COURSE STRUCTURE

&

SYLLABUS
(3rd – 8th SEMESTER)

FOR B.TECH PROGRAMME
IN
CHEMICAL ENGINEERING

**BIJU PATNAIK UNIVERSITY OF TECHNOLOGY ORISSA,
ROURKELA**

2007 - 2008

COURSE STRUCTURE
SECOND YEAR B.TECH PROGRAMME
CHEMICAL ENGINEERING

3rd Semester				4th Semester			
Theory		Contact Hrs.	Credit	*Theory*		ContactHrs.	Credit
		L-T-P				**L-T-P**	
BSCM 2201	Mathematics - III	3-1-0	4	BSCM 2202	Mathematics - IV	3-1-0	4
BENG 1201	Electrical Machine	3-1-0	4	CPME 6203	Fluid Mechanics &		
	or				Hydraulic Machines	3-1-0	4
CPME 6203	Fluid Mechanics &				or		
	Hydraulic Machines			BENG 1201	Electrical Machines		
BSCC 2201	Chemistry - II	2-0-0	2	BSCC 2201	Chemistry - II	2-0-0	2
	or				or		
BSCC 2202	Material Sciences			BSCC 2202	Material Sciences		
BCSE 3201	Object Oriented	3-0-0	3	BCSE 3202	Relational Database	3-0-0	3
	Programming UsingC++				Management System		
HSSM 4201	Engineering	3-0-0	3	HSSM 4202	Organisational	3-0-0	3
	Economics & Costing				Behaviour		
	or				or		
HSSM 4202	Organisational			HSSM 4201	Engineering		
	Behaviour				Economics & Costing		
CPCH 7201	Mechanical Operations	3-1-0	4	CPCH 7202	Fluid Flow & Flow	3-1-0	4
					Measurement		
	Total		**20**		**Total**		**20**

3rd Semester				4th Semester			
Practicals/Sessionals		Contact Hrs.	Credit	*Practicals/Sessionals*		ContactHrs.	Credit
BENG 9202	Basic Electronics	0-0-3	2	BENG 9201	Basic Electrical	0-0-3	2
	Laboratory				Engineering Laboratory		
	or				or		
BENG 9201	Basic Electrical			BENG 9202	Basic Electronics		
	Engineering Laboratory				Laboratory		
BCSE 9201	OOPs Computer Lab	0-0-3	2	BCSE 9202	RDBMS Laboratory	0-0-3	2
BENG 9203	Mechanical	0-0-3	2	CPCH 9202	Fuel Technology	0-0-3	2
	Engineering Laboratory				Laboratory		
CPCH 9201	Mechanical Operations	0-0-3	2	CPCH 9203	Fluid Flow Laboratory	0-0-3	2
	Laboratory						
			8				**8**
	Total		**28**		**Total**		**28**

L-Lecture   **T-Tutorial**   **P-Practical**

3RD SEMESTER

BSCM 2201 MATHEMATICS - III (3-1-0)

Module - I (9 Lectures)

Partial differential equations : The vibrating string. The wave equation & its solution.

The Heat equation and its solution

Module - II (10 Lectures)

Two - dimensional wave equation and its solution.

Laplace equation in polar, cylindrical and spherical coordinates. Potential.

Module - III (13 Lectures)

Complex analysis : Complex numbers and functions conformal mappings

Complex integration. Cauchy's Theorem Cauchy's integral formulas.

Module - IV (8 Lectures)

Taylor's and Laurent's series, Residue theorem, evaluation of real integrals.

The Course covered by : Advance Mathematics by E. Kreyszig, John Wiley & Son's (P) Ltd. (8th Edition)
Chapter 11 (except 11.6)
Chapter 12, 13, 14, 15

BENG 1201 ELECTRICAL MACHINES (3-1-0)

Module I (10 Lectures)

D.C Mechanics :
D.C Generator – construction and principle of operation, E.M.F. equation ; types of generator; no load and load characteristics; Voltage build-up of shunt
Generator; voltage regulation, Application.
D.C Motor –construction and principle of operation ; back E.M.F; torque and speed equations; characteristics and performance curves; speed control of series and shunt motors; motor starters; industrial application.
Losses and Efficiency of D.C machines.

Module II (10 Lectures)

Transformer:
Single phase – construction and principle of operation; E.M.F. equation; Phasor diagram; actual and approximate equivalent circuits; open and short circuit tests, voltage regulation; losses and efficiency.
Three Phase – Construction and principle of operation; connection of three single –phase units in wye, delta, open delta configurations; Autotransformer; conventional transformer connected as Autotransformer. Special Transformers – induction heating and high impedance and high frequency transformer.

Module III (10 Lectures)

Synchronous Machines :
Three- phase alternators – construction and principle of operation; E.M.F. equation; distribution and pitch factors; Synchronous reactance; performance of alternators on no-load and load; Phasor diagram; voltage regulation, power calculations of turbine and hydro-generators,; synchronization of a generator.
Three-Phase Synchronous Motor- construction and principle operation; V- curves; Phasor diagram; methods of starting; applications.

Module IV (10 Lectures)

Three-Phase induction Motor- construction of slip ring and squirrel cage type induction motors; Phasor diagram and equivalent circuit; torque-slip characteristics; maximum torque calculations; open and short-circuit tests; losses and efficiency; starting of induction motors; speed control; Induction generator.
Single-Phase Induction Motor- construction and principle of operation; capacitor- start and capacitor-run motors; Universal motor; Stepper motors.

Books :

1.   Electrical Machines, Drives and Power Systems, 5th edition by Theodore Wildi (Pearson) : Text.
2.   Electrical Machinery by A.E. Fitzerald and Charles Kingsley, Jr., and S.D. Umans, Tata McGraw Hill Publication.
3.   Principles of Electric Machines by V.K Meheta and R. Meheta , S. Chand Publication.

CPME 6203 - FLUID MECHANICS AND HYDRAULIC MACHINE (3-1-0)

Module – I   (12 hours)
Introduction : Scope of fluid mechanics and its development as a science

Physical property of Fluid

Density, specific gravity, specific weight, specific volume, surface tension and capillarity, viscosity, compressibility and bulk modulus, Fluid classification.

Fluid static

Pressure, Pascal's Law, Pressure variation for incompressible fluid, atmospheric pressure, absolute pressure, gauge pressure and vacuum pressure, monometer.

Hydrostatic process on submerged surface, force on a horizontal submerged plane surface, force on a vertical submerged plane surface.

Module – II   (12 hours)

Buoyancy and flotation, Archimedes' principle, stability of immersed and floting bodies, determination of metacentric height.

Fluid kinematics : Introduction, description of fluid flow, classification of fluid flow. Acceleration of fluid particles, flow rate and continuity equation, differential equation of continuity.

Fluid dynamics : Introduction, Euler's equation along a streamline, energy equation, Bernoulli's equation, Analysis of finite control volumes and its application to siphon, venture meter, orifice meter

Module – III   (6 hours)

Turbine : Classification, reaction, Impulse, outward flow, inward flow and mixed flow turbines, Francis & Kaplan turbines, Pelton wheel, Physical description and principle of operation, Governing of Turbine.

Module – IV   (8 hours)

Centrifugal Pump : Principles of classification, Blade angles, Velocity triangle, efficiency, specific speed, characteristics curve.

Reciprocating Pump : Principles of working, slip, work done, effect of acceleration and frictional resistance, separation

Tex Books

1.   Fluid Mechanics, A.K. Mohanty, PHI
2.   Introduction to Fluid Mechanics and Fluid Machines, S.K. Som and G. Biswas, TMH
3.   Fluid Mechanics, Modi & Seth

BSCC 2201 CHEMISTRY - II (2-0-0)
(Total No. of Lectures = 40)

Module I (10 Lectures)

Water quality parameters and standards. Treatment of water for industrial and domestic purpose.

Hardness of Water : Types of hardness, Units of hardness, Determination of hardness(EDTA method). Disadvantages of hardwater in boiler, Water Softening Techniques (Lime soda, Ion exchange and zeolite). Boiler feed water, Water for Domestic purposes (Municipal / Drinking Water)

Module II (14 Lectures)

(To develop the basic concepts on corrosion and industrially important polymers.

1.   Corrosion:

Dry and wet corrosion, Galvanic Corrosion, Stress Corrosion, Factors affecting corrosion, Corrosion Control : (Proper design and fabrication procedure, Cathodic protection, Passivation).

(6 Lectures)

2.   Polymers:

Nomenclature and classification, Mechanism of polymerization (free radical and ionic) Thermoplastic and thermosetting resins, Some typical useful polymers: Polyethylene, PVC, polystyrene, PMMA, Nylon 6 : 6, Nylon 6, Bakelite, Terylene, Silicones, Natural and synthetic rubbers: Neoprene, Butyl and Polyuarethane rubber, Vulcanization.

(8 Lectures)

Module III (10 Lectures)

(To introduce the students about the basic concepts of fuels)

1.   Fuels:

Classification of fuels, calorific value, Analysis of Coal, Manufacturing process of metallurgical coke,   Refining of Crude oil, Fractional distillation, Cracking, Knocking and antiknocking, Octane and Cetane number.

Gaseous Fuel : Producer gas, Water gas, LPG & CNG.

Combustion Calculation.

Module IV (6 Lectures)

1.   Environment pollution :
Green house effect, acid rain, depletion of ozone layer; Water pollution- bio chemical effect of lead, arsenic, mercury and fluorides, sewage-B.O.D. and C.O.D.

Books :

1.   Engineering Chemistry by P. C. Jain and M. Jain.
2.   Engineering Chemistry by R. Gopalan, D. Venkapaya and S. Nagarajan - Vikas Publishing House.
3.   Environmental Pollution, A.K. Dey.

BSCC 2202 MATERIAL SCIENCES (2-0-0)

MODULE - I (8 Lectures)

1. Classification of Engineering Materials. Engineering properties of materials. Internal structure and properties.

2. Electron theory of solids : Free electron theory of metals. Electrical conductivity; Thermal conductivity, Quantum theory of free electrons. Band theory of solids, Conductivity of metals

3. Conductors, Insulators, Semiconductors, Intrinsic and extrinsic semiconductors, Band theory of semi conductors Hall effect.

MODULE - II (8 Lectures)

4. Super Conductors - Zero resistivity, Critical magnetic field and critical current density. Type I and II super conductors. Applications of Supercoductors.

5. Dielectric Materials : Microscopic Displacement of atoms and molecules in an external dc electric field, Polarization and dielectric constant, Dielectric susceptibiity. Temperature dependence, Dielectric Breakdown. Ferro electric material Piezoelectrics, Pyroelectrics, Dielectric Materials as electrical isulators.

6. Magentic Properties of Materials : Dia, Para and Ferro magenetic materials. Theory of magnetism, Ferro magnetic materials or Ferrites, Comparison of magnetic behaviour and magnetic parameters of Dia, Para and Ferro magnetic materials.

MODULE - III (7 Lectures)

7. Optical Properties of Materials : Scattering, Refraction, Theory of Refraction and absorption, Atomic Theory of optical properties. Lasers, Optical fibres - Principle, structure, application of optical fibre.

8. Organic Materials : Polymers - Mechanism of Polymerization : Addition, condensation and co-polymerisation, applications.
   Plastics - Types : Thermosetting and thermoplastics.

MODULE - IV (7 Lectures)

9. Composite Materials : Agglomerated Materials : Cermets, Reinforced Materials : Reinforced Concrete. Glass fibre reinforced plastics, Carbon fibre reinforced plastics. Whiskers, fibre reinforced plastics, Laminated plastic sheets. Tufnol, Properties of composites.

10. Ceramics : Types, Structure, Mechanical properties, applications

11. Performance of Materials in Service : Service performance, failure, design considerations, Corrosion - types, (Atmospheric, Pitting, Stress Corrosion), Control & prevention, protective coating, Performance of metals and Ceramics at high temperature.

Text Books :

1. Callister W.D., Materials Science and Engineering, John Wiley & Sons.
2. Vijaya M. S., Rangarajan G, Materials Science, TMH
3. Rajendra V., Marikani A., Materials Science, TMH
4. Van Vlack L. H., Elements of Material Science and Engineering, Addison Wesley

BCSE 3201 OBJECT ORIENTED PROGRAMMING USING C++ (3-0-0)

Module I (10 Hours)

Introduction to object oriented programming, user defined types, polymorphism, and encapsulation. Getting started with C++ -syntax, data-type, variables, strings, functions, exceptions and statements, namespaces and exceptions, operators. Flow control, functions, recursion. Arrays and pointers, structures.

