

Diploma -Chemical Technology & Certificate in Paper Technology

9

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	AM-111	Mathematics- I	4	1	0	5	5
2	PH-111	Physics-I	4	0	2	6	5
3	CY-111	Chemistry-I	4	0	2	6	5
4	HU-111	Communication Skills-I	2	0	0	2	2
5	WS-112	Workshop Practice	0	0	4	4	2
6	ME-111	Engineering Drawing	0	0	4	4	2
7	CH-111	Pulping & Bleaching Technology	2	0	2	4	3
Total			16	1	14	31	24

Semester-II (ICD)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	AM-121	Mathematics- II	4	1	0	5	5
2	PH-121	Physics-II	4	0	2	6	5
3	CY-121	Chemistry-II	4	0	2	6	5
4	HU-121	Communication Skills-II	1	0	2	3	2
5	CH-121	Unit Operation Lab	0	0	4	4	2
6	CH-122	Introduction of Paper Technology Lab	0	0	4	4	2
7	CS-121	Computer Fundamentals	3	0	2	5	4
Total			16	1	16	33	25

Semester-III A (ICD)

	TP-201	Two Weeks Practical Training during summer vacations				80	S/US
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Semester-III B (ICD)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	AM-211	Applied Mathematics	3	1	0	4	4
2	CH-211	Fluid Flow	3	1	0	4	4
3	CH-212	Pulp Washing & Chemical Recovery	3	1	4	8	6
4	CH-214	Paper Testing & Quality Control Lab	0	0	4	4	2
5	CH-215	Chemical Engg. Thermodynamics	3	2	0	5	5
6	CH-216	Mechanical Operation	3	1	0	4	4
Total			15	6	8	29	25

Semester-IV (ICD)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	CH-221	Heat Transfer	3	2	4	9	7
2	EE-221	Fundamental of Electrical Engineering	3	0	2	5	4
3	EC-221	Fundamentals of Electronics Engineering	3	0	2	5	4
4	CH-223	Stock Preparation & Paper Making	3	2	0	5	5
5	CH-225	Paper Making Lab	0	0	4	4	2
6	MC-221	Moral values and Professional ethics	1	0	0	1	0
Total			13	4	12	29	22

Semester-V A (ICD)

	TP-301	Four Weeks Industrial Training during summer vacations				160	
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Semester-VB (ICD)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	CH-311	Process Instrumentation	3	0	4	7	5
2	CH-312	Mass Transfer	3	1	0	4	4
3	CH-313	Chemical Reaction Engineering	3	2	4	9	7
4	CH-314	Industrial Stoichiometry	3	2	0	5	5
5	CH-315	Alternate Energy Sources	3	1	0	4	4
5	TP-301E	Industrial Training					S/US
Total			15	6	8	29	25

Semester-VI (ICD)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	HU-321	Entrepreneurship	2	0	0	2	2
2	MC-321	Environmental Studies	2	0	0	2	2
3	CH-321	Chemical Process Industries	3	2	0	5	5
4	CH-322	Petroleum Technology	3	1	4	8	6
5	CH-333	Process Equipment Design	1	1	4	6	4
6	CH-335	Project	0	0	4	4	2
Total			11	4	12	27	21

Title of the course : **Pulping and Bleaching Technology**
 Subject Code : **CH-111**
 Weekly load : 2 LTP 2-0-2
 Credit : 3 (Lecture 2; Tutorial 0 ; Practical 1)

Unit	Course outlines	Lecture
Unit-1	Introduction Definition of pulping as a fiber separation process, classification of raw materials used in paper making process (wood, non wood and agricultural residues)	03
	Raw material preparation Brief study of debarking, chipping and chip screening operations, operating procedures and safeguards of chipper and chip screens.	03
	Pulping equipments Different types of digesters: Batch and continuous digesters, difference between batch and continuous digesters, Heating methods: Direct and Indirect Methods, Digester room operations like Chip filling, liquor charging, digester relief and blow down operations.	04
	Pulping Methods Different pulping processes like chemical, mechanical and semi chemical pulping. Alkaline Pulping: Description of soda and kraft pulping processes, pulping of non wood raw materials, Introduction to semi chemical pulping processes like CMP and CTMP.	04
Unit-2	Bleaching of Pulp Fundamentals of pulp bleaching, important bleaching agents; their advantages and disadvantages. Brightness as a measure of pulp bleaching. Storage, handling and safety of chlorine and chlorine based bleaching agents, introduction to chlorine free bleaching.	07
	Bleaching equipments and sequences Introduction of common bleaching sequences, Flow sheets for important bleaching sequences like CE, CEHDED, CEDED, OCEDED, CEHP, CED, CEHH, CEHD with emphasis on operational measures and equipments used.	07

