

 सत्यं शिवं सुन्दरम्		The Maharaja Sayajirao University of Baroda Faculty: Technology and Engineering Department: Chemical Engineering Kalabhavan, Vadodara.		
Email ID: head-chemengg@msubaroda.ac.in				
Name of the Programme: M.E. Chemical (Petrochemical Engineering)				
Type of the Programme: M.E. Part - I Chemical (Petrochemical Engineering)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2106 PAPER NAME: PROCESS SYNTHESIS	Credit	
Semester	I		Hours	45
UNIT – I	Basic concept in process synthesis. The synthesis step, Structure and synthesis of process flow diagrams. Product life cycles. Understanding process conditions.			7
UNIT – II	Design and scheduling of batch processes, Gantt charts, transfer policies, sizing of vessels, inventories. Optimal design and scheduling of multiproduct batch plants			8
UNIT – III	Synthesis of heat exchanger networks. Pinch technology, Heat and power integration.			8
UNIT – IV	Synthesis of distillation sequences, energy conservation in distillation, heat integration techniques in distillation. MILP model for distillation sequences.			8
UNIT – V	Synthesis of reactor networks, elements of process flowsheet optimization, green engineering.			7
UNIT – VI	Process flexibility analysis, economic analysis of process, capital expenditure and operating expenditure.			7
REFERENCES				
1.	Robin Smith, ‘Chemical Process Design and Integration’, Wiley, 2005.			
2.	L.T. Biegler, I.E. Grossmann and A.W. Westerberg, ‘Systematic Methods of Chemical Process Design’, Prentice Hall, 1997.			
3.	W.D. Seider, J.D. Seader, D.R. Lewin, ‘Product and Process Design Principles’, 2nd Ed, Wiley 2004.			

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Type of the Programme: M.E. Part - I Chemical (Petrochemical Engineering)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2107 PAPER NAME: PROCESS MODELLING, AND CONTROL	Credit	
Semester	I		Hours	45
UNIT – I	Philosophy of mathematical modelling, classifications of models, procedure of model development.			5
UNIT – II	Theoretical process modelling – Heat and mass balances, development of process models for liquid level, stirred tank heaters, CSTR, gas absorbers, Heat exchangers, packed bed reactor, Fluid catalytic cracking, etc.			10
UNIT – III	Process identification: Principles of Empirical modelling. Identification by step response, Impulse response and frequency response.			7
UNIT – IV	Review of Controller selection and design for feedback control loops. Controller design issues, Analysis of typical control loops, advanced control strategies, Model predictive control.			8
UNIT – V	Multi variable process control, Interaction analysis and multiple single loop design, relative gain array, loop pairing, design and tuning of multivariable controller. Multivariable controller trouble shooting			8
UNIT – VI	Control loop hardware and troubleshooting. Aspects of distributed control systems, programmable logic controllers, fieldbus technology. Actuator systems, Sensor systems. Troubleshooting control loops.			7
REFERENCES				
1.	D.M. Himmelblau and K.B. Bishoff ‘Process Analysis and Simulation’, Wiley 1968.			
2.	W.L. Luyben, ‘Process Modeling, Simulation and Control for Chemical Engineers’, 2nd Ed., Mc Graw-Hill, 1990.			
3.	B.W. Bequette, ‘Process Dynamics’, Prentice Hall, 1998.			
4.	B. Ogunnaike and W. Harmon Ray ‘Process Dynamics, Modeling and Control’, Oxford, 1994.			