Module II (10 Hours)

Abstraction mechanisms: Classes, private, public, constructors, member functions, static members, references etc. Class hierarchy, derived classes.

Inheritance: simple inheritance, polymorphism, object slicing, base initialization, virtual functions.

Module III (12 Hours)

Prototypes, linkages, operator overloading, ambiguity, friends, member operators, operator function, I/O operators etc.

Memory management: new, delete, object copying, copy constructors, assignment operator, this input/output.

Exception handing: Exceptions and derived classes, function exception declarations, Unexpected exceptions, Exceptions when handling exceptions, resource capture and release etc.

Module IV (8 Hours)

Templates and Standard Template library: template classes, declaration, template functions, namespaces, string, iterators, hashes, iostreams and other type.

Design using C++ design and development, design and programming, role of classes.

Text Books:

1.   Bhave & Patekar- Object oriented Programming with C++, Pearson Education

2.   Ashok N. Kamthane- Object oriented Programming with ANSI & Turbo C++, Pearson Education.

3.   Robert Lafore- Object oriented programming in Microsoft C++.

4.   Balguru Swamy-C++, TMH publication

HSSM 4201 ENGINEERING ECONOMICS AND COSTING(3-0-0)

Module I (10 Hours)

Present worth comparisons, Comparisons of assets with equal, unequal and infite lives, comparison of deferred investments, Future worth comparison, pay back period comparison.

Module II (10 Hours)

Benefit/ Cost analysis, quantification of project, cost and benefits, benefit/ cost applications, Cost – effectiveness analysis.

Module III (10 Hours)

Hours)

Text Book

1.   Horn green, C.T., Cost Accounting, Prentice Hall of India

2.   Riggs, J.L ., Dedworth, Bedworth, D.B, Randhawa, S.U. Engineering Economics, McGraw Hill International Edition, 1996 (Chapter 2,3,4,5,7,8,9,11,12)

HSSM 4202 ORGANIZATIONAL BEHAVIOUR (3-0-0)

Module I (8 Hours)

The Study of Organizational Behaviour : Learning objectives, Definition and Meaning, Why Study OB, An OB Model, New Challenges for OB Manager.

Learning – Nature of Learning, How Learning occurs, Learning and OB.

Case Analysis

Module II (10 Hours)

Foundations of Individual Behaviour : Personality – Meaning and Definition, Determinants of Personality, Personality Traits, Personality and OB.

Perception – Meaning and Definition, Perceptual Process, Importance of Perception in OB. Motivation – Nature and Importance, Hertzberg's Two Factor Theory, Maslow's Need Hierarchy Theory, Alderfer's ERG Theory, Evaluations.

Case Analysis

Module III (12 Hours)

Organizational Behaviour Process : Communication – Importance, Types, Gateways and Barriers to Communication, Communication as a tool for improving Interpersonal Effectiveness. Groups in Organizations - Nature, Types, Why do people join groups, Group Cohesiveness and Group Decision-making Managerial Implications, Effective Team Building. Leadership – Leadership & Management, Theories of Leadership – Trait theory, Leader Behaviour theory, Contingency Theory, Leadership and Follwership, How to be an effective Leader. Conflict – Nature of Conflict and Conflict Resolution.

An Introduction to Transactional Analysis (TA).

Case Analysis

Module IV (10 Hours)

Organization : Organizational Culture – Meaning and Definition, Culture and Organizational Effectiveness. Introduction to Human Resource Management – Selection, Orientation, Training and Development, Performance Appraisal, Incentives Organizational Change – Importance of Change, Planned Change and OB techniques. International Organizational Behaviour – Trends in International Business, Cultural Differences and Similarities, Individual and Interpersonal Behaviour in Global Perspective.

Case Analysis

TEXTBOOKS:

Keith Davis, Organizational Behaviour, McGraw – Hill.

K.Aswathappa, Organizational Behaviour, Himalaya Publishing House.

REFERENCE BOOKS:

Stephen P. Robbins, Organizational Behaviour, Prentice Hall of India.

Pradip N. Khandwalla, Organizational Behaviour, McGraw – Hill, New Delhi.

CPCH 7201 MECHANICAL OPERATION (3-1-0)

Objective : This course acquaints the students to the mechanical methods of sizing, separating and transporting of particles.

Module I

Particle size, Shape, Average size, Specific surface area, Storage of slides, Size reduction, Laws of erasing, Principle of size reduction equipment, Brake jaw crusher, Gyratory crusher, Crushing rolls, Toothed roll crusher, revolving mills, Ball mills, Attrition mill, Ultra fire girders, Fluid energy mill, Open circuit and closed circuit grinding.

Module II

Size separation, Screening, Screening equipments, Grizzly, Revolving Screens, Trammels, Capacity and effectiveness of screen, Magnetic separators, Electronic separators, Froth floating, Conveying, Different conveyors.

Module III

Filtration, Theory of Filtration, Equipment, Plate and frame filter press, Leaf filters, Cartridge filters, Filter aids, Rotary drum filter, Centrifugal filtration, Mixing and agitator, Power consumption of mixtures, Mixing equipment.

Module IV

Motion of particles through fluids, drag coefficient, Free and hindered setting, Setting velocities, Thickener, Cyclones, Classification, Sink and float method, Jigging, Tabling

Suggested Text books and References :

1. Mc Cabe. Kl and Smith J.C, Unit Operation of Chemical Engineering, Mc Graw Hill and Kogakusha.
2. Coulson J.H. and Richardson J.F, Chemical Engineering, Vol-2, Pergramon Press and ELBS.
3. Brown Etal., Unit Operation, Asia Publication Home.

PRACTICALS
BENG 9202 BASIC ELECTRONICS LAB. (0-0-3)

(At least 8 experiments including 1 - 7 and any one from 8 - 10)

1. Familiarity with electronics components and Devices

    Testing of a semiconductor Diode and a Transisitor. IC pins connection (Digital Multimeter should be used should be used in testing components and devices).
2. Study and use of Oscilloscope to view waveforms and measure its amplitude and frequency.
3. V - I Characterstic of a semiconductor diode. Determining DC and AC resistance.
4. Half wave and Full wave rectifiers without and with capacitor filter. Record of waveforms, Measurement of Average and rms values.
5. V - I Characterstics of anpn or pnp transistor. DC Biasing and measurement of dc voltages and currents.
6. Gain - frequency response of JFET common source R-C coupled amplifier/BJT CE RC coupled Amplifier.
7. Op amp in Inverting, non inverting, Integrating and Differentiating configuration, Record of wave forms.
8. Truth Tables of logic gates.
9. Study and experiment using MUX - DEMUX ICs / Shift Register IC.
10. Study on CMOS logic Inverter.

BENG 9201 BASIC ELECTRICAL ENGINEERING LAB. (0-0-3)

List of Experiment (Any 8 of the following)
1. Study and measurement the armature and field resistance of a DC machine.
2. Calibration of ammeter, voltmeter and wattmeter with the help of sub-standard instrument.
3. Verification of circuit theorems. Thevenin's and Superposition theorems (with DC source only).
4. Voltage-current characteristics of incandescent lamps and fusing time-current characteristics of fuse wire.
5. Measurement of current, voltages and power in R-L-C series circuit excited by Single Phase AC supply.
6. Connection and starting of a three phase induction motor using direct online (DOL). or star-delta starter.
7. Connection and measurement of power consumption of a fluorescent lamp.
8. Determination of open circuit characteristics (OCC) of DC machine.
9. Starting and speed control of a DC shunt motor.
10. Connection and testing of a single phase energy meter (unity power factor load only)
11. Study of fan motor

BCSE 9201 COMPUTER (OOP) WITH C++ LAB. (0-0-3)
(10 classes for 10 different programs)

1. Programs on concept of classes and objects.(1 class)
2. Programs using inheritance.(1 class)
3. Programs using polymorphism.(1 class)
4. Programs on use of operator overloading.(1 class)
5. Programs on use of memory management.(1 class)
6. Programs on exception handling and use of templates.(1 class)
7. Programs on File handling in C++.(1 class)

8.   Design problem on stock and accounting of a small organization, railway reservation, payroll preparation and optimization problem.(3 classes)

BENG 9203 MECHANICAL ENGINEERING LAB. (0-0-3)

Group A (Mechanics / Material Testing Lab.
1.   Determination of equilibrium of coplanar forces.
2.   Determination of Moment of Intertia of Flywheel
3.   Determination of tensile strength of materials by Universal Testing Machine.

Group B
4.   Determination of Metacentric Height and application to stability of floating bodies.
5.   Verification of Bernoulli's Theorem and its application to Venturimeter.
6.   Determination of Cd and Cd of Orifices.

Group C
7.   Calibration of Bourden Type Pressure gauj and measurement pressure using manometers.
8.   Study of Cut-Sections of 2 stroke and 4 stroke Diesel Engine.
9.   Study of Cut-Sections of 2 stroke and 4 stroke Petrol Engine.

CPCH 9201 MECHANICAL OPERATION LAB. (0-0-3)

1.   To find out the average size of particles in a sample (Volume - suface mean diameter).
2.   To determine the Grindability Index of coal by Hard Groove machine.
3.   To determine the time of grinding in a ball mill for producing a product with 80% passing a given screen.
4.   To separate a mixture of coal into two fractions using sink and float method.
5.   To separate a mixture of coal into two fractions using flotation technique.
6.   To determine the Optimum time of sieving for a given sample of material.
7.   To verify the Rittinger's and Kick's law using crushing rolls and to find out the Work Index of the coal.
8.   To find out the effectiveness of hand screening of a given screen.
9.   To determine the batch sedimentation data and to calculate the minimum thickner area under given conditions.
10.   To determine the specific cake resistance and filter medium resistance of a slurry in Plate - and - frame filter press.
11.   To verify the laws of size reduction using a vibrating mill.
12.   To find the effectiveness of a Trommel.
13.   To find the size analysis of a given fine sample using Beaker decantation method.
14.   To compare open circuit and closed circuit grinding by means of a ball mill.
15.   To concentrate a given material by means of Trabling.

BSCM 2202 MATHEMATICS - IV (3-1-0)

Module - I

Solution of equations by iteration, Newton's method, Secant method, Interpolation
Numerical integration and differntiation

Module - II

Gauss Siedel iteration method for solving a system of linear equations, Ruage Kutta Methods, Introductory Linear Programming, Introductory Programming

Module - III

Probability, Random variables, Probability distribution, mean & variance of distribution
Binomial, Poisson, hyper-geometric and normal distributions

Module - IV

Random sampling, estimation of parameters, confidence intervals, Testing of hypothesis, acceptance sampling, correlation and regression

Course covered by : Advance Mathematics by E. Kreyszig (8th Edition)
Chapter 17 (17.1 - 17.3, 17.5), Chapter 18 (18.4), Chapter 19 (19.1), Chapter 20, Chapter 21, Chapter 22

CPME 6203 FLUID MECHANICS AND MACHINES (3-1-0)

1. **Introduction :** Scope of fluid mechanics and its development as a science

2. Physical property of Fluid

    Density, specific gravity, specific weight, specific volume, surface tension and capillarity, viscosity, compressibility and bulk modulus, Fluid classification.

3. Fluid static

    Pressure, Pascal's Law, Pressure variation for incompressible fluid, atmospheric pressure, absolute pressure, gauge pressure and vacuum pressure, monometer.

4. Hydrostatic process on submerged surface, force on a horizontal submerged plane surface, force on a vertical submerged plane surface.

    Buoyancy and flotation, Archimedes' principle, stability of immersed and floting bodies, determination of metacentric height.

    Fluid kinematics : Introduction, description of fluid flow, classification of fluid flow. Acceleration of fluid particles, flow rate and continuity equation, differential equation of continuity.

    Fluid dynamics : Introduction, Euler's equation analog a streamline, energy equation, Bernoulli's equation, Analysis of finite control volumes and its application to siphon, venture, office

    Turbine : Classification, reaction, Impulse, outward flow, inward flow and mixed flow turbines, Francis & Kaplan turbines, Pelton wheel, Physical description and principle of operation, Governing of Turbine.

    Centrifugal Pump : Principles of classification, Blade angles, Velocity triangle, efficiency, specific speed, characteristics curve.

