



West Bengal State Council of Technical Education

(A Statutory Body under West Bengal Act XXI of 1995)
Kolkata Karigori Bhavan, 2nd Floor, 110 S. N. Banerjee Road, Kolkata - 700 013.

Syllabus for REACTION KINETICS & REACTOR DESIGN

Name of the Course: REACTION KINETICS & REACTOR DESIGN			
Course Code:		Semester: Fifth	
Duration: : Seventeen weeks		Maximum Marks: 150	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Semester Exam.:20Marks	
Tutorial: Nil hrs./week		Attendance & Teacher's Assessment 10 Marks	
Practical: 3 hrs./week		End Semester Exam.:70Marks	
Credit: 5		Practical :50	
Aim:			
Sl. No.			
1.	To impart the knowledge of reaction mechanism and kinetics .		
2.	Ideas on different type of industrial reactors.		
3.	Process design of reactors of different types.		
Objective:			
Sl. No.			
1.	To provide knowledge on design, operation and performance analysis of industrial reactor		
Pre-Requisite:			
Sl. No.			
1.	Students should have sound knowledge on mathematics		
2.	Students should know the basic principles, stoichiometry of chemical reaction		
Contents :		TOTAL PERIODS: 51 hrs /week	
		Hrs./Unit	Marks
Unit: 1 KINETICS OF HOMOGENOUS REACTIONS	Simple & multiple reactions — Elementary & non-elementary reactions — Molecularity & order of a reaction — Searching for a mechanism of reactions (associated problems) — Temperature dependency of rate equation from: Arrhenius' law – Thermodynamics (Van't Hoff equation) – Collision theory – Transition state theory	15	
Unit: 2 INTERPRETATION OF BATCH REACTOR DATA	Integral method of analysis of data — Irreversible unimolecular type first order reactions — Irreversible bimolecular type second order reactions — Zero order reactions — Overall order of irreversible reactions from half-life — Irreversible reactions in series & parallel — Homogenous catalysed reactions — Auto catalytic reactions — First order reversible	15	

	reactions (derivations & associated problems)		
Unit: 3 REACTORS	Basic idea of: Batch – Plug-flow – CSTR – Heterogeneous Catalytic reactors	10	
Unit: 4 REACTOR DESIGN	Basic idea of reactor design — Space time — Space velocity — Single ideal batch reactor — Steady state back mix reactors (associated problems)	11	
Total		51	
Text Books:			
Name of Authors	Title of the Book	Edition	Name of the Publisher
Octave Levenspiel	Chemical Reaction Engineering		Tata McGraw Hill Wiley Eastern Pvt. Ltd., New Delhi
Reference Books:			
Name of Authors	Title of the Book	Edition	Name of the Publisher
J.M. Smith	Chemical Engineering Kinetics		McGraw-Hill Book Co. Ltd., New York and Kogakusha Co. Ltd., Tokyo
Walas	Reaction Kinetics for Chemical Engineers		McGraw-Hill Book Co. Ltd., New York
C. Guha, S.C. Roy	Reaction Engineering		Tata McGraw Hill
Sl. No.	Question Paper setting tips		
	<p>Question Paper Setting Tips :</p> <p>Short questions :20 marks, Students will answer 20 questions out of 25 questions ,each carrying 1 mark</p> <p>Long question :50 marks ,Students will answer 5 questions , out of 8 questions, each carrying 10 marks</p>		



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Syllabus For Chemical Technology I

Name of the Course: : Chemical Technology I	
Subject Code:	Semester: Fifth
Duration: 17 Weeks	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Mid Semester Exam.: 20 Marks
Tutorial: Nil	Attendance, Assignment & interaction: 10 Marks
Practical: Nil	End Semester Exam.: 70 Marks
Credit: 3	
Aim:	
Sl. No.	
1.	This subject will provide the knowledge of Chemical process & industry.
2.	It will help a student to deal with the manufacturing process & process development in his professional career.
3.	This subject will provide adequate information about the raw materials requirement, chemistry involved & process details of important chemical products.
4.	It will impart knowledge on the analysis of chemical process from engineering & technical view points.
Objective:	
Sl. No.	Students will be able to Learn
1	Sources of water. Impurities present in water. Different treatment processes.
2.	Raw materials of Acid Industry Manufacturing processes. Process flowsheet.
3.	About the types of fertilizer Manufacturing process of different fertilizer Process flow sheet.

4.	Products of Chlor Alkali Industry. Manufacturing process of products of chlor alkali industry. Process flow sheet.
5.	Production of pulp & paper. Process flow sheet
6.	Production of Soap & Detergent Process flow sheet
7	Types of cement. Manufacturing of Portland Cement. Process flow sheet.
8	Raw materials & manufacturing of Glass. Raw materials of ceramic products. Manufacturing of Porcelain
Pre-Requisite:	
Sl. No.	
1.	Knowledge of basic concepts of sciences such as physics, chemistry.
2.	Knowledge of the names of equipment related to chemical Engineering field.
3.	Knowledge of unit operations & unit processes.