Recommended Books:

Author	Title	Publisher
G.A. Smook	Handbook of Pulp and Paper Technologists	
J.P. Casey	Pulp & Paper Chemistry and Chemical Technology Vol. I	
Rydholm	Pulping Processes	
Libbey	Textbook of Pulp and paper Making	
C. Biermann	Handbook of Pulp and Paper Technologists	
R.P. Singh	Bleaching of Pulp	

Title of the course : **Pulping and Bleaching Technology**
 Subject Code : **CH-111**

List of Experiments

1. Preparation of 100 gpl NaOH solution for cooking.
2. Calculation of amount of raw material required for pulping in batch digester.
3. Study of Pulping Process parameters in lab digester.
4. Washing and screening of Pulp
5. Preparation of hypochlorite bleach liquor.
6. Calculation of volume of hypochlorite bleach liquor required for given quantity of pulp.
7. Bleaching of Pulp by sodium hypochlorite.
8. Bleaching of Pulp using hydrogen peroxide.
9. Washing of bleached pulp and calculation of Yield percentage.
10. Measurement of bleaching effect by brightness testing.

Title of the course : **Unit Operation Lab**
Subject Code : **CH-121**
Weekly load : 0 LTP 0-0-4
Credit : 2 (Practical 2)

List of Experiments:

1. Calibration of Venturimeter.
2. Calibration of Orificemeter.
3. Study of Jaw Crusher
4. Study of Ball Mill
5. Study of Rotary Drum Filter
6. Study of Filter Press
7. Study of flow through pipes of different cross-sectional shapes
8. Study of Fittings

Title of the course : **Introduction of Paper Technology Lab**
Subject Code : **CH-122**
Weekly load : 0 LTP 0-0-4
Credit : 2 (Practical 2)

List of Experiments:

1. Identification of different grades of paper.
2. Measurement of bulk density of raw material.
3. Determination of ash content of paper/raw material
4. To determine the moisture content of given raw material.
5. Visual inspection of dirt and speck content of paper.
6. Visual inspection of quality of paper.
7. Find out the gsm of given sample of paper.
8. Identification and qualitative description of different cellulosic raw materials used for paper making.
9. Chart preparation of different printing processes.
10. Chart preparation for an integrated paper mill.

Title of the course : **Fluid Flow**
 Subject Code : **CH-211**
 Weekly load : 3
 Credit : 4 (Lecture 3; Tutorial 1)

LTP 3-1-0

Unit	Course outlines	Lecture
Unit-1	Introduction Units and dimensions	02
	Fluid Properties Various types of flow: steady and unsteady flow, uniform and non-uniform flow, stream line flow, laminar and turbulent flow	05
	Classification of fluids Types of fluids: compressible and incompressible fluid, Newtonian and non-Newtonian fluid. Physical properties of fluids	06
	Dimensional analysis Dimensionless numbers and their physical significance.	03
	Boundary Layer and equations Flow through the pipes and channels, concept of boundary layer. Continuity equation, Bernoulli's theorem and its application (without correction factor) and Reynold number, Skin friction and form friction, Fanning factor, frictional losses in pipes and fittings.	08
Unit-2	Fluid Meters & Flow Measurement Fluid pressure, various types of manometers, Pitot tube, Introduction to variable head meters and variable area meters. Wet gas meter, magnetic flow meter and anemometer, Simple numerical problems related to these topics.	11
	Fluid Moving Machinery Pumps, construction and performance of centrifugal pump, reciprocating pump, rotary pump, characteristics curves of centrifugal pump, cavitation, Net positive suction Head & Priming. Selection and specification of pumps. Blowers and compressors.	13

Recommended Books:

Author	Title	Publisher
Gupta & Gupta	Fluid Mechanics and its Applications	Wiley Eastern Publications
P. Chattopadhyay	Unit Operations of Chemical Engg. Vol. I	Khanna Publishers
Coulson and Richardson	Chemical Engineering, Vol. I & II	Pergamon Press Publications
McCabe & Smith	Unit Operation of Chemical Engineering	Tata McGraw Hill Publications
Badger & Banchero	Introduction to Chemical Technology	Tata McGraw Hill Publications

Title of the course : **Pulp Washing and Chemical Recovery**
 Subject Code : **CH-212**
 Weekly load : 3 LTP 3-1-4
 Credit : 6 (Lecture 3; Tutorial 1; Practical 2)

