Structure and Syllabus

TE (Petrochemical Engineering)

2015 Course

Savitribai Phule Pune University

(WEF 2017-18)

T.E. (Petrochemical Engineering)-2015 Course
(W.e.f. Academic year 2017-18)

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)						Credits
		Lect.	Tut	Pr.	Theory		TW	PR	OR	Total	
					In Sem.	End Sem.					
312401	Numerical and Statistical Methods	4		2	30	70	25	--	--	**125**	**4**
312402	Applied Hydrocarbon Thermodynamics	3	1	--	30	70	25	--	--	**125**	**4**
312403	Mass Transfer –I	4	--	2	30	70	--	--	50	**150**	**5**
312404	Refining Operations	4	--	2	30	70	--	50	--	**150**	**5**
312405	Process Instrumentation and Instrumental Analysis	3	--	2	30	70	--	--	50	**150**	**4**
312406	Skill Development	--	--	2	--	--	50	--	--	**50**	**1**
312407	Audit Course 3 (Practices in Petrochemical Industry I)	-			-		-	-	-	-	**-**
Total of Semester – I		**18**	**1**	**10**	**150**	**350**	**100**	**50**	**100**	**750**	**23**

T. E. (Petrochemical Engineering) Semester – II

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)						Credits
		Lect.	Tut	Pr.	Theory		TW	PR	OR	Total	
					In Sem.	End Sem.					
312408	Transport Phenomena	3	1	-	30	70	25	--	--	**125**	**4**
312409	Mass Transfer-II	4	--	2	30	70	--	--	50	**150**	**5**
312410	Reaction Engineering- I	3	1	-	30	70	25	--	--	**125**	**4**
312411	Petrochemical Processes	4	-	-	30	70	--	--	--	**100**	**4**
312412	Process Equipment Design	4	--	2	30	70	25	--	25	**150**	**4**
312413	Petrochemical Engineering Laboratory	-	-	4*			--	50	--	**50**	**2**
312414	Seminar	--	--	2			50		--	**50**	**2**
312415	Audit Course 4 (Practices in Petrochemical Industry II)										
Total of Semester – II		**18**	**02**	**10**	**150**	**350**	**125**	**50**	**75**	**750**	**25**

***** *Twice a Week*

Abbreviations: TW: Term Work, OR: Oral, PP: Passed (Only for Audit courses), NP: Not Passed (Only for Audit courses)

Important Notes

1. In-Semester Theory examination will be conducted approximately one and half month after the commencement of each semester

2. In-Semester Theory examination will be based on first three units from Syllabus and will be conducted by the Savitribai Phule Pune University.

3. Total time allotted for In-Semester Theory examination will be 1 hr.

4. Total time allotted for End-Semester Theory examination will be 2 hrs. 30 min.

5. Audit course 3 and 4 will be conducted in the first and second term of third year of Petroleum Engineering respectively. This is inclusive of submission of assignments based on sessions conducted by the industry professionals by way of workshop, guest sessions, soft skills workshops, and also by submitting report of mini project if given and industry tour report. Any value addition by the students such as completion of any online certificate course can also be considered under this. This should be submitted at the end of the term and successful submission should be given PP in the mark sheet and NP if not submitted or incomplete submission. The audit course should cover work equivalent to twenty hours in the term and submission should be in the form of a comprehensive report. Details are given in appropriate sections.

T.E. (Petrochemical Engineering) –2015Course

Numerical and Statistical Methods [312401]

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme(Marks)						Credits
		Lect.	Tu	Pr.	Theory		TW	PR	OR	Total	
					In Sem.	End Sem.					
312401	Numerical and Statistical Methods	4	--	2	30	70	25	--	--	125	4

COURSE OBJECTIVES

1. To introduce various numerical techniques to solve engineering problems.
2. To acquaint the students with operations research tools required in Petrochemical engineering practice.
3. To equip the students withstatistical methods for analyzing and interpreting experimental data.

COURSE OUTCOMES:

On successful completion of this course, student will be able

1. To apply finite difference techniques, interpolation, numerical integration in various Petrochemical engineering problems.
2. To solve system of equations arising in solutions of heat and wave equations.
3. To solve initial and boundary value problems which do not have closed form solutions using numerical methods.
4. To apply the optimization techniques in planning and allocation of available resources.
5. To use statistical methods for solving problems related to petrochemical engineering.

Unit-I Numerical Analysis (08 hrs.)

Calculus of Finite difference, Finite difference Operators, Newton's, Lagrange's and Stirling's interpolation formulae, Lagrange's method for interpolation.

Numerical differentiation and numerical Integration, Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules, Weddle's rule, Gauss Quadrature 2 and 3 point formulae, Error analysis.

Unit – II Solutions of Equations (08 hrs.)

Solution of Algebraic and transcendental equations, Method of false position, Newton-Raphson method, Method of successive approximation, Convergence and stability criteria, Solution of System of simultaneous linear equations, Gauss elimination method, Gauss-Seidel method, Method of least square for curve fitting.

Unit – III Ordinary and Partial Differential Equations (08 hrs.)

Solution of ordinary differential equations, Euler's method, modified Euler's method, Runge-Kutta method.
Solution of partial differential equations using finite difference technique, Explicit and implicit methods. Solution of one dimensional unsteady state problem in heat and mass transfer.

Unit – IV Operations Research (08 hrs.)

Linear programming, Formulation and solution, convex set, Simplex method, Duality, Applications of Linear programming in Petrochemical engineering.

Unit – V Transportation and Assignment Problems (08 hrs.)

Transportation problem, Vogel's approximation method for initial basic feasible solution, Balanced and Unbalanced Transportation problem, Degeneracy, Assignment Problem, Hungarian method, Travelling Salesman Problem, Introduction to unconstrained optimization.

Unit – VI Statistics and Probability (08 hrs.)

Correlation and Regression of data, Probability, Probability distributions, Binominal, Normal and Poisson distribution, Testing of hypothesis, χ^2 distribution .

Term Work:

Every student should carry out minimum eight practicals from the list below .The students should submit journal based on the practicals performed and get it certified from the internal examiner. The students should bring certified journal for the term work examination.

List of Practicals:

1. Solve Pre-formulated Mathematical Models for Petroleum Engineering Operations Using C, C++ or Mathematical Software Packages.
2. To fit the Regression lines to the set of given Data points.
3. Using Chi Square Distribution, testing the goodness of fit of the given distribution.
4. Solution of Algebraic and transcendental equations using Newton Raphson Method.
5. Interpolation Techniques using Forward, Backward and Central Differences. Lagrange's Method for unequal intervals.
6. Numerical Integration.
7. Least Square Approximation for Curve Fitting.

8. Gauss Elimination and Gauss Siedel Methods for System of Simultaneous Linear Equations.
9. Solution of Ordinary Differential Equation with initial condition using Runge-Kutta Method.
10. Solution of one dimensional and two dimensional Heat Flow/Mass Transfer.

