

BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA

Chemical Engineering.

3rd Semester					4th Semester				
Theory Code	Subject	Contact Hours		Credit	Theory Code	Subject	Contact Hours		Credit
		L	T-P				L	T-P	
BSCM1205	Mathematics - III	3	0-0	4	BSCM1210	Mathematics - IV	3	0-0	4
BSCC1208	Chemistry – II	3	0-0	3	BSMS1209	Material Science	3	0-0	3
	OR					OR			
BSMS1209	Material Science				BSCC1208	Chemistry – II			
BECS2212	C++ & Object Oriented Programming	3	0-0	3	BECS2208	Database ManagementSystem	3	0-0	3
HSSM3204	Engg. Economics & Costing	3	0-0	3	HSSM3205	Organisational Behavior	3	0-0	3
	OR					OR			
HSSM3205	Organisational Behavior				HSSM3204	Engg. Economics & Costing			
PCCH4201	Fluid Flow & Flow measurement	3	0-0	3	PCCH4203	Chemical Process & Calculation	3	1-0	4
PCCH4202	Chemical Process Technology	3	0-0	3	PCCH4204	Mechanical Operation	3	1-0	4
Theory Credits				19	Theory Credits				21
Practical/ Sessional					Practical/ Sessional				
HSSM7203	COMMUNICATION AND INTERPERSONAL SKILLS FOR CORPORATE READINESS	0	0-3	2	BECS7208	Database Management System Lab	0	0-3	2
BECS7207	C++ & Object Oriented Programming Lab	0	0-3	2	PCCH7205	Fuel Technology Lab.	0	0-3	2
PCCH7201	Fluid Flow Lab	0	0-3	2	PCCH7204	Mechanical Operation Lab	0	0-3	2
PCCH7202	Chemical Technology	0	0-3	2	Practical/ Sessional Credits				6
Practical/ Sessional Credits				8	Practical/ Sessional Credits				6
TOTAL SEMESTER CREDITS				27	TOTAL SEMESTER CREDITS				27

BSCM1205 **Mathematics - III**

Module-I

(18 hours)

Partial differential equation of first order, Linear partial differential equation, Non-linear partial differential equation, Homogenous and non-homogeneous partial differential equation with constant co-efficient, Cauchy type, Monge's method, Second order partial differential equation
The vibrating string, the wave equation and its solution, the heat equation and its solution, Two dimensional wave equation and its solution, Laplace equation in polar, cylindrical and spherical coordinates, potential.

Module-II

(12 hours)

Complex Analysis:

Analytic function, Cauchy-Riemann equations, Laplace equation, Conformal mapping,
Complex integration: Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytic functions

Module –III

(10 hours)

Power Series, Taylor's series, Laurent's series, Singularities and zeros, Residue integration method, evaluation of real integrals.

Text books:

1. E. Kreyszig," Advanced Engineering Mathematics:, Eighth Edition, Wiley India Reading Chapters: 11,12(except 12.10),13,14,15
2. B.V. Ramana, " Higher Engineering Mathematics", McGraw Hill Education, 2008
Reading chapter: 18

Reference books:

1. E.B. Saff, A.D.Snider, " Fundamental of Complex Analysis", Third Edition, Pearson Education, New Delhi
2. P. V. O'Neil, "Advanced Engineering Mathematics", CENGAGE Learning, New Delhi

BSCC1208 Chemistry - II

Module I

1. Water Technology: Hardness of Water : Types of hardness, Units of hardness and their interrelation, Determination of hardness(EDTA method only). Disadvantage of hard water . Water softening technology (internal and external (limesoda,zeolite,and ion exchange methods) Desalination(electrodialysis, reverse osmosis, Sterilization of water by bleaching power, chlorine, ozone, chloramine. Determination of B.O.D and C.O.D of water sample.

2. Corrosion: Theories of corrosion , Types of corrosion , Factors affecting corrosion, Corrosion Control: (Proper design and fabrication procedure, Cathodic protection, Passivation).

MODULE-II

1. Fuels: Classification of fuels, calorific value, (Determination by Dulong's formula),G.C.V&N.C.V

Liquid fuel: Classification of petroleum, Refining of petroleum , Cracking, Knocking and anti knocking,cetane and octane numbers . Unleaded petrol, synthetic petrol, power alcohol

Gaseous Fuel : Producer gas, Water gas, LPG , CNG, Kerosene gas

Combustion Calculation.

2. Battery technology

Introduction, Batteries and cells, Basic components of battery, its Classification characteristics,Chemical batteries(dry, Lead acid & gel batteries) Alkaline batteries(zinc-air,aluminium-air,Nickel metal hydride battery) Reserve batteries(magnesium-copper,Gordan-magnesium battery) Nickel cadmium battery

Module III

1. POLYMER . Polymer: Types, polymerization process and mechanisms

Conducting polymers(poly aniline, poly acetylene),polymer composite(carbon fiber)

Preparation. Properties and uses of following polymer(polyethylene,PMMA,PTFE

Bakelite,polyurethanes,polycarbonate)

2 Nano materials

Nano material; Carbon nano tube,(synthesis, properties and application.) Application of nano material in medicine, fuel cell, catalysis (only general idea)

Text Books:

1. Engineering chemistry by Putti R.vljayasrarhy ,PHI Ltd
2. Engineering chemistry by P.C jain and M. jain

Reference Books:

1. Engineering chemistry by N Krishnamurthy ,p vallinaygam,Dmadhavan, PHI Ltd
2. Engineering chemistry by mary,jane.shultz ,Cengage learning publication
3. Engineering chemistry by R.Gopalan,D.venkaapaya,and SNagarajan, Vikas publishing house.

BSMS 1209 **Material Sciences**

MODULE – I

1. Classification of Engineering Materials. Engineering properties of materials. Selection of Materials.
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.
4. Super Conductors – Zero resistivity, Critical magnetic field and critical current density. Type I and II super conductors. Applications of Superconductors.

MODULE – II

5. Dielectric Materials : Microscopic Displacement of atoms and molecules in an external dc electric field, Polarization and dielectric constant, Dielectric _nitially_lity. 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.
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.

MODULE – III

8. Plastics – Types : Thermosetting and thermoplastics. Transfer moulding, injection moulding, extension moulding, Blow moulding, Welding of plastics; Rubber types, application.
9. Ceramics : Types, Structure, Mechanical properties, applications
10. Composite Materials : Agglomerated Materials : Cermets, Reinforced Materials : Reinforced Concrete. Glass fibre reinforced plastics, Carbon fiber reinforced plastics. Whiskers, fiber reinforced plastics, Laminated plastic sheets. Tufnol, Properties of composites. Metal matrix composites, manufacturing procedure for fibre reinforced composites.
11. Environmental Degradation: Oxidation-Direct atmospheric attack, Aqueous corrosion-Electro chemical attack, Glavanic two –metal corrosion, corrosion by Gaseous reduction, Effect of mechanical stress on corrosion, method of corrosion prevention

Text book:

1. Vijaya M. S., Rangarajan G, Materials Science, TMH
2. Introduction to Materials science for engineers by James.F.shackelford, Madanapalli.k.Muralidhara , Pearson (sixth edition)

Reference Book:

1. Rajendra V., Marikani A., Materials Science, TMH
2. Van Vlack L. H., Elements of Material Science and Engineering, Addison Wesley
3. Raghavan , Material Science
4. Callister W.D., Materials Science and Engineering, John Wiley & Sons.
5. Smith, Materials Science & Engineering. Mc. Graw Hill.
6. Processes and Material of manufacture : Lindberg, PHI.

BECS2212 C++ & Object Oriented Programming

Module I

(08 hrs)

Introduction to object oriented programming, user defined types, structures, unions, polymorphism, encapsulation. Getting started with C++ syntax, data-type, variables, strings, functions, default values in functions, recursion, namespaces, operators, flow control, arrays and pointers.

Module II

(16 hrs)

Abstraction mechanism: Classes, private, public, constructors, destructors, member data, member functions, inline function, friend functions, static members, and references.

Inheritance: Class hierarchy, derived classes, single inheritance, multiple, multilevel, hybrid inheritance, role of virtual base class, constructor and destructor execution, base initialization using derived class constructors.

Polymorphism: Binding, Static binding, Dynamic binding, Static polymorphism: Function Overloading, Ambiguity in function overloading, Dynamic polymorphism: Base class pointer, object slicing, late binding, method overriding with virtual functions, pure virtual functions, abstract classes.

Operator Overloading: This pointer, applications of this pointer, Operator function, member and non member operator function, operator overloading, I/O operators.

Exception handling: Try, throw, and catch, exceptions and derived classes, function exception declaration.

Module III

(08 hrs)

Dynamic memory management, new and delete operators, object copying, copy constructor, assignment operator, virtual destructor.

Template: template classes, template functions.

Namespaces: user defined namespaces, namespaces provided by library.

Text Books:

1. Object Oriented Programming with C++ - E. Balagurusamy, McGraw-Hill Education (India)
2. ANSI and Turbo C++ - Ashoke N. Kamthane, Pearson Education

Reference Books:

1. Big C++ - Wiley India
2. C++: The Complete Reference- Schildt, McGraw-Hill Education (India)
3. "C++ and Object Oriented Programming" – Jana, PHI Learning.
4. "Object Oriented Programming with C++" - Rajiv Sahay, Oxford
5. Mastering C++ - Venugopal, McGraw-Hill Education (India)
6. "Object Oriented Programming with C++", David Parsons, Cengage Learning.

