ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
M. TECH. CHEMICAL ENGINEERING (Specialization in Pipeline Engineering)
REGULATIONS – 2023
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND I SEMESTER SYLLABI

Semester I

S. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
Theory								
1.	MA3155	Advanced Numerical Methods	FC	3	1	0	4	4
2.	RM3151	Research Methodology and IPR	RMC	2	1	0	3	3
3.	CL3101	Advanced Transport Phenomena	PCC	3	0	0	3	3
4.	PL3101	Fluid Operations and flow assurance	PCC	3	0	2	5	4
5.	CL3103	Advanced Process Control	PCC	2	0	2	4	3
6.	PL3102	Basics of Petroleum Engineering	PCC	3	0	0	3	3
7.	PL3103	Safety Measures in Petroleum Transportation by Pipelines	PCC	3	0	0	3	3
Total Credits				**19**	**2**	**4**	**25**	**23**

Semester II

S. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.		Piping Design for Transportation of Oil & Gas	PCC	2	1	0	3	3
2.		Operation &Maintenance of Pipelines in Oil & Gas	PCC	3	0	0	3	3
3.		Corrosion Prevention and Equipment Maintenance	PCC	3	0	0	3	3
4.		Pipeline Modelling &Networking	PCC	3	0	0	3	3
		Pipeline Standards and Codes	PCC	3	0	0	3	3
5.		Professional Elective III	PEC	3	0	0	3	3
6.		Professional Elective IV	PEC	3	0	0	3	3
Total Credits				**20**	**1**	**0**	**21**	**21**

Semester III

S. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
Theory								
1.		Modelling of Chemical Processes	PCC	3	1	0	4	4
2.		Pipeline Structural Engineering	PEC	3	0	0	3	3
3.		Professional Elective V	PEC	3	0	0	3	3
4.		Professional Elective VI	PEC	3	0	0	3	3
Practicals								
5.		Project Work I	EEC	0	0	12	12	6
			Total Credits	**12**	**1**	**12**	**25**	**19**

Semester IV

S. No.	Course Code	Course Title	Category	Periods per week			Total contact periods	Credits
				L	T	P		
Practicals								
1.		Project Work II	EEC	0	0	24	24	12
			Total Credits	**0**	**0**	**24**	**24**	**12**

TOTAL CREDITS: 23+21+19+12 = 75

Foundation Courses (FC)

S. No	Course Code	Course title	Periods Per Week			Credits
			L	T	P	
1.		Advanced Numerical Methods	4	0	0	4
Total Credits						**4**

List of Professional Core Courses (PCC)

S. No	Course Code	Course Title	Periods Per Week			Credits
			L	T	P	
1.		Advanced Transport Phenomena	3	0	0	3
2.		Fluid Operations and Flow Assurance	3	0	2	4
3.		Advanced Process Control	2	0	2	3
		Basics of Petroleum Engineering	3	0	0	3
4.		Piping Design for Transportation of Oil & Gas	2	0	2	3
5.		Operation & Maintenance of pipelines in Oil & Gas	3	0	0	3
6.		Corrosion Prevention and Equipment Maintenance	3	0	0	3
7.		Pipeline Modelling & Networking	3	0	0	3
		Pipeline Standards and Codes	3	0	0	3
8.		Pipeline Structural Engineering	3	0	0	3
9.		Modelling of Chemical Processes	3	1	0	4
Total Credits						**31**

Professional Elective Courses

S. No.	Course Code	Course Title	Category	Periods per week			Total Contact Periods	Credits
				L	T	P		
1.		Gas Transmission and Distribution piping system	PEC	3	0	0	3	3
2.		Pipeline Planning and Surveying	PEC	3	0	0	3	3
3.		Pipeline Project Management	PEC	3	0	0	3	3
4.		Pipeline Network Analysis	PEC	3	0	0	3	3
5.		Telemetry system in pipelines	PEC	3	0	0	3	3
6.		Piping and Instrumentation	PEC	3	0	0	3	3
7.		Fluidization Engineering	PEC	3	0	0	3	3
8.		Multiphase flow	PEC	3	0	0	3	3
9.		Computational Fluid Dynamics	PEC	3	0	0	3	3
10.		Supply Chain Management in Oil and Gas	PEC	3	0	0	3	3
11.		Petroleum Economics	PEC	3	0	0	3	3

Research Methodolgy and IPR Courses (RMC)

S.no	Course code	Course Title	Periods Per Week			Credits
			L	T	P	
1.	RM3151	Research Methodology and IPR	2	1	0	3