Unit	Course outlines	Lecture
Unit-1	Introduction Brown Stock Washing: Study of pulp washing on multistage rotary vacuum filters. Construction and working of a rotary vacuum filter. Operating procedures including startup and shutdown. Generation and maintenance of vacuum. Concept of dilution factor and elementary calculations.	10
	Washing Equipments Washing equipments other than rotary vacuum filters like horizontal belt washers and diffusion washers (only working principles and operational aspects). Black liquor as an asset rather than a liability, its importance as an energy source, overview of recovery process, Factors affecting brown stock washing and displacement efficiency, construction and working of 3-stage dilution/extraction pulp washing system.	12
Unit-2	Black liquor concentration & incineration Introduction of chemical Recovery system, Classification of evaporators and their objectives in chemical recovery process, Introduction to multiple effect evaporations of Black liquor, Brief description of types of evaporators, condensate systems, vacuum devices, feeding arrangement. Operation of evaporators and operational troubles, Introduction to direct contact evaporators. Description of Kraft Recovery Process.	16
	Causticizing Operations The causticizing reaction. Operation of slakers, causticizers, mud washers and mud filters, Definitions of Kraft pulping terms: Total Alkali, Total Titrable Alkali, Active Alkali, Activity, Causticity, Sulfidity, Causticizing efficiency.	10

Recommended Books:

Author	Title	Publisher
K.W. Britt	Handbook of Pulp and Paper Technology	
C. Biermann	Handbook of Pulp and Paper Technology	
R.P. Singh	Bleaching of Pulp	

Title of the course : **Pulp Washing and Chemical Recovery Lab**
Subject Code : **CH-212**

List of Practicals

1. Study of Rotary Drum Pulp Washer.
2. Laboratory washing of pulp.
3. Determination of specific gravity of Black liquor.
4. Measurement of degree twaddle (^oTW) of black liquor at different concentrations.
5. Determination of Total solids in black liquor.
6. Flow sheet of a Chemical Recovery System.
7. Determination of specific gravity of lime mud
8. Determination of moisture content in lime mud
9. Size reduction of lime in jaw crusher

Title of the course : **Paper Testing and Quality Control Lab**
Subject Code : **CH-214**
Weekly load : 0 LTP 0-0-4
Credit : 2 (Practical 2)

List of Experiments

1. Measurement of GSM and bulk of Paper.
2. Measurement of Caliper of Paper.
3. Determination of Burst strength of paper
4. Determination of Gurley porosity of paper
5. Determination of smoothness of paper
6. Determination of folding strength of paper
7. Measurement of brightness of paper
8. Measurement of opacity of paper
9. Measurement of Cobb value of paper
10. Measurement of gloss of paper

Title of the course : **Chemical Engineering Thermodynamics**
 Subject Code : **CH-215**
 Weekly load : 3 LTP 3-2-0
 Credit : 5 (Lecture 3; Tutorial 2)

Unit	Course outlines	Lecture
Unit-1	Introduction Basic Concept: Concept of Enthalpy, Internal Energy, Entropy, Free Energy and Equilibrium. Laws of Thermodynamics. Volumetric Properties of Fluids, Heat Effects, Heat Conduction In Gases and Liquids. Thermal Conductivity of Gases and Liquids.	13
	Thermodynamics Properties of Fluids Thermodynamic Properties of fluids: Properties of homogeneous mixtures; partial molar properties, fugacity, fugacity coefficient, chemical potential, activity coefficient.	11
Unit-2	Phase Equilibria Phase Equilibria: Vapor liquid equilibria, dew point and bubble point and their calculations for two phase systems, Gibbs Duhem equation. Chemical Reaction Equilibria: Clausius-clapeyron equation.	11
	Refrigeration and Liquification Refrigeration and Liquification: Various cycles of refrigeration. Carnot vapor compression, vapor absorption, Concept of solar refrigeration. Liquification process cycles, coefficient of performance. Choice of refrigerant, properties of refrigerant.	13

Recommended Books:

Author	Title	Publisher
Smith & Van Ness	Introduction to Chemical Engineering Thermodynamics	McGraw Hill Pub.
Kyle	Chemical & Process Thermodynamics	Prentice Hall Publications
YVC Rao	Chemical Engineering Thermodynamics	University Press Publications
Dodge	Chemical Engineering Thermodynamics	Tata McGraw Hill Publications

Title of the course : **Mechanical Operation**

Subject Code : **CH-216**
 Weekly load : 3
 Credit : 4 (Lecture 3; Tutorial 1)