HSSM3204 **Engineering Economics & Costing**

Module-I: (12 hours)

Engineering Economics – Nature and scope, General concepts on micro & macro economics. The Theory of demand, Demand function, Law of demand and its exceptions, Elasticity of demand, Law of supply and elasticity of supply. Determination of equilibrium price under perfect competition (Simple numerical problems to be solved). Theory of production, Law of variable proportion, Law of returns to scale.

Module-II: (12 hours)

Time value of money – Simple and compound interest, Cash flow diagram, Principle of economic equivalence. Evaluation of engineering projects – Present worth method, Future worth method, Annual worth method, internal rate of return method, Cost-benefit analysis in public projects. Depreciation policy, Depreciation of capital assets, Causes of depreciation, Straight line method and declining balance method.

Module-III: (12 hours)

Cost concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into fixed and variable costs. Break-even analysis-Linear approach. (Simple numerical problems to be solved)

Banking: Meaning and functions of commercial banks; functions of Reserve Bank of India. Overview of Indian Financial system.

Text Books:

1. Riggs, Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education India.
2. M.D. Mithani, Principles of Economics.

Reference Books :

1. Sasmita Mishra, "Engineering Economics & Costing ", PHI
2. Sullivan and Wicks, " Engineering Economy", Pearson
3. R.Paneer Seelvan, " Engineering Economics", PHI
4. Gupta, " Managerial Economics", TMH
5. Lal and Srivastav, " Cost Accounting", TMH

HSSM 3205 **Organizational Behaviour**

Module I :

The study of Organizational Behaviour : Definition and Meaning, Why Study OB

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

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, Herzberg's Two Factor Theory, Maslow's Need Hierarchy Theory, Alderfer's ERG Theory, Evaluations.

Module II :

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 Followership, How to be an effective Leader, Conflict-Nature of Conflict and Conflict Resolution. An Introduction to Transactional Analysis (TA).

Module-III :

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 Organisational Behaviour – Trends in International Business, Cultural Differences and Similarities, Individual and Interpersonal Behaviour in Global Perspective.

Text Books :

1. Keith Davis, Organisational Behaviour, McGraw-Hill.
2. K.Asawathappa, Organisational Behaviour, Himalaya Publishing House.

Reference Books :

1. Stephen P. Robbins, Organisational Behaviour, Prentice Hall of India
2. Pradip N. Khandelwal, Organizational Behaviour, McGraw-Hill, New Delhi.
3. Uma Sekaran, "Organizational Behaviour", TATA McGraw-Hill, New Delhi.
4. Steven L McShane, Mary Ann Von Glinow, Radha R Sharma" Organizational Behaviour" , TATA McGraw- Hill.
5. D.K. Bhattachayya, "Organizational Behaviour", Oxford University Press
6. K.B.L.Srivastava & A.K.Samantaray, "Organizational Behaviour" India Tech

PCCH4201 **Fluid Flow and Flow Measurement**

Module I:

Units and dimensional analysis, Types of Fluids.

Fluid Static: Hydrostatic Pressure, Pressure measuring Devices.

Introduction to fluids in motion, Flow in boundary layers. Its formation & growth in tubes & plates. Basic equations of fluid flow continuity, momentum & Bernoullies equation. Flow measuring devices; Venturi, Orifice, Pitot tube & Rotameter.

Module II :

Flow of incompressible fluid in pipes, Relation between skin friction & wall shear. Laminar flow in pipes, Hagen-Poiuilles equation, Friction factor, Friction from changes in velocity or direction, Flow of compressible fluids, Basic equations. Flow past immersed bodies, Drag Co-efficient. Motion of particles through fluids. Its mechanics, terminal Velocity.

Module III:

Friction inflow through beds of solids, Fluidization, Mechanism of fluidization, pressure drop in fluidization, Application of fluidization.

Transportation of fluids, Reciprocating rotary & centrifugal pump, fans, blowers & compressors. Characteristics curves & calculation of power & efficiency of pumps. Concept of slip.

Text Books

1. Unit operations of Chemical Engg. by Mc Cabe & Smith.
2. Fluid Mechanics for Chemical Engg. by Noel Drevvers.
3. A Text book of Fluid Mechanics & Hydralic Machines by R.K.Bansal
4. Fluid Mechanics by A.K.Jain

PCCH4202 **Chemical Process Technology.**

Module I:

Heavy Chemicals: Caustic Soda & Chlorine, HCL, Soda Ash, Sulphuric acid

Module II:

Extraction Refining of Oil, hydrogenation of Oil.

Soap & Synthetic detergents .

Pulp & Paper Industry

Technology of Pigment & Dyes, Natural Dyes

Module III:

Manufacture of Sugar, Starch & its derivative Industrial & Absolute Alcohol.

Synthetic fibers.

Polyethylene, PVC, Phenol formaldehyde & Poly Vinyl Acetate.

Books:

1. Outlines of Chemical Technology – C.E.Dryden, Edited & revised by M. Gopal Rao & M. Siftig .
2. A Textbook of Chemical Technology- S.D.Shukla & G.N.Pandey.
3. Shreeve's Chemical Process Industries, George.

HSSM7203 **Communication & Interpersonal skills for Corporate Readiness Lab.**

30 hours

This course will focus on communication in professional (work-related) situations of the kind that BPUT graduates may expect to encounter on entering the professional domain.

Some typical forms of work-related communication, oral or written, are listed below. Practice activities for all four skills can be designed around these or similar situations.

1. Gaining entry into an organization
 - i. Preparing job-applications and CVs
 - ii. Facing an interview
 - iii. Participating in group discussion (as part of the recruitment process)
- 2 In-house communication
 - a. Superior/ Senior → subordinate / junior (individual → individual / group)
 - i. Welcoming new entrants to the organization, introducing the workplace culture etc.
 - ii. Briefing subordinates / juniors : explaining duties and responsibilities etc.
 - ii. Motivating subordinates / juniors ('pep talk')
 - iii. Instructing/ directing subordinates/ juniors
 - iv. Expressing / recording appreciation, praising / rewarding a subordinate or junior
 - v Reprimanding / correcting / disciplining a subordinate/junior (for a lapse) ; asking for an explanation etc.
 - b. Subordinate / Junior → Superior / Senior
 - i. Responding to the above
 - ii. Reporting problems / difficulties / deficiencies
 - iii. Offering suggestions

BECS7207 **C++ & Object Oriented Programming Lab**

1. Programs on concept of classes and objects.(1 class)
2. Programs using inheritance.(1 class)
3. Programs using static polymorphism.(1 class)
4. Programs on dynamic polymorphism.(1 class)
5. Programs on operator overloading.(1 class)
6. Programs on dynamic memory management using new, delete operators.(1 class)
7. Programs on copy constructor and usage of assignment operator.(1 class)
8. Programs on exception handling .(1 class)
9. Programs on generic programming using template function & template class.(1 class)
10. Programs on file handling.(1 class)

PCCH7201 **Fluid Flow Lab**

1. Fluidised bed – To determine minimum fluidisation velocity and pressure drop.
2. Flow through pipes - To find out the pressure drop.
3. Centrifugal Pump – To draw the characteristics curves and find out the efficiency.
4. Reciprocating Pump – To draw the characteristics curves and find out the efficiency.
5. Venturi Meter – To find out the flow rate of fluid flowing inside a pipe.
6. Orifice Meter – To find out the flow rate of fluid flowing inside 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.

PCCH7202 **Chemical Technology Lab**

- (1) Manufacture of Soap from Vegetable Oil.
- (2) Determination Dissolve Oxygen of the given Water Sample.
- (3) Determination of PH value of the given slurry.
- (4) To determine Acid value of the given Oil Sample.
- (5) To determine concentration of Sugar solution by Refractometer.
- (6) Estimation of N₂ in Nitrogenous fertilizer.
- (7) Preparation of Jam & Jelly.
- (8) Preparation of Natural Dyes.

BSCM1210 **Mathematics – IV**

Module-I

(20 hours)

Numerical methods:

Approximation and round of errors, Truncation error and Taylor's series

Roots of equation: The bisection method, the false-position method, fixed point iteration, the Newton-Raphson method, Muller's method

Linear algebraic equation: LU decomposition, the matrix inverse, Gauss-Seidel method

Interpolation: Newton divided difference interpolation, Lagrange Interpolation, Newton's forward and backward interpolation.

Numerical integration: The trapezoidal rule, The Simpson's rules, Gauss quadrature

Ordinary differential equation: Euler's method, Improvement of Euler's method, Runge-Kutta methods

Module-II

(10 Hours)

Probability:

Probability, Random variables, Probability distributions, Mean and variance of distribution, Binomial, Poisson and Hypergeometric distributions, Normal distribution, Distribution of several random variables.

Module-III

(10 Hours)

Mathematical Statistics:

Random sampling, Estimation of Parameters, Confidence Intervals, Testing of hypothesis, Acceptance sampling, Chi square test for goodness of fit , Regression Analysis, Fitting Straight Lines, Correlation analysis.