    Reciprocating Pump : Principles of working, slip, work done, effect of acceleration and frictional resistance, separation

Tex Books

1.   Fluid Mechanics, A.K. Mohanty, PHI
2.   Introduction to Fluid Mechanics and Fluid Machines, S.K. Som and G. Biswas, TMH
3.   Fluid Mechanics, Modi & Seth

BENG 1201 ELECTRICAL MACHINES (3-1-0)

Module I (10 Lectures)

D.C Mechanics :

D.C Generator – construction and principle of operation, E.M.F. equation ; types of generator; no load and load characteristics; Voltage build-up of shunt

Generator; voltage regulation, Application.

D.C Motor –construction and principle of operation ; back E.M.F; torque and speed equations; characteristics and performance curves; speed control of series and shunt motors; motor starters; industrial application.

Losses and Efficiency of D.C machines.

Module II (10 Lectures)

Transformer:

Single phase – construction and principle of operation; E.M.F. equation; Phasor diagram; actual and approximate equivalent circuits; open and short circuit tests, voltage regulation; losses and efficiency.

Three Phase – Construction and principle of operation; connection of three single –phase units in wye, delta, open delta configurations; Autotransformer; conventional transformer connected as Autotransformer. Special Transformers – induction heating and high impedance and high frequency transformer.

Module III (10 Lectures)

Synchronous Machines :

Three- phase alternators – construction and principle of operation; E.M.F. equation; distribution and pitch factors; Synchronous reactance; performance of alternators on no-load and load; Phasor diagram; voltage regulation, power calculations of turbine and hydro-generators,; synchronization of a generator.

Three-Phase Synchronous Motor- construction and principle operation; V- curves; Phasor diagram; methods of starting; applications.

Module IV (10 Lectures)

Three-Phase induction Motor- construction of slip ring and squirrel cage type induction motors; Phasor diagram and equivalent circuit; torque-slip characteristics; maximum torque calculations; open and short-circuit tests; losses and efficiency; starting of induction motors; speed control; Induction generator.

Single-Phase Induction Motor- construction and principle of operation; capacitor- start and capacitor-run motors; Universal motor; Stepper motors.

Books :

1.   Electrical Machines, Drives and Power Systems, 5th edition by Theodore Wildi (Pearson) : Text.

2.   Electrical Machinery by A.E. Fitzerald and Charles Kingsley, Jr., and S. D. Umans, Tata McGraw Hill Publication.

3.   Principles of Electric Machines by V.K Meheta and R. Meheta , S. Chand Publication.

BSCC 2201 CHEMISTRY - II (2-0-0)
(Total No. of Lectures = 40)

Module I (10 Lectures)

Water quality parameters and standards. Treatment of water for industrial and domestic purpose.

Hardness of Water : Types of hardness, Units of hardness, Determination of hardness(EDTA method).

Disadvantages of hardwater in boiler, Water Softening Techniques (Lime soda, Ion exchange and zeolite). Boiler feed water, Water for Domestic purposes (Municipal / Drinking Water)

Module II (14 Lectures)

(To develop the basic concepts on corrosion and industrially important polymers.

1.   Corrosion:

Dry and wet corrosion, Galvanic Corrosion, Stress Corrosion, Factors affecting corrosion, Corrosion Control : (Proper design and fabrication procedure, Cathodic protection, Passivation).

(6 Lectures)

2. Polymers:

Nomenclature and classification, Mechanism of polymerization (free radical and ionic) Thermoplastic and thermosetting resins, Some typical useful polymers: Polyethylene, PVC, polystyrene, PMMA, Nylon 6 : 6, Nylon 6, Bakelite, Terylene, Silicones, Natural and synthetic rubbers: Neoprene, Butyl and Polyuarethane rubber, Vulcanization.

(8 Lectures)

Module III (10 Lectures)

(To introduce the students about the basic concepts of fuels)

1. Fuels:

Classification of fuels, calorific value, Analysis of Coal, Manufacturing process of metallurgical coke,   Refining of Crude oil, Fractional distillation, Cracking, Knocking and antiknocking, Octane and Cetane number.

Gaseous Fuel : Producer gas, Water gas, LPG & CNG.

Combustion Calculation.

Module IV (6 Lectures)

1. Environment pollution :
    Green house effect, acid rain, depletion of ozone layer; Water pollution- bio chemical effect of lead, arsenic, mercury and fluorides, sewage-B.O.D. and C.O.D.

Books :

1. Engineering Chemistry by P. C. Jain and M. Jain.
2. Engineering Chemistry by R. Gopalan, D. Venkapaya and S. Nagarajan - Vikas Publishing House.
3. Environmental Pollution, A.K. Dey.

BSCC 2202 MATERIAL SCIENCES (2-0-0)

MODULE - I (8 Lectures)

1. Classification of Engineering Materials. Engineering properties of materials. Internal structure and properties.
2. Electron theory of solids : Free electron theory of metals. Electrical conductivity; Thermal conductivity, Quantum theory of free electrons. Band theory of solids, Conductivity of metals
3. Conductors, Insulators, Semiconductors, Intrinsic and extrinsic semiconductors, Band theory of semi conductors Hall effect.

MODULE - II (8 Lectures)

4. Super Conductors - Zero resistivity, Critical magnetic field and critical current density. Type I and II super conductors. Applications of Supercoductors.
5. Dielectric Materials : Microscopic Displacement of atoms and molecules in an external dc electric field, Polarization and dielectric constant, Dielectric susceptibiity. Temperature dependence, Dielectric Breakdown. Ferro electric material Piezoelectrics, Pyroelectrics, Dielectric Materials as electrical isulators.

6. Magentic Properties of Materials : Dia, Para and Ferro magenetic materials. Theory of magnetism, Ferro magnetic materials or Ferrites, Comparison of magnetic behaviour and magnetic parameters of Dia, Para and Ferro magnetic materials.

MODULE - III (7 Lectures)

7. Optical Properties of Materials : Scattering, Refraction, Theory of Refraction and absorption, Atomic Theory of optical properties. Lasers, Optical fibres - Principle, structure, application of optical fibre.

8. Organic Materials : Polymers - Mechanism of Polymerization : Addition, condensation and co-polymerisation, applications.

   Plastics - Types : Thermosetting and thermoplastics.

MODULE - IV (7 Lectures)

9. Composite Materials : Agglomerated Materials : Cermets, Reinforced Materials : Reinforced Concrete. Glass fibre reinforced plastics, Carbon fibre reinforced plastics. Whiskers, fibre reinforced plastics, Laminated plastic sheets. Tufnol, Properties of composites.

10. Ceramics : Types, Structure, Mechanical properties, applications

11. Performance of Materials in Service : Service performance, failure, design considerations, Corrosion - types, (Atmospheric, Pitting, Stress Corrosion), Control & prevention, protective coating, Performance of metals and Ceramics at high temperature.

Text Books :

1. Callister W.D., Materials Science and Engineering, John Wiley & Sons.
2. Vijaya M. S., Rangarajan G, Materials Science, TMH
3. Rajendra V., Marikani A., Materials Science, TMH
4. Van Vlack L. H., Elements of Material Science and Engineering, Addison Wesley

BCSE 3202 RELATIONAL DATABASE MANAGEMENT SYSTEMS (3-0-0)

Module I   (10 Hours)

Database System Architecture - Data Abstraction, Data Independence, Data Definitions and Data Manipulation Languages.
Data models - Entity Relationship(ER), Mapping ER Model to Relational Model, Network .Relational and Object Oriented Data Models, Integrity Constraints and Data Manipulation Operations.

Module II   (10 Hours)

Relation Query Languages, Relational Algebra, Tuple and Domain Relational Calculus, SQL and QBE.
Relational Database Design: Domain and Data dependency, Armstrong's Axioms, Normal Forms, Dependency Preservation, Lossless design, Comparison of Oracle & DB2

Module III   (8 Hours)

Query Processing and Optimization: Evaluation of Relational Algebra Expressions, Query Equivalence, Join strategies, Query Optimization Algorithms.

Module IV   (12 Hours)

Storage Strategies: Indices, B-Trees, Hashing, Transaction processing: Recovery and Concurrency Control, Locking and Timestamp based Schedulers, Multiversion and Optimistic Concurrency Control Schemes.
Advanced topics: Object-Oriented and Object Relational databases. Logical Databases, Web Databases, Distributed Databases, Data Warehouse and Data Mining.

Text Books:-

1. Elmaski & Navathe -Fundamentals of Database Systems, 4th Edition, Pearson Education
2. C.J.Date - An introduction to Database Systems, Pearson Education
3. Bipin Desai -An introduction to Database System, Galgotia Publication.

HSSM 4202 ORGANIZATIONAL BEHAVIOUR (3-0-0)

Module I (8 Hours)

The Study of Organizational Behaviour : Learning objectives, Definition and Meaning, Why Study OB, An OB Model, New Challenges for OB Manager.
Learning – Nature of Learning, How Learning occurs, Learning and OB.
Case Analysis

Module II (10 Hours)

Foundations of Individual Behaviour : Personality – Meaning and Definition, Determinants of Personality, Personality Traits, Personality and OB.
Perception – Meaning and Definition, Perceptual Process, Importance of Perception in OB. Motivation – Nature and Importance, Hertzberg's Two Factor Theory, Maslow's Need Hierarchy Theory, Alderfer's ERG Theory, Evaluations.
Case Analysis

Module III (12 Hours)

Organizational Behaviour Process : Communication – Importance, Types, Gateways and Barriers to Communication, Communication as a tool for improving Interpersonal Effectiveness. Groups in Organizations - Nature, Types, Why do people join groups, Group Cohesiveness and Group Decision-making Managerial Implications, Effective Team Building. Leadership – Leadership & Management, Theories of Leadership – Trait theory, Leader Behaviour theory, Contingency Theory, Leadership and Follwership, How to be an effective Leader. Conflict – Nature of Conflict and Conflict Resolution.
An Introduction to Transactional Analysis (TA).
Case Analysis

Module IV (10 Hours)

Organization : Organizational Culture – Meaning and Definition, Culture and Organizational Effectiveness. Introduction to Human Resource Management – Selection, Orientation, Training and Development, Performance Appraisal, Incentives Organizational Change – Importance of Change, Planned Change and OB techniques. International Organizational Behaviour – Trends in International Business, Cultural Differences and Similarities, Individual and Interpersonal Behaviour in Global Perspective.
Case Analysis
TEXTBOOKS:
Keith Davis, Organizational Behaviour, McGraw – Hill.
K.Aswathappa, Organizational Behaviour, Himalaya Publishing House.
REFERENCE BOOKS:
Stephen P. Robbins, Organizational Behaviour, Prentice Hall of India.
Pradip N. Khandwalla, Organizational Behaviour, McGraw – Hill, New Delhi.

HSSM 4201 ENGINEERING ECONOMICS AND COSTING(3-0-0)

Module I (10 Hours)

Present worth comparisons, Comparisons of assets with equal, unequal and infite lives, comparison of deferred investments, Future worth comparison, pay back period comparison.

Module II (10 Hours)
Projects : Benefit/ Cost analysis, quantification of project, cost and benefits, benefit/ cost applications, Cost –effectiveness analysis.

Module III (10 Hours)
(12 Hours)

Text Book

1.   Horn green, C.T., Cost Accounting, Prentice Hall of India
2.   Riggs, J.L ., Dedworth, Bedworth, D.B, Randhawa, S.U. Engineering Economics, McGraw Hill International Edition, 1996 (Chapter 2,3,4,5,7,8,9,11,12)

CPCH 7202 FLUID FLOW AND FLOW MEASUREMENT (3-1-0)

Objective : This course gives a thorough idea about the fluids, flowing in the Process Equipment.
Module I

Units and dimensional analysis, types of fluid, Hydrostatic pressure, Pressure distribution in a static fluid, Pressure measuring devices.
Introduction to fluids in motion, Concept of stream lines, Visconity, Type of fluids, Flow in boundary layers, Its formation and growth in tubes and on plates, Basic equations of fluid flow-continuity, Momentum and buinoulis equation.
Module II

Flow of in compressible fluids in pipes, relation between skin friction –wall shear, Laminar flow in pipes, Hagen-poiuille equation, Friction factor, Friction from charges in velocity or direction, Flow of compressible fluids, Basic equations, Flow through variable area conduits, Adiabatic and isothermal flow.
Module III

Flow past immersed bodies, Drag, Drag coefficient, Friction in flow through beds of solids, Motion of particles through fluids, Its mechanics, Terminal velocity, Fluidization, Mechanism of fluidization, Pressure drop in fluidization, Applications of fluidization.
Module IV

Transportation and metering of fluids, pumps, Fans, Blowers and compressor, Reciprocating, Rotary and Centrifugal types, Characteristics and calculation regarding power and efficiency, Flow measuring devises, Venturi, Orifice, Pitot tube, Rot meters, Nothis and weing.