Books:

1. Chapra S.C.and Canale R.D.,‘Numerical Methods for Engineers’, WCB/McGraw-Hill Publications, 2001
2. Freund John, ‘Probability and Statistics for Engineers’, Prentice-Hall of India Pvt. Ltd., 2004
3. Kreyszig E. ‘Engineering Mathematics’,Wiley Eastern Ltd., 2006
4. Taha H. A., ‘Operations Research-An Introduction’, Seventh Edition, Prentice-Hall, 2002
5. Gupta S. K., ‘Numerical methods for Engineers’, New Age International Publishers Ltd., Wiley Eastern Ltd, 1999

T.E. (Petrochemical) - 2015 Course

Applied Hydrocarbon Thermodynamics [312402]

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)						Credits
		L	T	Pr.	Theory		TW	PR	OR	Total	
					In Sem.	End Sem.					
312402	Applied Hydrocarbon Thermodynamics	3	1	-	30	70	25	-	-	125	4

COURSE OBJECTIVES

1. To provide insight into phase equilibria and chemical equilibria.
2. To introduce crude oil thermodynamics for better downstream processing.
3. To help appreciate the applicability of biochemical systems in the process industry.

COURSE OUTCOMES:

On successful completion of this course, student will be able to

1. Apply the relations for compressible flows of gases flow at sonic and supersonic speeds to evaluate the thermodynamic properties.
2. Distinguish between ideal and non-ideal solutions and predict the properties of the same.
3. Apply the criteria of phase equilibrium to solve problems of multi component and complex hydrocarbon systems under different thermodynamic conditions.
4. Determine temperature and pressure conditions for a particular reaction system or process for obtaining optimum yield.
5. Classify reservoir fluids using PVT analysis and equilibrium data.
6. Apply thermodynamic principles to biochemical systems.

Unit – I: Thermodynamics of Flow Processes (08 hrs.)

Flow of Compressible fluids: Concept of stagnation state and Mach number, One dimensional isentropic flow, Flow through Pipes, Nozzles, Ejectors and Turbines, Throttling Process, Shock wave and Expansion waves, Duct flow with heat transfer (Rayleigh flow)

Unit – II: Phase Equilibrium-I ***(08 hrs.)***

Revision of Partial molar properties and Chemical Potential, Ideal and Non-ideal solutions, Lewis Randall rule, Raoult's law, Henry's law, Activity and activity coefficients, Gibbs-Duhem Equations, Property changes of mixing of solutions

Unit – III: Phase Equilibrium-II ***(08 hrs.)***

Criteria of Phase Equilibrium, Phase Rule for Non-reacting Systems, Phase diagrams for binary systems, Vapour Liquid Equilibria for ideal and non-ideal solutions, Azeotropes, Activity Coefficient Equations, Multi component VLE

Unit – IV: Chemical Reaction Equilibria ***(08 hrs.)***

Reaction Stoichiometry, Equilibrium Constant and Standard Free Energy Change, Effect of the following on Equilibrium Constant: Temperature, Pressure, Inert Materials, Excess reactants, Products., Heterogeneous Reaction Equilibria, Phase Rule for Reacting Systems.

Unit – V: Hydrocarbon Reservoir Thermodynamics ***(08 hrs.)***

Classification of Reservoirs and Reservoir Fluids, Retrograde phenomena, PVT Properties of Crude Oil, Equations of State, Phase Equilibria of Reservoirs, Phase Behaviour of Asphaltenes and Wax

Unit – V: Biochemical Thermodynamics ***(08 hrs.)***

Energy conversion in biological systems, Heat and work effects in metabolic processes and biochemical reactions, Thermochemical properties of biological fuels viz. carbohydrates, proteins and fats, Phase equilibria in biopolymers.

Term-Work

Every student should carry out minimum eight tutorial exercises based on the above units. The students should submit journal based on the tutorials performed and get it certified from the internal examiner. The students should bring certified journal for the term work examination.

Books:

1. Narayanan, K.V. 'A Textbook on Chemical Engineering Thermodynamics'. Prentice Hall of India Ltd. 2013
2. Cengel, Y.A. and Boles, M.A. 'Themodynamics: An Engineering Approach'. Seventh Edition, Tata McGraw Hill Education Pvt. Ltd.2011
3. Sandler, S.I.' Chemical, Biochemical and Engineering Thermodynamics. 4^{th} Ed. John Wiley and Sons Inc. 2006
4. Smith, J. M. and Van Ness H. C. 'Introduction to Chemical Engineering Thermodynamics'. McGraw-Hill, 1996.
5. Tarek Ahmed. 'Equations of State and PVT Analysis: Applications for Applied Reservoir Modeling'. Gulf Publishing Company. 2007

T.E. (Petrochemical Engineering) - 2012 Course
Mass Transfer -I [312403]

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)						Credits
		L	T	Pr.	Theory		TW	PR	OR	Total	
					In Sem.	End Sem.					
312403	Mass Transfer-I	4	--	2	30	70	--	--	50	150	5

COURSE OBJECTIVES

1. To acquaint the student with the fundamental concepts of mass transfer principles
2. To introduce equations describing molecular diffusion through gases, liquids, and solids.
3. To make the students conversant with techniques used to estimate mass transfer coefficients in laminar and turbulent flows.
4. To equip the student with the general approach for the design of continuous contact and stage wise operations.

COURSE OUTCOMES:

On successful completion of this course, student will be able to

1. Identify and formulate a mass transfer problem in diffusive and convective situations.
2. Formulate and solve interphase mass transfer problem encountered in real life
3. Identify, Formulate, and Solve single stage mass transfer problem
4. List and choose from the variety of gas-liquid contact equipment
5. Estimate mass transfer coefficient to be used in a real life application
6. Develop and Use Psychrometric Chart for designing humidification/dehumidification tower
7. Estimate time and energy required for batch drying

Unit – I Introduction to Mass Transfer and Molecular Diffusion (08 hrs.)

Molecular diffusion in gases and liquids, diffusivities of gases and liquids, types of diffusion, Fick's and Maxwell law of diffusion, diffusion in solids, unsteady state mass transfer, and Multi component diffusion.

Unit – II Interphase Mass Transfer (08 hrs.)

Equilibrium, Diffusion between phases, Local and average phase /overall mass transfer coefficients, Material balances for steady-state co current and countercurrent processes, Stage wise and differential contact, Theoretical stage. Stage efficiency.

Unit – III Mass Transfer Coefficients (08 hrs.)

Theories for mass transfer: Film Theory, Penetration theory, Surface renewal theory, Convective mass transfer, Dimensionless groups in mass transfer and their significance. Analogies and correlations between heat, mass, and momentum transfer.

Unit – IV Equipment for Gas-Liquid Operation (08 hrs.)

Gas dispersed: Sparged vessel/Bubble column, mechanically agitated vessels for gas liquid contact, Tray towers, Type of trays, flow arrangements on tray, Tray efficiency, Sparged vessels

Liquid dispersed: Ventury Scrubber, Wetted wall tower, Spray tower, Spray chamber, Packed tower, Mass Transfer coefficients for packed tower, Types of packings, Tray tower Verses packed tower, Liquid hold up – determination of interfacial area based on hold up and mass transfer coefficients, Co-current flow of gas and liquid, hydrodynamic behavior of packed and tray towers

Unit – V Humidification and Dehumidification Operations (08 hrs.)

