phase Gas-Liquid-Liquid Flow; Three phase Gas-Liquid-Solid Flow

UNIT-V:

Hydrates, Wax &Asphaltenes:
Physics & Phase Behavior; Hydrate Prevention; Hydrate Remediation; Hydrate Control Design Philosophies; Recovery of Thermodynamic Hydrate Inhibitors.
Wax; Wax Management; Wax remediation; Asphaltenes; Asphaltene control design philosophies

Text Books:

1. Pipe Flow-1 Single Phase Flow Assurance – Over Bratland (e-Book). eISBN: 9780123820356.
2. Subsea Engineering Handbook – Yong Bai & Qiang Bai – Gulf Professional Publishing. eISBN: 9780123852402

Reference Books:

1. Pipe Flow-2 Multi Phase Flow Assurance – Over Bratland (e-Book). eISBN: 9780123858749
2. Natural Gas Hydrates in Flow Assurance – Dendy Sloan et.al – GPP. eISBN: 9780123865488.
3. Natural Gas Hydrates, Experimental Techniques and their applications, Yuguang Ye, Changling Liu, Springer Berlin Heidelberg. eISBN: 9783540937240

Web Links:

1. https://en.wikipedia.org/wiki/Flow_assurance
2. https://en.wikipedia.org/wiki/Non-Newtonian_fluid
3. http://www.oilfieldwiki.com/wiki
4. https://en.wikipedia.org/wiki/Hydraulics
5. http://spe-iran.org/workshop1

Midstream Project Economic Analysis

Course Code: 241PT028	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO1: Understand the petroleum economics in all its aspects: reserves, investments, players, costs, benchmarking.
CO2: Explain the concepts and make simplified forecast of oil production.
CO3: Understand of Oil and Gas Market as well as International Trading.
CO4: Apply cash flow techniques in economic analysis and evaluations
CO5: Understand of different kind of international agreements and especially Production Sharing Agreements

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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: Petroleum Industry, the main aspects.
Midstream and Downstream segments. The modern tendencies and the current condition of the industry.

Unit-II

Reserves and production forecast. Reserves classification. Approaches in production forecast. Decline curve, decline rate. Frequently used exponential decline curve. Oil and Gas Market. Main Players
Crude oil supply and demand. Crude oil characteristics, pricing, benchmarks. Sale contracts. Gas sales. International oil trading. Platts quotations. Wet and paper barrel, hedging.

Unit-III

Cash flow Capital and operating expenditures. Constructing a project Cash Flow. Economic Decision Tools. Economic indicators and yardsticks. The time value of money. Discounted Cash Flow.

Unit-IV

Risk and Uncertainties. Probability and frequency distribution. Sensitivity and risk analyses. Decision tree analysis. Monte Carlo simulation. Financing and Ownerships. Source of financing. Cost of capital

Unit-V

Petroleum Industry Accounting. Costs and taxes. Depreciation, Depletion and Amortization. Oil Company's annual report.
Budgeting, planning, scheduling. Authorization for expenditure (AFE) Economic Analysis. Rate acceleration projects. Equipment replacement. Leasing. International Agreements Production Sharing Agreement

Text Books:

1. Fraser H.Allen and Richard D.Seba, Economics of Worldwide Petroleum Production. Third Edition eISBN: 9781560325010
2. Rognvaldur Hannesson, Petroleum Economics: issues and strategies of oil and natural gas production eISBN: 9783540240483

Reference Books:

1. Project Finance for the International Petroleum Industry, Robert Clews, 2016. eISBN: 9780750655541

Web Links:

1. https://www.petrosync.com/blog/oil-and-gas-industry/
2. https://mdpi-res.com/d_attachment/energies/energies-16-04117/article_deploy/energies-16-04117.pdf?version=1684225862
3. https://www.smartsheet.com/content/project-cash-flow
4. https://medium.com/analytics-vidhya/building-a-probabilistic-risk-estimate-using-monte-carlo-simulations-cf904b1ab503
5. https://www.pwc.com/id/en/publications/assets/eumpublications/financial-reporting-in-the-oil-and-gas-industry.pdf

Storage & Transportation of Oil & Natural Gas

	L	T	P	C
Course Code: 241PT033	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO1: Recognize specified equipment for testing various samples
CO2: Apply various apparatus/equipment for the analysis of various petroleum products
CO3: Illustrate the storage facilities for petroleum products.
CO4: Identify the physical properties of different petroleum products
CO5: Choose transport properties of different petroleum products

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-
CO4	2	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
Introduction
Crude oil Trade, Selection of Port Location, Ship Building/Shipyards

Unit – II
Natural Gas Regasification Technology
Commercial Sourcing of Natural Gas, Different Kinds of Regasification Techniques, Regasification Process & Cold Utilization, Synchronization of Degasified natural gas and Pipelines, Current Status in India.

Unit – III
Crude Oil Transportation
Transportation techniques of crude oil, Pipeline specification, Corrosion Prevention techniques, Pressure drop, Pumps and Booster station, Wax deposition and prevention, Chemical treatment.

Unit – IV

Design Basic Engineering Aspects of Terminal Design, Design of Liquefaction Train, Ship Building/Shipyards, Storage Facilities.

Unit – V

Characteristics Of Storage Technical Qualities and Storage, Properties of Storage Reservoir, Rocks & Fluids. Flow through Storage Reservoir; Gas Flow Performance, Gas Deliverability. Design & Development of Underground Storage Fields: Operation of Storage Fields. Recent Developments Advanced Storage Techniques, Case Histories.

Text Books:

1 Oilfield Processing: Crude Oil (Oilfield Processing of Petroleum R. Solvay, Pennwell Books). eISBN: 9780878143181.
2 Advances in Environmental Control Technology: Storage Tank Paul Cheremisinoff Gulf Professional Publishing; 1ST edition eISBN: 9780884153518

Reference Books:

1 Natural Gas Transportation, Storage and Use, Mark Fennell Amazon Digital Services, Inc., 2011. eISBN: 9781463706146
2 Natural Gas: Production, Processing and Transport, Alexandre Rojey, Editions OPHRYS eISBN: 9782708007275

Web Links:

1 https://www.samco.in/knowledge-center/articles/crude-oil-trading-the-ultimate-beginners strategyguide/#:~:text=Strategies%20%26%20Tips%20for%20Crude%20Oil%20Trading %201,Trading%20Strategy.%20...%204%20Spread%20Trading%20Strategy.%20
2 https://en.wikipedia.org/wiki/Natural_gas
3 https://www.breakthroughfuel.com/blog/oil-in-motion-visibility-into-crude-oil-transportation
4 https://crp.trb.org/acrpwebresource2/overview-of-air-cargo-terminal-design aspects/
5 https://www.osti.gov/biblio/780306

Data Analytics & AI For Process Industry

Course Code: 241PT025	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO1: Understand the Data Analytics and AI
CO2: Explain the concepts in Data Science Languages.
CO3: Apply the Knowledge of Data Warehousing and OLAP
CO4: Apply Mastery of Statistical Methods and Techniques
CO5: Explain the Competence in Classification and Big Data Tools

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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: Introduction to Data Analytics and Artificial Intelligence- Some illustrations of AI problems-Data-Information-Knowledge-Applications of Data Analytics-Introduction to the Languages of Data Science: R, SQL, and Python.