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Type of the Programme: M.E. Part - I Chemical (Petrochemical Engineering)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2108 PAPER NAME: ADVANCED TRANSPORT PROCESSES	Credit	
Semester	I		Hours	45
UNIT – I	Rheology: Classification of fluid behavior, rheological models, Rheometry, flow of non-Newtonian fluids in closed conduits.			8
UNIT – II	Kinematics and Dynamics of fluids: Lagrangian and Eulerian specifications, Time derivatives, Stream functions. Conservation laws, constitutive equations for Newtonian fluids, Navier-Stokes equation and its solutions.			8
UNIT – III	Boundary Layer Theory: Laminar and Turbulent boundary layers, von Karman momentum integral, Blasius Solution.			7
UNIT – IV	Particulate flows and Introduction to fluidization: Particle characterization, interparticle and fluid particle forces, behavior of fluidized beds, minimum fluidization velocity, pressure drops, void age, transport disengaging height, bubbling bed models, turnover rates of solid, interchange coefficients.			7
UNIT – V	Heat Transfer: Finite difference methods for steady and unsteady state conduction. Analogy between momentum and heat transfer. Radiant heat transfer.			8
UNIT – VI	Mass Transfer: Inter phase mass transfer, interfacial turbulence, Marangoni effect, mass transfer with chemical reaction.			7
REFERENCES				
1.	R.B. Bird, W.E. Stewart and E.N.Lightfoot, ‘Transport Phenomena’, 2nd Ed, Wiley,2002.			
2.	J.C. Slattery,’ Momentum Heat and Mass transfer in Continuiua’, McGraw-Hill, 1972			
3.	J.W. Goodwin and R.W.Hughes, ’Rheology for Chemists’, RSC Publishing, 2008.			
4.	D.Kunni and O. Levenspiel, ‘Fluidization Engineering’, 2nd Ed, Butterworth-Heinemann, 1991.			
5.	W.M. Deen, ‘Analysis of Transport Phenomena’, Oxford, 1998.			

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Type of the Programme: M.E. Part - I Chemical (Petrochemical Engineering)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2109 PAPER NAME: ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS	Credit	
Semester	I		Hours	45
UNIT – I		Review of Chemical Engineering Thermodynamics: Property estimation methods, PVT behavior and EOS, Fundamental property relations, Thermodynamics derivatives, Residual and Excess properties, Partial molar properties	9	
UNIT – II		Solution Thermodynamics: EOS models and fugacity estimation and mixing rules for extension to mixtures Excess free energy models and activity estimation: Local composition and group contribution models, Parameter estimation using regression analysis, Methodology for associating molecules.	9	
UNIT – III		Vapour-Liquid Equilibria: Experimental techniques, K-values, BUBL P, DEW P, BUBL T, DEW T and Flash Calculations, $\Phi - \Phi$ and $\gamma - \Phi$ approach, Liquid-liquid Equilibria: Binary and ternary systems, stability criteria, Vapour-liquid-liquid Equilibria: Concept, calculations and applications.	10	
UNIT – IV		Chemical reaction equilibria for complex and multiple reactions, Analysis, methods and computations.	6	
UNIT – V		Vapour-liquid equilibria in ternary systems: Distillation lines, Residue curve maps.	5	
UNIT – VI		Solid-liquid, Solid-Gas and Supercritical fluid equilibria: Fundamentals, Experimental techniques, modelling and applications.	6	
REFERENCES				
1.	J. M. Smith H. C. VanNess, M. M Abbott, Introduction to Chemical Engineering Thermodynamics (6th Ed), McGraw Hill, Singapore, 2001.			
2.	J.M. Prausnitz, R. N. Lichtenthaler, E. G.De Azevedo, Molecular Thermodynamics of Fluid Phase Equilibria (3rd Ed), Prentice Hall, 1986.			
3.	S. M. Walas Phase Equilibria in Chemical Engineering, Butterworth 1985.			

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Name of the Programme: M.E. Chemical (Petrochemical Engineering) Type of the Programme: M.E. Part - I Chemical (Petrochemical Engineering)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: AMT 2127 PAPER NAME: ADVANCED COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING	Credit	
Semester	I		Hours	45
UNIT – I				
UNIT – II				
UNIT – III				
UNIT – IV				
UNIT – V				
UNIT – VI				
REFERENCES				
1.				
2.				
3.				

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Type of the Programme: M.E. Part - I Chemical (Petrochemical Engineering)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2105 PAPER NAME: SEMINAR	Credit	
Semester	I		Hours	45
UNIT – I		Literature Survey based investigation preferably in the areas to Environment, Safety and Hazard management in Refining/ Petrochemical/ Polymer industries. During the term two presentations on the area of investigation has to be made to the department		

