

PANDIT DEENDAYAL PETROLEUM UNIVERSITY
SCHOOL OF TECHNOLOGY
COURSE STRUCTURE FOR B. TECH. CHEMICAL ENGINEERING

SEMESTER VII			B.TECH. CHEMICAL ENGINEERING										
Sr No	Course Code	Course Name	Teaching Scheme					Examination Scheme					
			L	T	P	C	Hrs/wk	Theory			Practical		Total marks
								MS	ES	IA*	LW	LE/Viva	
1	CH 401T	Computer Aided Process Design	2	--	0	4	2	30	60	10	--	--	100
	CH 401P		--	--	4	2	4	--	--	--	25	25	50
2	CH 402	Polymer Science and Technology	3	--	--	6	3	30	60	10	--	--	100
3	CH 403	Petroleum Refining and Petrochemicals	3	--	--	6	3	30	60	10	--	--	100
4	CH 404	B. Tech. Seminar	--	--	6	3	6				50	50	100
5	CH-01XT	Department Elective I	3	--	--	6	3	30	60	10	--	--	100
6	HS 410	Industrial Economics	3	--	--	6	3	30	60	10	--	--	100
7	TP 310	Industrial Training (evaluation)	--	--	--	6	--	--	--	--	80	20	100
		Total	14	0	10	39	24						750

MS = Mid Semester, ES = End Semester; * IA = Internal assessment (like quiz, assignments etc)
LW = Laboratory work; LE = Laboratory Exam

Department Elective I: Food Technology; Nanotechnology; Pharmaceutical Engineering; Fertilizer Technology

CH 401T Computer Aided Process Design										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total marks
					MS	ES	IA	LW	LE/Viva	
2	--	--	4	2	30	60	10	--	--	100
<p>UNIT I</p> <p>Introduction to Computer Aided Design (CAD), Engineering Tools for CAD Development of simple, Introduction to AutoCAD, various tools of designing in Autocad, Steady state flow sheeting on the computer, approach to flow sheeting systems, Mathematical methods used in flow sheeting and simulation, Degree of freedom in a flow sheet for various processes, Sequential modular approach to flow sheet, Flow sheet solution by equation solving methods based on tearing</p> <p>Introduction to Excel solver, Different operators in Solver, Solving linear and nonlinear algebraic equations, Simulation by linear methods and quasi-linear approach</p> <p>UNIT II</p> <p>Introduction to MATLAB in chemical engineering, Introduction to toolboxes in MATLAB, Control design and tuning in MATLAB, Algorithms for problems related to chemical engineering, Computerized physical property systems- physical property calculations, example of physical and thermodynamics property estimation.</p> <p>Exposure to UNIFAC and other methods for distillation, Multi component distillation</p> <p>UNIT III</p> <p>Introduction to ASPEN, Solvers in Aspen, Heat and Power Integration of various chemical units, Heat-integrated Distillation Trains, Heat Engines and Heat Pumps, Optimum integration of energy, Threshold Approach Temperature, Optimum Approach Temperature, flash calculations</p> <p>UNIT IV</p> <p>Optimal Design and Scheduling of Batch Processes using GAMS: Introduction, Design of various Process Units, Design of Single & Multi Product Processing Sequences. Optimization of energy.</p> <p>Texts and References</p> <ol style="list-style-type: none"> 1. Warren D. Seider, J. D. Seader, Daniel R. Lewin, "Product and Process Design Principles: Synthesis, Analysis, and Evaluation", 2nd Edition, Wiley (2003) 2. Lorens T Biegler, E. I. Gnacio Grossmann Arthur W Westerberg, "Systematic Methods of Chemical Process Design", PHI International. 3. T.F. Edgar and D.M. Himmelblau, "Optimization of Chemical Processes", Chemical Engg. Series, McGraw Hill 4. B. A. Finlyason, "Introduction to Chemical Engineering Computing", Wiley-Interscience, 1st edition, 2006 5. Richard G. Brereton, "Chemometrics: Data Analysis for the Laboratory and Chemical Plant", Wiley, 2003. 										

