JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
COLLEGE OF ENGINEERING (Autonomous), ANANTHAPURAMU
B.Tech (Chemical Engineering) :2017-18
COURSE STRUCTURE

I YEAR I Semester

S.No	Subject code	Subject	L	T	P	C
1	17A15501	English	3	-	-	3
2	17A15101	Mathematics -I	2	2	-	3
3	17A15302	Physical Chemistry	2	2	-	3
4	17A10101	Environmental Studies	3	-	-	3
5	17A10103	Engineering Mechanics& Strength of Materials	2	2	-	3
6	17A10501	Problem Solving & Computer Programming	3	-	-	3
7	17A15304	Physical Chemistry Lab	-	1	3	2
8	17A13501	Engineering Workshop & IT Workshop	-	1	3	2
9	17A15502	English Language Communication Skills Lab.	-	1	3	2
10	17A10801	Comprehensive Objective type Examination	-	-	-	1
		Total	15	8	9	25

I YEAR II Semester

S.No	Subject code	Subject	L	T	P	C
1	17A25501	Technical Communication and Presentation Skills	3	-	-	3
2	17A25101	Mathematics -II	2	2	-	3
3	17A25201	Engineering Physics	2	2	-	3
4	17A20303	Engineering Drawing	1	1	3	3
5	17A22401	Elements of Electrical and Electronics Engineering	3	-	-	3
6	17A20801	Introduction to Chemical Engineering	3	-	-	3
7	17A25202	Engineering Physics Lab	-	1	3	2
8	17A20504	Computer Programing Lab	-	1	3	2
9	17A22402	Electrical and Electronics Engineering Lab	-	1	3	2
10	17A29901	Community Service (Audit)	-	-	2	-
11	17A20304	Comprehensive Objective type Examination	-	-	-	1
		Total	14	08	14	25

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CHEMICAL ENGINEERING DEPARTMENT

II YEAR I SEMESTER

S.No.	Subject code	Subject	L	T	P	C
1	17A35102	**Mathematical Methods**	2	2	-	3
2	17A35301	Organic Chemistry	2	2	-	3
3	17A30801	Chemical Process Calculations	2	2	-	3
4	17A30802	Momentum Transfer	2	2	-	3
5	17A30803	Material science for Chemical Engineers	2	2	-	3
6	17A30804	Process instrumentation	2	2	-	3
7	17A39901	**Human Values & Professional Ethics(Audit)**	2	-	-	-
8	17A30104	Organic Chemistry Lab	-	-	2	1
9	17A30805	Momentum Transfer Lab	-	-	2	1
10	17A35104	Exploratory Data Analysis	-	-	2	1
11	17A30806	**Comprehensive Objective type Examination**	-	-	-	1
		Total	**14**	**12**	**6**	**22**

II YEAR II SEMESTER

S.No.	Subject code	Subject	L	T	P	C
1	17A45402	**Management Science**	3	-	-	3
2	17A45102	**Probability and Statistics**	2	2	-	3
3	17A40801	Analytical Chemistry	2	-	-	2
4	17A40802	Process Heat Transfer	2	2	-	3
5	17A40803	Mechanical Operations	2	2	-	3
6	17A40804	Chemical Engineering Thermodynamics	2	2	-	3
7	17A40805	**Mechanical Operations Lab**	-	1	2	1
8	17A40806	Process Heat Transfer Lab	-	1	2	1
9	17A40807	**Comprehensive Objective type Examination**	-	-	-	1
		Total	**13**	**10**	**4**	**20**

III YEAR I SEMESTER

S.No	Subject code	Subject	L	T	P	C
1	17A50801	Process Dynamics & Control	3	-	-	3
2	17A50802	Phase and Chemical Equilibria	3	-	-	3
3	17A50803	Chemical Reaction Engineering-I	2	2	-	3
4	17A50804	Mass Transfer Operations-I	2	2	-	3
5	17A50805	Chemical Technology	2	2	-	3
6	17A50806	Process Modelling & Simulation	3	-	-	3
7	17A59901	**Foreign Language (Audit)**	2	-	-	-
8	17A50807	Process Dynamics & ControlLab	-	-	4	2
9	17A50808	Energy & Environmental Engineering Lab	-	-	2	1
10	17A59902	**Internship / Skill Development (Audit)**	-	-	-	-
11	17A50809	**Comprehensive Objective type Examination**	-	-	-	1
		Total	**17**	**6**	**8**	**23**

III YEAR II SEMESTER

S.No.	Subject code	Subject	L	T	P	C
1	17A60801	Mass Transfer Operations-II	3	-	-	3
2	17A60802	Chemical Reaction Engineering-II	2	2	-	3
3	17A60803	Chemical Plant Design and Economics	3	-	-	3
	17A60804	Chemical Process Equipment Design	3	-	-	3
4	17A60805	Industrial Pollution Control Engineering	3	-	-	3
5	17A60806	**Open Elective I**	2	2	-	3
6	17A65501	**Advanced Communication Skills Lab**	-	1	3	2
7	17A60807	Mass Transfer Operation Lab	-	-	2	1
10	17A60808	Chemical Reaction Engineering Lab	-	-	2	1
11	17A60809	**Comprehensive Objective type Examination**	-	-	-	1
		Total	**16**	**5**	**7**	**23**

Open Elective:
1. **Basics of Nanotechnology**
2. **Green Technology**
3. **Nuclear Engineering**
4. **Solid Waste management**

IV YEAR I SEMESTER

S.No.	Subject code	Subject	L	T	P	C
1	17A70801	Transport Phenomena	4	-	-	4
2	17A70802	Optimization of Chemical Processes	4	-	-	4
3	17A70803	Separation Processes	3	-	-	3
4	17A70804	Industrial Safety & Hazard Management	3	-	-	3
5	17A70805	**Open Elective-II**	3	-	-	3
6	17A70806	**Elective – I**	3	-	-	3
7	17A79906	**MOOC-I (Audit)**	-	-	-	-
8	17A70807	Process Equipment Design & Drawing Lab	-	1	3	2
9	17A70808	Process Simulation Lab	-	1	3	2
10	17A70809	**Comprehensive Objective type Examination**	-	-	-	1
		Total	**20**	**2**	**6**	**25**

Open Elective-II:
1. **Applied Numerical Methods**
2. **Computational Fluid Dynamics**
3. **Design & Analysis of Experiments**

Elective I:
1. **Energy Engineering**
2. **Non-Conventional Sources of Energy**
3. **Waste to Energy Conversion Technologies**

Note: Project Work shall initiate in IV-I Semester with a target of submission of Abstract and finalization of topic, and the evaluation of project work shall be done in IV-II Semester

*** The student should select the subject in the open elective which is not studied in previous semesters.**

**** The student can select the subject of any discipline for MOOC-I. However the agency will decide by the BoS Chair persons.**

IV YEAR II SEMESTER

S.No.	Subject code	Subject	L	T	P	C
1	17A80801	**Elective – II**	3	-	-	3
2	17A80802	**Elective – III**	3	-	-	3
3	17A80803	**Elective – IV**	3	-	-	3
4	17A80804	**Elective – V**	3	-	-	3
5	17A89906	**MOOC-II(Audit)**	-	-	-	-
6	17A80805	**Seminar**	-	-	2	1
7	17A80806	**Project Work**	-	-	16	8
8	17A80807	**Comprehensive Objective type Examination**	-	-	-	1
		Total	**12**	**-**	**18**	**22**

***** The student should select the subject of discipline centric for MOOC-II. However the agency will decide by the BoS Chair persons.**

Note: All End Examinations (Theory and Practical) are of three hours duration.

L – Lectures T- Tutorial P – Practical/Drawing C – Credits

Elective II:
1. **Bio-Chemical Engineering**
2. **Industrial Biotechnology**
3. **Enzyme Engineering**

Elective III:
1. **Fluidization Engineering**
2. **Interfacial Engineering**
3. **Polymer Technology**

Elective IV:
1. **Technology of Pharmaceuticals & Fine Chemicals**
2. **Food Processing Technology**
3. **Corrosion Engineering**

Elective V:
1. **Petroleum Refining & Petrochemicals**
2. **Rheology of Polymers**
3. **Process Intensification**

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I Year B.Tech - I Semester

ENGLISH(17A15501)
(Common to all Branches)

OBJECTIVES:

1. To enable the students to communicate in English for academic and social purpose
2. To enable the students to acquire structure and written expressions required for their profession.
3. To develop the listening skills of the students
4. To inculcate the habit of reading for pleasure
5. To enhance the study skills of the students with emphasis on LSRW skills

SYLLABUS:

UNIT –I

Chapter entitled *Humour* from "Using English"
Chapter entitled '*Homi Jehangir Bhabha'* from "New Horizons"

L- Listening -Techniques - Importance of phonetics
L- Meet & Greet and Leave taking, Introducing Oneself and Others (Formal and Informal situations)
R- -Reading Strategies -Skimming and Scanning
W- Writing strategies- sentence structures
G-Parts of Speech –Noun-number, pronoun-personal pronoun, verb- analysis
V-Affixes-prefix and suffix, root words, derivatives

UNIT –II

Chapter entitled *Inspiration* from "Using English"
Chapter entitled 'My Struggle for an Education' from "New Horizons"

L- Listening to details
S- Apologizing, Interrupting, Requesting and Making polite conversations
R-note making strategies
W- Paragraph-types- topic sentences, unity, coherence, length , linking devices
G-Auxiliary verbs and question tags
V- synonyms-antonyms, homonyms , homophones, homographs, words often confused

UNIT –III

Chapter entitled *Sustainable Development* from "Using English"
Chapter entitled 'The Autobiography of Abraham Lincoln' from "New Horizons"

L- Listening to themes and note taking

S- Giving instructions and Directions, making suggestions, Accepting ideas, fixing a time and Advising

R- Reading for details -1

W- Resume and cover letter

G- Tenses – Present tense, Past tense and Future tense

V-Word formation and One-Word Substitutes

UNIT –IV

Chapter entitled *Relationships* from "Using English"

Chapter entitled ' T*he Happy Prince* from "New Horizons"

L- Listening to news

S- Narrating stories, Expressing ideas and opinions and telephone skills

R- Reading for specific details and Information

W- Technical Report writing-strategies, formats-types-technical report writing

G- Voice and Subject – Verb Agreement

V- Idioms and prepositional Phrases

UNIT –V

Chapter entitled Science and Humanism from "Using English"

Chapter entitled 'If'from "New Horizons"

L- Listening to speeches

S- Making Presentations and Group Discussions

R- Reading for Information

W- E-mail drafting

G- Conditional clauses and conjunctions

V- Collocations and Technical Vocabulary and using words appropriately

EXPECTED OUTCOME:

The students will get the required training in LSRW skills through the prescribed texts and develop communicative competence

Prescribed Books:

1. **Using English (for detailed study)** published by Orient Black Swan, 2013
2. **New Horizons** published by Pearson, 2013

Suggested Reading:

1. **Raymond Murphy's English Grammar with CD,** Murphy, Cambridge University Press, 2012.
2. **English Conversation Practice –**Grant Taylor, Tata McGraw Hill,2009.
3. **Communication Skills, Sanjay Kumar & Pushpalatha** Oxford University Press, 2012.
4. **A Course in Communication Skills**- Kiranmai Dutt & co. Foundation Books, 2012.
5. **Current English grammar and usage-**S M Guptha, PHI, 2013.
6. **Modern English Grammar**-Krishna SWAMI .McMillan, 2009.
7. **Powerful Vocabulary Builder**- Anjana Agarwal New Age International Publishers, 2011.
8. **Writing with a Purpose, Tickoo and Sasi Kumar, OUP, 2011**
9. **Strengthen Your Writing, Orient Blackswan**

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I Year B.Tech - I Semester

MATHEMATICS – I(17A15101)

(Common to All Branches)

Objectives

- To train the students thoroughly in Mathematical concepts of ordinary differential equations and their applications.
- To prepare students for lifelong learning and successful careers using mathematical concepts of differential and Integral calculus, ordinary differential equations and vector calculus.
- To develop the skill pertinent to the practice of the mathematical concepts including the students abilities to formulate and modeling the problems, to think creatively and to synthesize information.

UNIT – I

Exact, linear and Bernoulli equations, Applications to first order equations.

Non-homogeneous linear differential equations of second and higher order with constant coefficients with RHS term of the type e^{ax}, sin ax, cos ax, polynomials in x, e^{ax} V(x), xV(x), method of variation of parameters, linear equations with variable coefficients: Euler-Cauchy Equations, Legendre's linear equation. Applications of linear differential equations- Mechanical and Electrical oscillatory circuits and Deflection of Beams.

UNIT – II

Taylor's and Maclaurin's Series - Functions of several variables – Jacobian – Maxima and Minima of functions of two variables, Lagrange's method of undetermined Multipliers with three variables only. Radius of curvature, center of curvature, Involutes, evolutes and envelopes..

UNIT – III

Curve tracing – Cartesian, polar and parametric curves. Length of curves, surface area of solid of revolution (single integrals)

UNIT – IV

Multiple integral – Double and triple integrals – Change of Variables – Change of order of integration. Applications to areas and volumes in Cartesian and polar coordinates using double and triple integral.

UNIT – V

Vector Calculus: Gradient – Divergence – Curl and their properties; Vector integration – Line integral - Potential function – Area – Surface and volume integrals. Vector integral theorems: Green's theorem – Stoke's and Gauss's Divergence Theorem (Without proof). Application of Green's, Stoke's and Gauss's Theorems.

TEXT BOOKS:

1. Engineering Mathematics-I, E. Rukmangadachari & E. Keshava Reddy, Pearson Publisher
2. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.

REFERENCES:

1. Engineering Mathematics Volume-I, by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad, S.Chand publication.
2. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India.
3. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
4. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier.

Outcomes:

- The students become familiar with the application of differential and integral calculus, ordinary differential equations and vector calculus to engineering problems.
- The students attain the abilities to use mathematical knowledge to analyze, formulate and solve problems in engineering applications.

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I Year B.Tech - I Semester

PHYSICAL CHEMISTRY(17A15302)

Course Objectives:

- To acquire basic knowledge of basic types of reactions
- To acquire knowledge about the mechanisms through which the chemical reactions proceed.
- To understand the impact of nature on metals.

Unit-I: Kinetics

Introduction to chemical kinetics-theories of reaction rates-Collision theories-Modified collision theory – Absolute reaction rate theory (Transition state theory)-reaction between ions, Chain reactions-Hydrogen and bromine, hydrogen and oxygen (Steady state treatment)-.explosion limits.

UNIT-II: Colloids

Definition of colloids, classification of colloids, solids in liquids (Sols) – properties, kinetics, optical and electrical, stability of colloids, protective action, Hardy-Schultze Law, Gold Number. Liquids in liquids (Emulsions) -Types of Emulsions, preparation, Emulsifier. Liquids in solids (Gels) – Classification, preparation & properties, Inhibition, General, applications of colloids.

UNIT-III: Catalysis

Definition-Homogeneous and heterogeneous Catalysis- Characteristics of a good catalyst-Theories of Catalysis: Intermediate compound formation theory and adsorption theory, relevant examples- Types of catalysis: Acid-base catalysis and enzymatic catalysis (10h)

Unit-IV: Surface Chemistry

Adsorption, characteristics of adsorption, physical & chemical adsorption, Langumuir adsorption isotherm, B.E.T. equation, BET plot, surface area determination of solids. Numerical calculations of surface area, Heterogenous catalysis, Mechanism of catalysis-Langmuir-Hinsel Wood mechanism of surface catalyzed reactions, Eley-Rideal mechanism surface catalysed reactions. Applications of catalysis in industry. (12h)

UNIT-V: Electrochemistry

i)Review of electrochemical cells, Numerical calculations, Batteries: Rechargeable batteries (Lead acid, Ni-Cd, Lithium Ion Batteries),Fuels cells: (Hydrogen-Oxygen and Methanol-Oxygen)

ii)Electrochemical sensors: Potentiometric Sensors and Voltammetric sensors. Examples : analysis of Glucose and urea

iii)Corrosion: Electrochemical Theory of corrosion, Factors affecting the corrosion. Prevention: Anodic and cathodic protection and electro and electroless plating. (12h)

Course Outcome:

The student may acquire enough knowledge on industrial processes and Products

BOOKS:

1. Quantitative analysis, R.A.Day & A.L. Underwood , 5th edition, Printice- Hall of India Pvt. Ltd., 2000.
2. Vogel's Text Book of Qualitative chemical analysis, J. Mendham, R.C.Denney, J. Darnes, M.J.K. Thomas, Persar education 6th edition, 2002.
3. Elements of Physical Chemistry-Peter Atkins, Oxford Uni.Press, 3rd Edition, 2010.

REFERENCES:

1. Atkin's Physical Chemistry – P. Atkins and J. De Paula, Oxford Univ.Press, 9th Edition, 2012
2 Instrumental lMethods of Chemical Analysis, Gurdeep R.Chatwal, Sham K.Ananad, Himalayha publishing House,5th Edition, 2012.
3. Advanced physical chemistry – Gurudeepraj, Goel Publishing House, 2000
4. Essentials of Physical Chemistry- Arun Bahl, B.S.Bahl and G.D.Tuli, S.Chand Publishers, New Delhi.

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I Year B.Tech - I Semester

ENVIRONMENTAL STUDIES(17A10101)

(Common to all Branches)

OBJECTIVE: To make the students to get awareness on environment, to understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life to save earth from the inventions by the engineers.

UNIT – I

MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES: – Definition, Scope and Importance – Need for Public Awareness.

NATURAL RESOURCES : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

UNIT – II

ECOSYSTEMS: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

a. Forest ecosystem.
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

BIODIVERSITY AND ITS CONSERVATION : Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity –

Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III

ENVIRONMENTAL POLLUTION: Definition, Cause, effects and control measures of :

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

SOLID WASTE MANAGEMENT : Causes**,** effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

UNIT – IV

SOCIAL ISSUES AND THE ENVIRONMENT: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

UNIT – V

HUMAN POPULATION AND THE ENVIRONMENT: Population growth, variation among nations. Population explosion – Family Welfare Programmed. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

FIELD WORK : Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc..

TEXT BOOKS :

(1) Text book of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, Universities Press.
(2) Environmental Studies by Palaniswamy – Pearson education
(3) Environmental Studies by Dr.S.Azeem Unnisa, Academic Publishing Company

REFERENCES :

(1) Textbook of Environmental Science by Deeksha Dave and E.Sai Baba Reddy, Cengage Pubilications.
(2) Text book of Environmental Sciences and Technology by M.Anji Reddy, BS Publication.

(3) Comprehensive Environmental studies by J.P.Sharma, Laxmi publications.
(4) Environmental sciences and engineering – J. Glynn Henry and Gary W. Heinke – Printice hall of India Private limited.
(5) A Text Book of Environmental Studies by G.R.Chatwal, Himalaya Pubilishing House
(6) Introduction to Environmental engineering and science by Gilbert M. Masters and Wendell P. Ela - Printice hall of India Private limited.

Outcomes:

- Gain a higher level of personal involvement and interest in understanding and solving environmental problems.
- Comprehend environmental problems from multiple perspectives with emphasis on human modern lifestyles and developmental activities.
- Demonstrate knowledge relating to the biological systems involved in the major global environmental problems of the 21st century
- Recognize the interconnectedness of — human dependence — on the earth's ecosystems
- Influence their society in proper utilization of goods and services.
- Learn the management of environmental hazards and to mitigate disasters and have a clear understanding of environmental concerns and follow sustainable development practices.

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I Year B.Tech - I Semester

ENGINEERING MECHANICS & STRENGTH OF MATERIALS (17A10103)

Objective: This course will serve as a basic course by introducing the concepts of basic mechanics which will help as a foundation to various courses.

UNIT – I

Introduction of Engineering Mechanics – Basic concepts – System of Forces – Momentum of forces and its applications – Couples and Resultant of Force system – Equilibrium of System of Forces – Degree of Freedom – Free body diagrams – Types of Supports –Support reaction for beams with different types of loading – Concentrated, uniformly distributed and uniformly varying loading.

UNIT – II

Friction – Types of friction – laws of friction – limiting friction –Cone of limiting friction – Static and Dynamic frictions – Motion of bodies – Wedge, Screw jack and differential screw jack.

Centroid and Center of Gravity: Centroid of simple figures – Centroids of Composite figures – Centre of Gravity of bodies – Area moment of Inertia – parallel axis and perpendicular axis theorems – Moment of Inertia of Composite figures.

Mass Moment of Inertia: Moment of inertia of simple solids – Moment of Inertia of composite masses (Simple problems only)

UNIT – III

Simple Stresses and Strains: Deformable bodies – Elasticity and plasticity – Types of stresses and strains – Hooke's law – Stress – strain diagram for mild steel – working stress – Factor of safety – lateral strain, Poisson's ratio and volumetric strain –

Elastic moduli and the relationship between them – Bars of Varying section – Composite bars – Temperature stresses. Strain energy – Resilence – Gradual, Sudden, impact and shock loadings – simple applications.

UNIT – IV

Shear Force and Bending Moment: Definition of beam – types of beams – Concept of Shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and over changing beams subjected to point loads, uniformly distributed load, uniformly varying loads and combination of these loads – point of contra flexure – Relation between S.F, B.M and rate of loading at section of a beam.

UNIT – V

Flexural Stresses: Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/Y = E/R – Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hallow), I, T, Angle and Channel Sections – Design of simple beam sections.

Shear Stresses: Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T and angle sections.

TEXT BOOKS:

(1) Engineering Mechanics by Shames & Rao – Pearson Education
(2) Engineering Mechanics by Dr. R.K Bansal, Lakshmi Publications
(3) Strength of Materials by Ghosh & Datta, New Age Publishers
(4) Strength of Materials by B.C Punmia – laxmi publications

REFERENCES:

(1) Engineering Mechanics by Fedrinand L.Singer – Harper Collings publishers
(2) Engineering Mechanics by Shesigiri Rao, Universities Press, Hyderabad
(3) Engineering Mechanics by B.Bhattacharya, Oxford University Publications
(4) Engineering Mechanics by Rjasekharan , Vikas Publications
(5) Engineering Mechanics by S.Timoshenko, D.H Young and J.V Rao, Tata McGraw-Hill Company
(6) A Text book of strength of materials by R.K Bansal – Laxmi publications (p) Ltd, New Delhi
(7) Strength of Materials by R.Subramanian, Oxford University Press

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I Year B.Tech. I-Sem

PROBLEM SOLVING USING C(17A10501)

Course Objectives:

- To understand the various steps in Program development.
- To understand the basic concepts in C Programming Language.
- To learn how to write modular and readable C Programs
- To understand the basic concepts such as Abstract Data Types, Linear and Non Linear Data structures.
- To understand the notations used to analyze the Performance of algorithms.
- To understand and analyze various searching and sorting algorithms.

UNIT - I

Introduction: Programs and Programming, Programming Languages, Compiler, Interpreter, Loader and Linker, Program Execution, Classification of Programming, Structured Programming Concept, Algorithms, Flowcharts, System Developments.

Fundamentals Algorithms: Exchange the Values between two variables, Counting, Summation of set of numbers, Factorial Computation, Generation of the Fibonacci sequence, Reversing the digits of a integer.

Basics Of C: Introduction**,** Developing Programs in C, A Simple C program, Parts of C Program Revisited.

UNIT – II

Structure of C: Structure of a C Program, Concept of a Variable, Data Types in C, Program Statements, Declaration, Tokens, Operators and Expressions, Type conversion in C.

Input and Output: Introduction, Basic Screen and Keyboard I/O in C, Non-Formatted Input and Output, Formatted Input and Output Function.

Control Statements: Introduction, Specifying Test Condition for Selection and Iteration, Writing Test Expression, Conditional Execution and Selection, Iteration and Repetitive Execution. Nested Loops.

UNIT – III

Arrays and Strings: Introduction, One-Dimensional Array, Strings, Multidimensional Arrays, Arrays of Strings.

Function: Introduction, Concept of Functions, Using Functions, Call by Value Mechanism, Working with Functions, Passing Arrays to Functions, Scope and Extent, Inline Function, Recursion.

UNIT - IV

Factoring Methods: Finding Square root of a Number, The Smallest Deviser of an Interger, The GCD of Two Integers, Generating Prime Numbers.

Pointers – Introduction, Understanding Memory, Address Operator, Pointer, Void Pointer, Null Pointer, Use of pointer, Arrays and Pointers, Pointers and string, Pointers and string, Pointers to pointers, Array of pointers, Pointers to Function, Dynamic Memory Allocation,.

UNIT – V

User-Defined Data Types and Variables: Introduction, User-defined Data Types, Structures, Union, Enumeration Types.

Files in C: Introduction, Using Files in C, Working with text Files, Working with Binary Fields, Direct File Input and Output, Files of Records, Random Access to Files of Records.

TEXT BOOKS:

1. Programming in C, Pradip Dey, Manas Ghosh, Second Edition, OXFORD,
2. How to Slove it by Computer by R.G. Dromey, Pearson.

REFERENCES:

1. Programming in C and Data Structures, Jeri R. Hanly, Elliot B. Koffman, Ashok Kamthane and A.Ananda Rao, Pearson Education.
2. C Programming with problem solving, J.A. Jones & K. Harrow, dreamtech Press
3. Programming In C, Remma Teraja, Second Edition OXFORD.
3 Programming in C – Stephen G. Kochan, III Edition, Pearson Eductaion.
3. C for Engineers and Scientists, H.Cheng, Mc.Graw-Hill International Edition
4. Education / PHI
5. C Programming & Data Structures,E.Balagurusamy,TMH.

Outcomes:

- Able to design the flowchart and algorithm for real world problems
- Able to learn and understand new programming languages
- Able to construct modular and readable programs
- Able to write C programs for real world problems using simple and compound data types
- Adapt programming experience and language knowledge to other programming language contexts
- Employee good programming style, standards and practices during program development

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I Year B.Tech - I Semester

PHYSICAL CHEMISTRY LAB(17A15304)

Course Objectives:
To confirm the formation and nature of the product in a chemical processes, the knowledge of some physical, chemical and instrumental methods is essential for a chemical engineer.

I. PHYSICAL CHEMISTRY LAB:

1. Determination of Specific rotation of substance by Polarimeter.
2. Study of inversion of Sucrose by Polarimetry.
3. Conductometric titration of Strong acid Vs Strong base.
4. Conductometric titration of Weak acid Vs Strong base.
5. Potentiometric titration between Potassium Dichromate and Ferrous iron.
6. Potentiometric Titration of Strong acid Vs Strong base
7. a)Determination of the specific rate (first order kinetics) of the hydrolysis of Methyl acetate by volumetric method.
   b) Study of first order kinetics(hydrolysis of methylacetat by raising $10^{o}C$
8. Study of Adsorption characteristics of acetic acid on Charcoal.
9. Estimation of critical solution temperature of Phenol-Water System.
10. Determination of Molecular weight of a given Polymer from Visicocity measurements.