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Name of the Programme: M.E. Chemical (Petrochemical Engineering)				
Type of the Programme: M.E. Part – II Chemical (Petrochemical Engineering)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE	Credit	
		PAPER CODE: CHL 2213		
Semester	II	PAPER NAME: PRODUCTION OF PETROCHEMICALS – I	Hours	45
UNIT – I		Introduction: Global status of petrochemicals, Assessment of petrochemical feed-stocks, Technology trends, petrochemical scenario in India.	04	
UNIT – II		Production of Olefins by Steam cracking of Hydrocarbons: Thermodynamic aspects, kinetics and mechanisms of Naphtha cracking and Gas cracking. Comparative aspects. Severity concept, effect of operating parameters viz. temperature, residence time and feedstock on product yield.	08	
UNIT – III		Steam cracker furnace design and operation, tube metallurgy, decoking and run length, Transfer line exchangers. Primary fractionation, compression and refrigeration section, separation and purification of cracked products viz. Ethylene, Propylene, C4 olefins and diolefins, C5 olefins and diolefins.	10	
UNIT – IV		Processing of C4 cuts, Separation of butadiene from C4 olefin gases by extractive distillation, Butenes recovery. Separation of isoprene from C5 fractions. Upgrading of olefins of C5 cuts.	07	
UNIT – V		Polyethylene classification, High pressure technologies for LDPE production. Exxon Mobil and Polymerieuropa technologies for LDPE. Polymerization catalysis and mechanism. Processes for HDPE and LLDPE production. Polymerization reactor systems, advantages and limitations of various reactor systems. Polypropylene production technologies Unipol, Spheripol, Spherizone processes.	10	
UNIT – VI		Recent advances in olefin and polyolefin technologies, Methanol to olefins, KBR Score Front end deethanizer and depropanizer. Bimodal HDPE production, LLDPE/HDPE swing technologies. Safety and Health aspects, Environmental aspects, Clean Technologies.	06	
REFERENCES				
1.	P. Desikan and T.C. Sivakumar, ‘Unit Processes in Organic Chemical Industries’, IIT Madras, 1982			
2.	E.C. Leonard, ‘Vinyl and Diene Monomers’, Wiley 1969			
3.	H.G. Franck & J.W. Stadelhofer, ‘Industrial Aromatic Chemistry’, Springer Verlag, 1988.			
4.	R. A. Meyers, ‘Handbook of petrochemical production processes’ , McGraw Hill, 2005			

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Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE	Credit	
		PAPER CODE: CHL 2214		
Semester	II	PAPER NAME: PRODUCTION OF PETROCHEMICALS – II	Hours	45
UNIT – I		Steam reforming, Thermodynamic and Kinetic aspects, catalysts, Shift converters, Partial oxidation, Production of hydrogen, purification of hydrogen and carbon monoxide, synthesis gas.	08	
UNIT – II		Production of Methanol, Thermodynamic and kinetic aspects, Lurgi Mega methanol technology, Methanol to gasoline, Formaldehyde, Acetic acid, Synthesis involving Carbon Monoxide, Fischer Tropsch synthesis, Oxo synthesis, Johnson Matthey process.	08	
UNIT – III		Ethylene based chemicals: Production of Ethylene Oxide, Ethylene Glycol, Acetaldehyde, Vinyl chloride, Vinyl acetate, Ethanol etc.	08	
UNIT – IV		Propylene based chemicals: Production of Propylene Oxide, Isopropyl alcohol, Acetone, Acrylic acid, Acrylonitrile etc. Synthesis of higher olefins from paraffins by dehydrogenation.	07	
UNIT – V		Isolation of aromatics from reformates and pyrolysis gasoline, production of Cumene and Phenol. Separation of xylenes, Production of Ethylbenzene, Styrene, LAB, Maleic anhydride, Cyclohexane, Caprolactum etc.	07	
UNIT – VI		Xylene derivatives: Production of Phthalic anhydride, Terephthalic acid Dimethyl terephthalate etc. Safety and Health aspects in petrochemical processing, Clean Technologies, Future beyond Petroleum.	07	
REFERENCES				
1.	P. Desikan and T.C. Sivakumar, ‘Unit Processes in Organic Chemical Industries’, IIT Madras, 1982			
2.	H.G. Franck & J.W. Stadelhofer, ‘Industrial Aromatic Chemistry’, Springer Verlag, 1988			
3.	A. Chauvel, G. Lefebvre, ‘Petrochemical Processes Vol 2’ Gulf Publishing Co., 1989.			
4.	R. A. Meyers ‘ Handbook of Petrochemical Production Processes’ McGraw-Hill, 2005			