LTP 3-1-0

Unit	Course outlines	Lecture
Unit-1	Introduction Introduction to mechanical operation	03
	Solid Handling Classification of solid particles, properties of particulate masses, storage of solids, transportation of solid materials, hydraulic and pneumatic conveying equipments	08
	Size reduction Principles of size reduction, determination of mean particles size, size distribution equations, laws of crushing and grinding, Kick's Law, Bond's Law and Rittinger's Law.	08
	Size Reduction Equipment Classification of industrial mills such as ball mill, fluid energy mill, jaw crusher and blake crusher; chippers, choppers and cutters.	07
Unit-2	Separation techniques Industrial screening, effectiveness of screen, methods of solid, solid, solid-liquid, solid-gas separation, mixing of solids and pastes, filtration, centrifugation and cyclone separators.	08
	Settling Elutriation, classification and sedimentation, flow of fluids past solid; fluidization, Stoke's Law, free and hindered setting	07
	Thickeners Types of thickness; batch and continuous and their industrial applications.	07

Recommended Books:

Author	Title	Publisher
McCabe, Smith & Harriott	Unit Operation of Chemical Engineering	McGraw Hill Publications
Coulson and Richardson	Chemical Engineering, Vol. I & II	Pergamon Press Publications
Badger & Banchero	Introduction to Chemical Technology	McGraw Hill Publications
Gupta & Gupta	Fluid Mechanics and its Applications	Wiley Eastern Publications
Foust	Principles of Unit Operations	John Wiley Publications

Title of the course : **Heat Transfer**
 Subject Code : **CH-221**

Weekly load : 3
 Credit : 7 (Lecture 3; Tutorial 2; Practical 2)

LTP 3-2-4

Unit	Course outlines	Lecture
Unit-1	Introduction Modes of heat transfer: Conduction, Convection, Radiation	07
	Conduction Fourier's Law, thermal resistance, thermal conductivity of materials, one dimension steady state heat conduction through composite walls, cylinders, spheres, Insulation and insulating materials, critical thickness of insulation, physical properties of insulating materials. Concept of unsteady state heat transfer.	10
	Convection Concept of heat transfer coefficient, Free and forced convection, Significance of dimensionless groups such as Reynolds number, Prandtl's number, Nusselt's Number, Stanton number and Grashof number. Empirical correlations for free and forced convection. Heat transfer with phase change.	11
Unit-2	Radiation Laws of radiation, Black body, Grey body, angle factor, view factor. Exchange of radiant heat between black bodies, grey bodies. Radiation from gas and vapour, Radiant exchange between gray surfaces, Radiant flux, Radiation intensity.	10
	Heat Exchange Equipment Heat Exchange Equipments: General discussion about various types of heat exchangers, evaporators, condensers and furnaces.	10

Recommended Books:

Author	Title	Publisher
D.S. Kumar	Heat & Mass Transfer	S.K. Kataria & Sons
D. Q. Kern	Process Heat Transfer	Tata McGraw Hill
Kreith	Principles of Heat Transfer	Harper & Row Publications
McCabe & Smith & Harriott	Unit Operations of Chemical Engineering	Tata McGraw Hill
Chapman	Heat Transfer	Macmillan Publications
J. P. Hollman	Heat Transfer	McGraw-Hill

Title of the course : **Heat Transfer Lab**
 Subject Code : **CH-221**

List of Experiments

1. Study the Shell and Tube Heat Exchanger
2. To find out the thermal conductivity of liquids.
3. To find out the thermal conductivity of metal rod apparatus
4. To study the temperature distribution in the composite cylinder.
5. To study the double pipe heat exchanger.
6. To determine the thermal resistance of composite wall.

Title of the course : **Stock Preparation & Paper Making**
 Subject Code : **CH - 223**

Weekly load : 3
 Credit : 5 (Lecture 3; Tutorials 2)

LTP 3-2-0

Unit	Course outlines	Lecture
Unit-1	Introduction General block diagram of a paper industry post brown stock washing. Important operations.	2
	Stock Preparation Different processes during stock preparation. Introduction to mechanical treatment of pulp fibers. Equipments used for mechanical treatment. Concept of freeness and its measurement. Operating procedures for refiners and beaters. Different internal sizing agents. Preparation and storage of size solution and alum. Brief study of wet end additives like starches, gums, dyes, fillers and strength improvement resins.	10
	Screening, Cleaning, and secondary fibers Study of pulp screening systems, working of knotters, vibrating screens, pressure screens and centri-cleaners batteries. Classification of secondary fibers. Pulpers and pulper additives. Operation of pulpers. Different deinking processes; equipments.	10
Unit-2	Approach flow and wet end operations Various stock distribution systems. Operation and maintenance of open and air cushion type roll headboxes. Introduction to hydraulic headboxes. Introduction to different parts of a Fourdrinier paper machine. Operating procedures and practices. Maintenance and troubleshooting. Brief study of drainage elements. Concept of basis weight and its control. Introduction to twin wire forming. Startup and shutdown procedures. Tackling a web break.	13
	Pressing, Drying, and Finishing Transfer of sheet from the wire part to the press part. Types of draws. Brief study of different types of presses and felts. Loading and unloading procedures. Web break events. Arrangement and operation of multicylinder dryers and yanki dryers. Dryer felts. Grouping of dryers. Working procedures for steam and condensate removal systems. Startup and shutdown procedures. Operation of calendars and pope reels. Working and maintainance of rewinders cutters and guillotines.	13

