JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
COLLEGE OF ENGINEERING (Autonomous), ANANTHAPURAMU

B.Tech (Chemical Engineering) 2013-14
COURSE STRUCTURE & SYLLABUS (R13 REGULATIONS)

I YEAR I Semester

S.No	Code	Subject	L	P	C
1	Theory	English	4	-	3
2	Theory	Mathematics -I	4	-	3
3	Theory	Physical Chemistry	4	-	3
4	Theory	Environmental Studies	4	-	3
5	Theory	Basic Engineering Drawing	4	-	3
6	Lab	Physical Chemistry Lab	-	3	2
7	Lab	Engineering Workshop & IT Workshop	-	3	2
8	Lab	English Language Communication Skills Lab.	-	3	2
		Total	**20**	**9**	**21**

I YEAR II Semester

S.No	Code	Subject	L	P	C
1	Theory	Technical Communication and Presentation Skills	4	-	3
2	Theory	Mathematics -II	4	-	3
3	Theory	Applied Physics	4	-	3
4	Theory	Computer Programming	4	-	3
5	Theory	Engineering Mechanics	4	-	3
6	Theory	Introduction to Chemical Engineering	4	-	3
7	Lab	Computer Programming Lab	-	3	2
8	Lab	Engineering Physics Lab	-	3	2
		Total	**24**	**6**	**22**

B.Tech (Chemical Engineering)-COURSE STRUCTURE

II YEAR I SEMESTER

S.No	Code	Subject	T	P	C
1	Theory	Mathematical Methods	4	0	3
2	Theory	Electrical and Electronics Engineering	4	0	3
3	Theory	Chemical Engineering Fluid Mechanics	4	0	3
4	Theory	Energy Engineering	4	0	3
5	Theory	Organic Chemistry	4	0	3
6	Theory	Chemical Process Calculations	4	0	3
7	Theory	Human Values & Professional Ethics(Audit)	2	0	0
8	Lab	Chemical Engineering Fluid Mechanics Lab	0	3	2
9	Lab	Organic Chemistry Lab	0	3	2
		Total	**26**	**6**	**22**

II YEAR II SEMESTER

S.No	Code	Subject	T	P	C
1	Theory	Probability and Statistics	4	0	3
2	Theory	Process Heat Transfer	4	0	3
3	Theory	MaterialsScience for Chemical Engineers	4	0	3
4	Theory	Analytical Chemistry	4	0	3
5	Theory	Chemical Engineering Thermodynamics	4	0	3
6	Theory	Mechanical Unit Operations	4	0	3
7	Theory	Process Heat Transfer Lab	0	3	2
8	Lab	MechanicalUnit Operations Lab	0	3	2
		Total	**26**	**6**	**22**

B.Tech (Chemical Engineering)-COURSE STRUCTURE

III YEAR I SEMESTER

S.No	Code	Subject	T	P	C
1	Theory	Process Instrumentation	4	0	3
2	Theory	Process Dynamics & Control	4	0	3
3	Theory	Phase and Chemical Equilibria	4	0	3
4	Theory	Chemical Reaction Engineering-I	4	0	3
5	Theory	Mass Transfer Operations-I	4	0	3
6	Theory	Petroleum Refining and Petrochemicals	4	0	3
7	Theory	Energy & Environmental Engineering Lab	0	3	3
8	Lab	Process Dynamics & Control Lab	0	3	2
		Total	**24**	**06**	**22**

III YEAR II SEMESTER

S.No	Code	Subject	T	P	C
1	Theory	Industrial Engineering and Management	4	0	3
2	Theory	Chemical Technology	4	0	3
3	Theory	Mass Transfer Operations – II	4	0	3
4	Theory	Chemical Reaction Engineering-II	4	0	3
5	Theory	Process Modeling and Simulation	4	0	3
6	Theory	Chemical Plant Design and Economics	4	0	3
7	Theory	Chemical Reaction Engineering Lab	0	3	2
8	Lab	Mass Transfer Operations Lab	0	3	2
9	Lab	Advanced Communication Skills Lab (Audit)	2	0	0
		Total	**26**	**6**	**22**

B.Tech (Chemical Engineering)-COURSE STRUCTURE

IV YEAR I SEMESTER

S.No	Code	Subject	T	P	C
1	Theory	Transport Phenomena	4	0	3
2	Theory	Chemical Process Equipment Design	4	0	3
3	Theory	Optimization of Chemical Processes	4	0	3
4	Theory	Separation Techniques for Bioprocessing	4	0	3
5	Theory	**OpenElective** Basics of Nanotechnology Industrial Safety & Hazard Management Nuclear Engineering Solid Waste Management	4	0	3
6	Theory	**Elective – I (Through MOOC)**	4	0	3
7	Lab	Process Equipment Design& Drawing Lab	0	3	2
8	Lab	Simulation Lab	0	3	2
9		Project Work – Part A	0	0	2
		Total	**24**	**06**	**22**

IV YEAR II SEMESTER

S.No	Code	Subject	L	P	C
1	Theory	Biochemical Engineering	4	0	3
2	Theory	Industrial Pollution Control Engineering	4	0	3
3	Theory	**Elective-II** Technology of Pharmaceutical & Fine Chemicals Interfacial Engineering Polymer Technology Design & Analysis of Experiments	4	0	3
4	Theory	**Elective – III** Computer Aided Process Design Food Processing Technology Entrepreneurship Development Corrosion Engineering	4	0	3
5		Seminar& Comprehensive Viva-Voce	0	0	3
6		Project Work	0	0	10
7		**Total**	**16**	**0**	**25**

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

L – Theory P – Practical/Drawing C – Credits

JNTUA College of Engineering (Autonomous), Ananthapuramu

I Year B.Tech - I Semester	**L**	**P**	**C**
	3+1*	**0**	**3**

ENGLISH
(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 rs (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, 20 1**
9. **Strengthen Your Writing, Orient Blackswan**

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I Year B.Tech-I semester	**L**	**P**	**C**
	3+1*	**0**	**3**

MATHEMATICS – I
(Common to All Branches)

OBJECTIVES:

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

UNIT – I

Exact, linear and Bernoulli equations.Applications to Newton's law of cooling, law of natural growth and decay, orthogonal trajectories.

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. Applications to oscillatory electrical circuits, Deflection of Beams, whirling of shafts.

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, e nd envelopes..

UNIT – III

Curve tracing – Cartesian, polar and parametric curves. Length of curves.

UNIT – IV

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

UNIT – V

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.

TEXT BOOKS:

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

REFERENCES:

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

Outcomes:

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

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I Year B.Tech - I Semester	**L**	**P**	**C**
	3+1*	**0**	**3**

ENVIRONMENTAL STUDIES
(Common to all Branches)

OBJECTIVE: To make the students to get awareness on environment, 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 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	**L**	**P**	**C**
	3+1*	**0**	**3**

PHYSICAL CHEMISTRY

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, reactions-Hydrogen and bromine, hydrogen and oxygen (Steady state treatment)-.

UNIT-II: Colloids

Definition of colloids, classification of colloids, solids in iquids (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

Unit-IV: Surface Chemistry

Adsorption, characteristics of adsorption, physical & l 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.

UNIT-V: Electrochemistry

i).Review of electrochemical cells, Numerical calculat ies: 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 electro ing

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.

Outcomes:

- Apply the fundamental concepts of chemistry to solve the problems in their respective fields of work
- Realize and formulate new energy initiatives to meet the present and future needs of society
- Understand the corrosion factors and implement the prevention measures
- Get well equipped with basic understanding and developments in solar energy and can assimilate the applications of it in all aspects of science and engineering

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I- Year B.Tech. I-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

ENGINEERING GRAPHICS
(CIVIL, EEE, ECE, CSE & CHEMICAL)

OBJECTIVES:

- Give Clear picture about the Importance of Engineering Graphics in the field of Engineering
- Develop drawing skills and impart the student to follow standards prescribed by Bureau of Indian standards
- Give an idea about Engineering curves, Orthographic projections and Pictorial projections
- Develop an imagination about the orientation of points, lines, surfaces and solids.