(Any 10 experiments from the above list)

Course Outcomes

- Would be confident in handling energy storage systems and would be able combat chemical corrosion
- Would have acquired the practical skill to handle the analytical methods with confidence.
- Would feel comfortable to think of design materials with the requisite properties
- Would be in a postion to technically address the water related problems.

TEXT BOOKS:

1. Vogel's Text book of Quantitative Chemical Analysis, Sixth Edition – J. Mendham et al, Pearson Education.
2. Chemistry Practical – Lab Manual by Chandra Sekhar, GV Subba Reddy and Jayaveera.

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I B.Tech.-I Sem

Engineering & IT Workshop(17A13501)

(Common to All Branches)

Part – A: Engineering Workshop Lab

Objectives:

- Make the students correctly use measuring and marking tools
- Practice the correct use of hand tools
- Apply safe workshop practices when performing basic fitting, carpentry, tin smithy and electrical wiring skills
- Develop the fabrication skills among the students
- Read and interpret the component drawings
- Gain practical skills to apply student's knowledge of theory concepts in real time practice

1. TRADES FOR EXERCISES:

At least 2 exercise In each:

1. Carpentry
2. Fitting
3. House-wiring
4. Black Smithy
5. Tin smithy
6. Power Tools Demonstration

TEXT BOOK:

1. Work shop Manual / P.Kannaiah/ K.L.Narayana/ Scitech Publishers.

Objective: The objective of this subject is to provide the basic concepts about different manufacturing processes and use of various workshop tools the exposer to the Power tools used in the inclusion

Question Paper pattern: Test in any two out of 6 trades.

Outcomes:

- Expected to improve practical skills
- Able to develop and fabricate the experimental setups for academic and research purposes.
- Able to assemble components for making various systems

PART – B: IT Workshop

Objectives:

- To provide Technical training to the students on Productivity tools like Word processors, Spreadsheets, Presentations
- To make the students know about the internal parts of a computer, assembling a computer from the parts, preparing a computer for use by installing the operating system
- Disassemble and Assemble a Personal Computer and prepare the computer ready to use
- Prepare the Documents using Word processors
- Prepare Slide presentations using the presentation tool
- Install single or dual operating systems on computer

Preparing your Computer (4 weeks)

Task 1: Identify the internal parts of a computer of a computer, and its peripherals. Represent the same in the form of diagrams including Block diagram.

Task 2: Disassemble and assemble the PC back to working condition. Students should be able to trouble shoot the computer and identify working and non-working parts. Student should identify the problem correctly by various methods available. Students should record the process of assembling and trouble shooting a computer.

Task 3: Student should install Linux on the computer. Student may install another operating system (including proprietary software) and make the system dual boot or multi boot. Students should record the entire installation process.

Task 4: Students should record the various features that are supported by the operating system installed and submit it.

Productivity tools (3 weeks)

Task 5: Word Processor: Students should be able to create documents using the word processor tool. Some of the tasks that are to be performed are inserting and deleting the characters, words and lines, Alignment of the lines, Inserting header and Footer, changing the font, changing the colour, including images and tables in the word file, making page setup, copy and paste block of text, images, tables etc, linking the images which are present in other directory, formatting paragraphs, spell checking, etc. Students should be able to prepare project cover pages etc at the end of the task. Students should submit a user manual of the word processor considered.

Task 6: Spreadsheet: Students should be able to create, open, save the application documents and format them as per the requirement.Some of the tasks that may be practiced are Managing the worksheet environment, creating cell data, inserting and deleting cell data, format cells, adjust the cell size, applying formulas and functions, preparing charts, sorting cells. Students should submit a user manual of the Spreadsheet application considered.

Task 7: Presentations : creating, opening, saving and running the presentations; Selecting the style for slides, formatting the slides with different fonts, colours; creating charts and tables, inserting and deleting text, graphics and animations; bulleting and numbering; hyperlinking, running the slide show, setting the timing for slide show. Students should submit a user manual of the Presentation tool considered.

References:

1. "Introduction to Computers", Peter Norton, Mc Graw Hill
2. "LaTeX Companion" – Leslie Lamport, PHI/Pearson.
3. "MOS study guide for word, Excel, Powerpoint & Outlook Exams", Joan Lambert, Joyce Cox, PHI.
4. "Introduction to Information Technology", ITL Education Solutions limited, Pearson Education.
5. "Networking your computers and devices", Rusen, PHI "Trouble shooting, Maintaining & Repairing PCs", Bigelows, TMH.

Outcomes:

- Students attain complete knowledge of a computer i.e. hardware as well as operating systems.
- Students will be technically strong in using Word processors, Spreadsheets.
- Prepare Slide presentations that helps them in their career

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I Year B.Tech - I Semester

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ENGLISH LANGUAGE COMMUNICATION SKILLS (ELCS) LAB (17A15502)

The **Language Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations and contexts.

OBJECTIVES:

1.To train students to use language effectively in everyday conversations, to participate in group discussions, to help them face interviews, and sharpen public speaking skills

2.To expose the students to a varied blend of self-instructional learner-friendly modes of language learning through computer-aided multi-media instruction.

3.To enable them to learn better pronunciation through stress on word accent, intonation, and rhythm.

4.To help the second language learners to acquire fluency in spoken English and neutralize mother tongue influence

5.To train students to use language appropriately for interviews, group discussion and public speaking

SYLLABUS:

UNIT- I

Phonetics – Introduction to Sounds of Speech – Vowels – Consonants – Phonetic Transcription & Orthographic Transcription

UNIT – II

Syllabification – Word Stress – Rules of word stress – Intonation – Falling tone and Rising tone

UNIT – III

Situational Dialogues – Role-play – Expressions in various situations – Self Introduction – Introducing others – Greetings – Apologies – Requests – Social and Professional etiquettes – Telephone Etiquettes

UNIT – IV

JAM – Describing object/person/place/situation – Giving directions

UNIT – V

Debates and Group Discussions

OUTCOMES :

- Develop linguistic and communicative competence through the development of the language skills.
- Becoming active participants in the learning process and acquiring proficiency in spoken English of the students
- Speaking with clarity and confidence thereby enhancing employability skills of the students

MINIMUM REQUIREMENT FOR ELCS LAB:

The English Language Lab shall have two parts:

1. Computer Assisted Language Learning (CALL) Lab:
   The Computer aided Language Lab for 60 students with 60 systems, one master console, LAN facility and English language software for self- study by learners.
2. The Communication Skills Lab with movable chairs and audio-visual aids with a P.A. system, Projector, a digital stereo-audio & video system and camcorder etc.

System Requirement (Hardware component):

Computer network with LAN with minimum 60 multimedia systems with the following specifications:

i) P – IV Processor
   a) Speed – 2.8 GHZ
   b) RAM – 512 MB Minimum
   c) Hard Disk – 80 GB

ii) Headphones of High quality

Suggested software:

1. Clarity Pronunciation Power – Part I (Sky Pronunciation)
2. Clarity Pronunciation Power – part II
3. K-Van Advanced Communication Skills
4. TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
5. *DELTA's key to the Next Generation TOEFL Test: Advanced Skills Practice.*
6. Lingua TOEFL CBT Insider, by Dreamtech
7. English Pronunciation in Use (Elementary, Intermediate, Advanced) CUP
8. Cambridge Advanced Learners' English Dictionary with CD.

Reference books:

1. **A Textbook of English Phonetics for Indian Students** 2nd Ed T. Balasubramanian. (Macmillian),2012.
2. **A Course in Phonetics and Spoken English**, Dhamija Sethi, Prentice-Hall of India Pvt.Ltd
3. **Speaking English Effectively**, 2nd Edition Krishna Mohan & NP Singh, 2011. (Mcmillan).
4. **A Hand book for English Laboratories**, E.Suresh kumar, P.Sreehari, Foundation Books,2011
5. **English Pronunciation in Use. Intermediate &Advanced** ,Hancock, M. 2009. CUP
6. **Basics of Communication in English** ,Soundararaj, Francis. 2012.. *New Delhi: Macmillan*
7. **Spoken English** (CIEFL) in 3 volumes with 6 cassettes, OUP.
8. **English Pronouncing Dictionary**, Daniel Jones Current Edition with CD.Cambridge, 17th edition, 2011.

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I- Year B.Tech. I-Sem

Comprehensive Objective Type Examination (17A10801)

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I- Year B.Tech. II-Sem

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TECHNICAL COMMUNICATION &PRESENTATION SKILLS (17A25501)

Preamble:

In the increasingly globalized world, technical communication and presentation skills are assuming great importance. Industries and employers constantly complain that young engineers have adequate technical knowledge, but no communication and presentation skills. Success is defined these days in terms of possessing these skills. The syllabus has been designed to develop communicative competencies of the students.

Objectives:

1. To develop awareness in students of the relevance and importance of technical communication and presentation skills.
2. To prepare the students for placements
3. To provide students with interactive practice sessions to make them internalize these skills

UNIT 1:

Basics of Technical Communication – Introduction – Objectives & Characteristics of Technical Communication – Importance and need for Technical communication - LSRW Skills – Barriers to effective communication

UNIT II

Informal and Formal Conversation - Verbal and Non-verbal communication –Kinesics, Proxemics, Chronemics, Haptics, Paralanguage

UNIT III

Written communication – Differences between spoken and written communication – Features of effective writing –Advantages and disadvantages of spoken and written communication

UNIT IV

Presentation Skills – Nature and importance of oral presentation – Defining the purpose – Analyzing the audience - Planning and preparing the presentation, organizing and rehearsing the presentation –Individual and group presentations - Handling stage fright

UNIT V

Interview Skills – The Interview process –Characteristics of the job interview – Pre-interview preparation techniques – Projecting the positive image – Answering Strategies

Prescribed Books

1. Effective Technical Communication, Ashrif Rizvi, TataMcGrahill, 2011
2. Technical Communication by Meenakshi Raman & Sangeeta Sharma, O U Press 2009

Reference Books

1. Communication Skills by Pushpalatha & Sanjay Kumar, Oxford Univsesity Press

2. Books on TOEFL/GRE/GMAT/CAT/ IELTS by Barron's/DELTA/Cambridge University Press.2012.

3. Soft Skills for Everyone, Butterfield Jeff, Cengage Publications, 2011.

4. Management Shapers Series by Universities Press (India) Pvt Ltd., Himayatnagar, Hyderabad 2008.

5. Handbook for Technical Writing by David A McMurrey & Joanne Buckely CENGAGE Learning 2008.

6. English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata Mc Graw-Hill 2009.

Outcomes:

- Turning out the students with a clear concept of communication like speaking convincingly, express their opinions clearly, initiate a discussion, negotiate, and argue using appropriate communicative strategies
- Read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well as for method of presentation
- Getting them ready for placements and equipping them with readiness to implement their communication and Presentation skills at work place.

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I- Year B.Tech. II-Sem

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MATHEMATICS – II(17A25101)
(Common to All Branches)

Objectives: Our emphasis will be more on conceptual understanding and application of Fourier series, Fourier, Z and Laplace transforms and solution of partial differential equations.

UNIT – I

Laplace transform of standard functions – Inverse transform – First shifting Theorem, Transforms of derivatives and integrals – Unit step function – Second shifting theorem – Dirac's delta function – Convolution theorem – Laplace transform of Periodic function.

Differentiation and integration of transform – Application of Laplace transforms to ordinary differential equations of first and second order.

UNIT – II

Fourier Series: Determination of Fourier coefficients – Fourier series – Even and odd functions – Fourier series in an arbitrary interval – Even and odd periodic continuation – Half-range Fourier sine and cosine expansions- Parseval's formula- Complex form of Fourier series.

UNIT – III

Fourier integral theorem (only statement) – Fourier sine and cosine integrals. Fourier transform – Fourier sine and cosine transforms – Properties – Inverse transforms – Finite Fourier transforms.

UNIT – IV

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Method of separation of variables – Solutions of one dimensional wave equation, heat equation and two-dimensional Laplace's equation under initial and boundary conditions.s

UNIT – V

z-transform – Inverse z-transform – Properties – Damping rule – Shifting rule – Initial and final value theorems. Convolution theorem – Solution of difference equations by z-transforms.

TEXT BOOKS:

1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
2. Engineering Mathematics, Volume - II, E. Rukmangadachari Pearson Publisher.

REFERENCES:

1. Mathematical Methods by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad S. Chand publication.
2. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
3. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India.

Outcomes: The student gains the knowledge to tackle the engineering problems using the concepts of Fourier series, various transforms and partial differential equations.

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I- Year B.Tech. II-Sem

ENGINEERING PHYSICS(17A25201)

(Common to Civil, Mechanical & Chemical Engg.)

Objectives:

- To evoke interest on applications of superposition effects like interference and diffraction, the mechanisms of emission of light, achieving amplification of electromagnetic radiation through stimulated emission, study of propagation of light through transparent dielectric waveguides along with engineering applications.
- To understand and employ the concepts of waves & oscillations and acoustics to engineering applications.
- To open new avenues of knowledge in dielectric and magnetic materials which find potential in the emerging micro device applications.
- To give an impetus on the subtle mechanism of superconductors using the concept of BCS theory and their fascinating applications.Considering the significance of microminiaturization of electronic devices and significance of low dimensional materials, the basic concepts of nano and smart materials, their properties and applications in modern emerging technologies are elicited.

- To enlighten the characterization of materials by different techniques, the periodic arrangement of atoms in crystals, Bragg's law and X-Ray diffraction technique.

UNIT 1:PHYSICALOPTICS, LASERS AND FIBRE OPTICS

PhysicalOptics: Introduction to interference – Colours in thin films – Newton's Rings – Michelson interferometer - Fraunhoffer diffraction due to single slit, double slit – Diffraction grating.

Lasers: Introduction – Characteristics of laser – Spontaneous and stimulated emission of radiation –- Einstein's coefficients — Population inversion – Pumping mechanisms - Ruby laser – He-Ne laser – Applications of lasers.

Fiberoptics: Introduction– working principle of optical fiber –Numerical aperture and acceptance angle – Types of optical fibers –Optical fiber communication system –Attenuation and losses in optical fibers – Applications of optical fibers.

UNIT 2: **WAVES&OSCILLATIONS AND ACOUSTICS**

Waves&Oscillations: Categories of waves: Mechanical, electromagnetic, matter and gravitational – Reflection and transmission of waves at a boundary – Free oscillations – Damped Oscillations – Forced oscillations – Resonance – Coupled oscillations.

Acoustics: Sound absorption – Absorption coefficient and its measurement – Reverberation time – Sabine's formula – Eyring's formula.

UNIT 3: **DIELECTRICSAND MAGNETIC MATERIALS**

Dielectrics: Introduction – Dielectric Polarization – Types of Polarization – Lorentz field – Clausius- Mosotti equation – Dielectric strength, loss, breakdown.

Magneticmaterials: Introduction – Basic definitions – Origin of magnetic moment – Classification of magnetic materials into dia, para, ferro, antiferro and ferri magnetic materials – Hysteresis – Soft and hard magnetic materials – Applications of magnetic materials.

UNIT 4: **ADVANCED MATERIALS**

Superconductors: Introduction – Properties of superconductors – Meissner effect– Type I and Type II superconductors – ac and dc Josephson effects – BCS theory (qualitative treatment) – High T_c superconductors – Applications of superconductors.

Nanomaterials: Introduction – Significance of nanoscale – Surface area and quantum confinement – Physical properties: optical, thermal, mechanical and magnetic – Carbon nanotubes & their properties – Applications of nanomaterials.

SmartMaterials: Shape Memory Alloys: Definition – Two phases – One way and two way memory effect – Pseudo elasticity – Applications
of shape memory alloys.

UNIT 5:MATERIAL CHARACTERIZATION AND CRYSTALLOGRAPHY

Material Characterization:Electron microscopy:SEM, TEM, AFM – UV-Visible and IR Spectroscopy – Non-destructive testing: objectives – Methods: Pulse-echo method.

Crystallography*:* Introduction – Space lattice –Unit cell – Lattice parameters –Bravias lattice – Crystal systems – Packing fractions of SC, BCC and FCC - Miller indices – Interplanar spacing in cubic crystals – X-ray diffraction – Bragg's law – Laue method.

Prescribed Text books:

1. Engineering Physics – Dr.M.N.Avadhanulu & Dr.P.G.Kshirsagar, S.Chand and Company
2. Engineering physics – S. ManiNaidu, Pearson Education
3. Instrumental methods of analysis - Willard and Meritt

Reference Books:

1. Introduction to modern optics – Grant R Fowles
2. A text book on Optics – Brijlal & Subramanyam
3. Laser Fundamentals – William T. Silfvast, Cambridge University Press
4. Fundamentals of Physics – Halliday, Resnick and Walker, John Wiley &Sons
5. Introduction to Nanotechnology – C P Poole and F J Owens, Wiley
6. Shape Memory Alloys-Modeling and Engg. Applications – C Lagoudas, Springer
7. Hand Book of Non-destructive evaluation, C.J.Hellier, McGraw-Hill
8. Engineering Physics – V. Rajendran, K.Thyagarajan Tata MacGraw Hill Publishers
9. Engineering Physics – M.R.Srinivasan, New Age Publications
10. Engineering Physics – D K Pandey, S. Chaturvedi, Cengage Learning
11. Engineering Physics - Sanjay D. Jain, D. Sahasrambudhe and Girish, University Press
12. Engineering Physics – M. Arumugam, Anuradha Publications

Outcomes:

- The different realms of physics and their applications in both scientific and technological systems are achieved through the study of physical optics, lasers and fiber optics.
- The concepts of types of waves and oscillations ,acoustics are highlighted
- The dielectric and magnetic response of materials are focussed.
- The importance of superconducting materials, nano and smart materials along with their engineering applications are well elucidated.
- Characterization of materials by advanced techniques, the important properties of crystals like the presence of long-range order and periodicity, structure determination using X-ray diffraction technique are focused.

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I- Year B.Tech. II-Sem

ENGINEERINGDRAWING (17A20303)

Unit-I

Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance Drawing Instruments and their Use – BIS Conventions in drawing and Lettering.

Curves used in practice:

a) Conic sections including the Rectangular Hyperbola
b) Cycloid, Epicycloid and Hypocycloid –Normals and Tangents
c) Involute of a circle –Normals and Tangents

Principles of orthographic projection, I and III angle projections –Conventions –Projections of points.

Unit –II

Projection of lines inclined to both planes –traces, Projection of plane figures inclined to both planes.

Unit –III

Projection of simple solids inclined to both planes.

Unit –IV

Sections and Developments: Sections and Sectional views of Regular solids –Prism, Cylinder, Pyramid, Cone – True shapes.

Unit –V

Isometric projections: Principles of pictorial representations-Isometric projection- Isometric scale-Isometric views- conventions- Isometric views of plane figures, solids-Isometric projection of objects with non isometric lines-Isometric projection of spherical parts.

TEXT BOOKS:

1. Engineering Drawing, N.D. Bhat, Charotar Publishers
2. Engineering Drawing, K.L. Narayana& P. Kannaih, Scitech Publishers, Chennai.

REFERENCES:

1. Engineering Drawing, Johle, Tata McGraw-Hill Publishers.
2. Engineering Drawing, Shah and Rana,2/e, Pearson Education
3. Engineering Drawing and Graphics, Venugopal/New age Publishers
4. Engineering Graphics, John&john.

Suggestions:

Student is expected to buy a book mentioned under 'Text books' for better understanding.
Student should prepare rough sketches for all the problems given at the end of each chapter to improve his / her imaginations.
Student should also practice Auto CAD or any other drawing software to help understanding better.

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I Year B.Tech. II-Sem

ELECTRICAL AND ELECTRONICS ENGINEERING (15A24301)

(Common to Mech. Engg. & Chemical)

PART – A

ELECTRICAL ENGINEERING (17A22401)

OBJECTIVES:

- To understand the basic concepts of different types of electrical machines and their

performance.

- To understand the basic types of Circuits, DC generators & motors, Transformers, Induction motors and their performance aspects.
- To understand the concepts of semiconductors, various types of semiconductors, diodes rectifiers, transistors, amplifiers and number systems for digital electronics

UNIT – I Introduction to DC & AC Circuits

Ohm's Law, Basic Circuit Components, Kirchhoff's Laws, Types of Sources, Resistive Networks, Series Parallel Circuits, Star Delta and Delta Star Transformation. Principle of AC Voltages, Waveforms and Basic Definitions, Root Mean Square and Average Values of Alternating Currents and Voltage, Form Factor and Peak Factor, Phasor Representation of Alternating Quantities, The J Operator and Phasor Algebra, Analysis of Ac Circuits With Single Basic Network Element, Single Phase Series.

UNIT-II DC Machines

D.C Generators: Principle of Operation of Dc Machines, Types of D.C Generators, E.M.F Equation in D.C Generator, O.C.C. of a D.C. Shunt Generator

D.C Motors:Principle of Operation of Dc Motors, Types of D.C Motors, Torque Equation, Losses and Efficiency Calculation in D.C Motor- Swinburne's Test

UNIT-III AC Machines

Transformers: Principles of Operation, Constructional Details, Losses and Efficiency, Regulation of Transformer, Testing: OC & SC Tests.

Three Phase Induction Motors: Principle of Operation, Slip and Rotor Frequency, Torque (Simple Problems).

Alternators: Principle of Operation-Constructional Details-EMF Equation-Voltage Regulation by Synchronous Impedance Method.

PART-B
ELECTRONICS ENGINEERING

UNIT I

Semiconductor Devices-N-Type and P-Type Semiconductors, The p-n Junction Diode - Drift and Diffusion Currents, Volt-Ampere Characteristics- Diode Specifications, Applications of Diode, Diode as a Switch. Diode as a Rectifier-types of Rectifier, Rectifiers with Filters, Zener Diode-Characteristics, Zener Diode as Voltage Regulator. Silicon Controlled Rectifier, DIAC, TRIAC.

UNIT II

Bipolar Junction Transistor (BJT) – Types of Transistors, Theory and Operations of Transistors, Input-Output Characteristics of BJT Configurations, Transistor Biasing- Fixed Bias, Voltage Divider Bias, Transistor Applications- Transistor as an Amplifier and Switch, Junction Field Effect Transistor (JFET)- (construction, principle of Operation, symbol), Characteristics -

Input/output, Transfer Characteristics, Configurations of JFET, JFET Applications- JFET as an Amplifier and Switch, Comparison of BJT and JFET, MOSFET-The Enhancement and Depletion MOSFET, Characteristics and Applications of MOSFET

UNIT III

Digital Electronics: Number Systems-Decimal System, Binary System, Octal System, Hexadecimal System, Code Conversions, Binary Arithmetic- Binary Addition, Binary Subtraction, Logic Gates and Truth Tables-NOT, OR, AND, EX-OR, EX-NOR, Universal Gates-NAND, NOR Gates. Boolean algebra and De Morgan's Theorems,

Text Books:

TEXT BOOKS:

1. Basic Electrical Engineering - By M.S.Naidu and S. Kamakshiah – TMH.
2. Basic Electrical Engineering –By T.K.Nagasarkar and M.S. Sukhija Oxford University Press.
3. Electrical and Electronic Technology-By Hughes – Pearson Education.
4. Basic Electrical and Electronics Engineering, M.S.Sukhija, T.K.Nagsarkar, Oxford University Press, 1st Edition, 2012.
5. Basic Electrical and Electronics Engineering, S.K Bhattacharya, Pearson Education, 2012.

REFERENCES:

1. Theory and Problems of Basic Electrical Engineering by D.P.Kothari & I.J. Nagrath PHI.
2. Principles of Electrical Engineering by V.K Mehta, S.Chand Publications.
3. Fundamentals of Electrical Electronics Engineering by T.Thyagarajan, SCITECH Publications 5th Edition-2007

Outcomes:

1: Students shall gain knowledge on basics of Electrical Circuits, DC Machines, Transformers, Induction motors, Alternators.

2: Students shall gain knowledge on various types of semiconductor devices, transistors, amplifier and digital electronics.

3: Students shall be able to apply the knowledge of Electrical and Electronic systems real-world Chemical Engineering problems and applications.

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I- Year B.Tech. II-Sem

INTRODUCTION TO CHEMICAL ENGINEERING(17A20801)

Unit-I

Introduction, Chemical Engineering in everyday life, Scaling up or down, Engineering applications of portable devices, challenges in petroleum sector, versatility of a Chemical

Engineer, role of Chemical Engineers in Biomedical Engineering, similarities in dissimilar applications.

Batch Processing, paint manufacture, transition from batch to continuous processing, Case study: Manufacture of Sulphuric acid, role of basic sciences in Chemical Engineering (Introduction) (Text Book 1)

Unit-II

Introduction, Unit operations, basic laws, units and dimensions, partial pressure, vapor pressure. Solutions, concentration measurements,humidityand saturation. Material and Energy balances.

Flow of fluids: Introduction, nature of fluid, viscosity, velocity profile, flow field, types of fluid motion, laminarand turbulent flow, flow of a fluid past a solid surface, Reciprocating, rotary, and centrifugal pumps(Text Book 2)

Unit-III

Heat transfer: Conduction, convection (omit correlations for calculation of heat transfer coefficients, heattransfer with change in phase) and radiation. Flow arrangement in heat exchangers, variation of fluidtemperatures in heat exchangers, heat transfer equipment (double pipe & Shell and tube heat exchanger),evaporation, long tube vertical type and forced circulation type evaporators, multiple effect evaporation,methods of feeding(Text Book 2)

Unit-IV

Mass transfer: Introduction - Diffusion, mass transfer operation, equipment for gas-liquid operations, contact patterns, classification of separation processes and applications, basic definitions of separation processes, VLE, LLE, boiling point diagram.(Text Book 2)

Unit-V:

Introduction to mechanical operations: Size reduction, filtration, basic differences between agitation and mixing.

Types of reactions and reactors.

Introduction to environmental pollution: types and their effect.

Safety in chemical process industries (case study on DDT, environmental hazards of a green project)(Text Book 1&2)

TEXT BOOK:

1. Introduction to chemical engineering by S. Pushpavanam, PHI, 2012.
2. Introduction to chemical engineering by S. K. Ghosal, S. K. Sanyal and S. Dutta, TMH publications, 1993.

REFERENCE:

1. Unit operations in chemical engineering by W.L. McCabe and J.C. Smith and Peter Harriott, McGraw Hill5th ed. 1993.

Objectives:

1. To impart the role of Chemical Engineers in everyday life and the importance of

Chemical Engineering.
2. To learn the role of various Unit Operations and Unit Processes in Chemical industries.
3. To learn the role of Chemical Engineers in environmental and safety aspects in process industries.