Recommended Books:

Author	Title	Publisher
M.J. Kocurrek	Pulp & Paper manufacture	TAPPI Publication
J.P. Casey	Pulp and Paper chemistry and chemical Technology	Wiley
K.W. Britt	Handbook of Pulp and paper Technology	Wiley
G.A. Smook	Handbook for pulp and paper Technology	TAPPI Publication

Title of the course : **Paper Making Lab**

Subject Code : **CH-225**
Weekly load : 0
Credit : 2 (Practical 2)

LTP 0-0-4

List of Experiments

1. Beating of Pulp for different time interval at constant load.
2. Measurement of freeness of pulp (^oSR) & study of equipment.
3. Study of Bauer McNett fiber classifier.
4. Study of lab sheet former & preparation of 80 & 100 GSM sheets.
5. Addition of internal sizing chemical & study of its effect.
6. Study of filler addition in paper & its effect on paper properties.
7. Measurement of filler retention in paper.
8. Study of alum addition on pH of Pulp stock.
9. Study of effect of ^oSR on drainage rate of pulp.
10. Measurement of consistency of Pulp slurry.

Title of the course : **Environmental Studies**

Subject Code : MC-311/MC-321

Weekly load : 2

LTP 2-0-0

Credit : 2 (Lecture 2)

Theory

Unit	Main Topics	Course outlines	Lecture(s)
Unit-1	1. Contemporary environmental issues	Human population growth and environmental challenge. Deforestation, desertification, global warming and climate change. Role of individual in environmental conservation.	08
	2. Natural resource management	Equitable use of resources. Overutilization and wasteful utilization of natural resources. Conservation of wildlife and biodiversity.	08
Unit-2	3. Environmental pollution	Vehicular pollution, industrial pollution, municipal wastes, noise pollution. Introductory ideas of water and air pollution control. Nuclear hazards.	10
	4. Environmental Regulations	Water Act, Air Act, Forest Conservation Act.	06

Total=32

Recommended Books:

1. E. Bharucha, Textbook for Environmental Studies; UGC Publication.
2. K.D. Wanger, Environmental Management; W.B. Saunders Publication.
3. T.G. Miller, Environmental Science; Wadsworth Publishing Co.
4. Pollution Control Acts, Rules and Notifications; CPCB Publication.

Title of the course : **Process Instrumentation**

Subject Code : **CH-311**

Weekly load : 3

LTP 3-0-4

Credit : 5 (Lecture 3; Tutorial 0; Practical 2)

Unit	Course outlines	Lecture
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Unit-1	Introduction Importance of instruments in chemical process industries, general classification of instrument. Indicating and recording type instrument. Description and construction details, working principle, range and application of following instruments. Pressure and Vacuum Gauge: Liquid column gauge, bourdon tube gauge. Thermometer and Pyrometer: Liquid expansion thermometer, bimetallic thermometer, thermocouple, resistance thermometer, optical and radiation pyrometer.	12
	Liquid level meters, Flow Meters and Analyzers Liquid Level Meter: visual indicators, float actuated level meter, static pressure instrument. Flow meter orifice, venture, pitot tube, rotameter. Analyzer: pH meter, chemical composition analyzer, various types of analyzers, oxygen analyzer and infra-red analyzer, orsat analysis.	12
Unit-2	Transmission & Instrumentation Diagram Transmission: Pneumatic and electrical transmission (inductance transmission only) and their fields of application. Process instrumentation, recording instruments, indicating and recording instruments, transmission of instrument reading, control centre, instrumentation diagram, instrumentation in modern chemical plant.	14
	Controllers & control valves Basic concept of process control, types of controllers and control valves.	10

Recommended Books:

Author	Title	Publisher
S.K. Singh	Industrial Instrumentation and Control	Tata McGraw Hill Pub.
D. Patranabis	Principles of Industrial Instrumentation	Tata McGraw Hill Pub.
D. Patranabis	Principles of Process Control	Tata McGraw Hill Pub.
Eckman	Industrial Instrumentation	Wiley Eastern Publication.
Coughnour	Process System Analysis and Control	McGraw Hill Pub.