Unit-II

Data warehousing: Introduction to Data warehousing, Concepts of Data warehousing-OLAP-Data Preparation and Visualization.

Unit-III

Descriptive Statistics: Central Tendency and Variability, Inferential Statistics-Probability-Central Limit Theorem-Exploratory Data Analysis-Hypothesis Testing-Linear Regression.

Unit-IV

Classification: KNN, Naïve Bayes and Logistic Regression-K-means and Hierarchical Clustering-Decision Trees-Support Vector Machines-Neural Networks-Association Rule Mining.

Unit-V

Introduction to Big Data and Hadoop: Managing Big Data-Hadoop Ecosystem Tools (Sqoop and Hive).

Introduction to Spark: Big Data Analysis using Spark R-Spark SQL-Case studies

Text Books:

1. Thomas A. Runkler, Data Analytics: Models and Algorithms for Intelligent Data Analysis. Springer 2012. eISBN: 9783642201526
2. Wes McKinney, Python for Data Analysis. O'Reilly 2013. eISBN: 9781449323592.

Reference Books:

1. Keith R. Holdaway, Harness Oil and Gas Big Data with Analytics: Optimize Exploration and Production with Data-Driven Models. Wiley (2014). eISBN: 9781118468220.
2. Robert Haining, Spatial Data Analysis: Theory and Practice. Cambridge University Press (2003). eISBN: 9780521777865

Web links:

1. https://www.coursera.org/articles/ai-in-data-science
2. https://www.digitalvidya.com/blog/introduction-to-data-warehousing/
3. https://www.geeksforgeeks.org/descriptive-statistics/
4. https://www.datasciencecentral.com/comparing-classifiers-decision-trees-knn-naive-bayes/
5. https://www.geeksforgeeks.org/hadoop-components-functionality-and-challenges-in-big-data/

Petroleum Economics, Policies & Regulations

Course Code: 241PT030	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO1: Identify the importance of petroleum sector in the world economy
CO2: Explain various analysis and techniques of economics in petroleum industry
CO3: Apply project evaluation methods in petroleum industry
CO4: Identify the Demand and Marketing of Petroleum Products
CO5: Study the laws and regulations in petroleum industries.

Mapping of Course Outcomes with Program Outcomes:

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

Unit – I

Introduction: Role and Value of Oil and Gas - Government and corporate interests, Evolution of national oil companies -Organization of Petroleum Exporting Countries - Political Environment related to Petroleum Industry. Principles, Methods, and Techniques of Petroleum Engineering Economics: Time value in capital expenditures, Depreciation, and depletion in oil projects- Financial measures and profitability analysis.

Unit – II

Risk analysis:Analysis of alternative selections and replacements- Risk, uncertainty, and decision analysis, Break even and sensitivity analysis- Optimization Techniques.

Unit – III

Application and Project Evaluation: Oil fields exploration and drilling operations-Oil fields' estimation of oil reserves and evaluation of an oil property- Project financial analysis. Project

development and Joint development utilization Oil fields production operations- Oil transportation- Crude oil processing.

Unit – IV

Demand and Marketing of Petroleum Products: Crude oil fundamentals - Price of crude -Crude oil prices in transactions. Internal Markets and Prices -Marketing and sale of Motor – Aviation – Lubricant -Asphalt and Propane. Transportation: Fundamentals of transportation –Pipelines - Oil tankers - Downstream transportations. Distribution of Petroleum Products.

Unit – V

Petroleum or Oil & Gas Policies and Regulations: Petroleum and Oil & Gas Rules and Regulations in India – The Oil fields Regulations and Development Act –NELP & OALP – Functions of Directorate General of Hydrocarbons – Petroleum and Natural Gas Regulatory Board.

Text Books:

1 Petroleum Economics and Engineering, Third Edition, Hussein K. Abdel- Aal, Mohammed A. Alsahlawi, CRC Press, 2013. eISBN: 9781466583714
2 The Global Oil & Gas Industry: Management, Strategy and Finance, Andrew Inkpen & Michael H. Moffett, 2011. eISBN: 9780123858804

Reference Books:

1 Petroleum Economics, Jean Masseron, Technip; 4threvised Edition, 2000.eISBN: 9782710807573.

Web Links:

1 https://ivypanda.com/essays/petroleum-industrys-ethical-and-societal-overview/
2 https://en.wikipedia.org/wiki/Mathematical_optimization
3 https://www.pmclounge.com/types-of-project-management-life cycle/#:~:text=%20Types%20of%20Project%20Management%20Life%20Cycle%20,Small%2C%20usable%20pieces%20of%20the%20project...%20More%20

Pipeline Project Management

Course Code: 241PT032	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO1: Explain pipeline integrity management and framework
CO2: Apply Engineering concepts for pipeline integrity
CO3: Explain Elements of a pipeline integrity management system
CO4: Apply Integrity hazard and threat susceptibility and assessment
CO5: Explain the Consequences assessment for pipelines

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

Pipeline Integrity Management: Integrity Management (IM) core purpose, Key Integrity Management Terminology, First Hydrocarbon Transmission Pipelines, Reservoirs and Legislation, Pipeline Integrity Management Eras, History and Evolution , Pipeline Integrity Management Framework

Unit – II

Engineering Concepts for Pipeline Integrity: Design of Pipelines,Line Pipe, Pipeline Routing, The Design Process,Pipeline Construction Elaboration of contents of required Offshore pipelines

Unit – III

Elements of a Pipeline Integrity Management System (PIMS), Management Systems and Pipeline Integrity, Integrity Management Program (IMP), PIMS: Management System and Integrity, Management Program Linkage, PIMS Policy and Commitment, PIMS Planning:

Purpose and High Level Processes, PIMS Implementation, Conformance and Compliance Verification and Action Plans, Management Review: Integrity Performance and KPIs

