University of Pune

Faculty of Engineering

Master of Engineering

Syllabus

For

ME (Petrochemical Engineering)

Effective from June 2013

M.E. Petrochemical Engineering, 2013 Course
Semester I

Code	Subject	Teaching Scheme	Examination Scheme					Credits
		Lectures /Practicals	Paper		TW	Oral/ Presentation	Total	
			In semester assessment	End semester assessment				
512201	Recent Trends in Petroleum Refining Operations	4	50	50	-	-	100	4
512202	Advanced Transport Phenomena	4	50	50	-	-	100	4
512203	Advanced Numerical and Statistical Methods	4	50	50	-	-	100	4
512204	Research Methodology	4	50	50	-	-	100	4
512205	Elective I	5	50	50	-	-	100	5
512206	Lab Practice I	4	-	-	50	50	100	4
Total		25	250	250	50	50	600	25

M.E. Petrochemical Engineering, 2013 Course
Semester II

Code	Subject	Teaching Scheme	Examination Scheme					Credits
		Lectures /Practicals	Paper		TW	Oral/ Presentation	Total	
			In semester assessment	End semester assessment				
512207	Applied Process Design and Synthesis	4	50	50	-	-	100	4
512208	Safety, Health and Environment in Petrochemical Plants	4	50	50	-	-	100	4
512209	Advanced Process Control	4	50	50	-	-	100	4
512210	Elective II	5	50	50	-	-	100	5
512211	Lab Practice II	4	50	50	-	-	100	4
512212	Seminar I	4			50	50	100	4
Total		25	250	250	50	50	600	25

M.E. Petrochemical Engineering, 2013 Course

Semester III

Code	Subject	Teaching Scheme	Examination Scheme					Credits
		Lectures /Practicals	Paper		TW	Oral/ Presentation	Total	
			In semester assessment	End semester assessment				
512213	Advances in Petrochemical Processes	4	50	50	-	-	100	4
512214	Advances in Process Optimization	4	50	50	-	-	100	4
512215	Elective III	5	50	50	-	-	100	5
512216	Seminar II	4	-	-	50	50	100	4
512217	Project Stage I	8	-	-	50	50	100	8
Total		25	150	150	100	100	500	25

M.E. Petrochemical Engineering, 2013 Course

Semester IV

Code	Subject	Teaching Scheme	Examination Scheme					Credits
		Lectures /Practicals	Paper		TW	Oral/ Presentation	Total	
			In semester assessment	End semester assessment				
512218	Seminar III	5	-	-	50	50	100	5
512217	Project Stage II	20	-	-	150	50	200	20
Total		25	-	-	200	100	300	25

M.E. (PETROCHEMICAL ENGINEERING)

512201 Recent Trends in Petroleum Refining Operations

Teaching Scheme:
Lectures: 4 Hours/Week

Examination Scheme:
In semester assessment: 50 Marks
End semester assessment : 50 Marks
Credits: 4

Refinery flow, Refinery Products, Characterization of petroleum and petroleum products, Chemical composition of crude petroleum. Engineering aspects of refining

Crude heating, Primary distillation, principles, Separation of cuts, Gaps/ overlaps, Stripping, Desalting, Energy input and recovery, Vacuum distillation, Types of trays, Draw offs, intermediate product quality control.

Refinery configuration development, Blending Refinery Distillation, Use of Packie Charts, Design of atmospheric and Vacuum Distillation, Lube refining. Wax refining, Gas processing.

Fluid catalytic cracking, principles, recent developments, Feedstocks and product yields and qualities, Catalysts and operating parameters. Hydrocracking, principles, process requirements, product yields and qualities, Residcracking – implications and technology.

Hydrogen Production: Feedstocks, Process Chemistry, Commercial Processes: Heavy Residue Gasification and Combined Cycle Power Generation, Hybrid Gasification Process, Hydrocarbon Gasification, Hypro Process, Shell Gasification (Partial Oxidation) Process, Steam Methane Reforming, Steam Naphtha Reforming, Synthesis Gas Generation, Texaco Gasification (Partial Oxidation) Process.

Alternative sources of Petroleum based applications**:** Hydrogen production and Fuel cells, Gas to Liquid Fuels, First & Second Generation Biofuels

Catalytic reforming and Isomerisation, Principles, developments in technology, Catalyst types and their performance, Sulphur removal, Aromatics removal, Hydrofinishing, Catalyst regeneration, Catalytic dewaxing. Environmental aspects of refining, Economics of petroleum refining. Global and Indian refining scenario.

Reference books:

1. Mcketta S. (Ed), “Petroleum Processing Handbbok”, Marcell Dekker Inc., 1992.
2. Nelson N., “Petroleum Refinery Engineering”, McGraw Hill, 1985.
3. Gary J., Handework G., “Petroleum Refining Technology and Economics”, Marcell Dekker Inc. 1984.
4. Jones D. S. J., “Elements of Petroleum Processing”, John Wiley and Sons, 1995.
5. Watkins R. N., “Petroleum Refinery Distillation”, Gulf Publication Company, 1990

M.E. (PETROCHEMICAL ENGINEERING)

512202 Advanced Transport Phenomena

Teaching Scheme:
Lectures: 4 Hours/Week

Examination Scheme:
In semester assessment: 50 Marks
End semester assessment: 50 Marks
Credits: 4

Vector Notations, Curl, Divergence, Vector Differential Operations, Laplacian of a Vector Field, Substantial Derivative of a Vector Field, Second Order Tensors, Multiplication of Tensors.

Equations of change for isothermal systems, Turbulent flow, Interphase transport in isothermal systems, Velocity distribution with more than one independent variable, Macroscopic balances for isothermal systems.

Equations of change for non-isothermal systems, Turbulent flow, Energy transport by Radiation, Macroscopic balances for Non-isothermal systems, Temperature distribution with more than one independent variable.

Concentration Distribution in Solids and in Laminar Flow, Equations of change for multicomponent systems, Interphase in multicomponent systems, Macroscopic balances for multicomponent systems, Concentration distribution with more than one independent variable.

Simultaneous heat, mass and momentum transfer, Overview of computational fluid Dynamics (CFD), Process design based on understanding of transport phenomena, Usage of CFD in Operating Process Plants.

Reference books:

1. Bird R., Stewart W. and Light Foot E., “Transport Phenomena”, John Wiley, 1984.
2. Slattery J., “Momentum, Energy and Mass Transfer in continua”, Friger Publication Co., NY, 1981.
3. Bennett C. Myers J., “Momentum Heat and Mass Transfer”, McGraw Hill, 1985.
4. Ranade Vivek, “CFD in Reactor Design”, Academic Press, 1999.
5. Slattery, J. C., “Advanced transport phenomena”, Cambridge University Press, 2001

M.E. (PETROCHEMICAL ENGINEERING)

512203 Advanced Numerical and Statistical Methods

Teaching Scheme:
Lectures: 4 Hours/Week

Examination Scheme:
In semester assessment: 50 Marks
End semester assessment: 50 Marks
Credits: 4

Gauss Elimination and LU Decomposition, Gauss – Seidel and Relaxation Methods, Rank of a Matrix, Check for Uniqueness of Solution, Eigen values and Eigenvectors, Application in the solution of Petrochemical Engineering problems.

Bisection Method, Method of false position, Newton – Raphson Technique, Secant Technique, Multivariable Methods, Hessian Matrix, Multivariable Newton – Raphson Technique, Catastrophy and Singularity Theories.

