

FACULTY OF ENGINEERING

Syllabus for the
M.E (Petrochemical Engineering)
(W.e.f 2008-2009)

THE SYLLABUS IS PREPARED BY:

**BOS- Petroleum and Petrochemical Engineering
University of Pune**

PEER REVIEW BY:

- Dr. P B Jadhav (Chairman)
- Dr Raju Mankar, Director, Laxminarayan Institute of Technology, Nagpur
- Mr. S P Singh, Process Manager, Praj India Limited, Pune
- Dr. V K Jayaraman, NCL Pune

note:- This syllabus is subject to change without prior notice by the concerned BOS

UNIVERSITY OF PUNE
STRUCTURE OF M.E. (PETROCHEMICAL ENGINEERING)
REVISED TWO-YEAR COURSE (2008)

SEMESTER I

Code	Subject	Teaching Scheme		Examination Scheme					Credits
		L	Pr.	P	TW	Or	Pr	Total	
512201	Advances in Petroleum Refining	3	-	100	-	-	-	100	3
512202	Advanced Transport Phenomena	3	-	100	-	-	-	100	3
512203	Mathematical Methods in Petrochemical Engineering	3	-	100	-	-	-	100	3
512204	Elective I	3	-	100	-	-	-	100	3
512205	Elective II	3	-	100	-	-	-	100	3
512206	Lab Practice I	-	6	-	50	-	-	50	3
512207	Seminar I	-	4	-	50	-	-	50	2
Total of First Term		15	10	500	100	-	-	600	20

512204 Elective I

- a) Advanced Petrochemical Processes
- b) Petroleum Exploration, Drilling and Production
- c) Fuels, Combustion and Gasification Technology

512205 Elective II

- a) Novel Separation Techniques.
- b) Principles of Green Technologies
- c) Energy Engineering

SEMISTER II

Code	Subject	Teaching Scheme		Examination Scheme					Credits
		L	Pr	P	TW	Or	Pr	Total	
512208	Applied Process Design for Petrochemical Plants	3	-	100	-	-	-	100	3
512209	Safety, Health and Environment in Petrochemical Plants	3	-	100	-	-	-	100	3
512210	Advanced Process Control	3	-	100	-	-	-	100	3
512111	Elective III	3	-	100	-	-	-	100	3
512112	Elective IV (Open)	3	-	100	-	-	-	100	3
512113	Lab Practice II	-	6	-	50	-	-	50	3
512114	Seminar II	-	4	-	50	-	-	50	2
Total of Second Term		15	10	500	100	-	-	600	20

512211 Elective III

- a) Modeling and Simulation of Petrochemical Processes
- b) Piping Design and Engineering
- c) Advanced Natural Gas Technology

512212 Elective IV (Open)

- a) Catalysis and Catalytic Reactor Design
- b) Multiphase Reactor Design
- c) Polymerization Process Modeling
- d) Any other elective from other branches

SEMISTER III

Code	Subject	Teaching Scheme		Examination Scheme					Credits
		L	Pr	P	TW	Ora l	Pr	Total	
512215	Seminar III	-	4	-	50	-	-	50	2
512216	Project Stage I	-	18	-	-	-	-	-	6
Total of Third Term		-	22	-	50	-	-	50	08

SEMISTER IV

Code	Subject	Teaching Scheme		Examination Scheme					Credits
		L	Pr	Project	TW	Ora l	Pr	Total	
512216	Project Stage II	-	18	200	-	50	-	250	12
Total of Fourth Term		-	18	200	-	50	-	250	12

Note- The Contact Hours for the calculation of load of teacher

Seminar- 1 Hr / week / student

Project - 2 Hr / week / student

M.E. (Petrochemical Engg.)

512201 Advanced Petroleum Refining

Teaching Scheme:

Lectures: 3 Hrs/week

Examination Scheme:

Paper: 100 Marks

Duration: 3 Hrs.