Unit – IV

Integrity Hazard and Threat Susceptibility and Assessment, Introduction, Threat Management Cycle, Pipeline Integrity Threat Assessment Process, Pipeline Integrity Hazards and Threats, Pipeline Integrity Hazard Identification, Threat Susceptibility Assessment ,Pipeline Threat Assessment

Unit – V

Consequence Assessment for Pipelines

Introduction, Pipeline Consequence Categories, Consequence Assessment Process, Consequence Analysis: Fluid Discharge and Dispersion, Consequence Classification along the Pipeline,Validation of the Consequence Classification, Consequence Assessment Results, Content and Format

Text Books:

1. Pipeline Integrity Management Systems, A practical Approach, Rafael. G. Mora, Phil Hopkins, EdgarI.Cote, Taylor shie, ASME press, 2016 eISBN: 9780791875767
2. Pipeline Design and Construction: A Practical Approach, M. Mohitpour, H. Golshan and M.A. Murray, 2ndEdition, ASME Press, 2007. eISBN: 9780791802037

Reference Books:

1. Piping Calculation Manual, E. ShashiMenon, McGraw-Hill, 2004. eISBN: 9780071408810.
2. Pipeline Planning and Construction Field Manual, E. ShashiMenon, Gulf Professional Publishing, 2011. eISBN: 9780123858774.
3. Pipeline Rules of Thumb Handbook, E. W. McAllister, 7 Edition, 2009. eISBN: 9780123819787.

Web Links:

1. http://petrowiki.org/Pipelines
2. http://www.pipingguide.net/2008/01/piping-codes-standards.html
3. http://naturalgas.org/naturalgas/transport/
4. http://physics.bu.edu/~duffy/py105/Firstlaw.html
5. http://petrowiki.org/Centrifugal_pumps

Minor Stream: Fire and Safety in Petroleum Industries

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
241PT039	Fundamentals of Petroleum Engineering	FC	2			2	50	50	100	-
241PT038	Fire Risk & Control	FC	3			3	50	50	100	-
241PT041	Occupational Health & Safety	FC	3			3	50	50	100	-
241PT045	Statutory Rules & Regulation	FC	3			3	50	50	100	-
241PT036	Advances In Sustainable Development	IC	3			3	50	50	100	OHS
241PT040	Hazard Identification & Risk Assessment	IC	3			3	50	50	100	OHS
241PT046	Structural Fire Protection System	IC	3			3	50	50	100	FRC
241PT042	Process Safety & Security	IC	3			3	50	50	100	OHS
241PT044	Safety In Engineering Industry	AC	3			3	50	50	100	HIRA
241PT043	Safety In Drilling	AC	3			3	50	50	100	HIRA
241PT037	Disaster Risk Management	AC	3			3	50	50	100	-
Total			**32**			**32**				

Fundamentals of Petroleum Engineering

Course Code: 241PT039	L	T	P	C
	2	0	0	2

Course Outcomes:

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

CO 1: Identify the various streams in the petroleum industry.
CO 2: Outline the onshore and offshore reservoirs.
CO 3: List out the various artificial lift techniques.
CO 4: Illustrate various attributes in mid-stream processing and storage.
CO 5: Describe the crude oil products and their specifications.

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	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

What is Petroleum Engineering & Significance? Introduction Petroleum Industry- Upstream Sector- Midstream Processing-Downstream Processing-Indian and World Scenario of Petroleum and Natural Gas- Petroleum Trade- Geopolitics.

UNIT II

Exploration & Production-Indian and World Scenario of Petroleum and Natural Gas Resources- The Reservoir-Reservoir fluids- Hydrocarbon Phase diagrams- Onshore and Offshore Reservoirs
- Reservoir Drives. Exploration and Drilling Rigs- Rig Components-Drill and drill bits- Drilling fluids.

UNIT III

Well Completions Production System: Sketches of Well - Well head- Christmas tree and Casing and various other parts- Cementing-Safety Systems.

Artificial Lift: Principles and operation of Rod Pumps Down hole Pumps - Gas Lift - Plunger Lift- Electrical submersible pumps.

UNIT IV

Separation of Reservoir Fluids- Manifolds and Gathering - Production Separators - Gas Treatment and Compression - Oil & Gas Storage.

Midstream processing: Transportation of Crude Oil & its Products and Natural Gas- - World and Indian pipeline scenario- Design of Oil and Gas pipelines Safety aspects of pipelines- Environmental issues.

UNIT V

Crude Oil Refining: Classification and Composition - Constituents - Products and their specifications- Pre-treatment of crude oil- Refinery distillation- Safety in refinery operations.

Text Books:

1. Havard Devold, Oil and Gas Production Handbook: An Introduction to Oil & Gas Production, ABB ATPA Oil and Gas. eISBN: 978-1329783454
2. John R. Fanchi and Christiansen, R.L. Introduction to Petroleum Engineering, John Wiley & Sons. eISBN:9781119193463

Reference Books:

1. Production and transport of oil and gas (part B: gathering and transport); Szilas A.P; Elsevier publications, 2nd Edition. eISBN: 0-444-99564-1
2. Subsea Engineering Handbook; Yong Bai., QiangBai; Gulf Professional Publishing; Elsevier eISBN: 978-1-85617-689-7

Web Links:

1. https://www.studentenergy.org
2. https://petrowiki.org/Hydrate_problems_in_production
3. https://en.wikipedia.org/wiki/Pipeline_transport
4. https://petrowiki.org/Production_system

Fire Risk & Control

Course Code: 241PT038	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO 1: Know the fundamentals of fire & explosion and their general requirements.
CO 2: Apply their learning in implementing fire safety requirements at the work place to minimize fire incidence.
CO 3: Develop skill set or competency in assessing /analyzing or comparing fire safety system requirements towards minimization of fire & explosion in
CO 4: Do the inspection/ audit at the workplace in accordance with required requirements.
CO 5: Use an engineered approach in establishing or maintaining updated fire prevention measures specific to the organizational scope.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT I:
Fire Chemistry

Physics and chemistry of fire, Fire Properties of Solids, Liquids and Gases, Fire spread, Toxicity of Products of Combustion, Theory of Combustion and Explosion, Vapour Clouds, Flash Fire, Jet Fires, Pool Fires, Unconfined Vapour Cloud Explosion, Shock Waves, Auto-Ignition, Boiling Liquid expanding Vapour Explosion. Toxic effects of combustion gases.