Text books:

1. S. C. Chapra and R. P. Canale, "Numerical methods for Engineers", Fifth Edition, McGraw Hill Education
Reading Chapters : 2, 3(3.1, 3.2), 4(4.2, 4.3), 5(5.1, 5.2, 5.3), 6(6.4), 9(9.1, 9.2), 10(10.2), 13(13.1,13.2,13.5), 16(16.1, 16.2), 17(17.3), 20(20.1, 20.2, 20.3)
2. E. Kreyszig," Advanced Engineering Mathematics:, Eighth Edition, Wiley India
Reading Chapters: 22, 23(except 23.5 and 23.8)

Reference books:

1. Jay L. Devore, "Probability and Statistics for Engineering and Sciences", Seventh Edition, Thomson/CENGAGE Learning India Pvt. Ltd
2. P. V.O'Neil, "Advanced Engineering Mathematics", CENGAGE Learning, New Delhi

BECS2208 Database Management System

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 : (12 hours)

Relation Query Languages, Relational Algebra and Relational Calculus, SQL.

Relational Database Design: Domain and Data dependency, Armstrong's Axioms, Normal Forms, Dependency Preservation, Lossless design.

Query Processing Strategy.

Module III: (10 hours)

Transaction processing: Recovery and Concurrency Control. Locking and Timestamp based Schedulers.

Database Recovery System: Types of Data Base failure & Types of Database Recovery, Recovery techniques

Text Books:

1. Database System Concepts by Sudarshan, Korth (McGraw-Hill Education)
2. Fundamentals of Database System By Elmasari & Navathe- Pearson Education

References Books:

- (1) An introduction to Database System – Bipin Desai, Galgotia Publications
- (2) Database System: concept, Design & Application by S.K.Singh (Pearson Education)
- (3) Database management system by leon &leon (Vikas publishing House).
- (4) Fundamentals of Database Management System – Gillenson, Wiley India
- (5) Database Modeling and Design: Logical Design by Toby J. Teorey, Sam S. Lightstone, and Tom Nadeau, “”, 4th Edition, 2005, Elsevier India Publications, New Delhi

PCCH4203 **Chemical Process Calculations**

Module-1

Units & dimensions, The chemical equation & stoichiometry, concept of limiting & excess reactants, conversion, degree of conversion, yield etc.

Ideal gas laws, equation of state, Vapor pressure, Clausius-Clapeyron equation, humidity-relative saturation & percentage saturation, concept of wet & dry bulbs thermometer, use of humidity Chart.

Module-2

Material balances & unit operation-drying, crystallization dissolution, combustion.

Solving material balance with Chemical reaction, recycle, bypass & purge Calculations.

Module-3

Energy balance concepts & units, Heat capacity, Calculation of enthalpy changes without change of phase, Energy balance with Chemical reaction, Standard heat of reaction at constant, pressure & constant volume, effect of temperature, on heat of reaction, Adiabatic reaction of temperature, heat of solution & mixing.

Text books

- (1) Chemical process principles-Hoejen, Watson, John Wiley & Asia pub.
- (2) Stoichiometry-Bhatt BI & SM Vora
- (3) Stoichiometry & process Calculations by-K.V. Narayanan & B-lakshmikatty

PCCH4204 **Mechanical Operation**

Objective: This course acquaints the students of the mechanical method of sizing, separating & transportation of particles.

Module-I: Particle size, shape, Specific surface area, etc.

Size Reduction: Laws of grinding, Jaw, roll and gyratory crushers, revolving mills, Ball mill, attrition mill, fluid energy mill, open Circuit & closed Circuit grinding.

Module-II : Size Separation, screening, screening equipments, Trommels, Capacity & effectiveness of screens, Magnetic and Electrostatic Separators.

Motion of particles through fluid, drag Coefficient, Free and hindered setting, Thickeners, Cyclones etc.

Module-III: Classifications: Sink & float method, Jigging, Tabling.

Fillration, Theory, plats & frame filter pron, Leaf fietr, Rotary filter,

Mixing & Agitation power consumption of Mixer Mixing equipment. Forth flotation, Conveying, Different Conveyers

Books Recommended:

- 1) Mc Cabe & Smith ,Unit operations of Chemical engineering, Mc Graw lim
- 2) Coulson & Richabol Vol-2 Chemical Engineering pergammic Press.
- 3) Brown etcl,Chint operation,Asian Publication.

BECS7208 **Database Managements System Lab**

1. Use of SQL syntax: insertion, deletion, join, updation using SQL. (1 class)
2. Programs on join statements and SQL queries including where clause. (1 class)
3. Programs on procedures and functions. (1 class)
4. Programs on database triggers. (1 class)
5. Programs on packages. (1 class)
6. Programs on data recovery using check point technique. (1 class)
7. Concurrency control problem using lock operations. (1 class)
8. Programs on ODBC using either VB or VC++. (1 class)
9. Programs on JDBC. (1 class)
10. Programs on embedded SQL using C / C++ as host language. (1 class)

PCCH7205 **Fuel Technology Lab**

1. Determination of Moisture Content, Volatile Matter, Carbon and Ash by Proximate Analysis method.
2. Determination of Cloud & Pour Point of an oil sample.
3. Determination of flash & fire Point on an oil sample.
4. Determination of Moisture content of an oil sample by Dean & Stark Apparatus.
5. Determination of Carbon Residue of an oil sample by Conradson's Apparatus.
6. Determination of Aniline Point of an oil sample.
7. Determination of Viscosity of an oil sample.
8. Determination of Calorific Value by Bomb Calorimeter.

PCCH 7204 **Mechanical Operation Lab**

1. To find out the average size of particles in a sample (Volume - surface 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.

BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA

Chemical Engineering

<u>5th SEMESTER</u>				<u>6th SEMESTER</u>			
<i>THEORY</i>		<i>Contact Hours</i>		<i>THEORY</i>		<i>Contact Hours</i>	
<i>Code</i>	<i>Subject</i>	<i>L-T-P</i>	<i>Credits</i>	<i>Code</i>	<i>Subject</i>	<i>L-T-P</i>	<i>Credits</i>
HSSM3303	Environmental Engineering & Safety or	3-0-0	3	HSSM3301	Principles of Management or	3-0-0	3
HSSM3301	Principles of Management			HSSM3303	Environmental Engineering & Safety	3-0-0	
PCCH4301	Heat Transfer	3-1-0	4	PCCH4304	Process Dynamics and Control	3-1-0	4
PCCH4302	Mass Transfer - I	3-0-0	3	PCCH4305	Chemical Reaction Engineering	3-1-0	4
PCCH4303	Process Equipment Design	3-1-0	4	PCCH4306	Mass Transfer - II	3-0-0	3
Professional Elective – I (<i>Any One</i>)		3-0-0	3	Professional Elective – II (<i>Any One</i>)		3-0-0	3
PECH5304	Process Instrumentation			PCML4301	Transport Phenomena		
PECH5303	Fuel & Energy Technology			PECH5302	Fertilizer Technology		
				PECH5301	Paper & Pulp Technology		
Free Elective – I (<i>Any One</i>)		3-0-0	3	Free Elective – I (<i>Any One</i>)		3-0-0	3
HSSM3302	Optimization Engineering			FESM6302	Numerical Methods		
FECH6303	Interfacial Surface Engineering			FECH6302	Biotechnology		
			Credits (Theory)				Credits (Theory)
			20				20
<i>PRACTICALS/SESSIONALS</i>				<i>PRACTICALS/SESSIONALS</i>			
PCCH7303	Equipment Lab.	0-0-3	2	PCCH7304	Process Control Lab.	0-0-3	2
PCCH7301	Heat Transfer Lab.	0-0-3	2	PCCH7305	Chemical Reaction Engineering Lab.	0-0-3	2
PCCH7302	Mass Transfer Lab.	0-0-3	2	PCCH7306	Computer Aided Design Lab.	0-0-3	2
			Credits (Practicals / Sessionals)				Credits (Practicals/Sessionals)
			6				6
TOTAL SEMESTER CREDITS			26	TOTAL SEMESTER CREDITS			26
TOTAL CUMULATIVE CREDITS				TOTAL CUMULATIVE CREDITS			

HSSM3303 **ENVIRONMENTAL ENGINEERING & SAFETY**

(3-0-0)

Module – I

Ecological Concepts: Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Oxygen cycle, Nitrogen cycle etc., Environmental gradients, Tolerance levels of environment factor, EU, US and Indian Environmental Law. Chemistry in Environmental Engineering: Atmospheric chemistry, Soil chemistry. Noise pollution- Noise standards, measurement and control. Water Treatment: water quality standards and parameters, Ground water. Water treatment processes, Pre-treatment of water, Conventional process, Advanced water treatment process.

Module – II

(a)Waste Water Treatment: DO and BOD of Waste water treatment process, pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion, Reactor configurations and methane production.

(b)Air Pollution : Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change –greenhouse gases, non-criteria pollutants, air pollution meteorology, Atmospheric dispersion. Industrial Air Emission Control. Flue gas desulphurization, NOx removal, Fugitive emissions.

(c) Solid waste, Hazardous waste management, Solid Waste Management, Source classification and composition of MSW: Separation, storage and transportation, Reuse and recycling, Waste Minimization Techniques. Hazardous Waste Management, Hazardous waste and their generation, Transportation and treatment: Incinerators, Inorganic waste treatment. E.I.A., Environmental auditing,

Module – III

Occupational Safety and Health Acts, Safety procedures, Type of Accidents, Chemical and Heat Burns, Prevention of Accidents involving Hazardous substances, Human error and Hazard Analysis. Hazard Control Measures in integrated steel industry, Petroleum Refinery, L.P.G. Bottling, Pharmaceutical industry. Fire Prevention – Detection, Extinguishing Fire, Electrical Safety, Product Safety. Safety Management- Safety Handling and Storage of Hazardous Materials, Corrosive Substances, Gas Cylinders, Hydro Carbons and Wastes. Personal Protective Equipments.