Least Squares Curve Fit, Newton Interpolation Formulae, B Splines Techniques, Weighted Least Square Approximations, Fourier Transforms, Approximation of Functions.

Solution by Taylor's Series, Modified Euler's Method, Explicit Adams – Bashforth Technique, Predictor Corrector Techniques, Runge – Kuta Methods, Stability of Algorithms, Stiffness of ODEs, Gear's Method for stiff equations.

Finite Difference Methods, Shooting Methods for linear system, Regular Perturbation Method. Method of Weighted Residuals and Orthogonal Collocation to solve first and higher order BVP in ODE's, Galerkin Finite Element Technique.

Method of lines, Finite Difference Scheme for solving PDEs, Orthogonal Collocation, The ADI Method, Iterative Methods for Solution of Equations, Application to Petrochemical Engineering.

Reference Books:

1. Chapra S. C. and Canale R. , Numerical Methods of Engineers, McGraw Hill, NY, 1989
2. Gupta, S. K., Numerical Methods for Engineers, New Age International, New Delhi,2008
3. Sastry, S. S., Introductory Methods of Numerical Analysis, 4th Edition, Prentice Hall of India, New Delhi, 2005
4. Sienfield and Lapidus, " Mathematical Methods in chemical Engineering", Prentice – Hall, 1987

M.E. (PETROCHEMICAL ENGINEERING)

512104 Research Methodology

Teaching Scheme:
Lectures: 4 Hours/Week

Examination Scheme:
In semester assessment: 50 Marks
End semester assessment: 50 Marks
Credits: 4

Research Problem: Meaning of research problem, Sources of research problem, Criteria / Characteristics of a good research problem.

Types of research: Descriptive vs. Analytical Research, Applied vs. Fundamental Research, Quantitative vs. Qualitative Research, and Conceptual vs. Empirical Research.

Research Methodology: An Introduction, Research Process, Basic Overview, Formulating the Research Problem, Defining the Research Problem

Literature Review: Review Concepts and Theories, Formulation of Hypothesis, Sources of Hypothesis, Characteristics of Hypothesis, Role of Hypothesis.

Tests of Hypothesis: Research Design, Sampling Design.

Data Collection, Observation Method, Interview Method, Questionnaires, Case Study Method.

Processing and Analysis of Data: Processing Operations, Statistics in Research, Descriptive Statistics, Inferential Statistics, Elements / Types of Analysis.

Interpretation of Data

Current trends in Research: Mono-disciplinary Research, Interdisciplinary Research, Role of Internet in Research, Threats and Challenges to Good Research

Writing a: BlogSpot, Article, Essay, Research Paper, Research Project, Legislation Drafting, Judgment Writing, Thesis, Dissertation, Book, Reviews - Book Review; Case Review Criteria of Good Research, Research Ethics, Intellectual property rights (IPR), Professional ethics.

Citation Methods: Foot Note, Text Note, End Note, Bibliography.

Reference Books:

1. C.R. Kothari, “Research Methodology Methods and Techniques”, 2nd Edition Vishwa Prakashan, 2006.
2. Wilkinson K.P, L Bhandarkar, “Formulation of Hypothesis” Himalaya Publication, Mumbai, 2006
3. John W Best and V. Kahn, “Research in Education”, PHI Publication, 2004
4. Ranjit Kumar, “Research Methodology- A step by step guide for beginners”, 2nd Edition, Pearson education, 2005
5. Donald H.Mc Burney, “Research Methods”, 5th Edition, Thomson Learning, 2006

M.E. (PETROCHEMICAL ENGINEERING)

512205 Elective I

Teaching Scheme:
Lectures: 5 Hours/Week

Examination Scheme:
In semester assessment: 50 Marks
End semester assessment: 50 Marks
Credits: 5

Students should select any two modules of 2 credits each of the following from Group I and any one module of 1 credit from Group II

GROUP I:

Module 1: Advanced Petrochemical Processes (2 Credits)

Overview of petrochemical industrial Growth in India, Economics, Feedstock Selection for Petrochemicals, Size and scope of the industry

Commercial manufacture process of LDPE, LLDPE, HDPE, Polypropylene, PVC, Polystyrene, Phenol, Nylon 66, and Polyester Filament Yarn.

Technologies and engineering problems encountered in exploiting in natural gas, gas hydrates, and alcohol obtained from agricultural sources and coal,

Principles of furnace design, Design of pipe stills and cracking furnaces, materials of construction for furnaces, chimney designs.

Reference books:

1. Hatch L.F., Matar S., "From Hydrocarbons to Petrochemicals," Gulf Publishing Company, 1981.
2. Chauvel A., Lefebure G., "Petrochemical Processes Vol-I & II", Gulf Publication Company, 1989.
3. M.W. Thring, "The Science of Flame and Furnaces", Chapman and Hall, 1990

Module 2: Chemistry of Hydrocarbons and Production Operations (2 Credits)

Petroleum Hydrocarbons and Coals, Origins, Chemical Precursors, Diagenesis, Biomarkers, Kerogens. Rheological Features of Heavy Hydrocarbon Reservoirs.

Petroleum Host Rocks, The Host Rocks of Heavy Hydrocarbons, Carbonate Reservoir, Sandstone reservoirs, Hydrocarbon – Rock Interactions.

Typical Wellhead Assembly, Design aspects of Wellhead Equipments and Chokes, Well Completion Techniques and Equipments, Flowing Well Performance

Work over Jobs, Workover Fluids, Water and Gas Coning, Formation Damages, Corrosion Problems, Well Stimulation Operations, Artificial lift and Gravel Packed Wells.

Reference Books:

1. Cholet H, Well Production Practical Handbook, Technip Editions, Paris, France (2002)
2. Berger B. D., Anderson K. E. Modern Petroleum, Penwell Books (1997).
3. Kumar S., Gas Production Engineering, Gulf Publishing Co. (1987).
4. Mian M. A., Petroleum Engineering Handbook, Vol I and II, Penwell Books (2004)

Module 3: Combustion and Gasification Technology (2 Credits)

Fossil fuel feedstock, Coal, Natural Gas and Petroleum, Reserves, Present and Future Production Trends, Distribution and utilization pattern of existing fossil reserves.

Combustion of fuels, Combustion thermodynamics, Combustion of Oil; Combustion of Coal; Fluidized bed combustion process. Combustion Controls

Coal Bed Methane, Coal Gasification, Technologies for exploitation of these resources, Technology for coal gasification and Syngas production, Fischer Tropsch Synthesis

Burner Design and Furnaces, Fluidized bed combustion process; various methods of flame stabilization; Basic features and design of burners for solid/

References

1. Christian Ngo and J.B. Natowitz, 'Our Energy Future: resources, alternatives and environment, John Wiley and Sons, 2009
2. John Rezaiyan and Nicholas P.Cheremisinoff, 'Gasification Technologies: a primer for engineers and scientists', Taylor and Francis, 2005
3. Mark Crocker' Thermo chemical Conversion of Biomass to Liquid Fuels and Chemicals' Royal Society of Chemistry, 2010
4. Borman G. L. and Ragland K. W.: Combustion Engineering. McGraw Hill, 1997.

Module 4: Polymer Processing Technology (2 Credits)

Moulding: compression molding, transfer molding, injection molding, RIM, bow molding, rotational molding, thermoset molding

Extrusion – coextrusion, film extrusion, pultrusion, calendaring, casting, coating, foaming, forming laminates. Multipolymer systems and composites.