UNIT II:

Fire Prevention & Protection

Sources of Ignition- Fire Triangle, Principles of Fire Extinguishing, Active and Passive Fire Protection Systems, Various Classes of Fires, A, B, C, D, E types of Fire Extinguishers, Fire Stoppers, Hydrant Pipes, Hoses, Monitors, Fire Watchers, Lay Out of Stand Pipes, Fire Station, Fire Alarms and Sirens, Maintenance of Fire Trucks, Foam Generators, Escape from Fire, Rescue Operations, Fire Drills, Notice, First Aid for burns

UNIT III:

Fire Alarm & Detection System

Industrial fire Protection System , Sprinkler-Hydrants -Stand Pipes, Special Fire Suppression Systems (Deluge and Emulsifier), Selection Criteria of the above Installations, Reliability, Maintenance , Evaluation and Standards, Alarm and Detection Systems, Other Suppression Systems (CO_2 System - Foam System , Dry Chemical Powder (DCP) System, Halon System), Need For Halon Replacement, Smoke Venting, Portable Extinguishers, Flammable Liquids, Tank Farms, Indices of In flammability, Fire Fighting Systems

UNIT IV:

Fire Assurance & Measurements

Fire Load, Fire Resistant Material and Fire Testing, Structural Fire Protection, Structural Integrity, Exits and Egress, Fire Certificates, Fire Safety requirements for high-rise Buildings.

UNIT V:

Fire & Explosion Principles

Principles of Explosion, Detonation and Blast Waves, Explosion Parameter, Explosion Venting, Inert Gases, Plant for Generation of Inert Gas, Rupture Disc in Process Vessels & Lines Explosion, Suppression System based on Carbon Dioxide (CO_2) & Halons Hazards in LPG, Ammonia (NH_3), Sulphur Dioxide (SO_3), Chlorine (CL_2) etc. Indian Explosive Act and Rules, Static and Mobile Pressure Vessel (SMPV) rules.

Textbooks

1. Rao and Saluja (1997), Electrical Safety, Fire Safety Engineering and Safety Management, New Delhi: Khanna Publishers. eISBN: 9788174090144
2. Prekash Sesha (2017), Manual of Fire Safety, New Delhi: CBS Publication eISBN: 9789386419277

Reference books

1 M. Ya Roytman (1975), Principles of fire safety standards for building construction, Washington DC: Amerind. eISBN: 9780846300590.

2 V K Jain (2001), Fire Safety in Building, New Delhi: New Age International. eISBN: 9788122413485

3 Purkiss and Yuan Li (2013), Fire Safety Engineering Design of Structures, Florida: CRC Press. eISBN: 9780415502362.

Web links

1. https://maiif.org/wp-content/uploads/2017/08/Guide-for-Conducting-Marine-Fire-Investigations-Chapter-1.pdf
2. https://fire.nv.gov/uploadedfiles/firenvgov/content/bureaus/FST/4-ifipp-PSsm.pdf
3. https://www.scribd.com/doc/296196433/Fire-Protection-of-Buildings
4. https://mohua.gov.in/upload/uploadfiles/files/Chap-7.pdf

Occupational Health & Safety

Course Code: 241PT041	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO1: Understand the types of occupational hazards in the workplace and their effects on human health.
CO2: Identify the root causes of workplace illness and adapt effective ways to control it.
CO3: Apply effective industrial hygiene program for the workplace and monitor its effectiveness.
CO4: Develop and standardize the most effective occupational health and safety program in the workplace.
CO5: Distinguish Biological and Ergonomic 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	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:

Human Anatomy, & Hazard

Definition- Anatomy and Physiology of human organs – The lungs, Skin, Ear, Eyes and skin – Functions of organs – Impairment of organs – Effects of various hazards on organs; Cardiopulmonary resuscitation; Audiometric tests, eye tests, vital functional tests; Exposure routes of toxic materials and protective mechanisms; Recognition of health hazards, and Methods for measuring and evaluating health hazards.

UNIT II:

Physical Hazards

Noise-exposure regulation, properties of sound, occupational damage, risk factors, sound measuring instruments, hearing conservation programs; vibration, types, effects, instrument measurement procedure, permissible exposure limit; Ionizing and Non-Ionizing radiation, types, effects, monitoring instruments, control programs; Thermal Heat stress - Methods for controlling thermal exposures.

UNIT III:

Chemical Hazards

Chemical hazards-Classification-dust, fumes, mist, vapor, fog, gases, types, concentration, Threshold Limit Value (TLV) - Methods of Evaluation- Sampling methodology- Industrial Hygiene calculations, Air Sampling Methods; dust sample collection devices, personal sampling, methods of control; Toxicology, classes of toxicants- sources; human health risk assessment and Environmental risk assessment. Weapons of Mass Destruction (WMD)-Toxic Chemicals-effects Effects of various chemicals on human health- Lead, nickel, chromium, manganese toxicity, gas poisoning – prevention methods.

UNIT IV:

Occupational Health & Toxicology

Concept and spectrum of health - Medical Surveillance, Medical Surveillance Program Development, Emergency Treatment, Non-Emergency Treatment; Occupational-related diseases; evaluation of physiological requirements of jobs – parameters of measurements – personal hygiene.

UNIT V:

Biological & Ergonomic

Classification of Bio-hazardous agents –bacterial agents, viral agents, fungal, parasitic agents, -infectious diseases; Biohazard control program, employee health program-laboratory safety program-animal care and handling; Ergonomics-Concepts, objectives, Work Related Musculoskeletal Disorders –Carpal Tunnel Syndrome (CTS)- Tendon pain disorders of the neck- back injuries, Ergonomic management program; Pandemic and Management with Case Study

Textbooks

1. National Safety Council. (2010). Handbook of occupational safety and health. Chicago, IL: Author. eISBN: 9780879122747
2. Stellman, J. M. (Ed.). (2012). Encyclopedia of occupational health and safety (Vols. I and II). Geneva, Switzerland: International Labour Organization. eISBN: 9789221267120
3. Leatham, D. G., & Reynolds, J. R. (2018). Occupational health and safety (3rd ed.). eISBN: 9780128147204

Reference Books

1. Plog, B. A., Quinlan, P. J., & Villareal, J. (2012). Fundamentals of industrial hygiene (6th ed.). National Safety Council. eISBN: 9780879122846
2. Allsopp, W. D., & Mastor, M. S. (2018). Occupational safety and health engineering (4th ed.). eISBN: 9781119395680.
3. Plog, B. A., & Lees, F. N. (2021). Fundamentals of industrial hygiene (6th ed.). eISBN: 9781119550124.