Text Book :

1. Environmental Engineering Irwin/ McGraw Hill International Edition, 1997, G. Kiely,
2. Environmental Engineering by Prof B.K. Mohapatra, Seven Seas Publication, Cuttack
3. Industrial Safety Management, L. M. Deshmukh, Tata McGraw Hill Publication.

Reference Books

1. Environmental Engineering by Arcadio P. Sincero & Gergoria A. Sincero PHI Publication
2. Principles of Environmental Engineering and Science, M. L. Davis and S. J. Masen, McGraw Hill International Edition, 2004
3. Environmental Science, Curringham & Saigo, TMH,
4. Man and Environment by Dash & Mishra
5. An Introduction to Environmental Engineering and Science by Gilbert M. Masters & Wendell P. Ela - PHI Publication.
6. Industrial Safety Management and Technology, Colling. D A – Prentice Hall, New Delhi.

HSSM3301 **PRINCIPLES OF MANAGEMENT** (3-0-0)

Module I: Functions of Management

Concept of Management, Management as an Art or Science, The Process of Management, Managerial Skills, Good Managers are Born, not Made, Management is concerned with Ideas, Things and People, How a Manager Induces Workers to Put in Their Best, Levels and Types of Management, **Evolution of Management Thought:** Managerial Environment, The process of Management-Planning, Organizing, Directing, Staffing, Controlling.

Module II: Marketing Function of Management.

Modern Concept of Marketing, The Functional Classification of Marketing, Functions of a Marketing Management, Marketing Mix, Fundamental Needs of Customers, The Role of Distribution channels in Marketing, Advertising, Marketing, Consumerism and Environmentalism.

Module III: Financial Function & HRM Functions.

Financial Functions, Concept of Financial Management, Project Appraisal, Tools of Financial decisions making, Overview of Working Capital.

HRM Function of Management: Human Resource Management, Human Resource Development, Importance of HRM, Overview of Job Analysis, Job Description, Job Specification, Labour Turnover. Manpower Planning, Recruitment, Selection, Induction, Training and Development, Placement, Wage and Salary Administration, Performance Appraisal, Grievance Handling, Welfare Aspects.

Reference Books:

1. *Business Organization & Management*, CR Basu, TMH
2. *Business Organization & Management*, Tulsia, Pandey, Pearson
3. *Marketing Management*, Kotler, Keller, Koshi, Jha, Pearson
4. *Financial Management*, I.M. Pandey, Vikas
5. *Human Resource Management*, Aswasthapa, TMH.
6. *Modern Business Organisation & Management* by Sherlekar, Himalaya Publishing House.

PCCH4301 HEAT TRANSFER (3-1-0)

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, unsteady state heat conduction through a semi-infinite slab, cylindrical and sphere. critical insulation of 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, Analogy between heat and momentum transfer: Reynold's Prandtl and Colburn analogies. Heat transfer to liquid metals. 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.

Heat Exchanges : Types of heat exchangers, logmean temperature difference. Energy balances, Overall heat transfer Coefficients Heat Exchanger effectiveness. Fouling factors, Design and description of heat transfer equipment. 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.

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 gases on ratio of condensation. Heat transfer to boiling liquids. Boiling of a saturated 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, emissivity, grey body, laws of black body radiation, geometric factor, Radiation in enclosures with black surfaces and grey surfaces. Large parallel plates, concentric, cylindrical, spheres. Combined heat transfer by conduction, convection and radiation.

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. A. Domkundware, A course on heat and mass transfer, Dhanpat Ray and sons publication
4. Kern D. Q., Process Heat Transfer
5. R.K Rajput, Heat and mass transfer, S. Chand publication
6. Gupta, C. P. & Prakash, R., Engineering Heat Transfer (6th Edition) Nom Chand & Bros., Roorkee (1994).

PCCH4302 **MASS TRANSFER - I** (3-0-0)

Module - I

Introduction to Mass transfer operations, molecular diffusion in fluids, binary solutions, Fick's law, equation of continuity, steady state equimolar counter current diffusion, Stefan's equation, diffusivity of gases and liquids, application of molecular diffusion, mass transfer coefficients, in laminar and turbulent flow, Film theory, Penetration theory, surface-renewal theories, analogy between mass, heat and momentum transfer.

Module – II

Principle of VLE for binary systems, phase diagrams, relative volatility, ideal solutions, azeotropes, enthalpy concentration diagrams, flash vaporization, partial condensation, differential distillation steam distillation, azeotropic and extractive distillation.

Continuous distillation: Mc Cabe - Thiele method, Ponchon - Savarit method, Tray efficiencies, introduction to multi component distillation.

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.

Module - IV

Humidification Operations : Definition of fundamental terms, Psychrometric charts, theory of adiabatic saturation and wet bulb temperature, Lewis relation, Gas liquid contact, Dehumidification, Adiabatic Humidification. Equipments: Natural Circulation, Natural draft, Mechanical draft, Spray tower, Spray chamber, Spray pond, Humidity Measurement: Direct chemical method, Hygrometer method, Sling psychrometer, Dew point method, Mirror method

Textbooks and References :

1. R. E. Treybal, Mass Transfer Operations, McGraw Hill, New York.
2. Mc Cabe & Smith., Uni Operations in Chemical Engineering, Mc Graw Hill International Edn
3. B. D. Smith, Design of Equilibrium Stage Process, Mc Graw Hill.
4. J. M. Coulson and J. F. Richardson, Chemical Engineering, Vol - II, Asian books private Ltd.
5. A.Suryanarayana, Mass Transfer Operations: New age international publishers

PCCH4303 **PROCESS EQUIPMENT DESIGN** (3-1-0)

Following Books are Allowed –

1. M.V. Jhosi, Process Equipment Design
2. Coulson J. M. & Richardson J. F., Chemical Engineering, Vol VI, Pergamon Press

Module - I

Design of pressure vessels and storage tanks , Rotary dryers, Isothermal reactors.

Module - II

Detailed process design of the following equipments; Heat exchangers – concentric tube, shell and tube types, Condensers – condenser coolers and de-superheater condensers for single vapour only, Evaporators – single and multi effects,

Module - III

Absorbers – for binary systems without reactions, Distillation columns – for binary mixtures along with tray hydraulics,

Text Book:

1. D. Q. Kern, *Process Heat Transfer*.
2. R. E. Treybal, *Mass Transfer Operations*.

Reference Book:

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

PECH5304 **PROCESS INSTRUMENTATION** (3-0-0)

Module - I

Basic concepts and qualities of measurement, Level measurement: Methods of liquid level measurement, Direct methods, Hook-type level indicator, sight glass, Float-type level indicator, Displacer level detectors, Indirect methods, Hydrostatic pressure type, Pressure gauge method, Air bellows, Air purge system, Liquid purge system, Electrical methods.

Module – II

Flow Measurement: Methods of flow measurement, Inferential flow measurement, Quantity flowmeters, Mass flowmeters, Calibration of flowmeters, Selection of flowmeters.

Pressure measurement: Pressure, Methods of pressure measurement, Manometers, Elastic pressure transducers, Measurement of vacuum, Force-balance pressure gauges, Electrical pressure transducers, Pressure switches, Calibration of pressure measuring instruments, Maintenance and repair of pressure measuring instruments, Troubleshooting.

Module – III

Temperature measurement: Temperature, Temperature scales, Methods of temperature measurement, Expansion temperature, Filled-system thermometers, Electrical temperature instruments. Pyrometers: Radiation and optical, Methods of composition analysis: Spectroscopic analysis, Absorption spectroscopy, Emission spectroscopy, Mass spectroscopy

Text books and References :

1. D. P. Eckman, 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
4. S.K.Singh, Industrial instrumentation and control, Tata Mc Graw-Hill.

PECH5303 **FUEL AND ENERGY TECHNOLOGY** (3-0-0)

Module - I

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, Petrographic constituents of coal, Carbonization of coal, manufacture and properties of metallurgical coke, recovery of by-products.

Module - II

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.

Module - III

Synthetic Fuels : Hydrogenation of coal, Fischer – Tropsch synthesis, Introduction.

Nuclear fuels and nuclear reactors, 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 :

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.

HSSM3302 **OPTIMIZATION IN ENGINEERING** (3-0-0)

Unit-I (10 Hours)

Idea of Engineering optimization problems, Classification of optimization algorithms, Modeling of problems and principle of modeling.

Linear programming: Formulation of LPP, Graphical solution, Simplex method, Big-M method, Revised simplex method, Duality theory and its application, Dual simplex method, Sensitivity analysis in linear programming

Unit-II (10 Hours)

Transportation problems: Finding an initial basic feasible solution by Northwest Corner rule, Least Cost rule, Vogel's approximation method, Degeneracy, Optimality test, MODI method, Stepping stone method

Assignment problems: Hungarian method for solution of Assignment problems

Integer Programming: Branch and Bound algorithm for solution of integer Programming Problems

Queuing models: General characteristics, Markovian queuing model, M/M/1 model, Limited queue capacity, Multiple server, Finite sources, Queue discipline.

Unit-III (10 Hours)

Non-linear programming: Introduction to non-linear programming.

Unconstrained optimization: Fibonacci and Golden Section Search method.