	Content s : Total Periods : 51 hrs /week CHEMICAL TECHNOLOGY I	hrs/Unit	Marks
Unit 1 : WATER & ITS TREATMENT	Sources of water. Impurities present in water. Methods of water treatment : Lime – Soda Process ,Softening of water by zeolites, Demineralization, Coagulation, Flocculation, Aeration, Deaeration etc.	5	
Unit 2 ACID INDUSTRIES	Manufacturing of Sulfuric Acid : Description of Contact and DCDA process with flow sheet. Manufacturing of Hydrochloric Acid : Manufacturing from common salt and synthetic hydrochloric acid production with flow sheet. Manufacturing of Nitric Acid : By ammonia oxidation process with flow sheet. Manufacturing of Phosphoric Acid : By Electric Furnace process & Wet process with flow sheet.	10	

Unit 3 : FERTILIZER INDUSTRY	Production of Nitrogenous Fertilizer : Production of Ammonia, Urea, Ammonium nitrate, Nitrolime with process flow sheet. Production of Phosphatic Fertilizer : Super phosphate & Tripple Super Phosphate with flow sheet. Production of N-P-K fertilizer.	10	
Unit 4 : CHLOR – ALKALI INDUSTRY	Production of Soda Ash by Solvay process with flow sheet. Production of Sodium Hydroxide and Chlorine by Electrolytic Process. Working principle of Diaphragm Cell, Membrane Cell, Mercury	10	
Unit 5 : PAPER & PULP INDUSTRY	Classification of Pulping Process, Composition of Cooking liquor , Description of Kraft Pulping process with flow sheet,Screening,Cleaning and Bleaching of Pulp. Making of Paper from Pulp.	5	
Unit 6 : SOAP & DETERGENT INDUSTRY	Classification of Soap making Process. Description of Full Boiled Process of Soap manufacture with flow sheet. Classification of Detergent. Manufacturing of one Anionic Detergent like Dodecyl Benzene Sulphonate.	4	
Unit 7 : CEMENT INDUSTRY	Types of Cement. Manufacturing process of Port land Cement with flow sheet.	4	
Unit 8 : GLASS & CERAMIC INDUSTRY	Raw materials requirement and manufacturing of glass. Raw materials of Ceramic product. Porcelain manufacturing with flow sheet	3	
TOTAL		51	

Text and reference books:

Sl. No.	Title of the Book	Name of Authors	Publisher
1.	Chemical Process Industries	Shreve	McGraw-Hill Book Co. Ltd., New York and Kogakusha Co. Ltd., Tokyo.
2.	A Text Book of Chemical Technology, Vol. 1 & 2	Sukla and Pandey	Vikas Publishing House Pvt. Ltd., New Delhi.

3.	Outlines of Chemical Technology	Dryden	Affiliated East-West Press Pvt. Ltd., New Delhi
4.	Introduction to Chemical Engineering	Ghosal, Sanyal, Dutta	Tata McGraw-Hill Pub. Co. Ltd., New Delhi

Question Paper Setting Tips :

Short questions :20 marks, Students will answer 20 questions out of 25 questions ,each carrying 1 mark

Long question :50 marks ,Students will answer 5 questions , out of 8 questions, each carrying 10 marks.



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Syllabus for : SEPARATION PROCESS- I

Name of the Course: <u>SEPARATION PROCESS I</u>	
Course Code:	Semester: Fifth
Duration: : Seventeen weeks	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Mid Semester Exam.:20Marks
Tutorial: Nil hrs./week	Attendance & Teacher's Assessment 10 Marks
Practical: 3 hrs./week	End Semester Exam.:70Marks
Credit: 5	
Aim:	
Sl. No.	
1.	This subject will provide the students the basic concept of mass transfer.
2.	It will impart knowledge to understand working of mass transfer equipment used in chemical process industries.
3.	This subject will provide adequate information about the unit operation involved in Absorption, Distillation, Extraction.
Objective:	
Sl. No.	The students will be able to Learn :
1.	General principles of mass transfer & its application. Concept of Diffusion, Diffusivity, Molecular Diffusion. Simple numerical problems.
2.	Concept of absorption & stripping, Choice of solvent for absorption, minimum solvent requirement, Absorption factor, Concept of channelling, loading & flooding, types & selections of regular & random packing. Concept of HETP, HTU & NTU, simple calculation of diameter and height of packed column using NTU & HTU method. Simple numerical problems.

3.	<p>Concept of relative volatility,</p> <p>Batch, continuous, flash, vacuum, steam, low pressure, molecular, azeotropic, extractive & multicomponent distillation.</p> <p>Location of feed plate, minimum & optimum reflux, use of open steam.</p> <p>Simple calculation of number of theoretical plate based on McCabe–Thiele method.</p> <p>Basic concept about bubble cap tray & sieve tray column.</p> <p>Simple numerical problems</p>		
4.	<p>Concept of liquid extraction,</p> <p>Use of triangular diagram, selectivity, choice of solvent.</p> <p>Basic concept about percolation tank,</p> <p>Dorr – agitator, thickener & classifier,</p> <p>Hydro cyclone, rotocell,</p> <p>Kennedy & Bollman extractor.</p> <p>Simple numerical problems.</p>		
Pre-Requisite:			
Sl. No.			
1.	Knowledge of basic concepts of sciences such as physics, chemistry.		
2.	Knowledge of the names of equipment related to chemical Engineering field.		
3.	Knowledge of unit operations.		
4.	Knowledge of solving numerical problems.		
Contents : TOTAL PERIODS: 51 hrs /week		Hrs./Unit	Marks
INTRODUCTION :	<p>General principles of mass transfer & its applications, Mass transfer coefficients,</p> <p>Concept of diffusion, diffusivity, application of molecular diffusion.</p> <p>Simple numerical problems.</p>	6	