Fiber Technology: Textile and fabric properties, Spinning – melt spinning, dry spinning, and wet spinning. Fiber after treatments scouring, lubrication, sizing, dyeing, finishing

Elastomers technology: Compounding and elastomers properties, Vulcanization – chemistry of vulcanization, Sulphur vulcanization, physical aspects of vulcanization

Injection moulding: Role of rheology in injection moulding, Reaction injection moulding: Overall moulding cycle, metering system for components, mixing head design, mould construction.

Reference books:

1. Odian George., 'Principals of Polymerization' Wiley-Interscience, 4th Edition, 2004
2. Handbook of Plastic Testing Technology, Brown and Vishnu Shah, A. Wiley, Inter science Publication, 2007
3. Agassant, J.F. Avenas, P, Sergant, J, Ph., and Correon, P.J. Polymer Processing – Carl Hamsen Verlag Munich, 1991.
4. Rotational Moulding of Plastics – R.J. Crawford, Research Studies Press Ltd.

Module 5: Advanced Separation Techniques (2 Credits)

Mechanism of Separation, Rate based and equilibrium separations, Energy requirements of separation processes. Surfactant based separations, Adsorptive bubble separations, Microemulsions and Macroemulsions, Cross flow filtration, Fractional precipitation.

Types and choice of membranes, commercial, pilot plant and laboratory membrane pemeators involving dialysis, reverse osmosis, Nanofiltration, Ultrafiltration, micro filtration, economics of membrane operations.

Mechanism, types and choice of adsorbents, normal adsorption techniques, affinity chromatography and immuno chromatography, types of equipment and commercial processes, recent advances and process economics

Separations involving lyophilization, zone melting, supercritical fluid extraction, oil spill management, Reactive separations. Bioseparation, Reverse micelle extraction, Isoelectric focusing. Frontiers in separation technology

Reference books:

1. King C. J. " Separation Process", McGraw Hill, 1982
2. Schweitzer Philip " Handbook of Separation Techniques for Chemical Engineers", 1981
3. Garside John "Separation Technology "The next ten years" Institution if Chemical Engineers. U.K, 1990.
4. Rousseau R. W. (Ed) "Handbook of Separation Process Technology", John Wiley & Sons, 1987.

Module 6: Human Rights (2 credits)

Human Rights – Concept, Development, Evolution: Philosophical, Sociological and Political debates, Benchmarks of Human Rights Movement, Human rights for woman, children and workers.

Human Rights and the Indian Constitution: Constitutional framework , Fundamental Rights & Duties, Directive Principles of State Policy, Welfare State & Welfare Schemes

Human Rights and State Mechanisms: Police & Human Rights, Judiciary and Human Rights , Prisons & Human Rights, National and State Human Rights Commissions

Human Rights of the Different Sections and contemporary issues: Unorganized Sector, Right to Environment, particularly Industrial sectors of Petroleum Engineering and Petrochemical Engineering , Globalization and Human Rights, Right to Development

Citizens' Role and Civil Society: Social Movements and Non-Governmental Organizations, Public Interest Litigation, -Role of Non Government organizations in implementation of Human rights, Right to Information

Human Rights and the International scene: International Concern for Human Rights, International Actions For the Protection of Human Rights, United Nations' Bodies in the Promotion of Human Rights, Primary Information with reference to engineering Industry. (2 hrs)

- UN Documents
- International Mechanisms (UN & Regional)
- International Criminal Court

Reference Books:

1) M. R. Ishay, The History of Human Rights, Orient Longman, New Delhi, 2004.
2) Conor Greaty and Adam Tomkins (Eds).Understanding Human Rights, London: Manshell, 1996
3) Michael Freeman, Human Rights: An Interdisciplinary Approach, Oxford: Polity, 2002.
4) Upendra Baxi,: The Future of Human Rights, New Delhi: Oxford University Press, 2004
5) Study material on UNESCO,UNICEF website
6) Usha Ramanathan , Human Rights In India A MAPPING,Usha Ramanathan
   This book can be downloaded in PDF format from IELRC's website at
   http://www.ielrc.org/content/w0103.pdf
7) I Curtis F. J. Doebbler, Introduction to International Humanitarian Law CD Publishing, 2005.

Internal Assessment:

(i) Assignments based on topics from syllabus and case studies as applicable to relevant discipline of Engineering.

(ii) Power point and oral presentation based on of selected topic from syllabus.

GROUP-II

Students should select any one modules of 1 credits each of the following Group II

Module 1: Green and Sustainable Technologies (1 Credit)

Concept of green technology; evolution; nature, scope, importance and types , Reactions solvent free reactions, Catalyzed (heterogeneous/homogeneous) reactions, Green technology in batteries, production and recycling, Fuel cell and electric vehicles, Solar energy and hydrogen production, Biodiesel, bio-hydrogen

Esterification: transesterification, autogeneous pressure of methanol, transesterification under supercritical conditions, Best practices in Green Chemistry for sustainable development with suitable examples.

Criteria for choosing appropriate green energy, technologies, life cycle cost; the emerging trends – process/product innovation-, technological/ environmental leap-frogging; Eco/green technologies for addressing the problems of Water, Energy, Health, Agriculture and Biodiversity, design for sustainability

Reference Books:

1. Anastas, P.; Warner, J. Green Chemistry: Theory and Practice; Oxford University Press: London, 1998.
2. Zimmerman, J.B.; Anastas, P.T. "The 12 Principles of Green Engineering as a Foundation for Sustainability" in Sustainability Science and Engineering: Principles. Ed. Martin Abraham, Elsevier Science., 2005.
3. Anastas, P.; Zimmerman, J. "Design through the Twelve Principles of Green Engineering," Environmental Science and Technology, 37, 94A – 101A, 2003.

Module 2: Advanced Hydrocarbon Thermodynamics (1 Credit)

Solution Thermodynamics Applications: Models for the Excess Gibbs Energy: Wilson equation, Van-Laar equations, NRTL equation, UNIQUAC equation

Chemical reaction equilibrium: Effect of Temperature on the Equilibrium Constant, Relation of equilibrium constants to composition.

Thermodynamics of Fluid flow; distillation and other separation processes. Refrigeration and Liquefaction, Application of thermodynamics in cryogenics.

Stastical Thermodynamics: Role of Stastical mechanism, Energy levels and degeneration of energy, Microscopic and Macroscopic states, Entropy from microscopic and probability point of view,

Reference Books:

1. Smith J.M. and Van Ness, H.C, Introduction to Chemical Engineering Thermodynamics, 7th Ed., McGraw Hill Book Co., 2005
2. Balzhiser R., Samuels M., Eliassen J., Chemical Engineering Thermodynamics, Prentice Hall, 1972
3. Denbeigh K. G., "Chemical Engineering Thermodynamics", Cambridge Univ. Press,1990
4. Dodge B. F., "Chemical Engineering Thermodynamics", McGraw Hill Publications,1986

Module 3: Recent advances in Natural Gas Engineering(1 credit)

Gas composition based on source and its evolution, Raw natural gas composition, Properties of natural gas.

Development and operation of gas fields, Gas from condensate and oil fields, Thermodynamics and energy change,, hydrate formation, gas liquid equilibria.

Conditioning Operations, Purification, Refrigeration, Low Temperature Processing, Liquefaction Phenomena, LNG and NGL recovery, sweetening of natural gas and Sulphur recovery.

Various types of tanks, Underground Storage, Conservation of natural gas to liquid fuels: process and principles, Safety aspects, Transportation of CNG and LNG, Marine Vessels.