Outcomes:

The student will be able to explain:

1. The role of Chemical Engineers in everyday life and the importance of Chemical Engineering.
2. The role of various Unit Operations and Unit Processes in Chemical industries.
3. The role of Chemical Engineers in environmental and safety aspects in process industries.

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L	T	P	C
0	1	3	2

I- Year B.Tech. II-Sem

ENGINEERING PHYSICS LABORATORY (17A25202)

Objectives:

- To evoke interest on applications of superposition effects like interference and diffraction, the mechanisms of emission of light, achieving amplification of electromagnetic radiation through stimulated emission, study of propagation of light through transparent dielectric waveguides along with engineering applications.
- To understand and employ the concepts of waves & oscillations and acoustics to engineering applications.
- To open new avenues of knowledge in dielectric and magnetic materials which find potential in the emerging micro device applications.
- To give an impetus on the subtle mechanism of superconductors using the concept of BCS theory and their fascinating applications. Considering the significance of micro miniaturization of electronic devices and significance of low dimensional materials, the basic concepts of nano and smart materials, their properties and applications in modern emerging technologies are elicited.
- To enlighten the characterization of materials by different techniques, the periodic arrangement of atoms in crystals, Bragg's law and X-Ray diffraction technique

Any EIGHT of the following experiments has to be performed during the SEMESTER

1. Determination of wavelengths of various colours of mercury spectrum using diffraction grating in normal incidence method
2. Determination of dispersive power of prism
3. Determination of thickness of thin object by wedge method
4. Determination of radius of curvature of lens by Newton's rings
5. Laser : Diffraction due to single slit
6. Laser : Diffraction due to double slit
7. Laser: Determination of wavelength using diffraction grating
8. Determination of Numerical aperture of an optical fiber
9. Meldes experiment: Determination of the frequency of tuning fork
10. Sonometer: Verification of the three laws of stretched strings
11. Energy gap of a material using p-n junction diode
12. Electrical conductivity by four probe method
13. Hall effect: Determination of mobility of charge carriers in semiconductor
14. B-H curve
15. Magnetic field along the axis of a current carrying coil – Stewart and Gee's method
16. Determination of dielectric constant and Curie temperature of a ferroelectric material

Outcomes:

- The different realms of physics and their applications in both scientific and technological systems are achieved through the study of physical optics, lasers and fiber optics.

- The concepts of types of waves and oscillations ,acoustics are highlighted
- The dielectric and magnetic response of materials are focussed.
- The importance of superconducting materials, nano and smart materials along with their engineering applications are well elucidated.
- Characterization of materials by advanced techniques, the important properties of crystals like the presence of long-range order and periodicity, structure determination using X-ray diffraction technique are focused.

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I- Year B.Tech. II-Sem

L	T	P	C
0	1	3	2

ELECTRICAL & ELECTRONICS ENGINEERING LABORATORY ((17A22402)

PART-A

The following experiments are required to be conducted as compulsory experiments:

1. Swinburne's Test on DC Shunt Machine (Predetermination of Efficiency of a Given DC Shunt Machine Working as Motor and Generator).
2. OC & SC Tests on Single-Phase Transformer (Predetermination of Efficiency and Regulation at Given Power Factors and Determination of Equivalent Circuit).
3. Brake Test on 3-Phase Induction Motor (Determination of Performance Characteristics)
4. Regulation of Alternator by Synchronous Impedance Methods.
5. Speed Control of D.C.Shunt Motor by
   a) Armature Voltage Control B) Field Flux Control Method
6. Brake Test on D.C Shunt Motor

PART-B

LIST OF EXPERIMENTS:

1. PN Junction diode characteristics A) Forward bias B) Reverse bias.
2. Zener diode characteristics and Zener as voltage Regulator
3. Full Wave Rectifier with & without filter
4. Wave Shaping Circuits (Clippers & Clampers)
5. Input & Output characteristics of Transistor in CB / CE configuration
6. Frequency response of CE amplifier.
7. Inverting and Non-inverting Amplifiers using Op Amps
8. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs
9. Verification of Truth Tables of RS, JK, T & D flip flops using respective ICs

LAB REQUIREMENTS:

Cathode Ray Oscilloscopes (30MHz)
Signal Generator /Function Generators (3 MHz)
Dual Regulated Power Supplies (0 – 30V)
IC Trainer Kit
Bread Boards
Electronic Components

I Year B.Tech II Semester

0	1	3	2

COMPUTER PROGRAMMING LAB(17A20504)
(Common to Civil, EEE, ME, CSE, Chemical)

Objectives:

- To work with the compound data types
- To explore dynamic memory allocation concepts
- Able to design the flowchart and algorithm for real world problems
- Able to write C programs for real world problems using simple and compound data types
- Employee good programming style, standards and practices during program development

Week-1

1) Write an algorithm and draw a flowchart to make the following exchange between the variables a-> b -> c->d - > a
2) Write an algorithm and draw a flowchart to generate the first n terms of the sequence. A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence.
3) Write a algorithm and draw a flowchart to carry out the arithmetic operations addition, subtraction, multiplication, and division between two variables
4) Write a algorithm and draw a flowchart for printing prime numbers between 1 and n.

Week-2

1) Write a C program to construct a multiplication table for a given number.
2) Write a program to reverse the digit of a given integer.
1) Write a C program to calculate the factorial of a given number

Week-3

Write a program to calculate tax, given the following conditions:

a) If income is less than 1,50,000 then no tax.
b) If taxable income is in the range 1,50,001 – 300,000 then charge 10% tax
c) If taxable income is in the range 3,00,001 – 500,000 then charge 20% tax
d) If taxable income is above 5,00,001 then charge 30% tax

Week-4

1) Write a program to print the calendar for a month given the first Week- day of the month.

Input the first day of the month (Sun=0,Mon=1,Tue=2,Wed=3,.....) :: 3

Total number of days in the month : 31

Expected output

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
-	*-*	*-*	*1*	*2*	*3*	*4*
5	*6*	*7*	*8*	*9*	*10*	*11*
12	*13*	*14*	*15*	*16*	*17*	*18*
19	*20*	*21*	*22*	*23*	*24*	*25*
25	*26*	*27*	*28*	*29*	*30*	*31*

Week-5

1) Write a program to print the Pascal triangle for a given number
2) Write a program to calculate the following expression for given x value

$$f(x) = a_0 + \sum_{n=1}^{\infty} \left(a_n \cos\frac{n\pi x}{L} + b_n \sin\frac{n\pi x}{L} \right)$$

Week-6

1) Write C code to define a function cash_dispense, which takes an amount as its input, and returns the number of 1000, 500, 100, 50, 20, 10, 5, 2, 1 rupee denomination that make up the given amount.
2) Write C code to reverse the contents of the array. For example, [1,2,3,4,5] should become [5,4,3,2,1]
3) Write a program that will search and find out the position where the given key element exist in a user chosen array and print it as output.

Week-7

1) Write C code to compute the frequency table of survey responses given by 20 users. The survey responses range from 1 to 5 and are stored in an array. For example, 10 responses are stored in the array [1,1,5,2,3,3,5,5,2,2]. The frequency table will be as shown below:
   a. 1 = 2
   b. 2 = 3
   c. 3 = 2
   d. 4 = 0
   e. 5 = 3
2) Write a program to define a function to sort an array of integers in ascending order by using exchange sort.

Week-8

1) Write a C program to check whether a given string is a palindrome or not, without using any built-in functions
2) Write a function that accepts a string and delete the first character.
3) Write a function that accepts a string and delete all the leading spaces.

Week-9

Write a program to accept a string from user and display number of vowels, consonants, digits and special characters present in each of the words of the given string.

Week-10

1) Write a C program to define a union and structure both having exactly the same numbers using the sizeof operators print the sizeof structure variables as well as union variable
2) Declare a structure *time* that has three fields *hr, min, secs.* Create two variables, *start_time* and *end_time.* Input there values from the user. Then while *start_time* is not equal to *end_time* display GOOD DAY on screen.

Week-11

1) Write a program to read in an array of names and to sort them in alphabetical order. Use sort function that receives pointers to the functions strcmp, and swap, sort in turn should call these functions via the pointers.
2) Write a program to read and display values of an integer array. Allocate space dynamically for the array using the *malloc().*

3) Write a program to calculate area of a triangle using function that has the input parameters as pointers as sides of the triangle.

Week-12

1) Two text files are given with the names text1 and text2. These files have several lines of text. Write a program to merge (first line of text1 followed by first line of text2 and so on until both the files reach the end of the file) the lines of text1 and text2 and write the merged text to a new file text3.
2) Write a program to split a given text file into n parts. Name each part as the name of the original file followed by .part<**n**> where n is the sequence number of the part file.

Reference Books:

1. Computer Science, A Structured Programming Approach Using C by Behrouz A. Forouzan & Richard F. Gilberg, Third Edition, Cengage Learning
2. C Programming A Problem-Solving Approach, Behrouz A. Forouzan & E.V. Prasad, F. Gilberg, Third Edition, Cengage Learning
3. Programming with C Rema Theraja, Oxford
4. "C Test Your Skills", Kamthane, Pearson Education
5. Programming in C: A Practical Approach, Ajay Mittal, Pearson
6. Problem solving with C, M.T.Somasekhara, PHI
7. C Programming with problem solving, J.A. Jones & K. Harrow,Dreamtech Press
8. Programming with C, Byron S Gottfried, Jitender Kumar Chhabra, TMH, 2011

Outcomes:

- Able to have fundamental concept.
- Able to write, compile and debug programs in C language.
- Able to formulate problems and implement algorithms in C.
- Able to effectively choose programming components that efficiently solve computing problems in real-world.
- Able to use different data types in a computer program.
- Able to design programs involving decision structures, loops and functions.

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L	T	P	C
0	0	2	0

I- Year B.Tech. II-Sem

COMMUNITY SERVICE (AUDIT) (17A29901)

JNTUA College of Engineering (Autonomous), Ananthapuramu

I- Year B.Tech. II-Sem

L	T	P	C
0	0	0	1

Comprehensive Objective Type Examination (17A20802)

JNTUA College of Engineering (Autonomous),

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L	T	P	C
2	2	0	3

II- Year B.Tech. I-Sem

MATHEMATICAL METHODS (17A35102)

Objectives:

- This course aims at providing the student with the concepts of Matrices, Numerical Techniques and Curve fitting.

UNIT – I

Elementary row transformations-Rank – Echelon form, normal form – Consistency of System of Linear equations. Linear transformations. Hermitian, Skew-Hermitian and Unitary matrices and their properties. Eigen Values, Eigen vectors for both real and complex matrices. Cayley – Hamilton Theorem and its applications – Diagonolization of matrix. Calculation of powers of matrix and inverse of a matrix. Quadratic forms – Reduction of quadratic form to canonical form and their nature.

UNIT – II

Solution of Algebraic and Transcendental Equations: The Bisection Method – The Method of False Position– Newton-Raphson Method, Solution of linear simultaneous equation: Crout's triangularisation method, Gauss - Seidal iteration method.

UNIT – III

Interpolation: Newton's forward and backward interpolation formulae – Lagrange's formulae. Gauss forward and backward formula, Stirling's formula, Bessel's formula.

UNIT – IV

Curve fitting: Fitting of a straight line – Second degree curve – Exponentional curve-Power curve by method of least squares. Numerical Differentiation for Newton's interpolation formula. Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule.

UNIT – V

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Euler's Method-Runge-Kutta Methods. Numerical solutions of Laplace equation using finite difference approximation.

TEXT BOOKS:

3. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
4. Introductory Methods of Numerical Analysis, S.S. Sastry, PHI publisher.

REFERENCES:

2. Engineering Mathematics, Volume - II, E. Rukmangadachari Pearson Publisher.
3. Mathematical Methods by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad, S. Chand publication.
3. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
4. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India.

Outcomes: The student will be able to analyze engineering problems using the concepts of Matrices and Numerical methods.

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II Year B.Tech. I-Sem

L	T	P	C
2	2	0	3

ORGANIC CHEMISTRY(17A35301)

Objectives:

- The Mechanism of organic chemical reaction is essential to synthesis new organic compounds in drug and pharmaceutical industries. In order to study their kinetics of reactions to regulate the process for optimization of production of drugs and pharmaceutical, the principles of organic chemistry are essential.
- For chemical engineer to carry out a processes industrially for the manufacture of drgus and pharmaceuticals, Comprehension on basic reactions, reagents and their applications is needed.
- He/She should know the electronic behavior of organic molecules, their special and geometrical arrangement of functional groups.
- He/She should have insight of reaction mechanisms for different types of reactions.
- He/She must have knowledge to conduct the most common reactions like addition, substitution, oxidation, reduction etc., on large scale.

UNIT I:

Polar effects – Inductive effect, electromeric effect, resonance, hyper conjugation, steric hindrens, and aromaticity – examples.

UNIT II:

Electrophilic reactions: a) Friedel-Craft reaction b) Riemer- Teimenn Reaction c) Backmann rearrangement.

Nucleophillic reactions : a) Aldol condensation b) Perkin Reaction c) Benzoin condensation.

UNIT – III:

Stereo isomerism; Optical isomerism; Symmetry and chirality; Optical isomerism in lactic acid and tartaric acid; Sequence rules; Enantiomers, diastereomers; Geometrical Isomerism; E-Z system of nomenclature, conformational analysis of ethane and Cyclohexane.

UNIT.IV

Some Reagents of Synthetic importance:

Preparation and applications of Aluminum Chloride, N-Bromosuccnamide (NBS), Diazomethane, Dicyclohexylcarbodiimide(DCC), Potassiumtertiarybutoxide and Grignard reagent

UNIT.V:

Some Useful Reactions in Organic Synthesis:

i). Protection of functional groups: Hydroxyl, Carbonyl and amino groups

ii). Oxidation: Oxidation of alcohols and carbonyl compounds with suitable examples

iii). Reduction: Reduction of double and triple bonds and carbonyl compounds with suitable

examples.

TEXTBOOKS:

1. Text book of Organic Chemistry – Morrsion and Boyd.
2. Organic Reaction Mechanisms by VK Ahulwalia and RK Parashar

REFERENCES:

1. Reaction mechanism – Peter Skyes.
2. Text book of Organic Chemistry – P.L. Soni.
3. Organic Chemistry Vol- I-IL. Finar.
4. Reactions and Reagents – O.P. Agrawal.
5.A Text Books of Organic Chemistry- Bahl and Arun Bahl, S. Chand company, New Delhi
6. Polymer Science and Technology- Hema Singh, Acme Learning, New Delhi

Outcomes:

1. Will be able to understand the essentiality of organic chemical reaction to synthesis new organic compounds in drug and pharmaceutical industries.
2. To gain knowledge on basic reactions, reagents and their applications.
3. To gain knowledge on electronic behavior of organic molecules, their special and geometrical arrangement of functional groups.
4. To gain necessary knowledge to conduct the most common reactions like addition, substitution, oxidation, reduction etc., on large scale.

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L	T	P	C
2	2	0	3

II- Year B.Tech. I-Sem

CHEMICAL PROCESS CALCULATIONS(17A30801)

UNIT- I

Stoichiometric & Composition relations: Stoichiometric relation, basis of calculations, methods of expressing compositions of mixtures and solutions, density and specific gravity, Baume and API gravity scales.

(For Assignments only: Use of Log-Log and Semi-Log graphs; Graph plotting using plotters like MS-Excel, Polymath, Minitab, Origin, etc..)

Behavior of Ideal gases: Kinetic theory of gases, application of ideal gas law, gaseous mixtures, gases in chemical reactions.

UNIT -II

Vapor pressure: Liquefaction and liquid state, vaporization, boiling point, effect of temperature on vapor pressure, Antoine equation, vapor pressure plots, estimation of critical properties, vapor pressure of immiscible liquids and ideal solutions, Raoult's law, Non volatile solutes.

Humidity and Saturation: Partial saturation, Humidity- Absolute Humidity, Vaporization process, Molal humidity, Relative and percentage saturation, dew point, humid heat, wet bulb and dry bulb temperatures, use of humidity charts, adiabatic vaporization.

UNIT- III

Material balances: Tie substance, Yield, conversion, limiting reactant, excess reactant, processes involving reactions, Material balances with the help of Stoichiometric equations, Material balances involving drying, dissolution, & crystallization. Material balance calculations for processes involving recycle, bypass and purge.

UNIT -IV

Thermo physics: Energy, energy balances, heat capacity of gases, liquid and mixture solutions. Kopp's rule, latent heats, heat of fusion and heat of vaporization, Trouton's rule, Kistyakowsky equation for non polar liquids enthalpy and its evaluation.

Thermo chemistry: Calculation and applications of heat of reaction, combustion, formation and neutralization, Kirchoff's equation, enthalpy concentration change,

UNIT- V

Flame Temperature Calculations: Calculation of theoretical and actual flame temperatures.

Combustion Calculations: Introduction, fuels, calorific value of fuels, coal, liquid fuels, gaseous fuels, air requirement and flue gases, combustion calculations, incomplete combustion, material and energy balances, thermal efficiency calculations.

TEXTBOOKS

1. Chemical process principles, Part -I, Material and Energy Balance, Hougen O A, Watson K.M. and Ragatz R.A. 2nd Edition,John Wiley and Sons, New York, 1963.

REFERENCES:

1. Basic principles and calculations in chemical engineering by D.H. Himmelblau, 7th Ed. PHI, 2013
2. Stoichiometry by B.I. Bhatt and S.M. Vora (3rd Ed.) Tata McGraw Hill publishing company, Ltd. New Delhi (1996)

Data Tables: Use of Humidity Chart is permitted in the Examination hall

OBJECTIVE: To develop the basic knowledge in material and energy balance industry recycle streams.

OUTCOME: This course will enable students to evaluate the effeciency of a process in terms of yield, energy and provide guidance to improve upon them

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L	T	P	C
2	2	0	3

II- Year B.Tech. I-Sem

MOMENTUM TRANSFER (17A30802)

UNIT- I

Unit operations and unit processes, unit systems, basic concepts, nature of fluids, hydrostatic equilibrium, applications of fluid statics.

Fluid flow phenomena-Laminar flow, Shear rate, Shear stress, Rheological properties of fluids, Turbulence, Boundary layers.

UNIT- II

Basic equation of fluid flow –Mass balance in a flowing fluid; continuity equation, differential momentum balance; equations of motion, Macroscopic momentum balances, Bernoulli equation.

Incompressible Flow in pipes and channels- shear stress and skin friction in pipes, laminar flow in pipes and channels, turbulent flow in pipes and channels, friction from changes in velocity or direction.

UNIT- III

Dimensional analysis: Buckingham π Theorem and Rayleigh's method.

Flow of compressible fluids- Definitions and basic equations, Processes of compressible flow, Isentropic flow through nozzles, adiabatic frictional flow, and isothermal frictional flow.

UNIT -IV

Flow past immersed bodies, Drag and Drag coefficient, friction in flow through beds of solids, Kozeny-Carman, Blake-Plummer and Ergun equations, and motion of particles through fluids.

Fluidization: Conditions for fluidization, Minimum fluidization velocity, Types of fluidization, Expansion of fluidized beds, Applications of fluidization, Continuous fluidization:Slurry and pneumatic transport.

UNIT- V

Transportation and Metering of fluids: Pipes, fittings and valves, Fluid- moving machinery, Fans, blowers, and compressors.

Measurement of flowing fluids:Variable head meters- Orifice meter, Venturi meter, Pitot tube; Area meter- Rota meter.

TEXTBOOKS

1. Unit Operations of Chemical Engineering by W.L.McCabe, J.C.Smith& Peter Harriot, McGraw-Hill, 7^{th}ed, 2007

REFERENCES:

1. Transport processes and unit operations by Christie J. Geankoplis, PHI

2. Unit operations, Vol-1 –Chattopadhya, Khanna publishers
3. Principles of Unit Operations, Foust *et al*, 2nd ed., John Wiley, 1999
4. Chemical Engineering, Vol-I, Coulson and Richardson, Pergamon Press.

OBJECTIVE: The behavior of fluids is important to process Engineering and constitutes foundations for the study of unit operations. An understanding of fluids is essential to students not only for accurately treating problems on the moment of fluids through pipes, pumps, but for dealing with all kinds of process equipment.

OUTCOME: To apply the concept of hydrostatic equilibrium and to have knowledge on fluid flow phenomena and to determine engineering design quantities for laminar and turbulent flow.

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II- Year B.Tech. I-Sem

L	T	P	C
2	2	0	3

MATERIALS SCIENCE FOR CHEMICAL ENGINEERS(17A30803)

UNIT- I

Introduction:Engineering Materials – Classification – levels of structure.

Crystal Geometry and Structure Determination: Space lattice and Unit cell. Bravais lattices, crystal systems with examples. Lattice coordinates, Miller indices, Bravais indices for directions and places: crystalline and non crystalline solids; ionic, covalent and metallic solids; packing efficiency, coordination number; structure determination by Bragg's X-ray diffraction and powder methods.

UNIT -II

Crystal Imperfection: Point defects, line defects-edge and screw dislocation, Berger's circuit and Berger's vectors, dislocation reaction, dislocation motion, multiplication of dislocations during deformation , role of dislocation on crystal properties; surface defects, dislocation density and stress required to move dislocations.

UNIT -III

Basic thermodynamic functions: phase diagrams and phase transformation: Primary and binary systems-general types with examples; tie line& lever rule, non equilibrium cooling: phase diagrams of Fe-Fe_3-C, Pb-Sn, Cu-Ni systems.

Phase transformations in Fe-Fe_3-C steels, Time-Temperature-Transformation (TTT) curves for eutectoid steels and plain carbon steels; effect of alloying elements on properties of steels; types of steels, alloys and other metals used in chemical industry.

UNIT -IV

Elastic, an elastic and plastic deformations in solid materials; rubber like elasticity, visco elastic behavior (models); shear strength of real and perfect crystals, work hardening mechanisms, cold working, hot working; dynamic recovery, recrystallization, grain growth, grain size and yield stress, Brief description of heat treatment in steels.

Magnetic materials: Terminology and classification, magnetic moments due to electron spin, ferro-magnetism and related phenomena, domain structure, hysteresis loop, soft and hard magnetic materials.

UNIT- V

Fracture in ductile and brittle materials, creep: mechanism of creep and methods to reduce creeping in materials, creep rates and relations. Fatigue-mechanisms and methods to improve fatigue resistance in materials. Composite materials: types; stress-strain relations in composite materials, applications.

Oxidation and Corrosion: Mechanisms of oxidation, oxidation resistant materials, principles and types of corrosion, protection against corrosion.

TEXT BOOK:

1. Materials Science and Engineering, 5thed. V. Raghavan, PHI Learning Pvt. Ltd., New Delhi, 2009.

REFERENCES:

1. Elements of Materials Science, L.R. Van Vlack,

2. Science of Engineering Materials, vols. 1&2, ManasChanda, McMillan Company of India Ltd.

Objective: This course will help students to learn about the relationship between structure and properties of materials, application of various classes of materials including metals, ceramics, polymers.

Outcome: This course will enable the student to learn about proper selection of materials for designing various equipment in a chemical industry.

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II- Year B.Tech. II-Sem

L	T	P	C
2	2	0	3

PROCESS INSTRUMENTATION(17A30804)

UNIT I

Elements of instruments, static and dynamic characteristics, basic concepts of response of first order type instruments, mercury in glass thermometer, bimetallic thermometer, pressure spring thermometer, static accuracy and response of thermometers.

Unit II:

Thermo electricity: Industrial thermocouples, thermocouple wires, thermo couple wells and response of thermocouples. Thermal coefficient of resistance, industrial resistance thermometer bulbs and circuits, radiation receiving elements, radiation, photoelectric and optical pyrometers.

Unit III:

Composition analysis, spectroscopic analysis by absorption, emission, mass and color measurement spectrometers, gas analysis by thermal conductivity, analysis of moisture, gas chromatography, refractometer.

Unit IV:

Pressure vacuum and head: liquid column manometers, measuring elements for gauge pressure and vacuum, indicating elements for pressure gauges, measurement of absolute pressure, measuring pressure in corrosive liquids, static accuracy and response of pressure gauges.

Head, density and specific gravity, direct measurement of liquid level, pressure measurement in open vessels, level measurements in pressure vessels, measurement of interface level, density measurement, and level of dry materials.

Unit V:

Head flow meters, area flow meters, open channel meters, viscosity meters, quantity meters, flow of dry materials, viscosity measurements.

Recording instruments, indicating and signaling instruments, transmission of instrument readings, control center, instrumentation diagram, process analysis.

TEXT BOOK:

1. Industrial instrumentation by Donald P.Eckman, Wiley eastern, 1950.

REFERENCE:

1. Principles of industrial instrumentation by PatraNabis, TMH.
2. Instruments for measurements and control by Holbrock W.C. Van Nostrand
East West.
3. Hand book Instrumentation, Considine, McGraw Hill,

OBJECTIVE: The course will give an idea about different instruments for measuring T, P, flow rate, level and composition of various process streams in chemical industry.

OUTCOME: This course enables the student to select and design an instrument for measurement of flow, level, temperature, pressure and composition in chemical process industries.

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L	T	P	C
2	0	0	0

II- Year B.Tech. I-Sem

HUMAN VALUES AND PROFESSIONAL ETHICS
(AUDIT COURSE) (17A39901)

Objectives:

• To create an awareness on Engineering Ethics and Human Values.
• To instill Moral and Social Values and Loyalty
• To appreciate the rights of Others

Students will be able to:

- Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field
- Identify the multiple ethical interests at stake in a real-world situation or practice
- Articulate what makes a particular course of action ethically defensible
- Assess their own ethical values and the social context of problems
- Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects
- Demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work
- Integrate, synthesize, and apply knowledge of ethical dilemmas and resolutions in academic settings, including focused and interdisciplinary research

Unit I: HUMAN VALUES

Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty - Courage- Co Operation – Commitment – Empathy –Self Confidence Character – Spirituality.

Unit II: ENGINEERING ETHICS

Senses of 'Engineering Ethics- Variety of moral issued – Types of inquiry – Moral dilemmas – Moral autonomy –Kohlberg's theory- Gilligan's theory- Consensus and controversy – Models of professional roles- Theories about right action- Self interest - Customs and religion –Uses of Ethical theories – Valuing time –Co operation – Commitment.

Unit III :**ENGINEERING AS SOCIAL EXPERIMENTATION**

Engineering As Social Experimentation – Framing the problem – Determining the facts – Codes of Ethics – Clarifying Concepts – Application issues – Common Ground - General Principles – Utilitarian thinking respect for persons.

UNIT IV: ENGINEERS RESPONSIBILITY FOR SAFETY AND RISK

Safety and risk – Assessment of safety and risk – Risk benefit analysis and reducing risk- Safety and the Engineer- Designing for the safety- Intellectual Property rights(IPR).