Concept of humidity and definitions, vapor-liquid equilibria, enthalpy of pure substances, wet bulb temperature relation, psychrometric chart, Lewis relation, methods of humidification and dehumidification, Humidification and dehumidification operations, Humidifier height calculations, cooling tower principle and operation, types of equipment, design calculation, HTU, NTU concept.

Unit – VI Drying Operations (08 hrs)

Principles, equilibrium in drying, types of moisture content, mechanism of batch drying, continuous drying, time required for drying, mechanism of moisture movement in solid, Classification and selection of industrial dryers,

Oral Examination

The students should submit journal based on the experiments performed during practical hours and get it certified from the internal examiner. The students should bring certified journal for the oral examination. Oral examination will be based on the experiments conducted and class assignments.

List of Experiments: carry out any eight experiments from the list given below.

1. To determine diffusivity of acetone in air.
2. To determine mass transfer behavior of packed bed.
3. To determine mass transfer behavior of plate column.
4. To determine mass transfer behavior of wetted wall tower.
5. To determine mass transfer behavior of spray chamber.

6. To determine mass transfer behavior of a sparged vessel.
7. To determine mass transfer coefficient for surface evaporation.
8. To determine liquid hold up in packed tower.
9. To evaluate performance of humidification/ de-humidification column.
10. To determine drying characteristics of a wet solid material using tray dryer
11. Study of hydrodynamic behavior of packed towers

Books:

1. Treybal, R.E., ‘Mass Transfer Operations’, 3rd edition, McGraw Hill, 1980.
2. Geankoplis, C.J, ‘Transport Processes and Unit Operations’, PHI, 3rd Edition, 1993
3. Coulson, J. M.; Richardson, J. F., ‘Chemical Engineering – Vol. I & II’, 6th edition, Butherworth-Heinemann, 1999.
4. Cussler E.L., ‘Diffusion: Mass transfer in fluid Systems’; 2nd Edition, Cambridge University Press, 1998.

T.E. (Petrochemical) - 2015 Course
Refining Operations [312404]

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)						Credits
		L.	T	Pr.	Theory		TW	PR	OR	Total	
					In Sem.	End Sem.					
312404	Refining Operations	4	-	2	30	70	-	50	-	150	5

COURSE OBJECTIVES

1. To illustrate the importance of crude oil as source of fuel and the size of refining industry
2. To summarize the various refinery processes and the products along with their specifications
3. To show the challenges involved in refining from viewpoint of economic considerations and environmental regulations.

COURSE OUTCOMES:

On successful completion of this course, student will be able to

1. Outline the overall refinery flow.
2. Classify crude oil on the basis of its properties and characterization methods.
3. Identify the specifications required for good quality petroleum product
4. Explain the process of purification and fractionation of crude oil
5. Decide the proper conversion route to upgrade the products from ATU and VDU
6. Apply chemical engineering principles to the analysis of safe and efficient refinery operations

Unit – I: Overview of Production and Refining of Crude Oil (08 hrs.)

Origin, formation, exploration and production of crude oil, Reserves and deposits in the world, Petroleum industry in India, Overall Refinery flow, Petroleum Products, Nelson complexity factor

Unit – II: Composition and evaluation of Crude oil and its Products (08 hrs.)

Classification of crude oil, Composition of crude oil, Crude Assay, ASTM/TBP/EFV curves, Specifications and Test methods for: LPG, Naphtha, Gasoline, Kerosene, Diesel, Lube oil, Waxes, Bitumen and Coke.

Unit – III: Refinery Processes I: Distillation and Cracking ***(08 hrs.)***

Desalting of Crude, Preheating Train, Atmospheric Distillation of Crude oil, Vacuum Distillation, Catalytic Cracking, Hydrocracking.

Unit – IV: Refinery Processes II: Conversion Processes ***(08 hrs.)***

Catalytic Reforming, Alkylation, Isomerization, Hydroprocessing, Hydrotreating, Coking

Unit – V: Manufacture of Lube oil and Bitumen ***(08 hrs.)***

Lube oil processing, Propane deasphalting, Solvent Extraction, Dewaxing, Finishing Processes, Lube oil additives, Properties of Bitumen, Methods of Manufacture of Bitumen

Unit – VI: Supporting Processes and Pollution Control in Refineries ***(08 hrs.)***

Product Blending, Hydrogen Production, Sulphur Recovery, Control of air and water pollution, solid waste management

Practical Examination

The students should submit journal based on the experiments performed during practical hours and get it certified from the internal examiner. The students should bring certified journal for the practical examination. Practical examination will be based on the experiments conducted.

List of Practicals: Carry out any eight experiments out of the following,

1. To characterize a petroleum product by ASTM Distillation
2. To characterize a given crude oil sample for water content
3. To characterize a given crude oil sample for Viscosity Gravity Constant
4. To determine the Conradson Carbon Residue for crude oil sample
5. To determine the softening point of bituminous material
6. To determine the melting point of petroleum wax
7. To determine the smoke point and flash point of given fuel sample
8. To determine the aniline point and diesel index of diesel
9. To determine the cloud point and pour point of a given fuel sample
10. To determine the Reid Vapour Pressure of a gasoline sample
11. To determine the calorific value of a petroleum product using bomb calorimeter
12. To determine the oxidation stability of gasoline
13. To generate pseudocomponents for crude oil using commercial simulation software like ASPEN HYSYS

Books:

1. Gary, J.H and Handework, G.E., 'Petroleum Refining Technology and Economics', Fourth Edition, Marcel Dekker, Inc. 2001
2. Ram Prasad, 'Petroleum Refining Technology', First Edition, Khanna Publishers. 2013

3. Bhaskara Rao, B.K, 'Modern Petroleum Refining Processes', Fifth Edition, Oxford and IBH Publishing Co. Pvt. Ltd. 2007
4. Fahim, M.A., Alsahhaf, T.A. and Elkilani, A. 'Fundamentals of Petroleum Refining', Elsevier, 2010
5. Nelson, N.L. (1985) 'Petroleum Refinery Engineering', McGraw Hill Book Co.

T.E. (Petrochemical Engineering) - 2015 Course

Process Instrumentation and Instrumental Analysis [312405]

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)						Credits
		L	T	Pr.	Theory		TW	PR	OR	Total	
					In Sem.	End Sem.					
312405	Process Instrumentation and Instrumental Analysis	3	--	2	30	70	--	--	50	150	4

COURSE OBJECTIVES

1. To impart understanding of the fundamentals of process instrumentation and instrumental analysis.
2. To help students understand the working of and interpret the results obtained using various analytical instruments.
3. To familiarize the students with recent advances in instrumentation and analytical techniques

COURSE OUTCOMES: At the end of the course the student will be able to

1. Measure, Calibrate and Select measuring instrument for field applications.
2. Analyze the given sample using appropriate analytical technique, interpret the results.
3. Report the technical problems associated with process instruments.

Unit – I Introduction to Process Instrumentation (06 hrs.)