Web links

1. https://byjus.com/biology/human-body-anatomy/
2. https://egyankosh.ac.in/bitstream/123456789/70614/1/Unit-1.pdf
3. https://www.acgih.org/science/tlv-bei-guidelines/tlv-chemical-substances-introduction/
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6309353/

Statutory Rules & Regulation

Course Code: 241PT045	L	T	P	C
	3	0	0	3

Course Outcomes:

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

- **CO 1:** Know the fundamentals of abbreviation as per different statues for safety, health, welfare and environment.
- **CO 2:** Demonstrate understanding of basic terms and definitions as per different acts and rules.
- **CO 3:** Understand statutory requirements concerning safety, welfare and health of workers engaged in industries
- **CO 4:** Apply the legal aspects granting of license for storage, transportation and usage of explosive and flammable substance as per various acts and rules
- **CO 5:** Evaluate the compliance legal and other requirements in a workplace

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:

Factories Act 1948

Definitions, preliminary, inspecting staff, Health, Safety, Provisions relating to hazardous processes, welfare, working hours of adults, Employment of young persons, Special provisions, Penalties, Supplemental. All related amendments.

UNIT II:

Dock Workers (Safety, Health & Welfare) Act, 1986

Definitions, Powers of Inspectors, Power of Govt. to direct Inquiry, Obligation of Dock workers, General Provisions relating to rules and regulations. Dock workers (SHW) Rules-Definitions, Inspection Procedure, Inquiry into certain accidents, Advisory Committee, Inquiry

in Public. Dock workers (SHW) Regulations- Definitions, Power of Inspectors. Penalties, Responsibilities, Safety Officers, Reporting of accidents, Emergency Action Plan, Safety Committee, Occupational Health services for dock workers, various safety and health regulations in brief.

UNIT III:
Explosives Act 1884, Petroleum Act 1934.
Explosives Act: Definitions; Grant of license, Notice of Accidents, Inquiry into ordinary and serious accidents, Punishment for offences, Extension of definition to other explosive substances.
Petroleum Act - Definitions, Control over Petroleum import, transport, storage, production, refining and blending, Need for license, exemption. Inspection and sampling for testing, Notice of Accidents and Inquiries. Petroleum Rules - Definitions, brief idea on the rules relating to safety aspects in transport, storage, refining and blending of petroleum, Notice of Accidents.

UNIT IV:
Social Legislations In India
Workmen's Compensation Act. ESI Act & Rules. Public Liability Act & Rules- Substantive provisions in the above Acts and Rules.

UNIT V:
Environmental Legislations In India
Pollution Water Act: Definitions, Powers and Functions of Central, State and Joint Boards, Provisions regarding prevention and control of water pollution, Penalties, Central & State Water Laboratories, Power to make rules, Power of supersession and overriding effect. Rules on Consent for Establishment.
Air Act - Definitions, Power & Functions of Boards, Prevention & Control of Air Pollution, Penalties, Application for Consent as per Air Rules. Environment (Protection) Act- Definitions, general powers of central government, prevention, control and abatement of environmental pollution. EP Rules-Definitions, standards for emission, prohibition and restrictions on siting and operation of industries.
MSIHC Rules- Definitions, Duties of Authorities, Notification of Major Accidents Safety Reports, On-site & Off-site Emergency Plan, Giving safety information to public. Chemical Accidents (Emergency Planning, Preparedness and Response) Rules- Definitions, Constitution, functions & powers of various Crisis groups.

Textbooks

1. Ganguly, S., & Changeriya, K. (2018). Health safety and environment (safety management). New Age International. eISBN: 9789386240424.
2. Sharma, J. P. (2019). Factories Act, 1948. LexisNexis India eISBN: 9789351436870.

Reference books

1. Sahu, G. J. (2014). Environmental jurisprudence and the Supreme Court: Litigation, interpretation, implementation. LexisNexis India. eISBN: 9789351436160
2. Diwan, S., & Rosencranz, A. (2001). Environmental law and policy in India: Cases, materials and statutes (2nd ed.). Oxford University Press. eISBN: 9780195672280

Web links

1. https://unacademy.com/content/bpsc/study-material/general-awareness/factories-act-1948/
2. https://indiacode.nic.in/bitstream/123456789/1867/1/A1986-54.pdf
3. https://www.acgih.org/science/tlv-bei-guidelines/tlv-chemical-substances-introduction/
4. https://egyankosh.ac.in/bitstream/123456789/17197/1/Unit-5.pdf
5. https://www.clearias.com/environmental-laws-india/

Advances In Sustainable Development

Course Code: 241PT036	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO-1: Recall and describe the three pillars of sustainable development: social, environmental, and economic, and explain their interconnectedness.
CO-2: Explain the significance of the Anthropocene era and its implications for Earth's environment, climate, and resources.
CO-3: Understand and discuss the major global trends, including population growth, urbanization, and the challenges related to energy, water, food, and globalization.
CO-4: Apply critical thinking to analyze the roles and contributions of various actors in advancing sustainable development initiatives.
CO-5: Analyze and evaluate the effectiveness of global policy frameworks and sustainability indicators in addressing contemporary challenges and propose potential improvements or adaptations.

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:
Concept Of Sustainable Development
Understand the Foundations of Sustainable Development: Analyze Global Trends and Contemporary Challenges, Evaluate Stakeholder Roles, and Contributions. The Three Pillars of Sustainability, Sustainable Development Goals (SDGs), Stakeholders in Sustainable Development, Policies and Strategies for Sustainability, Sustainable Communities.

UNIT II:
Sustainability and The Triple Bottom Line
Introduction to Sustainability and the Triple Bottom Line, Economic Sustainability, Social Sustainability, Environmental Sustainability, The Triple Bottom Line Framework,

Sustainability Reporting and Metrics, Sustainable Supply Chain Management, (CSR), Sustainable Business Models, Green Marketing and Consumer Behaviour.

UNIT III:
Sustainable Development and International Response
Role of developed countries in the development of developing countries, international summits, Stockholm to Johannesburg, Rio Principles, Agenda 21, Conventions, Agreements, Tokyo Declaration, Doubling Statement, Transboundary issues:

UNIT IV:
Sustainable Development of Socio-Economic Systems
Demographic dynamics of sustainability, Policies for socio-economic development, Strategies for implementing eco-development programmed, Sustainable development through trade, Economic growth, Urbanization and Sustainable Cities, Sustainable Energy and Agriculture, Sustainable Livelihoods, Ecotourism.

UNIT V:
Framework For Achieving Sustainability
Sustainability indicators, Hurdles to Sustainability, Operational guidelines, Interconnected prerequisites for sustainable development, Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities, Business and Industry, Science and Technology for sustainable development, Constraints and barriers for sustainable development.