UINIT V: GLOBAL ISSUES

Globalization – Cross culture issues- Environmental Ethics – Computer Ethics – Computers as the instrument of Unethical behavior – Computers as the object of Unethical acts – Autonomous Computers- Computer codes of Ethics – Weapons Development - Ethics and Research – Analyzing Ethical Problems in research – Intellectual property Rights(IPR).

Text Books:

1. Engineering Ethics includes Human Values" by M.Govindarajan, S.Natarajan anad, V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009
2. "Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.
3. "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger – Tata McGraw-Hill– 2003.
4. "Professional Ethics and Morals" by Prof.A.R.Aryasri, Dharanikota Suyodhana-Maruthi Publications.
5. "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran- LaxmiPublications.
6. "Professional Ethics and Human Values" by Prof.D.R.Kiran-
7. Indian Culture, Values and Professional Ethics" by PSR Murthy-BS Publication

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L	T	P	C
0	0	2	1

II- Year B.Tech. I-Sem

ORGANIC CHEMISTRY LAB(17A35104)

Course Objectives:

To confirm the formation and nature of the product in a chemical processes, the knowledge of some physical, chemical and instrumental methods is essential for a chemical engineer.

ORGANIC CHEMISTRY LAB:

1. Criteria of Purity of Solid and Liquid, Determination of Melting Point & Boiling Point. Detecting Nitrogen, Sulphur, and Halogens in Organic Compounds.
2. Identification of an Unknown Substance from the following classes of Organic Compounds, Alcohols, Phenols, Aldehydes, Ketenes, Carbohydrates and Carboxylic acids.
3. Preparation of Aspririn
4. Preparation of Paracetamol
5. Preparation of Acetanilide
6. Preparation of Sulphonic acid
7. Preparation of derivatives for Aldehydes and Amines.
8. Beckman Rearrangement (Preparation of Benzanilide from Benzophenone oxime).
9. Determination of strength of a Glycine Solution.
10. Estimation of an Aldehyde.

Course Outcome:

Student will get the knowledge of methods to confirm the formation and the nature of the product.

TEXT BOOKS:

1. Vogels Text Book of Qualitative Organic Analysis.

TEXTBOOKS:

1. Text book of Organic Chemistry – Morrsion and Boyd.

2. Organic Reaction Mechanisms by VK Ahulwalia and RK Parashar

REFERENCES:

1. Reaction mechanism – Peter Skyes.
2. Text book of Organic Chemistry – P.L. Soni.
3. Organic Chemistry Vol- I-IL. Finar.
4. Reactions and Reagents – O.P. Agrawal.
5. A Text Books of Organic Chemistry- Bahl and Arun Bahl, S. Chand company, New Delhi
6. Polymer Science and Technology- Hema Singh, Acme Learning, New Delhi

JNTUA College of Engineering (Autonomous), Ananthapuramu

II- Year B.Tech. I-Sem

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MOMENTUM TRANSFER LAB(17A30805)

1. Identification of laminar and turbulent flows
   Major equipment - Reynolds apparatus
2. Measurement of point velocities
   Major equipment - Pitot tube setup
3. Verification of Bernoulli's equation
   Major equipment – Bernoulli's Apparatus
4. Calibration of Rotameter
   Major equipment – Rotameter Assembly
5. Variation of Orifice coefficient with Reynolds Number
   Major equipment - Orifice meter Assembly
6. Determination of Venturi coefficient
   Major equipment – Venturi meter Assembly
7. Friction losses in Fluid flow in pipes
   Major equipment - Pipe Assembly with provision for Pressure measurement
8. Pressure drop in a packed bed for different fluid velocities
   Major equipment - Packed bed with Pressure drop measurement
9. Pressure drop and void fraction in a fluidized bed
   Major equipment - Fluidized bed with Pressure drop measurement
10. Studying the coefficient of contraction for a given open orifice
    Major equipment - Open Orifice Assembly
11. Studying the coefficient of discharge in a V-notch

Major equipment - V-notch Assembly

12. Studying the Characteristics of a centrifugal pump
    Major equipment - Centrifugal Pump
13. Drag studies using two different fluids

Objective: The lab provides knowledge on various flow patterns, flow measuring devices and pumps.

Outcome: Student will be able to understand the concept of fluid flow phenomena, different flow regimes, flow measuring devices like venturi, orifice and rotameter.

JNTUA College of Engineering (Autonomous), Ananthapuramu

II- Year B.Tech. I-Sem

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EXPLORATORY DATA ANALYSIS LAB (17A35104)

COURSE DESCRIPTION: Statistical and Numerical Techniques – Measures of central tendency/dispersion, Curve fitting by method of least squares, linear regression and correlation, ANOVA; Data analysis using R, Numerical Solution of algebraic, transcendental and ordinary differential equations, Inverse and Eigen values of a matrix – Numerical method.

LIST OF EXPERIMENTS

Required softwares: ORIGIN, MATLAB, R-LAB.

I. Statistical and Fourier series Techniques:

To a given set of data:

1. Determine measures of central tendency/dispersion - Mean, Median, Mode, Range and Variance; Box plot representation using Origin Software.
2. Fit a straight line, parabola, exponential curve.
3. Determine the coefficient of correlation and regression.
4. Analysis of variance (ANOVA) for one variable.
5. Determine R function and give interpretation.
6. Transforming signal in time domain into frequency domain.
7. Represent in contour plot using matlab.

II. Numerical Techniques:

8. Solving algebraic and transcendental equations using Regula - Falsi and Newton - Raphson methods.
9. Determine the inverse of a matrix; solving system of algebraic equations using Gauss-Siedal method.
10. Determine the Eigen values of a matrix and dominant Eigen value by power method.
11. Numerical differentiation and integration.
12. Numerical solution of Ordinary differential equations - Modified Euler method & R-K fourth order method.

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II- Year B.Tech. I-Sem

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Comprehensive Objective Type Examination (17A30806)

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3	0	0	3

II- Year B.Tech. II-Sem

MANAGEMENT SCIENCE (17A45402)

COURSE OBJECTIVES :

To provide fundamental knowledge on Management, Administration, Organization & its concepts.

To understand the role of management in Production

To study Materials/Purchases/Stores/Inventory/Marketing Management and Quality control

To study HRM in order to have an idea on Recruitment, Selection, Training &Development, job evaluation and Merit rating concepts.

To identify Strategic Management areas & to Study the PERT/CPM for better Project Management.

UNIT I:INTRODUCTION TO MANAGEMENT:

Management-Concept and meaning-Nature-Functions-Management as a Science and Art and both. Schools of Management Thought-Taylor's Scientific Theory-Henry Fayol's principles-Eltan Mayo's Human relations-Systems Theory- **Organizational Structure and Design**: Features of Organizational Structure-Work Specialization-Departmentation-Span of Control-Centralization and Decentralization. **Organisational Designs**-Line organization-Line & Staff Organization-Functional Organization-Matrix Organization-Project Organization-Committee form of Organization-Social responsibilities of Management.

UNIT II:OPERATIONS MANAGEMENT:

Principles and Types of Plant Layout-Methods of Production (Job, batch and Mass Production), Work Study- Statistical Quality Control**:***C* chart, *P* chart, (simple Problems) Deming's contribution to Quality.

Material Management: Objectives-Inventory-Functions, Types, Inventory Techniques-EOQ-ABC Analysis-Purchase Procedure and Stores Management-Just-In-Time (JIT). **Marketing Management:** Concept- Meaning - Nature-Functions of Marketing- Marketing Mix- Channels of Distribution - Advertisement and Sales Promotion- Marketing Strategies based on Product Life Cycle.

UNIT III:HUMAN RESOURCES MANAGEMENT (HRM):

HRM- Definition and Meaning – Nature-Managerial and Operative functions-Evolution of HRM-Job Analysis -Human Resource Planning(HRP)-Employee Recruitment-Sources of Recruitment-Employee Selection- Process and Tests in Employee Selection- Employee Training and Development-On- the- job & Off- the- job training methods-Performance Appraisal Concept-Methods of Performance Appraisal-Placement-Employee Induction-Wage and Salary Administration-Objectives-Essentials of Wage and Salary Administration-Job Evaluation-Employee Grievances-Techniques of handling Grievances.

UNIT IV:STRATEGIC & PROJECT MANAGEMENT:

Definition& Meaning-Setting of Vision- Mission- Goals- Corporate Planning Process- Environmental Scanning-Steps in Strategy Formulation and Implementation-SWOT Analysis. **Project Management:**Network Analysis- Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying Critical Path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (Simple problems).

UNIT V:CONTEMPORARY ISSUES IN MANAGEMENT:

The concept of Management Information System(MIS)- Materials Requirement Planning (MRP)-Customer Relations Management(CRM)- Total Quality Management (TQM)- Six Sigma Concept-Supply Chain Management(SCM)- Enterprise Resource Planning (ERP)- Performance Management-Business Process Outsourcing (BPO), Business Process Re-engineering and Bench Marking -Balanced Score Card-Knowledge Management.

Text Books:

1. A.R Aryasri: Management Science, TMH, 2013
2. Stoner, Freeman, Gilbert, Management, Pearson Education,New Delhi, 2012.

COURSE OUTCOMES:

1. To apply the concepts & principles of management & designs of organization in a practical world.

To design good plant layout and apply Work-study principles, Quality Control techniques, in real life industry & To maintain & control the Inventory & students can able to identify the importance of marketing in emerging world.

To apply the concepts of HRM in Recruitment, Selection, Training & Development.

To develop PERT/CPM Charts for projects of an enterprise and estimate time & cost of project & to analyse the business through SWOT .

They can aware of the latest and contemporary issues of management science.

References:

1. Koontz & Weihrich: Essentials of Management, 6/e, TMH, 2005.
2. Thomas N.Duening & John M.Ivancevich ManagementPrinciples and Guidelines,Biztantra.

3. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.
4. Memoria & S.V.Gauker, Personnel Management, Himalaya, 25/e, 2005
5. Samuel C.Certo: Modern Management, 9/e, PHI, 2005
6. Schermerhorn, Capling, Poole & Wiesner: Management, Wiley, 2002.
7. Parnell: Strategic Management, Biztantra, 2003.
8. Lawrence R Jauch, R.Gupta &William F.Glueck: Business Policy and Strategic Management, Frank Bros., 2005.

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II- Year B.Tech. I-Sem

PROBABILITY AND STATISTICS(17A45101)
(Common for CE, ME, Chemical)

Objectives: To help the students in getting a thorough understanding of the fundamentals of probability and usage of statistical techniques like testing of hypothesis, Statistical Quality Control and Queuing theory

UNIT – I: Basic concepts of Probability – Random variables – Expectation – Discrete and continuous Distributions – Distribution functions. Binomial and poison distributions Normal distribution – Related properties.

UNIT – II: Test of Hypothesis: Population and Sample - Confidence interval of mean from Normal distribution - Statistical hypothesis - Null and Alternative hypothesis - Level of significance. Test of significance - Test based on normal distribution - Z test for means and proportions.

UNIT – III: Small samples - t- test for one sample and two sample problem and paired t-test, F-test and Chi-square test (testing of goodness of fit and independence).

UNIT – IV: Statistical Quality Control: Concept of quality of a manufactured product -Defects and Defectives - Causes of variations - Random and assignable - The principle of Shewhart Control Chart-Charts for attribute and variable quality characteristics- Constructions and operation of $\overline{X}$ - Chart, R-Chart, p - Chart and C-Chart.

UNIT – V: Queuing Theory: Pure Birth and Death process, M/M/1 & M/M/S & their related simple problems.

TEXT BOOKS:

1. Probability & Statistics by E. Rukmangadachari & E. Keshava Reddy, Pearson Publisher.
2. Probability & Statistics for engineers by Dr. J. Ravichandran WILEY-INDIA publishers.

REFERENCES:

1. Probability & Statistics by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad, S.Chand publications.
2. Statistical methods by S.P. Gupta, S.Chand publications.
3. Probability & Statistics for Science and Engineering by G.Shanker Rao, Universities Press.
4. Probability and Statistics for Engineering and Sciences by Jay L.Devore, CENGAGE.
5. Probability and Statistics by R.A. Jhonson and Gupta C.B.

Outcomes: The student will be able to analyze the problems of engineering & industry using the techniques of testing of hypothesis, Statistical Quality Control and Queuing theory and draw appropriate inferences.

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II- Year B.Tech. II-Sem

ANALYTICAL CHEMISTRY(17A40801)

Course Objectives:

- To acquire basic principles of simple instrumental methods for estimation of organic/inorganic species.
- To acquire basic knowledge of industrial separations
- To acquire Knowledge in Characterization of the Materials synthesized by chemical industry
- To understand the Preparations, properties and reactions of materials

UNIT-I: Basic Principles of Quantitative Analysis

Limitations of analytical methods, Classification of errors, Accuracy, Precision, How to reduce systematic errors, Significant figures, Calculators and Computers, Mean and Standard deviation, Distribution of Random errors, Reliability of Results, Confidence interval , Comparison of results, Comparing the means of two samples, Paired T-test, Correlation and regression, Standard deviations.

UNIT-II: Chromatographic Methods:

Column chromatography-general principles, terminology: retention time, rotation volume, separation factor, resolution of peaks. Principles of gas chromatography, block diagram of gas chromatograph - detectors (FID, ECD), stationary phases for column, mobile phases,

chromatogram, qualitative analysis, special plots, quantitative analysis, HPLC: Principles of High Performance Liquid Chromatography. Block diagram of HPLC Systems, function of each component, stationary phases, eluting solvents, pumps, detectors, quantitative applications of HPLC. Ion chromatography-seperation of anions and cations. Suppressed & non-suppressed ion chromatography. Numerical calculations.

Unit-III: Thermal methods of Analysis:

Introduction to Thermal methods, Thermogravimetric Analysis (TGA)-principles, and applications (determination of drying temperatures, kinetic methods, automatic thermo gravimetric Analysis) DTA: Differential thermal analysis-Principles and applications (exothermic and endothermic peaks, heat of reaction, catalysis, decompositions etc.,)

DSC: Differential scanning calorimettry, principles & applications (exothermic & endothermic peaks, compound purity determination, percentage crystallinity, glass transition temperature).

Unit-IV: Electro-Analytical Techniques

i). Polarography: Definition, advantage of dropping mercury electrode, factors affecting on limiting current, Half wave potentials and significance, Applications of Polarography

ii), Amperometric Titrations: Basic principle involved in the Amperometry, Amperometric Titrations and applications, Advantages and disadvantages of Amperometric Titrations.

Unit-V: Spectrophotometric Methods:

Introduction to Analysis: Qualitative & Quantitative Analysis; Conventional & Instrumental methods of analysis. Molecular spectrophotormetry-Beer's law Block diagram of UV-Visible Spectrophotometer – quantitative analysis direct method for the determination metal ions: Chromium, Manganese, Iron, etc in alloys. Infrared spectrophotormetry-principle, instrumentation and Functional group analysis of organic compounds using infrared spectra. Quantitative analysis of organic molecules. Atomic absorption spectrophotormetry(AAS) and flame photometry: principles, instrumentation and applications (Determination of Sodium, Potassium and Calcium.) (12h)

Course Outcome:

The student may acquire enough knowledge on industrial processes and Identification of Products using different analytical and instrumental techniques.

BOOKS:

1. Quantitative analysis, R.A.Day & A.L. Underwood , 5th edition, Printice- Hall of India Pvt. Ltd., 2000.
2. Vogel's Text Book of Qualitative chemical analysis, J. Mendham, R.C.Denney, J. Darnes, M.J.K. Thomas, Persar education 6th edition, 2002.
3. Elements of Physical Chemistry-Peter Atkins, Oxford Uni.Press, 3rd Edition, 2010.

REFERENCES:

1. Atkin's Physical Chemistry – P. Atkins and J. De Paula, Oxford Univ.Press, 9th Edition, 2012
2 Instrumental lMethods of Chemical Analysis, Gurdeep R.Chatwal, Sham K.Ananad, Himalayha publishing House,5th Edition, 2012.
3. Advanced physical chemistry – Gurudeepraj, Goel Publishing House, 2000
4. Essentials of Physical Chemistry- Arun Bahl, B.S.Bahl and G.D.Rulasi, S.Chand Publishers, New Delhi.

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II- Year B.Tech. II-Sem

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PROCESS HEAT TRANSFER (17A40802)

UNIT -I

Introduction: Nature of heat flow, conduction, convection, natural and forced convection, radiation.

Heat transfer by conduction in Solids: Fourier's law, thermal conductivity, steady state conduction in plane wall & composite walls, compound resistances in series, heat flow through a cylinder, conduction in spheres.

Unsteady state heat conduction: Equation for one-dimensional conduction, Semi-infinite solid.

UNIT- II

Principles of heat flow in fluids: Typical heat exchange equipment, countercurrent and parallel current flows, energy balances, rate of heat transfer, overall heat transfer coefficient, electrical analogy, critical radius of insulation, logarithmic mean temperature difference, variable overall coefficient, multi-pass exchangers, individual heat transfer coefficients, resistance form of

overall coefficient, fouling factors, classification of individual heat transfer coefficients, magnitudes of heat transfer coefficients, effective coefficients for unsteady-state heat transfer.

UNIT- III

Heat Transfer to Fluids without Phase change: Regimes of heat transfer in fluids, thermal boundary layer, heat transfer by forced convection in laminar flow, heat transfer by forced convection in turbulent flow, the transfer of heat by turbulent eddies and analogy between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes.

Natural convection: Natural convection to air from vertical shapes and horizontal planes, effect of natural convection in laminar-flow heat transfer.

UNIT -IV

Heat transfer to fluids with phase change: Heat transfer from condensing vapors, heat transfer to boiling liquids.

Radiation: Introduction, properties and definitions, black body radiation, real surfaces and the gray body, absorption of radiation by opaque solids, radiation between surfaces, radiation shielding, radiation to semi transparent materials, combined heat transfer by conduction, convection and radiation.

UNIT- V

Heat exchange equipment: General design of heat exchange equipment, heat exchangers, condensers, boilers and calendrias, extended surface equipment, heat transfer in agitated vessels, scraped surface heat exchangers, heat transfer in packed beds, heat exchanger effectiveness (NTU method)

Evaporators: Evaporators, performance of tubular evaporators, capacity and economy, multiple effect evaporators, methods of feeding, vapor recompression.

TEXT BOOK:

1. Unit Operations of Chemical Engineering, 6th ed., W.L. McCabe, J.C. Smith and P. Harriot, McGraw-Hill, New York, 2001

REFERENCES:

1. Process Heat Transfer, D.Q. Kern, Tata McGraw-Hill, New Delhi, 1997.
2. Heat Transfer, 4th ed., J.P. Holman, McGraw-Hill, New York, 1976.
3. Chemical Engineering, Volume-I, J. Coulson and R.F. Richardson, Pergamon Press

Objective: To impart the students about knowledge on modes of heat transfer and design of heat transfer equipment evaporators etc.,

Outcome: Student will be able to use the heat transfer principles in selection and design of heat exchanger, evaporator, etc. for a chemical industry.

JNTUA College of Engineering (Autonomous),

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II- Year B.Tech. II-Sem

MECHANICAL OPERATIONS (17A40803)

UNIT- I

Properties, handling and mixing of particulate solids: Characterization of solid particles, properties of particulate masses, storage and mixing of solids, types of mixers, mixers for cohesive solids, mixers for free flowing solids.

UNIT- II

Size reduction: Principles of comminution, computer simulation of milling operations, size reduction equipment-crushers, grinders, ultra fine grinders, cutting machines, Equipment operation. Laws of crushing: Kick's law, Bond's law, Rittinger's law

Screening, Industrial screening equipments, Effectiveness of the screen, differential & cumulative analysis.

UNIT -III

Filtration, cake filters, centrifugal filters, cyclone separators, electro-static precipitators.

Principles of cake filtration, Clarifying filters, liquid clarification, gas cleaning, principles of clarification.

UNIT- IV

Separations based on motion of particles through fluids: gravity settling processes and centrifugal settling processes, float and sink method, differential settling, coagulation, Flotation-separation of ores, flotation agents

Transportation of solid particulate mass:Belt, screw, apron conveyers, bucket elevators, pneumatic conveying.

UNIT- V

Agitation and mixing of liquids: Agitation of liquids, circulation velocities, power consumption in agitated vessels. Blending and mixing of liquids, suspension of solid particles, dispersion operations.

TEXT BOOK:

1. Unit Operations in Chemical Engineering by W.L. McCabe and J.C. Smith and Peter Harriott, McGraw Hill 7th ed. 2001.

REFERENCES:

1. Chemical engineers hand book, J.H. Perry, 7th ed. McGraw Hill
2. Introduction to Chemical Engineering by J.T.Banchero& W.L. Badger., TMH, 1997.

Objective: This course deals with the different mechanical unit operations in chemical engineering. Specific attention is given on particle and separation techniques.

Outcome: Student will gain knowledge on various mechanical separation operations used in chemical industry.

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L	T	P	C
2	2	0	3

II- Year B.Tech. II-Sem

CHEMICAL ENGINEERING THERMODYNAMICS (17A40804)

UNIT -I

Introduction: The scope of thermodynamics, temperature, defined quantities; volume, pressure, work, energy, heat, Joules Experiments.

The first law and other basic concepts: The first law of thermodynamics, thermodynamic state and state functions, enthalpy, the steady-state steady-flow process, equilibrium, the phase rule, the reversible process, constant-V and constant- P processes, heat capacity, isobaric, isochoric, isothermal, adiabatic and polytrophic processes.

UNIT -II

Volumetric properties of pure fluids: The PVT behavior of pure substances, virial equations, the ideal gas, the applications of the virial equations, second virial coefficients from potential functions. Cubic equations of state, generalized correlations for gases, generalized correlations for liquids, molecular theory of fluids.

UNIT- III

The second law of thermodynamics: Statements of the second law, heat engines, thermodynamic temperatures scales, thermodynamic temperature and the ideal gas scale

Entropy, Entropy changes of an ideal gas, mathematical statement of the second law, the third law of thermodynamics, entropy from the microscopic view point, calculation of ideal work and lost work.

UNIT -IV

Power cycles: Carnot cycle, Rankine cycle, Otto cycle, Diesel cycle.

Refrigeration and liquefaction: The Carnot refrigerator, the vapor compression cycle, the comparison of refrigeration cycles, the choice of refrigerant, absorption refrigeration, the heat pump, liquefaction processes.

UNIT –V

Thermodynamic properties of fluids: Property relations for homogeneous phases, residual properties, two phase systems, thermodynamic diagrams, tables of thermodynamic properties, generalized property correlation for gases.

TEXT BOOKS

1. J.M.Smith and HC Van Ness, Introduction to Chemical Engineering Thermodynamics, 6thed, McGraw Hill,2003.

REFERENCE

1. Y.V. C. Rao, Chemical Engineering Thermodynamics, University publications.
2. K. V. Narayanan, Chemical Engineering Thermodynamics, PHI,2001

Objective: To provide the students with the terminology of thermodynamics like system, properties, processes, reversibility, equilibrium, phases, components; the relationship between heat and work by understanding the significance of the thermodynamic laws.

Outcome: This course will enable the student to understand the spontaneity and energy efficiency of a process.

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II Year B.Tech. II-Sem

MECHANICAL OPERATIONS LAB (17A40805)

1. To determine the time of grinding in a ball mill for producing a product with 80 % passing a given screen.

Major equipment - Ball mill Apparatus, Sieve shaker, Different sizes of sieves, weighing balance.

2. To verify the laws of crushing using any size reduction equipment like crushing rolls or vibrating mills and to find out the working index of the material.

Major equipment – Jaw Crusher, Sieve shaker, Different sizes of sieves, WeighingBalance, Energy meter.

3. To find the effectiveness of hand screening and vibrating screen of a given sample.
   Major equipment - Vibrating Sieve shaker, Different sizes of sieves, WeighingBalance.
4. To achieve beneficiation of a ore using froth flotation technique.
   Major equipment - Froth flotation cell
5. To obtain batch sedimentation data and to calculate the minimum thickner area under given conditions.
   Major equipment- Sedimentation apparatus
6. To determine the specific cake resistance and filter medium resistance of a slurry in plate and frame filter press.
   Major equipment - Plate and frame filter press.
7. To separate a mixture of particles by Jigging.
   Major equipment - Jigging apparatus
8. To calculate separation efficiency of particles in a mixture using cyclone separator.
   Major equipment - Cyclone separator
9. To determine reduction ratio of a given sample in a pulverizer.
   Major equipment - Pulverizer
10. Filtration Studies using

    a. Plate and Frame Filter Press
    b. Rotary Drum Filter
    c. Batch Centrifuge

11. To Perform mixing studies using Ribbon Mixer.

12. To determine reduction ratio of a given sample in .a grinder Major equipment - Grinder

Objective: The course will equip students with the practical knowledge of different mechanical unit operations & operational conditions of different equipments.

Outcome: Student will be able to develop knowledge on various mechanical separation operations used in a chemical industry.

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II- Year B.Tech. II-Sem

PROCESS HEAT TRANSFER LAB(17A40806)

1. Determination of total thermal resistance and thermal conductivity of composite wall.
   Major equipment - Composite wall Assembly

2. Determination of thermal conductivity of a metal rod.
   Major equipment - Thermal Conductivity apparatus
3. Determination of natural convective heat transfer coefficient for a vertical tube.
   Major equipment - Natural convection heat transfer apparatus
4. Determination of critical heat flux point for pool boiling of water.
   Major equipment- Pool boiling apparatus
5. Determination of forced convective heat transfer coefficient for air flowing through a pipe
   Major equipment – Forced convection heat transfer apparatus
6. Determination of overall heat transfer coefficient in double pipe heat exchanger.
   Major equipment - Double pipe heat exchanger apparatus
7. Determination of heat transfer coefficient for a helical coil in an agitated vessel.
   Major equipment – Helical coil in a agitated vessel.
8. Study of the temperature distribution along the length of a pin-fin under natural and forced convection conditions
   Major equipment - Pin fin apparatus
9. Estimation of un-steady state film heat transfer coefficient between the medium in which the body is cooled.
   Major equipment - Heat transfer coefficient determination apparatus
10. Determination of Stefan – Boltzmann constant.
   Major equipment - Stefan Boltzmann apparatus
11. Determination of emissivity of a given plate at various temperatures.
   Major equipment - Emissivity determination apparatus

Objective: This lab will provide practical knowledge on various heat transfer process and equipment like heat exchangers and evaporators.

Outcome: The student will be able to understand the thermal conductivity measurement, heat transfer coefficient, calculation in natural and forced convection and some of the radiation aspects.