Title of the course : **Process Instrumentation Lab**
Subject Code : **CH-311**

List of Experiments:

1. To find out the least count of Hg Glass thermometer
2. To Calibrate the given Rotameter
3. To Calibrate a Thermostat
4. To Calibrate Orificemeter
5. To Calibrate Venturimeter
6. To Calibrate pH meter
7. To Calibrate Pressure Gauge

Title of the course : **Mass Transfer**
Subject Code : **CH-312**
Weekly load : 3 LTP 3-1-0
Credit : 4 (Lecture 3; Tutorial 1)

Unit	Course outlines	Lecture
Unit-1	Introduction	09

	Mass Transfer operations and their applications, molecular diffusion, eddy diffusion, diffusion of solids	
	Diffusion Molecular diffusion, eddy diffusion, diffusion of solids	05
	Distillation Relative volatility, vapor liquid equilibrium, various distillation methods: flash distillation, batch distillation, continuous distillation, steam distillation. Introduction to azeotropic, extractive distillation. Different types of distillation columns, concept of flooding, weeping, entrainment and loading in distillation columns.	10
Unit-2	Gas-Liquid, Liquid-Liquid and Solid-Liquid Operations Principles and equipments for absorptions, extraction, leaching and humidification.	11
	Crystallization Study of various factors effecting crystallization. Nucleation, crystal growth, size and shape variation of different materials during crystallization, types of crystallizers.	07
	Drying Principles of drying operations and drying equipments, industrial applications of drying	06

Recommended Books:

Author	Title	Publisher
Treybal	Mass Transfer Operations	Tata McGraw Hill
Badger & Banchero	Introduction to Chemical Technology	McGraw Hill
McCabe & Smith	Unit Operation of Chemical Engineering	McGraw Hill
Sherwood Pigford & Wilke	Mass Transfer	McGraw Hill
Perry	Chemical Engineers Handbook	McGraw Hill

Title of the course : **Chemical Reaction Engineering**
Subject Code : **CH-313**
Weekly load : 3 LTP 3-2-4
Credit : 7 (Lecture 3; Tutorial 2; Practical 2)

Unit	Course outlines	Lecture
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Unit-1	Introduction Kinetics of Homogeneous Reactions: Introduction to different chemical reactions, fundamentals of Chemical reaction equilibrium, order of reaction, molecularity, effect of temperature and pressure on equilibrium constant	10
	Variable affecting reaction rate Zero order, first order, second order and higher order reactions for irreversible and reversible reactions: Residence time, space time and space velocity. Representation of a Reaction rate, kinetic models for non-elementary reactions, temperature dependent term of a rate equation, Activation energy and temperature dependency	14
Unit-2	Different Reaction Vessels Introduction to single and multiple reactions, different types of reactors and their applications: Exposure to ideal and non-ideal reactions in different types of reactors and ideal reactors.	12
	Steady state flow reactors Steady state mixed flow reactor, steady state plug flow reactor, holding time and space time for flow systems	12

Recommended Books:

Author	Title	Publisher
Octave Levenspiel	Chemical Reaction Engineering	John Wiley Publications
Smith	Chemical Engineering Kinetics	McGraw Hill Publications
Scott Fogler	Elements of Chemical Reaction Engineering	Prentice Hall Publications
Wales	Reaction Kinetics for Chemical Engineers	McGraw Hill Publications
Denbigh & Turner	Chemical Reaction Theory – An Introduction	Cambridge University Press

Title of the course : **Chemical Reaction Engineering Lab**
Subject Code : **CH-313**

Lists of Experiments

1. To Study Combined Flow Reactor.
2. To Study Isothermal Continuous Stirred Tank Reactor (CSTR).
3. To Study Plug Flow Reactor.
4. To Study Isothermal Semi-Batch Reactor.
5. To Study CSTR's in Series (Cascade CSTR).
6. To Study Packed Bed Reactor.
7. To Study Adiabatic Batch Reactor.
8. To Study Isothermal Batch Reactor.
9. To calibrate the thermostat on Isothermal Plug Flow Reactor.
10. To calibrate the thermostat on Isothermal CSTR.
11. To calibrate the thermostat on Isothermal Batch Reactor.
12. To calibrate the thermostat on Isothermal Semi-batch Reactor.
13. To calibrate the selected rotameter on Isothermal Plug Flow Reactor.
14. To calibrate the selected rotameter on Isothermal CSTR.
15. To calibrate the selected rotameter on Combined Flow Reactor.
16. To calibrate the selected rotameter on Cascade CSTR.