Suggested text books and References :

1.   Mc Cabe. W.L & Smith, J.C: Unit Opertaion of Chemical Engineering
2.   Brown, etal : Unit Operation, Asian Publishing House
3.   Knudsen, J.G & Katz, D.L : Fluid Dynamics and Heat Transfer
4.   Jain, A.K : Fluid Mechanics : Khanna Publishers, New Delhi
5.   Kumar, K.L. : Engineering Fluid Mechanics, Euraria Publishing House, New Delhi

PRACTICAL

BENG 9201 BASIC ELECTRICAL ENGINEERING LAB. (0-0-3)

List of Experiment (Any 8 of the following)

1.   Study and measurement the armature and field resistance of a DC machine.
2.   Calibration of ammeter, voltmeter and wattmeter with the help of sub-standard instrument.
3.   Verification of circuit theorems. Thevenin's and Superposition theorems (with DC source only).
4.   Voltage-current characteristics of incandescent lamps and fusing time-current characteristics of fuse wire.
5.   Measurement of current, voltages and power in R-L-C series circuit excited by Single Phase AC supply.
6.   Connection and starting of a three phase induction motor using direct online (DOL). or star-delta starter.
7.   Connection and measurement of power consumption of a fluorescent lamp.
8.   Determination of open circuit characteristics (OCC) of DC machine.
9.   Starting and speed control of a DC shunt motor.
10.   Connection and testing of a single phase energy meter (unity power factor load only)
11.   Study of fan motor

BENG 9202 BASIC ELECTRONICS LAB. (0-0-3)

(At least 8 experiments including 1 - 7 and any one from 8 - 10)

1. Familiarity with electronics components and Devices

   Testing of a semiconductor Diode and a Transisitor. IC pins connection (Digital Multimeter should be used should be used in testing components and devices).

2. Study and use of Oscilloscope to view waveforms and measure its amplitude and frequency.

3. V - I Characterstic of a semiconductor diode. Determining DC and AC resistance.

4. Half wave and Full wave rectifiers without and with capacitor filter. Record of waveforms, Measurement of Average and rms values.

5. V - I Characterstics of anpn or pnp transistor. DC Biasing and measurement of dc voltages and currents.

6. Gain - frequency response of JFET common source R-C coupled amplifier/BJT CE RC coupled Amplifier.

7. Op amp in Inverting, non inverting, Integrating and Differentiating configuration, Record of wave forms.

8. Truth Tables of logic gates.

9. Study and experiment using MUX - DEMUX ICs / Shift Register IC.

10. Study on CMOS logic Inverter.

BCSE 9202 COMPUTER (RDBMS) LAB. (0-0-3)
(10 Classes for 10 Different Programs)

1. Use of SQL syntax : Insertion, Deletion, Join), Updation using SQL. (1 class)

2. Program segments in embedded SQL using C as host language to find average grade point of a student, etc.. (1 class)

3. Program for Log based data recovery technique. (1 class)

4. Program on data recovery using check point technique. (1 class)

5. Concurrency control problem using lock operations. (1 class)

6. Use of package (ORACLE) for programming approaches(2 classes)

7. Use of package (DB2) for programming approaches(2 classes)

8. Programs on JDBC/ODBC to print employee's / student's information of a particular department. (1 class)

CPCH 9203 FLUID FLOW LAB. (0-0-3)

1. Fluidised bed - To determine minimum fluidisation velocity and pressure drop.

2. Flow through pipes - To fid out the Pressure drop.

3. Centrifugal Pump - To draw the characterstics curves and find out the efficiency.

4. Reciprocating Pump - To draw the characterstics curves and find out the efficiency.

5. Venturi Meter - To find out the flow rate of fluid flowing inncide a pipe.

6. Orifice Meter - To find out the flow rate of fluid flowing inncide a pipe.

7. Reynold's Apparatus - To verify the flow whether it is laminar or turbulent.

8. Bernoulli's Apparatus - To verify the Bernoulli's Equation.

9.   Pitot tube - To find out the point velocity of Fluid.

10.   V - Notch - To Measure the flow rate of a fluid by using V - Notch.

11.   Packed Bed - To find out the pressure drop when a fluid is flowing through a packed bed.

COURSE STRUCTURE
THIRD YEAR B.TECH PROGRAMME
CHEMICAL ENGINEERING

5th Semester			6th Semester		
Theory	ContactHrs.	Credit	*Theory*	ContactHrs.	Credit
	L-T-P			**L-T-P**	
HSSM4301 Optimisation Engineering	3-0-0	3	HSSM4302 Production & Operation Mgmt.	3-0-3	3
CPCH7301 Industrial Stochiometry	3-1-0	4	CPCH7305 Process Dynamics & Control	3-1-0	4
CPCH7302 Process Equipment Design	3-1-0	4	CPCH7306 Chemical Reaction Engg	3-1-0	4
CPCH7303 Mass Transfer - I	3-0-0	3	CPCH7307 Mass Transfer - II	3-0-0	3
CPCH7304 Heat Transfer	3-0-0	3	**Elective II and III (any two)**	3-0-0	6
Elective I (any one)	3-0-0	3	PECH7304 Petroleum Refinery Engineering		
PECH7301 Chemical Engineering			PECH7305 Polymer Technology		
Thermodynamics			PECH7306 Paper & Pulp Technology		
PECH7302 Fertilizer Technology			PECH7307 Electrochemical Engineering		
PECH7303 Fuel Technology			**Total**		**20**
Total		**20**			
Practicals/Sessionals	Contact Hrs.	Credit	*Practicals/Sessionals*	Contact Hrs.	Credit
CPCH9301 Equipment Design - I	0-0-3	2	CPCH9304 Process Control Lab.	0-0-3	2
CPCH9302 Mass Transfer Lab.	0-0-3	2	CPCH9305 Chemical Reaction Engg. Lab.	0-0-3	2
CPCH9303 Heat Transfer Lab.	0-0-3	2	CPCH9306 Equipment Design - II	0-0-3	2
		6			**6**
Total		**26**	**Total**		**26**

L-Lecture   **T-Tutorial**   **P-Practical**

HSSM 4301 OPTIMIZATION IN ENGINEERING (3-0-0)

Course Objective : The course aims at acquainting the students to mathematical modeling of engineering design, operation and maintenance problems and their optimization algorithms.

Module – I (10 hours)

Formulation of engineering optimization problems : Decision variables, objective function and constraints. Example of typical design, operation and maintenance problems in engineering : Design of a water tank, design of a truss, design of a network (electrical, communication sewerage and water supply networks), product mix problem, transportation and assignment problems, shift scheduling of employees, design of reliable devices, design of reactors, shortest route problem, set covering problem, traveling salesman problems. Only physical problems and their mathematical models to be discussed.

Linear Programming Problem : Formulation, Graphical solution, Simplex method, Duality theory, Dual simplex method, Formulation and solution of engineering problems of planning and scheduling.

Module – II (10 hours)

Sensitivity Analysis, Transportation Problem, Assignment Problem, Network Models : Minimal Spanning Tree Problem, Maximal Flow Problem, Shortest Route Problem, Minimum Cost Flow Problem. Algorithms and applications to be covered.

Module – III (10 hours)

Integer Linear Programming Problem. Branch and Bound and Cutting Plane Methods. Zero-one Programming Problem, Knapsack Problem, Set covering Problem, Set Partitioning Problem, Traveling Salesman Problem. Deterministic Dynamic Programming Problems. Applications and algorithms to be discussed.

Module – IV (12 hours)

Queueing theory, Game theory, Simulation, Decission theory & Sequencing Problem

REFERENCES :

1.	H. A. Taha – Operations Research, Prentice Hall of India, 2004.

2.	D. T. Phillips, A Ravindran and J.J. Solaberg, Principles of Operation Research, John Wiley and Sons

3.	S. Kalavathi, Operations research, Vikash Publication.

4.	B.E Gillett, Introduction to operations research, TMH

CPCH 7301 INDUSTRIAL STOCHIOMETRY (3-1-0)

Module – I

Units and dimensions, the mole unit Convention in methods of analysis and measurement basis, Physical and Chemical properties of Compounds and mixtures, The Chemical equation and stoichiometry, Concept of limiting and excess reactants, calculations involving percentage excess, conversion degrees of completion, yield, etc.

Module – II

Ideal gas laws, vapor pressure, saturation and equilibrium, vapor and non-condensable gas at equilibrium, partial saturation and humidity-relative saturation, molal saturation and percentage saturation, concept of wet and dry bulb thermometry, Use of humidity charts.

Module – III

The material balances, program of analysis of material balance problems, problems of material balances involving condensation and vaporization, solving, material balance problems that do not contain simultaneous equations - drying, crystallization dissolution, Problems of material balance involving combustion of fuels.

Solving material balance problems involving simultaneous equations, Recycles, bypass and purge calculations solving material balance problems involving multiple sub systems.

Module – IV

Energy balance concepts and units. Heat capacity, calculations of Enthalpy changes without change of phase. Enthalpy change for phase transitions. The general energy balance. Reversible processes and mechanical energy balances, Energy balance with chemical reaction, standard heat of reaction at constant pressure and constant volume. Incomplete reactions, effect of temperature of heat of reaction. Adiabatic reaction temperature, Heat of solution and mixing.

Textbooks and References :

1. Houghen, O; Watson KIM and Ragatz, R.A. : Chemical Process Principles Part - I, John Wiley & Asia Publishing, 1970.
2. David M. Himmelbleau, Basic Principles and Calculation in Chemical Engineering, Practice Hall Inc.
3. Williams B. T. & Johnson R.c, Stochiometry for Chemical Engineers, Mc Graw Hill Book Company, Inc. Tokyo.
4. Lewis W. K., Radasch A. H. & Lewis H. C., Industrial Stochiometry, Mc-Graw Hill Book Company, Inc. Tokyo.

CPCH 7302 PROCESS EQUIPMENT DESIGN (3-1-0)

Module - I

Introduction to plant design and Costs, Process Deign Development, General design considerations, such as plant location, plant layout, pollution control etc. Materials and fabrication selection (Chapters 1, 2, 3 and 12 in Peters and Timmerhaus)

Module - II

Mechanical design of pressure vessels, Storage vessels, Distillation and fractionation equipment, Heat exchangers, Evaporators and high pressure vessels. (Chapter 6, 7, 11, and 12 in Joshi).

Material transfer, Handling and treatment equipment design and costs (Chapter 14 in Peters and Timmerhaus).

Module - III

Heat Transfer design and costs, optimum design of Chemical Equipment (Chapter 11 & 15 in Peters and Timmerhaus).

Module - IV

Mass Transfer and reaction equipment design and costs (Chapter 16 in Peters and Timmerhaus).

Textbooks and References :
1. Peters, M. S. & Timmerhaus, K. D., Plant Design and Economics for Chemical Engineers, 4th Edition, Mc Graw Hill Book Co.

2. Joshi M. V., Process Equipment Design, Macmillan India.
3. Backhurst J. R. & Harker J. H., Process Plant Design, Heinmann Educational Books.
4. Coulson J. M. & Richardson J. F., Chemical Engineering, Vol VI, Pergamon Press.

CPCH 7303 MASS TRANSFER - I (3-0-0)

Module - I
Introduction to Mass transfer operations, molecular diffusion in fluids, binary solutions, Fiek's law, equation of continuity, steady state equimolal counter current diffusion, Steffen's diffusion, diffusivity of gases and liquids, application of molecular diffusion, mass transfer coefficients in tubulent flow, theories of mass transfer, analogy between mass transfer coefficient in simple situations, diffusion in solids.

Inter phase mass transfer, material balances in steady state co-current and counter-current stage processes.

Module - II
Humidification Operations : Definition of fundamental terms, Psychometric charts, theory of adiabatic saturation and wet bulb temperature, Lewis relation, gas-liquid contact operations, water cooling with air, dehumidification of air water vapour mixture, cooling towers, evaporative cooling.

Equipments for gas-liquid operations, spragged vessels, mechanically agitated vessels for single phase liquids and gas liquids and gas liquid mixtures. Tray towers, sieve tray design for absorption and distillation, design of batch distillation columns, Venturi scrubbers, spray towers and spray chambers, design of packed towers for absorption and distillation, Tray tower versus packed towers.