Reference Books:

1. Kumar S., Gas Production Engineering, Gulf Publishing Co.,1987
2. Negi, B. S., LNG: An Indian Scenario, Technology Publication, Dehradun,2008
3. Beggs, H. D., Gas Production Operations, OGCI Publication,1984
4. Ikoku, C. K., Natural Gas Engineering, John Wiley,1984
5. Alexandre, R., Natural Gas: Production, Processing and Transport, Hyperion Books 1995

M.E. (PETROCHEMICAL ENGINEERING)

512206 Laboratory Practice – I

Teaching Scheme:
Practical: 4 Hours/Week

Examination Scheme:
Term Work: 50 Marks
Oral Presentation: 50 Marks
Credits: 4

Each candidate should perform at least six experiments from the list of experiments given below and submit the journal, which will form the term work for the subject.

It is recommended that the students should study any one of the standard software in petroleum engineering with respect to data input, data analysis and interpretation.

The term work shall consist of minimum of six exercises from the list given below.

1. Kinetic studies on laboratory set-up for gas-solid catalytic reactor. (Using GC for composition analysis).
2. Design of piping system for any selected petrochemical process.
3. Design of a petrochemical process plant using standard commercial process design software.
4. Characterization of a crude petroleum sample and petroleum product sample.
5. Heat exchanger network synthesis HEN'S for a refining plant using any standard heat integration program based on pinch analysis.
6. Sequencing of separation columns for a petrochemical plant using synthesis tools having extensive heuristics and analysis capabilities.
7. Characterization of gaseous, liquid and solid wastes from refinery/petrochemical process plants.
8. Detailed design of a pollution control equipment.
9. Experiment designed to understand the utility of network methods in petrochemical engineering.
10. Study of material of construction for furnaces.

M.E. (PETROCHEMICAL ENGINEERING)

512207 Applied Process Design and Synthesis

Teaching Scheme:
Practical: 4 Hours/Week

Examination Scheme:
In semester examination: 50 Marks
End semester examination: 50 Marks
Credits: 4

Plant Engineering and Process Development, General Overall considerations, Optimum economic design, Optimum operation design, Formulation of plant design problem, scope and objectives; Practical considerations in design, Feasibility study and initial design considerations.

Detailed equipment design, additional design considerations, Process control and Instrumentation, Safety, Loss prevention and HAZOP

Diagrams for understanding of chemical processes: Block diagram, process flow diagram, Piping and Instrumentation diagram, Utility diagram, Logic diagram, 3-D plant model, recycle structure of process, construction of process description, process flow diagram, mass and energy balance

Structure and synthesis of Process flow diagrams, Hierarchy in Process design, design calculation for batch processing, Design of equipment for multiproduct batch processes, strategies of chemical product design., Tracing chemicals through process flow diagram,

Synthesis and optimization of Chemical Processes, Synthesis of Process using simulation and simulation trouble shooting, pinch technology, heat integration and network design, Analysis of process performance, Process Input and output models, tools for evaluation of process performance, Process trouble shooting and debottlenecking analysis.

Plant location, site selection, Environment impact analysis, selection and sizing of major process equipment; construction materials selection; equipment layout, plot plan, Cost estimation and plant economic analysis; plant design report preparation.

Reference Books:

1. Ludwig, E.E., Applied Process Design for Chemical and Petrochemical Plants, Volume I, II and III, Third Edition, 1993
2. Richard Turton, Richard C. Bailie, Wallace B. Whiting, Analysis, synthesis, and design of chemical processes, Prentice-Hall international series in the physical and chemical engineering sciences, Fourth edition, 2012
3. Baasel, W.D., 1990, Preliminary Chemical Engineering Plant Design, Second Edition, van Nostrand, New York, 1990
4. Peters, M.S. and K.D. Timmerhaus, Plant Design and Economics for Chemical Engineers, McGraw-Hill Book Co., Inc., New York, 1991

M.E. (PETROCHEMICAL ENGINEERING)

512208 Safety, Health and Environment in Petrochemical Plants

Teaching Scheme:
Practical: 4 Hours/Week

Examination Scheme:
In semester examination: 50 Marks
End semester examination: 50 Marks
Credits: 4

Safety, Environment and plant operation, Petrochemical equipments – overview, Introduction to process safety and loss prevention, Hazard identification methods, Plant operation – refinery processes ,Inherent safety – refinery processes, Environmental aspect of refinery processes

Environmental issues at global, regional and national levels, Types of environmental pollution and their control, Effluent Guidelines and standards; Wastewater and its treatment. Industrial waste treatment and disposal, Environmental Management and Auditing system (EMAS), Environment friendly technologies and cleaner production.

Occupational Safety and Health management systems, Hazards and risks identification, Safety, health, Identification and assessment of the hazards, Hazard operability (HAZOP) hazard analysis (HAZAN); Assessment of the risk, fault tree, event tree, scope of risk assessment; Control of hazards, Prevention of losses

Risks incurred by flammable products; flash point, explosive limits, Ignition sources; flames, self-ignition temperature, sparks and static electricity, hydrophobic products, Preventive measures and precautions: during normal conditions, during draining and sampling; in the event of leaks; with regard to storage tanks; during loading and unloading; during repair work

Safety automation, Alarm and interlocks system, Relief system, Hazard Incident Scenario – case study, Fault Tree Analysis, Quantitative Risk Assessment, Risk Acceptability and Tolerability, Case study – refinery processes

Regulations and legislation, Role of government role, risk management routines, Human factors in risk management, Difficulties in improving safety results, typical safety organization. Keys for a good safety management in the field.

Reference Books:

1. Crowl D A, Louvar J F, " Chemical Process Safety Fundamentals with applications", 2nd Prentice Hall, Englewood Cliffs, 2002
2. R.K. Jain and Sunil S.Rao, Industrial Safety, Health and Environment Management Systems, Khanna publishers, New Delhi, 2006
3. Goetsch D.L., "Occupational Safety and Health for Technologists", Engineers and Managers", Prentice Hall, 1999
4. C. Ray Asfahl, Industrial Safety and Health Management, Fifth Edition McGraw Hill, 1998
5. Slote. L, Handbook of Occupational Safety and Health, John Willey and Sons, New York, 2004

M.E. (PETROCHEMICAL ENGINEERING)

512209 Advanced Process Control

Teaching Scheme:
Practical: 4 Hours/Week

Examination Scheme:
In semester examination: 50 Marks
End semester examination: 50 Marks
Credits: 4

Review of dynamic process models - linear and non-linear, lumped and distributed parameter systems. Control of linear systems - Laplace and Z transforms, review of single-loop feedback control systems.

State Space Models, Transfer Functions, Poles, and Zeros, First Order + Dead Time, Integrator + Dead Time, Parameter Estimation.

Response to Set Point changes, Determination of Stability, Response to Disturbances, PID Controller Tuning.

Practical Open Loop Controller Design, Model Uncertainty and Disturbances, IMC Background, IMC Architecture, IMC Procedure, Manipulated Variable Saturation, IMC-Based PID Control Design Procedure.

Cascade Control Analysis, Cascade Control Design, Cascade IMC, Feed Forward Controller Design, Static Feed Forward Control, Antireset Windup, and Auto tuning techniques, Ratio Control, Selective and Override Control, Split Range Control, Relative Gain Array.

Zeros and Performance Limitations, Scaling Considerations, Block Diagram Analysis, Decoupling, Model Predictive Control, Dynamic Matrix Control, MPC with Industrial Applications.