Refinery flow. Refinery Products. Characterization of petroleum and petroleum products. Chemical composition of crude petroleum. Refinery configuration development. Blending Refinery Distillation. Use of Packie Charts. Design of atmospheric and Vacuum Distillation. Lube refining. Wax refining. Gas processing. Alkylation and Polymerization. Catcracking. Reforming. Hydroprocessing Coking. Visbreaking. Resid upgradation technologies. Sulfur removal technologies. 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.

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512202

Advanced Transport Phenomena

Teaching Scheme:

Lectures: 3 Hrs/Week

Examination Scheme:

Paper: 100 Marks.

Duration: 3 Hrs.

Tensor Analysis:

Momentum Transport: Equations of change for isothermal systems, Turbulent flow, Interphase transport in isothermal systems. Macroscopic balances for isothermal systems.

Energy Transport: Equations of change for non-isothermal systems. Turbulent flow. Energy transport by Radiation. Macroscopic balances for Non-isothermal systems.

Mass Transport: Equations of change for multicomponent systems. Turbulent flow. Interphase in multicomponent systems. Macroscopic balances for multicomponent systems.

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

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)

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512203 **Mathematical Methods in Petrochemical Engineering**

Teaching Scheme:

Lectures: 3 Hrs/Week

Examination Scheme:

Paper: 100 Marks.

Duration: 3 Hrs.

Numerical solution of ordinary and partial differential equations with boundary conditions. Numerical solution of linear and non-linear algebraic equations. Matrix methods. Regression and correlation. Design of experiments. Constrained and unconstrained optimization in petrochemical process design.

Reference books:

1. Sienfield and Lapidus, "Mathematical Methods in chemical Engineering", Prentice – Hall, 1987
2. Aoki M., "Introduction to Optimization Techniques", Macmillan, 1980
3. Edgar T. F. and Himmelblau D. M., "Optimization of Chemical Processes", McGraw Hill, 1989.
4. Chapra S. C. and Canale R. P., "Numerical Methods of Engineers", McGraw Hill NY, 1989.
5. Constrantinides A., "Applied Numerical Methods with Personal Computers", McGraw Hill NY, 1987.

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Elective I

512204 (a) Advanced Petrochemical Processes

Teaching Scheme:

Lectures: 3 Hrs/Week

Examination Scheme:

Paper: 100 Marks.

Duration: 3 Hrs.

Production and separation of C₁, C₂, C₃, C₄ and Aromatic cuts.

Review of conventional and new technologies starting from C₁, C₂, C₃, C₄ and Aromatic cuts. Global and Indian Scenario.

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:

1. M.W. Thring, "The Science of Flame and Furnaces", Chapman and Hall.
2. Chauvel A., Lefebure G., " Petrochemical Processes Vol-I & II", Gulf Publication Company, 1989.

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Elective I

512204 (b) Petroleum Exploration, Drilling and Production

Teaching Scheme:

Lectures: 3 Hrs/Week

Examination Scheme:

Paper: 100 Marks.

Duration: 3 Hrs.

Petroleum as a resource material. Composition and physical properties. Origin and occurrence. Exploration methods. World petroleum reserves. Indian Well Cementing. Completion and Logging Techniques. Production equipment. Work over. Well Stimulation Reserves Evaluation, Storage and Transport.

Reservoir basics. Flow through porous media. Enhanced Oil Recovery Methods.

Reference books:

1. Bradley H. B. "Petroleum Engineering Handbook", SPE
2. Berger B. D., Anderson K. E. "Modern Petroleum", Penwell Books.
3. Deshpande B. G. "The World of Petroleum"
4. Cole F. W. "Reservoir Engineering Manual"

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Elective I

512204 (c) Fuels, Combustion and Gasification Technology

Teaching Scheme:

Lectures: 3 Hrs/Week

Examination Scheme:

Paper: 100 Marks.

Duration: 3 Hrs.

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. Compendium: 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

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Elective – II

512205 (a) Novel Separation Techniques

Teaching Scheme:

Lectures: 3 Hrs/Week

Examination Scheme:

Paper: 100 Marks.

Duration: 3 Hrs.