<p>Unit: 2: ABSORPTION :</p>	<p>Concept of absorption & stripping, Choice of solvent for absorption, minimum solvent requirement, Absorption factor, Concept of channelling, loading & flooding, Types & selections of regular & random packing. Concept of HETP, HTU & NTU, Simple calculation of diameter and height of packed column using NTU & HTU method. Simple numerical problems</p>	<p>15</p>	
<p>Unit 3: DISTILLATION :</p>	<p>Concept of relative volatility, Concept of batch, continuous, flash, vacuum, steam, low pressure, molecular, azeotropic, extractive & multicomponent distillation. Location of feed plate, Minimum & optimum reflux, Use of open steam. Simple calculation of number of theoretical plate based on McCabe–Thiele method. Basic concept about bubble cap tray & sieve tray column. Simple numerical problems.</p>	<p>15</p>	
<p>Unit 4 EXTRACTION :</p>	<p>Concept of liquid extraction, Use of triangular diagram, Selectivity, choice of solvent. Basic concept about percolation tank, Dorr – agitator, thickener & classifier, hydro cyclone, rotocell, Kennedy & Bollman extractor. Simple numerical problems.</p>	<p>15</p>	
Total		<p>51</p>	

Text and reference books:			
Sl. No.	Title of the Book	Name of Authors	Publisher
1.	Mass Transfer Operations,	Treybal	McGraw-Hill Book Co. Ltd., New York and Kogakusha Co. Ltd., Tokyo.
2.	Unit Operations of Chemical Engineering.	McCabe and Smith	McGraw-Hill Book Co. Ltd., New York and Kogakusha Co. Ltd., Tokyo.
3.	Introduction to Chemical Engineering,	Badger and Banchero	McGraw-Hill Book Co. Ltd., New York and Kogakusha Co. Ltd., Tokyo
4.	Introduction to Chemical Engineering	Ghosal, Sanyal, Dutta	Tata McGraw-Hill Pub. Co. Ltd., New Delhi
5.	Chemical Engineering, Vol. 1, 2, 4 & 5,.	Coulson and Richardson	Pergamon Press, Oxford
<p>Question Paper Setting Tips :</p> <p>Short questions :20 marks, Students will answer 20 questions out of 25 questions ,each carrying 1 mark</p> <p>Long question :50 marks ,Students will answer 5 questions , out of 8 questions, each carrying 10 marks.</p>			



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CHEMICAL PROCESS EQUIPMENT DESIGN-I.

Name of the Course : Chemical Process Equipment Design (I & II)	
Course Code:	Semester: Fifth
Duration: : Seventeen weeks	Maximum Marks: 50
Practical: 3 hrs./week	
Credit: 3	
Sl. No.	Skills to be developed
1	Concept of Design of an equipment.
2.	Useful guidelines in designing the process equipment.
3.	Principles of design of various Unit Operation Equipments.
4.	Fabrication aspects.

NAME OF THE COURSES	COURSES OFFERED IN	MARKS ALLOTTED
Chemical Process Equipment Design (Part-II)	Part – III First Semester	<p>Continuous Internal Assessment of 25 marks is to be carried out by the teachers throughout the two semesters where marks allotted for assessment of sessional work undertaken in each semester is 25 Distribution of Marks: Class Performance –15, Report –10.</p> <p>External Assessment of 25 marks shall be held at the end of the Part – III First Semester on the entire syllabi of Chemical Process Equipment Design-I.</p> <p>Viva-voce – 25.</p>
Chemical Process Equipment Design (Part-I)	Part – III Second Semester	

MODULAR DIVISION OF THE SYLLABUS

(Only Chemical Design , Mechanical Design and Drawing are not necessary)

JOB NO.	TOPIC
Chemical Process Equipment Design- I	
1	DESIGN OF A PIPE LINE NET WORK FOR A FLUID FLOW OPERATION.
2	DESIGN OF ORIFICE METER & VENTURI METER.
3	DESIGN OF SHELL & TUBE HEAT EXCHANGER.
4	DESIGN OF SINGLE OR MULTIPLE EFFECT EVAPORATORS.

REFERENCE BOOKS

1. Ludwig: Applied Process Design for Chemical and Petrochemical Plants, Vol. 1, 2 & 3, Gulf Publishing Co. Houston, Texas.
2. Brownel and Young: Process Equipment Design, John Wiley & sons, Inc., New York.
3. Joshi: Process Equipment Design, Macmillan India, New Delhi.
4. Bhattacharya: Chemical Equipment Design-Mechanical Aspects Chemical Engineering Education Development Centre, IIT, Madras.
5. Code for unfired pressure vessels, Bureau of Indian Standards.
6. TEMA: Standards of Tubular Exchanger Manufacturers Association.