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Type of the Programme: M.E. Part - I Chemical (Petrochemical Engineering)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2215 PAPER NAME: PROCESS DESIGN	Credit	
Semester	II		Hours	45
UNIT – I		Design information and data, property estimation by correlations and using simulation softwares.		04
UNIT – II		Design of piping systems for single phase and two-phase flows. Piping colours and codes. Selection and specifications of pipes and its components, pumps and compressors.		08
UNIT – III		Classification and Design of single-phase Heat exchangers, Design of Condensers and thermosiphon Reboiler.		10
UNIT – IV		Design of Furnaces.		07
UNIT – V		Design of Multicomponent distillation using shortcut techniques, introduction to rigorous techniques. Multicomponent absorption and extraction system design.		10
UNIT – VI		Design of valve tray towers.		06
REFERENCES				
1.	H.Z. Kister, ‘Distillation Design’, McGraw-Hill, 1992.			
2.	J.G. Stichlmair and J.R. Fair, ‘Distillation Principles and Practice’, Wiley, 1998.			
3.	J.D. Seader and E.J. Henley “Separation Process Principles”, J. Wiley& Sons, 1998.			
4.	D. W. Green, R. H. Perry, ‘Perry’s Chemical Engineers Handbook’, McGraw-Hill, 2007.			

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Type of the Programme: M.E. Part - I Chemical (Petrochemical Engineering)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2216 PAPER NAME: PETROCHEMICAL REACTION ENGINEERING	Credit	
Semester	II		Hours	45
UNIT – I	Gas phase non catalytic reaction: Kinetics and mechanism of free radical reactions. Cracking of Naphtha.			05
UNIT – II	Heterogeneous Catalysis: Historical development, Fundamental principles, components of industrial catalysts, catalyst activity, selectivity, catalyst preparation, catalyst storage etc. Characterization and morphology of solid catalysts. Catalyst support, effect of surface structure and support on catalyst activity, Zeolite catalysts.			07
UNIT – III	Kinetics of Solid catalysed reactions: Development of kinetic rate expression using Langmuir Hinshelwood Hougen Watson Models, Eli –Rideal mechanism combined effect of chemical and physical kinetics, pore diffusion effects, Thiele modulus, effectiveness factors, inter phase and intra phase temperature gradient, parametric estimation and parametric sensitivity, steady state multiplicity.			10
UNIT – IV	Catalyst Deactivation: Mechanistic approach, phenomenological approach.			06
UNIT – V	Multiphase reaction systems: Basic concepts, kinetics and mechanism of specific multiphase reactions, enhancement factors in gas-liquid and liquid-liquid reactions key physical parameters affecting reaction rates, transport coefficients and their estimation.			08
UNIT – VI	Reactor Design: -Design of fixed bed and fluidized bed catalytic reactors. Design considerations for multiphase reactors such as Trickle bed reactors, Slurry reactors, Bubble columns, Packed beds etc.			09
REFERENCES				
1.	M.V. Twigg, ‘Catalyst Handbook’, Manson Publishing, 1996.			
2.	C.H. Bartholomew and R.J. Farrauto, ‘Fundamentals of Industrial Catalytic Processes’, Wiley Interscience, 2006.			
3.	H. Scott Fogler, ‘Elements of Chemical Reaction Engineering’, 3rd Ed, Prentice Hall India, 2002.			
4.	L. Schmidt, ‘The Engineering of Chemical Reactions’, 2nd Ed, Oxford, 2008.			
5.	J.M. Smith, ‘Chemical Engineering Kinetics’, 4rd Ed, McGraw-Hill, 1981			
6.	C.N. Satterfield, ‘Heterogeneous Catalysis in Industrial Practice 2 nd Ed, McGraw-Hill 1993			

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Name of the Programme: M.E. Chemical (Petrochemical Engineering) Type of the Programme: M.E. Part - I Chemical (Petrochemical Engineering)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2217 PAPER NAME: PETROLEUM REFINERY ENGINEERING	Credit	
Semester	II		Hours	45
UNIT – I		Origin, formation, migration & accumulation of petroleum, Exploration, Drilling, Well completion, Recovery (primary, secondary & tertiary), Separation and transportation. Phase diagrams, Indian Refining scenario.	06	
UNIT – II		Crude composition, classification, evaluation and identification. Crude pre-treatment, ASTM, TBP & EFV distillation, calculation procedure for characterizing crudes, Heat and Mass balance calculations for atmospheric and vacuum distillation, atmospheric and vacuum distillation columns, refinery products, tests and specifications, product blending. Treatment of Petroleum products.	10	
UNIT – III		Catalytic cracking and Hydro cracking: Principles, feedstock’s technologies, hardware, catalysts, operational conditions, products etc. Hydro desulfurization.	08	
UNIT – IV		Catalytic Reforming: Principles, feed stocks, technologies, hardware, catalysts, operational conditions, products etc. Extraction of aromatics, Toluene disproportionation.	06	
UNIT – V		Vis-breaking, Coking, Isomerization, Alkylation, Trans-alkylation and Polymerization. Lube processing: Deasphalting Solvent extraction and Dewaxing.	10	
UNIT – VI		Natural gas processing, Gas processing technologies, gas dehydration, CO2 removal, CH4-CO2 separations.	05	
REFERENCES				
1.	James Speight, ‘The Chemistry and Technology of Petroleum’, 2nd Ed, Marcel Dekker, 1991			
2.	R.A. Meyers, ‘Handbook of Petroleum refining processes’, 3rd Ed, McGraw Hill, 2004			
3.	B.K. Bhaskarrao, ‘Modern Petroleum refining processes’ Oxford& IBH, 1984			
4.	Nelson, ‘Petroleum Refining Engineering’, McGraw-Hill, 1949			
5.	R.N. Watkins, ‘Petroleum Refinery Distillation’, Gulf Publications, 1979.			