Selection of separation technique. Rate based and equilibrium separations. Energy requirements of separation processes. Adsorptive bubble separations. Microemulsions. Cross flow filtration. Fractional precipitation. Membranes: Choice, design and economics. Pressure swing adsorption and temperature swing adsorption. Parametric pumping, chromatographic separation. Ion exchange separations. Supercritical extraction. Reactive separations. Bioseparation, Reverse micelle extraction, Isoelectric focussing. 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 of Chemical Engineers. U.K, 1990.
4. Rousseau R. W. (ed) " Handbook of Separation Process Technology", John Wiley & Sons, 1987.

M.E. (Petrochemical Engg.)

Elective – II

512205 (b) Principles of Green Technologies

Teaching Scheme:

Lectures: 3 Hrs/Week

Examination Scheme:

Paper: 100 Marks.

Duration: 3 Hrs.

Overview of Green Chemistry, Chemistry of the Atmosphere, principles of sustainable and green chemistry, Photochemical smog, Basic principles of green technology, Concept of Atom economy, Tools of Green technology, zero waste technology. Greenhouse Effect, Climate Change, Biocatalysis, Green chemistry in battery, Biofuel, Fuel cell and electric vehicles, Solar energy and hydrogen production, Green Synthetic Methods, Catalytic methods in synthesis, Synthesis in aqueous media, Unconventional energy sources in synthesis

Reference Book:

Paul T. Anastas John C. Warner, Green Chemistry: Theory and Practice, Oxford University Press, 2000

M.E. (Petrochemical Engg.)

Elective – II

512205 (c) Energy Engineering

Teaching Scheme:

Lectures: 3 Hrs/Week

Examination Scheme:

Paper: 100 Marks.

Duration: 3 Hrs.

Energy crisis in the world and position in India, energy need of growing economy, long-term energy scenario, energy pricing, energy sector reform, energy conservation and its importance, energy conservation act.

Energy strategy, energy policy & energy planning, objective of energy management, trade off between energy management,

Types & procedure of energy audits, modern techniques and instruments for energy audit. , Techniques- energy consumption, production & cumulative sum of differences (CUSUM).

Recent advancement in energy technology towards 21st century, transport of energy, ethanol as a fuel. Fusion – introduction potential, condition for fusion, magnetic confinement fusion reactor, cold fusion laser induced fusion.

Case Studies: Energy conservation in different units of refinery likes FCCU, HCU & ADU.

Reference Books:

1. Hinrich & Kleinbach “Energy: its use and the environment” III ed. Harcourt.
2. Boyle “Renewable Energy: Power for a sustainable future” Oxford.
3. Capenart & Turner “ Guide to energy management ” 6 ed. Keinnedu fairmant press
4. Turner, Wayne C.(Editor), 1982, Energy Management Handbook, John Willey and Sons, New York (USA)

M.E. (Petrochemical Engg.)

512206 Laboratory – I

Teaching Scheme:
Practical: 6Hrs/Week

Examination Scheme:
Term Work: 50 Marks.

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 Engg.)

512207 Seminar - I

Teaching Scheme:
Practical: 4 Hr/week

Examination Scheme:
TW: 50 Marks

Each student is required to deliver a seminar in the first semester.

Topic of the seminar should be based on current trends in advanced research emphasizing literature review. A seminar report of about 30 typed pages should be submitted under the supervision of a teacher. Available case studies may also be incorporated.

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512208 Applied Process Design for Petrochemical Plants

Teaching Scheme:

Lectures: 3 Hrs/Week

Examination Scheme:

Paper: 100 Marks.

Duration: 3 Hrs.

Formulation of plant design problem, scope and objectives; construction of flow sheet; plant location selection; construction of process description, process flow diagram, mass and energy balance; selection and sizing of major process equipment; construction materials selection; equipment layout plot plan; construction cost estimation and plant economic analysis; piping and instrumentation diagram; plant design report preparation.