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Syllabus for : : PROCESS CONTROL ENGINEERING

Name of the Course: PROCESS CONTROL ENGINEERING				
Course Code:		Semester: 5th		
Duration : : Seventeen weeks		Maximum Marks: 150		
Teaching Scheme		Examination Scheme		
Theory: 3 hrs./week		Mid Semester Exam.:20Marks		
Tutorial: Nil hrs./week		Attendance & Teacher's Assessment 10 Marks		
Practical: 3 hrs./week		End Semester Exam.:70Marks		
Credit: 5		Practical : 50		
Aim:				
Sl. No.				
1.	Understand the basic principles of control system.			
2.	In modern day technical scenario, almost all technologies are based on Automated control despite manual one. To understand & implement those precision control techniques the knowledge of this subject is very much essential.			
3.	Application of the Control techniques in Chemical Process Industries.			
Objective:				
Sl. No.				
1.	Introduction and application on Laplace Transform			
2.	Automatic control system – Concept of automatic process control			
3.	First order system- Basic concept with problems and idea on time constant.			
4.	Second order system- Basic concept.			
5.	Introduction to Servo and Regulator problem.			
6.	Concept on standard block diagram and different controllers(P,Pi,PID)			
Pre-Requisite:				
Sl. No.				
1.	Basic knowledge in Algebra ,Differential and Integral Calculus.			
2.	Elementary knowledge about Laplace transform.			
Contents :		Total 51 hrs/week	Hrs./Unit	Mark s
Unit 1:	Concept about Laplace Transforms of simple functions – step, exponential, impulse, ramp and sine functions.		8	

Introduction	Transforms of derivatives & integrals. Inversion by partial fractions – solutions of ordinary differential equations.		
Unit: 2 Automatic control system	Concept of automatic process control, Linear open loop system. Response of first order systems – transfer function, properties of transfer function, step response, impulse response, sinusoidal response. Simple problems.	8	
Unit: 3 First order system & Second order system	First order system --Physical examples of first order systems –Mercury in Glass Thermometer, Liquid level system, mixing. Linearization of nonlinear systems. Response of first order systems in series(Simple Problems). Second order system – Definition of under damped, critically damped & over damped systems, overshoot, decay ratio, rise time, response time, period of oscillation, natural period of oscillation & transportation lag (No Problems)	12	
Unit: 4 The control system	Components of a control system, concept about block diagram, negative & positive feedback system, and servo & regulator problem. Development of block diagram of a control system.	8	
Unit: 5 Closed loop transfer function	Standard block diagram symbols, Closed loop system – overall transfer function for single loop system – for change in set point & for change in load variable. Overall transfer functions for multiloop control system.	10	
Unit: 6	Introduction to P, PI, PID controller.	5	
Total		51	
Text Books:			
Name of Authors	Title of the Book	Edition	Name of the Publisher
Coughanowr	Process System Analysis and Control,		McGraw-Hill co. New Delhi.
Stephanopoulos	Chemical Process Control- An Introduction to Theory and Practice		, Prentice Hall of India Pvt. Ltd., New Delhi
Reference Books:			
Name of Authors	Title of the Book	Edition	Name of the Publisher
Eckman	Automatic Process Control		Wiley Eastern Pvt. Ltd., New Delhi.
Patranobis	:Principles of Process Control,.		Tata McGraw-Hill Pub. Co. Ltd., New Delhi
Sl. No.	Question Paper setting tips		

A	Short questions: 20 marks, students will answer 20 questions out of 25 questions, each carrying 1 mark.
B	Long questions: 50 marks, students will answer 5 questions out of 8 questions, each carrying 10 mark.



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Syllabus for PETROLEUM REFINERY ENGINEERING (Elective I)

Name of the Course: PETROLEUM REFINERY ENGINEERING (Elective I)	
Course Code:	Semester: Fifth
Duration: : Seventeen weeks	Maximum Marks: 150
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Mid Semester Exam.:20Marks
Tutorial: Nil hrs./week	Attendance & Teacher's Assessment 10 Marks
Practical: hrs/week	End Semester Exam.:70Marks
Credit: 5	Practical :50
Aim:	
Sl. No.	
1.	This subject will provide the knowledge of Petroleum Industry.
2.	It will provide the knowledge of Chemistry & Technology of Petroleum , which is a basic raw materials for much of the synthetic organic chemical industry.
3.	This subject will make the student conversant with the refinery processes and operations for production of marketable products.
Objective:	
Sl. No.	The students will be able to Learn :
1.	Origin , Composition & Classification of Petroleum. Refinery products & their uses. Nature of Indian Crude.
2.	Crude heating ,Desalting. Distillation of Crude oil : Single stage, two stage, three stage Distillation. Atmospheric & Vacuum distillation unit.
3.	Different methods of purification of petroleum products.
4.	Some important properties of Petroleum products. The importance of these properties. The test methods to determine these properties
5	Types of Cracking and Reforming, Some commercial Cracking and Reforming Processes.
Pre-Requisite:	
Sl. No.	
1.	Knowledge of basic science.
2.	Knowledge of unit operation in Chemical Engineering field.