Textbooks

1. Boubel, R. W., Fox, D. L., & Stern, A. C. (2011). Fundamentals of air pollution (4th ed.). Academic Press. eISBN: 9780123821732.
2. Cunniff, P. E. (1987). Environmental noise pollution. McGraw-Hill. eISBN: 9780471189435

Reference books

1. CPHEEO, Ministry of Urban Development, GoI. (1999). Manual on water supply and treatment. New Delhi, India: Author. eISBN:
2. Masters, G. M. (2011). Introduction to environmental engineering and science. New Delhi, India: Prentice-Hall of India. eISBN: 9788131717086

Web links

1. https://byjus.com/commerce/meaning-and-features-of-sustainable-development/
2. https://www.era-environmental.com/blog/sustainability-management-triple-bottom-line
3. https://www.un.org/en/our-work/support-sustainable-development-and-climate-action
4. https://www.tandfonline.com/doi/full/10.1080/1331677X.2021.1989319
5. https://tracextech.com/5-widely-used-sustainability-frameworks-and-standards/

Hazard Identification & Risk Assessment

Course Code: 241PT040	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO1: Identify the Hazard and risk analysis
CO2: Summarize impacts of petroleum industry wastes and waste treatment methods.
CO3: Demonstrate the oil mines regulations in various petroleum industry operations.
CO4: Makeuse of thehazop study concepts for safe Practices in Petroleum industry.
CO5: Illustrate the fire triangle, different methods of suppression of hydrocarbon fires.

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:

Hazard Identification

Introduction - Hazard - Process - Hazard - Monitoring - Risk - Issues - Perception - Management Assessment-Analysis-Safety Audits-Management System Audits-Check Lists-Material Safety Data.

UNIT II:

Risk Analysis

What If Analysis-Event Tree-Fault Tree Analysis-Hazard and Operability Studies- Coarse Hazard Studies-Human Error Analysis-Safety Review System-Hazard Warning Methods-Hazard Warning Analysis- Plant Safety Audit.

UNIT III:

Software for Risk Analysis

Basic Concepts of Risk Analysis - Quantitative - Qualitative Methods - Hazard Models System-Hazard Assessment Systems - Principles of Applications of Software's- ALOHA - Hazard Operability Studies (HAZOP) - EFFECTS - Hazard Analysis (HAZAN) - PHAST - SAFETI - Failure Mode and Effect Analysis (FMEA).

UNIT IV:

Risk Control & Management

Impact estimation: Property, People, Man and Machine System, Job and Personal Risk Factors-Standards-Selection and Training-Body Size and Posture-Body Dimension (Static/Dynamic)-Adjustment Range- Penalties. - Guide Lines for Safe Design and Postures-Evaluation and Methods of Reducing Posture Strain.

UNIT V:

Man-Machine Interface-Controls-Types of Control-Identification and Selection-Types of Displays-Compatibility and Stereotypes of Important Operations-Fatigue and Vigilance-Measurement Characteristics and Strategies for Enhanced Performance Human Factor Engineering & Behavioral based safety.

Text Books

1. American Institute of Chemical Engineers (AIChE). (1992). Guidelines for hazard evaluation procedures (2nd ed.). Centre for Chemical Process Safety. eISBN: 9780470926063
2. American Institute of Chemical Engineers (AIChE). (2000). Guidelines for chemical process quantitative risk analysis (2nd ed.). Centre for Chemical Process Safety. eISBN: 9780470926070.

Reference Books

1. Lees, F. P. (1996). Loss prevention in the process industries (2nd ed.). Butterworth-Heinemann. eISBN: 9780750628223
2. National Safety Council. (n.d.). Accident prevention manual for business and industry, Vol. I. eISBN: 9780879123222

Web links

1. https://www.osha.gov/safety-management/hazard-Identification
2. https://www.investopedia.com/terms/r/risk-analysis.asp
3. https://clickup.com/blog/risk-management-software/
4. https://www.investopedia.com/terms/r/risk-control.asp
5. https://www.upm.com/investors/governance/risk-management-and-control/

Structural Fire Protection System

Course Code: 241PT046	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO-1: To explain the building's materialistic properties and their effect on fire exposure.
CO-2: Resolve the structural fire safety issues and challenges in occupancies by applying their skills and potential.
CO-3: Analyze or assess the fire safety conditions at the workplace and recommend for best fire-resistant and retardant material for minimizing fire vulnerabilities.
CO-4: Use their skills and potential to assist in planning and designing passive fire protection systems at the workplace.
CO-5: Design and develop a new methodology, process/ procedure for structural fire protection.

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:
Fire & Life Safety
Life Safety Objectives- Life safety, Property protection, Environmental protection; Fire Development- Fire behaviour, Human Behavior, Fire detection and Fire protection (Active/passive); Conceptual framework of fire safety-Scenario analysis, QRA; Fire Resistance- Objective example and fire design; Effect of temperature on the building material – Steel, Concrete. Wood, Glass & Plastics.

UNIT II:
Classification of Buildings, Zoning
Classification of buildings, Zoning- Building by-laws Compartments and compartmentation, elements of building contributing to a compartment; Standard Time-Temperature curves for building and oil/gas fires and associated standards;

UNIT III:
Fire Severity & Fire Resistance
Fire Severity & Fire Resistance- fire resistance, fire severity, fire resistance test, specifying fire resistance, fire resistance of assemblies. Means and methods of enhancing fire resistance of materials; fire doors; fire stops; products of combustion from various materials;

UNIT IV:
Health Effects of Smoke and Fire Products
Health effects of smoke and fire products- burns; Stack effect; smoke vents; pressurization of staircases; evacuation planning; special aspects of fire safety in high-rise and multi-occupancy premises. Layout, separation, and segregation for fire safety in industrial facilities; exposure protection.

UNIT V:
Introduction to Fire Modelling
Introduction to fire modelling- Various fire modelling methods, Applications; Advanced calculation methods- fire models, thermal response model, advanced structural models, hand calculation methods.

Text books

1. M. Ya Roytman (1975), Principles of fire safety standards for building construction, Washington DC: Amerind. eISBN: 9780750623451
2. V K Jain (2001), Fire Safety in Building, New Delhi: New Age International. eISBN: 9788122413485.