Reference Books:

1. Bequette, B. W., Process Control: Modeling, Design and Simulation, Prentice Hall of India, New Delhi ,2003
2. Luyben, M. L. and Luyben, W. L., Essentials of Process Control, McGraw Hill, New York, 1997
3. L. Ljung, System Identification – Theory for the User, Prentice Hall,1987
4. Marlin, T. E., Process Control: Designing Processes and Control Systems for Dynamic Performance, 2nd Edition, McGraw Hill, New York, 2000
5. Ogunnaike, B. A. and Ray, W. H., Process Dynamics, Modeling and Control, Oxford, New York ,1994

M.E. (PETROCHEMICAL ENGINEERING)

512210 Elective – II

Teaching Scheme:
Practical: 5 Hours/Week

Examination Scheme:
In semester examination: 50 Marks
End semester examination: 50 Marks
Credits: 5

Students should select any two modules of 2 credits each of the following from Group I and any one module of 1 credit from Group II

GROUP I:

Module 1: Advances in Process Optimization (2 Credits)

Single variable optimization, Multivariable optimization without constraints, Multivariable optimization with inequality,

Standard for of linear programming problems, Solution of a system of linear simultaneous equations, Simplex algorithms, Duality in linear programming.

Random search, Complex method, Sequential linear programming, generalized reduced gradient Method, Sequential quadratic programming, Penalty methods

Multivariable optimization, Pareto optimality, Genetic Algorithm, Binary coded genetic algorithm, Genetic operators, real coded genetic algorithms

Reference books:

1. A. Ravindran, K. M. Ragsdell, G. V. Reklaitis, “Engineering Optimization: Methods and
2. Applications”, 2nd Edition, John Wiley, 2006
3. T.F. Edgar and D.M. Himmelblau," Optimization Techniques for Chemical Engineers",
4. McGraw-Hill, New York, 1985.
5. K. Deb, "Optimization for Engineering Design: Algorithms and Examples", Prentice Hall of India, 2006

Module 2: Piping Design for Process Plants (2 Credits)

Flow through pipe, Flow through perforated pipes and porous media, two phase flow, Piping networks, Piping systems for petroleum products, yard piping; fire fighting

Pipe stress analysis and pipe supports, Pipe racks, Fabrication, installation and testing, Statutory regulations and safety aspects, Thermal insulation, bill of material, Costing for piping, P& I diagram , piping code, standards and specifications, materials for piping system their selection for various operating conditions, supports for piping system.

Drawings basics, the design logic, statutory regulations, plot plan and plant layout, Equipment layout and piping layouts, Good layout practice.

Reference Books:

1. Ed Bausbacher and Roger Hunt, 'Process Plant Layout and Piping Design', 1st Edition, Prentice Hall, 1993
2. Robert A. Rhea, Roy A Parisher, "Pipe Drafting and Design", 2nd Edition, Gulf Professional Publishing, 2003
3. R. Turton, R. C. Bailie, W. B. Whiting, and J. A. Shaeiwitz, "Analysis, Synthesis, and Design of Chemical Processes", Prentice Hall, 1998.
4. John J. Mcketta, by Marcel Dekker, "Piping Design Handbook" Inc, New York, 2000
5. Mohinder Nayyar, "Piping Handbook", 7th edition, McGraw- Hill, 2000.

Module 3: Multiphase Reactor Design (2 Credits)

Rate of a Catalytic Reaction, Surface Consideration in Catalytic Kinetics, Langmuir-Hinshelwood Models, Effective Diffusion, Effectiveness Factor.

Reaction of a Component of a fluid at the Surface of a Solid, Mass and Heat Transfer Resistances, Multicomponent Diffusion, Combination of External and Internal Diffusion Resistances.

Optimal Operation Policies and Control Strategies, Kinetic Analysis of Nonisothermal Data, Steady State reactor Design, Stability of Operation and Transient Behaviour.

Design Models for Multiphase Flow Reactors, Bubble Column, Trickle Bed Reactor.

Reference books:

1. Froment, G.F. and K.B. Bischoff, Chemical Reactor Analysis and Design, John Wiley, 1990
2. Doraiswamy, L.K. and Sharma M.M., Heterogeneous Reactions: Analysis, Examples and Reactor Design, Vol 1: Gas-Solid and Solid-Solid Reactions, John Wiley ,1984
3. Rase, H.F., Fixed-Bed Reactor Design and Diagnostics, Butterworths,1990
4. Richardson, J.T., Principles of Catalyst Development, Plenum Press,1989

Module 4: Computational Fluid Dynamics (2 Credits)

Conservation Laws of Fluid Motion and Boundary Conditions, Governing equations of fluid flow and heat transfer, Equations of state, Navier-Stokes equations for a Newtonian fluid

Effect of turbulence on time-averaged Navier-Stokes equations, Turbulence models, Mixing length model, The k-ε model, Reynolds stress equation models, Algebraic stress equation models.

Finite Volume Method for Convection-Diffusion Problems, The power-law scheme, Higher order schemes for convection-diffusion, Quadratic upwind differencing scheme.

Fundamentals of multiphase flows, Eulerian-Lagrangian (ELAG) approach, Eulerian-Eulerian (E2P) approach, Volume of Fraction (VOF) approach, solving example problems.

Reference books:

1. Anderson, J.D. 'Computational Fluid Dynamics: The Basics with Applications', Mc-Graw Hill, 1995.
2. K. Versteeg and W. Malalasekera, An introduction to computational fluid dynamics: the finite volume method , Longman scientific & technical publishers, 2007
3. John D. Anderson, Computational fluid dynamics: The Basics with Applications McGraw-Hill, .New York, 1995
4. Ranade, V.V. 'Computational Flow Modeling for Chemical Reactor Engineering', Process Engineering Science, Volume 5, 2001.
5. Wilcox, D.C. 'Turbulence Modeling for CFD', 1993.

Module 4: Catalysis and Catalytic Reactor Engineering (2 Credits)

Adsorption on Solid Catalysts, Rate Equations, Langmuir – Hinshelwood Model, Riedel Model, Single Reactions, Complex Reaction Networks, Catalyst Deactivation, Fouling, Sintering, Coke Deposition.

Selecting Type of Reactor, Mode of Operation, Operating Conditions for Maximizing Yield, General Design Considerations.

Pseudohomogenous Models, Heterogeneous Models, Calculation of Pressure Drop, Runaway Criteria, Multibed Adiabatic Reactor

Catalytic Cracking of Gas Oil, Fluidized Bed Catalytic Cracking, Transport or Riser Catalytic Cracking, Heat Transfer in Fluidized Beds, Modeling of Fluidized Bed Reactors,

Reference books:

1. Farrauto R. J. and Bartholomer C. H., Fundamentals of Industrial Catalytic Processes, Blackie Academic & Professional, London ,1997.
2. Satterfield C. N., Heterogeneous Catalysis in Industrial Practice, Second Edition, McGraw Hill, 1993.
3. Froment, G.F. and Bischoff, K.B., Chemical Reactor Analysis and Design, John Wiley, 1990
4. Rase, H.F., Chemical Reactor Design for Process Plants, Vol 1: Principles and Techniques, Butterworths ,1977

Module 5: Cyber Law and Information Security-I (2 Credits)

Basic Concepts of Technology and Law: Basics of Information Technology, Basics of Indian Legal System, Information Technology Act 2000 (Amended), Relevant Amendments in all other laws

E-Contract: The essence of digital contracts, Law of Contract, Construction of E-contracts, Issues of security, Employment contracts, Consultant Agreements and Digital signature

Intelligent Property Issues in Cyber space: Doman names and related issues, Copyright in digital media, Patents in cyber world.