Module - III
Absorption : Solubility of gases in liquids, two components system, multi component system, ideal and non - ideal solutions, choice of solvent for absorption, single component absorption material balance, counter current multistage operations, dilute gas mixtures, non - isothermal operation, tray efficiency, continuous contact equipment, HETP, HTU, NTU concepts for single component absorption with chemical reaction, multi component absorption, Horton and Franklla method.

Module - IV
Principle of VLE for binary systems, phase diagrams, relative volatility, ideal solutions, azeotropes, enthalpy concentration diagrams, flesh vaporization, partial condensation, differential distillation steam distillation, continuous distillation, Mc Cabe - Thielt method, Ponchon - Savarit method, Tray efficiencies, introduction to multi component distillation, azeotropic and extractive distillation.

Textbooks and References :
1. Treybal, R. B., Mass Transfer Operations (3rd Edition)., McGraw Hill, New York.
2. Mc Babe & Smith., Umt Operations in Chemical Engineering, Mc Graw Hall & Kogakusha.
3. B. D. Smith, Deisgn of Equilibrium Stage Process, Mc Graw Hill.
4. J. M. Coulson and J. F. Richardson, Chemical Engineering, Vol - II, ELBS Pergamon Press, 1970.

CPCH 7304 HEAT TRANSFER (3-0-0)

Module - I
Introduction : Modes of heat transfer, basic laws of heat transfer, analogy between heat flow and electrical flow.

Conduction : The Fourier heat conduction equation, Steady-state one dimensional heat conduction through plane wall, cylindrical wall, spherical wall and composite structures. Heat transfer from extended surfaces, Three dimensional hear conduction equation. Numerical problems on unsteady state heat conduction through a semi-infinite slab, cylindrical and sphere, critical insulation thickness.

Module - II
Convection : The convective heat transfer coefficient, introduction to thermal boundary layer, Dimensionless numbers in heat transfer and their significance. Dimensional analysis.

Forced Convection : Heat transfer by forced convection inside tubes and ducts in laminar, transition and turbulent flow. Analogy between heat and momentum transfer, Reynold's Pradtl and Colburn analogies. Heat transfer to liquid metals. Forced convection over exterior surfaces. Heat transfer for tubes in cross flow, Empirical relations in agitated vessels packed beds.

Natural Convection : Grashoff number, Natural convection from vertical and horizontal surfaces.

Module - III
Heat Transfer with phase change : Heat transfer from condensing vapours, film and drop-wise condensation. Derivation and practical use of Nusselt equation. Condensation of superheated vapours. Effect of non-condensable geases on ratio of condensation. Heat transfer to boiling liquids. Boiling of astursted liquids. Maximum heat flux and critical temperature, minimum flux and film boiling, sub cooled boiling.
Heat transfer by radiation : Thermal radiation, Black body radiation, Kirchhoff's law, emisisivilty, grey body laws of black body radiation, geometric factor, Radiation in enclosures with black surfaces and grey surfaces. Large parallel plates, concetric, cylinderical spheres.

Combined heat transfer by conduction, convection and radiatries.

Module - IV
Heat Exchanges : Types of heat exhangers, logman temperature difference. Energy balances, Overall heat transfer Coefficients Heat Exchanges effectiveness. Fouling factors, Design and description of heat transfer equipment. Heat exchanges, condensers, boilers and kinetics. Extended surface equipment.

Evaporation : Types of evaporators, capacity and economy of evaporators. Boiling point elevation and Duhring's rule Material and Energy evaporators, Methods of feeding, capacity and economy of multiple effect evaporators.

Textbooks and References :

1. Mc Cabe W. L. & Smith J. C. & Harriot P, Unit Operations of Chemical Engineering (5th Edition), Mc Graw Hill, New York.

2. Mc Adams, W. H., Heat Transmission.

3. Kaudsen, J. G. & Karz, D. L., Fluid Dynamics & Heat Transfer

4. Kem D. G., Process Heat Transmission

5. Chapman. A. J., Heat Trasnfer (4th Edition), Mac Millan Publishing Co., Newyork (1984).

6. Gupta, C. P. & Prakash, R., Engineering Heat Trasnfer (6th Edition) Nom Chand & Bros., Roorkee (1994).

PECH 7301 CHEMICAL ENGINEERING THERMODYNAMICS (3-0-0)

Module - I

The first law of thermodynamics and other basic concepts : Joule's experiment Formulation of the First law of thermodynamics, the thermodynamic state and state functions, Enthalpy, the steady state flow process. Equilibrium, Phase Rule, Reversible process, constant volume and constant pressure processes. Heat Capacity.

Volumetric properties of fluids : P Vs T behaviour of pure substances, Virial equation. The ideal Gas, Generalized correlations for gases and liquids.

Module - II

Heat effects : Sensible heat effects, Heat effects accompanying phase changes of pure substances. The standard heat of formation, reaction and combustions, effect of temperature on the heat of reaction.

Second law of thermodynamics. Entropy changes of an ideal gas, increase of entropy statement of the second law, entropy from the microscopic view point, third law of thermodynamics.

Module - III

Thermodynamic properties of fluids : Homogeneous and two phase systems, Generalized correlations of Thermodynamic properties for gases.

Thermodynamic of flow process : Flow in pipes, expansion and compression processes.

System of variable composition, Ideal behaviour, Non - ideal behaviour, phase equilibria at low to moderate pressures.

Solution thermodynamics, Thermodynamic properties and VLE from equations of state.

Module – IV

Chemical reaction equilibria : Reaction coordinate, application of equilibrium criteria to chemical reactions, Standard Gibba Energy change and equilibrium constant, effect of temperature, evaluation, relation to composition, calculation of equilibrium conversion for single reactions, the Phase Rule and Duhem's Theorem for reacting systems, Multi reaction equilibria.

Textbooks and References :
1. Van Ness & Smith, J. M., Introduction to Chemical Engineering Thermodynamics (4th Edition), Mc Graw Hill, New York.
2. Husang F. F., Engineering Thermodynamics (2nd Edition), Mac Millan Publishing Co., Newyork.
3. Nag, P. K., Engineering Thermodynamics (2nd Edition), TMH.
4. Gupta, C. P. & Prakashm, R., Engineering Thermodynamics, New Chand & Bros., Roorkee.
5. Woods, L. C., The Thermodynamics of Fluid Systems, Clarendon Press, Oxford, New York.

PECH 7302 FERTILIZER TECHNOLOGY (3-0-0)

Fertilizers : Chemical Fertilizers and Organic manures, Types of Chemical Fertilizers, Fertilizer applications and agronomically details.

Nitrogenous Fertilizers : Feedstock for production of Ammonia Gas, Associated Gas, Coke Oven Gas, Naphtha, Fuel Oil, Petroleum Heavy Stock, Coal, Lignite, Coke, Water. Methods of production, characteristics, specification and storage of Ammonium sulphate, ammonium sulphate nitra, urea, calcium ammonium nitrate and ammonium chloride.

Phosphatic Fertilizers : Raw materials - phosphate rock, sulphur, pyrites. Methods of production, characteristics, specification and storage of single super phosphate, triple super phosphate.

Potassic Fertilizers : Methods of production, characteristics, specification and storage of potassium chloride, potassium sulphate and potassium schoenite.

Complex and NPK Fertilizers : Methods of production, characteristics specification and storage of ammonium phosphate sulphate, di-ammonium phosphate, nitro phosphates, ureaammonium phosphate, mono ammonium phosphate and various grades of NPK fertilizers.

Other Fertilizers : Secondary nutrients, micronutrients, Fluid fertilizers, controlled release fertilizers.

Books Recommended :

1. Handbook of fertilizer technology, Fertilizer Association of India, New Delhi

2. Fertilizer Industry - An Introductory survey, M. G. Menon, Higginbothams (P) Ltd.

3. Fertilizer Manual, United Nations Industrial Development Organization, United Nations, New York.

PECH 7303 FUEL TECHNOLOGY (3-0-0)

Fuels : Solid Fuels : Coal - Origin, Chemical composition, calorific value, Classifications, Characteristics & distribution of Indian coals, Storage and spontaneous combustion of coal, Coal washing and blending, Pertrographic constituents of coal, Carbonization of coal, manufacture and properties of metallurgical coke, recovery of by-products.

Liquid Fuels : Origin and composition of crude oil, crude oil distillation and its products with special reference to gasoline, Kerosene and diesel oil, cracking and reforming, Coaltar distillation Products, Shale oil.

Gaseous Fuels : Natural gas, coal gas. Coke oven and blast furnace gas, Manufacture of Water gas and producer gas, Carburetted water gas.

Synthetic Fuels : Hydrogenation of coal, fisher - Tropscti synthesis, Introduction to nuclear fuels and nuclear reactors, Fuels, moderators and structural materials.

Combustion : Combustion of solids fuels, Pulverized coal. Calculation of volumes and weights of air necessary for combustion of fuels, gas analysis.

Books Recommended :

1. Fuels and Combustion - S. Sarkar

2. Elements of Fuel Technology - Himus

3. Solid, Liquid and gaseous fuel - Brame and King.

4. Elements of Fuels, Furnaces and Refractories, O. P. Gupta.

PRACTICALS

CPCH 9301 EQUIPMENT DESIGN - I LAB. (0-0-3)

1.   Design of Flanges as per ASME and ISI specifications.
2.   Design drawing of Pipe fillings like Elbows, Cross, Teet, Bend and Joints.
3.   Design of formed Heads and Nosels.
4.   Design of Supports like lug, Skirt and saddle support.
5.   Design of barring plate and achor bolts.
6.   Design of Expansion Joints.
7.   Design of Storage tanks.

CPCH 9302 MASS TRANSFER LAB. (0-0-3)

1.   Simple Distillation
2.   Steam Distillation

3. Packed bed Distillation
4. Surface Evaporation
5. Vapor Liquid Equilibrium
6. Diffusion of Organic Vapours
7. Bubble Cap Distillation Column
8. Force Draft Tray Dryer
9. Rotary dryer
10. Wetted Wall Column
11. Swanson walker Crystallizer
12. Soxhlet's Apparatus
13. Light weight Digital Balance

List of Experiments Conducted :

1. To verity Rayleigh's equation through simple distillation for binary mixture of water and ethanol.

2. To determine vaporization and thermal efficiencies in steam distillation of the given organic liquid i.e., nitrobenzene or aniline etc.

3. To study the height equivalent to a theoretical plate (HEPT) of packed column at total reflux for a binary system of ethanol and water using Fenske's equation.

4. To study the phenomenon of surface evaporation and determine the constants of Himus equation.

5. To determine the vapour –liquid equilibrium curve for carbon tetrachloride-tolune mixture.

6. To determine the diffusivity coefficient for carbon tetrachloride –air system.

7. Performance of lab scale bubble cap distillation column at different reflux ratios.

8. Drying of solids in a tray drier under forced draft condition.

9. A rotary dryer consists of a cylindrical shell, set with its axis at a right angle to the horizontal and mounted on rollers so that it can be rotated.

10. To determine that mass transfer coefficients for the given system using the experimental setup.

11. To study the performance of a Swenson walker Crystallizer and to determine the crystal yield and the efficiency of crystallizer.

12. To conduct extraction of oil from a sample of mustard cake.

CPCH 9303 HEAT TRANSFER LAB. (0-0-3)

1. Parallel flow and counter flow heat exchanger
2. Calandria Evaporator
3. Shell and Tube heat exchanger
4. Vertical and Horizontal condenser
5. Composite Wall
6. Bare and Fin tube heat exchanger
7. Film wise and Drop wise condensation apparatus
8. Pin Fin tutor
9. Jacketted Vessel
10. Thermal Conductivity of Liquid

List of Experiments Conducted :

1. To find overall heat transfer coefficient in counter flow hear exchanger.
2. To find overall heat transfer coefficient in parallel flow hear exchanger.
3. To study and operate single effect evaporator and to find its steam economy.

4. To calculate the overall heat transfer coefficient in vertical condenser.
5. To calculate the overall heat transfer coefficient in horizontal condenser.
6. To determine overall heat transfer coefficient experimentally of shell and tube heat exchanger.
7. To find thermal conductivity of composite walls.
8. To find overall heat transfer coefficient, fin effectiveness and fin efficiency for finned tube heat exchanger.
9. Determination of heat transfer coefficient for film wise and drop wise condensation.
10. To study forced convection heat transfer.
11. To study free convection heat transfer.
12. To determine the overall heat transfer coefficient of various degrees of agitation in a Jacketed Vessel.
13. To study heat transfer in a pin fin.
14. Determination of thermal conductivity of liquid.