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Type of the Programme: M.E. Part - I Chemical (Petrochemical Engineering)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL 2218L PAPER NAME: RESEARCH METHODOLOGY	Credit	
Semester	II		Hours	45
UNIT – I		Scientific Research: Characteristics of scientific research, steps in scientific research, types of scientific research, methods of scientific research.		8
UNIT – II		Hypothesis development: General aspects, specific aspects for petrochemicals.		8
UNIT – III		Research design, phases in research design, design for exploratory research in areas of petrochemicals.		8
UNIT – IV		Elements of content analysis, projective techniques. Scaling techniques, measurement, sampling and data analysis. Correlation development, regression analysis, correlation coefficients, statistical analysis.		8
UNIT – V		Design of experiments.		8
UNIT – VI		Ethics in research and publication.		5
REFERENCES				
1.	D. V. Thiel, Research Methods for Engineers, Cambridge University Press, 2014.			
2.	C. R. Kothari and G. Garg, Research Methodology, Methods and techniques, Third Edition, New Age Publications, 2014.			
3.	A. M. Novikov and D. A. Novikov, Research Methodology, CRC Press, 2013.			
4.	R. Snee, Experiments in Industry, Design, Analysis and interpretation of results. ASQ Publications, 1985.			
5.	K. M. DeVries, From Bench to Pilot Plant, American Chemical Society, 2002.			
6.	R. O Kuehl, Design of Experiments: Statistical Principles of Research Design and analysis, Duxbury/Thomson Learning, 2000			

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Type of the Programme: M.E. Part - II Chemical (Petrochemical Engineering)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL XXXX PAPER NAME: GAS PROCESSING TECHNOLOGIES	Credit	
Semester	II		Hours	39
UNIT – I		Gas resources: NG, CNG, LNG, LPG, various refinery gases. Aspects of processing natural gas: History, origin, sources, component classification, phase behaviour, properties, reserves, exploration, Review of Indian Scenario		7
UNIT – II		Production of natural gas, phase separation: gravity separators, theoretical and design considerations, Multistage separators, liquid gas coalescers: aerosols, coalescer construction, operation principle and performance, liquid-liquid coalescer: emulsions, principle, operation and performance		7
UNIT – III		Transportation: Multiphase flows, basic terminologies, flow regimes, design considerations, multiphase pipeline operations, leak detection, pipeline depressurization, Multiphase flow assurance: Hydrate prediction and prevention, corrosion, wax formation. NG compression: Thermodynamics of gas compression, compressor selection, design, controls.		8
UNIT – IV		General treatment concerning gas processing Gas sweetening: Solid bed processes, Chemical solvent processes, Physical solvent processes, direct conversion processes, membrane processes Gas dehydration: Glycol dehydration: process description, design considerations, operational issues, Solid desiccant dehydration: desiccant selection, capacity, operation and design considerations. H ₂ S removal, sulfur recovery and handling, tail gas treatment, CO ₂ removal, mercury removal		7
UNIT – V		NGL recovery processes: Absorption, Adsorption, Low temperature refrigeration, NGL fractionation, LNG pre-treatment and production processes, LNG storage, transportation and regasification		6
UNIT – VI		Gas processing plant control and safety aspects, Waste minimization and pollution prevention in gas processing		4
REFERENCES				
1.	S. Mokhatab, W. A. Poe, Handbook of natural gas transmission and processing, Gulf Professional Publishing, 2012.			
2.	Bahadori, Natural gas processing Technology and Engineering Design, Gulf Professional Publishing, 2014.			
3.	A.J. Kidnay, W. R. Parrish, D. G. McCartney, Fundamentals of Natural gas processing, CRC press, 3 rd Edition, 2020.			