3.	Knowledge of names of equipments used in Chemical Engineering field.			
Contents :		TOTAL PERIODS: 51 hrs /week	Hrs./Unit	Mark s
Unit 1 : INTRODUCTION	Origin of Petroleum. Composition of Petroleum Classification of Petroleum Nature of Indian Crude. Uses of Petroleum Products.	4		
Unit: 2: PROCESSING OF CRUDE OIL	Desalting of Crude oil. Heating of Crude oil , Working principle of Pipe Still Heater. Description of Single Stage ,Two Stage & Three Stage Distillation Unit with diagram. Atmospheric & Vacuum distillation unit.	10		
Unit 3: PURIFICATION OF PETROLEUM PRODUCTS.	Sweetening process : Doctor' Sweetening Process, Copper Chloride Sweetening process, Solutizer Process, Catalytic Desulphurisation process, Hydrofining Desulphurisation process. Dewaxing process : Chilling & Pressing process, Solvent Dewaxing (MEK & Propane)process, Urea dewaxing process. Deoiling of wax. Acid, Alkali & Clay treatmnt of Petroleum products. Deasphalting Deasphalting process. Dearomatisation of Kerosene (Edeleanu Process) Other Solvent Extraction Process ; fufural Extraction, Phenol Extraction, Duo- Sol Extraction, Udex (Glycol) Extraction Process.	14		
Unit 4: PROPERTIES OF PETROLEUM PRODUCTS.	Specific Gravity, Molecular Weight,Vapour Pressure, Viscosity (Red Wood Viscometer), Viscosity Index, Flash Point (Pensky Martin's apparatus), Fire Point, Cloud Point, Pour Point, Freezing Point, Smoke Point, Char Value, Carbon Residue, Aniline Point, Diesel Index, Octane Number, Cetane Number, Performance Number, Emulsification, Oxidation Stability, Distillation Range, Sulphur Content, Moisture Content (Dean & Stark apparatus), Sediment, Calorific Value, Ash in Petroleum Products.	8		

<p>Unit 5: CRACKING AND REFORMING :</p>	<p>Concept of Cracking , Types of Cracking Influence of Various parameters in Cracking. Thermal Cracking Processes : Pyrolysis , Visbreaking And Coking. Catalytic Cracking Processes : Thermofer Catalytic Cracking (TCC) Moving Bed Process, Single Stage Fluidised Bed Catalytic Cracking process, Hydrocracking.</p> <p>Concept of Reforming, Types of Reforming. Thermal reforming. Catalytic reforming : Reactions involved, Effect of Variables in Catalytic Reforming. Description of Commercial Reforming processes : Non –Regenerative Fixed Bed Platforming process, Regenerative fixed Bed Hydroforming process, Thermofer Catalytic Reforming (TCR) Moving Bed process, Fluidised Bed Hydroforming process.</p>	<p>15</p>	
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Total 51

Text and reference books:

Sl. No.	Title of the Book	Name of Authors	Publisher
1.	Modern Petroleum Refining Processes	Rao	Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
2.	Petroleum Refinery Engineering,	Nelson	McGraw-Hill Book Co., Inc., New York and Kogakusha Co. Ltd., Tokyo.
3.	Elements of fuels, furnaces and refractories .	Gupta	.Khanna Publishers, Delhi
4.	Petroleum Processing	Hengstebeck	McGraw-Hill Pub. Co. Ltd., New York
5	Indian Petroleum Handbook, Petroleum Information Service	Petroleum Information Service	11,Parliament Street, New Delhi
6.	Outlines of Chemical Technology	Dryden	Affiliated East-West Press Pvt. Ltd., New Delhi
7	Introduction to Chemical Engineering	Ghosal ,Sanyal & Dutta.	Tata McGraw-Hill Pub. Co. Ltd., New Delhi

Question Paper Setting Tips :

Short questions :20 marks, Students will answer 20 questions out of 25 questions ,each carrying 1 mark

Long question :50 marks ,Students will answer 5 questions , out of 8 questions, each carrying 10 marks.



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Syllabus for INTRODUCTION TO PACKAGING TECHNOLOGY (Elective I)

Name of the Course: <u>INTRODUCTION TO PACKAGING TECHNOLOGY (Elective I)</u>				
Course Code:		Semester: Fifth		
Duration: : Seventeen weeks		Maximum Marks: 150		
Teaching Scheme		Examination Scheme		
Theory: 3 hrs./week		Mid Semester Exam.:20Marks		
Tutorial: Nil hrs./week		Attendance & Teacher's Assessment 10 Marks		
Practical: hrs/week		End Semester Exam.:70Marks		
Credit: 5		Practical : 50		
Aim:				
Sl. No.				
1.	This subject will provide the knowledge of basic concepts of Packaging and its characteristics.			
2.	This subject will make the student conversant with different packaging materials and their application.			
Objective:				
Sl. No.	The students will be able to Learn :			
1.	About Packaging , different packaging components and Packaging materials.			
2.	The terms related with Packaging.			
3.	The basic concept of Polymer Packaging , Metal Packaging , Glass Packaging.			
4.	The elementary idea of Cellulose and Paper Packaging.			
5	Packaging of Hazardous Chemicals.			
Pre-Requisite:				
Sl. No.				
1.	Knowledge of basic science.			
2.	Knowledge of different types of materials manufactured in chemical factory which are used for Packaging.			
3.	Knowledge of raw materials of different packaging materials manufactured in Chemical Industry.			
Contents :		TOTAL PERIODS: 51 hrs /week	Hrs./Unit	Mark s