HSSM 4302 PRODUCTION AND OPERATIONS MANAGEMENT (3-0-0)

Objective :   This course aims at acquainting all engineering graduates irrespective of their specializations the basic issues and tools of managing production and operation functions of an organization.

Module I

1.   Operation Function in an Organization, Manufacturing Vrs Service Operation, System view of Operations, Strategic Role of Operations, Operations Strategies for Competitive Advantages, Operations Quality and Productivity Focus, Meeting Global Challenges of Production and Operations Imperatives.

(3 hours)

2.   Designing Products, Services and Processes New Product Design : Product Life Cycle, Product Development Process, Product Quality and Reliability Design, Process Technology : Project , Jobshop, Batch, Assembly Line, Continuous Manufacturing, Process Technology Life Cycle, Process Technology Trends; FMS, CIM, CAD, CAM, GT, Design for Services, Services Process Technology, Services Automation. Value Engineering, Standardization, Make or buy Decision.

(4 hours)

3.   Job Design and Work Measurement, Method Study : Techniques of Analysis, recording, improvement and standardization. Work Measurement : Work Measurement Principles using Stopwatch Time Study, Predetermined Motion Time Standards and Work Sampling, Standard Time Estimation.

(4 hours)

Module II

4.   Location and Layout Planning : Factor Influencing Plant and Warehouse Locations, Impact of Location on cost and revenues. Facility Location Procedure and Models : Qualitative Models, Breakeven Analysis, Single Facility, Location Model, Multi-facility Location Model, Mini max Location, Total and Partial Covering Model.
Layout Planning : Layout Types : Process Layout, Product Layout, Fixed Position Layout Planning, Systematic Layout Planning, CRAFT.
Group Technology and Cell Formation, Rank Order Clustering Method for Machine – Component Assignment,. Line Balancing : Basic concepts, General Procedure, Rank Positional Weight Method.

(7 hours)

5.   Forecasting : Principles and Method, Moving Average, Double Moving Average, Exponential Smoothing, Double Exponential Smoothing, Winter's Method for Searonal Demand, Forecasting Error Analysis.

(4 hours)

Module III

6.   Manufacturing Planning and Control : The Framework and Components : Aggregate Planning, Master Production Scheduling, Rough-cut-Capacity Planning, Material Requirements Planning, Capacity Requirements Planning, Shop Order System and Purchase Order System. Transportation Method for Aggregate Production Planning, Material Requirement Planning, Scheduling and Dispatching Functions, Progress Monitoring and Control.

(4 hours)

7.   Sequencing and Scheduling : Single Machine Sequencing : Basics and Performance Evaluation Criteria, Methods for Minimizing Mean Flow Time, Parallel Machines : Minimization

of Makespan, Flowshop sequencing : 2 and 3 machine cases : Johnson's Rule and CDS heuristic. Jobshop Scheduling : Priority dispatching Rules.

8.   Inventory Control : Relevant Costs, Basic EOQ Model, Model with Quantity discount, Economic Batch Quantity, Periodic and Continuous Review Systems for Stochastic Systems, Safety Stock, Reorder Point and Order Quantity Calculations. ABC Analysis.

Module - IV

9.   Project Management : Project Management through PERT / CPM. Network Construction, CPM, Network Calculation, Crashing of Project Network, Project Scheduling with Limited Resources. Line of Balance.

(5 hours)

10.   Modern Trends in Manufacturing : Just in Time (JIT) System; Shop Floor Control By Kanbans, Total Quality Management, Total Productive Maintenance, ISO 9000, Quality Circle, Kaizen, Poke Yoke, Supply Chain Management

(6 hours)

Reference

1.   J. L. Riggs : Production Systems : planning Analysis and Control, John Wiley.

2.   E. E Adam and R. J. Ebert " Production and Operation Management", Prentice Hall of India, 2004.

3.   S.N. Chary, " Production and Operations Management", Tata McGraw Hill.

4.   R. Paneerselvam, "Production and Operation Management, Prentice Hall of India, 2005.

CPCH 7305 PROCESS DYNAMICS AND CONTROL (3-1-0)

Module - I

Response of first order systems, Physical examples of first order systems Response of first order systems in series, Response of Second order systems, Transportation lag. Control System, controllers and final control elements, Block diagram of a Chemical Reactor Control system, Closed loop trasnfer functions, Transient response of simple control systems.

Module - II

Stability, Root locus, Frequency response, Control system design by frequency response.

Module - III

Cascade control feed forward control, Ratio control, Dead time compensation, Internal model control, controller tuning and process identification, control valves, theoretical analysis of complex process.

Module - IV

Introduction to sampled data controllers, sampled data control of a first order process with transportation tag, Design of sampled data controllers, Digital computer simulation of control systems.

Textbooks and References :

1. Corghnowr, D. R., Process Systems Analysis and Control, Mc Graw Hill Book Co.
2. Chemical Process Control, George Stephenopoulos, Prentice Hall.
3. J. M. Douglas, Process Dynamics & Control, Prentice Hall.

CPCH 7306 CHEMICAL REACTION ENGINEERING (3-1-0)

Module - I

Barch Reactors : Introduction and overview of the subject, kinetics of homogeneous, reactions, non elementary reactions, Collision theory and Transition - state theory.

Module - II

Various methods of analysis of batch reactor data (including variable volume and variable pressure data). Iso thermal batch reactor design.

Module - III

Homogeneous Flow reactors : Design equations for plug flow reactor (PFR) and Continuous Stirred Tank Reactor (CSTR), data analysis in flow reactors, Design of PFR, CSTR, Cascads of CSTR's and combination of PFR and CSIR.

Module - IV

Multiple Reactions, Non-isothermal Design, non-ideal flow : Design for multiple reactions, parallen reactions, series reactions, energy balance equation for batch, PFR and CSTR under non-isothermal conditions, Equilibrium conversion under adiabatic conditions, Design of homogeneous reactors under adiabatic conditions.

Textbooks and References :

1. Iavenspiel O. Chemical Reaction Engineering, Wiley International.
2. Fogler H. S., Chemical Kinetics and Reactor Calculation.
3. Smith J. M., Chemical Engineering Kinetics, Mc Graw Hill.
4. Wales J. M., Kinetics for Chemical Engineering, Mc Graw Hill.

CPCH 7307 MASS TRANSFER - II (3-0-0)

Module - I
Liquid - liquid Operations : Extraction : Introduction, liquid - liquid equilibria, analytical and graphical solutions for single and multistage operations, continuous, counter current operation without and with reflex, fractional extraction, equipment for liquid contracting operations, single stage, multistage and continuous contacting equipments.

Module - II
Adsorption : Theory of adsorption, Industrial adsorbents, adsorption equilibria, frounditch equation, single and multistage operators, Unsteady state adsorption, equipment for single stage and continuous contact, Ion - Exchange.

Module - III
Drying : Equilibria, Drying rate curve, Batch and continuous drying. Time of drying and calculations, mechanisms of batch drying, equipment for batch and continuous drying operations.

Module - IV
Leaching : Operation of solid, steady and unsteady stats operation, equipment, analytical methods both theoretical and problematic approaches for single and multistage operations.
Crystallization : Equipment analytical methods, factors governing nucleation and crystal growth rates, controlled rate of crystals, Incorporation of principles into the design of the equipment, Less conventional operations : Dialysis, Thermal diffusion, Mass Diffusion.

Textbooks and References :

1. Treybal R. B., Mass Trasnfer Operation, Mc Graw Hill.
2. Mc Cabe & Smith., Unit Operation in Chemical Engineering, Mc Graw Hill & Kogakusha.
3. Perry : Chemical Engineering Hand Book.
4. Smith B. D., Design of Equilibrium Stage Process, Mc Graw Hill

PECH 7304 PETROLEUM REFINERY ENGINEERING (3-0-0)

Module - I

Origin and formation of petroleum, Reserves and deposits of the world. Indian petroleum Industry, composition of crudes. Crude pretreatment, dehydration and desalting, Pipe still heater, atmospheric and vacuum distillation of crude oil.

Module - II

Treatment of products, additives, blending of gasoline. Treatment of gasoline, kerosene, lubes and lubricating oils, waxes.

Module - III

Thermal and catalytic cracking, Hydro cracking and hydro treating.

Module - IV

Coking, Visbreaking, Alkylation, Isomerization, Asphalt and air blown asphalt.

Textbooks and References :

1. Nelson, Petroleum Refinery Engineering, Mc Graw Hill Book.
2. Rao, B. K. B., Modern Petroleum Refining Processes, Oxford and IBH.

PECH 7305 POLYMER TECHNOLOGY (3-0-0)

Natural and synthetic Polymers. Types of Polymerization, Resinous and Crystalline state, Plastic state.

Kinetics of Polymerization & Poly-condensation. Introduction to reactor design for Polymerization.

Functionality, Properties of Plastics and macromolecular structure, Polymer degradation.

Molecular weight of Polymers and its determination by viscosity, light scattering and osmotic pressure.

Monomers and their manufacture.

Manufacture and uses of important plastic compositions like phenol fomaldehyde, urea fomaldehyde, venyl resins, acrylic resins, Polystyrene and polyethylene.

Compounding of Plastics, Plastic auxiliaries.

Moulding and design of moulds, casting and limitations Plastizers.

Plastic materials and elastomers as materials of construction in chemical equipments.

Books Recommended :

1. Bill Mayer, Polymer Science
2. Sabolev D., A First course in Polymer Chemistry, Mir Publishers
3. Tager, A., Physical Chemistry of Polymers, Mir Publishers
4. Odian, G., Principles of Polymer Chemistry, Mc Graw Hill.

PECH 7306 PAPER AND PULP TECHNOLOGY (3-0-0)

Processing of Raw Materials : Processes including Kruft Pulping, sulphite process

Pulp Washing and drying : Waste liquid treatment, bleaching environmental aspects of pulp and paper production, Economic aspects involved, builders, other additives, types of papers and boards for technical and speciality uses, preservation paper testing, elementary methods.

References :

1. Pulp and Paper manufacture, Joint Textbook C

PECH 7307 ELECTROCHEMICAL ENGINEERING (3-0-0)

Module - I

Electrolysis : Conductance, Specific conductance, Equivalent conductance, Molar conductance. Absolute ionic velocities and ionic motilities, Equivalent conductance at infinite dilution, Kohirausch law of independent ionic motilities, Strong and Weak electrolytes, Transport Nos. determination of Transport Nos. by Moving boundary method.

Faraday's laws, Significance, Applicability, Limitations and deviations from Faraday's laws, Conductivity cell and Cell constant.

Module - II

Degree of dissociation - Ostwalde, Dilution law, Dissociation constant.

Inter ionic attraction, Ionic atmosphere, Debye - Huckel theory, Time of relaxation of ionic atmosphere of Asymmetry effect. Debye-Huckel-Onager equation and its validity, Deviation from Onager equation and conductance ratio.

Ionic equilibria - Acid Base equilibria, Ionization of waster., pH and Hydrogen, Ion concentration, Acid Base neutralization, Hydrolysis of salts, Buffer action.

Module - III

Reversible electrode potentials, Thermodynamics of electrode potential, Single Electrode potential, Nearest equation for Electrode potential, Nerast equation for Electrode potential, Gibba-Halmholtz equation, Arbitrary zero of potential, EMF series, Limitations of EMF series, Electrode potential and Equilibrium Constant, Displacement equilibrium, Fe-Cu, FeZn, Cu-Zn systems, Liquid junction potentials, concentration cells, Standard Hydrogen Electrode (SHE), Calomel Electrode, Glass Electrode, Copper-Copper Sulphate reference Electrode.

Irreversible electrode processing. Energy Barriers and Electrode Kinetic, Polarization, Types of Electro-chemical polarization, over potential, Tafel equation and its derivation, Metal Dissointion - Corrotion.

Hydrogen Evolution reaction. Hydrogen Discharge reactions. Decomposition potentials.

Module - IV

Electro Chemical Measurements : Conductometric Analysis, Potentiometric Analysis, Polargraphy, Electro Gravimetry, Coulometric Analysis.

Textbooks and References :

1. Glasston, S., An Introduction to Electrochemistry, Affiliated East West Press.
2. Potter, B. C., Electro Chemistry - Principles and Applications, Cleaver - Hume Press, London.
3. Glasston S : Physical Chemistry.
4. Prentice, G., Electro Chemical Engineering Principles, Prentice Hall

PRACTICALS
CPCH 9304 PROCESS CONTROL LAB. (0-0-3)

List of Equipment Available :

1. Flow Process Station
2. Response of Single Tank System
3. Response of Two Interacting Tanks Systems.
4. Response of Two Non-Interacting Tanks System
5. Level Control Demo System

6. Bubble Cap Distillation Column

7. Digital Photo Colorimeter.

List of Experiments Conducted :

1. To study the operation of flow process to draw the characteristic curve.

2. To find out the resistance of the outlet valve for its particular position and determination of time constant of the process.