Instrumentation Basics: Sensors and Transducers, Standard Instrumentation Signals, Smart Transmitters, Instrument characteristics, Errors in Experimentation – Systematic and Random errors; Precision and Accuracy of Measuring Instruments; Uncertainty Analysis, Instrument Noise. Basic feedback control loop, Instrumentation Symbols.

Unit – II Temperature Measurement (06 hrs.)

Temperature scales, Non-electrical methods, electrical methods, Radiation methods, Digital Temperature Instruments, recent advances in Temperature measurements

Unit – III Pressure and Level Measurement (06 hrs.)

Pressure measurement: Moderate pressure measurement, high pressure measurement, vacuum measurement, Digital Pressure Instruments, recent advances in pressure measurements

Level measurement: Measurement techniques for liquids and slurries, Digital level Instruments, Recent advances in level measurements

Unit – IV Flow Measurements and Study of Valves ***(06 hrs.)***

Flow measurement: Review of venturimeter, Orifice meters, Rotameters, Pitot tube, working of Turbine, Vortex shedding, Electromagnetic flow meters. Hot Wire Anemometer, Laser Doppler Anemometer, Ultrasound, Particle Image Velocimetry.

Study of Valves: Types of valves, valve characteristics, Controllability and rangeability, Valve sizing, Valve selection criteria.

Unit – V Spectroscopic Techniques ***(06 hrs.)***

Introduction to instrumental analytical techniques and its classification.

Spectroscopic techniques: X-ray, Inductively Coupled Argon Plasma (ICAP), Ultraviolet – Visible (UV-VIS), Fluorescence, Infrared (IR), Raman Spectroscopy, Mass Spectrometry (MS), Nuclear Magnetic Resonance (NMR)

Unit – VI Chromatographic and Miscellaneous Techniques ***(06 hrs.)***

Chromatographic Techniques: Gas Chromatography (GC)and Thin Layer Chromatography (TLC), High Pressure Liquid Chromatography (HPLC)

Miscellaneous measurements and analysis: Refractometer, pH and redox potential measurements, Thermal conductivity gas analyzers, Oxygen determination, and Orsat analysis.

Oral Examination

The students should submit journal based on the experiments performed during practical hours and get it certified from the internal examiner. The students should bring certified journal for the oral examination. Oral examination will be based on the experiments conducted and class assignments.

List of Experiments:

Minimum eight experiments from the following should be completed as a part of practical course

1. Temperature Measurements Calibration.
2. Pressure Measurements Calibration.
3. Flow Measurements Calibration.
4. Level Measurements Calibration.
5. Types of Valves and Valve Characteristics
6. Analysis of samples using UV Spectrophotometer
7. Analysis of samples by Refractometer
8. Interpretation of trends of GC, HPLC, IR, NMR, MS
9. Working of Relays, Switches and Contactors

10. Study of Instrumentation Specification data sheet for T, P, L, F and Valves *(Assignment)*
11. Study of P& ID Diagram for simple process control loops *(Assignment)*

Books:

1. Nakra, B. C.; Chaudhary K. K. 'Instrumentation Measurement and Analysis'; 3rd Edition, Tata McGraw Hill, New Delhi, 2009
2. Patranabis, D. 'Principles of Industrial Instrumentation'; 3rd Edition Tata McGraw Hill, New Delhi, 2010
3. Bela G. Liptak ; 'Instrument Engineers' Handbook'; 4th Volume, CRC Press, 2003
4. Pradyot Patnaik: Dean's Analytical Chemistry Handbook', McGraw Hill Professional, 2004
5. Douglas A. Skoog, Donald M. West, F.James Holler, Timothy A. Nieman , 'Principles of Instrumental Analysis', 6th Edition, Thomson Brooks/Cole, 2007

T.E. (Petrochemical Engineering) - 2015 Course

Skill Development [312406]

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)						Credits
		L	T	Pr.	Theory		TW	PR	OR	Total	
					In Sem.	End Sem.					
312406	Skill Development	--	--	2	--	--	50	--	--	50	1

COURSE OBJECTIVES

1. To get an integrated view of basic subjects
2. To formulate the solution to open ended problems of the industry
3. To use the computational tools effectively
4. Prepare the students to lead high-performing, successful professional career in the future

COURSE OUTCOMES:

On completion of this course, the students should be able to demonstrate an,

1. Ability to have an integrated approach of the fundamental engineering subjects
2. Ability to tackle the open ended problems with defined methodology
3. Ability to structure, write, present and defend the technical report
4. Ability to use computational tools and its interface with professional software

(1) Computing in spreadsheet software such as MS Excel
  a. To perform mass and energy balance over entire plant for a given process
  b. To perform calculations using SOLVER function
  c. To perform calculations using Macros
  d. To develop T-x-y diagram for non-ideal systems

(2) Heat Exchanger Simulation such as HTRI:
  (i) To use simulator such as HTRI software for rating and design of heat exchangers.

(3) Process simulation using software such as Aspen Plus/ Hysys:
  (i) For simulation of VLE problems

(4) Exercise on design of a piping network system for a given process as per required norms and codes

(5) To do patent search for a process/product and submit a report.

(6) To decide the capacity of a new petrochemical production venture using reliable internet sources.

(7) To calculate Nelson Complexity Factor for a given refinery configuration.

(8) Using word processor such as MS WORD for scientific report writing through use of functionalities such as referencing, end note, tables, figures, equations, citations software, etc.

Term-Work

Every student shall perform minimum six exercises from the above list and submit a journal which will form the term work.

Term work and theory are considered to be integral part of the course. The Term work will include the evaluation of above exercises and a solution of a given problem using appropriate software tools and its report. Term work shall consist of a journal consisting of regular assignments and presentations completed in the practical class. Oral presentations exercises and group discussions should be conducted batch wise so that there is a closer interaction.

T. E. PETROCHEMICAL ENGINEERING 2015 COURSE
312 407: Audit Course 3
Practices in Petrochemical Industry

OBJECTIVE:

The objective of audit course is to expose students to different aspects of petroleum industry by organizing guest sessions on different topics on emerging areas, workshops on soft skills and personality development, industrial tours, mini projects, tutorials, assignments and also report based on internship carried out if any.

REQUIREMENTS FOR COURSE COMPLETION:

The students have to complete audit course as a part of curriculum. This can be divided into different components such as

1. Assignments given by faculty members based on the sessions conducted by industry professionals during the term.

2. Registration for any online course organized by recognized institute in India and outside like IITs, Stanford and MIT Course work and submit the assignments completed as a part of the course work.

3. Assignments completed as a part of learning of any professional software available in the department computer center under the supervision of faculty members.

4. Report on the industrial visit carried out in the term,

5. Report of the workshop conducted on soft skills and personality development organized if any. This should include exercises given in the class and their analysis and solution.

6. If students are deputed to any activity including internship, paper presentation, technical workshop, seminars and guest sessions outside campus, then a brief technical report of the same should be considered as a part of audit course.

The students individually have to submit at least four of the above activities towards the end of the semester for assessment. The audit course should cover work equivalent to twenty hours in the term and submission should be in the form of a comprehensive report.

Successful completion of audit course will allow students to earn PP in the marksheet and NP if failed to complete the audit course.