Reference books

1. A. K. Dass (2014), Principles of Fire Safety Engineering: Understanding Fire and Fire Protection, New Jersey: Prentice Hall. eISBN: 9789389347241
2. Bureau of Indian Standards (2008), Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System – Code of Practice", New Delhi: IS 2189:2008. eISBN: 9389347246

Web links

1. https://www.iafc.org/about-iafc/sections/fire-life-safety
2. https://www.findlaw.com/realestate/land-use-laws/types-of-zoning.html
3. https://www.venicefse.org/edizione2019/wp-content/uploads/2019/11/VanCoile_FireResistance_11_exclVideo-1.pdf
4. https://www.airnow.gov/sites/default/files/2021-08/how-smoke-from-fire-can-affect-your-health-2021-v1-d1.pdf
5. http://www.fireng.org/p/introduction-to-fire-modelling.html

Process Safety & Security

Course Code: 241PT042	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO-1: Understand the typical sources of risk in a process plant by hazard identification and examination of systems and accidents.
CO-2: Apply the knowledge of process safety and security to prevent high consequence incidents.
CO-3: Analyze the risk and estimate the consequences of failure of the system.
CO-4: Design safety and security systems for process industries to prevent major accidents from occurring.
CO-5: Analyze the chemical plant security

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:

Inherently Safer Design

Inherently safer design concepts and principles, Strategies, Approaches, Advantages, and disadvantages. Human factors in ISD, Process safety elements in ISD, Effective strategies of ISD; safety during startup and shutdown – safety checks in the design of the equipment, reactor safety, scrubbers and flares; safety in erection and commissioning of chemical plants. emergency safety devices.

UNIT II:

Safety In the Design of Chemical Process Plants

Design principles – reliability and safety in designing, Feasibility study, project organization and documentation, Types of contracts and liability, Basic engineering, detailed engineering, Understanding P&ID, and PFD. Material and heat balance, equipment, pipework, Assembly, commission, time schedule, aspects of safety licensing– new concepts in safety design and operation- Pressure vessel testing standards and methods.

UNIT III:

Reaction Kinetics

Stoichiometry of chemical reactions- key components-extent of reaction, conversion, selectivity, and yield. Chemical thermodynamics-reaction enthalpy-temperature and pressure dependency, chemical equilibrium, Free Gibbs enthalpy, Pressure influence on Chemical equilibrium, Kinetics-reaction rate-rate laws, decomposition-estimation of the chemical parameter. Thermochemical screening- Differential scanning calorimeter, Accelerated rate calorimetry, Thermo-gravimetry analyzer, Reaction calorimetry, Case studies. Stability and sensitivity tests, Hazard prediction by thermodynamic calculations.

UNIT IV:

Safety In the Operation of Chemical Process Plants

Properties of chemicals – Safety Data Sheets, Operational activities and hazards – safe operation of pumps, compressors, heaters, columns, reactors, pressure vessels, storage vessels, piping systems – effects of pressure, temperature, flow rate, and humidity on operations; corrosion and control its measures- condition monitoring; control valves – safety valves – pressure reducing valves, drains, bypass valves. Chemical splashes, eye irritation, and automatic showers. Storage -layouts-venting-relief valve size calculation- Hydrogen Safety-Handling-Storage, hazards, Preventive measures, case studies. Storage and handling of hazardous chemicals and industrial gases, safe disposal methods- safety in Pipeline transportation of materials, Color coding of pipelines. - Level and flow indicators, -Alarms, and lightning protection;

UNIT V:

Chemical Plant Security

Safety vs Security, Concept of security, Security Threats and vulnerability, Security risk standards, Security Vulnerability Assessment methods-API 780, CCPS SVA, VAM-CF, Security Risk Factor Table, Applications of Dynamic Risk Assessment. Prevention of Security incidents in various infrastructures handling hazardous materials- Industrial Vigilance, Case studies. Cybersecurity in process plants.

Textbooks

1. Crowl, D. A., & Louvar, J. F. (2002). Chemical process safety: Fundamentals with applications. Prentice Hall. eISBN: 9780132560707.
2. Security risk assessment: In the chemical and process industry (Integrated Security Science Book). De Gruyter. eISBN: 9783110497762

Reference books

1. Lees, F. P. (2005). Lees' handbook of loss prevention in chemical process industries: Hazard identification, assessment and control (3rd ed.). Butterworth-Heinemann. eISBN: 9780750663062.
2. Arendt, J. L., & Lorenzo, V. (2000). Evaluating process safety in the chemical industry. Centre for Chemical Process Safety, American Institute of Chemical Engineers. eISBN: 9780816906296.

Web links

1. https://www.icheme.org/media/8500/xxv-paper-33.pdf
2. https://www.linkedin.com/pulse/safety-design-process-plants-damian-connelly-6123687000219340800
3. https://byjus.com/jee/chemical-kinetics/
4. https://www.mt.com/in/en/home/applications/L1_AutoChem_Applications/Process-Safety.html#:~:text=To%20ensure%20safe%20and%20compliant,or%20environmental%20degradation%20or%20pollution.
5. https://www.cisa.gov/topics/critical-infrastructure-security-and-resilience/chemical-security

Safety in Engineering Industry

	L	T	P	C
Course Code: 241PT044	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO1: Develop management plans to prevent accidents in construction Industry.
CO2: Prepare plans to safe guard workers in construction of high-risk Buildings.
CO3: Ensure safety while operating construction machinery.
CO4: Outline safety plans for demolition of buildings.
CO5: Prepare fire safety plans for a given building.

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:

Safety In Metal Working Machinery and Woodworking Machines

Introduction to manufacturing processes, General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machines, planar machine and grinding machines, CNC machines, Woodworking machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards.

UNIT II:

Principles of Machine Guarding

Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding- Guarding and guarding devices- types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. Selection and suitability- case studies, benefits of good guarding systems.

UNIT III:

Safety In Welding and Gas Cutting

Gas welding and oxygen cutting, resistance welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-color coding – flashback arrestor – leak detection- pipe line safety-storage and handling of gas cylinders. Underwater welding-Hazards and control measures

UNIT IV:

Safety In Cold Forming and Hot Working Of Metals

Cold working, power presses, point of operation safeguarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot- operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes. Hot working safety in forging, hot rolling mill operation, safeguards in hot rolling mills – hot bending of pipes, hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes. Rapid Prototyping-Hazards and control measures.

UNIT V:

Safety In Finishing, Inspection and Testing

Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation. Health and welfare measures in engineering industry-pollution control in engineering industry-industrial waste disposal.

Textbooks

1. National Safety Council (1988). Accident prevention manual (13th ed.). Engineering and Technology. eISBN: 9780879120269
2. International Labour Organization. (n.d.). ILO encyclopaedia of occupational health and safety (Part XIII, Manufacturing industries). eISBN: 9789221092032

Reference books

1. Grimaldi, J. V., & Simonds, R. H. (2011). Safety management (9th ed.). Prentice Hall. eISBN: 9780256066982
2. Krishnan, N. V. (2018). Safety management in industry (7th ed.). Jaico Publishing House. eISBN: 9788172240295

Web links

1. https://www.scribd.com/presentation/554701362/Unit-1-Copy
2. https://www.dir.ca.gov/dosh/cal_vpp/best_Practices_symposiums/machine-guarding.barry-blodgett.pdf
3. https://www.lsu.edu/ehs/references/university-safety-manual/4J_Welding_cutting.php
4. https://rlsdhamal.com/safety-in-hot-and-cold-processes-manufacturing-of-steel/#:~:text=Good%20insulation%20over%20hot%20metal,dusts%2C%20fumes%2C%20gases%20etc.
5. https://www.engr.washington.edu/files/mycoe/safety/Workplace_A.PDF

Safety in Drilling

Course Code: 241PT043	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO-1: Describe the function, working principle of Drilling rig and its various components.