CH 401P Computer Aided Process Design

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total marks
					MS	ES	IA	LW	LE/Viva	
--	--	4	2	4	--	--	--	25	25	50

Laboratory: Process Simulators – Steady State Simulators, Dynamic Simulators with the help of case studies which includes energy and material recycle

Laboratory sessions: Softwares like Polymath, Chemcad, Gams, Aspen tec, etc. will be covered with suitable examples from theory portion.

- 1 Introduction to commercial chemical engineering softwares
- 2 Use of MATLAB for fine tuning of controllers
- 3 Introduction to Polymath and simulation of chemical engineering problems in polymath
- 4 Introduction to GAMS and basic syntax learning
- 5 Formulation of chemical engineering linear and Mixed integer linear programming problems and solving them using GAMS
- 6 Formulation of chemical engineering non- linear and Mixed integer non-linear programming problems and solving them using GAMS
- 7 Introduction to ASPEN and simulation of basic equipments such as Pump, Compressor, expander, Heat exchanger and Flash separator in ASPEN
- 8 Simulation of different types of reactions such as conversion reaction, equilibrium reaction in ASPEN
- 9 Simulation of equipments such as CSTR, absorber and separation columns in ASPEN

CH 402 Polymer Science and Technology										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total marks
					MS	ES	IA	LW	LE/Viva	
3	--	--	6	3	30	60	10	--	--	100
<p>UNIT I Introduction, Basic concepts of Polymer Science, concept of non Newtonian fluids, types of molecular weights and its distribution, determination of Molecular Weight (End group analysis, colligative property measurement, Gel Permeation Chromatography) structure property relationship, physical properties of polymers</p> <p>UNIT II Types of Polymerization including pre polymerization, study of polymerization mechanism, Kinetics, Effects of temperature, pressure, different types of polymerization techniques, Polymer Analysis & Characterization (esp. thermal, physical, mechanical properties)</p> <p>UNIT III Production of bulk polymers like PE, PP, PVC, SBR, Polyester, Nylons etc. by different processes, their differences wrt conventional chemical manufacturing Specialty polymers: Conducting polymers, Block copolymers, Polymer composites, special discussion on polyurethanes, Elastomers, spandex, etc.</p> <p>UNIT IV Polymer Processing: Molding, Extrusion, Thermoforming, calendaring, Reaction injection molding, principle and applications Additives and Compounding, composite plastics, engineering plastics Fiber Technology: Textile and Fabric properties, Spinning, Elastomer technology: Vulcanization, Reinforcement.</p> <p>Texts and References</p> <ol style="list-style-type: none"> 1. Premamoy Ghosh, Polymer Science and Technology, Tata McGraw Hill, 2nd Ed. 2002 2. Fred W. Billmeyer, Jr., Text book of Polymer Science: Second Edition, 1994, John Wiley and Sons, Inc., Singapore. 3. Anil Kumar and Gupta, R. K., Fundamentals of Polymers, McGraw Hill, 1998. 4. George Odian, Principals of Polymerization, Third Edition, 2002, John Wiley and Sons, 5. V. R. Gowariker, N. V. Viswanathan, J. Sreedha, Polymer Science, New Age International, 1986 										