Term II

T. E. PETROCHEMICAL ENGINEERING 2015 COURSE
TRANSPORT PHENOMENA [312408]

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)						Credits
		L	T	Pr.	Theor		TW	PR	OR	Total	
					In Sem.	End Sem.					
312408	**Transport Phenomena**	**3**	**1**		**30**	**70**	**25**	**-**	**-**	**125**	**4**

OBJECTIVES

1. To introduce students to differential forms of the equations of change in fluid flow, heat and mass transfer.
2. To familiarize students with the implementation of numerical schemes for practical problems based on transport phenomena principles.

COURSE OUTCOMES

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

1. Identify transport properties and analyze the mechanisms of molecular momentum, energy and mass transport.
2. Able to select appropriate coordinate systems for transport phenomena problems
3. Formulate the differential forms of the equations of change for momentum, heat and mass transfer problems for steady-state and unsteady flows.
4. Create solutions to fluid flow, heat transfer and mass transfer complex problems

Unit I: Introduction to Transport Phenomena ***(06 hrs.)***

Transport phenomena and unit operations, Mathematical formulations of basic conservation equations, Coordinate Systems, differential vector operations, transformation of operators, Lagrangian and Eulerian representations, Molecular and Convective Transport,

Unit II: Transport Analogies and Transport Coefficients **(*06 hrs.*)**

Dimensionless Numbers in fluid flow, heat and mass transfer, Transport Analogies.
Evaluation of Friction factor, Mass Transfer coefficient and heat transfer coefficient correlations for Flow past flat plate, Flow past single sphere, flow in circular pipes, Flow in packed beds

Unit III: Differential Equations of Fluid Flow **(*06 hrs*.)**

The differential continuity equation, Navier-Stokes Equation and its applications, Velocity Boundary layer, Boundary layer equations, Blasius's solution,Von Karman Integral analysis, Turbulence, turbulent shear stresses,, Mixing length hypothesis,

Unit IV: Differential Equations of Mass Transfer **(*06 hrs*.)**

Review of Mass transfer and diffusion in gases, liquids and solids, unsteady state diffusion, convective mass transfer coefficients, molecular diffusion Plus convection and chemical reaction, Numerical methods for unsteady state molecular diffusion, Boundary layer flow and turbulence in mass transfer. Dimensional analysis in mass transfer

Unit V: Differential Equations of Heat Transfer **(*06 hrs*.)**

Derivation of basic equation, unsteady state heat conduction, Numerical methods for unsteady state conduction, Differential equation for energy change, Boundary layer flow and turbulence in heat transfer, Dimensional analysis in heat transfer.

Unit VI: Introduction to CFD **(*06 hrs*.)**

Basics of CFD, Meshing, Problem solving with CFD, Finite volume method analysis, Finite volume method for one dimensional steady state diffusion, Finite volume for two dimensional diffusion problems, Solution of discretized equation, TDMA, Closure methods.

Term Work

Every student will complete six exercises .The students should submit journal based on the tutorials performed and get it certified from the internal examiner. The students should bring certified journal for the term work examination.

Books:

1. Geankoplis C. J.; 'Transport Processes and Separation Process Principles', Fourth Edition; Prentice Hall India, 2003.
2. Bird R. W. Stewart and E. Lightfoot; 'Transport Phenomena', Second Edition; John Wiley and Sons Inc., 2002.
3. Tosun Ismail; 'Modeling in Transport Phenomena: A Conceptual Approach', Elsevier Science B. V., Amsterdam, Netherlands, 2002.
4. Welty J.R, Wicks C.E, Wilson R.E, Rorrer G.L; 'Fundamentals of Momentum, Heat and Mass Transfer', Fifth Edition, John Wiley & Sons, 2010.
5. Versteeg H.K, Malalasekara W, 'An Introduction to Computational Fluid Dynamics, Longman Scientific and Technical publications, 1995

T.E. (Petrochemical Engineering) - 2015 Course

Mass Transfer-II [312409]

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)						Credits
		L	T	Pr.	Theory		TW	PR	OR	Total	
					In Sem.	End Sem.					
312409	Mass Transfer-II	4	--	2	30	70	--	--	50	150	5

COURSE OBJECTIVES

1. Equip the student with principles underlying the design equations for basic mass transfer operations.
2. Equip the student to perform design calculations for equilibrium staged separation processes.
3. Provide an understanding of the general principles of separation processes to allow students to make sensible options given a separation task.
4. Prepare the student for a role as designer/operator of separation columns.

COURSE OUTCOMES:

On successful completion of this course, student will be able to

1. Set up material balances over and calculate minimum phase ratio required for a staged separation column.
2. Design a separation tower using 'equilibrium stages' approach
3. Design a separation tower using NTU-HTU approach
4. State the key factors affecting and their effect on performance of a separation tower
5. Design internals of tray and packed towers

Unit – I Gas Absorption (08 hrs.)

Mechanism of gas absorption, equilibrium in gas absorption, Choice of solvent, Equilibrium and operating line concept in absorption calculations, application of mass transfer theories to absorption, absorption in wetted wall columns, packed tower and spray tower, calculation of HETP, HTU, NTU, calculation of height of packed and spray tower. Absorption in tray towers, absorption and stripping factors, tray efficiencies, calculation of number of trays for absorption.

Unit – II Distillation -I (08 hrs.)

Vapor-liquid equilibria, Relative volatility, Ideal Solutions, Azeotropic mixtures, Raoult's law and deviations from ideality, methods of distillation; fractionation of binary systems, Flash distillation, differential or simple distillation, steam distillation, multistage continuous rectification, Total reflux, minimum reflux ratio, optimum reflux ratio.

Unit – III Distillation –II (08 hrs.)

Design calculations by McCabe-Thiele and Ponchon-Savarit methods; continuous contact distillation tower (packed tower) design; extractive and azeotropic distillation, low-pressure distillation; effect of operating conditions on column performance, Murphree stage and overall efficiency, calculation of actual number of stages, batch distillation with reflux.

Unit – IV Liquid-Liquid Extraction and Leaching Operations (08 hrs.)

Liquid-Liquid equilibrium, ternary diagrams, solvent characteristics, Stage wise contact, Single stage extraction, Multistage crosscurrent and countercurrent extraction with and without reflux, Different types of extractors: Selection construction, sizing and operation, Solid-liquid extraction (Leaching), various types with application, method of calculations, leaching equipment.

Unit – V Adsorption and Ion Exchange (08 hrs.)

Adsorption – Types of adsorption, nature of adsorbents, adsorption equilibria, Adsorption isotherms, effect of pressure and temperature on adsorption isotherms, Freundlich equation, Langmuir equation, BET equation, break through curve, adsorption equipment for batch and continuous operation.

Ion exchange – Principle of Ion exchange, techniques and applications, industrial equipment.

Unit – VI Column Internals (08 hrs.)

Types of trays. Tray layout. Downcomer. Wier, Seal Pots, Tray spacing. Tray tower diameter. Design of sieve tray. Operating characteristics of sieve tray.

Types of packings. Pressure drop in two phase flow. Liquid hold up and mass transfer coefficients in packed tower. Flooding chart and its use in design of packed tower.