Employability Enhancement Courses (EEC)

S.No	Course Code	Course Title	Periods per			Credits
			L	T	P	
1.		Project Work I	0	0	12	6
2.		Project Work II	0	0	24	12
					Total Credits	**18**

Summary

	Name of the Programme: M.Tech. Chemical Engineering(Specialization in Pipeline Engineering)					
	Subject Area	Credits Per Semester				Credits Total
		I	II	III	IV	
1.	FC	4	-	-	-	4
2.	PCC	13	15	4	-	22
3.	PEC	3	6	9	-	21
4.	RMC	3	-	-	-	3
5.	EEC	-	-	6	12	18
6.	**Total Credit**	**23**	**21**	**19**	**12**	**75**

MA3155 ADVANCED NUMERICAL METHODS

L	T	P	C
3	1	0	4

OBJECTIVES:

- To make the students understand the methods/algorithms to numerically solve a system of simultaneous algebraic equations.
- To make the students understand the methods to numerically solve the system of simultaneous ordinary differential equations.
- To make the students understand the methods to numerically solve the partial differential equations.
- To make the students understand the methods to numerically solve the elliptic equations.
- To make the students understand the finite element methods for solving the PDEs.

UNIT I ALGEBRAICEQUATIONS 12

Systems of linear equations: Gauss Elimination method, pivoting techniques, Thomas algorithm for tridiagonal system – Jacobi, Gauss Seidel, SOR iteration methods - Systems of nonlinear equations: Fixed point iterations, Newton Method, Eigenvalue problems: power method, Faddeev – Leverrier Method.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 12

Runge Kutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep method, solution of stiff ODEs, shooting method, BVP: Finite difference method, collocation method, orthogonal collocation method, Galerkin finite element method

UNIT III FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATION 12

Parabolic equations: explicit and implicit finite difference methods, weighted average approximation - Dirichlet and Neumann conditions – Two dimensional parabolic equations – ADI method; First order hyperbolic equations – method of characteristics, Lax-Wendroff explicit and implicit methods; numerical stability analysis, method of lines – Wave equation: Explicit scheme-Stability of above schemes

UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS 12

Laplace and Poisson's equations in a rectangular region: Five point finite difference schemes, Leibmann's iterative methods, Dirichlet and Neumann conditions – Laplace equation in polar coordinates: finite difference schemes – approximation of derivatives near a curved boundary while using a square mesh.

UNIT V FINITE ELEMENT METHOD 12

Partial differential equations – Finite element method - collocation method, orthogonal collocation method, Galerkin finite element method.

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1 Solve numerically system of simultaneous algebraic equations.
CO2 Solve the simultaneous ordinary differential equations (IVP) numerically.
CO3 Solve numerically set of Partial differential equations.

CO4 Solve the set of Elliptic equations numerically.
CO5Solve the set of PDEs by finite element method.

REFERENCES:

1. Burden. R. L. and Faires. J. D., “Numerical Analysis; Theory and Applications”, India Edition, Cengage Learning, 2010.
2. Jain M.K., Iyengar S.R.K. and Jain R.K., Computational Methods for Partial Differential Equations, New Age International, 2nd Edition, New Delhi, 2016.
3. Morton K.W., and Mayers D.F., “Numerical Solution of Partial Differential Equations, Cambridge University Press, Second Edition, Cambridge, 2005.
4. Santosh K Gupta, “Numerical Methods for Engineers”, New Age International (P) Limited, Publishers, New Delhi, 2014.
5. Sastry S.S., "Introductory Methods of Numerical Analysis", Prentice - Hall of India Pvt. Limited, 5th Edition, New Delhi, 2012.
6. Saumyen Guha and Rajesh Srivastava, “Numerical methods for Engineering and Science”, Oxford Higher Education, New Delhi, 2010.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	3	2	2
CO2	3	3	3	3	2	2
CO3	3	3	3	3	2	2
CO4	3	3	3	3	2	2
CO5	3	3	3	3	2	2
Avg	3	3	3	3	2	2

RM3151 RESEARCH METHODOLOGY AND IPR L T P C
2 1 0 3

OBJECTIVES:

To impart knowledge on

- Formulation of research problems, design of experiment, collection of data, interpretation and presentation of result
- Intellectual property rights, patenting and licensing

UNIT I RESEARCH PROBLEM FORMULATION 9

Objectives of research, types of research, research process, approaches to research; conducting literature review- information sources, information retrieval, tools for identifying literature, Indexing and abstracting services, Citation indexes, summarizing the review, critical review, identifying research gap, conceptualizing and hypothesizing the research gap