Unit 1 : INTRODUCTION	Fundamental principle of packaging, definition of packaging as integral process in product and marketing, Function of package, Different package components, classification of packaging.	3	
Unit: 2: ELEMENTARY IDEA ABOUT PACKAGING MATERIALS	Concept of Primary Packaging Material , Secondary Packaging Material and Tertiary Packaging Material Some important Packaging Materials used in Food (Fresh foods, Dairy products, Fish, Meat , sea food & Drinks) Pharmaceutical and Other industries like Dairy , Cosmetics and Fertilizer industry etc.	3	
Unit 3: TERMS RELATED TO PACKAGING	Flexible packaging, Retail packaging, Shrink packaging, System packaging, Aseptic packaging, Vacuum packaging, Strip packaging, Skin packaging, Blister , Pouch, Sachets, Retort & Cushion packaging, Thermoform food container , Boil in bag , Bag in box .(Only definition , details not necessary) Wrapping --Definition, names of different wrapping methods and their advantages and disadvantages. Concept of shrink wrap , cling wrap etc. (Details are not necessary)	4	
Unit 4: POLYMER PACKAGING	Classification of Polymer materials. Properties of plastic materials commonly used for packaging. Different types of plastic & Their properties & uses – Polyethylene (LDPE, LLDPE, HDPE, HM-HDPE, VLDPE), Polypropylene (PP), Oriented polypropylene (OPP), Cast Polypropylene (CPP),By axially oriented polypropylene (BOPP), Pearlised OPP . Polystyrene (PS), Polyvinyl Chloride (PVC). Some important Packaging forms ---- Bag, Pouch, Blisters, Strip, Collapsible tubes, rigid containers, skin packaging , Multi layer composite film , Coextruded film .(Only definitions)	10	
Unit 5: METAL PACKAGING	Properties of Metal. Types of metal packaging (Names and application only) Characteristics , advantages and disadvantages of Metal Packaging. Aluminium Foil -- Characteristics, Application, Advantages.	8	

	<p>Collapsible Metal Tube – Material, Application, Advantages and Disadvantages.</p> <p>Aerosol Packaging -- Characteristics, Working Principle (Propellant; Actuators, Over caps, Dip Tubes.) Advantages, Disadvantages, Application.</p> <p>(Manufacturing and Testing of metal packaging are not necessary.)</p>		
Unit 6 : GLASS PACKAGING	<p>Physical and Chemical properties of Glass.</p> <p>Types of Glass Packaging used in packaging Industry.</p>	2	
Unit 7 : CELLULOSE, PAPER, PAPER BOARD PACKAGING AND CORRUGATED BOARD .	<p>Concept of Cellulose.</p> <p>Properties and application of cellulose materials, Cellophane – Introduction, properties, application.</p> <p>Types of Paper, Manufacturing and Properties of Paper , Classification of Paper.</p> <p>Speciality papers for packaging.</p> <p>Advantages & Limitation of paper based package materials, Paper laminates.</p> <p>Paper Board Packaging – Definition, classification.</p> <p>Testing of paper material-Tensile strength, Bursting strength, Rigidity, Cobb value, Moisture content, Wax pick up number, G.P properties in paper, smoothness of paper, Tear strengths, chloride & sulphate content of paper.</p> <p>Corrugated Board —Concept of Corrugated board , Type of Corrugated Board, Properties of Corrugated board.</p> <p>Type of Corrugated Boxes and application .</p> <p>(Manufacturing details are not necessary)</p>	16	
Unit 8: PACKAGING OF HAZARDOUS CHEMICALS	<p>Properties of Hazardous chemicals, Requisites for packaging materials, Common packages for hazardous chemicals.</p>	5	
Total		51	

Text and Reference Books:			
S.N	Name of the Author	Title of the Book	Name of the Publishers
1.	S. Natarajan M. Govindarajan	Fundamental of Packaging Technology	PHI Learning Private Limited.

	B.Kumar		
2.		Hand book of Packaging Technology	Engineers India Research Institute
3.	U.K Jain D.C Goupale S.Nayak	Pharmaceutical Packaging Technology	Pharma Med Press
4.		Packaging of food products	Indian Institute of Packaging

Question Paper Setting Tips :

Short questions :20 marks, Students will answer 20 questions out of 25 questions ,each carrying 1 mark

Long question :50 marks ,Students will answer 5 questions , out of 8 questions, each carrying 10 marks.