Oral Examination

The students should submit journal based on the experiments performed during practical hours and get it certified from the internal examiner. The students should bring certified journal for the oral examination. Oral examination will be based on the experiments conducted and class assignments.

List of Experiments:

1. To determine the mass transfer coefficient and number of plates in a sieve plate absorption column
2. To determine mass transfer coefficient in packed bed column
3. To generate and interpret VLE data in the laboratory
4. To verify Rayleigh’s equation for simple distillation

5. To evaluate performance of packed column used for Liquid –Liquid Extraction
6. To study the effect of number of stages on performance of cross current leaching operation.
7. To compare single stage vs multistage countercurrent extraction performance.
8. To plot and interpret breakthrough curve for fixed bed adsorption or ion exchange
9. To study the demonstrations of Novel Separations Methods and learn to identify the opportunities for their use.

Books:

1. Treybal, R.E., 'Mass Transfer Operations', 3rd edition, McGraw Hill, 1980.
2. Coulson, J. M.; Richardson, J. F., 'Chemical Engineering – Vol. I & II', 6th edition, Butherworth-Heinemann, 1999.
3. Philip Wankat, 'Equilibrium staged Operations', McGraw Hill; NJ, 1988
4. Seader J.D., Henley E.J, 'Separation Process Principles', John Wiley and sons, 1998.
5. Kister, Henry Z., 'Distillation Operation', 1st edition, McGraw-Hill, 1996.

T.E. (Petrochemical Engineering) - 2015 Course

Reaction Engineering-I [312410]

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)						Credits
		L	T	Pr.	Theory		TW	PR	OR	Total	
					In Sem.	End Sem.					
313410	Reaction Engineering-I	3	1	--	30	70	25	--	--	125	4

COURSE OBJECTIVES

1. Sensitize the student on implications of chemical kinetics for a real life reactor application
2. Make student conversant in identifying mixing patterns using the ideal reactor terminology.
3. Equip the student with knowledge of formulating design equations for ideal reactors and their use in solving rating and design problems.
4. Make student conversant in defining optimization problems related to reactors
5. Acquaint the student with techniques involved in interpretation of data obtained from laboratory and real life reactors

COURSE OUTCOMES:

On successful completion of this course, student will be able to

1. Develop stoichiometric table for a reactor
2. Interpret the data obtained on laboratory reactors
3. Derive design equations for different types of reactors based on mole and energy balance.
4. Analyze selectivity in multiple reactions carried in batch and flow reactors.
5. Estimate the temperature and pressure effects on the reaction rate
6. Design a batch or flow reactor for non-isothermal operation

Unit – I Introduction to Chemical Kinetics (08 hrs.)

Chemical kinetics and thermodynamics of reaction; General mole balance equation, Homogeneous and Heterogeneous Reaction rates, rate constants, stoichiometry, and reactor mass balance, Kinetics of homogeneous reaction, Temperature dependency of rate constant – Arrhenius law, Transition state theory and collision theory, Search for a reaction mechanism.

Unit – II Interpretation of Batch Reactor Data (08 hrs.)

Batch reactor concept, Constant volume Batch reactor system; Governing equation for batch reactor, Differential and integral methods for rate analysis, Regression analysis in fitting rate models, Variable volume Batch reactors.

Unit – III Ideal Flow Reactors (08 hrs.)

Concept of idealized mixing patterns, PFR and CSTR, Design equation for plug flow reactor and CSTR; Graphical interpretation of the design equations; Mean holding time;

Unit – IV Single and Multiple Reactor System (08 hrs.)

Size comparison of single reactors; Optimum size determination; Staging of reactors, Reactors in series and parallel; Performance of infinite number of back mix reactors in series, Back mix and plug flow reactors of different sizes in series and their optimum way of staging; Recycle reactors, Optimum recycle ratio.

Unit – V Temperature Effects in Homogeneous Reactions (08 hrs.)

Heat generation and removal, Energy balance in CSTR and PFR, Non-isothermal reactions, Design rate equation as a function of temperature. Material and energy balance for reactor design, Equilibrium conversion as function of temperature and pressure, Optimum temperature progression, Adiabatic and nonisothermal operations. Multiple steady states of CSTR.

Unit – VI Design for Multiple Reactions (08 hrs.)

Series and parallel reactions.Yield and selectivity. Overall factional yield for PFR and CSTR. Plot of overall fractional yield vs concentration. Choice of reactor combinations for yield maximization. Optimum reaction time for batch reactors.

Term-Work

Every student should carry out minimum six tutorial exercises based on the above units. The students should submit journal based on the tutorials performed during tutorial hours and get it certified from the internal examiner. The students should bring certified journal for the term work examination.

Books:

1. Levenspeil, O., ‘Chemical Reaction Engineering’, 3rd. edition, John Wiley & Sons, 2001.
2. Fogler, H. S., ‘Elements of Chemical Reaction Engineering’, 3rd edition, PHI, 2002.

T.E.(Petrochemical Engineering) - 2015 Course

Petrochemical Processes [312411]

Code	Subject	Teaching Scheme (Weekly Load in Hrs.)			Examination Scheme(Marks)						Credits
		L.	T	Pr.	T		TW	PR	OR	Total	
					In Sem.	End Sem.					
312411	Petrochemical Processes	4	--	--	30	70	--	--	--	100	4

COURSE OBJECTIVES

1. To introduce the scientific and technological principles of organic synthesis and related unit processes.
2. To familiarize the student with the role of Petrochemical engineer in unit processes used for organic synthesis and polymerization processes

COURSE OUTCOMES: At the end of the course students should be able to

1. Outline the structure of chemical process industry
2. State production routes for major petrochemicals starting from basic feed-stocks
3. State principles underlying various unit processes used in organic synthesis
4. Explain engineering challenges involved in manufacture of bulk organic chemicals
5. Identify polymers in domestic and industrial use
6. Explain the processes and process parameters employed in manufacture of polymers in domestic and industrial use

Unit – I* Profile of Petrochemical Industry *(8 hrs)

Introduction to Chemical process Industries. Raw material for Organic Chemical Industries. Profile of petrochemical Industry and its structure. Feedstocks: present and emerging.