UNIT II RESEARCH DESIGN AND DATA COLLECTION 9

Statistical design of experiments- types and principles; data types & classification; data collection - methods and tools

UNIT III DATA ANALYSIS, INTERPRETATION AND REPORTING 9

Sampling, sampling error, measures of central tendency and variation,; test of hypothesis- concepts; data presentation- types of tables and illustrations; guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript; guidelines for writing thesis, research proposal; References – Styles and methods, Citation and listing system of documents; plagiarism, ethical considerations in research

UNIT IV INTELLECTUAL PROPERTY RIGHTS 9

Concept of IPR, types of IPR – Patent, Designs, Trademarks and Trade secrets, Geographical indications, Copy rights, applicability of these IPR; , IPR & biodiversity; IPR development process, role of WIPO and WTO in IPR establishments, common rules of IPR practices, types and features of IPR agreement, functions of UNESCO in IPR maintenance.

UNIT V PATENTS 9

Patents – objectives and benefits of patent, concept, features of patent, inventive steps, specifications, types of patent application; patenting process - patent filling, examination of patent, grant of patent, revocation; equitable assignments; Licenses, licensing of patents; patent agents, registration of patent agents.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, the student can

CO1: Describe different types of research; identify, review and define the research problem
CO2: Select suitable design of experiment s; describe types of data and the tools for collection of data
CO3: Explain the process of data analysis; interpret and present the result in suitable form
CO4: Explain about Intellectual property rights, types and procedures
CO5: Execute patent filing and licensing

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Soumitro Banerjee, “Research methodology for natural sciences”, IISc Press, Kolkata, 2022,
3. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
4. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

CL3101 ADVANCED TRANSPORT PHENOMENA

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge on the concepts of transport phenomena and its relationships with other core chemical engineering subjects.
- To make the students to develop governing equations for complex system in chemical engineering
- To make the students to learn solution techniques in momentum, energy and mass transport phenomena.
- To help the students to understand the flow behavior in different systems
- To make the students to develop critical thinking skills, interpret physicochemical phenomena to and from mathematical expressions.

UNIT I BASIC CONCEPTS 9

Phenomenological Equations and Transport properties, Rheological behavior of fluids, Models for Rheological Behavior; Balance Equations – Differential and Integral equations

UNIT II APPLICATIONS OF DIFFERENTIAL EQUATIONS OF CHANGE 9

Applications in laminar and turbulent transport in compressible and incompressible fluids, Boundary layer theory – Momentum, Thermal and Concentration Boundary layer, Similarity Transformation – Blasius Solution

UNIT III APPLICATIONS OF INTEGRAL EQUATIONS OF CHANGE 9

Reynolds Transport Theorem – application of RTT to solutions for Macroscopic balance for isothermal and non-isothermal systems and their applications in Momentum, Heat and Mass transport problems.

UNIT IV INTERPHASE AND MULTIPHASE MOMENTUM TRANSFER 9

Friction factor, Fluid systems, Flow patterns in vertical and horizontal pipes, Formulation of bubbles and drops and their size distribution, Solid fluid systems, Forces acting on stagnant and moving solids, Flow through porous medium, capillary tube model and its applications.

UNIT V INTERPHASE TRANSPORT IN NON-ISOTHERMAL SYSTEMS 9

Heat Transfer coefficient, Forced convection in tubes, around submerged objects, Heat Transfer by free convection, film type and dropwise condensation and equations for heat transfer, Heat transfer in boiling liquids, Mass Transfer co-efficient in single and multiple phases at low and high mass transfer rates, Film theory, Penetration theory, Boundary layer theory, Macroscopic balance to solve steady and Unsteady state problems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Recall Phenomenological Equations, Transport properties and rheological behavior of fluids.
CO2: Apply differential equation of change for momentum, heat and mass transport problems.
CO3: Apply integral equations of change for momentum, heat and mass transport problems.
CO4: Analyze interphase and multiphase momentum transfer
CO5: Evaluate interphase transport in non-isothermal system andto solve steady and Unsteady state problems.