CH 403 Petroleum Refining and Petrochemicals										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total marks
					MS	ES	IA	LW	LE/Viva	
3	1	--	7	4	30	60	10	--	--	100
UNIT I										
Origin and occurrence, status of Indian petroleum industries. Onshore & off shore drilling techniques, Engineering limitations in offshore and use of robotics in deep sea exploration. Pretreatment of crude oil for refining, characterization of crude oil and product specification.										
UNIT II										
Reforming of naphtha, thermal and catalytic cracking, thermal reforming, plat forming (Catalytic reforming), vacuum distillation, fractionation. Processing of residuum, FCC, lubricating oil processing, blending and hydro treatment processes.										
UNIT III										
Alkylation and isomerization, Processing of natural and associated gases.										
Definition of petrochemical, source material for manufacture of chemicals from hydrocarbons, individual compounds and mixtures										
Manufacture of major olefin building block- ethylene, propylene, butadiene etc										
UNIT IV										
Manufacture of BTX aromatics, naphthalene etc.										
Current development in petrochemicals technologies – shale oil & gas extraction methods- fracturing, hazards and safety measures for fracturing, Underground natural gas storage in cravines and abandoned coal mines, methods for ensuring leak proof, testing of such facilities prior to storage, exposure to standards for shale oil/gas extraction.										
Texts and References										
<ol style="list-style-type: none"> 1. W.L. Nelson "Petroleum Refining Engineering", John Wiley and Sons Inc., 1965. 2. A. Gary "Handbook of Petroleum Refining" , Marcel Dekker, 1970. 3. B K Bhaskararao "A textbook on Petrochemicals," 3rd ed., Khanna Publishers, Delhi, 1999. 4. Dryden's Outlines of chemical technology, 3rd ed., M Gopal Rao, Marshall sitting 5. Encyclopedia of Chemical Technology, Kirk-Othmer, John Wiley & Sons. 6. A. Chauvel and G. Lefebvre, 'Petroleum Processes 1: Synthesis-Gas Derivatives and Major Hydrocarbons', Gulf Publishing Co. Editions Technip, 1989. 7. Guthrie's Virgil. B, "Petroleum Product Handbook", Knovel Publisher, 2005 										

CH-404 B Tech SEMINAR

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total marks
					MS	ES	IA	LW	LE/Viva	
--	--	6	3	6	--	--	--	50	50	100

Seminar topics can be based on the wide range of chemical engineering and its application areas including the fundamental technologies, design and development, current trends in technology, modeling, simulation, specific case studies, etc.

Student must meet the concerned supervisor to finalize the topics

1. Weekly/bimonthly reporting
2. Literature survey
3. Detail analysis and report writing
4. Intermittent progress evaluation
5. Final seminar presentation

CH-011 Food Technology										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total marks
					MS	ES	IA	LW	LE/Viva	
3	--	--	6	3	30	60	10	--	--	100
<p>UNIT I Introduction, general aspects of food industry, world food demand and Indian scenario, constituents of food, quality and nutritive aspects.</p> <p>Food chemistry: Lipids, proteins, carbohydrates, composition of foods nutrition. Food Microbiology: Introduction growth factors, degradation and spoilage of foods epidemiology of food borne diseases, food infections.</p> <p>UNIT II Food Biotechnology: Fermentation and enzymatic processes.</p> <p>Aseptic Techniques: Food handling, food sterilization sterilization of food processing equipments.</p> <p>Transport Phenomena in food processing: Non newtonian flow heat transfer simultaneous heat and momentum transfer thermal time distribution mixing unit operations in food systems, evaporation.</p> <p>UNIT III Preservation techniques: Thermal, Dehydration, microwave irradiation cold fermentation and by chemicals.</p> <p>Packaging and storage: Principles, shelf life, canning, modified atmosphere packaging, refrigeration.</p> <p>UNIT IV Post Harvesting Techniques: Grain drying and storage fruit and vegetable processing seafood and meat processing</p> <p>Supercritical extraction: Flavours, spices, and essence.</p> <p>Texts and References</p> <ol style="list-style-type: none"> 1. Fellows, P., Food Processing Technology: Principles and Practice, 2nd Edition, Woodhead Publishing Ltd., England, 2000 2. Toledo, R, Fundamentals of Food Process Engineering, 3rd Edition, Springer, 2010. 3. R. Paul Singh and Demis R. Heldman, Introduction to Food Engineering, 2nd ed, Academic Press, 1993. 4. Ernest L. Watson and John C Harper, Elements of Food Engineering, 2nd ed. Von Nostrand Reinhold Co., 1987 5. R. Macral, R. K. Robinson, and M. J. Sadler, Encyclopedia of Food Science, Food Technology and Nutrition, Vol. 8, Academic Press 1993. 										