Reference Books:

1. Ludwig, E.E., Applied Process Design for Chemical and Petrochemical Plants, Volume 1, 2 and 3, 3rd Edition, 1993
2. Baasel, W.D., 1990, Preliminary Chemical Engineering Plant Design, 2 Edition, van
3. Nostrand, New York
4. Peters, M.S. and K.D. Timmerhaus, 1991, Plant Design and Economics for Chemical Engineers, McGraw-Hill Book Co., Inc., New York
5. Sinnott, R.K., 1985, Coulson-Richardson's Chemical Engineering Volume 6:
6. An introduction to Chemical Engineering Design, Pergamon Press, Oxford, 1985,

M.E. (Petrochemical Engg.)

512209 Safety, Health and Environment in Petrochemical Plants

Teaching Scheme:

Lectures: 3 Hrs/Week

Examination Scheme:

Paper: 100 Marks.

Duration: 3 Hrs

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.

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.

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. Rao C S “Environmental Pollution Control Engineering”, McGraw Hill, 1998

3. C. Ray Asfahl, Industrial Safety and Health Management, Fifth Edition
McGraw Hill, 1998
4. Charles D. Reese, Occupational Health and Safety Management: A
Practical Approach, McGraw Hill, 1998

M.E. (Petrochemical Engg.)

512210 Advanced Process Control

Teaching Scheme:

Lectures: 3 Hrs/Week

Examination Scheme:

Paper: 100 Marks.

Duration: 3 Hrs.

Review of Single Input Single Output (SISO) Control; Model Based Control; Multivariable Control Strategies; Internal Model Control Preliminaries and Model Predictive Control, Model forms for Model Predictive Control: Parametric and Non-parametric Models, State Space and Transfer Function Representations and their inter relationships; Control Relevant Process Identification; Choice of Input signals and Model Forms; Parameter Estimation using Batch and Recursive Least Squares; Model Validations using Correlation Concepts; Identification of Non-parametric Representations; Model Predictive Control: Analysis of Dynamic Matrix Control (DMC) and Generalized Predictive Control (GPC) Schemes, Controller Tuning and Robustness Issues; Extensions to Constrained and Multivariable Cases.

Reference books:

1. L. Ljung, "System Identification – Theory for the User", Prentice Hall, 1987.
2. E. Camacho and R. Bourdons, "Model Predictive Control in the Process Industry", 1995.

M.E. (Petrochemical Engg.)

Elective – III

512211 (a) Modeling and Simulation for Petrochemical Processes

Teaching Scheme:

Lectures: 3 Hrs/Week

Examination Scheme:

Paper: 100 Marks.

Duration: 3 Hrs.

General principles. Laws of conservation continuity and conservation equations. Steady state and dynamic models. Degrees of freedom analysis. Solution of model equations. Model validation. Sequential and modular approaches to process simulation. Equation oriented simulation techniques.

Modeling and simulation of petrochemical processes such as cracking, reforming and distillation.

Reference books:

1. Luyben W., “ Process Modeling, Simulation and Control for Chemical Engineers”, McGraw Hill NY, 1990.
2. Husain A., “ Chemical Process Simulation”, Wiley Eastern Limited, New Delhi, 1986.
3. Crowe C. M. et. al., “ Chemical Plant Simulation; An Introduction to Computer Aided Steady-State Process Analysis”, Englewood, Cliffs, Prentice Hall, 1971.

M.E. (Petrochemical Engg.)

Elective – III

512211 (b) Piping Design and Engineering

Teaching Scheme:

Lectures: 3 Hrs/Week

Examination Scheme:

Paper: 100 Marks.

Duration: 3 Hrs.

Flow through pipe, Flow through perforated pipes and porous media. Two phase flow. Line sizing for steam, vacuum, and slurry pipeline. Piping networks. Piping manifolds.

Piping systems for petroleum products, yard piping; fire fighting, distillation and heat exchangers. Long distance pipelines.

Corrosion and materials of construction. Flow measurement. Pipe stress analysis and pipe supports. Pipe racks. Fabrication, installation and testing. Statutory regulations and safety aspects. Thermal insulation. Costing for piping.

Reference books:

1. Macetta, John., “ Piping Design Handbook”, M.Dekker , 1992

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Elective – III

512211 (c) Advanced Natural Gas Technology

Teaching Scheme:

Lectures: 3 Hrs/Week

Examination Scheme:

Paper: 100 Marks.