Rights of Neitzens and E- Governance: Privacy and freedom issues in cyber world, E-Governance, Cyber crimes and Cyber laws.

Information Security Fundamentals: Background, Importance, Statistics, National and International Scenario, Goals of security, Confidentiality, Privacy, Integrity, Non-repudiation, Availability.
Essentials of computer security - Sources of security threats – Intruders, Viruses, Worms and related threats - Threat identification - Threat analysis - Vulnerability identification and Assessment

Security Investigation: Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues

Security Policies and Management: Security Policy Design, Designing Security Procedures, Risk Assessment Techniques, Security standards, Security Models.

Reference Books:

1) Bakshi P M and Sri R K, Cyber and E-commerce Laws, Bharat Publishing House, 1st Edn, 2002
2) Syed shakil Ahmed, Rajiv Raheja, A handbook on Information technology: Cyber law and E-Commerce, Capital Law House, 2004
3) Rodney D Ryder, Business Process Outsourcing, Date Protection and Information Security, Wadhwa & Co., 1st Edn, 2001
4) Vakul Sharma, Information Technology Law and Practice, Delhi Law House, 3rd Edn, 2011
5) Lipton, K., Cyberspace Law Cases and Materials, 2nd edition. Aspen Publishers. NY: New York, 2006
6) Michael E Whitman and Herbert J Mattord, Principles of Information Security, Vikas Publishing House, New Delhi, 2003
7) Micki Krause, Harold F. Tipton, Handbook of Information Security Management, Vol 1-3 CRC Press LLC, 2004.
8) Michael E Whitman and Herbert J Mattord, Principles of Information Security, Vikas Publishing House, New Delhi, 2003

Students should select any one modules of 1 credit each of the following Group II

GROUP-II

Module 1: Energy Engineering (1 credit)

Energy crisis in the world and position in India, Growth and demand of energy, Energy availability, Review of alternative approaches and major models and studies, New energy technologies and conservations

Types of audit, Responsibility of energy management, Targeting and monitoring energy consumption, Scope of energy audit, General questionnaire, Case study of energy audit.

Waste heat recovery and utilization, Technologies, Cost and energy saving of waste heat recovery and utilization, recent advancement in energy technology towards 21st century,

Introduction, Advantages, Constraints, Feasibility, Scope, Benefits and constraints. Energy conservation act 2001, Energy conservation in India

Reference books:

1. D. Mohan Singh, Col. S. K. Murthy (Retd.), "Energy Conservation in Industries", Module I and II, AICTE, CEP, Code 358.
2. Devid Hu. S, "Handbook of Energy Conservation", McGraw Hill Publication.
3. The Bulletin on Energy Efficiency and Management by IRADA, MITCON,MEDHA etc.
4. Amit Tagi, "A Handbook Energy Audit", Tata McGraw Hill publication, 2000

Module 2: Reliability, Risk Analysis and Management (1 credit)

System reliability, Fault tree and even tree analysis; Block diagrams and network models; Introduction to Markov models and its application to system reliability calculations.

Renewal theory; Modeling of maintenance policies; Reliability prediction, Modeling and component reliability estimation; Criticality analysis.

Reliability in design, Failure processes; Damage growth and determination mechanisms; Inspection and condition monitoring in failure rate and risk reduction.

Fire and explosions risk analysis, Fire/ explosion protection systems; Plant layout; Fire and blast walls; Temporary refuges; Emergency management.

Reference books:

1. Safety, Reliability and Risk Analysis: Theory, Methods and Applications, (Ed), Sebastian Martorell, CRC Press, 2008
2. Witt and Ramzan, "Chemical Engineering and Chemical Process Technology, Vol-IV: Process Risk analysis" in Encyclopedia of Life Support System (ELOSS), 2011
3. Aven, T., Foundations of risk analysis, New Jersey, Wiley, 2003
4. McCormick, N. J., Reliability and risk analysis. New York: Academic Press, 1981

Module 3: Fuel cell & Hydrogen energy (1 credit)

Applications Hydrogen production methods, Production of hydrogen from fossil fuels, electrolysis, thermal decomposition, photochemical and photo-catalytic methods Hydrogen storage

Principle of working of fuel cells Fuel cell thermodynamics , second law analysis of fuel cells, efficiency of fuel cells, fuel cell electrochemistry - Nernst equation

Electrochemical kinetics, Butler-Volmer equation Fuel cell types, Fuel Cell Performance, Activation, Ohmic and Concentration over potential Fuel cell design and components

Polymer Electrolyte fuel cells (PEFC), Heat and mass transfer in polymer electrolyte fuel cells, water management in PEFCs

Reference Books

1. J. Larminie and A. Dicks, Fuel Cell Systems Explained, 2nd Edition, Wiley ,2003
2. Xianguo Li, Principles of Fuel Cells, Taylor and Francis,2005
3. S. Srinivasan, Fuel Cells: From Fundamentals to Applications, Springer,2006
4. O'Hayre, S. W. Cha, W. Colella and F. B. Prinz, Fuel Cell Fundamentals, Wiley,2005

M.E. (PETROCHEMICAL ENGINEERING)

512211 Laboratory Practice - II

Teaching Scheme:
Practical: 4 Hours/Week

Examination Scheme:
Term Work: 50 Marks
Oral Presentation: 50 Marks
Credits: 4

Each candidate should perform at least six experiments from the list of experiments given below and submit the journal, which will form the term work for the subject.

It is recommended that the students should study any one of the standard software in petroleum engineering with respect to data input, data analysis and interpretation.

1. Numerical solution of a system of ODEs and PDEs with boundary conditions. (Student should write his own code and compare the results with those obtained using any standard mathematical software).
2. Regression and correlation of data collected in laboratory/from literature.
3. Modeling and simulation of riser reactor and/or regenerator in fluid catalytic cracking.
4. Modeling and simulation of steam reformer and/or catalytic reformer.
5. Modeling and simulation of steam cracking unit.
6. Development of process flow sheeting code for any petrochemical process.
7. Solution of a flow problem using a standard CFD package.
8. Solution of mathematical model of a process involving simultaneous heat, mass and momentum transport.

M.E. (PETROCHEMICAL ENGINEERING)

512212 Seminar - I

Teaching Scheme:
Practical: 4 Hours/Week

Examination Scheme:
Term Work: 50 Marks
Oral/presentation: 50 marks
Credits: 4

Each student is required to deliver a seminar in the first semester. The students will be required to select an advanced research topics for the seminar and present the seminar during the semester.

A detailed report should also be submitted at the end of term and a presentation made based on the same. The assessment will be based on the quality in terms of research and development. Modern audio-visual techniques may be used at the time of presentation Available case studies may also be incorporated.

M.E. (PETROCHEMICAL ENGINEERING)

512213 Advances in Petrochemical Processes

Teaching Scheme:
Lectures: 4 Hours/Week

Examination Scheme:
In semester assessment: 50 Marks
End semester assessment: 50 Marks
Credits: 4

Overview of petrochemical industrial Growth in India, Economics, Feedstock Selection for Petrochemicals, Size and scope of the industry, Present and proposed capacities in India. Demand – supply scenario for major petrochemicals.

Overall view of petrochemicals intermediates manufacture, Production and separation of C_1, C_2, C_3, C_4 and Aromatic cuts, Global and Indian Scenario.