Title of the course : **Industrial Stoichiometry**
Subject Code : **CH-314**
Weekly load : 3 LTP 3-2-0
Credit : 5 (Lecture 3; Tutorial 2)

Theory

Unit	Course outlines	Lecture
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Unit-1	Introduction Basic Chemical Calculations: Units and dimensions, conversion factors, method of expressing composition, chemical formula, chemical stoichiometric equations, gas laws (for ideal and real gases), Raoult's Law for ideal solutions, Henry's Law	12
	Material Balance Material Balance (Steady State): Key components, techniques of problem solving, material balance problems with or without chemical reactions, bypass, recycle and purge systems.	12
Unit-2	Energy Balance Energy Balance (Steady State): First Law of thermodynamics, heat effects, heat capacities of solid, liquid, gases and solutions, heat of formation, heat of combustion, heat of dissolution, heat of reaction, heat of fusion, heat of vaporization.	14
	Stoichiometry & Unit Operations: Applications of stoichiometric calculations to chemical engineering processes/operations such as distillation, humidification, evaporation, crystallization and drying	10

Recommended Books:

Author	Title	Publisher
Himmelblau	Basic Principles and Calculation in Chemical Engineering	Prentice Hall Publications
Hougen & Watson	Chemical Process Principles	Wiley International Edition
Bhatt & Vohra	Industrial Stoichiometry	Tata McGraw Hill
Lewis & Lewis	Industrial Stoichiometry	McGraw Hill
G.K. Roy	Solved Examples in Chemical Engineering	Khanna Publications

Title of the course : **Alternate Energy Sources**
 Subject Code : **CH – 315**
 Weekly load : 3 LTP 3-1-0
 Credit : 4 (Lecture 3; Tutorial 1; Practical 0)

Unit	Course outlines	Lecture
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Unit-1	Introduction Importance of alternate sources of energy, present scenario, future prospects, economic criteria.	05
	Hydro Energy Hydro-Electric power plants.	09
	Solar Energy Photovoltaic cell, electricity generation, solar water heaters, solar furnaces, solar cookers, solar skills.	09
Unit 2	Wind Energy Wind mills, electricity generation from wind.	09
	Geothermal and Tidal Energy Steam generation and electricity generation	08
	Bio-Energy Biomass, Power Generation by using gassifiers. Biogas Plants	08

Recommended Books:

Author	Title	Publisher
Edited By M.S. Sodha, S.S. Mathur, M.A.S. Malik, T.C. Kandpal	Reviews of Renewable Energy Sources, Vol. 3	Wiley Eastern Limited, New Delhi
S.P. Sukhatme	Solar Energy – Principles of Thermal collection and storage	Tata McGraw Hill
G.D. Rai	Solar Energy Utilization	Khanna Publishers, New Delhi
Maheshwar Dayal	Energy Today and Tomorrow	Publications Division, Ministry of Information and Broadcasting, Govt. of India, New Delhi

Title of the course : **Chemical Process Industries**
 Subject Code : **CH - 321**
 Weekly load : 3
 Credit : 5 (Lecture 3; Tutorial 2)

LTP 3-2-0

Unit	Course outlines	Lecture
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Unit-1	Oils & Fats Fats & Oils: Chemical composition and physical properties of oils and fats. Process description of solvent extraction with flow sheet. Flow sheet, chemical reaction, raw material required, process description and major engineering problems associated with hydrogenation of oil.	08
	Paints Paint & Varnish: Definition of paint & varnish, Constituents of paints and varnishes. Enamel and its constituents. Special paints viz Luminescent paint, heat resistant paint and fire retardant paint.	05
	Polymers & Sugar Industries Polymer: Definition, degree of polymerization, types of polymerization, physical properties of polymers, classification of polymers, process description of manufacture of polyethylene, PCV and Teflon. Sugar Industry: Process description, flow sheet and major engineering problems associated with the manufacturing of sugar from sugarcane, sugar by-product utilization.	14
Unit-2	Rubber and Petroleum Rubber: Classification of rubber, pertinent properties of rubber polymers, vulcanization of rubber manufacture of Butadiene and Styrene, Butadiene Rubber (SBR), Manufacture of Nylon 66 with flow sheets. Industrial applications of rubber. Petroleum: Introduction, origin and composition of petroleum, classification of crude petroleum, refining of petroleum, uses of petroleum products, petroleum refining in India, definition of Octane number and Cetane number. Operations with examples (excluding design calculations).	11
	Paper Industry Paper Industry: Definition, types of paper product, raw materials required like bamboo, agricultural waste residue, baggase, and recycled fibers. Various additives and speciality chemicals like sizing materials, sizing materials, dry and wet strength additives, surface treatment additives and fillers used for paper making.	10