REFERENCE BOOKS:

1. Bird, R. B., Lightfoot, E. N., & Stewart, E. W., “Transport phenomenon”, Wiley, 2007.
2. Welty, J.R., Wicks, C. E. and Wilson, R. E., “Fundamentals of Momentum, Heat Mass Transfer”, 5th Edn., John Wiley and Sons, 2007
3. Deen, W. M., “Analysis of Transport Phenomena”, Topics in Chemical Engineering (Vol. Oxford University Press, New York. 1998.
4. Leal, L. G., “Advanced transport phenomena: fluid mechanics and convective transport processes”, (Vol. 7). Cambridge University Press, 2007.
5. Brodkey, R. S., and Hershey, H. C., “Transport phenomena: a unified approach”, Brodkey publishing, 2003.

Course Articulation Matrix:

Course Outcomes	**Program Outcomes**					
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO1	3	1	3	3	2	1
CO2	3	1	3	3	2	1
CO3	3	1	3	3	2	1
CO4	3	1	3	3	2	1
CO5	3	1	3	3	2	1
Average CO	3	1	3	3	2	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

PL3101	FLUID OPERATIONS AND FLOW ASSURANCE	L T P C 3 0 2 4

OBJECTIVES:

- To enable the students to understand in-depth study of fluid operating equipments and accessories commonly used in industrial fluid transportation systems and to get knowledge on flow assurance.

UNIT I FUNDAMENTALS OF FLUID FLOW AND SYSTEM HYDRAULICS

Fluid flow regimes, conservation equations, Darcy-Weisbach equation, Colebrook-White equation, head, system curves, effect on parameters of system curves. Types of phase diagrams, fluid behavior, hydrocarbon reservoirs and fluids, fluid properties and fluid property calculations

UNIT II PUMPS, COMPRESSORS AND ACCESSORIES

Pumps: Types of pumps, performance characteristics, power requirements

Compressors: Types of compressors, principles, operations, power requirements and parameters

Accessories: Valve functions, different types actuators, API, ASME , Elbows, tees, reducers, caps, unions, nipples, Gaskets and flanges

UNIT IIIFLOW ASSURANCE IN ONSHORE PIPELINES AND SUBSEA PIPELINES

Flow Assurance in Onshore Pipelines: Onshore pipeline components; Pressure Boosting; Topographical considerations; Pilferage and safety (Case Study); Flow Control vs Pressure Control; Considerations for multi-delivery pipelines; Ullage requirement calculations; Special considerations for station piping; Monitoring and detection of leaks.Flow Assurance in Subsea Pipelines: Infield Flowlines; Export Pipelines; Separation of Multiphase fluid; Processing of gasFlow Assurance in Multi-Product Pipelines.

UNIT IVFLOW ASSURANCE IN VARIOUS TYPES OF PIPELINES

Flow Assurance in Single Phase Liquid Pipelines, Single Phase Gas Pipelines; Flow Assurance in Multiphase pipelines: Flow Regimes and flow pattern maps, Significance of GOR and watercut, Liquid Hold-up, Slugging in pipelines.

Steady state Flow Assurance: Pipeline sizing, Hydraulics, Pressure, Temperature profile generation. Transient Flow Assurance in pipelines: Pipeline restart and shutdown analysis, Flow rate ramp-up and turndown, Cooldown analysis

UNIT VFLOW ASSURANCE IN WAXY, SLURRY PIPELINES AND SURGE ANALYSIS

Hydraulics, operation and equipment of Slurry Pipelines; Introduction, management and mitigation of waxy oil Pipelines; Surge Analysis: Basics of Surge, Design criteria for surge protection; surge control

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1: To Apply fundamental fluid mechanics principles to pump and compressor operation.
CO2: To Select and size various types of pumps based on fluid properties, process conditions
CO3: To select and size different types of compressors for gas handling applications.

CO4: Understand the function, selection criteria, and sizing of common pipe accessories (valves, fittings)
CO5: To understand the importance of Safety and economic considerations

TEXTBOOKS:

1. Karassik, I. J., Messina, J. P., Cooper, P., & Heald, C. C. (2001). Pump Handbook. McGraw-Hill.
2. Boyce, M. P. (2012). Centrifugal Compressors: A Basic Guide. PennWell Books.
3. Mohitpour, M., Murray, A., & McManus, M. (2009). Pipeline Design and Construction: A Practical Approach. ASME Press. (Relevant chapters on fittings, valves, etc.)
4. Yong Bai., Qiang Bai; Subsea Engineering Handbook; Gulf Professional Publishing; Elsevier., 2012

REFERENCES

1. Perry, R. H., Green, D. W., & Maloney, J. O. (Eds.). (2008). Perry's Chemical Engineers' Handbook. McGraw-Hill Education. (Relevant sections on fluid and gas transport)
2. Walas, S. M. (1990). Chemical Process Equipment: Selection and Design. Butterworth-Heinemann.
3. API Recommended Practice 520 (Parts I & II): Sizing, Selection, and Installation of Pressure-Relieving Devices.