Commercial manufacture process of LDPE, LLDPE, HDPE, Polypropylene, PVC, Polystyrene, Phenol & Urea formaldehyde Resins, SBR, Polyisoprene, Nylon 6, Nylon 66, and Polyester Filament Yarn.

Overview of feedstocks other than petroleum such as natural gas, gas hydrates, and alcohol obtained from agricultural sources and coal, Technologies and engineering problems encountered in exploiting these feedstocks. Review of the economic considerations involved

Principles of high temperature flame reactors, Design of typical high temperature flame reactors, Reaction Mechanisms in cracking reactions, Effect of process parameters on product distribution in cracking of naphtha and gas.

Principles of furnace design, Design of pipe stills and cracking furnaces, materials of construction for furnaces, chimney designs.

Reference books:

4. Hatch L.F., Matar S., “From Hydrocarbons to Petrochemicals,” Gulf Publishing Company, 1981.
5. Chauvel A., Lefebure G., “Petrochemical Processes Vol-I & II”, Gulf Publication Company, 1989.
6. M.W. Thring, “The Science of Flame and Furnaces”, Chapman and Hall, 1990
7. Kern D. Q., “Process Heat Transfer”, McGraw Hill, 1965.

M.E. (PETROCHEMICAL ENGINEERING)

512214 Advances in Process Optimization

Teaching Scheme:
Lectures: 4 Hours/Week

Examination Scheme:
In semester assessment: 50 Marks
End semester assessment: 50 Marks
Credits: 4

Functions of single and multiple variables - optimality criteria, direct and indirect search methods, Classification of optimization problems, Practical examples.

Single variable optimization, Multivariable optimization without constraints, Saddle point, Multivariable with equality constraints, Multivariable optimization with inequality, Kuhn – Tucker conditions.

Standard for of linear programming problems, Solution of a system of linear simultaneous equations, Simplex algorithms, Duality in linear programming.

Unimodal function, Elimination methods, Exhaustive search, Fibonacci technique, Golden section method, Interpolation methods, Newton Method, Secant Technique.

Random search, Complex method, Sequential linear programming, generalized reduced gradient Method, Sequential quadratic programming, Penalty methods, Lagrange multiplier method, Pontryagin's maximum principle.

Multivariable optimization, Pareto optimality, Genetic Algorithm, Binary coded genetic algorithm, Genetic operators, real coded genetic algorithms, simulated annealing, and Implementation strategy of simulated annealing.

Reference books:

1. A. Ravindran, K. M. Ragsdell, G. V. Reklaitis, “Engineering Optimization: Methods and
2. Applications”, 2nd Edition, John Wiley, 2006
3. T.F. Edgar and D.M. Himmelblau," Optimization Techniques for Chemical Engineers",
4. McGraw-Hill, New York, 1985.
5. K. Deb, "Optimization for Engineering Design: Algorithms and Examples", Prentice Hall of India, 2006
6. S. S. Rao, “Engineering Optimization: Theory and Practice”, Third Edition, New Age
7. International, 2005

M.E. (PETROCHEMICAL ENGINEERING)

512215 ELECTIVE-III

Teaching Scheme:
Practical: 5 Hours/Week

Examination Scheme:
In semester examination: 50 Marks
End semester examination: 50 Marks
Credits: 5

Students should select any two modules of 2 credits each of the following from Group I and any one module of 1 credit from Group II

GROUP I:

Module 1: Process Safety Engineering (2 Credits)

Historical Incident & Problem Areas, Risk Analysis Basics.

Process Hazards Analysis Techniques – Overview, Layers of Protection, Inherently Safer Design, Hazards Associated with Process Fluids, Leakage and Dispersion of Hydrocarbon Releases, Combustion Behavior of Hydrocarbons, Sources of Ignition

Hazards Associated with Specific Plant Systems, Plant Layout & Equipment Spacing, Pressure Relief and Disposal Systems, Corrosion & Materials Selection, Process Monitoring and Control.

Safety Instrumented Systems, Fire Protection Principles, Explosion Protection

Reference Books

1. Center for Chemical Process Safety (CCPS), 2011, Guidelines for Auditing Process Safety Management Systems, 2nd Edition, 900 pp.
2. Center for Chemical Process Safety (CCPS), 2010, A Practical Approach to Hazard Identification for Operations and Maintenance Workers

Module-2: Fuels, Combustion and Gasification Technology (2 credits)

Extraction, refinement and up grading of solid, liquid and gaseous fuels.

Gasification and combustion reactions, Stoichiometry, Thermo chemistry, Chemical Equilibrium., Chemical reaction kinetics.

Equipment used for gasification and combustion, Laminar and turbulent flames.

Generation of pollutants and possibilities to control this by modification of combustion conditions.

Reference Books:

1. Kjellström B., Lindberg J. and Keikkala G.; Combustion and Gasification in theory and practice, 2003.
2. Borman G. L. and Ragland K. W.: Combustion Engineering. McGraw Hill, 1997.
3. Turns S. R.; An Introduction to Combustion-Concepts and Applications, second edition. McGraw Hill, 2000.

Module-3 Air Pollution Control Technology (2 credits)

Brief review of industrial, municipal, and natural pollution sources. Physicochemical processes governing the dynamics of pollutants from point, non-point, line, and area sources

Generation, transport and decay of air pollutants; Sampling and monitoring methods. Strategies and methods for removal of gaseous pollutants and particulates from process exhaust streams; Air pollution abatement technology

Detail design of particulates and gaseous emission control equipment; Air pollution indices; Air pollution survey; Costs of air pollution control.

Air pollution legislation and regulations. Case studies of a few industrial pollution control systems

Reference Book:

1. De Nevers, N., Air Pollution Control Engineering, McGraw-Hill, Inc., 2000.
2. K. Wark, C.F. Warner & W.T. Davis Air Pollution Control: its Origin and Control, Addision-Wesley, 1998.
3. C. David Cooper and F. C. Alley, Air Pollution Control: A Design Approach, 4th Ed, Waveland Press, Inc., 2006

Module-4: Advanced Natural Gas Engineering (2 credits)

Properties and Measurement of Natural Gas:

Phase behavior fundamentals, qualitative and quantitative phase behavior, vapor liquid equilibrium.

Equation of state, critical pressure and temperature determination. Gas compressibility, viscosity and thermal conductivity, formation volume factor.

Gas flow measurement and fundamentals

Reference Books:

1. Lee, J, Wattenbarger, R. A., "Gas Reservoir Engineering", Society of Petroleum Engineers, TX, USA, 1996.
2. Ikoku, Chi, "Natural Gas Production Engineering", John Wiley and Sons, 1984.
3. Mokhatab, s, Poe, W A and Speight, J G, Handbook of Natural Gas Transmission and Processing, Gulf Professional Publishing, 2006

Module-5: Process Dynamics and Control (2 credits)

Advanced control strategies: Controller design for cascade control, feed-forward control, Smith predictor scheme, and inferential control. Adaptive control: MRAC and STR; Control configuration; Analysis and applications.

Model based control: Internal model control; Dynamic matrix control; Model predictive control. Multivariable control: State-space representation; Transfer function matrix; RGA and its application; Stability and interaction analysis;

Digital control: Hardware and software requirements; Introduction to DDC, DCS, supervisory (optimizing), and hierarchical control; z-and modified z-transformation and their inverse; Sampling, aliasing, and ringing; Controller design and implementation

An introduction to plant-wise control and on-line (real-time) optimization of plant, Case studies.