3. To study the response of a single tank with step change in inlet flow and to find out time constant graphically.

4. To study the response of two interacting tanks with step change in inlet flow rate and to find out the time constant graphically.

5. To study the response of two non-interacting tanks with step change in inlet flow rate and to find out the time constant graphically.

6. To study the performance of a control system.

7. To study the performance of inferential control system.

8. To study the characteristic and working of photo colorimeter.

CPCH 9305 CHEMICAL REACTION ENGINEERING LAB. (0-0-3)

List of Equipment Available :

1. RTD in Tabular Reactor

2. Plug Flow Reactor

3. Combined Reactor

4. Continuous Stirred Tank Reactor

5. Isothermal Batch Reactor

6. Light Weight Digital Balance

List of Experiments Conducted :

1. To study the non-ideality of plug flow reactor and to plot the exit time distribution of the reactor and to obtain the f-curve.

2. To determine the rate constant of the specification of ethyl acetate with NaOH in PFR.

3. To evaluate the performance of a series of mixed reactors for the given system NaOH and $CH_3COOC_2H_5$)

4. To perform kinetic studies to establish rate constant using CSTR.

5. To determine the reaction rate constant for the given specification reaction of :
   i) $CH_3COOC_2H_5$
   ii) To study the effect of terms on 'K' and determine the activation energy.

6. To study the performance of an isothermal batch reactor.

CPCH 9306 EQUIPMENT DESIGN - II (0-0-3)

Detailed Process design of the following equipments

1. Heat Exchangers (Shell & Tube Types)

2. Concentric Tubes.

3. Design of Single effect evaporators.

4. Design of multiple effect evaporators.

5. For binary systems

6. Design of distillation column.

COURSE STRUCTURE
FOURTH YEAR B.TECH PROGRAMME
CHEMICAL ENGINEERING

7th Semester			8th Semester		
Theory	*ContactHrs.*	*Credit*	*Theory*	*ContactHrs.*	*Credit*
	L-T-P			**L-T-P**	
HSSM4403 Environmental Engg. & Mgmt.	3-0-0	3	HSSM4404. Marketing Management	3-0-0	3
CPCH7401 Process Instrumentation	3-1-0	4	CPCH7405. Organic Chemical Technology	3-1-0	4
CPCH7402 Inorganic Chemical Technology	3-1-0	4	CPCH7406 Transport Phenomena	3-1-0	4
Elective IV & V (any two)	3-0-0	6	**Elective VI & VII (any two)**	3-0-0	6
PECH7401 Separation Techniques			PECH7404. Chemical Plant Waste Management		
PECH7402 Mineral Process Engineering			PECH7405 Safety Engineering		
PECH7403 Entrepreneurship			PECH7406 Process Simulation & Optimization		
PEBT8413. Biotechnology			PECH7407. Bio Chemical Engineering		
Total		**17**	**Total**		**17**

Practicals/Sessionals	*Contact Hrs.*	*Credit*	*Practicals/Sessionals*	*ContactHrs.*	*Credit*
CPCH9401 Project		5	CPCH9403 Project		5
CPCH9402 Seminar		1	CPCH9404 Seminar		1
PECH7403 Entrepreneurship Project		2	CPCH9405 Entrepreneurship Project		2
			CPCH9406 Comp. Viva Voce		2
		8			**10**
			Total		**27**
Total		**25**			

L-Lecture   **T-Tutorial**   **P-Practical**

HSSM 4403 ENVIRONMENTAL ENGINEERING AND MANGEMENT (3-0-0)

Objective : This course introduces the students to the environmental consequences of Industries, development actions etc. and the methods of minimizing their impact through technology and legal systems.

Module – I

Ecological Concepts and Natural Resources : Ecological perspective and value of environment. Environmental auditing, Biotic components, Ecosystem Process : Energy, Food Chain, Water cycle, Air cycle etc., Environmental gradients, Tolerance levels of environment factor, EU, US and Indian Environmental Law, Global Perspective.

Chemistry and Microbiology in Environmental Engineering : Physical and chemical properties of water, Atmospheric chemistry, Soil chemistry, Microbiology, Chemical and biochemical reactions, Material balances and Reactor configurations.

Concept in Hydrology : Hydrological cycle, Water balance, Energy budget, Precipitation, Infiltration, evaporation and evapotranspiration, Rainfall-runoff relationships, Urban hydrology, Ground water, Ground water chemistry, Water contamination and pollution prevention.

Module – II   (9 hours)

Water Pollution : water quality standards and parameters, Assessment of water quality, Aquatic pollution, Freshwater pollution, Estuarine water quality, Marine pollution, Organic content parameters, DO and BOD demand in streams,

Transformation process in water bodies, Oxygen transfer by water bodies, Turbulent mixing, Water quality in lakes and preservers , Ground water quality.

Air Pollution : Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change – green house gases, non-criteria pollutants, emission standard form industrial sources, air pollution meteorology, Atmospheric dispersion.

Noise Pollution : Physical Properties of sound, Noise criteria, Noise Standards, Noise measurement, Noise control.

Module – III   (15 hours)

Water Treatment : Water quality standards, Water sources and their quality, Water treatment processes, Pre-treatment of water, Conventional process, Advanced water treatment process.

Waste Water Treatment : Water flow rate and characteristics, Design of waste water network, Waste water treatment process, pretreatment, primary and secondary treatment of waste water, Activated sludge treatment : Anaerobic digestion and its microbiology, Reactor configurations and methane production. Application of anaerobic digestion. Bio-solids regulations, Characteristics and processing of bio-solids, first and second stage processing of sludge. Sludge disposal,. Integrated sewage and sludge management.

Solid Waste Management

Source classification and composition of MSW : properties and separation, storage and transportation, MSW Management, Waste minimization of MSW, Reuse and recycling, Biological treatment, Thermal treatment, Landfill, Integrated waste management.

Hazardous Waste Management, Hazardous waste and their generation, Medical hazardous waste, Household waste, Transportation and treatment of hazardous waste : Incinerators, Inorganic waste treatment, Treatment systems for hazardous waste, handling of treatment plant residue.

Industrial Air Emission Control :

Characterization of air stream, Equipment selection, Equipment design, Special Methods : Flue gas desulphurization, NO_x removal, Fugitive emissions.

Module – IV (8 hours)

Waste Minimization : Concept, Life Cycle Assessment, Elements of waste minimization strategy, Benefits of waste minimization, Elements of waste minimization programme, Waste reduction techniques.

Environment impact Assessment, Origin and procedure of EIA, Project Screening for EIA, Scope studies, Preparation and review of EIS.

Reference :

1. G. Kiely – Environmental Engineering Irwin/ McGraw Hill International Edition, 1997
2. M. L. Davis and S. J. Masen, Principles of Environmental Engineering and Science, McGraw Hill International Edition, 2004

CPCH 7401 PROCESS INSTRUMENTATION (3-1-0)

Module - I

Qualities of measurement, Temperature measurement, Expansion of Thermometers, Thermoelectric Temperature measurement.

Module - II

Resistance thermometers, Radiation temperature measurement.

Module - III

Composition analysis, measurement of pressure and vacuum.

Module - IV

Measurement of head and level, flow metering.

Textbooks and References :

1. Bckman, D. P., Industrial   Instrumentation, Wiley Eastern Ltd.
2. C. S. Rangan, G. R. Sarma and V. S. V. Mani, Instrumentation, Devices and Systems, TMH.
3. J. P. Bentley, Principles of Measurement Systems, Longman

CPCH 7402 INORGANIC CHEMICAL TECHNOLOGY (3-1-0)

Basic Inorganic Chemical Industries : Study of the following chemical industries laying emphasis on manufacturing steps, process flow sheet, engineering equipments involved along with their materials of construction and process kinetics.

1. Heavy Chemicals : Caustic Soda and Chlorine, Hydrochloric acid, Soda ash, Sulphuric acid and Phosphoric acid.
2. Marine Chemicals : Magnesium and Bromine.
3. Electrothermic Chemicals : Calcium carbide, carbon disulphide.

Inorganic Fertilizers : Fixation of nitrogen, various sources of hydrogen for ammonia synthesis, catalysts used in nitrogenous fertilizer industry, manufacture of ammonia, nitric acid, urea, ammonium sulphate, ammonium nitrate and calcium ammonium nitrate. Raw materials for phosphatic fertilizers, manufacture of phosphatic fertilizers like single and triple superphosphates, M.A.P., D.A.P., U.A.P. and nitrophosphate complex fertilizers.

Waste management inorganic chemical and fertilizer industries : Introduction to major types of effluents like the particulates and gases (CO_2, NO_x and SO_2) and important control measures.

Recommended Books :

1. Chemical Process Industries - R. N. Shreve.
2. Outline of Chemical Technology - C. E. Dryden
3. Publications of the Fertilizer Association of India, New Delhi

PECH 7401 SEPARATION TECHNIQUES (3-0-0)

Module - I

Rate governed processes, definitions and terminologies, membrane separation processes, preparation and characteristics of membranes.

Module - II

Principles of Reverse osmosis, nano-filtration, ultra-filtration, micro-filtration, osmotic controlled filtration, gel layer controlled filteration.

Module - III

Detailed design and Modeling : Film theory, design of membrane / Process modules, basic principles and modeling of dialysis.

Module - IV

Electric field separation process : Zeta potential, electric double layer, basic modeling of electric field enhanced filtration, liquid membrane and its modeling.

Basic design of gas separation and pervaporation.

Mechanical Separation Principles : Filtration, centrifuging, elutriation, magnetic and electrostatic separation, screening.

References :

1. Unit Operations of Chemical Engineering, W.L. Mc Cabe, J. C. Smith and P. Harriot, Mc Graw Hill.
2. Separation Processes, C. J. King, Mc Graw Hill.
3. Rousseau (ed), Handbook of Separation Process Technology, Wiley.
4. P. A. Schweitzer (Ed), Handbook of Separation Techniques for Chemical Engineers, Mc Graw Hill.
5. Ullmanns, Encyclopedia of Industrial Chemistry, Vol 32, Wiley - VCH.

PECH 7402 MINERAL PROCESS ENGINEERING (3-0-0)

Module - I

Thermal method in processing of Ores, Roasting, sintering, Calcination, polletisation and broquetting.

Module - II

Chemical Processes in mineral processing, Fundamentals of Mass Transfer accompanied by chemical reaction, Dissolution of solids with chemical reaction, estimation of reaction rate constant.

Module - III

Electrochemical methods in processing of ores, Ion exchange.

Module - IV

Amalgamation and Cyanidation, other methods like biochemical chlorination in mineral dressing, membrane technology.

Recommended Books :

1. Gaudin, A. M. and Prior, B. J., Principles of Mineral Dressing.
2. Eaddha, G. S. and Degalessn, T. B., Transport Phenomena in Liquid Extraction, TMH.

PECH 7403 ENTREPRENEURSHIP (3-0-0)

Enterprise Launching / Resourcing :

1. Environmental Analysis : Entrepreneurial Processes and Enterprise Building, Environmental Scanning and Analysis, Institutions and their role Procedures for launching small scale industries, Incentives and finances available to SSI units and new entrepreneurs. How to identity and select good business opportunity.

2. Project formulation : Feasibility : Industry and firm level feasibility, Study of formats of applications of financial institutions. Determining project size, Investment magnitude and forms organisation estimation of cost, project scheduling, financial analysis plant layout.

Enterprise Management :

1. Basic Management Concepts : Functions of Management, planning, Organizing, Directing, Controlling, Coordinating, Introduction to compute and management information systems, Business communication.

2. Personnel Management : Work motivation, labour relations, Wage Administration, Incentives etc.

3. Production Management : Production Planning and Control routing, Scheduling Dispatching, Expediting and Evaluation, Production Scheduling Technique, Quality control - inspection, Standards specifications - ISI.

PEBT 8413 BIOTECHNOLOGY (3-0-0)

Module - I

Introduction and application of microbiology, Structure and functioning of bacterial cell, Classification and Identification criteria for bacteria. Nutritional requirements and nutritional types of bacteria.

Module - II

Isolation of micro organisms, pure culture techniques and cultural characteristics. Bacterial growth, measurements and reproduction.