CL3103 ADVANCED PROCESS CONTROL L T P C
2 0 2 3

OBJECTIVES:

- To enable the students to learn fundamentals of linear time-varying systems and non-linear systems
- To make the students aware of different advanced control strategies for various industrial applications
- To impart students the knowledge on model-based control methods for linear and nonlinear systems
- To facilitate students the understanding on the dynamics of multivariable systems
- To educate the students on industrial implementation of digital control systems

UNIT I ADVANCED CONTROL STRATEGIES 6

Linear, nonlinear regression fitting for first order, second order models without and with time delay; development of discrete time model and parameter identification; Advanced control - Feed forward, cascade, dead time compensation, split range, inferential, selective and override control; smith predictor; automatic tuning and gain scheduling

UNIT II MODEL BASED CONTROL DESIGN 6

Model based control – IMC structure, development and design; Direct synthesis method; IMC based PID control, Overview of MPC - prediction for SISO and MIMO models, MPC calculation, set point calculation, selecting the tuning parameters in MPC, Design examples for typical case studies; Introduction to Non-linear MPC

UNIT III MULTIVARIABLE CONTROL6

Control loop interaction – general pairing problem, relative gain array and application, sensitivity; Multivariable control – zeros and performance limitations, directional sensitivity and operability, decoupling

UNIT IV DISCRETE SYSTEMS & NON-LINEAR SYSTEMS6

Z – Transform and inverse Z – transform properties; Discrete – Time Response of dynamic system, Pulse Transfer Function, Closed Loop System Stability; Models for Time-varying and Nonlinear systems; Hammerstein and Wiener Systems; Fuzzy logic controls; Neural network control

UNIT V DIGITAL FEEDBACK CONTROLLERS6

Design of digital feedback controllers - Essential components, Digital control implementation, Programmable Logic Controller, Distributed Control System, SCADA, Hardware for computer - based control, Interfacing computer system with process

THEORY: 30 PERIODS

LIST OF EXPERIMENTS

- Level control process with data acquisition
- Temperature control process with data acquisition
- Flow control process with data acquisition
- Pressure process trainer with data acquisition
- Implementation of Model Predictive Control in process control station
- Implementation of Fuzzy logic, control in process control station
- PLC and web based real time process control system
- Integration of process control equipment in COMOS software

- Create P & ID diagram
- Simulation of process plant using COMOS software

PRACTICAL: 30 PERIODS

COURSE OUTCOMES:

CO1: Identify and apply different advanced control configurations for specific applications
CO2: Compare and understand the capability of model-based control systems
CO3: Analyze the multivariable systems with interaction and its sensitivity
CO4: Gain fundamental knowledge on Z transform to analyze discrete systems
CO5: Gain exposure on the implementation of digital control systems
CO6: Implement PLC based control of a process
CO7: Implement Model Predictive control of a process
CO8: Implement PLC and webserver based real time process control

REFERENCE BOOKS:

1. Bequette, B. W., "Process Control: Modeling, Design, and Simulation", Prentice Hall, 2003
2. Stephanopoulos G., "Chemical Process Control", 1st ed., Pearson Education India, New Delhi, 2015.
3. Kannan M. Moudgalya, "Digital Process Control", John Wiley & Sons Ltd,2007
4. W L Luyben, "Process Modeling Simulation & Control for Chemical Engineers", McGraw Hill Education, 2nd edition, 2013
5. Seborg D.E., Edgar, T. F., Mellichamp D.A., "Process Dynamics and Control", 3rd ed., Wiley India, New Delhi, 2013.

Course Articulation Matrix

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	1	3	2	1
CO2	1	1	3	3	1	1
CO3	2	2	3	3	3	1
CO4	2	1	3	3	2	1
CO5	3	2	3	3	3	2
CO6	3	2	3	3	3	2
CO7	3	2	3	3	3	2
CO8	3	2	3	3	3	2
Average CO	2.38	1.63	2.75	3	2.5	1.5

PL3102 BASICS OF PETROLEUM ENGINEERING L T P C
3 0 0 3

UNIT I INTRODUCTION TO PETROLEUM ORIGIN, PETROLEUM GEOLOGY AND OIL EXPLORATION METHODS 9

Origin and accumulation of crude oil, Source and Reservoir rocks, entrapment and accumulation of petroleum, sedimentary basins, classification and types of exploration methods; Gravity, Magnetic and seismic methods;