CH-012 Nanotechnology										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total marks
					MS	ES	IA	LW	LE/Viva	
3	--	--	6	3	30	60	10	--	--	100
UNIT I										
Introduction and definition, nanoscale, electromagnetic spectrum, top down and bottom up approach, particle size, chemical and physical properties of nanomaterials, opto-electronic properties and phenomenon in nanostructures, quantum effects										
Synthesis, properties, stability and characterization of nano-particles: like Iron, platinum, copper, gold, silver, nickel, fullerene and carbon nanotubes and different types of nano-oxides, (Al ₂ O ₃ , TiO ₂ , ZnO etc.)										
UNIT I										
Sol-gel methods, chemical vapour deposition, ball milling etc. Preparation and properties of Carbon nanotubes										
Synthesis and properties of composite nano-particles, nanofillers, high performance materials, polymer nanocomposites, nanoclays, nanowires, nanotubes, nanoclusters etc. Coated nano-particles.										
UNIT III										
Nanomanipulation, Micro and nanofabrication techniques, Photolithography, Nanolithography., Introduction to MEMS, NEMS and nanoelectronics.										
Introduction to bionanotechnology and nanomedicines.										
UNIT IV										
Application of nano-particle in catalysis and quasi homogeneous reactions, heterogeneous reaction, fuel cell catalysis, selective hydrogenations, benzene hydrogenation, environmental clean up technology										
Nanoparticle characterization instruments, Safety issues with nanomaterials										
Texts and References										
<ol style="list-style-type: none"> 1. T. Pradeep, Nano: The Essentials; Tata McGraw-Hill, 2008. 2. B.S. Murthy et al., Textbook of Nano Science and Nanotechnology, Universities Press, 2012 3. Pulikel M. Ajayan, Nanocomposite science and technology, , Wiley-VCH 2005 4. David G. Bucknall, Nanolithography and patterning techniques in microelectronics, Wood head publishing 2005 5. D.K. Ferry and S.M. Goodmick, Transport in Nanostructures, Cambridge university press 1997. 6. Zheng Cui, Micro and Nanofabrication, Springer 2005 										

CH-013 Pharmaceutical Engineering										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total marks
					MS	ES	IA	LW	LE/Viva	
3	--	--	6	3	30	60	10	--	--	100
UNIT I										
Introduction to Pharmaceutics and its scope, definition of Pharmacy, Historical background and development of profession of pharmacy and pharmaceutical Industry in India, Chemical Engineering in the Pharmaceutical Industry, Unit processes and unit operations pharma industry,										
UNIT II										
The Role of Chemical Engineering in Pharmaceutical Active Pharmaceutical Ingredient (API) Process, concepts of chemical kinetics and catalysis,										
Process safety and risk assessment,										
UNIT III										
Design of distillation and crystallization processes, scale up studies,										
Study of novel separation techniques in pharmaceutical engineering,										
UNIT IV										
Process Modeling and simulation studies for drug design, packaging materials and concepts, design of packing units										
Texts and References										
1. David J. am Ende, Chemical Engineering in the Pharmaceutical Industry: R&D to Manufacturing, Wiley, 2010										
2. David B. Troy, Paul Beringer, 'Remington: The Science and Practice of Pharmacy', Lippincott Williams and Wilkins, 21 st edition, 2006										