Duration: 3 Hrs.

Development and operation of gas fields, gas from condensate and oil fields, thermodynamics and energy change.

Review of physical and chemical properties of natural gas and associate hydrocarbons.

Phase behavior studies: equations of states, multiple flashes, water hydrocarbon systems, chemical inhibition, hydrate formation, gas liquid equilibria.

Gas handling facilities: flow of fluids, compression of gases, applications of heat transfer and mass transfer principles in natural gas engineering systems, compressors, pumps, heat exchangers, furnaces and waster heat recovery facilities, transmission of natural gas in pipelines, LPG technology production and distribution.

Gas processing: purification, refrigeration and low temperature processing, liquefaction process, LNG and NGL recovery, sweetening of natural gas and sulphur recovery.

Gas storage: tanks, underground storage, and conservation of natural gas under coal gasification process and principles, safety. Economic consideration for development of gas fields.

Reference books:

1. Kumar S., " Gas Production Engineering", Gulf Publishing Co., 1987.
2. Beggs, H. D., " Gas Production Operations", OGCI Publication, 1984.

3. Ikoku, C. K., "Natural Gas Engineering", John Wiley, 1984.
4. Alexandre, R., "Natural Gas: Production, Processing and Transport", Hyperion Books, 1995.

M. E. (Petrochemical Engg.)

ELECTIVE IV

512212 (a) Catalysis and Catalytic Reactor Design

Teaching Scheme:

Lectures: 3 Hrs/week

Examination Scheme:

Paper: 100 Marks

Duration: 3 Hrs.

Introduction: industrial reactor types, fixed bed reactor; theoretical background: heterogeneous catalyst, heterogeneous catalytic reaction kinetics, transport phenomena; design and operation of reactors: modeling of fixed bed reactors, strategy and considerations in reactor design; evaluation of fixed bed reactor performance.

Reactor design, especially fixed bed reactor. Role of catalysts in chemical industries; development of catalysts; definition of catalyst; role of catalyst in accelerating reactions; catalytic reaction mechanisms; heterogeneous catalysts; catalytic reaction kinetics; development of catalysis theory; major constituents of catalysts; catalyst manufacturing methods; catalyst characterization; catalyst deactivation.

Reference books:

1. Richardson, J.T., 1989, Principles of Catalyst Development, Plenum Press
2. Twigg, M.V., 1989, Catalyst Handbook, Wolfe Publishers
3. Froment, G.F. and K.B. Bischoff, 1990, Chemical Reactor Analysis and Design, John Wiley
4. Rase, H.F., 1990, Fixed-Bed Reactor Design and Diagnostics, Butterworths

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ELECTIVE IV

512212 (b) Multiphase Reactor Design

Teaching Scheme:

Lectures: 3 Hrs/week

Examination Scheme:

Paper: 100 Marks

Duration: 3 Hrs.

Reaction kinetics for multiphase reactions, Brief idea about multiphase reactors and design considerations, Catalyst deactivation and regeneration. Review of reaction kinetics and reactor design

Industrial reactors: Trickle bed, Bubble column, segmented bed, Agitated slurry, Fluidized bed and slurry reactors, Constructional features and operation (Batch and continuous)

Models for analysis gas – liquid and gas – liquid – solid reactions, Film and penetration theories, RTD and macro mixing models, Review of methods obtaining RTD, Problems in scale-up.

Models for gas – liquid – solid reactors ,model formulations. Numerical solutions of model equation

Intrinsic kinetics: Catalysis, Langmuir – Hinshelwood models, Catalyst pellets, Effective diffusivity, Tortuosity, Effectiveness factors, Mass transfer and reaction in packed beds, Determination of limiting step from reaction data

Reference Books:

1. Y.T. Shaha, "Gas Liquid Reactor Design", McGraw Hill, 1979
2. Westerterp K.R., Van Swaaij and Beevackers, "Chemical Reactor Design and Operation", John Wiley and Sons, 1978
3. Carberry, Verma, "Chemical Reactions and Reaction Engineering", Marcell

Decker, 1987

4. Gianetta and Silverton, "Multiphase Chemical Reactor – Theory, Design, Scale-up", Hemisphere Publishing Corporation, 1986
5. Sharma and Doraiswamy, "Heterogeneous Reactions", Vol. I and II, John Wiley, 1984

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ELECTIVE IV

512212 (c) Polymerization Process Modeling

Teaching Scheme:

Lectures: 3 Hrs/week

Examination Scheme:

Paper: 100 Marks

Duration: 3 Hrs.