UNIT II OIL AND GAS WELL DRILLING TECHNOLOGY 9

Well planning. Drilling method. Drilling rigs Rig operating systems. Drilling fluids function and properties. Drilling fluid maintenance equipment. Oil & gas well cementing operations. Drill bit types and their applications. Drill string & Casing string function, operations, selection & design. Directional drilling tools. Offshore Drilling and Production Practices: Offshore oil and gas operations & ocean environment. Offshore fixed platforms, Offshore mobile units, Station keeping methods like mooring & dynamic positioning system.

UNIT III PETROLEUM REFINING AND PETROCHEMICALS 9

Crude oil classification, Overall refinery operation, Primary Separation-Atmospheric and Vacuum distillation units, Secondary conversion processes, blending, Petroleum Products and their specifications, Major Petrochemicals

UNIT IV PETROLEUM TRANSPORTATION AND STORAGE 9

Various modes of transport, Gas and liquid transport, Pipeline survey and construction, pumps and compressors, pipeline accessories, Storage of petroleum products and crude oil.

UNIT V ENERGY SCENARIO, SAFETY AND ENVIRONMENT 9

Introduction to Conventional Energy and Energy scenario, Hazards of Petroleum Industries, Environmental considerations, International policies on petroleum, Indian scenario in Petroleum upstream and downstream.

TOTAL: 45 PERIODS

REFERENCES:

1. The Petroleum Shipping Industry: Operations and Practices, Penwell Books, 1996.
2. Introduction to the Oil Pipeline Industry (Oil Pipeline Transportation Practices), The University of Texas at Austin - Petroleum Extension Service; 3rd edition 1984.
3. A.I. Levorsen, “Geology of Petroleum”, 2nd Edition. CBS, Publishers, 2006.
4. W.L. Nelson, “Petroleum Refinery Engineering”, 4th edition, Mc Graw Hill, 1985
5. Jones, D.S.J. and Pujadó, P.R., “Handbook of petroleum processing”, Springer, The Netherlands, 2006.

PL3103 SAFETY MEASURES IN PETROLEUM TRANSPORTATION BY PIPELINES

L	T	P	C
3	0	0	3

UNIT I HAZARDS AND SAFETY IN PETROLEUM TRANSPORTATION

Health hazards in Petroleum Industry: Toxicity, Physiological, Asphyxiation, respiratory and skin effect. Personal protection system & measures. HSE Policies. Safety in petroleum transportation. Hazard analysis techniques

UNIT II ENVIRONMENTAL IMPACTS OF PETROLEUM LEAKAGE

Environment: Environment concepts, impact on eco-system, air, water and soil. transport of petroleum wastes. Offshore environmental studies. Offshore oil spill, onshore oil leakage and control.

UNIT III SAFETY SYSTEMS

Manual & automatic shutdown system, blow down systems. Gas Monitoring System, Gas detection system, Emergency Shutdown**,** Pressure Limiting Devices, Windsock, Emergency Power Supply, Communication System

UNIT IV FIRE FIGHTING

Fire detection and suppression systems, Automatic Fire Detection and Alarm System, Fire Fighting Equipments, Fire protection system, Fire Water System, Fire Water Storage, Fire Water Pumps, Fire Hydrant Network, Medium Velocity Sprinkler System

UNIT V MONITORING, INSPECTION, TESTING OF PIPELINE AND EMERGENCY RESPONSE

Inspection, Monitoring, Control and Testing of Pipeline, radiography, ultrasonic test or other applicable NDT methods, Hydro-test, Hydrostatic Testing, Pneumatic Testing, Emergency Response' Disaster & crisis management.

REFERENCES BOOKS:

1. Dennis P. Nolan, Application of HAZOP and What-If Safety Review to the Petroleum, Petrochemical and Chemical Industries, Elsevier Science, 1994
2. J. C. Jones, Hydrocarbon Process Safety, 2nd edition, **Whittles Publishing**, 2014
3. Centre for Chemical Process Safety, Newyoek 'Guidelines for Engineering Design for Process Safety', 2nd edition, Wiley, 2012
4. Daniel E. Della-Giustina, Fire Safety Management Handbook 3rd edition, CRC Press, 2014
5. R. Winston Revie, Oil and Gas Pipelines: Integrity and Safety Handbook, 1st edition, Wiley, 2015