JNTUA College of Engineering (Autonomous), Ananthapuramu

II- Year B.Tech. II-Sem

L	T	P	C
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COMPREHENSIVE OBJECTIVE TYPE EXAMINATION (17A40807)

JNTUA College of Engineering (Autonomous), Ananthapuramu

III Year B.Tech. Chem. Engg. I-Sem

L	T	P	C
3	0	0	3

PROCESS DYNAMICS AND CONTROL (17A50801)

Objectives:

- Develop mathematical and transfer function models for dynamic processes.

- Analyze process stability and dynamic responses.
- Empirically determine process dynamics for step response data.
- Development of block diagrams, reading block diagrams, process and instrumentation diagrams
- Familiarity with different types of PID feedback controllers..
- Ability to understand feed forward control, cascade control and Smith predictors and their applications
- Knowledge of real time applications of process control implementation.

UNIT I

Introduction to process dynamics and control: Laplace transforms, Inverse Laplace transform, Response of First Order Systems. Physical examples of first order systems- Liquid level, mixing process, R- C circuit. Linearization.

UNIT II

Response of first order systems in series- interacting and non- interacting systems, second order systems, transportation lag.

Control system: Components of a control system, Servo Vs regulator problem, development of block diagram.

Controllers and final control elements: Control valve and its construction,P, PD, PI, PID controllers.

UNIT III

Stability: Concept of Stability, Stability criterion, Routh test for stability

Root locus: concept of root locus, rules for plotting the root locus diagram.

UNIT IV

Introduction to frequency response: Substitution rule, Bode diagrams

Control systems design by frequency response: Bode stability criterion, Gain and Phase margins.

Controller tuning: Tuning of P, PD, PI, PID controllers, trial and error method, Ultimate gain and ultimate period, Ziegler- Nichols technique, Cohen and Coon rules.

UNIT V

Advanced control strategies: Cascade control, feed forward control, ratio control, Smith predictor, dead time compensation. Control valve sizing, valve characteristics.

TEXT BOOK:

1. Process Systems Analysis and Control, 2nd ed., D.R. Coughanowr, McGraw-Hill, 1991

REFERENCES:

1. Chemical Process Control, G. Stephanopoulos, PHI Learning Pvt. Ltd., New Delhi, 2010

2. Process Control, B.W. Bequette, PHI Learning Pvt. Ltd., New Delhi, 2010

OUTCOME: Ability to model the dynamic processes, to analyze the dynamic processes, to design feedback control system for chemical, mechanical & electrical engineering systems and to design advanced control system for complex and normal processes.

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III Year B.Tech. Chem. Engg. I-Sem

L	T	P	C
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PHASE AND CHEMICAL EQUILIBRIA(17A50802)

OBJECTIVES:

To introduce the concepts of chemical potential, partial properties, property relations for ideal gases, fugacity excess properties and to develop the theoretical foundation for applications of thermodynamics to gas mixtures and liquid solutions and to perform the phase equilibrium calculations using simple models for VLE, Gamma/Phi approach and equation of state approach.

UNIT I

Solution Thermodynamics: Theory, Fundamental property relation, chemical potential as a criterion for phase equilibrium, partial properties, ideal gas mixtures, fugacity and fugacity coefficient for pure species, fugacity and fugacity coefficient for species in solutions, generalized correlations for Fugacity coefficient, The ideal solutions, excess properties.

UNIT II

Solution Thermodynamics: Applications: The liquid phase properties from VLE data, models for the excess Gibbs energy, property changes of mixing

VLE at low to moderate pressures: The nature of equilibrium, the phase rule, Duhems theorem, VLE: Qualitative behavior, the gamma /Phi formulation of VLE, Dew point and bubble point calculations, flash calculations, solute (1)/solvent (2) systems

UNIT III

Thermodynamic Properties and VLE from Equations of State: properties of fluids from the virial equations of state, properties of fluids from cubic equations of state, fluid properties from correlations of the Pitzer type, VLE from cubic equations of state

Topics in Phase Equilibria: Equilibrium and stability, Liquid-Liquid Equilibrium (LLE), Vapor- Liquid–Liquid Equilibrium (VLLE), Solid-Liquid Equilibrium (SLE), Solid Vapor Equilibrium (SVE).

UNIT IV

Chemical Reaction Equilibria: The reaction coordinate, application equilibrium criterion to chemical reactions, The standard Gibb's energy change and the equilibrium constant, effect of temperature on equilibrium constants, relation of equilibrium constants to composition, equilibrium conversion for single reactions, Phase rule and Duhem's theorem for reacting systems.

UNIT V

Introduction to Molecular Thermodynamics : Molecular Theory of Fluids,Second Virial Coefficients from Potential Functions,Internal Energy of Ideal Gases: Microscopic view, Thermodynamic Properties and Statistical Mechanics ,Hydrogen Bonding and Charge-Transfer Complexing ,Behavior of Excess Properties ,Molecular Basis for Mixture Behavior,VLE by Molecular Simulation.

TEXT BOOK:

1. Introduction to Chemical Engineering Thermodynamics, 6th ed., J.M. Smith, H.C. Van Ness and M.M. Abbott, Tata McGraw-Hill, New Delhi, 2003.

REFERENCE:

1. Chemical Engineering Thermodynamics, Pradeep Ahuja, PHI Learning Pvt. Ltd., New Delhi, 2009

2. A Text Book of Chemical Engineering Thermodynamics, K.V. Narayanan, PHI Learning Pvt. Ltd., New Delhi, 2001.

Outcome:

1. Students will learn the concepts of chemical potential, partial properties, property relations for ideal gases, fugacity excess properties and to develop the theoretical foundation for applications of thermodynamics to gas mixtures and liquid solution.

2. Students will be able to understand the procedures for estimating the thermodynamic properties and perform thermodynamic calculations oriented to the analysis and design of chemical processes.

L	T	P	C

2	2	0	3

CHEMICAL REACTION ENGINEERING – I(17A50803)

OBJECTIVES:

- The emphasis of this course is on the fundamentals of chemical reaction kinetics and chemical reactor operation.
- The overall goal of this course is to develop a critical approach toward understanding complex reaction systems and elucidating chemical reactor design.
- Integrate concepts from science & engineering to constitute a basis for the design of chemical reactor, a key element in the design of chemical process.
- Provide a foundation on deriving rate expressions for series, parallel, reversible reactions and the knowledge about product distribution in multiple reactions, recycle reactors and auto catalytic reactions

UNIT I

Overview of chemical reaction engineering-classification of reactions, variables affecting the rate of reaction definition of reaction rate, kinetics of homogenous reactions- concentration dependent term of rate equation, Temperature dependent term of rate equation, searching for a mechanism, predictability of reaction rate from theory.

Interpretation of batch reactor data- constant volume batch reactor:- Analysis of total pressure data obtained in a constant-volume system, the conversion, Integral method of analysis of data– general procedure, irreversible unimolecular type first order reactions, irreversible bimolecular type second order reactions, irreversible trimolecular type third order reactions, empirical reactions of nth order, zero-order reactions, overall order of irreversible reactions from the half-life, fractional life method, irreversible reactions in parallel, homogenous catalyzed reactions, autocatalytic reactions, irreversible reactions in series.

UNIT II

Constant volume batch reactor– first order reversible reactions, second order reversible reactions, reversible reactions in general, reactions of shifting order, Differential method of analysis of data. Varying volume batch reactor–differential method of analysis, integral method of analysis, zero order, first order, second order, nth order reactions, temperature and reaction rate, the search for a rate equation.

UNIT III

Introduction to reactor design- general discussion, symbols and relationship between C_A and X_A. Ideal reactors for a single reaction- Ideal batch reactor, Steady-state mixed flow reactor, Steady-state plug reactors.

Design for single reactions- Size comparison of single reactors, Multiple- reactor systems, Recycle reactor, Autocatalytic reactions.

UNIT IV

Design for parallel reactions- introduction to multiple reactions, qualitative discussion about product distribution, quantitative treatment of product distribution and of reactor size.

Multiple reactions-Irreversible first order reactions in series, quantitative discussion about product distribution, quantitative treatment, plug flow or batch reactor, quantitative treatment, mixed flow reactor, first-order followed by zero-order reaction, zero order followed by first order reaction.

UNIT V

Temperature and Pressure effects- single reactions- heats of reaction from thermodynamics, heats of reaction and temperature, equilibrium constants from thermodynamics, equilibrium conversion, general graphical design procedure, optimum temperature progression, heat effects, adiabatic operations, non adiabatic operations, comments and extensions. Exothermic reactions in mixed flow reactors-A special problem, multiple reactions.

TEXT BOOK:

1. Chemical Reaction Engineering, 3rd ed., O. Levenspiel, John Wiely & Sons, 1999.

REFERENCES:

1. Elements of Chemical Reaction Engineering, 2nd ed., H.S. Fogler, PHI Learning Pvt. Ltd., New Delhi, 2010.
2. Chemical Engineering Kinetics, 3rd ed., J.M. Smith, McGraw-Hill, New York, 1981.

Outcome:

- This course provides necessary knowledge for selection of the chemical reactors for a particular process.
- Analyze and interpret experimental data from batch reactors and determine the order of simple chemical reactions.
- Compare ideal reactor types (batch, CSTR and PFR) and apply quantitative methods to design and size reactors for simple chemical reaction schemes.
- Determine optimal ideal reactor design for multiple reactions for yield or selectivity.
- Predict reactor performance for reactors when the temperature is not uniform within the reactor

III Year B.Tech. Chem. Engg. I-Sem

L	T	P	C
2	2	0	3

MASS TRANSFER OPERATIONS-I (17A50804)

OBJECTIVES:

- To discuss the fundamental concepts of mass transfer principles and to apply those concepts to real engineering problems.
- To impart the basic concepts of molecular diffusion, mass transfer coefficients and analysis of different mass transfer processes
- Applies the concepts of diffusion mass transfer, mass transfer coefficients, convective mass transfer, inter-phase mass transfer, equipment for gas-liquid operations.

UNIT- I

The Mass Transfer Operations: Classification of the Mass-Transfer Operations, Choice of Separation Method, Methods of Conducting the Mass-Transfer Operations, Design Principles, Unit Systems

Molecular Diffusion In Fluids: Molecular Diffusion, Equation of Continuity, binary solutions, Steady State Molecular Diffusion in Fluids at Rest and in Laminar Flow, estimation of diffusivity of gases and liquids, Momentum and Heat Transfer in Laminar flow

Diffusion:Diffusion in Solids, Fick's Diffusion, Unsteady State Diffusion, Types of Solid Diffusion, diffusion through polymers, diffusion through crystalline solids, Diffusion through porous solids & hydrodynamic flow of gases.

UNIT- II

Mass Transfer Coefficients: Mass Transfer Coefficients, Mass Transfer Coefficients in Laminar Flow (Explanation of equations only and no derivation), Mass Transfer Coefficients in Turbulent Flow, eddy diffusion, Film Theory, Penetration theory, Surface-renewal Theory, Combination Film-Surface-renewal theory, Surface-Stretch Theory, Mass, Heat and Momentum Transfer Analogies, Turbulent Flow in Circular Pipes. Mass transfer data for simple situations.

Inter Phase Mass Transfer: Concept of Equilibrium, Diffusion between Phases, Material Balances in steady state co-current and counter current stage processes, Stages, Cascades, Kremser – Brown equation.

UNIT-III

Equipment For Gas-Liquid Operations: Gas Dispersed, Sparged vessels (Bubble Columns), Mechanical agitated equipments(Brief description),Tray towers, General characteristics, Sieve design for absorption and distillation (Qualitative Treatment), Different types of Tray Efficiencies, Liquid Dispersed venturi Scrubbers, Wetted-Wall Towers, Packed Towers, Counter current flow of Liquid & Gas through packing, Mass transfer coefficients for packed towers, End effects and Axial Mixing Tray tower vs Packed towers.

UNIT-IV

Absorption And Stripping: Absorption equilibrium, ideal and non ideal solutions selection of a solvent for absorption, one component transferred: material balances. Determination of number of Plates (Graphical), Absorption Factor, estimation of number of plates by Kremser Brown equation, Continuous contact equipment; HETP, Absorption of one component,

Determination of number of Transfer Units and Height of the Continuous Absorber, overall coefficients and transfer units, dilute solutions, overall height of transfer units.

UNIT-V

Humidification Operations: Vapor-Pressure Curve, Definitions, Psychometric Charts, Enthalpy of gas-vapor Mixtures, Humidification and Dehumidification, Operating lines and Design of Packed Humidifiers, Dehumidifiers and Cooling towers, Spray Chambers

TEXT BOOK:

1. Mass transfer operations by R.E. Treybal, 3rd ed. Mc Graw Hill, 1980.
2. Separation process C.J King, Tata Mc Graw Hill
3. Principles of Mass Transfer and Separation Processes by B K Dutta, Printice Hall of India Pvt Limited, New Delhi

REFERENCE:

1. Diffusion mass transfer in fluid system by E. L. Cussler.
2. Transport processes and unit operations by Christie J. Geankoplis
3. Separation Process Principles, J D Seader and E. J. Henley, John Wiley & Sons, Inc,. New York

Pre-requisite:---Nil---

Codes/Tables: *Psychometric Charts may be provided*

Outcome:

- Recognize the various modes of mass transfer, Determine mass transfer rates using Fick's Law.
- Fundamental knowledge on mass transfer mechanisms and operations like absorption, stripping, drying and humidification.
- Estimate diffusion coefficients, Solve unsteady state diffusion problems
- Determine convective mass transfer rates & mass transfer coefficients
- Determine the number of transfer units and height requirements for a packed column

L	T	P	C
2	2	0	3

CHEMICAL TECHNOLOGY(17A50805)

OBJECTIVES:

- Unit operations unit processes involved in manufacture of important and widely employed organic and inorganic chemicals.
- Develop skills in preparing /presenting a neat Engineering drawing for Chemical Process Industries.
- Impart clear description of one latest process along with its Chemistry, Process parameters, Engineering Problems and Optimum Conditions.
- Demonstrate the importance of updating the latest technological developments in producing products economically and environment friendly.
- Appreciate the usage of other engineering principles such as Thermodynamics, Heat, mass and momentum transfer in operation and maintain the productivity

UNIT – I

Water and Air: Importance of water, sources, plant location factors related to water, water shortage problems, methods of treating fresh water, methods of obtaining fresh water from saline waters, waste water treatment and disposal, air as a chemical raw material.

Soda ash, caustic soda and chlorine, Glass: manufacture of special glasses

UNIT – II

Industrial gases: carbon dioxide, hydrogen and oxygen – products of water gas, producer gas. Nitrogen industries: synthetic ammonia, urea, nitric acid (ammonium nitrate), ammonium chloride, ammonium phosphate and complex fertilizers

Sulphur and sulphuric acid, manufacture of sulphuric acid, hydrochloric acid and some other chemicals –Aluminum sulphate and alum.

UNIT – III

Cement manufacture, special cements, miscellaneous calcium compounds, magnesium compounds.

Manufacture of phenols, formaldehyde, vinyl chloride and vinyl acetate, manufacture of phenol-formaldehyde resin and polyvinyl chloride polymer, SBR

UNIT – IV

Oils: Definition, constitution, extraction and expression of vegetable oils, refining and hydrogenation of oils.

Synthetic fibers: Classification, manufacture of Nylon 66, polyester fiber and viscose rayon fiber.

Soaps and detergents: Definitions, continuous process for the production of fatty acids, glycerin and soap, production of detergents.

UNIT – V

Pulp and paper industry: methods of pulping, production of sulphate and sulphite pulp, production of paper –wet process

Pharmaceutical Industries: Classification, Alkylation, Carboxylation and Acetylation, Condensation and Cyclization, Dehydration,Halogenation, Oxidation, Sulfonation, Amination, Radio isotopes in Medicine, Fermentation and Life processing for Antibiotics, Hormones, and Vitamines, Biologicals, Steroid hormones, isolates and Animals.

Text books:

1. Shreve's Chemical Process Industries edited by Austin, Mc.graw-Hill.5th ed.1985.
2. Dryden's Outlines of Chemical Technology edited by M. Gopal Rao and M. Sittig, 2nd ed. 1973.

References:

1. Industrial Chemistry by B.K. Sharma,
2. Hand book of industrial chemistry Vol 1& II K.H.Davis & F.S. Berner Edited by S.C. Bhatia, CBS publishers
3. Chemical Technology: G.N. Panday, Vol 1& Vol II.

Pre-requisite:---Nil---

Outcomes:

Upon successful completion of the course the students will be able to:

1. Make a neat and easy to understand the plant process flow sheet.
2. Keeps up the productivity while maintaining all safety norms stipulated, during their job.
3. Solve Engineering problems that are likely to come across during the operation of plants.
4. Suggest alternative manufacturing process in terms of Economic viability of the product.

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III Year B.Tech. Chem. Engg. I-Sem

PROCESS MODELING AND SIMULATION(17A50806)

OBJECTIVES:

- Learn to develop mathematical model for problems.
- To impart knowledge on modeling of various equipment and their simulation using different numerical techniques.
- Formulate a chemical engineering problem as a mathematical model, and select an appropriate solution method.
- Understand the computational requirements of various solution options and use this understanding in the selection of the solution method
- Formulate and solve process design problems, based on fundamental analysis and using mathematical models of chemical processes

UNIT I

Mathematical models for chemical engineering systems: classification of mathematical models- steady state vs dynamic models, lumped vs distributed parameter models, deterministic vs stochastic models. **Examples of mathematical models**- Two heated tanks, batch reactor, constant volume CSTRs, non-isothermal CSTR, reactor with mass transfer, ideal binary distillation column, batch distillation with holdup.

UNIT II

Empirical model building- method of least squares, linear, polynomial and multiple regression, non-Linear regression. **Solution of Non- Linear Algebraic equations**- bisection, false position, Quasi Newton and Newton- Raphson methods.

UNIT III

Numerical integration- Trapezoidal rule, Simpson's rule and Newton– Cotes formula. **Numerical solution of differential equations**- Euler's method, Runge- Kutta methods, predictor corrector methods.

UNIT IV

Numerical solution of partial differential equations- elliptic, parabolic and hyperbolic equations.finite difference methods, Leibman's method, Crank Nicholson method. Apllications to steady state and Unsteady state heat conduction and temperature distribution problems.

UNIT V

Process Simulation examples: VLE dew point and bubble point calculations, binary distillation column, gravity flow tank, batch reactor, Non- isothermal CSTR, countercurrent heat exchanger.

Process simulation using modular and equation based solving approaches: Developing a simulation model, a simple flow sheet, Sequential modular approach, Simultaneous modular approach, Equation solving approach.

TEXTBOOKS:

1. Process modeling, Simulation and Control for Chemical Engineers, 2nd ed., W. L. Luyben, McGraw-Hill, New York, 1990.
2. Numerical Methods for Engineers, S.K. Gupta, Wiley Eastern, New Delhi, 1995.

REFERENCE:

1. Numerical Methods for Engineers and Scientists, S.S. Rao
2. Introduction to Numerical Methods in Chemical Engineering, P. Ahuja, PHI learning Pvt. Ltd., New Delhi, 2010
3. Process Modeling and Simulation, Amiya K. Jana, 2012.

Outcome:

- Understand the stages involved in the development of a process model.
- Formulate a chemical engineering problem as a mathematical model from basic engineering principles.
- Identify the appropriate numerical solutions used in solving the models
- Apply various simulation tools for solving the chemical engineering models developed.
- Understand the solution techniques for solving ODEs.

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Foreign Language (Audit)(17A59901)

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L	T	P	C
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PROCESS DYNAMICS AND CONTROL LAB (17A50807)

OBJECTIVES:

- To evaluate response of fist and higher order characteristics.
- Study the installed characteristics of the valve.
- Study if there is a hysteresis in the control valve and sensor.
- Evaluate the tuning of a PID control via manual and automatic tuning.
- Evaluate the effect controller on the control system

1. Calibration and determination of time lag of various first and second order instruments
Major equipment - First order instrument like Mercury-in-Glass thermometer and
Overall second order instrument like Mercury-in-Glassthermometer in a thermal well

2.Experiments with single tank system.
Single tank - Step Response
Single tank - Impulse Response

3. Experiments with two tank systems with and without interaction.
Non Interacting Tanks – Step Response
Interacting Tanks – Step Response
Non Interacting Tanks – Impulse Response
Interacting Tanks – Impulse Response

4. Level control trainer
Major equipment - Level control trainer set up with computer

5. Temperature control trainer
Major equipment - Temperature control trainer with computer

6. Experiments on proportional, reset, rate mode of control etc.
Major equipment – PID control apparatus

7. Control valve characteristics
Major equipment – Control valve set up

8. Estimation of damping coefficient for U-tube manometer
   Major equipment - U-tube manometer.

Outcome:

- Estimate the dynamic behavior of the control systems
- Understand the controllability, speed of response the control systems.
- Select proper control valve to meet process needs.
- Understand direct digital control systems handling and operation.
- Tuning of a PID control via manual and automatic tuning.
- Choose PID modes that effect controllability, speed of response the control systems

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L	T	P	C
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ENERGY AND ENVIRONMENTAL ENGINEERING LAB (17A50808)

List of Experiments:

1. Estimation of chemical and physical parameters of Ground and Surface water:
   P^H, TDS & Conductivity, Hardness, Turbidity, Fluoride, Color analysis.
   Pesticide Microbial analysis: e-coli/ total coli forms bacteria
2. Estimation of physical parameters of waste water:
   P^H, TDS, Hardness, Turbidity, Alkalinity etc.
3. Estimation of chemical parameters of waste water:
   COD, BOD, TSS
4. Water and waste water treatment:
   Small RO system for treatment of ground water.
   Same above system with UF membrane for turbidity removal and water disinfection.
5. Analysis of Air:
   Estimation of SPM, RSPM, Sox, Nox, CO and ozone in atmospheric air to study air pollution.
4. Fuel cell Test Kit [Energy]
   A small ½ watt to 1 watt fuel cell with water electrolysis kit (H_2 and O_2 Generation) plus small voltmeter and ammeter for measuring fuel cell performance.
7. Measurement of Flash point, fire point and calorific value of petroleum products.
8. Proximate Analysis of Coal – Moisture, Volatile Matter, Fixed Carbon and Ash. (Hot air Oven & Muffle Furnace)
9. Calorific value of Solid Fuels.
10. Energy auditing of your Department.

List of Equipment

P^H meter, Colorimeter, TDS meter, Aerobic /Anaerobic reactor 25L capacity, BOD incubator, High accuracy analytical balance (5 digit), Desiccators, RO system with domestic 2''x12'' Membrane module, H_2S vial kit, Water analysis kit, UV-Vis spectrophotometer, High volume air sampler, Bomb calorimeter, Fuel cell test kit, Microscope.

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COMPREHENSIVE OBJECTIVE TYPE EXAMINATION(17A50809)

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L	T	P	C
3	0	0	3

III Year B.Tech. Chem. Engg. II-Sem

MASS TRANSFER OPERATIONS-II(17A60801)

OBJECTIVES:

- Study of the stage wise mass transfer operations, principles of various stage wise contact processes like distillation, extraction and leaching and drying
- Design aspects of the equipments utilized for above mentioned operations.
- Attain practical knowledge of separation processes, conduct experiments and submit the report.

UNIT-I

Distillation: Fields of applications, VLE for miscible liquids, immiscible liquids, steam distillation, Positive and negative deviations from ideality, enthalpy-concentration diagrams, flash vaporization and differential distillation for binary and multi component mixtures, Batch distillation with Reflux.

UNIT-II

Continuous rectification-binary systems, multistage tray towers –method of Mc Cabe and Thiele, enriching section, Stripping section, feed introduction, total reflux, minimum and optimum reflux ratios, use of open steam, types of condensers, partial condensers, effect of cold reflux, multiple feeds , tray efficiencies, continuous-contact equipment (packed towers)

Multistage (tray) towers –the method of Ponchon and Savarit, the enriching and stripping sections, feed tray location, total reflux, minimum and optimum reflux ratios, types of reboilers, use of open steam, condenser and reflux accumulators, Azeotropic distillation, extractive distillation, comparison of Azeotropic and extractive distillation.

UNIT- III

Liquid-Liquid operations: fields of usefulness, liquid-liquid equilibrium, equilateral triangular co-ordinates, choice of solvent, stage wise contact, multistage cross-current extraction, Multi stage counter current without reflux

Multi stage counter current with reflux, Differential (continuous contact) extractors, spray towers, packed towers, mechanically agitated counter-current extractors, centrifugal extractors, dilute solutions, super critical fluid extraction, fractional extraction.

UNIT-IV

Drying: Equilibrium, Definitions, Drying Conditions- Rate of Batch Drying under constant drying conditions, Mechanisms of batch drying, Drying time Through Circulation Drying.
Classification Of Drying Operations: Batch and Continuous Drying Equipment, Material and Energy Balances of Continuous Driers, rate of drying for continuous direct heat driers.

UNIT-V

Leaching: Fields of applications, preparation of solid for leaching, types of leaching, leaching equilibrium, single stage and multi stage leaching calculations, constant under flow conditions, equipment for leaching operation.

TEXT BOOK:

1. Mass transfer operations by R.E. Treybal, 3rd ed. Mc Graw Hill, 1980.

REFERENCE:

1. Principles of Mass Transfer and Separation Processes by B K Dutta, Printice Hall of India Pvt Limited, New Delhi
2. Transport processes and unit operations by Christie J. Geankoplis
3. Separation Process Principles, J D Seader and E. J. Henley, John Wiley & Sons, Inc,. New York

Pre-requisite:---Mass Transfer Operations-I

Outcome:

- Have complete insight of stage wise contact processes absorption; distillation, extraction and leaching that are used in separation processes in industries.
- Explain the underlying principles and apply them for related separation processes in industries.
- Suggest and design equipment for various mass transfer operations mentioned above.
- Apply these separation processes for specific purposes by using the experience obtained while conducting experiments in laboratory.
- Can operate, design and debug any problems emanating in equipment used in industries for the above operations.
- Be able to operate and debug any problems emanating in equipments used in industries for the above operations.

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III Year B.Tech. Chem. Engg. II-Sem

L	T	P	C
2	2	0	3

CHEMICAL REACTION ENGINEERING – II(17A60802)

OBJECTIVES:

- Learn the importance of RTD and the compartmental models for modeling of Non-ideal flow reacting vessels.
- Calculate the conversions based on segregated flow model, dispersion model and tanks-in-series models.
- Knowledge of rate law given the rate controlling step in catalytic reactions, internal and external diffusion effects.
- Learn the factors influencing catalyst decay, the role of pore diffusion on catalyst activity rate.
- Shrinking core model for spherical particles of unchanging size and design the fluid-solid reactors.

UNIT I

Basics of non-ideal flow: E, the exit age distribution function of fluid, the RTD, conversion in non-ideal flow reactors, diagnosing reactors (qualitative discussion only).