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Type of the Programme: M.E. Part - II Chemical (Petrochemical Engineering)				
Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL XXXX PAPER NAME: POLLUTION CONTROL IN PETROLEUM AND PETROCHEMICALS	Credit	
Semester	II		Hours	39
UNIT – I		Introduction: Waste generation in petroleum and petrochemical industry. Impact on public health and environmental quality.	4	
UNIT – II		Air Pollution: Air pollutants produced by petrochemical manufacturing practices, Environment protection act (EPA), air emission control problems, sources of air emissions, statistics on quantities and types of emissions. Waste minimization methods.	8	
UNIT – III		Water Pollution: Wastewater streams in the production industry, toxic organic chemicals, design of wastewater treatment facilities for petrochemical production facilities, Monitoring wastewater composition to quality control.	7	
UNIT – IV		Solid Waste Management: suspended and dissolved solids such as waste polymers and inorganic salts, processes such as activated sludge, trickling filters, extended aeration, wastewater stabilization ponds, and anaerobic digestion.	8	
UNIT – V		Disposal of Hazardous waste: potential hazard to the health of humans or other living organisms. ignitability, corrosivity, reactivity, or toxicity of waste.	7	
UNIT – VI		Petroleum and petrochemical industries in developing industries. Energy considerations in pollution control. Future trends in pollution control.	5	
REFERENCES				
1.	M. Brett Borup, Pollution Control in the Petrochemicals Industry, 3 rd edition, CRC Publication, 2018.			
2.	Nancy Jean Sell, Industrial Pollution Control - Issues and Techniques, 4 th edition, 2011.			
3.	Thomas T. Shen, Industrial Pollution Prevention, 2 nd edition, Springer, 2013.			
4.	William Wesley Eckenfelder, William Wesley Eckenfelder, 3 rd edition, McGraw-Hill, 2000.			

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Year	I	CORE / ELECTIVE / FOUNDATION 1: ELECTIVE PAPER CODE: CHL XXXX PAPER NAME: POLYOLEFIN TECHNOLOGIES	Credit	
Semester	II		Hours	39
UNIT – I	Polyolefins as a material: Its characterization, Molecular weight distribution, products, Indian scenario of polyolefins			4
UNIT – II	Polyolefin catalysts and mechanisms: Ziegler Natta, Phillip’s, Metallocene, Late transition metal, supporting single site. Their characteristics and unique features.			7
UNIT – III	Reactor types and configuration for polyolefin production: Evolution of reactor configurations and their necessity. Gas phase reactors, fluidized bed reactors, vertical and horizontal slurry bed reactors, Multizone circulating reactors, slurry phase reactors, autoclaves, slurry loop reactors, solution reactors.			6
UNIT – IV	Polyethylene Processes: Types of polyethylene from VLDPE (Very Low-Density Polyethylene to UHMWPE (Ultra High Molecular Weight Polyethylene), their applications and processing capabilities, process chemistry and technology. Process description of major polyethylene technologies and key process variables with emphasis on process control and safety: Basell Spherilene, Borstar LDPE, HDPE technology, Chevron Phillips technology for linear PE, High pressure technologies: basic chemistry and process performance, Basell Hostalen process for bimodal HDPE production, Basell technologies for HDPE and LDPE, Unipol process, Swing technologies for PE.			9
UNIT – V	Polypropylene Processes: Aspects of process chemistry and thermodynamics, Role of catalyst system components, catalyst function: effect of catalyst size, shape, type, Replication factor, polymer chain length control, MWD of polymer, Effect of propane and other impurities, copolymers and hetrophasic copolymers, control of physical properties Process description of major polypropylene technologies and key process variables with emphasis on process control and safety: Unipol , Spheripol, Basell Spherizone, Borstar, Modular, Gas phase processes			9
UNIT – VI	Recent advancement in Polyolefin technologies: New products, New grades, Cycloolefin Polymerization, Catalyst development, Additives			4
REFERENCES				
1.	Robert A. Meyers, Handbook of Petrochemicals Production Processes, Second Edition Mc Graw Hill, 2019.			
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