Recommended Books:

Author	Title	Publisher
Dryden	Outlines of Chemical Technology	East West Press
Shreve	Chemical Process Industries	McGraw Hill
G.N. Pandey	A Textbook of chemical Technology, Vol.- II	Vikas Publications

Title of the course : **Petroleum Technology**
 Subject Code : **CH – 322**
 Weekly load : 3 LTP 3-1-4
 Credit : 6 (Lecture 3; Tutorial 1; Practical 2)

Unit	Course outlines	Lecture
Unit-1	Introduction Origin of Petroleum: Mendeleev & Englers theories, composition of petroleum, India oil fields, composition of Indian crude. Physical Properties of Crude and Products.	05
	Evaluation of oil stock Power number, octane, cetane number, Flash point, Fire point, Viscosity index, Pour point, clard point, inorganic acidity, organic acidity, Base of crude oil characteristics factor – T.B.P. apparatus, Gravity mid percent curve, yield curve. Equilibrium flash vaporization curve. ASTM distillation characteristics of products. ASTM end points & T.B.B. cut point.	14
	Processing of Crude Desalting & dehydration of crude. Topping, atmospheric and vacuum distillation	09
Unit 2	Cracking and Reforming Importance cracking and reforming reaction, Thermal cracking, Fixed bed, moving bed and fluidized bed catalytic cracking. Catalytic reforming processes like polyforming and hydro forming. Conversion of petroleum gases into motor fuels with special reference to Alkylation, Polymerization and isomerization.	11
	Treatment Processes Chemical Extraction, selection of solvent, Edeleanun process. Furfural Process, Solvent extraction, Sweetening Processes and desulfurization. Characteristics of important products like gasoline, kerosene, diesel, jet fuels and lubricating oils.	09

Recommended Books:

Author	Title	Publisher
W. L. Nelson	Petroleum Refinery Engineering	McGraw-Hill series in chemical engineering
R. J. Hengsbeck	Petroleum Processing	Mcgraw Hill Book Company Inc.

Title of the course : **Petroleum Technology Lab**
Subject Code : **CH – 322**

List of Experiments:

1. To find out the calorific value of a given oil (Petrol/Diesel)
2. To find out saponification value of (Petrol/Diesel)
3. To find out the Iodine value of (Petrol/Diesel)
4. To find out the density of (Petrol/Diesel)
5. To find out kinematic viscosity of (Petrol/Diesel)
6. To find out Flash Point of (Petrol/Diesel)
7. To find out Pour Point of(Petrol/Diesel)

Title of the course : **Process Equipment Design**
Subject Code : **CH-333**
Weekly load : 1
Credit : 4 (Lecture 1; Tutorial 1; Practical 2)

LTP 1-1-4

Unit	Course outlines	Lecture
Unit 1	Introduction General awareness about equipment design, economical pipe diameter for liquid and gases, pumps.	03
	Thickness calculations Thickness calculations of low and high pressure vessels, pressure vessels under vacuum	05
Unit 2	Design Calculations Design calculations of heat exchangers, distillation columns, evaporators	08

Recommended Books:

Author	Title	Publisher
Bhattacharya	Chemical Equipment Design	CBS Publishers
Dryden	Outlines of Chemical Technology	East-West Press
Ludwig	Applied Process Design for Chemical and Petrochemical Plants (Vol. 1,2 and 3)	Gulf Publications
Joshi	Process Equipment Design	McMillar India Ltd.
Brownell and Young	Process Equipment Design	John Wiley Publications
Peter M.S. & Timmerhaus K.D.	Plant Design and Economics for Chemical Engineers	McGraw Hill

Title of the course : **Process Equipment Design Lab**
 Subject Code : **CH-333**

List of Experiments:

1. Process Design of Shell & Tube Heat Exchanger
2. Process Design of Double Pipe Heat Exchanger
3. Process Design of Distillation Column
4. Process Design of Evaporators
5. Process Design of pumps.

Title of the course : **Project**
 Subject Code : **CH-335**

Weekly load	: 0	LTP	0-0-4
Credit	: 2 (Practical 2)		

Students are expected to complete the project work based on topics on Chemical Engineering.