The dispersion model: axial dispersion, correlations for axial dispersion, chemical reaction and dispersion.

UNIT II

The tanks in series model: pulse response experiments and the RTD, chemical conversion. The convection model for laminar flow- the convective model and its RTD, chemical conversion in laminar flow reactors

Earliness of mixing, segregation and RTD: self-mixing of a single fluid, mixing of two miscible fluids.

UNIT III

Catalysis and Catalytic reactors: catalysts, steps in catalytic reactions, synthesizing a rate law, mechanism and rate limiting step. (From chapter 10, Fogler)

Heterogeneous reactions: Introduction to Solid catalyzed reactions: The rate equation for Surface Kinetics- Pore diffusion resistance combined with surface kinetics, Porous catalyst particles, heat effects during reaction, Performance equations for reactors containing porous catalyst particles.

UNIT IV

Solid catalyzed reactions- Experimental methods for finding rates. Deactivating catalysts- mechanisms of catalyst deactivation, the rate and performance equations.

UNIT–V

Fluid-fluid reactions: kinetics- the rate equation.

Fluid-particle reactions: kinetics- selection of a model, shrinking core model for spherical particles of unchanging size, rate of reaction for shrinking spherical particles, extensions, determination of rate controlling step.

TEXT BOOKS:

1. Chemical Reaction Engineering, 3rd ed., O. Levenspiel, John Wiley & Sons, 1999.
2. Elements of Chemical Reaction Engineering, 4th ed., H.S. Fogler, PHI Learning Pvt. Ltd., New Delhi, 2010.

REFERENCES:

1. Chemical Engineering Kinetics, 3rd ed., J.M. Smith, McGraw-Hill, New York, 1981.
2. The Engineering of Chemical Reactions, 2nd ed., L.D. Schmidt, Oxford University Press, New Delhi, 2010

Outcome:

- Modeling of compartmental models for Non-ideal flow reacting vessels.
- Calculation of conversions based on variousmodels
- Students can design the fluid-solid reactors.

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L	T	P	C
3	0	0	3

CHEMICAL PLANT DESIGN AND ECONOMICS(17A60803)

OBJECTIVES:

- To familiarize the students about various economic aspects of chemical processes
- Learn basics of Cost estimation, Working Capital and Capital Investment and understand the time value of money
- Learn the importance of Cash flow diagrams and Break-even analysis.
- Study depreciation methods and methods of estimation of profitability of an industry
- Study the procedures adopted for Replacement and Selection from Alternatives.

UNIT I

Introduction, Process Design development.General design considerations, Cost and asset accounting.Cash flow for industrial operations, factors effecting investment and production cost, capital investments, estimation of capital investments, cost indices, cost factors in capital investment

UNIT II

Organizations for presenting capital investments, estimates by compartmentalization, estimation of total product of cost direction, production costs, fixed charges, plant overhead costs, financing.

Interest and investment cost, type interest, nominal and effective interest rates, continuous interest, present worth and discount annuities, cost due interest on investment, source of capital.

UNIT III

Taxes and insurances, type of taxes: federal income taxes, insurance-types of insurance, self insurance.

Depreciation : types of depreciation, services life, salvage value, present value, methods for determining depreciation, single unit and group depreciation.

UNIT IV

Profitability: alternative investments and replacements, profitability standards, discounted cash flow, capitalized cost, pay out period ,alternative investments, analysis with small investments, increments and replacements.

UNIT V

Optimum design and design strategy, incremental cost, general procedure for determining optimum condition, comparison of graphical and analytical methods, optimum production rates, semi continuous cyclic operation, fluid dynamics, mass transfer strategy of linearization

TEXT BOOK:

1. Plant Design and Economics for Chemical Engineering, 4^{th} ed., M.S. Peters and K.D. Timmerhaus, McGraw-Hill,1991

REFERENCE:

1. Process Engineering Economics, Schweyer

Outcome:

- Estimate various costs involved in a process industry and evaluate the tax burden of an establishment
- They will be ready with tools to estimate profitability of a company
- Find the replacement costs of an equipment and select best one from different alternatives
- Compute break even period for an investment and rate of return

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III Year B.Tech. Chem. Engg. II-Sem

L	T	P	C
3	0	0	3

CHEMICAL PROCESS EQUIPMENT DESIGN (17A60804)

OBJECTIVES:

- Study design safe process and design appropriate equipment like reactors, mass transfer heat transfer equipment, pipelines storage tanks etc.
- Study relevant codes for design of chemical plant equipment as per the standard procedures specified by design code books.
- Learn the fabrication techniques and testing methods.
- Learn design and engineering skills directly applied in design, installation and commissioning of equipments.

UNIT-I

Basic Considerations in Process Equipment Design: Introduction, general design procedure, fabrication techniques, equipment classification, power for rotational motion, drives for process equipment

Materials of Construction: Mechanical properties, materials, corrosion, corrosion prevention, choice of material.

UNIT-II

Design Considerations: Introduction, stress created due to static and dynamic loads, design stress, combined stresses and theories of failure, fatigue, brittle fracture, creep, effects of temperature, radiation and fabrication methods.

Process Hazards and Safety Mechanisms in Equipment Design: Introduction, hazards in process industries, safety measures, safety measures in equipment design, pressure relief devices.

UNIT-III

Material Handling Equipment Design: Piping in fluid transportation process-selection of piping material, design of piping system, pumping of fluids: selection of pumps, design procedures for pumps, compression and expansion of fluids: selection of compressors, fans and blowers, vacuum system equipment, turbines and expanders, design procedures for compressors, turbines and expanders

Heat Transfer Equipment Design: Selection of heat exchangers types- key heat exchanger types available, preliminary selection of heat exchanger types,Design of key heat exchanger types- Double pipe and multiple double pipe exchangers, shell and tube heat exchangers, plate exchangers, compact exchangers, air cooled exchangers.

UNIT-IV

Seperation Equipment Design: Distillation design procedures for columns with sieve trays, with random packing, with structural packing, Absorption and Stripping design procedures for trayed columns, packed columns separating dilute solutions

Equipment Selection for liquid-liquid extraction: Design procedure for liquid liquid extraction, selection of sorbent for separation by adsorption, basic adsorption cycles, selection of appropriate adsorption cycles, general design for separation by adsorption

UNIT-V

Pressure Vessels: Introduction, operating condition, pressure vessel codes, selection of materials, vessels operating at low temperatures and elevated temperatures, Design conditions and stresses.

Design of shell and its components, Fabrication, Inspection and Tests.

TEXT BOOKS:

1. Joshi's Process Equipment Design, Fourth Edition by V. V. Mahajani and S. B. Umarji, Macmillan Publishers India Ltd., 2009.
2. Plant Design and Economics for Chemical Engineers, Fifth Edition by Max. S. Peters, Klans Timmerhaus and Ronald E. West, McGrawHill International Edition, 2004.

REFERENCE BOOKS:

1. Coulson J.M. and Richardson J.F., Chemical Engineering Vol.VI (An introduction to Chemical Engineering Design), Pergamon Press, 1993.

Outcome:

The student will be able to do

1. Mechanical design of pressure vessels
2. Process design of separation equipments for distillation, absorption, stripping, liquid-liquid extraction, adsorption
3. Selection of piping materials, pumps, compressors, compressors, fans and blowers, vacuum system equipment, turbines and expanders
4. Design of material handling equipment like piping system, pumps, compressors, turbines and expanders.

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III Year B.Tech. Chem. Engg. II-Sem

L	T	P	C
3	0	0	3

INDUSTRIAL POLLUTION & CONTROL ENGINEERING(17A60805)

OBJECTIVES: The aim of this course is that the students will learn the essential principles used in industrial pollution abatement and understand important issues in industrial pollution abatement and pertinent environmental legislations.

UNIT I : Types of emissions from chemical industries and effects of environment, environment legislation, Type of pollution, sources of wastewater, Effluent guidelines and standards.
Characterization of effluent streams, oxygen demands and their determination (BOD, COD, and TOC), Oxygen sag curve, BOD curve mathematical, controlling of BOD curve, self purification of running streams, sources and characteristics of pollutants in fertilizer, paper and pulp industry, petroleum and petroleum industry.

UNITII: General methods of control and removal of sulfur dioxide, oxides of nitrogen and organic vapors from gaseous effluent, treatment of liquid and gaseous effluent in fertilizer industry.
Air pollution sampling and measurement: Types of pollutant and sampling and measurement, ambient air sampling: collection of gaseous air pollutants, collection of particulate air pollutants. Stack sampling: sampling system, particulate sampling, and gaseous sampling. Analysis of air pollutants: Sulphur dioxide, nitrogen oxides, carbon monoxide, oxidants and Ozones, hydrocarbons, particulate matter.

UNIT III : Air pollution control methods and equipments: Source collection methods: raw material changes, process changes, and equipment modification. Cleaning of gaseous equipments particulate emission control: collection efficiency, control equipment like gravitational settling chambers, Cyclone separators, fabric filters, ESP and their constructional details and design aspects. Scrubbers: wet scrubbers, spray towers, centrifugal scrubbers, packed beds and plate columns, venturi scrubbers, their design aspects. Control of gaseous emissions: absorption by liquids, absorption equipments, adsorption by solids, equipment and the design aspects.

UNIT IV : Introduction to waste water treatment, biological treatment of wastewater, bacterial and bacterial growth curve, aerobic processes, suspended growth processes, activated aerated lagoons and stabilization ponds,
Attached growth processes, trickling filters, rotary drum filters, anaerobic processes.

UNIT V : Methods of primary treatments: screening, sedimentation, flotation, neutralization, and methods of tertiary treatment. A brief study of carbon absorption, ion exchange, reverse osmosis, ultra filtration, chlorination, ozonation, treatment and disposal.
Hazardous waste management: Nuclear wastes: health and environment effects, sources and disposal methods. Chemical wastes: health and environmental effects, treatment and disposal:treatment and disposal by industry, off site treatment and disposal, treatment practices in various countries. Biomedical wastes: types of wastes and their control.

TEXT BOOKS:

1. Environmental Pollution and Control Engineering, C. S. Rao – Wiley Eastern Limited, India, New Delhi, 1993.
2. Pollution Control in Process Industries, S.P. Mahajan, Tata McGraw-Hill, New Delhi, 1985.

REFERENCES:

1. Wastewater Treatment, M. Narayana Rao and A.K.Datta, Oxford and IHB publ. New Delhi.

OUTCOMES:

2. Understand the different types of wastes generated in an industry, their effects on living and non-living things.
3. Understand environmental regulatory legislations and standards and climate changes.
4. Understand about the quantification and analysis of wastewater and treatment.
5. Understand the different unit operations and unit processes involved in conversion of highly polluted water to potable standards.
6. Understand the atmospheric dispersion of air pollutants, and operating principles, design calculations of particulate control devices.

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L	T	P	C
2	2	0	3

(OPEN ELECTIVE-I)

1. BASICS OF NANOTECHNOLOGY (17A60806)

OBJECTIVES:

- Basic knowledge of nanotechnology, classification and properties of nanomaterials
- Various methods of synthesis of nanomaterials
- Applications of nanomaterials

Unit I

Introduction: History and Scope, Can Small Things Make a Big Difference? Classification of Nanostructured Materials, Fascinating Nanostructures, Applications of Nanomaterials, Nature: The Best of Nanotechnologist, Challenges and Future Prospects.

Unit II

Unique Properties of Nanomaterials: Microstructure and Defects in Nanocrystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations. **Effect of Nano-dimensions on Materials Behavior:** Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, Enhanced solid solubility.

Unit III

Magnetic Properties: Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties and Mechanical Properties.

Unit IV

Synthesis Routes: Bottom up approaches: Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method ,Self assembly

Unit V

Top down approaches: Mechanical alloying, Nano-lithography.

Consolidation of Nanopowders: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

Applications of Nanomaterials: Nano-electronics, Nanosensors, Nanocatalysts, Structure and Engineering, Automotive Industry, Water- Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defence and Space Applications

TEXT BOOKS

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, Wley India Edition, 2012.

REFERENCES:

1. Nano: The Essentials by T.Pradeep, Mc Graw- Hill Education.
2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L.Schodek
3. Transport in Nano structures- David Ferry, Cambridge University press 2000
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S.,S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, Cambridge University press.

Outcomes:

- Understand the importance of nanotechnology and its interdisciplinary nature.
- Understand the methods of fabrications and applications of nanomaterials
- Understand the Unique properties of nanomaterials.

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L	T	P	C
2	2	0	3

(OPEN ELECTIVE -I)

2. GREEN TECHNOLOGY (17A60806)

Unit I: An introduction to environmental issues: Role of chemical processes and chemical products, Global environmental issues, Air and water quality issues, Ecology.
Risk concept: Description of risk, Risk assessment concept, Dose-response, Exposure assessment.

Unit II : Evaluating exposures: Occupational exposures: recognition, evaluation, control,

Exposure assessment for chemicals in the ambient environment, Designing safer chemicals.
Green chemistry: Green chemistry methodologies, Optimization based frameworks for the design of green chemical synthesis pathway.

Unit III : Evaluating environmental fate: Chemical and physical property estimation, Estimating environmental persistence, Estimating ecosystem risk, Classifying environmental risk based on chemical structure.

Unit IV : Life-cycle concepts: Life-cycle assessment, Life-cycle impact assessment

Unit V : Material flows in chemical manufacturing, Assessing opportunities for waste exchanges and byproduct synergies.

TEXT BOOKS

SHONNARD, D.ALLEN, D. Green Egineering: Environmentally Conscious Design of Chemical Processes.

Outcomes:

- To present approaches and methodologies for evaluating and improving the environmental performance of chemical processes and chemical products.
- To understand the basic knowledge of environmental issues and environmental regulations.
- To discuss the type of wastes and emissions that drive the environmental impacts.

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L	T	P	C
2	2	0	3

(OPEN ELECTIVE -I)

3. NUCLEAR ENGINEERING (17A60806)

UNIT-1

Introduction: Motivation for Nuclear Energy, India's Nuclear Power Program

Nuclear Physics: Nuclear model of the atom - Equivalence of mass and energy - Binding - Radio activity - Half life - Neutron interactions - Cross sections.

UNIT-II

Nuclear Reactions and Reactor Materials

Mechanism of nuclear fission and fusion - Radio activity - Chain reactions - Critical mass and composition - Nuclear fuel cycles and its characteristics - Uranium production and purification - Zirconium, thorium, beryllium.

UNIT-III

Reprocessing

Nuclear fuel cycles - spent fuel characteristics - Role of solvent extraction in reprocessing - Solvent extraction equipment.

UNIT-IV

Nuclear Reactors

Reactors - Types of fast breeding reactors - Design and construction of fast breeding reactors - heat transfer techniques in nuclear reactors - reactor shielding.

UNIT-V

Safety, Disposal and Proliferation

Nuclear plant safety- Safety systems - Changes and consequences of an accident - Criteria for safety - Nuclear waste - Type of waste and its disposal - Radiation hazards and their prevention - Weapons proliferation.

Text Books:

1. Thomas J.Cannoly, " Fundamentals of Nuclear Engineering ", John Wiley (1978).
2. G,Vaidyanathan," Nuclear Reactor Engineering", Chand Publishers, 2013

References:

1. Collier J.G., and G.F.Hewitt, " Introduction to Nuclear Power ", (1987), Hemisphere Publishing, New York.
2. Lamarsh U.R. " Introduction to Nuclear Engineering Second Edition ", (1983), Addison Wesley M.A.
3. Lipschutz R.D. " Radioactive Waste - Politics, Technology and Risk ", (1980), Ballingor, Cambridge. M.A.

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L	T	P	C
2	2	0	3

(OPEN ELECTIVE -I)

4. SOLID WASTE MANAGEMENT (17A60806)

OBJECTIVES:

- Material flow in society and generation of solid waste source
- Clarification of solid waste on characterization of the same
- Understand the sense of onsite handling storage and collection systems including transportation
- Understand processing technologies with mechanical volume reduction and thermal volume reduction corporate land filling, deep well injections.
- Learn to estimate material recovery a energy recovery from a given waste data using case standing

Unit I: Introduction: Definition, characteristics and perspectives of solid waste. Types of solid waste.Physical and chemical characteristics.Variation of composition and characteristics.Municipal, industrial, special and hazardous wastes. **General aspects:** Overview of material flow in society. Reduction in raw material usage.Reduction in solid waste generation.Reuse and material recovery.General effects on health and environment.Legislations.

Unit II: Engineered systems: Typical generation rates.Estimation and factors effecting generation rates.On site handling.Storage and processing.Collection systems and devices.Transfer and transport.

Unit III: Processing Techniques: Mechanical volume reduction.Thermal volume reduction.Component separation.Land filling and land forming.Deep well injection.

Unit IV: Material recovery: Mechanical size alteration. Electromagnetic separation. Drying and dewatering. Other material recovery systems.Recovery of biological conversion products.Recovery of thermal conversion products.
Energy recovery: Energy recovery systems and efficiency factors. Determination of output and efficiency.Details of energy recovery systems.Combustion incineration and heat recovery.Gasification and pyrolysis. Refuse derived fuels (RDF).

Unit V: Case studies: Major industries and management methods used in typical industries – Coal fired power stations, textile industry, oil refinery, distillery, sugar industry, and radioactive waste generation units.

Text Books:
1. Howard S. Peavy, Environmental Engineering, McGraw Hill International Edition, 1986.
2. Dutta, Industrial Solid Water Management and Land Filling Practice, Narose Publishing House, 1999.

Reference Books:
1. Sastry C.A., Waste Treatment Plants, Narose Publishing House, 1995.
2. Lagrega, Hazardous Waste Management, McGraw Hill, 1994.

Outcomes:
The student should be able to
- Apply his knowledge of characterization of waste and develop a suitable management plan
- Assess the cost of transportation laboratory processing of solid waste
- Identify hazardous nature of waste if any and can suggest suitable dumping methods.
- Suggest processing waste for material for energy recovery.
- Develop a management plan for land filling composting deep well injection for non-recoverable waste.

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ADVANCED ENGLISH LANGUAGE COMMUNICATION SKILLS LAB
(17A65501)

Objectives:

This lab focuses on using computer-aided multimedia instruction for language development to meet the following targets:

- To expose the students to a variety of self instructional, learner-friendly modes of language learning.
- To enable the students to learn better pronunciation and accent through listening and reading exercises.
- To train students to use language appropriately for interviews, group discussion and public speaking.
- To initiate them to greater use of the computer in resume preparation, format-making etc.
- To help the students to cultivate the habit of reading passages from the computer monitor, thus providing them with the required facility to face computer based competitive exams such as GRE, TOFEL, and GMAT etc.
- To enable the students to acquire good communication skills as well as soft skills to meet global demands.

Syllabus:

Unit I:Reading &Listening Comprehension: Skimming –scanning- Extensive and Intensive reading. Reading for making inferences. Active VS passive listening.Listening and Note taking, - Listening for making inferences.

Unit II: Writing Skills: Formal and informal writing-Resume Writing-E-Correspondence.

Unit III:Technical Presentations (Oral) : Planning-Preparation-Presentation . Art of Persuasion- Audience analysis- Handling questions.

Unit IV:Interview Skills: Types of Interviews - pre-interview planning- answering strategies. Analysis of One to one –interviews – group interviews - Mock interviews.

Unit V:Soft Skills: Inter Personal Skills- Goal setting – Etiquettes and good manners – Team Working – Work Ethics--Time management – Problem Solving.

Minimum Requirements

The English Language Lab shall have two parts:

The Computer Aided Language Lab for 60 students with 60 systems, one master console, LAN facility and English language software for self-study by learners.

The Communication Skills Lab with movable chairs and audio-visual aids with a PA System, a TV, a digital stereo-audio and video system, a Camcorder, etc

System Requirement (Hardware Component):

Computer network with LAN with a minimum of 60 multimedia systems with the following specifications:

P-IV Processor

Speed-2.8 GHZ

RAM_512 MB minimum

Hard Disk-80 GB

Headphones

Prescribed Software:

9. K-Van Advanced Communication Skills
10. Walden Infotech Advanced Communication Skills.

Books Suggested for English Language Lab Library (to be located within the lab in addition to the CDs of the text book which are loaded on the systems):

1. **Technical Writing and Professional Communication, Huckin and Olsen** Tata Mc Graw-Hil 2009.
2. **Technical Communication** by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
3. **Cambridge English for Job-Hunting** by Colm Downes, Cambridge University Press, 2008
4. **Resume's and Interviews** by M.Ashraf Rizvi, Tata Mc Graw-Hill, 2008

5.. English Language Communication : A Reader cum Lab Manual Dr A Ramakrishna Rao, Dr G Natanam & Prof SA Sankaranarayanan, Anuradha Publications, Chennai 2008.

6. Managing Soft Skills by K R Lakshminarayan and T.Muruguvel, Sci-Tech Publications, 2010

7. The ACE of Soft Skills by Gopal Ramesh and Mahadevan Ramesh, Pearson Education, 2010
8. **Soft Skills** by Dr. K. Alex, S.Chand
9. **Study Skills for Professional Students in Higher Education** by Dr. M. Adithan, S.Chand.
10. **Personality Development and Soft Skills by Barun** K. Mitra, Oxford Higher Education.

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MASS TRANSFER OPERATIONS LAB(17A60807)

OBJECTIVES: This lab gives an overall idea of various mass transfer operations used in the industry.

1. Estimation of diffusivity coefficients for vapor in gas
2. Estimation of solid diffusion coefficient in air
3. Steam distillation
4. Simple distillation
5. Evaluation of HETP in packed towers
6. Vapor Liquid Equilibria
7. Batch Drying
8. Evaluation of Mass transfer coefficients for Surface Evaporation
9. Evaluation of Mass transfer coefficients for Wetted wall column
10. Liquid- Liquid Equilibria (Tie line data)
11. Ternary Liquid Equilibria (binodal curve)

12. Leaching
13. Adsorption studies

Outcomes:

1: The student will be able to perform VLE, LLE related experiments and can estimate diffusivity coefficients.
2: The student will be able to learn about the calculation of different parameters in distillation, absorption, drying and evaporation.
3: The student will be able to design distillation units, drying and evaporation units.

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L	T	P	C
0	0	2	1

CHEMICAL REACTION ENGINEERING LAB(17A60808)

OBJECTIVES:

- Operate lab equipments like CSTR, Batch, PFR reactors.
- Analyze the concentration versus time data and determine the specific rate constant and the order of the reaction.
- Compare theoretical and experimental conversions in a CSTR and PFR.
- Estimate RTD and model parameters in a CSTR, PFR, packed bed and CSTRin-series.

1. Determination of the order of a reaction using a batch reactor and analyzing the data by (a) differential method (b) integral method.
2. Determination of the activation energy of a reaction using a batch reactor .
3. To determine the effect of residence time on conversion and to determine the rate constant using a CSTR.

4. To determine the specific reaction rate constant of a reaction of a known order using a batch reactor.
5. To determine the order of the reaction and the rate constant using a tubular reactor.
6. CSTRs in series- comparison of experimental and theoretical values for space times and volumes of reactors.
7. Mass transfer with chemical reaction (solid-liquid system) – determination of mass transfer coefficient.
8. Mass transfer with chemical reaction (liquid-liquid system) – determination of mass transfer coefficient
9. Axial mixing in a packed bed. Determination of RTD and dispersion number for a packed-bed using tracer
10. Determination of RTD and dispersion number in a tubular reactor using a tracer.

Outcomes:

- Skills of deriving the kinetic expressions by performing the experiments on batch and continuous flow reactors.
- Understand the effects of non ideal flow.
- Proficient to estimate RTD and model parameters in a CSTR, PFR, packed bed and CSTRin-series

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L	T	P	C
	2	0	3

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COMPREHENSIVE OBJECTIVE TYPE EXAMINATION(17A60809)

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L	T	P	C
2	2	0	4

TRANSPORT PHENOMENA(17A70801)

OBJECTIVES:

- Different types of fluids, their flow characteristics and different mathematical models applied to actual situations
- Mechanism of fluids in motion under different conditions.

UNIT-I

Viscosity and the mechanisms of momentum transfer: Newton's law of viscosity (molecular momentum transport), generalization of Newton's law of viscosity, pressure and temperature dependence of viscosity, molecular theory of the viscosity of gases at low density, molecular theory of the viscosity of liquids. Thermal conductivity and the mechanisms of energy transport: Fourier's law of heat conduction (molecular energy transport), temperature and pressure dependence of thermal conductivity, and theory of thermal conductivity of gases at low density. Diffusivity and the mechanisms of mass transport: Fick's law of binary diffusion (molecular

mass transport), temperature and pressure dependence of diffusivities, theory of diffusion in gases at low density.

UNIT -II
Shell momentum balances and velocity distributions in laminar flow: shell momentum balances and boundary conditions, flow of a falling film, flow through a circular tube, flow through annulus, flow of two adjacent immiscible fluids, creeping flow around a sphere.

UNIT -III
Shell energy balances and temperature distributions in solids and laminar flow: shell energy balances; boundary conditions, heat conduction with an electrical heat source, heat conduction with a nuclear heat source, heat conduction with a viscous heat source, heat conduction with a chemical heat source, heat conduction through composite walls, heat conduction in a cooling fin, forced convection, free convection.

UNIT -IV
Concentration distributions in solids and laminar flow: shell mass balances; boundary conditions, diffusion through a stagnant gas film, diffusion with a heterogeneous chemical reaction, diffusion with a homogeneous chemical reaction, diffusion into a falling liquid film (gas absorption), diffusion into a falling liquid film (solid dissolution), diffusion and chemical reaction inside a porous catalyst.

UNIT -V
The equations of change: Derivation of the equation of continuity in Rectangular and Polar coordinates, the equation of motion, the equation of energy, the equation of continuity of a component in multi component mixture (in rectangular coordinates only) the equations of change in terms of the substantial derivative. Use of equations of change to solve one dimensional steady state problems of momentum, heat and component transfer, Introduction to Turbulent transport, Time smoothing of equation change.

TEXT BOOK:
1. Transport Phenomena by Bird R.B., Stewart W.C., Lightfoot F.N., 2nd ed. John Wiley &Sons Inc,U.S.A,1960.

Reference:
1. Transport phenomena for engineers by L. Theodore, International text book company, U.S.A.1971.
2. Transport processes and unit operations by C.J. Geankoplis, PHI, 3rded. 1997.
3. Fundamental of heat, momentum and mass transfer, Welty, Wicks and Wilson, John Wiley.

Pre-requisite: Fluid Mechanics for Chemical Engineers, Process heat transfer, Mass Transfer operations- I & II and Chemical Reaction Engineering I and II

Codes / Tables: 1. Leonard – Jones potential parameters and critical properties.
2. Equations of change (from Bird)

<u>Outcomes</u>:

1. Ability to understand the chemical and physical transport processes and their mechanism.
2. Ability to do heat, mass and momentum transfer analysis.
3. Ability to analyze industrial problems along with appropriate approximations and boundary conditions.
4. Ability to develop steady and time dependent solutions along with their limitations.