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Name of the Course : REACTION KINETICS LABORATORY	
Course Code:	Semester: Fifth
Duration: : Seventeen weeks	Maximum Marks: 50
Practical: 3 hrs./week	
Credit: 2	

Sl. No.	Skills to be developed
1	Proper handling of instruments.
2.	Measuring physical quantities accurately.
3.	To observe the phenomenon and to list the observations in proper tabular form.
4.	To adopt proper procedure and precautions while performing the experiment.
5.	To plot the graphs
6	To verify the principles, laws, using given instruments under different conditions.
7.	Learning the Reactions involved in the experiment.

Examination scheme: Maximum marks: 50

- 1. Continuous Internal Assessment of 25 marks** is to be carried out by the teachers throughout the Part – III First Semester. **Distribution of marks:** Performance of Job – 15, Report– 10.
- 2. External Assessment of 25 marks** shall be held at the end of the 3rd Year First Semester on the entire syllabus. Viva-voce – 25

Laboratory Experiments :

Sl. No.	
1	Determination of reaction rate constant for the Hydrolysis of Ethyl Acetate catalysed by Hydrochloric Acid (1st order).
2	To determine the rate constant of the Hydrolysis of Methyl Acetate in presence of an Acid Catalyst.
3	To determine the rate constant of Saponification of Ester (Ethyl acetate by Sodium Hydroxide)
4	To study the influence of Ionic strength on reaction between Potassium Persulphate and Potassium Iodide solution.
5	To study the kinetics of decomposition of Hydrogen peroxide in presence of Potassium Iodide.
6.	To study the kinetics of Iodination of Acetone.

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Name of the Course : PROCESS CONTROL ENGINEERING LABORATORY	
Course Code:	Semester: Fifth
Duration: : Seventeen weeks	Maximum Marks: 50
Practical: 3 hrs./week	
Credit: 2	

Sl. No.	Skills to be developed
1	Proper handling of instruments.
2.	Measuring physical quantities accurately.
3.	To observe the phenomenon and to list the observations in proper tabular form.
4.	To adopt proper procedure and precautions while performing the experiment.
5.	To plot the graphs
6	To verify the principles, laws, using given instruments under different conditions.

Examination scheme: Maximum marks: 50

1. **Continuous Internal Assessment of 25 marks** is to be carried out by the teachers throughout the Part – III First Semester. **Distribution of marks:** Performance of Job – 15, Report– 10.
2. **External Assessment of 25 marks** shall be held at the end of the 3rd Year First Semester on the entire syllabus.. Viva-voce – 25.

Laboratory Experiments :

Sl. No.	
1	Calibration of rotameter.
2	To determine the first order response of a mercury in glass thermometer
3	To determine the characteristic curve of various types of thermocouples
4	Calibration of Bourdon Gauge using Dead Weight Tester .
5.	Determination of temperature inside a furnace using Optical Pyrometer.
6.	Study of control valve characteristics
7.	Studies on dynamics and control of level control set up and temperature control set up.



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Name of the Course : PETROLEUM REFINERY ENGINEERING LABORATORY (ELECTIVE I)	
Course Code:	Semester: Fifth
Duration: : Seventeen weeks	Maximum Marks: 50
Practical: 3 hrs./week	
Credit: 2	

Sl. No.	Skills to be developed
1	Proper handling of instruments.
2.	Measuring physical quantities accurately.
3.	To observe the phenomenon and to list the observations in proper tabular form.
4.	To adopt proper procedure and precautions while performing the experiment.
5.	To plot the graphs
6	To verify the principles, laws, using given instruments under different conditions.

Examination scheme: Maximum marks: 25

1. **Continuous Internal Assessment of 25marks** is to be carried out by the teachers throughout the Part – III First Semester. **Distribution of marks:** Performance of Job – 15, Report– 10.
2. **External Assessment of 25 marks** shall be held at the end of the 3rd Year First Semester on the entire syllabus. Viva-voce – 25.

Laboratory Experiments :

Sl. No.	
1	To determine the aniline point and diesel index of diesel oil.
2	To determine the boiling range characteristics (ASTM) distillation of a petroleum fraction
3	To determine the carbon residue of diesel oil
4	To determine the kinematic viscosity of lubricating oil by Redwood viscometer
5	To determine the moisture content of liquid fuel by Dean and Stark apparatus



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Name of the Course : PACKAGING TECHNOLOGY LABORATORY (Elective I)	
Course Code:	Semester: Fifth
Duration: : Seventeen weeks	Maximum Marks: 50
Practical: 3 hrs./week	
Credit: 2	

Sl. No.	Skills to be developed
1	Proper handling of instruments.
2.	Measuring physical quantities accurately.
3.	To observe the phenomenon and to list the observations in proper tabular form.
4.	To adopt proper procedure and precautions while performing the experiment.
5.	To plot the graphs
6	To verify the principles, laws, using given instruments under different conditions.

Examination scheme: Maximum marks: 50

- 1. Continuous Internal Assessment of 25 marks** is to be carried out by the teachers throughout the Part – III First Semester. **Distribution of marks:** Performance of Job – 15, Report– 10.
- 2. External Assessment of 25 marks** shall be held at the end of the 3rd Year First Semester on the entire syllabus. **Distribution of marks:** Viva-voce – 25

Laboratory Experiments :

Sl. No.	
1	To measure the Porosity / Roughness / Smoothness of Paper.
2	To determine the water absorption capacity of Paper.
3	To measure GSM of different Paper sample.
4	To measure bursting strength of Paper.
5	To measure coefficient of friction of different sample of plastic used in packaging.
6	To measure Melt Flow Index of plastic granules.