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.

Outcomes:

On Completion of the course the student will be able to

- perform free hand sketching of basic geometrical constructions and
- multiple views of objects.
- do orthographic projection of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- prepare isometric and perspective sections of simple solids.

Suggestions:

Student is expected to buy a book mentioned under 'Tex ooks' 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 pr tice Auto CAD or any other drawing software to help understanding better.

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I Year B.Tech - I Semester	**L**	**P**	**C**
	0	**3**	**2**

ENGLISH LANGUAGE COMMUNICATION SKILLS (ELCS) LAB

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 Semester

L	P	C
0	3	2

PHYSICAL CHEMISTRY LAB

OBJECTIVES:

- Introduce the fundamental principles of chemistry lab experiments to students which include volumetric analysis
- To confirm the formation and nature of the product in chemical processes, as the knowledge of some physical, chemical and instrumental methods is essential for a chemical engineer.
- To acquaint the students with the determination of molecular weight of a polymer

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. Determination of the specific rate (Second order kinetics) of the alkaline hydrolysis of ethyl acetate by Volumetric method.
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)

Outcomes

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis
- 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

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.	**L**	**P**	**C**
	0	**3**	**2**

Engineering & IT Workshop
(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 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 an Footer, changing the font, changing the colour, including images and tables in the word file, making page setup, copy a 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 appl ation 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. II-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

MATHEMATICS - II
(Common to All Branches)

OBJECTIVES:

- Get an idea of Fourier series expansion, various types of Fourier series and about Fourier Transforms of different functions.
- The knowledge of Laplace transforms to solve Differential Equations with initial conditions.
- To acquaint the student with the concepts of vector ca needed for problems in all engineering disciplines.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT – I

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.

UNIT – II

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

UNIT – III

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

UNIT – IV

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 – 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. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.

2. Engineering Mathematics, Volume - II, E. Rukmangadachari & E. Keshava Reddy, Pearson Publisher.

REFERENCES:

1. Engineering Mathematics, Volume - II, by G.S.S.Raju, CENGAGE publisher.
2. 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, W ley India.

Outcomes:

- Evaluate any type of integrals that arises in many branches of engineering and science to convert from Cartesian to polar, cylindrical and spherical and vice versa and also well verse with finding area, surface and volume depending on the geometry of the physical configuration.
- Determine or analyze the position, rate of a particle object in a space, conservative medium, circulations of the flows and also converting complicated geometries to simple geometry by transforming line to double, double to triple integrals and vice versa for physical problems.
- Find the solution of the real problems that arise in many fields like fluid mechanics, heat and mass transfer, chemical reactions, environmental fields and so on by different analytical methods.

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	3+1*	**0**	**3**

TECHNICAL COMMUNICATION & PRESENTATION SKILLS (Theory)

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 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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COMPUTER PROGRAMMING

OBJECTIVES:

- To understand the core aspects of computer problem solving techniques
- To understand the programming language constructs
- To understand the programming paradigms
- To understand the compound data types
- To understand dynamic memory allocation concepts

Unit - I

Introduction to Computers: Computer Systems, Computing Environment, Computer Languages, Creating and Running Programs, System Developments.

Introduction to the C Language: Introduction, C programs, Identifiers, Types, Variables, Constants, Input and Output, Programming Examples.

Introduction to Computer Problem Solving: Introduction , The Problem-Solving Aspect, Top-down Design, Bottom - up Approach, Flowcharts, Implementation of Algorithms, Program Verification, The Efficiency of Algorithms, The Analysis of Algorithms.

Unit – II

Structure of C program: Expressions, Precedence and Associatively, Evaluating Expressions, Type Conversion, Statements, Sample Programs.

Selections and Making Decisions: Logical Data and Operators, Two way Selection, Multiway Selection.

Repetition: Concept of Loop, Pretest and Posttest Loops, Initialization and Updation, Event and Counter Controller Loop, Loops in C, Looping Applications.

Fundamental Algorithms: Exchanging the values between two variables, Counting, Summation of a set numbers, Factorial Computation, Sine Function Computation, Generation of the Fibonacci Sequence, Reversing the digits of a integer, Basic conversions, Character to Number Conversion

Unit – III

Factoring Methods: Finding Square root of a Number, The Smallest Deviser an Integer, The GCD of two Integers, Generating Prime Numbers, Computing Prime Factor of an Integer, Computing the prime factors of an Integer, Generation Pseudo Random Number, Raising the number to Large Power, Computing the n^{th} Fibonacci.

Functions: Introduction, User Defined Functions, Inter Function Communication, Standard Functions, Scope, Programming Examples.

Array Techniques: Array Order Reversal, Array Counting, Finding the Maximum Number Set, Removal Duplicates from an Ordered Array, Partitioning an Array, Finding k^{th} smallest Element, Longest Monotone Subsequence.

Arrays: Introduction, Two Dimensional Arrays, Multi Dimensional Arrays, Inter Function Communication, Array Applications, Exchange Sort, Binary Search, Linear Search.

Unit – IV

Strings: String Concepts, C Strings, Sting Input/Output Functions, Arrays of Strings, String Manipulation Functions, String/Data Conversion.

Enumerated, Structure, and Union Types: The Type Definition, Enumerated Types, Structure, Unions, Programming Applications.

Bitwise Operators: Exact Size Integer Types, Logical Bitwise Operators, Shift Operators, Mask.

Unit – V

Pointers: Introduction, Pointers for Inter Function Communication, Pointers to Pointers, Compatibility, Lvalue and Rvalue.

Pointer Applications: Array and Pointers, Pointer Arithmetic and Arrays, Passing an Array to a Function, Memory Allocation Functions, Array of Pointers, Programming Applications.

Binary Input/output: Text Versus Binary Streams, Standard Library Functions for Files, Converting File Type.

Text Books :

1. How to Solve it by Computer by R.G. Dromey, Pearson
2. Computer Science, A Structured Programming Approach Using C by Behrouz A. Forouzan & Richard F. Gilberg, Third Edition, Cengage Learning

Reference Books :

1. Programming in C: A Practical Approach, Ajay Mittal, Pearson.
2. The C programming Language, B. W. Kernighan and Dennis M. Ritchi, Pearson Education.
3. Problem Solving and Programming Designs in C, J. R. Hanly and E.B. Koffman.,
4. Programming with C Rema Theraja, Oxford
5. Problem Solving with C, M.T.Somashekara, PHI
6. C Programming with problem solving, J.A. Jones & K. Harrow,Dreamtech Press
7. Programming with C, R.S.Bickar, Universities Press.

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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	3+1*	**0**	**3**

APPLIED PHYSICS

OBJECTIVES:

- To enrich the understanding of various types of materials and their applications in engineering and technology.
- Gaining the factual knowledge and analytical skills necessary in understanding of physical phenomena.
- To provide the working knowledge in the areas of Lasers and Laser based Communication principles.
- To introduce the latest developments and understanding of the solid-state physics especially the Nanotechnology and Engineering materials like Dielectric and Magnetic materials

UNIT 1:PHYSICAL OPTICS, LASERS AND FIBRE OPTICS

Physical Optics: Introduction - Interference in thin films by reflection – Newton's Rings – Fraunhofer diffraction due to single slit, double slit and 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.

Fibre optics: Introduction– Construction and working principle of optical fiber –Numerical aperture and acceptance angle – Types of optical fibers –Optical fiber communication system – Applications of optical fibers.