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IV Year B.Tech. Chem. Engg. I-Sem

L	T	P	C
3	2	0	4

OPTIMIZATION OF CHEMICAL PROCESSES(17A70802)

OBJECTIVES:

- To learn problem formulation of optimization.
- To realize the numerical methods of un-constrained optimization.
- To learn linear programming and its applications
- To understand the use of genetic algorithms in optimization
- To know the applications of numerical optimization.

UNIT I

Nature and organization of optimization problems: Introduction to optimization, scope and hierarchy of optimization, examples of applications of optimization, essential features of optimization problems, general procedure for solving optimization problems, Optimization of a

manufacturing problem with a stepwise procedure, obstacles of optimization, constraints in optimization, examples and formulation of constrained optimization problems.
Basic concepts of optimization: Continuity of functions, unimodal versus Multimodel functions. Convex and Concave functions, Convex region, Necessary and sufficient conditions for an extremum of an unconstrained function.

UNIT II
Optimization of unconstrained single variable functions: Region elimination methods: Fibonacci search, Golden section search. Polynomial approximation methods- Sequential search
Methods specifying optimum by a point: Newton's method, Secant method, Quadratic interpolation, Cubic interpolation. Applications of one- dimensional search methods to chemical engineering problems.

UNIT III
Unconstrained multivariable optimization: Random search methods, grid search, uni-variate search, multivariable Newton's method, steepest descent method, Conjugate search directions, Conjugate gradient method
.
UNIT IV
Optimization of Unit operations: Optimal pipe diameter, optimizing recovery of waste heat, optimization of multiple effect evaporator, Determination of optimal reflux ratio for staged distillation column, shell and tube heat exchanger.

UNIT V
Linear programming and applications: Basic concepts in linear programming, graphical solution, artificial variable technique, exceptional cases in LPP, non-existing feasible solution, degeneracy, duality in linear programming, dual simplex method, revised simplex method.

TEXT BOOKS:
1. Optimization of Chemical Processes, T.F. Edgar and D.M. Himmelblau, McGraw-Hill, New York, 2001.
2. Optimization for Engineering Design, Kalyan Moy Deb, PHI Pvt. Ltd., New Delhi, 2000

Outcome:

- Knowledge of optimization to formulate the problems and analyze the optimization criterion for solving problems
- Apply different methods of optimization and to suggest a technique for specific problem
- Advanced optimization techniques like Genetic algorithms and other optimization techniques can be used to solve the industrial problems of relevance to the chemical industry

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IV Year B.Tech. Chem. Engg. I-Sem

L	T	P	C
3	0	0	3

SEPARATION TECHNIQUES FOR BIOPROCESSING (17A70803)

OBJECTIVES:

- Learn the fundamentals of adsorptive separations and modeling
- Study the Pressure swing & thermal swing adsorption, Counter current separations.
- Study the basic concepts and design procedures of chromatographic columns.
- Learn different membrane separation technological processes and their design

UNIT -I

Crystallization: crystal geometry, principles of crystallization equilibria and yields, nucleation, crystal growth, adsorption and mass transfer theories, precipitation, crystallization from melts. (Textbook 3)

UNIT -II

Adsorption: Adsorption, types of adsorption, nature of adsorbents, adsorption equilibrium, single gases and vapors, Adsorption Hysteresis, effect of temperature, Heat of adsorption, vapor and gas mixtures: One component adsorbed, Effect of change of temperature or pressure. Liquids, Adsorption of solute from dilute solution, The Freundlich equation, Adsorption from concentrated solutions, adsorption operations, stage wise operation, application of Freundlich equation to single and Multistage adsorption (cross current & counter current).

Fluidized and teeter beds, adsorption of vapor from a gas, fluidized bed, continuous contact, steady state moving bed adsorbers, unsteady state–fixed bed adsorbers, adsorption wave, elution, adsorption-desorption operations- thermal desorption of gases, activated carbon solvent recovery, pressure swing and vacuum swing adsorption (qualitative treatment), regeneration with purge and desorbent, ion-exchange: principles of ion exchange, techniques and applications. (Textbook 2)

UNIT –III (qualitative treatment only)

Chromatography: Types of chromatography: Gas and liquid chromatography, paper and thin layer chromatography, polarization chromatography, and continues chromatography, large-scale chromatography. Electrophoretic separations: Theory of electrophoresis, basic concepts of electrophoresis, forces in electrophoresis, complicating factors in electrophoresis, methods of electrophoresis: Moving boundary electrophoresis, gel membrane and paper electrophoresis, zone spreading in zonal electrophoresis, affinity electrophoresis, free solution and capillary electrophoresis. (Textbook 1)

UNIT-IV (qualitative treatment only)

Pressure driven membrane separation processes, reverse osmosis, ultrafiltration, micro filtration, nano filtration, governing equations, effect of operating parameters on flux and rejection, applications. Concentration and electrical driven membrane processes(Text book 1)

UNIT –V(qualitative treatment only)

Gas separation in porous and non-porous membrane, pervaporation, dialysis, liquid membranes, governing equations, effect of operating parameters on flux and selectivity, applications, concentration polarization, approximate analysis for concentration polarization, mass transfer correlations, gel formation and fouling, membrane modules. (Textbook 1)

Text Book:

1. Rate controlled separation by Phillip C. Wankat, Springer international, 2005

2. Mass transfer operations by R.E. Tryebal, Mc Graw Hill, 3rd ed. 1980.

3. Unit operations of Chemical Engineering by Mc.Cabe & Smith, McGraw-Hill, 5th edition 1993

References:

1. Separation processes, C. J. King, Tata McGraw Hill.

2. Transport processes and unit operations, C.J. Geankoplis, Prentice-Hall India, 3rd edition, 2000

Pre-requisite: Mass Transfer operations-I, II, Phase and Chemical Equilibria, Chemical Process Calculations.

Outcome:

- The students would fully understand key concepts of separation processes including equilibrium stages, reflux, countercurrent contacting, limiting cases, efficiency and mass transport effects.
- The student will know about handling of separations using solid- fluid and separation techniques for the low-temperature, heat sensitive materials.
- Facilitate the students with the novel techniques that are required in downstream processing of biotechnology based industries.

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L	T	P	C
3	0	0	3

INDUSTRIAL SAFETY AND HAZARD MANAGEMENT (17A70804)

OBJECTIVES:

- Have awareness of different hazards in process industries
- Classification of hazards and their identifications
- Precautions in chemical storage and handling

- Learn risk analysis techniques and quantify them
- Learn emergency management plans

Unit – I

Introduction, Factors Contributing to the Costs of Accidents, List of some Notable accidents in the process industry/selected case histories, some common features of high cost accidents, reasons for high priority towards safety.

Unit – II

Material hazards1: Introduction Hazardous substances-categories, Toxicity, Radiation, Flammability, Ignition, Fires and explosions.

Unit – III

Material hazards 2: Fire balls, Fire damage, run away chemical reaction, incompatible materials, material safety and data sheets

Process and plant Hazards: Hazards of pressure, causes of over pressures, flow deviations, effects of leakages/releases, hazards of temperatures.

Unit – IV

Hazard analysis: process safety management, process hazards analysis, hazards analysis methods, check list, preliminary hazard analysis, what-if / check list, hazard and operability analysis, FMEA, Fault tree analysis, cause and consequence analysis.

Unit – V

Preventive and protective measures: Safety options, process safety approaches, inherent safety and design, plant layout, inherent security, explosion prevention and protection, personal protective systems, plant modifications and management change, relief valves and rupture discs, breather vents for storage tanks, explosions vents, flame arresters, flare systems

TEXT BOOK:

1. Chemical process industry safety by K S N Raju, Mc-Graw Hill education (India) Pvt.Ltd,2014
2. Chemical process Safety by Crowl

REFERENCES:

1. Chemical process safety by sanders

<u>Outcome</u>:

- The student will be equipped with the knowledge by which thorough safety is ensured in the organization.
- Classify and identify hazards in chemical industries

- Take precautions in chemical storage and handling
- Perform fault tree and event tree risk analysis and quantify them
- Suggest and make others in the plant about emergency management plans

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IV Year B.Tech. Chem. Engg. I-Sem

L	T	P	C
3	0	0	3

OPEN ELECTIVE-II

APPLIED NUMERICAL METHODS (17A70805a)

UNIT I : Eigen values and Eigen vectors: Introduction, Calculation of Largest and smallest Eigen Values and Corresponding Eigen vectors using power method.

Linear Algebraic Equations: Introduction, Gauss- Elimination, LU Decomposition, Gauss-Jordan Elimination, Gauss- Siedel methods.

UNIT II : Nonlinear Algebraic Equations: Introduction, single variable successive substitutions (Fixed point method), single variable Newton-Raphson Technique, Multivariable Newton-Raphson Technique.

UNIT III : Regression Analysis: Introduction, least squares curve-fitting methods, Newton's forward formulae, Newton's backward formulae. Interpolation Polynomial, Lagrangian Interpolation (Unequal Intervals),Pade' approximations,(upto second order both in numerator and denominator)

UNIT IV: Ordinary Differential Equations-Initial Value Problems (ODE-IVPs): Introduction, explicit and implicit Euler's method, Runge- Kutta fourth order method. **Ordinary Differential Equations- Boundary Value Problems (ODE-BVPs):** Introduction, Galerkin Finite Element (GFE) Technique, Shooting Techniques.

UNIT V: Advanced methods for Differential Equations: Introduction, the finite difference technique (method of lines), Orthogonal Collocation, Finite Volume Method.

TEXT BOOKS:

1.Numerical Methods in Engineering, S.K. Gupta., Tata Mc-Graw Hill.,1998,1st Edition.

REFERENCE BOOKS:

1. Numerical Methods in Engineering &Science, B.S.Grewal, Khanna Publisher, 6th Ed. 2005.

Objective: This course trains the students in learning and applying the numerical techniques to solve the chemical engineering problems.

Outcome: The student will learn different techniques to solve linear algebra equations, ODES, difference equitation.

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L	T	P	C
3	0	0	3

OPEN ELECTIVE-II

COMPUTATIONAL FLUID DYNAMICS (17A70805b)

Prerequisite: Fluid mechanics for chemical engineers, process heat transfer, mass transfer operations, chemical reaction engineering, process modeling & simulation

OBJECTIVE: This subject deals with different mathematical methods like finite difference techniques to solve Navier - Stokes equations & other fluid flow problems

UNIT I

Introduction - Finite difference methods- finite element method - finite volume method- Treatment of boundary conditions- Governing differential equations. Finite difference methods - Taylor's series - Errors associated with FDE- FDE formulation for steady state heat transfer problems.

UNIT II

Cartesian, cylindrical and spherical coordinate systems- boundary conditions- Un steady state heat conduction Explicit Method - Stability criteria - Implicit Method - Crank Nickolson method - 2-D FDE formulation ADI- ADE. Finite volume method - Generalized differential equation, Basic rules for control volume approach, Source term linearization, boundary conditions. Un-steady state one, two, three dimensional heat conduction.

UNIT III

Convection and diffusion, different methods i.e., upwind scheme, Exponential scheme, Hybrid scheme, power law scheme, calculation of flow field, staggered grid method, pressure and velocity corrections, SIMPLE Algorithms & SIMPLER (revised algorithm). Solution methods of elliptical, parabolic and hyperbolic partial differential equations in fluid mechanics - Burgers equation.

UNIT IV

Formulations for incompressible viscous flows - vortex methods -pressure correction methods.

UNIT V

Treatment of compressible flows- potential equation, Navier - Stokes equation - flow field dependent variation methods, boundary conditions. Linear fluid flow problems, 2-I) and 3- 1) fluid flow problems.

TEXT BOOKS:

1. Numerical heat transfer and fluid flow - S.V. Patankar
2. Computational Fluid Dynamics, T.J. Chung, Cambridge University
3. Text Book of Fluid Dynamics, Frank Chorlton, CBS Publishers

OUTCOME: The student will apply the principles of fluid dynamics to solve different problems of the industry

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IV Year B.Tech. Chem. Engg. I-Sem

L	T	P	C
3	0	0	3

OPEN ELECTIVE- II

DESIGN AND ANALYSIS OF EXPERIMENTS (17A70805c)

Objectives:

- Which factors affect a given experiment?

- Find the most significant factor for an experiment.
- Calculate the factor levels that optimize the outcome of an experiment.
- Factorial Design of experiments.

UNIT- I

Introduction to probability, probability laws, Baye's theorem.Probability distributions, parameters and statistics.Normal and t-distributions, central limit theorem, random sampling and declaration of independence significance tests

UNIT- II

Randomization and blocking with paired comparisons significance tests and confidence interval for means, variances, proportions and frequencies.

UNIT-III

Analysis of variance, experiments to compare k-treatment means, Two-way factorial designs, blocking, Yate's algorithm

UNIT- IV

Fractional factorial designs at two levels, concept of design resolution, Simple modeling with least squares (regression analysis), Matrix versions of normal equations

UNIT- V

Mechanistic model building, Empirical and mechanistic models, model building process, model testing with diagnostic parameters.

Text Book:

1. Statistics for experimenters by G.E.P. Box, William G. Hunter and J.S. Hunter, John Wiley & Sons.

Reference:

1. "Design and analysis of experiments" by D.C. Montgomery, 2nd edition John Wiley and sons, NewYork (1984).

Outcome:

- Predict how many numbers of experiments are to be carried out, given the number of important factor
- Design an experiment and calculate the factor levels that optimize a given objective.
- Use response surface methodology to optimize the process, by considering curvature effects.
- Understand strategy in planning and conducting experiments
- Choose an appropriate experiment to evaluate a new product design or process improvement

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L	T	P	C
3	0	0	3

ELECTIVE-I

ENERGY ENGINEERING (17A70806a)

OBJECTIVES:

- To acquaint the student with the conventional energy sources and their utilization.
- To understand the importance of heat recovery and energy conservation methods and energy audit

UNIT -I

Sources of energy, types of fuels- energy and relative forms. Calorific value- gross and net value, calculation of calorific value from fuel analysis, experimental determination energy resources present and future energy demands with reference to India.

Coal: origin, occurrence, reserves, petrography, classification, ranking, analysis, testing, storage, coal carbonization and byproduct recovery, liquefaction of coal, gasification of coal, burning of coal and firing mechanism, burning of pulverized coal.

UNIT- II

Liquid fuels: petroleum: origin, occurrence, reserves, composition, classification, characteristics, fractionation, reforming, cracking, petroleum products, specification of petroleum products, burning of liquid fuels.

Natural gas, coke oven gas, producer gas, water gas, LPG, burning of gaseous fuels, hydrogen (from water) as future fuel, fuel cells, flue gas, analysis: orsat apparatus.

UNIT -III

Steam Plant: Run time cycle, boiler plant, steam cost, steam distribution and utilization, combined heat and power systems, energy from biomass and biogas plants, gas purification, solar energy, wind energy, energy storage.

UNIT -IV

Waste heat recovery, sources of waste heat and potential application, various types of heat recovery systems, regenerators, recuperators, waste heat boilers

Energy conservation: conservation methods in process industries, theoretical analysis, practical limitations.

UNIT-V

Energy auditing: short term, medium term, long term schemes, energy conversion, energy index, energy cost, representation of energy consumption, Sankey diagram, energy auditing.

TEXT BOOKS:

1. Fuels, Furnaces and Refractories, O.P.Gupta
2. Fuels and Combustion, 3rd ed., Samir Sarkar, Universities Press, 2009.

REFERENCES:

1. Non-conventional Energy Resources, G.D.Rai, Khanna Publishers
2. Fuel and Energy, Harker and Backhurst, Academic press London 1981

3. Fuel Science- Harker and Allen, Oliver and Boyd, 1972

Outcomes:

- Students would have a good knowledge about conventional energy sources and their audit. Ability to apply the fundamentals of energy conversion and applications

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IV Year B.Tech. I-Sem

L	T	P	C
3	0	0	3

ELECTIVE-I

NON-CONVENTIONAL SOURCES OF ENERGY (17A70806b)

Objective:

It introduces solar energy its radiation, collection, storage and application. It also introduces the Windenergy, Biomass energy, Geothermal energy and ocean energy as alternative energy sources.

UNIT – I: PRINCIPLES OF SOLAR RADIATION: Role and potential of new and renewable source, the solar energyoption, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial andterrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation andsun shine, solar radiation data.

UNIT-II: SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentratingcollectors, orientation and thermal analysis, advanced collectors.SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, Sensible, latent heat andstratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation anddrying, photovoltaic energy conversion.

UNIT-III: WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performancecharacteristics, Betz criteria .BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gasyield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economicaspects.

UNIT-IV: GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy, potential inIndia.OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal andwave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

UNIT-IV: DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, principles of DEC. Thermoelectricgenerators, seebeck, peltier and joul Thomson effects, Figure of merit, materials, applications,MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHDEngine, power generation systems, electron gas Dynamicconversion,economicaspects.Fuelcells,principles, faraday’s law’s, thermodynamic aspects, selection of fuels and operating conditions.

References:

1. Non-Conventional Energy Sources /G.D. Rai

2. Renewable Energy Technologies /Ramesh & Kumar /Narosa

REFERENCE BOOKS:

1. Renewable energy resources/ Tiwari and Ghosal/ Narosa.

2. Non-Conventional Energy / Ashok V Desai /Wiley Eastern.

3. Non-Conventional Energy Systems / K Mittal /Wheeler

4. Solar Energy /Sukhame

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L	T	P	C
3	0	0	3

ELECTIVE-I

WASTE TO ENERGY CONVERSION TECHNOLOGIES (17A70806c)

Unit I: Solid Waste -Definitions: Sources, types, compositions; Properties of Solid Waste; Municipal Solid Waste: Physical, chemical and biological property; Collection, transfer stations; Waste minimization and recycling of municipal waste Landfill method of solid waste disposal; Landfill classification; Types, methods & siting consideration; Layout & preliminary design of landfills: Composition, characteristics, generation; Design of Sanitary Land fill - Movement and control of landfill leachate &gases; Environmental monitoring system for landfill gases.- Gas Recovery – Applications .

Unit II: Waste Treatment & Disposal Size Reduction: incineration; Furnace type& design; Types of Incinerators – Fuel Economy - Medical / Pharmaceutical waste / Hazardous waste / Nuclear Waste incineration.; Environmental impacts; Measures of mitigate environmental effects due to incineration;

Unit III : Energy Generation From Waste Types: Biochemical Conversion: Sources of energy generation, Industrial waste, agro residues; Anaerobic Digestion: Biogas production; Determination of BOD, DO, COD, TOC, & Organic loading, Aerobic & Anaerobic treatments – types of digester – factors affecting biodigestion - Activated sludge process. Methods of treatment and recovery from the in industrial waste water – Case Studies in sugar, distillery, dairy, pulp and paper mill, fertilizer, tanning, steel industry, textile, petroleum refining, chemical and power plant.

Unit IV: Rural applications of biomass –Combustion - Chulas - improved Chulas- Biomass – Physical - Chemical composition – properties of biomass – TGA – DSC characterization – Ash Characterization - Preparation of biomass – Size reduction – Briquetting of loose biomass Briequtting machine.

Unit V : Thermochemical Conversion -Basic aspects of biomass combustion - heat of combustion - different types of grates - Co combustion of biomass – Gasification - Fixed and Fluidized bed gasifier - Gasification technologies for the selected waste like Rice Husk, Coir pith, Bagasse, Poultry litter etc., - Pyrolysis.

References:

1. Parker, Colin, & Roberts, Energy from Waste - An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985.

2. Shah, Kanti L., Basics of Solid & Hazardous Waste Management Technology, Prentice Hall, 2000.

3. Manoj Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, 1997.

4. Rich, Gerald et.al., Hazardous Waste Management Technology, Podvan Publishers, 1987

5. Bhide AD., Sundaresan BB, Solid Waste Management in Developing Countries, INSDOC, New Delhi,1983.

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L	T	P	C
0	0	0	0

MOOC-I (AUDIT) (17A79906a)

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IV Year B.Tech. I-Sem

L	T	P	C
0	0	0	0

MOOC-I (AUDIT) (17A79906b)

JNTUA College of Engineering (Autonomous), Ananthapuramu

IV Year B.Tech. I-Sem

L	T	P	C
0	0	0	0

MOOC-I (AUDIT) (17A79906c)

JNTUA College of Engineering (Autonomous), Ananthapuramu

IV Year B.Tech. Chem. Engg. I-Sem

L	T	P	C
0	1	3	2

PROCESS EQUIPMENT DESIGN AND DRAWING LAB(17A70807)

OBJECTIVES: To make the student familiar with design and drawing aspects of chemical processes equipments.

1. Drawing of flow sheet symbols.
2. Drawing of instrumentation symbols.
3. Drawing of instrumentation diagrams.
4. Mechanical aspects chemical equipment design and drawing of following equipment.
    a) Double pipe heat exchanger
    b) Shell and tube heat exchanger
    c) Evaporator
    d) Distillation column
    e) Batch reactor.

Text Book:

1. Process Equipment Design by M. V. Joshi
2. Chemical Process Equipment Design and Drawing, S.C. Maidargi, PHI, 2013

Reference:

1. Process Equipment Design by Brownell and Young
2. Chemical Process Equipment Design by Bhattacharya
3. Process Equipment Design by Wallas

Pre-requisite: Chemical Process equipment design

Outcome:

- Students would gain knowledge to develop key concepts and techniques to design the process equipment in a process plant. These key concepts would be utilized to make design and operating decisions.

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IV Year B.Tech. Chem. Engg. I-Sem

L	T	P	C
0	1	3	2

SIMULATION LAB((17A70808)

Objective: To make the student familiar with software's and simulation of chemical processes equipments.

The following experiments have to be conducted using C and MATLAB

1. General introduction to MATLAB
2. Functions (log, exp, conv, roots).
3. Matlab Scripts and function files
4. Gravity Flow tank.
5. Three CSTRs in series – open loop
6. Three CSTRs in series – Closed loop
7. Non isothermal CSTR
8. Binary Distillation column
9. Batch Reactor isothermal; Batch reactor non isothermal – closed loop
10. Isothermal batch reactor – open loop
11. Heat Exchanger
12. Interacting System- two tank liquid level
13. Non interacting system-two tank liquid level
14. Plug flow reactor
15. Bubble point calculations
16. Dew point calculations

TEXT BOOKS:

1. A Guide to MATLAB for Chemical Engineering Problem Solving, Kip D. Hauch
2. Understanding MATLAB A Textbook for Beginners by S.N. Alam

Pre-requisite: Fluid mechanics for chemical Engineers, Process Heat transfer, Mass transfer operation- 1 & 2, Chemical Reaction Engineering.

Outcomes:

1. Helps to interconnect knowledge of mathematics, science, and engineering to real world problems.
2. Helps to identify, formulate, and solve engineering problems
   (for ex: most of chemical engineering problems are based on transport equations consisting broader areas of kinetics, thermodynamics and mass transfer which can be

thoroughly solved using MATLAB inbuilt functions)

- The complex multi component distillation column design can be modeled and simulated
- System of ordinary and partial differential equations obtained in multiple reactors in series/parallel can be solved
- Process control and optimization of reactors can be handled easily

3. "Genetic algorithms" can be implemented at a more pronounced way via MATLAB to solve various linear and non linear models of chemical engineering systems.
4. Most fascinating approach of Artificial Neural Networks (ANN) for electrical related concepts of chemical engineering systems can also be well handled in MATLAB
5. Steady state and unsteady state problems of chemical engineering and allied fields can be modeled and solved using MATLAB

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L	T	P	C
0	0	0	1

COMPREHENSIVE OBJECTIVE TYPE EXAMINATION (17A70809)

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IV Year B.Tech. Chem. Engg. II-Sem

L	T	P	C
3	0	0	3

Elective - II

BIOCHEMICAL ENGINEERING (17A80801a)

OBJECTIVES:

- Study introduction to the application of chemical engineering principles in biochemical systems.
- Be enabled to understand the biological systems and kinetics of enzymatic reactions.
- Learn the kinetics of growth of microorganisms, hence be able to control the process.
- Be able to design equipments for handing biological processes.
- Study Operations utilized in the purification of biological products enable them to recommend, install and easily learn to operate the equipments.

UNIT I

Introduction to microbiology: Biophysics and the cell doctrine, the structure of cells, important cell types, from nucleotides to RNA and DNA, amino acids into proteins. Kinetics of enzyme catalyzed reaction: the enzyme substrate complex and enzyme action, simple enzyme kinetics with one and two substrates, other patterns of substrate concentration dependence, modulation and regulation of enzyme activity, other influences on enzyme activity.

UNIT II

Immobilized enzyme technology: enzyme immobilization, industrial processes, utilization and regeneration of cofactors.Immobilized enzyme kinetics: effect of external mass transfer resistance, analysis of intraparticle diffusion and reaction.

Kinetics of cellular growth in batch and continuous culture, models for cellular growth – unstructured, structured and cybernetic models. Thermal death kinetics of cells and spores

UNIT III

Introduction to metabolic pathways, biosynthesis, transport across cell membranes, end products of metabolism, stoichiometry of cell growth and product formation.

Design and analysis of biological reactors: batch reactors, fed-batch reactors, enzyme catalyzed reactions in CSTR, CSTR reactors with recycle and cell growth, ideal plug flow reactors, sterilization reactors, sterilization of gases, packed bed reactors using immobilized catalysts. Fermentation technology: medium formulation, design and operation of a typical aseptic, aerobic fermentation process.

UNIT IV

Transport phenomena in bioprocess systems: Gas-liquid mass transfer in cellular systems, determination of oxygen transfer rates, overall k_La' estimates and power requirements for sparged and agitated vessels, scaling of mass transfer equipment, heat transfer.

UNIT V

Downstream processing: Strategies to recover and purify products; separation of insoluble products-filtration and centrifugation; cell disruption-mechanical and non-mechanical methods; separation of soluble products: liquid-liquid extractions, membrane separation (dialysis, ultra filtration and reverse osmosis), chromatographic separation-gel permeation chromatography, electrophoresis, final steps in purification – crystallization and drying.

TEXT BOOKS:

1. Biochemical Engineering Fundamentals, 2nd ed., J.E. Bailey and D.F. Ollis, McGraw-Hill, New York, 1987.

2. Bioprocess Engineering, 2nd ed., M. L. Shuler and F. Kargi, PHI Learning Pvt. Ltd, New Delhi, 2009.

REFERENCES:

1. Biochemical Engineering, J. M. Lee, Prentice-Hall, New Jersey 1992.

2. Bioprocess Engineering Principles, P. M. Doran, Elsevier, Gurgaon, 2005.

Outcome:

- This course will help the students to understand and apply the principles of biochemical engineering in analysis and design of industrial biochemical processes.
- Upon completion of this course, the students would develop the ability to design novel bioprocesses for their research in various areas. They will have the ability to find solutions to the problems which occur when materials and processes interact with the environment.
- Explain operations utilized in the purification of biological products are also studied by the students. This will enable them to recommend, install and easily learn to operate the equipment.