Module - III

Fundamentals of microbiology ecology and ecosystems, microbial associations and interactions.

Module - IV

Types of bacteria in water, sanitary examination of water, water purification, average disposal and sewage purification.

Recommended Books :

1. Reid, P., Microbiology, TMH.
2. Atlas, R. M. & Bartha, R., Microbiology Ecology - Fundamentals and Applications.

PRACTICALS

PECH 7403 ENTREPRENEURSHIP PROJECT (0-0-3)

1. The project will be for 2 credits and 3 periods per week is to be devoted for the project.
2. The teacher has to give elementary idea about entrepreneurship through classroom teaching before a project report is prepared by the student.
3. The teacher will first cover the following topics through lecturer and exercises on motivation and games.
   - Entrepreneurship concept, EDP in India, Indian middle class value.
   - Entrepreneurial qualities, motivation perception, risk taking etc.
   - Market survey, Business opportunity guidance
   - Role of DIC, SFC, Bank etc.
   - Working capital assessment, Balance Sheet, Costing, Book keeping.

- Decision making, Leadership, Communication skill
- Preliminary Project Report, preparation for a specific product and submission of the report.

4. Evaluation
   (a) The teacher has to conduct tests/ motivational exercises to assess entrepreneurial capability of the student (20%)
   (b) The teacher has to test the knowledge of the student on the above topic through a written test. (20%)
   (c) The teacher has to evaluate the report submitted by the student (i.e. Project report within 50 pages) (60%).

Reference Books

1. Entrepreneurship of Small Industries, M. V. Deshpande, Deep and Deep Publication

2. Management of Small Scale Industry, Vasant Desai, Himalaya Pub. House

HSSM 4404 MARKETING MANAGEMENT (3- 0- 0)

Objective of the Course : The course aims at introducing the basic concepts of marketing to the undergraduate students in engineering. The learning shall help the students in better designing, manufacturing and selling product/ service packages keeping competitive market, customers and cost in view.

Module – I (9 hours)

Marketing Management : Concept, Process, Functions and relevance in the current context.

Marketing Environment : Socio-economic forces. Competition : national and global, Technology, Government Policy, Suppliers, Buyers, Consumer Resistance considerations. Environment scanning tools and techniques

Competition Analysis : Factors contributing to competition, Competition analysis tools, Competitive arena mapping, Segmentation matrix.

Market Planning : Exploring Opportunity, Product –market selection, Approaches to Market Planning, Market Planning Process.

Module II (10 hours)

Market Research and Information Systems : Research Process, The Internet and World Wide Web based Information collection and processing, Database, Data Warehouses and Data Mining, Global Market Research, Competitive Intelligence.

Consumer Behaviour : Importance of buyer and his/ her role in purchasing. Influence of buyer behaviour, Buyer behaviour study tools. Organizational buying behaviour.

Market Segmentation, Targeting and Positioning : Definition, Bases and Methods of segmenting consumer and Industrial markets. Target Market strategies: Domestic and global perspective. Market Positioning.

Market Demand Forecasting : Key Terms, Forecasting Tools : Short term tools : Moving average and Exponential smoothing methods, Long-term forecasting Tools : Time series analysis, Econometrics methods, Qualitative tools : Buying Intention Survey, Sales Force Opinion and Delphi Techniques.

Module – III (11 hours)

Product Planning : Product Life Cycle, Locating products in PLC, New Product Development Process, Branding Strategy, Positioning a Brand, Brand Equity, Packaging and Labeling, Product-mix and Product Line, Product-Mix strategies, Planned Obsolescence.

Pricing Decision : Objectives and Factors influencing pricing, Cost-Plus Pricing, Breakeven Analysis, Price Based on Marginal Analysis, Price Elasticity of Demand, Operating statement, Markups Analysis Ratios, Pricing Strategies : Market-Entry, Discounts and allowances, Geographic Pricing, Special Pricing.

Promotion Decisions : Marketing Communication and Promotion Process, Promotion Mix, Advertising : Media and Media selection process. Organising for advertising, sales promotion.

Module -IV (10 hours)

Channels of Distributions : Designing Distribution Channels, Wholesaling and Physical Distribution, Retailing. Supply Chain Management (Basic only). Personal selling, Direct Marketing, Managing Sales Force.

Trends in Marketing : Global Marketing, Customer Services, Customer Relationship Management, Rural Marketing and Service Marketing.

References :

1.	M. J. Etazel , B. J. Walker and W. J. Stanton, Marketing, Tata McGraw Hill, 13th Edition, 2004.

2.	R. Saxena, "Marketing Management" Tata McGraw Hill, second Edition, 2003.

CPCH 7405 ORGANIC CHEMICAL TECHNOLOGY (3-1-0)

Study of the following industries laying emphasis on process flow-sheet, material requirements, process conditions and materials of construction.

Extraction and refining of oil, fat splitting, hydrogenation of oil.

Soaps and synthetic detergents - Recovery of glycerin, Pulp, paper and rayon Industries.

Manufacture of sugar, starch and its derivatives, Industrial and absolute alcohol.

Manufacture of DDT, Benzene Hexachloride and Linden.

Plastics : Poly ethylene, Poly vinyl chloride, phenol formal dehyde and Poly vinyl Acetate.

Synthetic Fibres : Nylon 6 and Terelene.

Organic Waste treatment and Waster utilization.

Books Recommended :

1.	Outlines of Chemical Technology - C. E. Dryden, edited and revised by M. Gopala Rao and M. Sittig.

2.	A Textbook of Chemical Technology, S. D. Shukla and G. N. Pandey.

3.	Shreeve's Chemical Process Industries, George

4.	Industrial Chemistry - Faith, Keyes and Clark.

5.	Handbook of Industrial Chemistry - Riegel

CPCH 7406 TRANSPORT PHENOMENA (3-1-0)

Momentum Transport : Viscosity and the mechanism of momentum transport, Velocity distribution with more than one independent variable, velocity distributions in turbulent flow, Inter phase transport is isothermal systems.

Energy Transport : Thermal conductivity and mechanism of energy transport, Temperature distributions in solids and in laminar flow, the equations of charge for non - isothermal systems, temperature distribution with more than one independent variable, temperature distributions in turbulent flow, Inter phase transport in non-isothermal systems.

Mass Transport : Diffusivity and the mechanism of mass transport, concentration distributions in solids and in laminar flow, the equations of change for multi component systems concentration distributions in turbulent flow, inter phase transport in multi component systems.

Books Recommended :

1.	Bird, R. B., Stewart, W. B. & Light Foot, B. N., Transport Phenomena, John Wiley & Sons.

2.	C. G. Bounet & J. B. Myers : Momentum, Heat and Mass Transfer, Mc Graw Hill.

PECH 7404 CHEMICAL PLANT WASTE MANAGEMENT (3-0-0)

Module - I

Different Chemical Plants and respective waste materials.

Module - II

Equipments to treat the solid, liquid and gaseous effluents like electrostatic precipitators, incinerators, bag filters etc.

Module - III

Theoretical aspects of the treatment solid, liquid and gaseous wastes - Aeration, fluidization, adsorption, acrobic digestion etc.

Module - IV

Principles of the design of neutralizers, acrators, incinerators, adsorbers, spray ponds etc.

References :

1. Shrev Chemical Process Technology, G. T. Austin, Mc Graw Hill.
2. M. Narayan Rao and A. K. Dutta, Waste Water Treatment, Oxford and IBH Publishing Company, New Delhi.
3. Handbook of Waste Treatment.
4. Journals on Waste Treatment.

PECH 7405 SAFETY ENGINEERING (3-0-0)

General aspects of Industrial Disaster : Disaster due to fire explosion, toxicity and radiation.

Chemical hazards - Classification of chemical hazards : Chemical as causes of occupational diseases : dist, fumes, gases and vapours.

Hazard analysis and health management

Engineering control of chemical plant hazard : Plant layout ventilation and lighting.

Pressure vessels, storage, handling and transportation Electrical systems and instrumentation.

Fire prevention. Emergency planning, Personnel protective devices, Maintenance Procedure.

Emergency Safety and laboratory safety. Legal aspects of safety.

Management information system and its application in monitoring disaster safety and health.

Recommended Books :

1. Safety in chemical industry : R.V. Betrabet and T.P.S Rajan in CHENTECH I, Chemical Engineering Education Development Centre, Chennai.
2. Safety and Accident Prevention on Chemical Operations, H. H. Aawactt and W. S. Wood, Interscience.
3. Walls, G. L., Safety in Process Plant Design, George Godwin Ltd., London.
4. Less, Frank P., Loss Prevention in the Process Industries, Butter worths
5. Kolb, J. and Roy Sterm S., Product Safety and Liability, Mc Graw Hill.

PECH 7406 PROCESS SIMULATION AND OPTIMIZATION (3-0-0)

Modeling :

Fundamentals : Uses of mathematical models, principles of formulation

Fundamental Laws : Continuity equation, energy equation, equation of motion, transport equations, equations of state, equilibrium, chemical kinetics.

Lumped and distributed parameter models.

Applications : Hydraulic tank, mixing vessel, simultaneous mass and energy balances *steam jacketed vessel, multiple feeds to jacketed vessel), boiling, C. S. T. R. (Single, series, isothermal, constant hold up, variable hold up, gas phase pressurized, non-isothermal), single component vapourizer, multi component flash drum, batch reactor, reactor with mass transfer, ideal binary distillation column.

Optimization : One variable optimization (analytical, dischotomous search, Fibonacci, golden section, regula falsi). Two or mote variables (analytical, geometric programming and linear programming). Newton's method, direct substitution, Wegstein method.

Simulation : Continuous and dynamic simulations (packages and languages). Techniques of digital simulation : developing a description of information flow, from process to information flow diagram, from information flow diagram to numerical form, planning the calculations - finding ercylcles, calculations of a recylce set. Idea of Computer aided design.

Digital simulation of C.S.T.R's in series, non-isothermal CSTR, binary distillation column, batch reactor.

Recommended Books :
1. Chemical Process Simulation : Asghar Hussain, Wiley Eastern Limited.
2. Chemical Plant Simulation : C. M. Crowe ebal, Prentice Hall Inc.
3. Process Modelling, Simulation & Control for Chemical Engineers, W. L. Luyben, Mc Graw Hill, Kogakhusa Ltd., New Delhi.
4. Modelling and Simulation in Chemical Engineering, Roger, G.E. Franks, Wiley Inter Science, New York.

PECH 7407 BIOCHEMICAL ENGINEERING (3-0-0)

Module - I
Introduction to Microbial growth, Enzyme catalyzed reactions.

Module - II
Introduction to Batch reactor, continuous bio-reactors.

Module - III
Sterilization of air and media, Acration and agitation in bioreactors. Management of culture ponds with reference to inland fish and prawn.

Module - IV
Production of penicillia, Insulin, Glucose, Bakers Yeast. Production of biogas and Ethanol.

Recommended Books :
1. Balley, J. B. & Oillis, P. R., Bio-Chemical Engineering Fundamentals.
2. Hurmphrey, B. A. & Mills, N. F., Bio-Chemical Engineering, Academic Press.
3. S. Aiba, A. E. Huntiery, Bio-Chemical Engineering, Academic Press.

PRACTICALS

PECH 7403 ENTREPRENEURSHIP PROJECT (0-0-3)

1. The project will be for 2 credits and 3 periods per week is to be devoted for the project.
2. The teacher has to give elementary idea about entrepreneurship through classroom teaching before a project report is prepared by the student.
3. The teacher will first cover the following topics through lecturer and exercises on motivation and games.
   - Entrepreneurship concept, EDP in India, Indian middle class value.
   - Entrepreneurial qualities, motivation perception, risk taking etc.
   - Market survey, Business opportunity guidance
   - Role of DIC, SFC, Bank etc.
   - Working capital assessment, Balance Sheet, Costing, Book keeping.
   - Decision making, Leadership, Communication skill
   - Preliminary Project Report, preparation for a specific product and submission of the report.
4. Evaluation

(a) The teacher has to conduct tests/ motivational exercises to assess entrepreneurial capability of the student (20%)

(b) The teacher has to test the knowledge of the student on the above topic through a written test. (20%)

(c) The teacher has to evaluate the report submitted by the student (i.e. Project report within 50 pages) (60%).

Reference Books

1. Entrepreneurship of Small Industries, M. V. Deshpande, Deep and Deep Publication
2. Management of Small Scale Industry, Vasant Desai, Himalaya Pub. House