CH-014 Fertilizer Technology										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total marks
					MS	ES	IA	LW	LE/Viva	
3	--	--	6	3	30	60	10	--	--	100
UNIT I										
Introduction and classification of fertilizers, use and applications, types of raw material and sources for plants, N-P-K values and calculations, Fertilizer Market scenario, environmental issues, Introduction to micro fertilizers, Nitrogenous Fertilizers : production of: nitrogenous fertilizer-ammonium sulphate, nitrate, granulated and prilled urea neem coated urea and calcium ammonium nitrate, ammonium chloride and their production, characteristics and specifications, packaging, storage and handling.										
UNIT II										
Phosphatic Fertilizers: Raw materials types and properties, , synthesis of sulphuric and phosphoric acids; phosphates fertilizers - ground rock phosphate; bone meal-single superphosphate, triple superphosphate, triple superphosphate, thermal phosphates and their methods of production, characteristics and specifications										
UNIT III										
Potassic Fertilizers: Methods of production of potassium chloride, potassium schoenite, their characteristics and specifications.										
Complex and NPK Fertilizers: Methods of production of ammonium phosphate, sulphate, nitrophosphates, various grades of NPK fertilizers produced in the country.										
UNIT IV										
Miscellaneous fertilizers: Mixed fertilizers and granulated mixtures; bio fertilizers & biopesticides, nutrients, secondary nutrients and micro nutrients; liquid fertilizers, controlled release fertilizers, controlled release fertilizers.										
Texts and References										
<ol style="list-style-type: none"> 1. Sittig M.and Gopala Rao M., Dryden's Outlines of Chemical Technology for the 21st Century, 3rd Edition, 2. WEP East West Press, 2010. 3. Austin G T, Shreve's Chemical Process Industries, McGraw Hill Book Company, 1986. 4. Slack, A.V.; Chemistry and Technology of Fertilizers, Interscience, New York, 1966 5. Menno, M.G.; "Fertilizer Industry - An Introductory Survey", Higginbothams Pvt. Ltd., 1973. 6. Sauchelli, V.; "The Chemistry and Technology of Fertilizers", ACS MONOGRAPH No. 148, Reinhold Publishing Cor. New York, 1980. 7. "Handbook of fertilizer technology", Association of India, New Delhi, 1977 										

HS 410 INDUSTRIAL ECONOMICS										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total marks
					MS	ES	IA	LW	LE/Viva	
3	--	--	6	3	30	60	10	--	--	100
UNIT I Introduction										
<ul style="list-style-type: none"> • Provide basic understanding of economic concepts such as Demand, supply, Concept and organization of a firm; ownership, control and objectives of the firm. • Need, importance and role of industries in economic growth and development, Industry and agriculture sector Linkages. 										
UNIT II Firms and Market Conduct										
<ul style="list-style-type: none"> • Public, Private, Joint and Co-operative sectors, private corporate sector, MNCS and their Role. • Cost behavior the firm. Types of cost, short run – long run, fixed and variable. Production function – short run and long run. Types and classification of market 										
UNIT III Location and Dispersion:										
<ul style="list-style-type: none"> • Location of industries - Theories of Location, Regulations/ Recommendation for plant layout and location • Diversification, Integration and Merger of Industrial Units, Dispersion; and Problem of Regional imbalance. 										
UNIT IV India's Industrial Sector and Issues of Labour:										
<ul style="list-style-type: none"> • Structure of Large - Scale Industries in India. • Emerging Global competition and Indian Industry. • Impact of Liberalization and Privatization on industrial sector. • New Industrial Policy 1991 and recent industrial policies in India, Industrial Growth and pattern in India. • Structure of Industrial Labour, Industrial relations exit policy and social security, Wages and problems of bonus 										
UNIT V Financing of Industry:										
<ul style="list-style-type: none"> • Role and functions of IFCI, IDBI, SIDBI, MSFC, GIDC, GIIC in Industrial Finance. 										
Texts and References										
<ol style="list-style-type: none"> 1. Barthwal, R. R, Industrial Economics: An Introductory Text Book, Wiley Eastern Ltd. New Delhi. 2. Cherunilam, F., Industrial Economics: Indian Perspective, Himalaya Publishing House, Mumbai. 3. Desai, B., Industrial Economy in India, Himalaya Publishing House, Mumbai. 4. Kuchhal, S.C., Industrial Economics, Himalaya Publishing House, Mumbai. 										

TP 310 INDUSTRIAL TRAINNING EVALUATION										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total marks
					MS	ES	IA	LW	LE/Viva	
--	--	--	6	--	--	--	--	80	20	100
Training evaluation based on min. 6-8 weeks of summer training										