UNIT 2:CRYSTALLOGRAPHY AND QUANTUM MECHANICS

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

Quantum Mechanics: Introduction to matter waves – de'Broglie hypothesis - Schrodinger's time independent wave equation – Significance of wave function - Particle in a one dimensional infinite potential well.

UNIT 3: FREE ELECTRON THEORY AND SEMICONDUCTORS

Free electron theory: Classical free electron theory –- Sources of electrical resistance - Equation for electrical conductivity - Quantum free electron theory – Fermi-Dirac distribution –Kronig-Penny model(qualitative) – Origin of bands in solids – Classification of solids into conductors, semiconductors and insulators.

Semiconductor physics: Introduction – Intrinsic and extrinsic semiconductors – Drift & diffusion currents and Einstein's equation – Continuity equation -Hall Effect.

UNIT 4: **DIELECTRICS AND MAGNETIC MATERIALS**

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

Magnetic materials: Introduction and 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 5: **SUPERCONDUCTIVITY AND PHYSICS OF NANOMATERIALS**

Superconductivity: Introduction - Properties of superconductors – Meissner effect– Type I and type II superconductors – Flux quantization – London penetration depth – ac and dc Josephson effects – BCS theory(qualitative) - Applications of superconductors.

Physics of Nanomaterials: Introduction - Significance of nanoscale - Surface area and quantum confinement – Physical properties, optical, thermal, mechanical and properties – Synthesis of nanomaterials: ball milling, chemical vapour deposition, sol-gel – Carbon nanotubes & its properties.

Prescribed Text books:

1. Engineering physics – S. ManiNaidu, Pearson Education
2. Engineering Physics – P.K.Palanisamy, Scitech Publications

Reference Books:

1. Engineering Physics – V. Rajendran, K.Thyagarajan Tata MacGraw Hill Publishers
2. Engineering Physics – D K Pandey, S. Chaturvedi, Cengage Learning
3. Engineering Physics - Sanjay D. Jain, D. Sahasrambudhe and Girish University Press
4. Engineering Physics – M. Arumugam, Anuradha Publications
5. Engineering physics – M.N. Avadhanulu and P.G. KrshiSagar, Chand and Co
6. Nanomaterials – A.K.Bandopadhyaya, New Age Publishers
7. Carbon nanotubes and Graphene Device Physics – H.S. Philip Wong, Deji Akinwande, Cambridge University Press

Outcomes:

- The students will have the knowledge on physics of materials and that knowledge will be used by them in different engineering and technology applications

- Understand concepts of electric and magnetic fields helps the students to understand Electromagnetic wave propagation which is required for Electro Magnetic Theory, Electrical circuits
- Application of quantum mechanics basic concepts in the various fields

- Use of lasers and OPTICAL FIBERS in modern communication

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	3	**0**	**3**

ENGINEERING MECHANICS

OBJECTIVES:

• Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.
• In-depth understanding of specialist bodies of knowledge within the engineering discipline.
• Application of established engineering methods to complex engineering problem solving.
• Application of systematic engineering synthesis and design processes.

UNIT – I

INTRODUCTION OF ENGINEERING MECHANICS – Basic concepts - System of Forces – Moment of Forces and its Application – Couples and Resultant of Force System – Equilibrium of System of Forces - Degrees of Freedom – Free body diagrams –Types of Supports – Support reactions 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.

UNIT – III

CENTROID AND CENTER OF GRAVITY: Centroids of simple figures – Centroids of Composite figures – Centre of Gravity of bodies – Area moment of Inertia - Parallel axis and perpendicular axis theorems - Moments 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 – IV

KINEMATICS: Rectilinear and Curvilinear motion – Velocity and Acceleration – Motion of A Rigid Body – Types and their Analysis in Planar Motion.

KINETICS : Analysis as a particle and Analysis as a Rigid Body in Translation – Central Forces of motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies – Work Energy Method – Equation for Translation – Work Energy application to Particle Motion, Connection System – Fixed axis Rotation and Plane Motion.

UNIT – V

ANALYSIS OF PERFECT FRAMES: Types of frames – cantilever frames and simply supported frames – Analysis of frames using method of joints, method of sections and tension coefficient method for vertical loads, horizontal loads and inclined loads.

MECHANICAL VIBRATIONS: Definitions, Concepts-Simple Harmonic motion-Free vibrations-Simple Compound and Torsional pendulum- Numerical problems

TEXT BOOKS:

(1) Engineering Mechanics by Shames & Rao – Pearson Education.
(2) Engineering Mechanics by Dr.R.k.Bansal, Lakshmi Publications.
(3) Engineering Mechanics – B. Bhattacharyya, Oxford University Publications.

REFERENCES:

(1) Engineering Mechanics by Fedrinand L.Singer – Harper Collings Publishers.
(2) Engineering Mechanics by Seshigiri Rao, Universities Press, Hyderabad.
(3) Engineering Mechanics by Rajsekharan, Vikas Publications.
(4) Engineering Mechanics (Statics and Dynamics) by Hibller and Gupta; Pearson Education
(5) Engineering Mechanics by S.Timoshenko, D.H.Young and J.V.Rao, Tata McGraw-Hill Company
(6) Engineering Mechanics by Chandramouli, PHI publications.
(7) Engineering Mechanics –Arthur P. Boresi and Richard J. Schmidt. – Brooks/Cole – Cengage Learning

Outcomes:

1. Use scalar and vector analytical techniques for analysing forces in statically determinate structures.
2. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
3. Apply basic knowledge of maths and physics to solve real-world problems

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	3+1*	**0**	**3**

INTRODUCTION TO CHEMICAL ENGINEERING

OBJECTIVES:

- Differentiate and explain the significance of each unit operation and unit process.
- Identify, relate and assess the importance of dimensionless groups.
- Describe the material balance, energy balance. Explain Humidity and saturation.
- Distinguish the types of fluids, fluid flow, the basic concepts related to heat transfer and mass transfer.
- Write about the importance and operation of chemical engineering equipment.

Unit-I

Introduction, Unit operations, basic laws, units and dimensions.

Energy, equivalent mass, solutions, humidity and saturation.Material balance, Energy balance.

Unit-II

Flow of fluids: Introduction, nature of fluid, viscosity, velocity profile, flow field, types of fluid motion, laminar and turbulent flow, flow of a fluid past a solid surface, iprocating, rotary, and centrifugal pumps

Unit-III

Heat transfer: Conduction, convection (omit correlations for calculation of heat transfer coefficients, heat transfer with change in phase) and radiation. Flow arrangement in heat exchangers, variation of fluid temperatures 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

Unit-IV

Mass transfer: Diffusion, mass transfer operation, absorption, Vapour-Liquid Equilibrium, Relative Volatility, Boiling point diagram. Distillation, reflux, Equipment for gas-liquid operations, selection of equipment for gas-liquid operations,

Unit-V:

Liquid-liquid extraction, extraction schemes, distribution coefficient, triangular diagram, selection of disperse phase, classification of industrial liquid-liquid contactors, industrial liquid-liquid contactors. Selection of liquid-liquid extraction contactors.Introduction of humidification and dehumidification - equipments, introduction of drying, equipment for drying.Introduction to crystallization, classification of crystallization equipment, crystallization equipment, adsorption, adsorption equipment.

Types of reactions and reactors.

TEXT BOOK:

1. 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, Mc Graw Hill 5th ed. 1993.