Unit – II Unit Processes (8 hrs)

Overview of unit processes with applications, Nitration- nitrobenzene, nitrotoluenes, Halogenation- DCM, MCA, VCM, chlorobenzene. Esterification- C1 to C_4 alcohols

Unit – III Production of Olefins and Derivatives ***(8 hrs)***

Naphtha and gas cracking for production of olefins. Recovery of chemicals from FCC and steam cracking. Ethylene derivatives: Ethylene Oxide, Ethylene glycol, Vinyl chloride, Propylene and Propylene oxide

Unit – IV Production of Aromatics ***(6 L)***

Aromatics separation train. Aromatics product profile-Benzene, Toluene, Xylene, Ethyl benzene &Styrene, Cumene and phenol, Bisphenol, Aniline

Unit – V Polymers and Elastomers ***(8 hrs)***

Polymers: Polyethylene, Polypropylene, Polystyrene,Polyvinylchloride, polycarbonate, Thermoset resin: phenol formaldehyde, uriaformaldehyde and melamine formaldehyde Elastomers: Styrene Butadiene Rubber(SBR), Poly butadiene, Nitrile rubber

Unit – VI Fibers ***(8 hrs)***

Polymides or Nylons(PA), DMT and Terephthalic Acid, Polyester, Acrylic Fibre, Modified Acrylic Fibre, Acrylonitrile, Acrolein, Viscose Rayon and Acetate rayon

Books:

1. Groggins PH, ‘Unit Processes in Organic Synthesis’, Tata McGraw Hill, 5thEdition, 1995.
2. Chauvel A and Lefebvre G.,‘Petrochemical Processes - I’GulfPublication;1stEdition, 1989
3. Mall I.D., ‘Petrochemical Process Technology’, Macmillan India Ltd, 2007
4. Rao M Gopala, Marshall Sittig, ‘Dryden’s Outlines of Chemical Technology’, East West Press; Third edition, 1997.
5. Wiseman P., ‘Petrochemicals,’ Ellis Horwood Ltd.,1986

T. E. PETROCHEMICAL ENGINEERING 2015 COURSE
PROCESS EQUIPMENT DESIGN [312412]

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)						Credits
		L	T	Pr.	Theory		TW	P	OR	Total	
					In Sem.	End Sem.					
312412	**Process Equipment Design**	**4**	**-**	**2**	**30**	**70**		**-**	**50**	**150**	**4**

OBJECTIVES

1. To learn about the design procedures of process equipment used in chemical process plants
2. To be familiar with process and mechanical aspects of equipment design.
3. To be exposed to various design codes and standards used in mechanical design of equipment.
4. To learn to draw various process equipment and mechanical components as per calculated design.
5. To test the equipment for safety against applied loads.

COURSE OUTCOMES

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

1. Design components like flange coupling and belt drive
2. Apply key criteria involved in the design of internal pressure vessels as per IS Code.
3. Design heat transfer equipment, understand heat exchanger sizing and develop a heat exchanger data sheet.
4. Design storage vessels and various parts of vessels (e.g. heads, Shell, bottom plate)
5. Demonstrate relationship between equipment design, safety and environment.

Unit I: Fundamentals of Design ***(08 hrs.)***

General Design procedure, Design methodology, steps in design activity, process design and mechanical design, mechanical properties of material, factor of safety, material of construction, Selection, Equipment fabrication methods and testing, Codes and standards, IS, ASME and TEMA codes in design and their significance. Economic considerations in the design process.

Unit II: Design of Basic Machine elements (Shafts, Keys and belt) **(*08 hrs.*)**

Design of mechanical components such as protected and unprotected types of flange couplings.

Shafts: Types of shafts, material used for shafts, torsion in shafts, power transmitted by shaft, torsion formula, bending and torsional stresses in shafts, shaft design based on rigidity, comparison of hollow and solid shafts. Types of keys, forces acting and stresses in key, design of sunk key based on shear and crushing.

Belt Drives: Types of belt drives, types of belts, material used for belts, stresses in belts, belt speed, velocity ratio of belt drive, slip of belt, length of an open and crossed belt drive, power transmitted by belt drive, centrifugal tension, maximum tension, condition for maximum power transmission, initial tension in belt, V- belt and rope drives.

Unit III: Design of Pressure Vessel **(*08 hrs.)***

A brief overview of process design aspects of pressure vessel (as a reactor for example), Codes and standards for pressure vessels design (IS: 2825: 1969) for unfired pressure vessel shell, design of head (Flat, hemispherical, torrispherical, elliptical & conical), flange joint, nozzle and supports. Selection of corrosion allowance and weld joint efficiency

Unit IV: Design of Storage Tanks **(*08***

Study of various types of storage vessels and applications, Atmospheric vessels, vessels for storing volatile and non-volatile liquids, storage of gases, Losses in storage vessels, Various types of roofs, Design of cylindrical storage vessels as per IS: 803- design of base plates, shell plates, roof plates, wind girders, curb angles for self-supporting and column supported roofs, stresses due to dead weight, wind load, Storage of gases (spherical vessels or hortonspheres).

Unit V: Design of Heat Exchanger **(*08 hrs.)***

Types of Heat Exchangers, Codes and standards for heat exchangers, Design of heat exchanger (U tube and fixed tube) i.e. shell, head, channel, channel cover, flanged joints, tubes, tube sheet, tie rods & baffles as per IS:4503 and TEMA standards. Complete fabrication drawing for designed Heat exchanger to a recommended scale, Design consideration of condensers and evaporators. Fouling in heat exchanger, Fouling types.

Unit VI: Safety Measures and over protection devices in equipment design **(*08 hrs*.)**

Safety Measures in Equipment Design, Hazards Analysis in equipment design, Over pressure protection devices such as blow down, Pressure relief valves, rupture disc, steam trap etc. Environmental considerations in the equipment design.

Term-Work and Oral Examination:

Every student should carry out minimum three drawings sheets based on the list below. The students should submit journal and drawing sheets and get it certified from the internal examiner. The students should bring certified journal and drawing sheets for the term work examination.
Oral examination will be based on the certified journal and drawing sheets.

List of Practicals:

Minimum *three* design assignments and respective drawings should be drawn (By hand or through AutoCAD) on full empirical drawing sheet from the following list.

1. Design of mechanical component such as protected / unprotected flange couplings.
2. Design of pressure / reaction vessel including shell, heads, supports, nozzles etc.
3. Design of storage tank including design of each course at different heights, rooftop, bottoms, vents etc.
4. Design of shell and tube heat exchanger including channels, baffles, tube sheets, and tie rods supports etc.
5. Design of distillation / absorption tower, including tall tower considerations, eccentrically loaded joints, supports, manholes reinforcement rings etc.
6. Optimum design of pressure vessel using design software such as Designer Desktop and IS Code 2825.

(At least one assignment should be drawn using design software)

Books

1. Mahajani, V V and S.B.Umarji, ".Joshi's, Process Equipment Design", Trinity Press, New Delhi. (2014).
2. Bhattacharya B. C., 'Introduction to Chemical Equipment Design Mechanical Aspects', CBS Publishers, Delhi, 1991.
3. E. Brownell and Edwin, H. Young, 'Process Equipment Design − Vessel Design', John Wiley, New York 1963.
4. R. S. Khurmi, J. K. Gupta, "A Text Book on Machine Design", Eurasia Publishing House (Pvt.) Ltd., New Delhi.
5. Walas S.,' Chemical Equipment Design', Butterworth-Heinemann, 1988.

T. E. PETROCHEMICAL ENGINEERING 2015 COURSE
PETROCHEMICAL ENGINEERING LABORATORY [312413]

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)						Credits
		L	T	Pr.	Theory		TW	PR	OR	Tot	
					In Sem.	End Sem.					
312413	**Petrochemical Engineering Laboratory**	**-**	**-**	**4**	**-**	**-**		**50**	**-**	**50**	**1**

* Twice a week

OBJECTIVES

1.To introduce students to commercial process engineering software.
2.To acquaint the students with laboratory skills in reaction engineering.