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Name of the Course : SEPARATION PROCESS LABORATORY-I	
Course Code:	Semester: Fifth
Duration: : Seventeen weeks	Maximum Marks: 50
Practical: 3 hrs./week	
Credit: 2	

Sl. No.	Skills to be developed
1	Proper handling of instruments.
2.	Measuring physical quantities accurately.
3.	To observe the phenomenon and to list the observations in proper tabular form.
4.	To adopt proper procedure and precautions while performing the experiment.
5.	To plot the graphs
6	To verify the principles, laws, using given instruments under different conditions.

NAME OF THE COURSES	COURSES OFFERED IN	MARKS ALLOTTED
Separation Process Laboratory (PART I)	Part – III First Semester	Continuous Internal Assessment of 25 marks is to be carried out by the teachers throughout the two semesters where marks allotted for assessment of sessional work undertaken in each semester is 25. Distribution of marks for each semester: Class Performance – 20, Notebook –5.
Separation Process Laboratory (PART II)	Part – III Second Semester	External Assessment of 25 marks shall be held at the end of the Part – III Second Semester on the entire syllabi of Separation Process Laboratory PART- I. Distribution of marks: , Viva-voce –25.

MODULAR DIVISION OF THE SYLLABUS & DETAIL COURSE CONTENT

Laboratory Experiments	DETAIL COURSE CONTENT
Sl no.	Separation Process Laboratory (PART I)
1	TO DETERMINE MOLECULAR DIFFUSIVITY OF A SUBSTANCE THROUGH A NON-DIFFUSING GAS.
2	TO VERIFY RAYLEIGH'S EQUATION FOR BATCH DISTILLATION OF A BINARY MIXTURE.
3	TO STUDY SOLVENT EXTRACTIONS.
4	TO STUDY WETTED WALL COLUMNS.
5	TO STUDY MASS TRANSFER IN A SPRAY TOWER.
6	TO STUDY AZEOTROPIC DISTILLATION.
7	TO STUDY EQUILIBRIUM DISTILLATION BY OTHMER STILL.



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CHEMICAL ENGINEERING PROJECT WORK (PART-I)

Name of the Course : CHEMICAL ENGINEERING PROJECT WORK (PART-I)	
Course Code:	Semester: Fifth
Duration : Seventeen weeks in each semester	Maximum Marks : 50
Credit :2	

COURSE & EXAMINATION SCHEDULE

NAME OF THE COURSES	COURSES OFFERED IN	CONTACT PERIODS	MARKS ALLOTTED
Chemical Engineering Project Work (Part-I)	Part – III First Semester	3 Hrs./ week	Continuous Internal Assessment of 25 marks is to be carried out by the teachers throughout the two semesters where marks allotted for assessment of sessional work undertaken in each semester is 25. Distribution of marks: Project Work –10, Project Report –5, Viva-voce –10.
Chemical Engineering Project Work (Part-II)	Part – III Second Semester	4 Hrs. / week	External assessment of 25 marks shall be held at the end of the Part – III First Semester on the syllabi of Chemical Engineering Project Work. The external examiner is to be from industry / engineering college / university / government organisation. Distribution of marks: Viva-voce – 25.

OBJECTIVE

Sl. No.	Students will be able to learn
1	Understanding of the interrelationship between different courses learnt in the entire diploma programme and to apply the knowledge gained in a way that enables them to develop & demonstrate higher order skills.
2	The basic objective of a project class would be to ignite the potential of students' creative ability by enabling them to develop something which has social relevance, again, it should provide a taste of real life problem that a diploma-holder may encounter as a professional.
3	Interaction with local industry and local developmental agencies viz. different <i>Panchayet</i> bodies, the municipalities etc. for choosing topics of projects and / or for case study.

GENERAL GUIDELINES

- Project Work is conceived as a group work through which the spirit of team building is expected to be developed. Students will be required to carry out their Project Works in groups under supervision of a lecturer of their core discipline who will work as a Project Guide. It is expected that most of the lecturers of the core discipline will act as project guide and each should supervise the work of at least two groups. Number of students per group will vary with the number of lecturers acting as Project Guide and student strength of that particular class.
- Each group has to undertake a single project which has to be executed in Part – III First & Second Semesters. The project work aims at giving exposure to the students to the considerations to be made and to the procedure to be followed in designing a process plant and equipment or in performing any type of chemical process that will be suitable for industry. This will provide the scope to learn how a chemical plant is set up on making a process selection. Students would collect information and technical data on their assigned projects from the departmental library or from elsewhere, and if necessary, they may visit a chemical plant to gather practical information.
- The **Project Report** should incorporate the following: —
 - a. Introduction and objectives of the project;
 - b. Review of literature,
 - c. Outlines of the procedure followed,
 - d. Material & energy balance of the process,
 - e. Design calculations,
 - f. Discussions and conclusion, and,
 - g. The drawings of the process flow sheet & the major equipments with fabrication details.