Rheology of polymer melts and polymer solutions and their characterization; Linear viscoelastic models; Co-rotational derivatives and non-linear viscoelastic models; Experimental techniques of determining the viscoelastic properties.

Distinctive features of polymerizations and Polymer reactors, polymers in bulk and in solution, classification of mechanism of polymerization,

Step growth polymerizations, Linear AB step polymerization, A_1+B_2 step polymerization Stoichiometry, Effect of monofunctional agents, cyclizations

Chain growth polymerizations, chemistries of free radical polymerizations, Molecular weight distributions in free radical polymerizations, Parameter estimation

Copolymerization, sequence length distributions in free radical Copolymerization, Parameter estimations and Characterizations

Nonlinear polymerization, structure property relations, critique of Geleation theory, Long chain branching

Reactor configuration, Homogenous continuous stirred tank reactors (HCSTR), Segregated continuous stirred tank reactors (SCSTR), Multistep reactors

Heterogeneous polymerization, suspension, emulsion polymerizations, Heterogeneous coordination Polymerization.

Reference Books:

Neil A. Dotson, Rafael Galva n, Robert L. Laurence, Polymerization Process Modeling, VCH, Cambridge, UK, 1996.

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512213 Laboratory - II

Teaching Scheme:
Practicals: 6 Hrs/week

Examination Scheme:
TW: 50 Mark

Term work shall consist of experiments and/or computational exercise related to the subjects in the second semester. Minimum of five exercises from the list given below.

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.

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512214 Seminar - II

Teaching Scheme:
Practical: 1 Hr/week

Examination Scheme:
TW: 50 Marks

Each student is required to deliver a seminar in second Semester and submit a report of about 30 typed pages.

Topic of the seminar should be based on the chosen discipline of research for dissertation work. It should be based on literature survey related to identified problem for research.

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512215 Seminar - III

Teaching Scheme:
Practical: 4 Hr/week

Examination Scheme:
TW: 50 Marks

Each student is required to deliver a seminar in the third semester on the objective; literature review, methodology and work carried out during the semester on his/ her dissertation topic.

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512216 Project stage I

Teaching Scheme:
Practical: 18 Hr/week

Examination Scheme: --

The project is aimed at training the students in literature search and critical appraisal of the same. The project may also involve some analytical and/ or experimental work. In a few cases the project may also involve a sophisticated design work. Each student will submit a report on his/ her project. The project report is expected to show clarity of thought and expression, critical appraisal of the existing literature and analytical and/ or experimental or design skill.

Each student is required to define objective, methodology, carry out literature review, and plan of work to be carried out during the semester on his/ her dissertation topic.

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512216 Project stage II

Teaching Scheme:

Practical: 18 Hr/week

Examination Scheme:

Project: 200 marks

TW: 50 marks

The project is aimed at training the students in literature search and critical appraisal of the same. The project may also involve some analytical and/ or experimental work. In a few cases the project may also involve a sophisticated design work. Each student will submit a report on his/ her project. The project report is expected to show clarity of thought and expression, critical appraisal of the existing literature and analytical and/ or experimental or design skill.

Each student shall submit three copies of the report containing the work carried out on his/ her dissertation topic during the semester for evaluation by the examiners.

On completion of dissertation work, each student will deliver a seminar to defend his/ her work.

Each student will submit three copies of the dissertation for evaluation and award. It must incorporate results of investigation on an assigned problem in Petrochemical engineering or allied discipline involving experimental and/ or theoretical work.