Constrained optimization with equality constraint: Lagrange multiplier, Projected gradient method

Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming
Introduction to Genetic Algorithm.

Text Books

1. A. Ravindran, D. T. Philips, J. Solberg, "*Operations Research- Principle and Practice*", Second edition, Wiley India Pvt Ltd
2. Kalyanmoy Deb, "*Optimization for Engineering Design*", PHI Learning Pvt Ltd

Reference Books:

1. Stephen G. Nash, A. Sofer, "*Linear and Non-linear Programming*", McGraw Hill
2. A.Ravindran, K.M.Ragsdell, G.V.Reklaitis," *Engineering Optimization*", Second edition, Wiley India Pvt. Ltd
3. H.A.Taha,A.M.Natarajan, P.Balalubramanie, A.Tamilarasi, "*Operations Research*", Eighth Edition, Pearson Education
4. F.S.Hiller, G.J.Lieberman, "*Operations Research*", Eighth Edition, Tata McDraw Hill
5. P.K.Gupta, D.S.Hira, "*Operations Research*", S.Chand and Company Ltd.

FECH6303 **INTERFACIAL SURFACE ENGINEERING** (3-0-0)

Module I

General introduction of colloids, interfaces, surfactants, and micellization.; Intermolecular forces, Van der Waals forces (Keesom, Debye, and London interactions), Colloidal systems and colloidal stability (van der Waals attraction and potential energy curves), Brownian motion and Brownian flocculation.

Module II

Surface and interfacial tension and surface free energy, Surface tension for curved interfaces, Surface excess and Gibbs equation. Theory of surface tension and contact angle, and wetting. Thermodynamics of interfaces, thermodynamics of micelle and mixed micellar formation.

Module III

Electrical phenomena at interfaces (Electrokinetic phenomena, Electrical double layer). Emulsion and micro-emulsion.; Application: General applications, Enhanced petroleum recovery, super hydrophobic and self cleaning surfaces, novel fabrication of nanostructured particles. Measurement techniques of surface tension, Contact angle, Zetapotential, Particle size.

Essential Reading:

1. P.C. Hiemenz, and R. Rajagopalan, *Principle of colloid and surface chemistry*, 3rd edition, Merceel Dekher, N.Y. 1997.
2. D. J. Shaw, *Colloid & Surface Chemistry*, Butterworth Heinemann, Oxford, 1992.

Suggested Reading:

1. M. J. Rosen, *Surfactants and Interfacial Phenomena*, Wiley-Interscience Publication, New York, 2004.
 2. Adamson, A. W. Gast, *A. P. Physical Chemistry of Surfaces*, Wiley-Interscience, New York, 1997.
- J. Israelachvili, *Intermolecular and Surface Forces*, Academic Press, New York, 1992.

PCCH7303 **EQUIPMENT DESIGN LAB** (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. Design of Absorption Column (Packed tower).
6. Design of Distillation Column (Plate tower).
7. Design of Rotary Drier.
8. Design of Storage tanks.
9. Design of supports like leg, skirt and saddle support.
10. Design of Flanges as per ASME and ISI specification.

PCCH7301 **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 Experiment

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 temperature distribution along the length of fin in forced convection heat transfer
11. To study temperature distribution along the length of fin in free convection heat transfer
12. To determine the overall heat of various degrees of agitation in a Jacketted Vessel
13. Determination of thermal conductivity of liquid.

PCCH7302 **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 verify 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 (HETP) 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-air system.
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 mustard cake.

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 transfer 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.

Module - IV

Introduction to sampled data controllers, sampled data control of a first order
process with transportation lag, 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.
2. Chemical Process Control, George Stephanopoulos, Prentice Hall.
3. J. M. Douglas, Process Dynamics & Control, Prentice Hall.

CHEMICAL REACTION ENGINEERING (3-1-0)

Module – I

Introduction and overview of the subject, kinetics of homogeneous reactions, elementary and non-elementary reactions, Concentration and temperature dependent term of a rate equation, Collision theory, Transition - state theory and Arrhenius theory. Interpretation of batch reactor data for both reversible and irreversible reactions.

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

Module - II

Homogeneous flow reactors : Design equations for steady state plug flow reactor (PFR) and steady state Continuous StirredTank Reactor (CSTR), data analysis in flow reactors, mean residence time, space time, space velocity. Combined reactors, Reactors in parallel and in series, size comparison of single reactors, Recycle reactors (PFR and CSTR)

Module – III

Design for parallel reactions, product distributions, contacting patterns for reactions in parallel, quantitative treatment of product distribution, selectivity, multiple reactions, qualitative treatment of batch, PFR and mixed reactors. Basics of non-ideal flow, RTD, Age distribution of fluid, pulse experiment, relationship between F and E curve only.

Textbooks and References :

1. Ivenspiel 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.

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 reflux, fractional extraction, equipment for liquid contacting operations, single stage, multistage and continuous contacting equipments.

Module - II

Leaching: Operation of solid, steady and unsteady state operation, equipment, analytical methods for single and multistage operations

Adsorption : Theory of adsorption, Industrial adsorbents, adsorption equilibria, freundlich equation, single and multistage operations, Ion - Exchange.

Module - III

Drying: Equilibria, Drying rate curve, Batch and continuous drying. Time of drying and calculations, mechanism of batch drying, equipments for batch and continuous drying operations. Design of dryers.

Textbooks and References :

1. Treybal R. E., Mass Transfer 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

TRANSPORT PHENOMENA (3-0-0)

Module I:

Momentum Transport : Viscosity and the mechanism of momentum transport, Shell momentum balances and Velocity distributions in laminar flow. The equation of changes for Isothermal systems. Velocity distributions with more than one independent variable. Inter phase transport in isothermal systems.

Module II:

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

Module III:

Mass Transport : Diffusivity and the mechanism of mass transport, concentration distributions in solids and laminar flow, the equations of change for multi component systems. concentration distributions with more than one independent variable, inter phase transport in non-isothermal mixtures.

Books Recommended :

1. Bird, R. B., Stewart, W. B. & Light Foot, B. N., Transport Phenomena, John Wiley & Sons. 2nd ed.
2. C. G. Bounet & J. B. Myers : Momentum, Heat and Mass Transfer, Mc Graw Hill.

FERTILIZER TECHNOLOGY (3-0-0)

Module I

Fertilizers: Chemical Fertilizers and Organic manures, Types of Chemical Fertilizers, Fertilizer applications and agronomic 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 nitrate, urea, calcium ammonium nitrate and ammonium chloride.

Module II

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 nitrate.

Module III

Complex and NPK Fertilizers: Methods of production, characteristics specification and storage of ammonium phosphate sulphate, di-ammonium phosphate, nitro phosphates, urea ammonium 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.

PAPER AND PULP TECHNOLOGY (3-0-0)

Processing of Raw Materials : Processes including Kraft Pulping, sulphite process Pulp Washing and drying : Waste liquid treatment, bleaching environmental aspects of pulp and paper production, Economic aspects involved, fillers, 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

FESM6302 **NUMERICAL METHODS** (3-0-0)

Unit-I :

Interpolation: Piecewise Linear Interpolation, Piecewise Quadratic Interpolation, Piecewise Cubic Hermite Interpolation, Piecewise Spline Interpolation.

Numerical Differentiation: First Derivative, Higher Derivatives, Partial Derivative, Richardson's Extrapolation.

Romberg algorithm for numerical integration.

Unit-II

Eigen values and Eigen Vectors: Basic power method, Rayleigh Quotient, Shifted power method, Accelerating convergence, Inverse power method, Basic QR method, Better QR method, Finding eigen vectors, Accelerating convergence

Fourier methods: Discrete Fourier Transforms, Fast Fourier Transforms, Matrix form of FFT, Algebraic form of FFT, Mixed-Radix FFT

Unit-III

Ordinary Differential Equations: Adams-Bashforth Methods, Adams-Moulton Methods, Adams Predictor-Corrector methods, Other Predictor-Corrector methods (Simpson's method and Milne's method)

Parabolic Partial Differential Equation: Explicit Method, Implicit method, Crank-Nicolson method

Hyperbolic Partial Differential Equation: Explicit Method, Implicit method.

Elliptic Partial Differential Equation: Finite-Element method.

Text Book:

1. L.V. Fausett, "Applied Numerical Analysis Using MATLAB", Pearson Education

Reference Books:

1. W.Cheney and D. Kincaid,"Numerical Mathematics and Computing", Fifth Edition, Thomson/CENGAGE Learning
2. S. C. Chapra, "Applied numerical methods with MATLAB", second edition, Tata McGraw Hills
3. R.J. Schilling and S.L.Harris,"Applied Numerical Methods for Engineering", CENGAGE learning

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.

PROCESS CONTROL LAB.

1. Single Tank System
2. Two Interacting Tank System.
3. Two Non-interacting Tanks System.
4. Pressure Control Trainer
5. Temperature Control Trainer
6. Digital Photo Colorimeter.

List of Experiments :

1. To study the response of a single tank with step change in inlet flow and to find out time constant graphically.
2. To study the transient response of two interacting tanks with step change in inlet flow rate and to find out the time constant graphically.
3. To study the transient response of two non-interacting tanks with step change in inlet flow rate and to find out the time constant graphically.
4. To study the open loop response and the operation of ON-off electronic temperature controller and determination of its performance to control the temperature of a system having capacity to store thermal energy.
5. To study the open loop response and the operation of ON-OFF electronic pressure controller and determination of its performance to control the pressure of a pressure vessel.
6. To study of effect of PD, PI and PID controller on a temperature control trainer.
7. To study of effect of PD, PI and PID controller on a pressure control trainer.
8. To study the stability of a temperature control trainer.
9. To study the stability of a pressure control trainer.
10. To study the dynamic characteristics of a mercury in glass thermometer.