Outcomes:

- Students acquire knowledge of the unit operations and processes their significance and applications
- Acquaintance of material and energy balance which will help them in knowing the importance, operation of chemical engineering equipment and designing of equipment
- Fundamentals of fluid flow and basic concepts of heat and mass transfer

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	0	**3**	**2**

APPLIED PHYSICS LABORATORY

OBJECTIVES:

- Develop Laboratory skills for the measurement of Physical parameters
- Train the students for systematic recording of experimental findings of various parameters.
- Students learn data analysis and comprehend basic phenomenon involving in the experiment
- Understand and realization of physics concepts by doing experiments
- Establish practical knowledge and gain confidence to do experiments individually

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 the prism
3. Determination of thickness of thin object by wedge met d.
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. Determination of thermistor coefficients (a, ß)
14. Hall effect : Determination of mobility of charge carr rs in semiconductor
15. B-H curve
16. Magnetic field along the axis of a current carrying co – Stewart and Gee's method.
17. Determination of lattice constant using X-ray spectrum.

Outcomes:

- The students will demonstrate the laboratory skills in handling of optical instruments
- The students are able to understand and experience physical principles of Sound, Optics
- The students are able to apply the principles of physics and measure the properties of materials
- The students able to characterize dielectric and semiconducting material devices
- Students able to analyze and study the emission spectral properties of light

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	0	**3**	**2**

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

OBJECTIVES:

- Learn program development steps like coding, compilation, execution and debugging
- Develop programs using Branching & Looping statements
- Develop applications using structures and unions
- Understand the use of recursion
- Experiment different file operations

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 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 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 withc, Byron S Gottfried, Jitender Kumar Chhabra, TMH, 2011

Outcomes:

- Plan a solution for a problem by writing a program
- Develop searching and sorting algorithms using loop statements
- Develop stacks, queues and trees programs using structures and pointers concepts

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	3+1*	**0**	**3**

MATHEMATICAL METHODS

OBJECTIVES:

- This course aims at providing the student with the concepts of Matrices, Numerical Techniques and Curve fitting.
- Derive appropriate numerical methods to solve non-linear algebraic and transcendental equations and linear system of equations
- Develop appropriate numerical methods to approximate a function and calculate a definite integral and to evaluate a derivative at a value
- Develop appropriate numerical methods to solve an ordinary differential equation and understand the various techniques to solve Partial differential equations
- Perform an error analysis for various numerical methods

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. 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.

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 and 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 – Predictor-Corrector Method – Milne's Method. 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:

3. Engineering Mathematics, Volume - II, E. Rukmangadachari & E. Keshava Reddy, Pearson Publisher.

4. Engineering Mathematics, Volume - II, by G.S.S.Raju, CENGAGE publisher.
5. Mathematical Methods by T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad, S. Chand publication.
4. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.
5. Advanced Engineering Mathematics, by Erwin Kreyszig, W ley India.

Outcomes:

- The student will be able to analyze engineering problems using the concepts of Matrices and Numerical methods
- Solve a linear system of equations and non-linear algebraic or transcendental equation using numerical method
- Approximate a function, calculate a definite integral and evaluate a derivative at a value using appropriate numerical methods
- Solve an Ordinary differential equation and partial differential equations using numerical methods

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ORGANIC CHEMISTRY

Objectives:

- The Mechanism of organic chemical reaction is essentia 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 uction 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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ELECTRICAL AND ELECTRONICS ENGINEERING

(Common to Mech. Engg. & Chem. Engg.)

PART – A

ELECTRICAL ENGINEERING

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 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, To ue (Simple Problems).

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

PART-B
ELECTRONICS ENGINEERING

UNIT I

Semiconductor Devices: Intrinsic semiconductors-Electron-Hole Pair Generation, Conduction in Intrinsic Semiconductors, Extrinsic Semiconductors-N-Type and P-Type Semiconductors, Comparison of N-Type and P-Type Semiconductors. The p-n Junction - Drift and Diffusion Currents, The p-n Junction Diode-Forward Bias, Reverse Bias, Volt-Ampere Characteristics-Diode Specifications, Applications of Diode, Diode as Switch. Diode as a Rectifier-Half-wave Rectifier, Full-Wave Rectifier, Full-Wave Bridge Rectifier, Rectifiers with Filters, Zener iode-Volt-Ampere Characteristics, Zener Diode as Voltage Regulator. Silicon Controlled Rectifier-Two Transistor Analogy of an SCR, Characteristics, Applications of SCR, DIAC, TRIAC.

UNIT II

BJT and FETs: Bipolar Junction Transistor (BJT) – Types of Transistors, Operation of NPN and PNP Transistors, Input-Output Characteristics of BJT-CB, CE and CC Configurations, Relation between I_C, I_B and I_E.Transistor Biasing- Fixed Bias, Voltage Divider Bias, Transistor Applications- Transistor as an Amplifier, Transistor as a Switch,. Junction Field Effect Transistor (JFET)- Theory and Operation of JFET, Output Characteristics, Characteristics, Configurations of JFET-CD, CS and CG Configurations, JFET Applications-JFET as an Amplifier, JFET as a Switch, Comparison of and JFET,MOSFET-The Enhancement and Depletion MOSFET, Static Characteristics of MOSFET, 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, Combinational Circuits-Adders and Subtractors.

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

Outcome:

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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	3+1*	**0**	**3**

CHEMICAL ENGINEERING FLUID MECHANICS

OBJECTIVES:

- Understand concepts on nature of fluids, pressure concepts and measurement of pressure by various experimental methods and by mathematical relations and enhancement of problem solving skills.
- Learn detailed explanation on types of fluids, stress d velocity relations, type of fluid flow and boundary layer relations.
- Understand relationship between kinetic energy, potential energy, internal energy and work complex flow systems using Bernoulli's equation with application to industrial problems.
- Understand clear concepts on Flow of incompressible fluids in conduits and thin layers and friction factor variations with velocity and friction losses using Bernoulli Equations and they will be demonstrated experimentally.
- Study Flow of compressible fluids, Dimensional analysis, Dimensional homogeneity and various dimensionless numbers and their applications.
- Understand principles and working of various types of ps, transportation and metering of fluids using various experimental techniques and applications to industry.

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

UNIT- II

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, Dimensional analysis including Buckingham p Theorem and Rayleigh's method.

UNIT- III

Flow of compressible fluids- Definitions and basic equations, Processes of compressible flow, Isentropic flow through nozzles, adiabatic frictional low, 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 fluidizat 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 meters- 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,* 2^{nd} ed., John Wiley, 1999
4. Chemical Engineering, Vol-I, Coulson and Richardson, Pergamon Press.

Outcomes:

- Analyze different types of fluids and they will be able to measure pressure difference for flow of fluids.
- Understand and analyze the relationship between kinetic and potential energy, internal energy, work, and heat in complex flow systems using Bernoulli's equation, macroscopic energy balances.
- Analyze and calculate friction factor for different types of flow in various types of constructions.
- Develop mathematical relations using Dimensional analysis by Rayleighs and Buckinghm –p method
- Identify the concepts and formulae of transportation of fluids.
- Identify the concepts and formulae of metering of fluids.
- Classify various pipes, valves and fittings based on usage.
- Classify and suggest the type and capacity of the pump for a specific purpose

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	3+1*	**0**	**3**

ENERGY ENGINEERING

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, classificat 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, ification, 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 a 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, theoretica 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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	3+1*	**0**	**3**

CHEMICAL PROCESS CALCULATIONS

OBJECTIVES:

- Learn basic laws about the behavior of gases, liquids nd solids and some basic mathematical tools.
- Learn what material balances are, how to formulate and apply them, how to solve them.
- Understand the heat properties such as heat capacity, iven compound/mixtures
- To learn the concepts of heat of reaction, exothermic and endothermic reactions, heat of formation, combustion; standard heat of formation, combustion and reaction
- Study the different types of fuels useful and their air requirements for combustion

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.

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 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, calculation of theoretical and actual flame temperatures.

UNIT- V

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)

Outcomes:

- Express the composition of mixtures and solutions in different modes that are required for design calculations ex: weight percent, volume percent and mole fraction
- Calculate partial pressure of the mixture using Raoult's law and find the different variables from the humidity chart for a given conditions(variables)
- Perform the calculations for single units involving drying, evaporation, dissolution and crystallization
- Determine the percentage conversion, yield in a given l process involving reaction
- Estimate the enthalpy change of a non reactive system with and without phase change in a isobaric systems
- Deduce the outlet temperature of reaction products under adiabatic systems
- Calculate the product gas composition for complete and incomplete combustion reactions

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	2	**0**	**0**

HUMAN VALUES AND PROFESSIONAL ETHICS

OBJECTIVES:

• To create awareness on Engineering Ethics and Human Values.

•To instill Moral and Social Values and Loyalty.

• To appreciate the rights of others.

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 and V.S.SenthilKumar-PHI Learning Pvt. Ltd
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, ikota Suyodhana-Maruthi Publications.
5. “Professional Ethics and Human Values” by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran- Laxmi Publications.
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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	0	**3**	**2**

CHEMICAL ENGINEERING FLUID MECHANICS LAB

OBJECTIVES:

- Know the different types of flow using Reynolds apparatus.
- Verify the Bernoulli's equation by using Bernoulli's apparatus.
- Calibrate the Rotameter.
- Find out the variation of orifice coefficients with Reynolds Number.
- Determine the venturi coefficient by using venturimeter.
- Find out the frictional losses in flow through pipes.
- Study the coefficient of contraction in an open orifice.
- Study the coefficient of discharge in V- Notches.
- Study the characteristic of a centrifugal pump.
- Find out the pressure drop in packed bed for different velocities.

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

OUTCOME:

- Student will be able to understand the concept of fluid flow phenomena and types of flow by calculating Reynolds number
- Calibrate the flow meters with actual discharge
- Characterize of a centrifugal pump and its efficiency.
- Calculate the pressure drop in packed bed for different velocities.

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	0	**3**	**2**

ORGANIC CHEMISTRY LAB

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.

Outcome:

CO1: Students will get the knowledge of methods to confirm the formation and the nature of the product.

CO2: Students will get the knowledge of some physical, chemical and instrumental methods that are essential for a chemical engineer.

TEXT BOOKS:

1. Vogels Text Book of Qualitative Organic Analysis.

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	3+1*	**0**	**3**

PROBABILITY AND STATISTICS

OBJECTIVES:

- To help the students in getting a thorough understanding of the fundamentals of probability and usage of statistical techniques like testing of hypothesis, ANOVA, Statistical Quality Control and Queuing theory
- Solve problems related to conditional and joint probability, problems based on density functions and cumulative density functions, mean, vari and standard deviations of random signals, joint and conditional distribution functions

UNIT – I

Conditional probability – Baye's theorem. Random variables – 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; 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 – III

Analysis of variance one way classification and two way classification (Latic square Design and RBD)

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 X-bar Chart, R-Chart, P-Chart and C-Chart.

UNIT – V

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

TEXT BOOKS:

1. Probability & Statistics for engineers by Dr. J. Ravichandran WILEY-INDIA publishers.

2. Probability & Statistics by T.K.V. Iyengar, B.Krishna hi, S.Ranganatham and M.V.S.S.N.Prasad, S.Chand publications.

REFERENCES:

1. Probability & Statistics by E. Rukmangadachari & E. Keshava Reddy, Pearson Publisher.
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, ANOVA, Statistical Quality Control and Queuing theory and draw appropriate inferences.
- Fundamental knowledge of the concepts of probability. Have knowledge of standard distributions which can describe real life phenomenon. Have notion of sampling distributions and statistical techniques used in management problems.

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	3+1*	**0**	**3**

ANALYTICAL CHEMISTRY

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, Acuracy, 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 editions.

UNIT-II: Chromatographic Methods:

Column chromatography-general principles, terminology: retention time, rotat 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 & ications (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 spectrophotometry-Beer's law Block diagram of UV-Visible Spectrophotometer – quantitative analysis direct method for the determination metal ions: Chromium, Manganese, Iron, etc in alloys. Simultaneous Spectrophotometric determination of chromium, manganese. Infrared spectrometry-Functional group analysis of organic compounds using infrared spectra. Quantitative analysis of organic molecules.Flame photometry-principles & applications.(Determination of Sodium, Potassium and Calcium.)

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.

Outcomes:

CO1: Shall gain To acquire basic principles of simple instrumental methods for estimation of organic/inorganic species.
CO2: Shall gain the basic knowledge of industrial separations.
CO3: Shall gain knowledge in Characterization of the Materials synthesized by chemical industry.

JNTUA College of Engineering (Autonomous), Ananthapuramu

II- Year B.Tech. II-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

PROCESS HEAT TRANSFER

OBJECTIVES:

- Study various modes of Heat transfer and their fundamental relations.
- Study conduction heat transfer and develop mathematical relations for various solid geometries.
- Understand different types of heat transfer coefficients and their estimations in various types of flows in different geometries.
- Understand the working of Heat exchangers and to learn design of double pipe, shell and tube heat exchangers and design of evaporators and conduct experiments and to submit the report.
- Understand the phenomenon of radiation, radiation shields and estimation of emissivity.

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 flow, heat transfer by forced convection in turbulent flow, the transfer of heat by ulent eddies and analogy between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes.

UNIT -IV

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

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

Outcomes:

- Student will be able to use the heat transfer principles in selection and design of heat exchanger, evaporator, etc. for a chemical industry.
- Utilize heat transfer coefficient correlations to determine overall heat transfers coefficients through individual heat transfer coefficients.
- Use the appropriate correlations to calculate convection heat transfer coefficient and rate of heat transfer in laminar and turbulent flow conditions.
- Design different types of heat exchanger like shell-and-tube heat exchangers, double pipe heat exchangers, evaporators etc.
- Apply energy and material balances determine performance (capacity, Economy) of evaporator.
- Design of single effect Evaporators
- Analyze radiation heat transfer between different surfaces.

JNTUA College of Engineering (Autonomous), Ananthapuramu

II- Year B.Tech. II-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

MATERIALS SCIENCE FOR CHEMICAL ENGINEERS

OBJECTIVES:

- Understand concepts on properties and selection of metals, ceramics, and polymers for design and manufacturing.
- Study variety of engineering applications through knowledge of atomic structure, electronic structure, chemical bonding, crystal structure, x-rays and x-ray diffraction, defect structure.
- Study Microstructure and structure-property relationships, Phase diagrams, heat treatment of steels.
- Study detailed information on types of corrosion and its prevention.
- Learn information on selection of materials for design and manufacturing.

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, 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 al 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 ls; 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: 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, Manas da, McMillan Company of India Ltd.

Outcomes:

- Identify various crystal systems.
- Calculate parameters for simple crystal structures predict the behavior of crystal systems due to imperfections.
- Predict the properties of simple alloys and steels based on their phase diagrams, phase transitions and heat treatment.
- Describe the mechanical behavior, failure and strengthening mechanisms of various metals, alloys and plastics.
- Identify various types of corrosion, illustrate methods to mitigate corrosion and select suitable material for various chemical processes
- Proper selection of materials for designing various equipment in a chemical industry.

JNTUA College of Engineering (Autonomous), Ananthapuramu

II- Year B.Tech. II-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

CHEMICAL ENGINEERING THERMODYNAMICS

OBJECTIVES:

- Students will learn PVT behaviour of fluids, laws of thermodynamics, thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.
- To provide the students with the terminology of thermodynamics like system, properties, processes, reversibility, equilibrium, phases, compone the relationship between heat and work by understanding the significance of the thermodynamic laws.
- Understand the clear concepts on P-V-T behavior, Equations of state, thermodynamic diagrams and compressibility charts, entropy, irreversibility and problem solving skills.
- Be able to understand the concept of refrigeration
- Able to explain the various liquefaction processes and their working principle

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 corre ions for gases, generalized correlations for liquids, molecular theory of fluids.

Heat effects: Sensible heat effects, Internal energy of ideal gases: Microscopic view, Latent heats of pure substances, heat effects of industrial reactions, heat effects of mixing processes.

Standard heat of reaction, Standard heat of formation, Standard heat of combustion, temperature dependence of heat of reaction

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, 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, 6^{th} ed, McGraw Hill,2003.

REFERENCE

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

Outcome:

- Understand the terminology associated with engineering thermodynamics. Understand the concepts of heat, work and energy conversion, and can Calculate heat and work quantities for industrial processes
- Analyze and find properties such as Pressure, Volume and temperature for equations of states and form the fundamentals of first law of thermodynamics.
- Find the feasibility and extent of conversion for any reaction.

JNTUA College of Engineering (Autonomous), Ananthapuramu

II- Year B.Tech. II-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

MECHANICAL UNIT OPERATIONS

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

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

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.

Cross flow filtration, types of membranes, permeate flux for ultra-filtration, Concentration polarization, particle rejection of solutes, micro filtration.

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; ***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.

UNIT- V

Crystallization: crystal geometry, principles of crystallization equilibria and yields, nucleation, crystal growth, ? L law, crystallization equipment including MSMPR crystallizers.

TEXT BOOK:

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

REFERENCES:

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

OUTCOME:

- Student will gain knowledge on various mechanical separation operations used in chemical industry.
- Classify and identify the storage, mixing and transportation equipment.
- Calculate the average size of solid particles of a given solid sample. Describe size reduction equipment and distinguish between different size reduction equipment.
- Choose the type of filtration process for a solid liquid separation.
- Explain the flow patterns in an agitator.
- Describe the stages involved for converting saturated to crystals and explain crystallization equipment.

JNTUA College of Engineering (Autonomous), Ananthapuramu

II- Year B.Tech. II-Sem	**L**	**P**	**C**
	0	**3**	**2**

PROCESS HEAT TRANSFER LAB

OBJECTIVES:

- This lab will provide practical knowledge on various heat transfer process and equipment like heat exchangers and evaporators.
- Learn basic Heat transfer principles.
- Impart the knowledge in heat transfer measurements and different heat transfer equipment
- Learn how the convection takes place in natural and forced convection and gain knowledge of the heat transfer taking place in different heat exchangers.

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 va ious temperatures.
    Major equipment - Emissivity determination apparatus

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.

- Demonstrate basic Heat transfer principles
- Apply thermal conductivity concept in industrial pipelines to control the heat losses.
- Design heat exchangers.
- Understand the concept of boiling & condensation processes.
- Identify appropriate heat exchanger for a set of process conditions.

JNTUA College of Engineering (Autonomous), Ananthapuramu

II- Year B.Tech. II-Sem	**L**	**P**	**C**
	0	**3**	**2**

MECHANICAL UNIT OPERATIONS LAB

OBJECTIVES:

- To enable the students to develop a sound working knowledge on different types of crushing equipments and separation characteristics of different mechanical operation separators.

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

Outcomes:

- Students would gain the practical knowledge and hands on various separation
- techniques like filtration, sedimentation, screening and centrifugation

JNTUA College of Engineering (Autonomous), Ananthapuramu

III Year B.Tech. Chem. Engg. I-Sem **L P C**

3+1* 0 3

PROCESS INSTRUMENTATION

OBJECTIVES: 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.

UNIT I

Elements of instruments, static and dynamic characteristics, basic concepts of response of first order type instruments, mercury in glass thermometer, ic 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 absorp 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, 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 Patra Nabis, TMH.
2. Instruments for measurements and control by Holbrock W.C. Van Nostrand
East West.
3. Hand book Instrumentation, Considine, McGraw Hill,

Outcomes:

- Identify the various elements and characteristics of an instrument required for measuring process variables.
- Recall the working principles of different instruments required for measuring temperature, pressure, composition, level, flow rate, density and viscosity.
- Describe the construction and working limitation of an instrument for measuring a process variable.
- Compare and choose the appropriate instrument for measuring a given process variable based on its working principle and measuring range.
- Apply the necessary method of monitoring the variable controlling and efficient running of the process.

JNTUA College of Engineering (Autonomous), Ananthapuramu

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

L	T	P	C
4	0	0	3

PROCESS DYNAMICS AND CONTROL

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 p blem, development of block diagram.

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

UNIT III

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

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

UNIT IV

Introduction to frequency response, Bode diagrams,

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

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

UNIT V

Advanced control strategies: Cascade control, feed forward control, ratio control, predictor, internal model control.

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.

JNTUA College of Engineering (Autonomous), Ananthapuramu

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

L	P	C
3+1*	0	3

PHASE AND CHEMICAL EQUILIBRIA

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 an 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 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 Ideal Gases: Microscopic view, Thermodynamic Properties and Statistical Mechanics ,Hydrogen Bonding and Charge-Transfer Complexing ,Behaviour of Excess Properties ,Molecular is for Mixture Behaviour,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.

JNTUA College of Engineering (Autonomous), Ananthapuramu

III Year B.Tech. Chem. Engg. I-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

CHEMICAL REACTION ENGINEERING – I

OBJECTIVES:

- The emphasis of this course is on the fundamentals of 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 parallel, reversible reactions and the knowledge about product distribution in multip 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 imolecular 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 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

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L	P	C
3+1*	0	3

MASS TRANSFER OPERATIONS-I

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 Continuo 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 b 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

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	3+1*	**0**	**3**

PETROLEUM REFINING AND PETROCHEMICALS

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, 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, prod 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 Ed ion, Mc Graw Hill, New York, 1969.

2. Rao, B.K.B. “Modern Petroleum Refining Processes”, 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 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 remova 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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	0	**3**	**2**

PROCESS DYNAMICS AND CONTROL LAB

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-Glass thermometer 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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	0	**3**	**2**

ENERGY AND ENVIRONMENTAL ENGINEERING LAB

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.
6. 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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	3+1*	**0**	**3**

INDUSTRIAL ENGINEERING AND MANAGEMENT

OBJECTIVES: The objective of the course, is to equip the Engineering students about the fundamental knowledge of general management, management of materials, human resource management, marketing management, inspection and quality control and will be exposed to the latest and contemporary issues of industrial 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-Weber's Ideal Bureaucracy –Eltan Mayo's Human relations – Systems theory- Situational or Contingency theory- Social responsibilities of management. **Organizational structure and design**: Features of organizational structure- Work specialization-Departmentation-Span of control-Centralization and Decentralization **Organisational design**s-Line Organization-Line & Staff Organization-Functional Organization- Matrix Organization-Project Organization-Committee form of Organisation

UNIT II

Plant Location and Material Management:

Definition- Factors affecting the plant location- comparison of rural and urban sites-methods for selection of plant-Types of Plant Layout-Methods of production (Job, batch and Mass Production)- Work Study. **Materials Management:** Inventory-functions-Inventory classification techniques-EOQ, ABC and VED analysis- Inventory Control System- Purchase-Procedure - Stores Management. **Marketing Mangement:** Definition- Functions of Marketing-Marketing Mix-Marketing strategies based on Product Life Cycle- Channels of distribution.

UNIT III

Human Resources Management (HRM):

HRM- Definition and meaning – Nature-Managerial and Operative functions-Evolution of HRM-Human Resource Planning(HRP)-Employee Recruitment-Sources of Recruitment - Employee Selection- Process and tests in employee selection- Employee training and development-On- the- job and Off –the- job training methods-Performance Appraisal systems-Concept-methods of Performance Appraisal-Placement-Employee Induction-Wage and Salary Administration-Objectives-Essentials of Wage and Salary Administration-Job Analysis-Process - Job Evaluation-Employee Grievances-Techniques of handling Grievances.

UNIT IV

Inspection and Quality Control: Types of inspections - Difference between Inspection & Quality Control- Statistical Quality Control techniques-Variables and Attributes- Variable control charts - R charts -Attributes control charts-P charts - C charts. Acceptance sampling plan-Single sampling - Double sampling plans-OC curves-Introduction to TQM-Quality Circles-ISO 9000 series procedures.

UNIT V

Contemporary Issues in Management:

The concept of MIS- Materials Requirement Planning (MRP)- Just-In-Time (JIT) System- Total Quality Management (TQM)- Six Sigma Concept- Supply Chain Management- Enterprise Resource Planning (ERP)- Performance Management- Business Process Outsourcing (BPO)- Business Process Re-engineering and Bench Marking- Balanced Score Card-Knowledge Management.

The students are required to submit any one of the following - two assignments/ a mini project/submission of any two case studies in the subject.

Outcome: After completion of this course, the prospective engineering technocrats will be able to understand various fundamentals of functional areas such general management, plant and materials management, marketing management,human resource management, statistical quality control techniques, strategic management and also aware of the latest and contemporary issues of industrial management.

Text Books:

1. GuptaA.K.EngineeringManagement,SChand&CompanyLimitedNewDelhi-2014(Reprint)
2. Khanna O.P and Dhanpat Rai Industrial Engineering &Management.

Reference Books:

1. A.R Aryasri: Management Science, TMH, 2013.
2. Stoner. Freeman. Gilbert. Managemem. 6th Ed, Pearson Education. New Delhi, .
3. Fanner Selvam, Production and Operations Management, PHI.
4. Dr. C. Nadha Muni Reddy and Dr. K. Vijaya Kumar Reddy, Reliability Engineering & Quality Engineering. Galgotia Publications, Pvt Limited.
5. Ralph M Barnes. Motion and Time Studies. John Wiley and Sons. 2004.
6. Chase. Jacobs. Aquilano. Operations Management. TM Ii 10th Edition. 2013.

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	3+1*	**0**	**3**

CHEMICAL TECHNOLOGY

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 Chemical Process Industries.
- Impart clear description of one latest process along w 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 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 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.Dav & 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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	3+1*	**0**	**3**

MASS TRANSFER OPERATIONS-II

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 s 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, 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, 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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	3+1*	**0**	**3**

CHEMICAL REACTION ENGINEERING – II

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 con n. The convection model for laminar flow- the convective model and its RTD, chemical conversion 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 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 various models
- Students can design the fluid-solid reactors

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	3+1*	**0**	**3**

PROCESS MODELING AND SIMULATION

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 damental 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 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 od. 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 chemica ineering models developed.
- Understand the solution techniques for solving ODEs.

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	3+1*	**0**	**3**

CHEMICAL PLANT DESIGN AND ECONOMICS

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, 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, 4th 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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	0	**3**	**2**

CHEMICAL REACTION ENGINEERING LAB

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 ion 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 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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MASS TRANSFER OPERATIONS LAB

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.

JNTUA College of Engineering (Autonomous), Ananthapuramu

III Year B.Tech. Chem. Engg. II-Sem	**L**	**P**	**C**
	0	**3**	**0**

ADVANCED ENGLISH LANGUAGE COMMUNICATION SKILLS LAB
(AUDIT Lab)

Objectives:

This lab focuses on using computer-aided multimedia instruction for language development o 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 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.

JNTUA College of Engineering (Autonomous), Ananthapuramu

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

L	P	C
3+1*	0	3

TRANSPORT PHENOMENA

OBJECTIVES:

- Different types of fluids, their flow characteristics 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 a circular tube, flow through annulus, flow of two adjacent immiscible fluids, creep low 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, 3rd ed. 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)

Outcomes:

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.

JNTUA College of Engineering (Autonomous), Ananthapuramu

IV Year B.Tech. Chem. Engg. I-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

CHEMICAL PROCESS EQUIPMENT DESIGN

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, fat gue, 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, com fans and blowers, vacuum system equipment, turbines and expanders
4. Design of material handling equipment like piping system, pumps, compressors, turbines and expanders.

JNTUA College of Engineering (Autonomous), Ananthapuramu

IV Year B.Tech. Chem. Engg. I-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

OPTIMIZATION OF CHEMICAL PROCESSES

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 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, Powell's method.

Constrained multi variable optimization- direct substitution, penalty function approach, slack variables, method of Lagrangian multipliers, Kuhn- Tucker conditions.

UNIT IV

Optimization of Unit operations: Optimal pipe diameter, minimum work of compression, Economic operation of a fixed bed filter, optimizing recovery of waste heat, optimization of multiple effect evaporator, optimization of flow rates in Liquid- Liquid extraction column, Determination of optimal reflux ratio for staged disti lation column.

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, linear programming applications including optimization of a thermal cracker.

TEXT BOOKS:

1. Optimization of Chemical Processes, T.F. Edgar and 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

JNTUA College of Engineering (Autonomous), Ananthapuramu

IV Year B.Tech. Chem. Engg. I-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

SEPARATION TECHNIQUES FOR BIOPROCESSING

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 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

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 and paper electrophoresis, zone spreading in zonal electrophoresis, affinity electrophoresis, free solution and capillary electrophoresis. (Textbook 1)

UNIT-IV

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

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 H ll, 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, counter current 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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IV Year B.Tech. Chem. Engg. I-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

BASICS OF NANOTECHNOLOGY (OPEN ELECTIVE)

OBJECTIVES:

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

Unit I

Introduction: History and Scope, Can Small Things Make a Big Difference? Classification of Nanostructured Materials, Fascinating Nanostructures, ions 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 ndaries, triple and disclinations. **Effect of Nano-dimensions on Materials Behavior:** Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, Enhanced solid solubility.

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

Unit III

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

Top down approaches: Mechanical alloying, Nano-lithography.

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

Unit IV

Tools to Characterize nanomaterials: X-Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nanoindentation.

Unit V

Applications of Nanomaterials: Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nanosensors, Nanocatalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Water- Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defence and Space Applications, Concerns and challenges of Nanotechnology.

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 methods of fabrications and applications of nanomaterials
- Understand principle and operations of applied analytical instruments.

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IV Year B.Tech. Chem. Engg. I-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

INDUSTRIAL SAFETY AND HAZARD MANAGEMENT (OPEN ELECTIVE)

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 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

Outcome:

- 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

JNTUA College of Engineering (Autonomous), Ananthapuramu

IV Year B.Tech. Chem. Engg. I-Sem **L P C**

3+1* 0 3

NUCLEAR ENGINEERING (OPEN ELECTIVE)

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 ", (198 , Hemisphere Publishing, New York.
2. Lamarsh U.R. " Introduction to Nuclear Engineering 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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IV Year B.Tech. Chem. Engg. I-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

SOLID WASTE MANAGEMENT (OPEN ELECTIVE)

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 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, distil ry, 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 Fill 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 well injection for non-recoverable waste.

JNTUA College of Engineering (Autonomous), Ananthapuramu

IV Year B.Tech. Chem. Engg. I-Sem	**L**	**P**	**C**
	0	**3**	**2**

PROCESS EQUIPMENT DESIGN AND DRAWING LAB

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. idargi, 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 d 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**	**P**	**C**
	0	**3**	**2**

SIMULATION LAB

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

JNTUA College of Engineering (Autonomous), Ananthapuramu

IV Year B.Tech. Chem. Engg. II-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

BIOCHEMICAL ENGINEERING

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 micro organisms, 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 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, 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 a 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.

JNTUA College of Engineering (Autonomous), Ananthapuramu

IV Year B.Tech. Chem. Engg. II-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

INDUSTRIAL POLLUTION & CONTROL ENGINEERING

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 a pollutants: Sulphur dioxide, nitrogen oxides, carbon monoxide, oxidants and Ozones, hydrocarbons, particulate matter.

UNIT III

Air pollution control methods and equipments: Source c ion methods: raw material changes, process changes, and equipment modification. Cleaning 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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IV Year B.Tech. Chem. Engg. II-Sem **L P C**

3+1* 0 3

TECHNOLOGY OF PHARMACEUTICALS AND FINE CHEMICALS (Elective- II)

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 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 steriliz 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	P	C
3+1*	0	3

INTERFACIAL ENGINEERING (Elective- II)
(Qualitative Treatment only)

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, B 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**	**P**	**C**
	3+1*	**0**	**3**

POLYMER TECHNOLOGY(Elective- II)

OBJECTIVES:

To enable the students to compute molecular weight ave es 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 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 addit ions

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 i and UV stabilizers v) Blowing agents vi)Coupling agents vii)Flame retardants viii) Inhibitors

Brief description of manufacture, properties and uses i) Polyethylene (HDPE&LDPE), ii) Poly propylene iii) Polyvinylchloride iv) Polystyrene Polytetra fluoroethylene vi) Polymethyl mehacrylate vii) Polyvinylacetate & Polyvinylalcohol.

Unit V

Brief description of manufacture, properties and uses 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 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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IV Year B.Tech. Chem. Engg. II-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

DESIGN AND ANALYSIS OF EXPERIMENTS (Elective – II)

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 bability 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 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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IV Year B.Tech. Chem. Engg. II-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

COMPUTER AIDED PROCESS DESIGN (Elective – III)

Objectives:

- To impart the basics of process design, flash calculations and optimization in process design.
- To impart the knowledge of using simulation software for process design of chemical systems like UniSim/Aspen Plus.

UNIT I

Introduction to process design; General design considerations; Hierarchy of chemical process design; Nature of process synthesis and analysis; Developing a conceptual design and flow sheet synthesis; Optimum process design. Material and Energy balance, Introduction to special software for steady state and dynamic simulation of chemical engineering systems – UniSim Design/Aspen Plus

UNIT II

Use of computers for physical property evaluation, Thermodynamic properties of gases, Liquids and binary mixtures, Methods of calculating vapour liquid equilibrium data for ideal and non-ideal mixture, Bubble point and dew point calculations, Flash calculations. Design of multi phase Flash drum.

UNIT III

Design of Pipe lines, Filter press, Centrifuge, Cyclone. Computer aided design of heat exchanger systems - double pipe and shell and tube heat exchangers; Computer aided design of evaporators - design of single effect evaporator and multiple effect evaporator systems.

UNIT IV

Computer aided design of Absorption tower- both plate as well as packed type and extraction columns; Computer aided design of bubble - cap distillation column.

Design of chemical reactors: Design of multiphase reactors - Fixed, fluidized, trickle bed, and slurry reactors.

UNIT V

Pinch analysis; Heat integration of heat exchangers, Reactors, Distillation columns, Evaporators and driers; Process change for improved heat integration; Heat and mass exchange networks and network design. Applications of simulation software in process design (UniSim/ Aspen).

Text books:

1. James M. Douglas “Conceptual Design of Chemical Processes”, McGraw Hill, New York, 1988.
2. B.C. Bhattacharyya and C.M. Narayanan, “Computer Aided Design of Chemical Process Equipment", 1st Edtn., New Central Book Agency (P) Ltd., New Delhi, 1992.

References:

1. Douglas Erwin P E,“Industrial Chemical Process Design”, McGraw hill.
2. Brownel and Young, “Process Equipment Design ”.Wiley (68).
3. G.F. Froment, K.B. Bischoff, "Chemical Reactor Analysis and Design", 2nd ed., John Wiley, New York, 1990.

Outcome:

- Through the course the student is expected to learn.
- Optimum design of chemical process equipments like flash drum, heat exchangers, evaporators, absorbers, distillation column, multiphase reactors.
- Knowledge of heat integration in process plants to reduce the energy costs.

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IV Year B.Tech. Chem. Engg. II-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

FOOD PROCESSING TECHNOLOGY (Elective – III)

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 versity Press, 1989.
3. Fundamentals of Food Engineering, D G Rao, PHI, New De , 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.Li ey, "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**	**P**	**C**
	3+1*	**0**	**3**

ENTERPRENEURSHIP DEVELOPMENT (Elective – III)

OBJECTIVES:

1. To make the students aware of the importance of entrepreneurship opportunities available in the society for the entrepreneur.
2. Acquaint them with the challenges faced by the entrepreneur

UNIT – I:

Introduction to entrepreneurship: Definition of entrepreneur, Entrepreneurial Traits, Entrepreneur vs. Manager, Entrepreneur vs Intrapreneur. The Entrepreneurial decision process.Role of Entrepreneurship in Economic Development, Ethics and social responsibility of Entrepreneurs.Opportunities for Entrepreneurs in India and abroad.Woman as Entrepreneur.

UNIT – II:

Creating and starting the Venture: Sources of new Ideas, Methods of generating Ideas, Creating problem solving, product planning and development process.

The Business Plan: Nature and scope of business plan , Writing Business ,Evaluating Business plans, Using and implementing business plans. Marketing plan, financial plan and the organizational plan, Launching formalities

UNIT – III:

Financing and Managing the new venture: Sources of capital, Record keeping, recruitment, motivating and leading teams, financial controls, Marketing and sales controls. E-commerce and Entrepreneurship, internet advertising.

New venture Expansion Strategies and Issues: Features and evaluation of joint ventures , acquisitions, merges, franchising. Public issues, right issues, bonus issues and stock splits.

UNIT – IV:

Choosing location and layout. Production and Marketing Management: Thrust of production management, Selection of production techniques, plant utilization and Designing the work place, Inventory control, material and quality control, Marketing functions, market segmentation, market research and channels of distribution, Sales promotion and product pricing.

UNIT – V: Global aspects of Entrepreneurship.

TEXT BOOK :

1. Robert Hisrich, & Michael Peters: Entrepreneurship, TMH,5th Edition.
2. Dollinger: Entrepreneurship, 4/e , Pearson, 2004.

REFERENCES :

1. Vasant Desai:Dynamics of Entrepreneurial Development and management,Himalaya publishing house, 2004.
2. Harvard Business Review on Entrepreneurship. HBR paper back, 1999.
3. Robert J. calvin : Entrepreneurial management, TMH, 2004 .
4. Gurmeet Naroola: The Entrepreneurial Connection,TMH,2001.
5. BOLton &Thompson: Entrepreneurs-Talent, Temperament, Technique, Butterworth Heinemann,2001.
6. Agarwal :Indian Economy, Wishwa Prakashan 2005.
7. Dutt& Sundaram:Indian Economy.s.chand,2005.
8. Srivastava: Industrial Relations &Labour laws , Vikas,2005.
9. Aruna Kaulgud:Entrepreneurship Management by, Vikas publishing house,2003.
10. Thomos W.zimmerer & Norman M. Scarborough: Essential of Entrepreneurship and small business management,PHI,4/e,2005.
11. Mary coulter: Entrepreneurship in Action,PHI,2/e.2005.
12. Kaplan: Patterns of Entrepreneurship ,Willey,2005.
13. ND Kapoor:Industrial Law, Sultan chand &Sons,2005.

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IV Year B.Tech. Chem. Engg. II-Sem	**L**	**P**	**C**
	3+1*	**0**	**3**

CORROSION ENGINEERING (Elective – III)

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 mecha 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.