Reference Books:

1. Bequette, B. W., Process Control*:* Modeling, Design and Simulation, Prentice Hall of India, New Delhi ,2003
2. Marlin, T. E., Process Control: Designing Processes and Control Systems for Dynamic Performance, 2nd Edition, McGraw Hill, New York, 2000
3. Ogunnaike, B. A. and Ray, W. H., Process Dynamics, Modeling and Control, Oxford, New York ,1994

Module 6: Cyber Law and Information Security-II (2 Credits)

Cyber Crimes and Intermediaries: Crime: Meaning and concept, Rights and liability-Civil, criminal and tortuous, Offences- concept and Legal parameters, Rights and liabilities of Intermediaries, IPR regime and Cyber Laws, Understanding Copy right information, Technology legal issues in internet and software copy right, Patents, Trade marks and Data base

Patents: Understanding Patents, International context of Patents, European Position on Computer related Patents, Legal position of US and India on Computer related Patents

Trademarks: Understanding trademarks, Trademark law in India, Infringement and passing off, Trademarks in Internet, Domain name registration, Domain name Disputes and WIPO

Physical and Environmental Security: Server room design, Fire fighting equipment, Temperature/humidity Control etc, Application Security: Databases, Email and Internet etc Organizational and Human Security, Human Factors in Security- Role of information security professionals.

Cyber Forensics: Introduction to forensic tools, Evaluation of crime scene and evidence collection, Usage of tools for disk imaging and recovery processes, Introduction to Information Security Standards, ISO 27001, PCI DSS etc.

Reference Books:

1) Vakul Sharma, Information Technology Law and Practice, Delhi Law House, 3rd Edn, 2011
2) Nandan Kamath, Law relating to Computers, Internet & E-Commerce: a guide to cyber laws, Universal Law Publishing Co. Pvt. Ltd., 2000
3) Michael E Whitman and Herbert J Mattord, Principles of Information Security, Vikas Publishing House, New Delhi, 2003
4) Micki Krause, Harold F. Tipton, Handbook of Information Security Management, Vol 1-3 CRC Press LLC, 2004.
5) Michael E Whitman and Herbert J Mattord, Principles of Information Security, Vikas Publishing House, New Delhi, 2003
6) Thomas R Peltier, Justin Peltier and John blackley, Information Security Fundamentals,2nd Edition, Prentice Hall, 1996
7) Jonathan Rosenoer, Cyber law: the Law of the Internet, Springer-Verlag, 1997.

Students should select one modules of 1 credit each out of the following Group II

GROUP-II

Module 1: Clean Development Mechanisms (CDM) (1 Credit)

Carbon Credits Generation, Trading, Markets. Carbon credit calculations. Clean Development Mechanisms (CDM), approved CDM methodologies, CDP Project Design Document, Case studies Petroleum Industry Energy savings.

Reference Books:

1. American Petroleum Institute, Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry. 2004.
2. Lohmann Larry, Carbon Trading, Development Dialogue, 48, 2006.
3. Hester R E and Harrison R M (editors), Carbon Capture: Sequestration and storage, Issue in Environmental Science and Technology, The Royal Society of Chemistry, 2010
4. Ibrahim Dincer Adnan Midi lli Arif Hepbasli, T. and Hikmet Karakoc (editors), Global Warming: Engineering Solutions, A series in Green Energy and Technology, Springer, 2010

Module 2: Refining Technology (1 credit)

Overview of refining flow, products, specifications, market in India and global scenario Refinery Feedstocks, crude distillation, coking and thermal processes,

Catalytic cracking, hydrocracking, hydroprocessing and resid processing, hydrotreating Catalytic reforming and isomerism, Alkynation and polymerization, product blending

Reference Books:

1. Nelson N.L., 'Petroleum Refinery Engineering', McGraw Hill Book Co.,1985
2. James H. Gary and Glenn E. Handework, 'Petroleum Refining Technology and Economics', Fourth Edition, Marcel Dekker, Inc.,2001
3. Waquier, J.P., 'Petroleum Refining' Vol .I and II, Second Edition, Technip, 1995

Module 3: Non-Newtonian Flow and Heat Transfer (1 Credit)

Constitutive equations of various Non-Newtonian fluids; Problems related to development of constitutive equations; Evaluation of relevant physical properties.

Laminar and turbulent flows in conduits; Packed and fluidized beds, Flow around submerged objects. Viscoelastic effects; Mixing and agitation.

Temperature distribution and heat transfer in laminar and turbulent flows. Boundary layer flows with and without heat transfer

Reference Books:

1. A.H.P Skelland, Non-Newtonian Flow and Heat Transfer, Wiley, 1967
2. William Lionel Wilkinson, Non-Newtonian fluids: fluid mechanics, mixing and heat transfer, Pergamon Press, 1960.
3. G. Böhme, Non-Newtonian Fluid Mechanics, Elsevier Science & Technology, 1987.

M.E. (PETROCHEMICAL ENGINEERING)

512216 Seminar - II

Teaching Scheme:
Practical: 4 Hours/Week

Examination Scheme:
Term Work: 50 Marks
Oral/presentation: 50 marks
Credits: 4

Each student is required to deliver a seminar in the first semester. The students will be required to select an advanced research topics for the seminar and present the seminar during the semester.

A detailed report should also be submitted at the end of term and a presentation made based on the same. The assessment will be based on the quality in terms of research and development. Modern audio-visual techniques may be used at the time of presentation Available case studies may also be incorporated.

M.E. (PETROCHEMICAL ENGINEERING)

512217 Project stage I

Teaching Scheme:
Lectures/Practical: 8 Hours/Week

Examination Scheme:
Term work 50 Marks
Oral/Presentation 50 Marks
Credits: 8

The students, at individual level, under the supervision of an internal teacher and/or an external teacher/guide if required, shall undertake a dissertation in a specialized area of Petroleum Engineering.

The students shall first define the problem and scope of work of the project work. Individually they shall undertake an extensive library search on the topic selected to take an overview of developments. They shall prepare a manuscript based on literature survey in consultation with the guide and submit the same.

The report shall also include objectives of study, and methodology required to complete the project work of stage I.

M.E. (PETROCHEMICAL ENGINEERING)

512218 Seminar - III

Teaching Scheme:
Practical: 5 Hours/Week

Examination Scheme:
Term Work: 50 Marks
Oral/presentation: 50 marks
Credits: 4

Each student shall submit and present a seminar based on topic of dissertation related petroleum engineering in the first semester.

The students shall present literature review and developments related to dissertation indicating recent trends of the industry. They shall carry out extensive literature survey to analyze, comprehend and synthesize the topic of study, supported by proven case study.

A seminar report of about 30 typed pages shall be submitted under the supervision of a faculty member.

M.E. (PETROCHEMICAL ENGINEERING)

512217 Project stage II

Teaching Scheme:
Lectures: 20 Hours/Week

Examination Scheme:
Term work 150 Marks
Oral/Presentation 50 Marks
Credits: 20

The students, at individual level, under the supervision of an internal teacher and/or an external teacher/guide if required, shall undertake a dissertation in a specialized area of Petroleum Engineering.

Based on remarks received in stage I, the students at individual level may carry out dissertation at industry workspace or in house.

The study shall include experimental work, use of some software available in the company workplace or in house, analysis and synthesis of data, and consistency of results. The data may be compared with the published data.

The students at individual level, shall publish his/her findings at least one paper in reputed journals or national/international conference. Reprint of the same may be attached as annexure in the project.

The students shall submit three copies of dissertation work certified and forwarded by internal guide and mentor if any.