CHEMICAL REACTION ENGINEERING LAB.

1. Tabular Reactor
2. Plug Flow Reactor
3. Combined Reactor
4. Continuous Stirred Tank Reactor
5. Isothermal batch Reactor
6. Packed bed/Fluidized bed Reactor

List of Experiments : (any six)

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 CH₃COOC₂H₅)
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) CH₃COOC₂H₅
 - ii) To study the effect of terms on 'K' and determine the activation energy.
6. To study the performance of an isothermal batch reactor.
7. Reaction kinetics in a Fluidized/Packed bed reactor

COMPUTER AIDED DESIGN LABORATORY

1. Finding out matrix addition, multiplication, inversion, rank, Eigen values using MATLAB simulator.
2. Plotting set of data using MATLAB.
3. Parameter estimation using least-square technique using MATLAB.
4. Writing "m." files in MATLAB platform to solve coupled linear algebraic equations using Gauss elimination method.
5. Writing "m." files in MATLAB platform to solve non-linear algebraic equations using Newton Raphson Technique.
6. Design of a shell & tube heat exchanger by using AUTOCAD.
7. Design of a distillation column by using AUTOCAD.
8. Design of a single effect evaporator by using AUTOCAD.
9. Design of an absorption tower by using AUTOCAD.
10. Design of a storage vessel by using AUTOCAD.

BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA

Chemical Engineering

<u>7th SEMESTER</u>				<u>8th SEMESTER</u>			
<i>THEORY</i>		<i>Contact Hours</i>		<i>THEORY</i>		<i>Contact Hours</i>	
<i>Code</i>	<i>Subject</i>	<i>L-T-P</i>	<i>Credits</i>	<i>Code</i>	<i>Subject</i>	<i>L-T-P</i>	<i>Credits</i>
PCCH4401	Chemical Engineering Thermodynamics	3-1-0	4	HSSM3403	Marketing Management	3-0-0	3
PCCH4402	Fundamentals of Biochemical Engineering	3-0-0	3	PCCH4403	Petroleum Refinery Engineering	3-0-0	3
	Professional Elective – III (Any One)	3-0-0	3		Professional Elective – IV (Any One)	3-0-0	3
PECE5401	Chemical Engineering Mathematics			PECE5404	Process Simulation and modeling.		
PECE5402	Polymer Technology			PECE5405	Fluidisation Engineering		
PECE5403	Mineral Process Engineering			PECE5406	Modern Separation Techniques		
	Free Elective – II (Any One)	3-0-0	3		Free Elective – IV (Any One)	3-0-0	3
PCMT4403	Corrosion & degradation of Materials			PCBT4403	Food Biotechnology		
HSSM3401	Entrepreneurship Development			PEEI5403	Industrial Instrumentation		
PEEE5406	Soft Computing			PECS5410	Algorithms for Bio-Informatics		
			Credits (Theory) 13				Credits (Theory) 12
	PRACTICALS/SESSIONALS				PRACTICALS/SESSIONALS		
	<i>PRACTICALS/SESSIONALS</i>				<i>PRACTICALS/SESSIONALS</i>		
PCCE7401	Project – I	0-0-6	4	PCCE7404	Project – II (50% External Evaluation)	0-0-9	6
PCCE7402	Seminar	0-0-3	2	PCCE7405	Comprehensive Viva-Voce (External Evaluation)	0-0-0	3
PCCE7403	Entrepreneurship project	0-0-3	2				
			Credits (Practicals / Sessionals) 8				Credits (Practicals / Sessionals) 9
	TOTAL SEMESTER CREDITS		21		TOTAL SEMESTER CREDITS		21
	TOTAL CUMULATIVE CREDITS				TOTAL CUMULATIVE CREDITS		

CHEMICAL ENGINEERING THERMODYNAMICS (3-0-0)

Module – I

The first law of Thermodynamics, the thermodynamic state and state function, Constant volume constant pressure process, Properties of pure fluids; PVT behavior of pure substances, Virial equations of state, The ideal gas, Applications of Virial equations, Cubic equation of state, Theorem of corresponding states. Second Law: Entropy, work function, phase rule, Introduction to third law.

Module —II

Criteria of phase equilibrium, Ideal solutions (use of Raoult) law, Generation of Pxy and Txy diagram for ideal solution,

Non – ideal behavior, partial properties, Gibbs – Duhem equation, calculation of fugacity coefficient using generalized correlation, excess Gibbs energy, Lewis – Randall Rule, activity coefficient for VLE data

Module – III

Solution thermodynamics – thermodynamic properties and VLE from equation of state, properties of fluid mixtures using Redlich – Kwong equation of states. Chemical reaction equilibrium criteria to chemical reactions, Gibbs energy change equilibrium constant, effect of temperature, calculation for single reaction in homogeneous and heterogeneous system.

Text Books

1. Introduction to Chemical Engg. Thermodynamics by Smith and H.C. Vannes and M. Abbot (7th edition)
2. Chemical Engg. Thermodynamics by Y.V.C. Rao – University Press
Chemical Engg. Thermodynamics by K.V.Narayan

FUNDAMENTALS OF BIOCHEMICAL ENGINEERING

Module I

Overview of microbiology, Aerobic & Anaerobic fermentation processes, fermenter design, sterilization of microbial medium, kinetics of microbial growth, enzymes and its kinetics, immobilization of enzymes, chemostats.

Module II

Transport phenomena in Biochemical Engineering, Heat and Mass transfer in Bioprocessing, oxygen transfer in fermenter, monitoring and control of fermentation process.

Module III

Downstream processing: - Recovery and Purification of products, allied unit operation for product recovery, production of biogas and ethanol, Effluent treatment by biological method

Text book

1. Bailey JB and Ollis OR, Biochemical Engineering Fundamentals
2. Aiba S, Biochemical Engineering, Academic press
3. Rao D G, Introduction to Biochemical Engineering, Tata Mc Graw Hill
4. Michael L. Shuler/ Fikret Kargi, Bio Process Engineering , Pearson Education

CHEMICAL ENGINEERING MATHEMATICS

Module: I

Mathematical formulation of physical problem: series solution, Bessel's equation, Bessel's function solution.

Continuity equation, mass transfer in a binary mixture, equation of motion of a perfect fluid.

Module: II

Important properties of Laplace transform, inverse Laplace transform, application of Laplace transform method to solve differential equation, application to heat transfer, problems for specific cases of unsteady state heat conduction in a solid of infinite thermal conductivity, unsteady state heat conduction in a semi-infinite solid.

Module: III

Finite difference formulation for ordinary and partial differential equation with more emphasis on explicit schemes, Crank-Nicolson method.

Alternative direction method: Gamma function, value of gamma and beta function, connection of gamma and beta function, error function of probability integral.

Books to refer:

1. Mathematical Methods by Potter Goldberg , Publisher: PHI
2. Advanced Engineering Mathematics by E. Kreyszig, Publisher: John Willey & Sons Inc – 8th Edition
3. Higher Engineering Mathematics by B. S. Grewal
4. Applied Mathematics in Chemical Engineering by Harold S. Mickley, T.S. Sherwood and C.E. Reed.

POLYMER TECHNOLOGY

(3-0-0)

Module - I

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.

Module - II

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 formaldehyde, urea formaldehyde, vinyl resins, acrylic resins, Polystyrene and polyethylene.

Module - III

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.

PE **MINERAL PROCESS ENGINEERING** (3-0-0)

Module- I

Thermal methods in processing of Ores, Roasting, Sintering, Calcination, Pelletisation and briquetting.

Module- II

Chemical and electrochemical methods in mineral processing, Leaching, leaching process variables, Dump and heap leaching, Acid Leaching, Bacteria leaching.

Module- III

Solid-liquid separation in hydrometallurgy, solution purification, Amalgamation and cyanidation.

Recommended Books:

1. Handbook of hydrometallurgy.
2. Mineral processing technology by B.A.Wills and T. J. Napier-Mum
3. Gaudin, A. M. and Prior, B.J., Principle of Mineral Dressing.

CORROSION & DEGRADATION OF MATERIALS (3-0-0)

Module I (12 Hours)

Technological importance of corrosion study, corrosion as non equilibrium process, corrosion rate expressions, electrochemical principles of corrosion-cell analogy, concept of single electrode potential, reference electrodes, e.m.f. and galvanic series-their uses in corrosion studies, polarization, passivity.

Module II (12 Hours)

Different forms of corrosion-uniform attack, galvanic, crevice, pitting, intergranular, selective leaching, erosion, stress corrosion cracking-their characteristic features, causes and remedial measures.

Principles of corrosion prevention-material selection, control of environment including inhibitors, cathodic and anodic protection, coatings and design considerations. Corrosion testing methods.

Module III (14 Hours)

Introduction to high temperature corrosion, Pilling-Bedworth ratio, oxidation kinetics, oxide defect structures, Wagner-Hauffe valence approach in alloy oxidation, catastrophic oxidation, internal oxidation.

Considerations in high temperature alloy design, prevention of high temperature corrosion -use of coatings.

Liquid metal attack - liquid metal embrittlement, preventive measures.

Chemical degradation of non-metallic materials like rubbers, plastics, ceramics etc.

Hydrogen damage - types, characteristics, mechanism and preventive measures.

Books for reference:

1. Corrosion Engineering by Fontana, M.G., McGraw-Hill.
2. Corrosion & Corrosion Control by H.H. Uhlig, John Wiley & Sons.
3. Introduction to Metallic Corrosion by Evans.
4. Introduction to Electrochemistry by S.Glasstone.
5. An Introduction to Science of Corrosion & its Inhibition by S.N. Banerjee, Oxonian Press Pvt. Ltd.

ENTREPRENEURSHIP DEVELOPMENT

Module I: Understanding Entrepreneurship 10Hrs
Concept of Entrepreneurship, Motivation for Economic Development and Entrepreneurial Achievement, Enterprise and Society
Why and how to start Business – Entrepreneurial traits and skills, Mind Vrs Money in Commencing New Ventures, Entrepreneurial success and failures, Environmental dynamics and change.
Entrepreneurial Process
Step by step approach to entrepreneurial start up
Decision for Entrepreneurial start up.

Module II: Setting up of a small Business Enterprise. 10Hrs
Identifying the Business opportunity - Business opportunities in various sectors, formalities for setting up small enterprises in manufacturing and services, Environmental pollution and allied regulatory and non-regulatory clearances for new venture promotion in SME sector.
Writing a Business plan, components of a B-Plan, determining Bankability of the project.

Module III: Institutional Support for SME. 10Hrs
Central / State level Institution promoting SME.
Financial Management in small business.
Marketing Management, problems & strategies
Problems of HRM – Relevant Labour – laws.
Sickness in Small Enterprises.
Causes and symptoms of sickness – cures of sickness.
Govt. policies on revival of sickness and remedial measures.

Reference Books:

1. Entrepreneurship Development, Small Business Enterprises, Chavantimath, Pearson.
2. Entrepreneurial Development, S.S. Khanka, S Chand
3. Entrepreneurship, Barringer BR, Ireland R.D., Pearson
4. Entrepreneurship, David H Holt, PHI
5. Entrepreneurship, Kurilko, D.F. and Attodgets RM, Cengage
6. The Dynamics of Entrepreneurial Development & Management, Vasant Desai, HPH.
7. Entrepreneurship, Roy, Oxford
8. Entrepreneurship, Hisrich, Peters, Shepherd, TMH

SOFT COMPUTING (3-0-0)

MODULE-I

(12 Lectures)

Introduction: Soft Computing Constituents and Conventional Artificial Intelligence, Neuro-Fuzzy and Soft Computing Characteristics.

Fuzzy Sets: Introduction, Basic Definitions and Terminology, Set Theoretic Operations, MF Formulation and Parameterization.

Fuzzy Rules & Fuzzy Reasoning: Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning.

Fuzzy Inference Systems: Mamdani Fuzzy Models, Sugeno Fuzzy Models, Tsukamoto Fuzzy Models, Other Considerations.

(BOOK-1:- Chap-1: 1.1 to 1.3, Chap-2: 2.1 to 2.4, Chap-3: 3.2 to 3.4 & Chap-4: 4.2 to 4.5)

MODULE-II

(14 Lectures)

Neural Networks: Neuron Abstraction, Neuron Signal Functions, Mathematical Preliminaries, Neural Networks Defined, Architectures: Feed forward and Feedback, Salient Properties and Application Domains of Neural Networks, Multi-layered Network Architectures, Back-propagation Learning Algorithm, Practical Considerations in Implementing the BP Algorithm, Structure Growing Algorithms, Universal Function Approximation and Neural Networks, Applications of Feed Forward Neural Networks, Reinforcement Learning, Radial Basis Function Networks, Regularization Theory Route to RBFNs, Generalized Radial Basis Function Network, Learning in RBFNs, Associative Learning, Hopfield Network, Content Addressable Memory, Bidirectional Associative Memory, Self Organizing Feature Maps, Applications of the Self Organizing Map.

(BOOK-2:-Chap-3: 3.1 to 3.6, Chap-6: 6.1 to 6.2, 6.5 to 6.6 & 6.8 to 6.10, Chap-8: 8.4 to 8.7,

Chap-10: 10.2 & 10.5 to 10.6 & 10.16 and Chap-12: 12.8 to 12.9)

MODULE-III

(08 Lectures)

Regression & Optimization: System Identification: an Introduction, Least Squares Estimator, Geometric Interpretation of LSE, Recursive Least Squares Estimator.

Derivative-Free Optimization: Genetic Algorithms, Simulated Annealing, random Search, Downhill Simplex Search.

Adaptive Neuro-Fuzzy Inference Systems (ANFIS): ANFIS Architecture, Hybrid Learning Algorithm.

(BOOK-1:- Chap-5: 5.1, 5.3 to 5.5, Chap-7: 7.2 to 7.5 and Chap-12: 12.2 to 12.3)

TEXT BOOK:

1. "**Neuro-Fuzzy and Soft Computing**" By J.-S.R.Jang, C.-T.Sun & E. Mizutani, PHI
2. "**Neural Networks: A Classroom Approach**" By Satish Kumar, TMH Education

Reference Book:

1. "**Neural Networks Fuzzy Logic & Genetic Algorithms; Synthesis & Applications**, S.Rajasekaran & G.A. VijayaLaxmi Pai, Prentice Hall, India, May'2006- LakshmiPai
2. Principle of Soft Computing, S.N. Sivanandan & S.N. Deepa, Wiley India Edition,2010.

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 (10 hours)

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

Marketing Environment: Elements of micro and macro environment

Competition Analysis: Factors contributing to competition, porter's five forces model, Identifying and analyzing competitors.

Marketing Planning : Exploring Opportunity, Product –market selection, Marketing Planning Process.

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.

Consumer Behavior: Factors influencing consumer behavior, consumer decision process. Organizational buying behavior.

Module II (10 hours)

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

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

Module – III (10 hours)

Pricing Decision: Objectives and Factors influencing pricing, Pricing method and strategies.

Integrated Marketing Communication(IMC)- Concept of IMC, the marketing communication process, Promotion Mix, elements of promotion mix, Direct marketing.

Channels of Distributions: Types of intermediaries, functions of distribution channels, channel levels, Designing Distribution Channels, Physical Distribution, Supply Chain Management (Basic only).

Trends in Marketing: Green Marketing, Customer Relationship Management, E-marketing, Rural Marketing and Service Marketing (concepts only)

Books:

Text Book:

1. Etzel , Walker , Stanton and Pandit, *Marketing*, 14/e, Tata McGraw Hill.
2. Saxena, "Marketing Management" Tata McGraw Hill, 4/e.

Reference

1. Grewal, Levy, 'Marketing' Tata McGraw Hill, special Indian edition.
2. Karunakaran "Marketing Management", Himalaya Publishing House, 2010/e.
3. Kotler, Keller, Koshy and Jha, "Marketing Management", 13/e, Pearson Education.

PETROLEUM REFINERY ENGINEERING

(3-0-0)

Module - I

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

Important products – properties and test methods: natural gas, Associated gas, Dissolved gas, Refinery off gas, LPG, Reid vapour pressure, ASTM distillation, Octane number and Cetane number.

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.

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.

PROCESS SIMULATION AND MODELLING

Module I

Modeling: Fundamentals of mathematical models and formulation – Continuity equation, Equation of motion, Transport equations, Energy equation, Equations of state, Equilibrium, Chemical kinetics and their applications; Lumped and distributed parameter models – Fluid systems, C.S.T.R. (single, series, isothermal, constant hold up, variable hold up, gas phase pressurized and non-isothermal), Single component vaporizer, Multi-component flash drum, Batch reactor, Reactor with mass transfer, Ideal binary distillation column, Batch distillation, Heat exchanger, etc;

Module II

Optimization: Single variable optimization (analytical, dichotomous search, fibonacci, golden section, regula falsi), Multivariable optimization (analytical, geometric programming, linear programming), Convergence methods (Newton's methods, direct substitution, Wegstein's method).

Module III

Simulation:; Techniques of digital simulation – Information flow, from process to information flow diagram, From information flow diagram to numerical form, Recycles, Calculation of a recycle set, etc.

Essential Reading:

1. W. L. Luyben, *Process Modelling, Simulation and Control for Chemical Engineers*, McGraw Hill, 1990.

Suggested Readings:

1. B. V. Babu, *Process Plant Simulation*, Oxford University Press, 2004.
2. S. S. Rao, *Engineering Optimization: Theory and practice*, New Age Publishers, 1999.
3. A. Hussain and K. Gangaiah, *Optimisation Techniques for Chemical Engineers*, Macmillan, 2001.
4. B. W. Bequette, *Process Control: Modeling, Design and Simulation*. Prentice-Hall India, 2006.

FLUIDIZATION ENGINEERING (3-0-0)

Module – I

Introduction:

The Phenomenon of Fluidization, Liquidlike Behavior of a Fluidized Bed, Advantages and Disadvantages of Fluidized Beds for Industrial Operations, Fluidization Quality,

Industrial Applications of Fluidized Beds:

Historical Highlights: Coal Gasification, Gasoline from Other Petroleum Fractions, Gasoline from Natural and Synthesis Gases, Synthesis Reactions, Metallurgical and Other Processes
Physical Operations: Heat Exchange, Solidification of a Melt to Make Granules, Coating Metal Objects with Plastic, Rying of Solids, Coating of Objects and Growth of Particles, Adsorption

Synthesis Reaction: Phthalic Anhydride, Fischer-Tropsch Synthesis, Acrylonitrile by the Sohio Process, Maleic Anhydride

Cracking of Hydrocarbons: Fluid Catalytic Cracking (FCC), Fluid Coking and Flexi-Coking, Thermal Cracking

Combustion and Incineration: Fluidized Combustion of Coal, Incineration of Solid Waste

Carbonization and Gasification: Gasification of Coal and Coke, Activation of Carbon, Gasification of Solid Waste, Calcination

Reactions Involving Solids: Roasting Sulfide Ores, Silicon for the Semiconductor and Solar Cell Industries, Chlorination and Fluorination of Metal Oxides, Reduction of Iron Oxide, Biofluidization

Module – II

Fluidization and Mapping of Regimes

Fixed Beds of Particles: Characterization of Particles, Fixed Beds-One Size of Particles, Fixed Beds-Solids with a Distribution of Sizes,

Fluidization without Carryover of Particles: Minimum Fluidizing Velocity, u_{mf} , Pressure Drop-versus-Velocity Diagram, Effect of Pressure and Temperature on Fluidized Behaviour, Sintering and Agglomeration of Particles at High Temperature.

The Geldart Classification of Particles

Fluidization with Carryover of Particles: Terminal Velocity of Particles, u_t

Fast Fluidization, Mapping of Fluidization Regimes

The Dense Bed: Distributors, Gas Jets, and Pumping Power

Distributor Types: Ideal Distributors, Perforated or Multiorifice Plates, Tuyeres and Caps, Pipe Grids and Spargers

Pressure Drop Requirements across Distributors

Bubbling Fluidized Beds

Estimation of Bed Properties: Gas Flow in the Emulsion phase, Bubble Gas flow, Bubble Size and Bubbles Growth, Bubble Rise Velocity, Beds with Internals.

Module -III

Solid Movement: Mixing, Segregation and Staging

Vertical Movement of Solids: Dispersion Model, Counterflow Solid Circulation Models, Relating the Counterflow to the Dispersion Model, coarse Particle Beds.

Horizontal Movement of Solids: Mechanistic Model Based on the Davidson Bubble, Mixing index.

Segregation of Particles: Mixing-Segregation Equilibrium, Steady State Separation of Particles.

Large Solid in Beds of Smaller Particles: Large Solids Resting on Distributors.

Books:

1. Fluidization Engineering: Daizo Kunii and Octave Levenspiel

MODERN SEPARATION TECHNIQUES

Module - I

Rate governed processes, definitions and terminologies, Membrane, Types of membranes, Membrane modules, Classification of membrane processes, Materials of membrane construction, Advantages of membrane processes, Major areas of application, preparation and characteristics of membranes.

Module - II

Principles of Reverse osmosis, nano-filtration, ultra-filtration, micro-filtration, osmotic controlled filtration, gel layer controlled filtration. Basic principles and modeling of dialysis.

Module - III

Electric field separation process: Zeta potential, Electric double layer, Basic modeling of electric field enhanced filtration, Ionic separations like Electro dialysis, Electrophoresis. Ion exchange chromatography.

Liquid membrane and its modeling. Basic design of gas separation and pervaporation.

References:

1. W.L. McCabe, J. C. Smith and P. Harriott-"Unit Operations of Chemical Engineering", Mc Graw Hill.
2. C. J. King -"Separation Processes", Tata McGraw Hill Publishing Co Ltd.
3. Ronald W. Rousseau- Handbook of Separation Process Technology, John 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.6.
6. C.J. Geankoplis-"Transport processes and unit Operations", PHI, New Delhi.
7. Kausikh Nath-"Membrane separation Processes", PHI, New Delhi.

FOOD BIOTECHNOLOGY (3-0-0)

Module I: Food quality and Production technology

Analysis of food, major ingredients present in different product, Food additives colour, flavour, vitamins, Single cell protein, mushroom, Fermentative production of food, Pickling and alcoholic beverages, Genetically manipulated crop based food, oriental foods, probiotics/prebiotics in food products.

Module II: Technology for improved process

Enzyme in bakery, fermented cereal products, Enzymes in fat/oil industries, Protease in cheese making, enzymes in beverage production, Utilization of food waste for production of value added products, enzymes in sugar syrup, genetically modified food

Module III: Food spoilage and control

Spoilage of food, Microbiology of water, meat, milk, vegetables, Microbial safety of food products, Chemical safety of food products, heavy metal, fungal toxins, pesticide and herbicide contamination, Food preservatives and additives, Post-harvest technology for food preservation. Technology – canning, dehydration, ultrafiltration, sterilization, irradiation etc.

Text Books

1. Jay, Modern Food Microbiology, CBS Publishers, 1987
2. Frazier, Food Microbiology
3. G.Reed, Prescott and Dunn's Microbiology, CBS publishers, 1987
4. Desrosier, Technology of food preservation, CBS publishers
5. R.P. Singh and D.R. Headman, Introduction to food engineering, Aca. Press

INDUSTRIAL INSTRUMENTATION

Module 1

18 Hours

Introduction: Functional Units, Classification, Performance characteristics, Dynamic Calibration, Errors: An Overview, Statistical Error Analysis, Reliability and Related Topics (Chapter 1 of Text book)

Instruments for Analysis: Introduction, Gas Analysers, Liquid Analysers, X-ray Methods, Chromatography (Chapter 8 of Text Book)

Module II:

10 Hours

Telemetry: Introduction, Pneumatic Means, Electrical Means, Frequency Telemetry, Multiplexing, Modulation, Modulation of Digital Data, Transmission Channels, Briefing of a Telemetry System in Operation, Wireless I/O (Chapter 10 of Text Book)

Module III:

10 Hours

Power Plant Instruments: Introduction, The Power Plant Scheme, Pressure, Temperature, Flow and Level, Vibration and Expansion, Analysis, Flue Gas Analysis (Chapter 12 of Text Book)

Hazard and Safety: Initial consideration, Enclosures, Intrinsic Safety, Prevention of Ignition, Methods of Production, Analysis Evaluation and Construction (Chapter 13 of Text Book)

Text Book:

1. Principles of Industrial Instrumentation, Third Edition, D Patranabis, Tata McGraw Hill Education Private Limited, New Delhi

Reference Books:

1. Process/Industrial Instruments and Controls Handbook, Gregory K. Mc Millian Editor-in-Chief, Douglas M. Considine Late Editor-in-Chief

ALGORITHMS FOR BIOINFORMATICS

Module 1

8Hrs

Introduction, Algorithms and Complexity: Biological Algorithms versus Computer Algorithms, Notations, Algorithm Design Techniques, Tractable versus Intractable Problems.

Molecular Biology Primer: Genes, Molecules, Structure of DNA, Proteins, Analysis.

Exhaustive Search: Restriction Mapping, Impractical Restriction Mapping Algorithms, A Practical Restriction Mapping Algorithm, Regulatory Motifs in DNA Sequences, Profiles, The Motif Finding Problem, Search Trees, Finding Motifs, Finding a Median String.

Module 2

8Hrs

Greedy Algorithms: Genome Rearrangements, Sorting by Reversals, Approximation Algorithms, Breakpoints: A Different Face of Greed, A Greedy Approach to Motif Finding. **Dynamic Programming Algorithms**: The Power of DNA Sequence Comparison, The Change Problem Revisited, The Manhattan Tourist Problem, Edit Distance and Alignments, Longest Common Subsequences, Global Sequence Alignment, Scoring Alignments, Local Sequence Alignment, Alignment with Gap Penalties, Multiple Alignment, Gene Prediction, Statistical Approaches to Gene Prediction, Similarity-Based Approaches to Gene Prediction, Spliced Alignment. **Divide-and-Conquer Algorithms**: Divide-and-Conquer Approach to Sorting, Space-Efficient Sequence Alignment, Block Alignment and the Four-Russians Speedup, Constructing Alignments in Subquadratic Time.

Module 3:

10Hrs

Graph Algorithms: Graphs and Genetics, DNA Sequencing, Shortest Superstring Problem, DNA Arrays as an Alternative Sequencing Technique, Sequencing by Hybridization, SBH as a Hamiltonian Path Problem, SBH as an Eulerian Path Problem, Fragment Assembly in DNA Sequencing, Protein Sequencing and Identification, The Peptide Sequencing Problem, Spectrum Graphs, Protein Identification via Database Search, Spectral Convolution, Spectral Alignment.

Combinatorial Pattern Matching: Repeat Finding, Hash Tables, Exact Pattern Matching, Keyword Trees, Suffix Trees, Heuristic Similarity Search Algorithms, Approximate Pattern Matching, BLAST: Comparing a Sequence against a Database.

Text Book: No Indian Print is available.

References:

- 1) Neil C. Jones and Pavel A. Pevzner, An Introduction to Bioinformatics Algorithms, MIT Press, 2004.
- 2) Bioinformatics Algorithms, Techniques & Applications – Wiley Inter Science
- 3) Wing-Kin Sung, "Algorithms in Bioinformatics: A Practical Introduction", CRC Press (Taylor & Francis Group), 2009.
- 4) Ion Mandoiu, Alexander Zelikovsky, Bioinformatics Algorithms: Techniques and Applications Wiley, 2008.