COURSEOUTCOMES

On completion of this course, the students will be able

1. Solve complex engineering problems using modeling and simulation tools such as ASPEN-HYSYS and COMSOL.
2. Generate and interpret the data obtained on batch and flow reactors.

Following Laboratory and Computing Sessions to be conducted in two sessions of two hours per week. The Term Work will consist of the submissions based on six experiments each from Part A and Part B given below

Part A: Petrochemical Process Simulation

To simulate process units/operations given below using commercial simulation software such as ASPEN HYSYS

1. Solids Handling Operations such as Filtration and Screening.
2. Rotating equipment such as Pump and Compressor.
3. Control and Relief Valves
4. Stream Mixers and Splitters
5. Reactors
6. Distillation and Absorption Columns
7. Three Phase Separator
8. Industrial Petrochemical Production Unit such as Toluene Hydrodealkylation and Ammonia Synthesis.

Part B: Experimentation and Modeling

1. Experiments based on Batch Reactor
2. Experiments based on CSTR
3. Experiments based on PFR
4. Experiments based on Reactors in Series
5. Modeling and Numerical Solution of Transport Equations in 1D, 2D and 3D.
6. Mass transfer in dilute and concentrated mixtures
7. Reactor models with generation of kinetic expressions based on chemical formulas.
8. Hagen-Poiseuille equation, Navier Stokes, Darcy's Law and the Brinkman Equations

Books:

1. Bruce A. Finlayson, ‘ Introduction to Chemical Engineering Computing’, Wiley Inter-Science, John Wiley & Sons Publication, 2006
2. Chapra S.C, Canale R.P, ‘Numerical Methods for Engineers’, Sixth Edition, McGraw Hill Publications, 2008
3. Levenspeil, O., ‘Chemical Reaction Engineering’, 3rd. edition, John Wiley & Sons, 2001.
4. Fogler, H. S., ‘Elements of Chemical Reaction Engineering’, 3rd edition, PHI, 2002.
5. User guides for ASPEN HYSYS and COMSOL.

T.E. (Petrochemical Engineering) - 2015 Course

Seminar [312414]

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)						Credits
		L.	T.	Pr.	Theory		TW	PR	OR	Total	
					In Sem.	End Sem.					
312414	Seminar	--	--	2	--	--	50	--	--	**50**	**1**

COURSE OBJECTIVES

1. Investigate some of the current scientific and Technological issues facing society
2. Develop learning tools that will help student be life-long learners
3. To improve skills in writing, oral presentation
4. To work on a chosen topic, create a technical report and present it
5. Develop of intellectual and professional competence

COURSE OUTCOMES:

On successful completion of this course, student will be able to

1. Conduct literature review relevant to an advanced topic
2. Present the work in a variety of formats (written, oral, formal presentation) in front of an audience and to explore topics of their own choosing in detail
3. Evaluate the reliability of sources of information
4. Cope with rapidly changing technological environments with the core knowledge central to multidisciplinary development

Contents:

Seminar should be based on a detailed study of any topic related to Petrochemical Engineering (preferably the advanced areas / application) and the topic should preferably be relevant to the curriculum. Students may undertake studies in research survey, literature review and analysis, synthesis, design and development, generation of new ideas and concept, modification in the existing process/system, development of computer programs, solutions, modeling and simulation related to the subject. Topics of interdisciplinary nature may also be taken up. A detailed literature survey is expected to be carried out as a part of the work. A technical report is required to be submitted at the end of the term and a presentation made based on the same. Modern audio-visual techniques may be used at the time of presentation

It is expected that the student collect information from reference books, standard journals. The report submitted should reveal the student's internalization of the collected information. Mere compilation from the net and other resources is discouraged.

Format of the Seminar report should be as follows:

1. The report should be neatly written or typed on white paper. The typing shall be with normal spacing and on one side of the paper (A-4 size).

2. The report should be submitted with front and back cover of card paper neatly cut and bound or spirally together with the text.
3. Front cover: This shall have the following details:

   a) Title of the seminar report.
   b) The name of the candidate with roll number examination seat number at the middle.
   c) Name of the guide below the candidate's details.
   d) The name of the institute and year of submission on separate lines at the bottom.
   e) Seminar approval sheet.

Format of the text of the seminar reports:

The report shall be presented in the form of a technical paper. The introduction should be followed by literature survey. The report of analytical or experimental work done, if any, should then follow. The discussion and conclusions shall form the last part of the text. They should be followed by nomenclature and symbols used followed by acknowledge the bibliography should be at the end. References should be written in the standard format. The total number of typed pages, excluding cover shall be about 25 to 30 only. All the pages should be numbered. This includes figures and diagrams.

Two copies of the seminar report shall be submitted to the college. The candidate shall present the seminar before the examiners. The total duration of presentation and after-discussion should be about 20 minutes. (15 min + 5 min. Audience can ask questions only if the examiner permits. Such questions will not have any bearing on marks).

The assessment for the subject shall be based on

1. Report submitted.
2. Presentation.
3. Discussion.

Seminar – Conduct, Evaluation:

1. Review – I: during month of February (Compulsory) as per the Academic Calendar
2. Review – II : The last week of March (Optional)
3. Seminar is an individual activity with separate topic and presentation.
4. Duration of presentation – 15 minutes
5. Question and answer session – 5 minutes

Seminar Evaluation Scheme: based on rubrics developed on following lines**:**

1. Relevance of Seminar topic
2. Appropriate Abstract writing
3. Quality of literature review and originality in writing
4. Use of software and ability to formulate, analyze and solve problem
5. Investigation and interpretation skills
6. Presentation skills and
7. Understanding of topic through questions and answer
8. Professional ethics by acknowledging the original source

312415: Audit Course 4
Practices in Petrochemical Industry II

OBJECTIVE:

The objective of audit course is to expose students to different aspects of petroleum industry by organizing guest sessions on different topics on emerging areas, workshops on soft skills and personality development, industrial tours, mini projects, tutorials, assignments and also report based on internship carried out if any.

REQUIREMENTS FOR SUCCESSFUL COMPLETION:

The students have to complete audit course as a part of curriculum. This can be divided into different components such as

1. Assignments given by faculty members based on the sessions conducted by industry professionals during the term.

2. Registration for any online course organized by recognized institute in India and outside like IITs, Stanford and MIT Course work and submit the assignments completed as a part of the course work.

3. Assignments completed as a part of learning of any professional software available in the department computer centre under the supervision of faculty members.

4. Participation in the case study competition organized by an institute and submission of the same after verifying correctness of solution from any faculty member.

5. Report of the workshop conducted on soft skills and personality development organized if any. This should include exercises given in the class and their analysis and solution.

6. If students are deputed to any activity including internship, paper presentation, technical workshop, seminars and guest sessions outside campus, then a brief technical report of the same should be considered as a part of audit course.

The students individually have to submit at least four activities inclusive of the above towards the end of the semester for assessment. The audit course should cover work equivalent to twenty hours in the term and submission should be in the form of a comprehensive report

Successful completion of reports will allow students to earn PP in the marksheet and NP if failed to complete the audit course.