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L	T	P	C
3	0	0	3

IV Year B.Tech. Chem. Engg. II-Sem

ELECTIVE - II

INDUSTRIAL BIOTECHNOLOGY (17A80801b)

UNIT-I

Fundamentals of biochemical engineering sciences; Biotechnology – ancient and modern. Exploitation of microbes – Large-scale process, commercial exploitation, micro-gravity biotechnology (space biotechnology);

UNIT -II

Animal biotechnology – application of animal cell culture, monoclonal antibodies, transgenic animal and gene therapy;Plant biotechnology – plant cell, tissue and organ culture processes – engineering perspectives

UNIT -III

Industrial production of Antibiotics, Alcoholic beverages, Citric Acid, Vitamins, vaccines and industrial enzymes

UNIT -IV

Large-scale separation processes- ATPS, gradient elution and affinity interaction. Techno economics of biotechnology industries

UNIT -V

Legal, social and ethical aspects of biotechnology. Fermentation Economics, Isolation of Micro-organisms of potential industrial interest, Market potential, Recovery costs.

TEXT BOOKS:

1. Text book of Biotechnology; HK Das, Wiley Dremtechs Publications

2. Industrial Biotechnology, Casida, New Age Publication

3. Industrial Microbiology, Presscott and Dunn.

REFERENCES:

1. Concepts in Biotechnology by Balasubramayam, University Press, 2nd ed.,2004

Pre-requisite: Biochemical Engineering

Objective: The objective of the courses to impart the basic knowledge on process biotechnology plant biotechnology and animal biotechnology.

Codes / Tables:---Nil---

Question paper Pattern: 5 Question to be answered out of 8 questions.

Each question should not have more than 3 bits.

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L	T	P	C
3	0	0	3

ELECTIVE-II

ENZYME ENGINEERING (17A80801c)

Course Objectives:

- To impart the basic concepts of enzymes and the reactors involved in free and immobilized enzyme system •To understand the kinetics and physicochemical characteristics of enzymes

UNIT I: Classification of enzymes, commercial application of enzymes in food, pharmaceutical and other industries. Enzymes for analytical and diagnostic applications. Production and purification of crude enzymes. Extracts from plant, animal and microbial sources

UNIT II: Mechanism of Enzyme action, Concept of active site, enzyme-substrate complex and enzyme action, Simple enzyme kinetics with one substrate. Michaelis - Menten kinetics. Evaluation of parameters in the Michaelis - Menten kinetics Equation. Types of inhibition. Influences of pH, temperature, fluid forces, chemical agents and irradiation on enzyme activity.

UNIT III: Enzyme immobilization. Physical and chemical techniques for enzyme immobilization adsorption, matrix entrapment, encapsulation, cross – linking, covalent binding. Advantages and disadvantages of different immobilization techniques. Application of immobilized enzyme systems.

UNIT IV: Mass transfer effects in immobilized enzyme systems. Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions.

UNIT V: Batch Operation of a stirred reactor Time course for batch enzyme reaction. continuous operation in a stirred tank reactor. Immobilized enzyme reaction in a CSTR and plug flow reactor.Enzyme biosensors, application of enzymes in analysis, design of enzyme electrodes and their application in industry, health care and environment

References:

1. Gerharts, W, Enzymes in industry – Production and application.

2. James E Bailey & David F Ollis "Biochemical Engineering Fundamentals" McGraw Hill

3. Pauline M Doran "BiopriocessEngg. Principles" – Academic press

4. Taylor, R.F.(Ed.) "Protein Immobilization – Fundamentals and applications". Wiley online Library.

5. Zubay G, Biochemistry, Maxwell Macmillan International Education

Expected Outcome: Students will be able to: i. Classify enzymes along with their applications in different fields ii. Analyse the kinetics of enzymes and apply the same in the design of reactors iii. Outline the types and methods of immobilization of enzymes iv. Summarize the various types of enzyme reaction systems and reactors.

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IV Year B.Tech. Chem. Engg. II-Sem

L	T	P	C
3	0	0	3

ELECTIVE-III

FLUIDIZATION ENGINEERING (17A80802a)

UNIT I

Introduction: The phenomenon of fluidization; liquid like behavior of a fluidized bed; Comparison with other contacting methods; Advantages and disadvantages of fluidized beds.

Industrial applications of fluidized beds: Coal gasification; gasoline from other petroleum fractions; Gasoline from natural and synthesis gases; Heat exchange; Coating of metal objects with plastics; Drying of solids; Synthesis of phthalic anhydride; Acrylonitrile; Polymerization of olefins; FCCU; Fluidized combustion of coal; incineration of solid waste; Activation of carbon; gasification of waste; bio-fluidization.

UNIT II

Fluidization and mapping of regimes: Minimum fluidization velocity; Pressure drop vs. velocity diagram; effect of temperature and pressure on fluidization; Geldart classification of particles; terminal velocity of particles, Transport disengaging height; turbulent fluidization; pneumatic transport of solids; fast fluidization; solid circulation systems; Voidage diagram; Mapping of regimes of fluidization.

UNIT III

Bubbles in dense bed: Single rising bubbles; Davidson model for gas flow at bubbles; Evaluation of models for gas flow at bubbles.

Bubbling Fluidized beds: Experimental findings; Estimation of bed Voidages; Physical models: simple two phase model; K-L model.

UNIT IV

High velocity Fluidization: Turbulent fluidized bed; Fast fluidization pressure drop in turbulent and fast fluidization.

Solids Movement, Mixing, Segregation and staging: Vertical movement of solids; Horizontal movement of solids; Staging of fluidized beds.

UNIT V

Gas Dispersion and Gas interchange in Bubbling Beds: Dispersion of gas in beds; Gas interchange between bubble and emulsion; Estimation of gas interchange coefficients.

Particle to Gas Mass Transfer: Experimental interpolation of mass transfer coefficients; Heat transfer; Experimental heat transfer from the bubbling bed model.

TEXT BOOKS

1. Fluidization Engineering by Kunil, Diazo and Octave Levenspiel, John Weiley & Sons Inc, Newyork, 1969.

2. Fluidization Engineering by J.R. Howard, Adam Heilgar.

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L	T	P	C
3	0	0	3

ELECTIVE-III

INTERFACIAL ENGINEERING (17A80802b)

Objectives:

1. Importance of various components of interfacial science in different chemical engineering industries viz. food, paint and pharmaceutical industries are emphasized.
2. The properties and functioning of surfactants and detergency are made familiarized. Interfacial and vander Waals forces play important role in the nano particles

UNIT-I:

Basic concepts of Colloids and Interfaces: Introduction, Examples of Interfacial Phenomena, Solid-Fluid Interfaces, Colloids. Properties of Colloid Dispersions: Introduction, Sedimentation under Gravity, Sedimentation in a Centrifugal Field, Brownian Motion, Osmotic pressure, Optical properties, Electrical Properties, Rheological Properties of Colloid Dispersions.

UNIT-II:

Surfactants and their properties: Introduction, Surfactants and their Properties, Emulsions and Microemulsions, foams.

UNIT-III:

Surface and Interfacial Tension: Introduction, Surface tension, Interfacial Tension, Contact Angle and Wetting, Shape of the Surfaces and interfaces.Measurement of Surface and Interfacial Tension, Measurement of Contact Angle;

UNIT-IV:

Intermolecular and Surface Forces: Introduction, Vanderwalls Forces.Intermolecular and Surface Forces: Electrostatic double layer force, The DLVO theory, Non-DLVO forces.

UNIT-V:

Adsorption at interfaces: Introduction, The Gibbs Dividing surface, Gibbs Adsorption Equation, Langmuir and Frumkin Adsorption Isotherms, Surface Equation of state(EOS), Effect of Salt on Adsorption of Surfactants.Adsorption Isotherms incorporating the Electrostatic Effects, Calculation of Free energy of Adsorption.

TEXT BOOKS:

1. **Foundations of Colloid Science by** R. J. Hunter, 2nd edition, Oxford University Press, USA, 2001.
2. **Principles of Colloid and Surface Chemistry**, Third edition, Revised and Expanded, Paul C. Hiemenz and Raj Rajagopalan.
3. **Physical Chemistry of Sciences**, 6th edition, A. Adamson, 1997.

4. **Interfacial Science: An Introduction by** G.Barnes, I.Gentle, Oxford University Press, USA, 2006.
5. **Coloid and Interface Science by** Pallab Ghosh, PHI, NEWDELHI.

Outcomes:

1. Realize the factors influencing stability of dispersions & emulsions.
2. Get the knowledge to measure surface tension & contact angle and apply them for practical problems.
3. Comprehend about detergency, surfactants and their applications.

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IV Year B.Tech. Chem. Engg. II-Sem

L	T	P	C
3	0	0	3

ELECTIVE-III

POLYMER TECHNOLOGY(17A80802b)

OBJECTIVES:

To enable the students to compute molecular weight averages from the molecular weight distribution, Condensation polymerization and transition in polymers

Unit I

Introduction; definitions: polymer& macro molecule, monomer, functionality, average functionality, co-polymer, polymer blend., plastic and resin. Classification of polymers: based on source, structure, applications, thermal behavior, mode of polymerization. Concept of average molecular weight of polymers, molecular weight distribution, poly disparity index. Determination of average molecular weights: End group analysis, osmometry, light scattering techniques, viscometer, Gel permeation chromatography.

Unit II

Natural polymers: brief study of i) Natural rubber ii) shellac iii) rosin iv) cellulose v) proteins.

Mechanism and kinetics of: Addition or chain polymerization

a) Free radical addition polymerization b) Ionic addition polymerizations

c) Coordination polymerization d) Coordination or step growth or condensation polymerization.

Unit III

Methods of polymerization: mass or bulk polymerization process, solution polymerization process, suspension polymerization process and emulsion polymerization method comparison of merits and demerits of these methods. Properties of polymers: crystalline and amorphous status, melting and glass transition temperatures and their determination, effect of polymer structure on mechanical, physical, chemical and thermal properties.

Unit IV

Degradation of polymers, Role of the following additives in the polymers: i) Fillers and reinforcing fillers ii) Plasticizers iii) Lubricants iv)Antioxidants and UV stabilizers v) Blowing agents vi)Coupling agents vii)Flame retardants viii) Inhibitors

Brief description of manufacture, properties and uses of: i) Polyethylene (HDPE&LDPE), ii) Poly propylene iii) Polyvinylchloride iv) Polystyrene v) Polytetra fluoroethylene vi) Polymethyl mehacrylate vii) Polyvinylacetate & Polyvinylalcohol.

Unit V

Brief description of manufacture, properties and uses of: i) Polyesters (Polyethylene terephthalate polycarbonate and unsaturated polyesters) ii) Nylon(Nylon 66) iii) Phenol-Formaldehyde resins iv) Epoxy resins v) Polyurethane vi) Silicones

Compounding of polymer resins, brief description of: i) Compression and transfer moulding ii) Injection moulding iii) Extrusion iv) Blow moulding v) Calendaring vi) Laminating and pultrusion

TEXT BOOKS:

1. Polymer Science & Technology, 2nd ed., J.R. Fried, PHI Learning Pvt. Ltd., New Delhi, 2009
2. Plastic materials, J.A. Brydson, Newnes-Butterworth (London) 1989.

REFERENCES:

1. Text book of polymer science, F.W.Jr. Bill Meyer, (3rd ed.) John Wiely&sons 1984
2. Introduction to Plastics, J.H. Brison and C.C. Gosselin, Newnes-Butterworth, London 1968.

Outcome:

- Classify the polymers and also able to identify the structural configurations of any polymer.
- Distinguish the modification of a polymer and also in a position to examine the mechanism of a polymerization.
- Synthesize any elastomer and optimize their deformation properties on applying force.
- Explain the processing of polymer, identify the mode of deformation of a polymer and test the mechanical strength of a polymer.

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L	T	P	C
3	0	0	3

ELECTIVE-IV

TECHNOLOGY OF PHARMACEUTICALS AND FINE CHEMICALS (17A80803a)

UNIT I

A brief outline of grades of chemicals, sources of impurities in chemicals, principles (without going into details of individual chemicals) of limit test for arsenic, lead, iron, chloride and sulfate in Pharmaceuticals.

UNIT II

Outlines of Preparation, properties, uses and testing of the following Pharmaceuticals - sulfacetamide, paracetamol, riboflavin, nicotinamide,

Outlines of Preparation, properties, uses and testing of the following fine chemicals - Methyl orange, fluorescence, procaine hydrochloride, paramino salicylic acid, isonicatinic acid hydrazide.

UNIT III

Manufacture with flowsheets, properties uses and testing of the following Pharmaceuticals – aspirin, penicillin, calcium gluconate.

UNIT IV

Manufacture with flowsheets, properties uses and testing of the following ferric ammonium citrate, pthallic anhydride and phenol flourobenzene process and benzene sulfate process, other processes in outline only.

UNIT V

Tablet making and coating, granulation equipments, Preparation of capsules, extraction of crude drugs.Sterilization: introduction, risk factor, methods of sterilization, heat (dry and moist), heating with bactericide, filtration, gaseous sterilization and radiation sterilization, suitable example to be discussed.

TEXT BOOKS:

1. Remington’s Pharmaceutical Science,16th ed, Mac publishing company, 1980.
2. Industrial Chemicals, 3rd ed., Faith, Kayes and Clark, John Wiley & Sons,. 1965.

REFERENCE:

1. Blently’s Text Book of Pharmaceutical Chemistry, 8th ed, H A Rawlins,
2. B Tindell and Box,. Oxford University Press, London, 1977.

Outcomes:

1: Understand the principle of plant design in Pharmaceutical Industry.
2: Understand the knowledge of base chemicals and drug intermediates.

3: Understand kinetics, thermodynamics and plant construction material for the production of bulk drugs and fine chemicals.

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IV Year B.Tech. Chem. Engg. II-Sem

L	T	P	C
3	0	0	3

ELECTIVE-IV

FOOD PROCESSING TECHNOLOGY (17A80803b)

Objectives: To impart knowledge to the students about food processing and various unit operations involved in it, packaging, storing and preservation.

UNIT I

Food process engineering - Fundamentals: Fundamentals of food process engineering, application of quantitative methods of material and energy balances in food engineering practices.

UNIT II

Unit Operations in food industries: Fluid flow, thermal process calculations, refrigeration, evaporation and dehydration operations in food processing.

UNIT III

Microwave heating: Theory of microwave heating, microwave properties of foods, comparison of microwave and conventional heating, benefits of microwave heating, applications in food processing, microwave heating equipment, hazards of microwave heating.

UNIT IV

Mechanical Operations in food processing: Conversion operations, Size reduction and screening of solids, mixing and emulsification, filtration and membrane separation, centrifugation, crystallization, extraction.

UNIT V

Preservation operations: Preservation methods & Strategies, Thermal Methods, Nabla Factor Sterilization Types Pasteurization Dehydro freezing Irradiation Dosimetry Transport of food & Preservation strategies Cheap and applicable everywhere.

TEXT BOOKS

1. R. T. Toledo, "Fundamentals of Food Process Engineering", AVI Publishing Co., 1980.
2. R. Angold,G.Beech and J.Taggart, " Food Biotechnology", Cambridge University Press, 1989.
3. Fundamentals of Food Engineering, D G Rao, PHI, New Delhi, 2012.

REFERENCES

1. J. M. Jackson and B. M. Shinn, "Fundamentals of Food Canning Technology", AVI Publishing Co., 1978.
2. J. G. Bernnan, J. R. Butters, N. D. Cowell and A.E.V.Lilley, "Food Engineering Operations", 2nd Edn., Applied Science, 1976.

Outcomes:

1. Understanding the various causes of food deterioration and food poisoning.
2. Identification of appropriate processing, preservation, and packaging method.
3. Analyze product quality and effect of processing technique on it.

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IV Year B.Tech. Chem. Engg. II-Sem

L	T	P	C
3	0	0	3

ELECTIVE-IV

CORROSION ENGINEERING (17A80803c)

OBJECTIVES:

The course will enable the students to:

1. Be introduced to the principles of electrochemistry as well as the essential elements of electrochemical corrosion.
2. Lay a foundation for understanding the forms of corrosion, the mechanisms of corrosion, electrochemical methods.
3. Develop the thermodynamic and kinetic aspects of electrochemistry, including potential-pH (Pourbaix) diagrams, mixed potential theory, and the theory and application of polarization.
4. Design methods for combating corrosion, the principles and methods leading to mitigation of corrosion problems that might occur in engineering practice.

UNIT- I:

Introduction

Definitions of Corrosion - Overall classification of types of corrosion-Basic electrochemistry – Galvanic and electrolytic cells – Potential measurements - EMF and Galvanic series – Galvanic corrosion and bimetallic contacts – Eh – pH diagrams, Cost of Corrosion, Metallurgical properties influencing corrosion.

UNIT-II:

Forms of Corrosion

Uniform attack, galvanic, crevice, pitting, Inter granular, selective leaching, erosion and stress corrosion – Mechanisms, testing procedures and their protection.

UNIT- III:

Electrode kinetics and polarization phenomena

Electrode – solution interface – Electrode kinetics and polarization phenomena – Exchange current density – Polarization techniques to measure corrosion rates – Mixed potential theory – Activation and diffusion controlled mixed electrodes.

UNIT IV:

Methods of corrosion prevention and control

Design, coatings and inhibition – Cathodic protection – Stray current corrosion – Passivity phenomena and development of corrosion resistant alloys – Anodic control.

UNIT-V:

Industry Approach

Selection for a given Chemical Engineering Service Environment- Materials for Chemical Engineering Industry to resist the given chemical Environment.-Ferritic, Austenitic steels and

stainless steels- Copper and its alloys-Brasses, bronzes, Nickel and its alloys- Monel alloys-materials for a petroleum refinery industry.

TEXT BOOKS:

1. M. G. Fontana, Corrosion Engineering (Third Edition) McGraw-Hill Book Company.
2. Denny A Jones, Principles and Prevention of Corrosion (second edition), Prentice-Hall, N. J. (1996).

REFERENCE:

1. H. H. Uhlig and R. W. Revie, Corrosion and Corrosion Control, Wiley (NY) (1985).

Outcomes:

At the end of the course, the students will be able to:

1. Understand the electrochemical and metallurgical behavior of corroding systems.
2. Apply the electrochemical and metallurgical aspects of combating eight forms of corrosion.
3. Select or choose the testing procedures for corroding systems.
4. Evaluate the polarization behavior of corroding systems.
5. Design of suitable materials, methods to combat corrosion.
6. Predict the function of corrosion inhibitors.

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L	T	P	C
3	0	0	3

ELECTIVE-V
PETROLEUM REFINING AND PETROCHEMICALS(17A80804a)

OBJECTIVES:

- Learn the formation, refining of crude oil and products of refinery.
- Understand the means of processing data including thermal properties, important products characteristics.
- Develop skills in drawing neat flow diagrams of different petroleum refining processes
- (cracking/reforming/alkylation/isomerization / hydrocracking etc.,) that are aimed at producing high value/demand products.
- Identify important testing methods for important petroleum products.
- Have idea on Indian standards for major petroleum products

UNIT-I:

Origin, formation and composition of petroleum: Origin and formation of petroleum, Reserves and deposits of world, Indian Petroleum Industry. Petroleum processing data: Evaluation of petroleum, thermal properties of petroleum fractions, important products, properties and test methods.

UNIT-II:

Fractionation of petroleum: Dehydration and desalting of crudes, heating of crude pipe still heaters, distillation of petroleum, blending of gasoline. Treatment techniques: fraction-impurities, treatment of gasoline, treatment of kerosene, treatment of lubes.

UNIT-III:

Thermal and catalytic processes: Cracking, catalytic cracking, catalytic reforming, Naphtha cracking, coking, Hydrogenation processes, Alkylation processes, Isomerization process.

UNIT-IV:

Petrochemical Industry – Feed stocks Chemicals from methane: Introduction, production of Methanol, Formaldehyde, Ethylene glycol, PTFE, Methylamines.

UNIT-V:

Chemicals from Ethane-Ethylene-Acetylene: Oxidation of ethane, production of Ethylene, Manufacture of Vinyl Chloride monomer, vinyl Acetate manufacture, Ethanol from Ethylene, Acetylene manufacture, Acetaldehyde from Acetylene.

TEXT BOOKS:

1. Nelson. W.L. "Petroleum refining Engineering", 4 Edition, Mc Graw Hill, New York, 1969.

2. Rao, B.K.B. "Modern Petroleum Refining Processes", 4 Edition, Oxford and IBH Publishing, 2002.

REFERENCES:

1. Goldstine. R.F. "The Petroleum Chemicals Industry", Taylor and Francis, London, 1967.

2. Gruese. W.S.and Stevens, D.R. "Chemical Technology of Petroleum", McGraw Hill, 1980.

3 Chauvel. A. and Lefevrev, "Petro Chemicals", Volume 1 and 2, Gulf Publishing company 1989.

Outcomes:

- Describe the formation of crude oil, its refining techniques.
- Describe the chemical composition and physical properties of crude oil
- Understand various processes employed in petroleum refinery such that we can meet customer demand in terms of quality & quantity.
- Demonstrate the different methods available for removal of impurities from crude and products manufacture
- Understand, draw and describe the process flow diagrams of various refinery processes like distillation, cracking and reforming etc.,
- Understand the difference between thermal and catalytic cracking.

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IV Year B.Tech. Chem. Engg. II-Sem

L	T	P	C
3	0	0	3

ELECTIVE-V

Rheology of Polymers (17A80804b)

Unit I: Stress tensor, principal stress and invariants, polar decomposition theorem, finger tensor, strain tensor, inverse deformation tensors, principal strains, uniaxial extension and simple shear in neo-hookean solid, rate of deformation tensor, Newton's law in three dimensions, uniaxial extension, viscosity models for general viscous fluids and visco-plastic models.

Unit II : General linear viscoelastic model, stress relaxation and creep, non-linear viscoelasticity - normal stress difference in shear, shear thinning, interrelations between shear functions, extensional thickening, differential-type constitutive equations - single mode differential constitutive equations and multimode constitutive equations for viscoelastic fluids, integral type constitutive equations, rate-type constitutive equations for viscoelastic fluids, material functions for steady state shear flow, oscillatory shear flow, material functions for steady state extensional flow.

Unit III: Shear rheometer: sliding plates, falling ball rheometer, concentric cylinder rheometer, cone and plate rheometer, parallel disks, capillary rheometer, slit rheometer and squeezing flow behavior. Extensional rheometry: simple extension - end clamps, rotating clamps, buoyancy bath, spinning drop, lubricated compression, planner squzeeing, sheet stretching, multiaxial extension, fiber spinning, tubeless siphon, bubble collapse, stagnation flow.

Unit IV: Rheology of polymeric liquids: polymer chain conformation, zero shear viscosity, rheology of dilute polymer solutions, entanglement, Reptation Model, effect of long chain branching, effect of molecular weight distribution, temperature dependence.

Unit V: Rheology in polymer processing operations: Calendaring and two roll mill, Twin screw extruders, Blow molding, Wire coating, Thermoforming, Sheet extrusion, Internal mixers, Rubber extrusion

Reference books:

1. Rheology, Principles, Measurements and Applications, Christopher W. Macasko, WileyVCH,1994

2. Rheology and Processing of Polymeric Materials, Vol. 1, Oxford University Press, 2007

3. Rheology: Concepts, Methods, and Applications, Prof. Dr. Alexander Ya. Malkin, Prof. Dr. Avraam I Isayev, ChemTec Publishing, 2006

4. Dynamics of Polymeric Liquid, Volume I, R. Byron Bird, Robert C Armstrong, Ole Hassager, John Wiley and Sons, 1976

5. Polymer Processing Fundamentals, Tim A Osswald, Hanser Publishers, Munich, 1998.

6. Melt Rheology and its Role in Plastic Processing: Theory and applications, John M. Dealy, Kurt F. Wissbrun, Reprinted by Chapman and Hall,1999.

7. Principles of Polymer Engineering Rheology, James Lindsay White, John Wiley & Sons, 20-Jul- 1990.

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L	T	P	C
3	0	0	3

ELECTIVE-V
PROCESS INTENSIFICATION (17A80804c)

UNIT I: Introduction to Process Intensification(PI): sustainability-related issues in process industry, definitions of Process Intensification, fundamental principles and techniques of PI, the original ICI PI strategy, benefits of PI and obstacles to PI

Issues in designing of a sustainable, inherently safer processing plant

UNIT-II: PI Approaches: STRUCTURE - PI approach in spatial domain, ENERGY - PI approach in thermodynamic domain, SYNERGY - PI approach in functional domain and TIME - PI approach in temporal domain. **Mechanisms involved in PI:** Mechanisms of intensified heat transfer, mass transfer, electrically enhanced processes, micro fluidics

UNIT –III: Application of PI techniques to heat transfer: Compact & micro heat exchangers.

Application of Pi techniques to reactors: Spinning disc reactors, oscillatory baffled reactors (OBR), Rotating reactors, Micro reactors, membrane reactors, micro reactors, Reactive separation/ super critical operation and other intensified reactor types.

UNIT-IV: Intensification of Separation Processes: Distillation, Centrifuges, membranes, drying, precipitation and crystallization.**Intensified Mixing**: Inline mixers, mixing on spinning disk, induction heated mixer

UNIT –V: Application areas of PI:Petrochemicals and Fine Chemicals: Refineries, Bulk Chemicals, Fine Chemicals, Fine Chemicals and Pharmaceuticals, bio processing.Offshore Processing, Nuclear Industries, Food and drink water sector, Textiles, Aerospace, biotechnology

Text Books

1.David Reay, Colin Ramshaw, Adam Harvey, Process Intensification- Reengineering for efficiency, sustainability and flexibility, Butterworth Heinemann, (Elsevier)2008.

2, Stankiewicz, A. and Moulijn, (Eds.), Reengineering the Chemical Process Plants, Process Intensification, marcel dekker 2003

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L	T	P	C
0	0	0	0

MOOC – II (17A89906a)

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L	T	P	C
0	0	0	0

MOOC – II (17A89906b)

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L	T	P	C
0	0	0	0

MOOC – II (17A89906c)

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L	T	P	C
0	0	2	1

SEMINAR (17A80805)

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L	T	P	C
0	0	16	8

Project work (17A80806)

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L	T	P	C
0	0	0	1

COMPREHENSIVE OBJECTIVE TYPE EXAMINATION (17A80807)