CO-2: Calculate drilling efficiency and selection of Drilling tubulars & Circulation.

CO-3: Demonstrate the various safety issues considered during drilling.

CO-4: Detail and suggest prevention of Kick Causes and Indicators

CO-5: Describe about Safety Issued in Oil and Gas Production

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 Drilling Rig and Components
Hoisting System: Component Parts; Derricks, Mast, Substructures, Weight Indicator, Wire Line and Draw Works, Power System: Prime Moves, Transmission System, Rotary System: Swivel, Kelly, Rotary Table.

UNIT II:
Fundamentals of Drilling Tubulars & Circulation
Tubulars: Drill Pipe, Tool Joint, Casing Pipe, Design Consideration, Circulation System: Drilling Fluid Types, Preparation and Conditioning System, Additive, Pumping System, Cutting Removal, Pressure Loss Circulation, Drilling Practices: Bit Choice, Weight on Bit, Rotary Speed, Hydraulic Effect, Air- Gas Drilling, Coring, Drilling Efficiency.

UNIT III:
Cementation & Safety Issues in Drilling
Cementing Operations: Cement Types, Additives, Process and Equipment, Complication: Lost Circulation, Fishing, Blow Outs, Well Planning: GTO, Safety Consideration in well Completion

UNIT IV:
Basics of Well Control
Oil field Pressure, Kick Causes and Indicators, well control equipment's, Types of Well control, Kill Sheet.

UNIT V:
Production
Well Completion Practices: Well- Head Assemble, Installation and Testing, Activation, Well Testing, Self-Flowing Wells, Gas Lift: Sucker Rod and Down Hole Motor Pumping of Oil, Safety Issued in Oil and Gas Production.

Textbooks

1. IADC Well CAP Drilling Well Control and Blowout Prevention Training Program (2017). International Association of Drilling Contractors. eISBN:
2. API Recommended Practice 51 Recommended Practice for Blowout Prevention Equipment Systems for Drilling Wells (2016). American Petroleum Institute. eISBN:

Reference books

1. Taylor, I. L. (Ed.). (n.d.). Methods of exploration and production of petroleum resources (Vol. V). eISBN:
2. Hyne, F. J. (1991). Dictionary of petroleum exploration, drilling & production. PennWell Books. eISBN:

Web links

1. https://en.wikipedia.org/wiki/List_of_components_of_oil_drilling_rigs
2. https://www.slideshare.net/slideshow/q931de1b03/41904147
3. https://www.saigaogroup.com/news/cementing-complex-problems.html
4. https://petex.utexas.edu/images/book_previews/Practical-Well-Control_previewwtrmrk.pdf
5. https://en.wikipedia.org/wiki/Completion_(oil_and_gas_wells)

Disaster Risk Management

Course Code: 241PT037	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO-1: Understand basic concept and appreciate the institutional framework in India for disaster preparedness and mitigation.
CO-2: Characterize and analyzes natural and manmade hazards, to identify their causes, mechanisms and evaluate their significance for the human population.
CO-3: Create strategies and implementation plan for Prevention, Responsive mitigation and recovery during industrial or natural disasters.
CO4: Apply the best Practices and gaps from case studies on natural and manmade disasters.
CO5: Explain relief and rehabilitation in disasters

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 - Hazards and Disasters

Introduction - Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, Institutional framework in India for disaster preparedness and mitigation, Common disaster types in India; Legislations in India on disaster management; National disaster management policy; The Sendai Framework for Disaster Risk Reduction- targets, priorities for action, guiding principles.

UNIT II:

Natural Disaster: Earthquake, Landslide and Forest Fire

Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, Landslide and land degradation: Causes – tectonic conditions – erosion – avalanches – rock fall –damage assessment. Forest fire, causes, control and prevention, urban fire, building construction and structural fire protection, electric hazard, shock and protection, aircraft fire, actions required for rescue and fire fighting in air crafts.

UNIT III:

Floods, Tsunami Marine Environment Pollution and Control

Floods: General characteristics causes – geomorphology and floods – flood forecasting – river and coastal flood – flash flood – lake outburst – risks, environmental planning – flood control and management. Drought control and management, Cyclone and Tsunami: Structure and nature of cyclones and Tsunamis – characteristics hazard donation – factors-hazard potential – impact assessment. Coastal and marine environment pollution and control – marine environment degradation – land use changes in coastal zones – wave – tidal storms – erosion habitat pollution – sediment discharge and control. Droughts Causes – vulnerability – tides – famines – desert and desertification.

UNIT IV:

Man Made Disaster

Manmade hazards: Toxic chemicals, noise pollution, industrial disaster and accident, Terrorist disaster / War, Hazardous wastes, reactivity, toxicity, nuclear war, biological weapons, biodiversity extinction and deforestation. causes and adverse effects Epidemics. National & Worldwide Scenario: History of disasters - various disasters in various countries - Worldwide Aid and Agencies, Study of different case studies on natural disaster & man-made disaster.

UNIT V

Relief And Rehabilitation in Disasters

Relief and rehabilitation in disasters at local, national and global levels, Disaster Risk Assessment, understanding hazards, vulnerability and exposure, risk analysis and risk mapping techniques, Disaster risk reduction, Disaster Preparedness and response, disaster recovery and rehabilitation, emergency planning and preparedness, post disaster assessment and recovery

planning, reconstruction and infrastructure building, vulnerability and capacity assessment, Community Engagement and public awareness, communication strategies for raising public awareness about disaster risk, Case Studies and Practical real applications : Analysing real world disaster and their application

Textbooks

1. Donald Hyndman, David Hyndman "Natural Hazards and Disasters" Third Edition,JHJK Publisher : Cengage Learning, Inc; 3rd ed. edition (25 August 2010) eISBN: 9780495416657
2. Coppola P Damon, 2007. Introduction to International Disaster Management, Carter, Nick 1991. eISBN: 9780123738900.

Reference Books

1. Government of India, Ministry of Home Affairs, National Disaster Management Division, 2004, Disaster Management in India – A Status Report eISBN:
2. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012) eISBN: