DEPARTMENT OF CHEMICAL ENGINEERING
SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502

R-18 Effective from the Academic Year 2018-2019

DEPARTMENT OF CHEMICAL ENGINEERING :: S V U C E :: TIRUPATI

SCHEME OF INSTRUCTION –- CHOICE BASED CREDIT SYSTEM

R-18 B.Tech (Chemical Engineering), Effective 2018-19,

I Semester

Course Code	COURSE TITLE	SCHEME OF INSTRUCTION, hr/week				Credits	SCHEME OF EVALUATION, Marks		TOTAL MARKS
		L	Tut	P/D	TOTAL		Internal	End Sem	
MABST 101	Mathematics – I	3	1	--	4	**4**	40	60	100
CHBST 102	Chemistry for Chemical Engineering - I	3	1	--	4	**4**	40	60	100
ENHST 103	English	2	--	--	2	**2**	40	60	100
EEEST104	Basics of Electrical & Electronics Engineering	3	1	--	4	**4**	40	60	100
MEEST 105	Engineering Graphics and Design	2	--	3	5	**3.5**	40	60	100
ENHSP 106	English Communication Lab	--	--	3	3	**1.5**	40	60	100
	TOTAL	**13**	**3**	**6**	**22**	**19**	**240**	**360**	**600**

DEPARTMENT OF CHEMICAL ENGINEERING :: S V U C E :: TIRUPATI

SCHEME OF INSTRUCTION –- CHOICE BASED CREDIT SYSTEM

R-18 B.Tech (Chemical Engineering), Effective 2018-19,

II Semester

Course Code	COURSE TITLE	SCHEME OF INSTRUCTION, hr /week, L	Tut	P/D	TOTAL	**Credits**	SCHEME OF EVALUATION, Marks Internal	End Sem	TOTAL MARKS
MABST 201	Mathematics-II	3	1	--	4	**4**	40	60	100
PYBST 202	Engineering Physics	3	1	--	4	**4**	40	60	100
CSEST 203	Programming for Problem Solving	2	1	--	3	**3**	40	60	100
CHBST 204	Chemistry for Chemical Engineering - II	4	--	--	4	**4**	40	60	100
MEESP 205	Workshop / Manufacturing Practice	--	--	3	3	**1.5**	40	60	100
CSESP 206	Programming for Problem Solving Lab	--	--	3	3	**1.5**	40	60	100
CEMCT 207	Environmental Science	4	--	--	4	**--**	100	--	100
	TOTAL	**16**	**3**	**6**	**25**	**18**	**340**	**360**	**700**

DEPARTMENT OF CHEMICAL ENGINEERING :: S V U C E :: TIRUPATI

SCHEME OF INSTRUCTION –- CHOICE BASED CREDIT SYSTEM

R-18 B.Tech (Chemical Engineering), Effective 2018-19,

III Semester

Course Code	COURSE TITLE	SCHEME OF INSTRUCTION, hr/week				**Credits**	SCHEME OF EVALUATION, Marks		TOTAL MARKS
		L	Tut	P/D	TOTAL		Internal	End Sem	
MABST 301	Mathematics – III	3	--	--	3	**3**	40	60	100
CEEST 302	Engineering & Solid Mechanics	2	1	--	3	**3**	40	60	100
CHPCT 303	Chemical Process Calculations	3	1	--	4	**4**	40	60	100
CHPCT 304	Momentum Transfer	3	1	--	4	**4**	40	60	100
CHPCT 305	Mechanical Unit Operations	3	1	--	4	**4**	40	60	100
CHPCP306	Fluid and Particle Mechanics Lab	--	--	3	3	**1.5**	40	60	100
CHPCP 307	Analysis Lab	--	--	3	3	**1.5**	40	60	100
	TOTAL	**14**	**4**	**6**	**24**	**21**	**280**	**420**	**700**

DEPARTMENT OF CHEMICAL ENGINEERING :: S V U C E :: TIRUPATI

SCHEME OF INSTRUCTION –- CHOICE BASED CREDIT SYSTEM

R-18 B.Tech (Chemical Engineering), Effective 2018-19,

IV Semester

Course Code	COURSE TITLE	SCHEME OF INSTRUCTION, hr/week L	Tut	P/D	TOTAL	**Credits**	SCHEME OF EVALUATION, Marks Internal	End Sem	TOTAL MARKS
PAMCT 401	Constitution of India	3	--	--	3	**--**	100	--	100
MABST 402	Probability & Statistics	2	1	--	3	**3**	40	60	100
CHPCT 403	Chemical Engineering Thermodynamics – I	3	1	--	4	**4**	40	60	100
CHPCT 404	Heat transfer	3	1	--	4	**4**	40	60	100
CHPCT 405	Mass Transfer – I	3	1	--	4	**4**	40	60	100
CHPCT 406	Chemical Technology	3	--	--	3	**3**	40	60	100
CHBST 407	Fundamentals of Bio-technology	2	--	--	2	**2**	40	60	100
CHPCP408	Heat Transfer Lab	--	--	2	2	**1**	40	60	100
	TOTAL	**19**	**4**	**2**	**25**	**21**	**380**	**420**	**800**

NOTE: Industry Internship (Not less than 4 weeks) at the end of IV / VI Semesters, during summer Performance reflected in VII Semester

DEPARTMENT OF CHEMICAL ENGINEERING :: S V U C E :: TIRUPATI

SCHEME OF INSTRUCTION –- CHOICE BASED CREDIT SYSTEM

R-18 B.Tech (Chemical Engineering), Effective 2018-19,

V Semester

Course Code	COURSE TITLE	SCHEME OF INSTRUCTION, hr/week				**Credits**	SCHEME OF EVALUATION, Marks		TOTAL MARKS
		L	Tut	P/D	TOTAL		Internal	End Sem	
MABST 501	Numerical Methods in Chemical Engg.	2	--	--	2	**2**	40	60	100
CHPCT 502	Chemical Engineering Thermodynamics – II	3	1	--	4	**4**	40	60	100
CHPCT 503	Mass Transfer – II	3	1	--	4	**4**	40	60	100
CHPCT 504	Chemical Reaction Engineering – I	3	1	--	4	**4**	40	60	100
	Program Elective- I	3	--	--	3	**3**	40	60	100
CHPCP507	Mass Transfer Lab	--	--	3	3	**1.5**	40	60	100
CHPCP 508	Computational Techniques Lab	--	--	3	3	**1.5**	40	60	100
		14	**3**	**6**	**23**	**20**	**280**	**420**	**700**

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SCHEME OF INSTRUCTION –- CHOICE BASED CREDIT SYSTEM

R-18 B.Tech (Chemical Engineering), Effective 2018-19,

Course Code	COURSE TITLE	SCHEME OF INSTRUCTION, hr/week				**Credits**	SCHEME OF EVALUATION, Marks		TOTAL MARKS
		L	Tut	P/D	TOTAL		Internal	End Sem	
CHPCT 601	Chemical Reaction Engineering - II	3	1	--	4	**4**	40	60	100
CHPCT602	Transport Phenomena	3	1	--	4	**4**	40	60	100
CHPCT603	Process Dynamics & Control	3	1	--	4	**4**	40	60	100
MEHST604	Industrial Management	3	--	--	3	**3**	40	60	100
	Program Elective – II	3	--	--	3	**3**	40	60	100
CHOET606	Open Elective- I Online	--	--	--	--	**3**	MOOCs		*100*
CHOET607	Open Elective – II Online	--	--	--	--	**3**	MOOCs		*100*
CHPCP 608	Reaction Engineering Lab	--	--	3	3	**1.5**	40	60	100
CHPCP 609	Process Dynamics & Control Lab	--	--	3	3	**1.5**	40	60	100
	TOTAL	**15**	**3**	**6**	**24**	**27**	**280**	**420**	**700 + 200**

NOTE : Industry Internship (Not less than 4 weeks) at the end of IV / VI Semesters, during summer
Performance reflected in VII Semester
Open Elective – MOOCS: 2 courses - Study in III to VI Semesters, Performance Reflected in VI Semester

DEPARTMENT OF CHEMICAL ENGINEERING :: S V U C E :: TIRUPATI

SCHEME OF INSTRUCTION –- CHOICE BASED CREDIT SYSTEM

R-18 B.Tech (Chemical Engineering), Effective 2018-19,

VII Semester

Course Code	COURSE TITLE	SCHEME OF INSTRUCTION, hr/week				**Credits**	SCHEME OF EVALUATION, Marks		TOTAL MARKS
		L	Tut	P/D	TOTAL		Internal	End Sem	
CHPCT701	Plant Design & Process Economics	2	--	--	2	**2**	40	60	100
	Program Elective – III	3	--	--	3	**3**	40	60	100
CHHST 703	Engineering Ethics	2	--	--	2	**2**	40	60	100
CHPCP 704	Process Equipment Design & Drawing	--	--	3	3	**1.5**	40	60	100
CHPCP 705	Simulation Lab	--	--	3	3	**1.5**	40	60	100
CHPCI 706	Industry Internship	--	--	--	--	**3**	100	--	100
CHPCW 707	Project Work – Phase I	--	--	6	6	**3**	100	--	100
	TOTAL	**7**	**--**	**12**	**19**	**16**	**400**	**300**	**700**

NOTE : Industry Internship (Not less than 4 weeks) at the end of IV / VI Semesters, during summer Performance reflected in VII Semester78

DEPARTMENT OF CHEMICAL ENGINEERING:: S V U C E :: TIRUPATI

SCHEME OF INSTRUCTION –- CHOICE BASED CREDIT SYSTEM

R-18 B.Tech (Chemical Engineering), Effective 2018-19, Modified AY 2019-2020

VIII Semester

Course Code	COURSE TITLE	SCHEME OF INSTRUCTION, hr/week L	Tut	P/D	TOTAL	**Credits**	SCHEME OF EVALUATION, Marks Internal	End Sem	TOTAL MARKS
	Program Elective- IV	3	--	--	3	3	40	60	100
CHOET 802	Open Elective – III Online	--	--	--	--	3	MOOCs		*100*
CHOET803	Open Elective – IV Online	--	--	--	--	3	MOOCs		*100*
CHPCW801	Project Work - Phase II	--	--	18	18	9	40	60	100
		3	**--**	**18**	**21**	**18**	**80**	**120**	**200 + 200**

Open Elective – MOOCS: 2 courses - Study in III to VIII Semesters, Performance Reflected in VIII Semester

B.TECH. I SEMESTER CHEMICAL ENGINEERING

MABST 101 **MATHEMATICS -I**

Instruction Hours/Week: 3(L) +1(T) Credits: 4 Assessment : 40 + 60

Course Objectives:

1. To enlighten the learners in the concept of differential equations and multivariable calculus.
2. To familiarize students with analytical methods of solving differential equations.
3. The student develops the idea of using Laplace transforms.
4. To enable the students to analyze and apply differentiation and integration for multivariable functions**.**
5. To introduce the evaluating of multiple integrals in two- and three-dimensional spaces.

UNIT I

Differential Equations: Linear differential equations of second and higher order with constant coefficients-particular integrals-homogeneous differential equations with variable coefficients-method of parameters-simulation equations.

UNIT II

Laplace Transforms I: Laplace transforms of standard functions-inverse transforms-transforms of derivatives and integrals-derivatives of transforms-integrals of transforms.

UNIT III

Laplace Transforms II: Transforms of periodic functions-convolution theorem-applications to solution of ordinary differential equations.

UNIT IV

Calculus: Roll's and Mean value theorems - Taylor's and Maclaurins's series-maxima and minima for functions of two variables - Infinite series - Convergence Tests series of positive terms - comparison, Ratio tests - Alternating series - Leibnitz's rule - Absolute and conditional convergence.

UNIT V

Multiple Integrals: Curve tracing (both Cartesian and polar coordinate) - Evaluations of double and Triple integrals-change of order of integrations-change of variables of integrations-simple applications to areas and volumes.

Text/Reference Books

1. B S Grewal, Higher Engineering Mathematics, 40th Edition, Khanna Publications, 2007.
2. M K Venkataraman, Engineering Mathematics, National Publishing Company, Chennai.
3. B V Ramana, Higher Engineering Mathematics, 6th Reprint, Tata McGraw-Hill, 2008.
4. Bali and Iyengar, Engineering Mathematics, 6th Edition, Laxmi Publications, 2006.

Course Outcomes: At the end of the course, students will be able to

1. Analyze differential equations and solve them. Apply differential equations to engineering problems.

2. Use shift theorems to compute the Laplace transform, inverse Laplace transform and the solutions of second order, linear equations with constant coefficients.
3. Solve an initial value problem for an n^{th} order ordinary differential equation using the Laplace transform.
4. Expand functions as power series using Maclaurin's and Talor's series
5. Draw an approximate shape by the study of some of its important characteristics such as symmetry, tangents, regions etc using curve tracing method to find length, area, volume. Use multiple integral in evaluating area and volume of any region bounded by the given curves.

Mapping of Course Outcomes with Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**											
CO2		**2**			**2**							
CO3			**3**	**1**								
CO4			**1**									
CO5					**3**	**2**						

CHBST 102 CHEMISTRY FOR CHEMICAL ENGINEERING – I

Instruction Hours/Week: 3(L) +1(T) Credits: 4 Assessment : 40 + 60 marks I Semester

Course Objectives:

1. To be productive in applying life science concepts and biological engineering principles in engineering practice or for state-of-the-art study
2. To achieve knowledge, skills and resources for continued education of the chemical engineering course, over a lifetime.
3. To develop the strength in processing and manufacturing and outline the scholarly accomplishments of its faculty to combine conventional chemical engineering subjects with specialized studies in the modern fields of biological engineering, nano-materials engineering, nuclear engineering and paper engineering.
4. To go after rewarding professional careers by skilfully leveraging chemical engineering principles

Unit I : Introduction to quantum theory for chemical systems: (6L + 2T): Schrodinger equation, Quantum mechanical model of atom, wave mechanical model of hydrogen atom and Particle in one dimensional and three dimensional box, harmonic oscillator, rigid rotor, Applications to Hydrogen atom, concepts of Atomic orbital, many electron atoms.

Unit II : Chemical bonding in molecules: (12L + 4T): MO Theory, Structure, bonding and energy levels of bonding and shapes of many atom molecules, Coordination Chemistry: Formation of coordination complexes, EAN rule for coordination compounds, Electronic spectra and magnetic properties of complexes with relevance to bio-inorganic chemistry, organo metallic chemistry

Unit III : Introduction to Stereochemistry: (6L+ 2T): Stereo descriptors – R, S, E, Z. Enantiomers and Diastereomers. Racemacs and their resolution. Conformations of cyclic and acyclic systems. Geometrical isomerism, Optical activity and optical isomerism.

Unit IV : Reactivity of organic molecules: (9L + 3T): Factors influencing acidity, basicity, and nucleophilicity of molecules, kinetic vs. thermodynamic control of reactions. SN^1 and SN^2reactions. Hyper conjugation, Aromatic nucleophilic substitution reactions.

Unit V: Strategies for synthesis of organic compounds: (12L + 4T) Total 60(L+T): Reactive intermediates, stability and reactivity of carbonation, cation- anion substitution, elimination, rearrangement, kinetic and thermodynamic aspects, role of solvents.

Text / Reference Books:

1. Physical Chemistry: G.W.Castellan, Narosa
2. Organic Chemistry: Finar; I.L. — Vol — I & II, Pearson Education
3. Organic Chemistry: Morrison & Boyd; PHI/Pearson Education.
4. Physical Chemistry: P. W. Atkins: Oxford.
5. A Text book of Physical Chemistry: K. L. Kapoor: Macmillan
6. A guide Book to Mechanism in Organic Chemistry: Peter Sykes
7. Organic Chemistry: Loudon: Oxford.

Course Outcomes:

At the end of the course, **s**tudents will be able to

1. Quantum mechanical model of atom, wave mechanical model , Applications to Hydrogen atom.
2. Bonding and energy levels of bonding and shapes of many atom molecules , EAN rule for coordination compounds.
3. Conformations of cyclic and acyclic systems. Geometrical isomerism, Optical activity and optical isomerism.
4. Factors influencing acidity, basicity, and nucleophilicity of molecules, Hyper conjugation.
5. Strategies for synthesis of organic compounds.

Mapping of Course Outcomes with Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**											
CO2		**2**			**2**							
CO3			**3**	**1**								
CO4			**1**									
CO5					**3**	**2**						

ENHST 103 **ENGLISH**

Instruction Hours/Week: 2(L) Credits: 2 Assessment : 40 + 60 marks I Semester

Course Objectives

1. Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers.
2. Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials.
3. Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations.
4. Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information.
5. Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing.

UNIT I

Vocabulary Building: The concept of Word Formation- Root words from foreign languages and their use in English- Acquaintance with prefixes and suffixes from foreign languages in English form derivatives- Synonyms, antonyms and standard abbreviations.

UNIT II

Basic Writing Skills: Sentence Structures – Use of phrases and clauses in sentences –Importance of proper punctuation - Creating coherence – Organizing principles of paragraphs in documents - Techniques for writing precisely

UNIT III

Identifying CommonErrorsinWriting: Subject-verb agreement -Noun-pronoun agreement - Misplaced modifiers -Article -Prepositions -Redundancies -Clichés

UNIT IV

NatureandStyleof Sensible Writing: Describing - Defining - Classifying –Providing examples or evidence –Writing introduction and conclusion

UNIT V

Writing Practices: Comprehension - Précis Writing –Essay Writing

Reference/Text Books:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper ResourceBook. 2001
4. Study Writing. LizHamp- Lyonsand Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills. Sanjay Kumar and Pushplata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

Course Outcomes: At the end of the course, students will be able to

1. Learn the elements of grammar and composition of English Language.
2. Learn literary texts such as Short stories and prose passages.
3. Maintain linguistic competence through training in vocabulary, sentence structures and pronunciation.
4. Develop communication skills by cultivating the habit of reading comprehension passages.
5. Develop the language skills like listening, speaking, reading and writing.
6. Make use of self-instructed learner friendly modes of language learning through competence.

Mapping of Course Outcomes with Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	2									
CO2	2		2	2								
CO3		1		2	2							
CO4			2	2	3							
CO5		1	1	2								

EEEST 104 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Instruction Hours/Week: 3(L) +1(T) Credits: 4 Assessment : 40 + 60 marks I Semester

Course Objectives:

1. To introduce basics of electric circuits.
2. To teach DC and AC electrical circuit analysis.
3. To explain working principles of transformers and electrical machines.
4. To impart knowledge on Power system generation, transmission and distribution

UNIT-I

Electric DC Circuits: Kirchhoff's Voltage & Current laws, Superposition Theorem, Star – Delta Transformations.

AC Circuits: Complex representation of Impedance, Phasor diagrams, Power & Power Factor, Solution of Single Phase Series & Parallel Circuits. Solution of Three Phase circuits and Measurement of Power in Three Phase circuits.

Unit-II

Single Phase Transformers: Principle of Operation of a Single Phase Transformer, EMF equation, Regulation and Efficiency of a single phase transformer.
DC Machines: Principle of Operation, Classification, EMF and Torque equations, Characteristics of Generators and Motors

UNIT-III

Three Phase Induction Motor: Principle of Rotating Magnetic Field, Principle of Operation of 3-φ I.M., Torque-Speed Characteristics of 3-φ I.M.

UNIT-IV

p-n junction operation, diode applications, Zener diode as regulator.
Transistor and applications: Introduction to transistors, BJT Characteristics, biasing and applications

UNIT-V

Integrated Circuits: Operational amplifiers, Applications: adder, subtractor, Integrator and Differentiator.

Digital Circuits: logic gates, Combinational Logic circuits, Flip-Flops, counters and shift registers, Laboratory measuring instruments: digital multi-meters and Cathode Ray Oscilloscopes (CRO's).

Text Books :

1. Electrical Technology by Edward Hughes
2. Basic Electrical Engineering by Nagrath and Kothari

Course Outcome:

CO1	Demonstrate and able to explain electrical components, electrical circuits and Kirchoff's laws.
CO2	Acquire knowledge of DC circuit analysis, DC network theorems and their applications
CO3	Formulate and solve complex AC, DC circuits.
CO4	Understand the principles of operation of DC machines, single phase transformers and three phase induction motors
CO5	Identify the starting methods of starting synchronous and induction motors and speed control methods for DC motors

Mapping of Course Outcomes with Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1		2								
CO2	2	1	2									
CO3		1		2	2							
CO4			2	2	1	1						
CO5			1	1	2							

MEEST 105 **ENGINEERING GRAPHICS AND DESIGN**

Instruction Hours/Week: 2(L) + 3 (D) Credits: 3.5 Assessment : 40 + 60 marks I Semester

Course Objectives:

1. Bring awareness that Engineering Drawing is the Language of Engineers.
2. Familiarize how industry communicates technical information.
3. Teach the practices for accuracy and clarity in presenting the technical information.
4. Develop the engineering imagination essential for successful design.

Unit I

Introduction to Engineering Drawing : Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only);Cycloid, Epi-cycloid, Hypo-cycloid and Involutes.

Unit II

Scales **:** Scales– construction of Plain &Diagonal Scales.
Projections of points, lines : Projections of Points and lines inclined to both planes, including traces

Unit III

Projections of planes : Projections of planes (Regular surfaces only) inclined Planes-Auxiliary planes
Projections of Regular Solids (Simple solids - cylinder, cone, prism & pyramid) those inclined to both the Planes-Auxiliary Views

Unit IV

Isometric Projections& Orthographic projections : Principles of Orthographic Projections-Conventions Draw simple objects, dimensioning and scale. Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric
Views to Orthographic Views and Vice-versa, Conventions

Unit V

Introduction to CAD : CAD workstation and peripherals, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars Standard, Object Properties, Draw, Modify and Dimension, Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom used in CAD, Select and erase objects.;

Text/Reference Books:

1. Bhatt N.D., Panchal V.M. &Ingle P.R., (2014), Engineering Drawing, CharotarPublishing House
2. Shah,M.B.&RanaB.C.(2008),EngineeringDrawingandComputerGraphics,PearsonEdu.
3. AgrawalB.&AgrawalC.M.(2012),Engineering Graphics, TMH Publication
4. Narayana, K.L. &P Kannaiah(2008),Text book on Engineering Drawing,

ScitechPublishers

5. Corresponding set of) CAD Software Theory and User Manuals

Course Outcomes: At the end of the course, the student will be able to

1. Make a distinction between first angle projection and third angle projection of drawing.
2. Draw hyperbola, parabola, Involutes and Cycloidal curves.
3. Draw sections of solids including cylinders, cones, prisms and pyramids.
4. Draw projections of lines, planes, solids and sections of solids.
5. Draw orthographic projections of lines, planes, and solids.

Mapping of Course Outcomes with Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	2	1	1			1	1					
CO 2	2	1				1	1					
CO 3		2		2		2						1
CO 4			1	2			1					
CO 5		1		2		3						

ENHSP 106 **ENGLISH COMMUNICATION LAB**

Instruction Hours/Week: 0 + 3 (P) Credits:1.5 Assessment : 40 + 60 marks

Course Objectives

1. Students will be exposed to a variety of self instructional, learner friendly modes of language learning.
2. Students will learn better pronunciation through stress, intonation and rhythm
3. Students will be trained to use language effectively to face interviews, group discussions, and public speaking.
4. Students will be initiated into greater use of the computer in resume preparation, report writing, format making etc

Listening Comprehension -Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations

Reference/Text Books:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. RemedialEnglishGrammar.F.T. Wood. Macmillan.2007
3. OnWritingWell.WilliamZinsser. Harper ResourceBook. 2001
4. StudyWriting.LizHamp– Lyonsand Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills. SanjayKumarandPushpalata. Oxford University Press. 2011.
6.Exercises in Spoken English.PartsI-III.CIEFL, Hyderabad. Oxford University Press

Course Outcome:

CO1	Better pronunciation and accent
CO2	Ability to use functional English
CO3	Competency in analytical skills and problem solving skills
CO4	Increase possibilities of job prospects
CO5	Communicate confidently in formal and informal contexts

Mapping of Course Outcomes with Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	2									
CO 2	2		2	2								
CO 3		1		2	2							
CO 4			2	2	3							
CO 5		1	1	2								

B.TECH. II SEMESTER CHEMICAL ENGINEERING

MABST 201 **MATHEMATICS - II**

Instruction Hours/Wek: 3(L) + 1 (T) Credits: 4 Assessment : 40 + 60 marks II Semester

Course Objectives:

1. This course will illuminate the students in the concepts of linear algebra.
2. To introduce the vector methods and Vector calculus in evaluating multiple integrals in two and three dimensional spaces.
3. To equip the students with standard concepts of Fourier series and Harmonic analysis and their applications.
4. To familiarize the students with the techniques of evaluating improper integrals.
5. To provide knowledge on Legendre's polynomials and properties of Bessel's functions

Unit I

Matrices: rank of a matrix-solution of system of linear equations-Eigen values, vectors –Canley-Hamilton theorem-quadratic forms-diagonalization.

Unit II

Vector Calculus: Gradient, Divergence, Curl of a vector and related properties-line, surface, volume integrals- Green's, Stokes's and Gauss Divergence theorems and its applications.

Unit III

Fourier Series: Fourier series-even and odd functions, periodic functions-half range sine and cosine series-harmonic analysis.

Unit IV

Special Functions I: Gamma and Beta functions-series solutions of differential equations-ordinary points.

Unit V

Special Functions II: Bessel function-recurrence formulae-generating function for $J_n(X)$-Lengender polynomials-recurrence formulae-generating function for $P_n(X)$ - Rodriguez's formula - orthogonality of Lengender polynomials.

Text/Reference Books

1. B S Grewal, Higher Engineering Mathematics, 40th Edition, Khanna Publications, 2007.
2. M K Venkataraman, Engineering Mathematics, National Publishing Company, Chennai.
3. B V Ramana, Higher Engineering Mathematics, 6th Reprint, Tata McGraw-Hill, 2008.
   Bali and Iyengar, Engineering Mathematics, 6th Edition, Laxmi Publications, 2006.

Course Outcomes: At the end of the course, students will be able to

1. Check whether the system of linear equations is consistent or not .UseCayley-Hamilton theorem to find inverses or powers of matrices.
2. Use Eigen values and vectors to reduce Quadratic forms to normal form. Use Green's theorem to evaluate line integrals along simple closed contours on the plane.Use Stokes' theorem to give a physical interpretation of the curl of a vector field
3. Find the Fourier Series to represent function as a series of constants times sine and cosine functions of different frequencies in order to observe periodic phenomenon.
4. Evaluate certain improper integrals to make them simple with introduction of Gamma and Beta functions.
5. Study certain special functions that arise in solving certain ordinary differential equations to model many physical phenomena.

Mapping of Course Outcomes with Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**											
CO2		**2**			**2**							
CO3			**3**	**1**								
CO4			**1**									
CO5					**3**	**2**						

PYBST 202 **ENGINEERING PHYSICS**

Instruction Hours/Week: 3(L) + 1 (T) Credits: 4 Assessment :40 + 60 marks II Semester

Course Objectives

To make a bridge between the physics in school and engineering courses.

1. To identify the importance of the optical phenomenon i.e. interference, diffraction and polarization related to its Engineering applications
2. To understand the mechanisms of emission of light, the use of lasers as light sources for low and high energy applications, study of propagation of light wave through optical fibres along with engineering applications.
3. To explain the significant concepts of dielectric and magnetic materials that leads to potential applications in the emerging micro devices.
4. To enlighten the concepts of Quantum Mechanics and to provide fundamentals of de'Broglie waves, quantum mechanical wave equation and its applications, the importance of free electron theory and band theory of solids.
5. Evolution of band theory to distinguish materials, basic concepts and transport phenomenon of charge carriers in semiconductors. To give an impetus on the subtle mechanism of superconductors using the concept of BCS theory and their fascinating applications.

UNIT I Wave Optics

Interference: Huygen`s Principle-Principle of Superposition-Interference of Light-Young`s double slit experiment- -Newton's Rings.

Diffraction:Fraunhofer Diffraction at a Single Slit and a Circular Aperture-Plane Diffraction grating –Resolving Power-Rayleigh`s Criterion-Resolving power of Grating and Microscope.

Lasers: Introduction – Spontaneous and Stimulated Emission of Radiation – Population Inversion – Types of Lasers – Ruby Laser – He-Ne Laser – Semiconductor Laser – Applications of Lasers.

UNIT II Mechanics of Rigid Body & Continuous Media

Rigid Body-Rotational Motion and Kinematics Relations-Kinetic Energy and Angular Momentum of a Rotating Body-Equation of Motion of a Rigid body (Torque of a Rigid Body)-Combined Translation and Rotational Motion of a Rigid Body- Body Rolling on an inclined Plane.

Elasticity, Stress and Strain- Hook`s Law and Behaviour of Wire Under Load- Elastic Constants-Relation Between Elastic Modulii-Types of Supports, Beams and Loads-Different types of Bending-Cantilever with an End Load. Ultrasonic Waves - Sound Absorption and Reverberation -Sabine Formula - Acoustics of Buildings.

UNIT III Electromagnetism and magnetic properties of Materials

Laws of Electrostatistics- Electric Current- Laws of Magnetism- Ampere`s, Faraday`s laws- Maxwells Equations – Polarization - Permeability and dielectric constant- Polar and non-polar Dielectrics, Clausius-Mossotti equation, Applications of Dielectrics.

Magnetization - Permeability and Susceptibility- Classification of Magnetic Materials, Ferromagnetism-Magnetic Domains and Hesteresis, Applications of ferromagnetic materials.

UNIT IV Quantum Mechanics

Wave – Particle duality – de Broglie Concept of Matter Waves – Properties of Matter Waves – Davison and Germer Experiment – G.P.Thomson Experiment – Heisenberg's Uncertainty Principle – Schrödinger's Time Independent and Time Dependent Wave equation – Significance of Wave Function – Electron in an Infinite Square Potential Well – Probability Densities and Energy Levels.

UNIT V NanoPhysics and Nanotechnology

Introduction to Nanomaterials –Properties: Optical Properties – Quantum Confinement – Electrical properties. Synthesis of Nanomaterials: Ball milling, Arc deposition method – Chemical Vapour Deposition-Pulsed laser deposition. Characteristics of C^{60} (Zero dimensional), Carbon Nanotubes (One Dimensional) and Graphene(Two Dimensional). Applications of Nanomaterials.

Text Books / Reference Books:

1. R.K.Gaur and S.L.Gupta ``Engineering Physics" Sultan and Chand Pub., New Delhi
2. S.L.Gupta and SanjeevGupta`UnifiedPhysics`Vol.I Jai PrakashNath& Co., Meerut.
3. HitendraK.Malik and A.K.Singh ``Engineering Physics" Tata MCGraw Hill Education Pvt.Ltd., New Delhi
4. M.N.Avadhanulu and P.G.Kshirsagar ``A Text Book of Engineering Physics`` S.Chand and Company Pvt.Ltd., New Delhi
5. B.L Theraja, "Modern physics", S.Chand& Company.
6. V. Raghavan "Material Science", Tata McGraw Hill Publications.
7. M.S.Ramachandra Rao and Shubra Singh, ``Nanoscience and Nanotechnology`` Wiley India Pvt.Ltd, New Delhi

Course Outcomes: At the end of the course, students will be able to

1. Develop appropriate competence and working knowledge of laws of modern Physics in understanding advanced technical engineering courses
2. Understand the quantum mechanics and ultimately the quantum behaviour of charged particles when they are in motion.
3. Identify and apply appropriate analytical and mathematical tools of Physics in solving Engineering problems
4. Apply the basic principles of Mechanics of rigid body and continuous media and their applications
5. Understand the principles in electrostatics and electromagnetics and magnetic properties of materials.
6. Understand size depended properties of nano dimensional materials and their effective utilization in making nano- and micro-devices for further microminiaturization of electronic devices.
7. Think and participate deeply, creatively, and analytically in emerging areas of engineering technology.
8. Learn the basics of instrumentation, design of laboratory techniques, measurement, data acquisition, interpretation, and analysis.
9. Provide multidisciplinary experiences throughout the curriculum.

CSEST 203 **PROGRAMMING FOR PROBLEM SOLVING**

Instruction Hours/Week: 2(L) + 1 (T) Credits: 3 Assessment : 40 + 60 marks II Semester

Course Objectives:

1. To acquire problem solving skills.
2. To be able to develop flowcharts and algorithems for the given problem.
3. To learn how to write modular programs in C.
4. To able to use arrays, pointers, strings and structures in solving problems.
5. To explain the difference between object- oriented programming and procedural programming.
6. To understand principles of object- oriented programming.

UNIT-I

Introduction to Programming -Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) -
Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart / Pseudocode with examples -From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code -Arithmetic expressions and precedence**.**

UNIT-II

Conditional Branching and Loops - Writing and evaluation of conditionals and consequent branching - Iteration and loops -Arrays (1-D, 2-D), Character arrays and Strings.

UNIT-III

Basic Algorithms -Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection) - Finding roots of equations, notion of order of complexity through example programs (no formal definition required).

UNIT-IV

Functions -Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference - Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc - Quick sort or Merge sort.

UNIT-V

Structure -Structures, Defining structures and Array of Structures- Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation) File handling.

Text Books / Reference Books :

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course outcomes:

At the end of the course, students will be able to

1. Develop and test programs in C & correct syntax and logical errors
2. Implement conditional branching, iteration and recursion
3. Decompose a problem into functions and synthesize a complete program
4. Use arrays, pointers, strings and structures to formulate algorithms' and programs
5. Use file to perform read and write operations
6. Handle programming assignments based on class, abstraction, encapsulation, overloading and inheritance.

CHBST 204 **CHEMISTRY FOR CHEMICAL ENGINEERING-II**

Instruction Hours/Week: 4(L) Credits: 4 Assessment : 40 + 60 marks II Semester

Course Objectives

1. To be effective in applying chemical engineering principles in engineering practice or for advanced study in chemical engineering.
2. To have a productive career in the many diverse fields of chemical engineering such as bioengineering, energy and the environment,
3. To function effectively in the complex modern work environment with the ability to assume professional leadership roles.

UNIT I

Colloids:Classification of colloids; Size and shape; preparation of sols; Origin of charge in Colloidal particles: Stability of Colloids: Kinetic. Optical & electrical Properties: Electro kinetic phenomena: Electrical Double Layer; Ultracentrifuge and Molecular weight determination of Macromolecules. Viscosity: Definition of viscosity of a liquid; Determination of Viscosity; Surface Tension: Introduction: Origin of Surface Tension: Surface energy, Capillarity; Contact Angle; Measurement of Surface Tension by Capillary rise method; Variation of Surface Tension of a liquid with Temperature and Concentration.

UNIT II

Kinetic theory of gases: Van der Waals Equation of state, Maxwell distribution law, vapour-liquid equilibrium, Colligative property. Adsorption: Introduction; Gibb's adsorption equation; Surface Excess; Adsorption isotherms: Freundlich, Langmuir, BET adsorption equations: Surface Films: Langmuir Balance: two-dimensional equation of state.

UNIT III

Heterocyclic Compounds -Nomenclature - preparation and chemical properties of Pyrrole, Furan, Thiophene, Pyridine, Quinoline, and Indole - their important derivatives.

UNIT IV

Common organic reactions and their mechanisms**:** Friedel-Crafts, Claisen Condensation, Cannizaro, Aldol condensation. Fischer-Troapsch synthesis, Birch reduction, pekins reaction, Riemer Tiemer reaction Wolf Kishner Reductio and Grignard reaction;

UNIT V

Aminoacids: Classification; General methods of preparation and properties of amino acids, polypeptide synthesis, General properties of proteins, colour tests, enzymes. Lipids, fats and steroids; nucleic acid, DNA & RNA - generation and structure. Carbohydrate: Classification, Glucose and fructose, Disaccharides: Sucrose, maltose.

Text / Reference Books:

1. Physical Chemistry: G.W.Castellan, Narosa
2. Organic Chemistry: Finar; I.L. — Vol — I & II, Pearson Education
3. Organic Chemistry: Morrison & Boyd; PHI/Pearson Education.
4. Physical Chemistry: P. W. Atkins: Oxford.
5. A Text book of Physical Chemistry: K. L. Kapoor: Macmillan
6. A guide Book to Mechanism in Organic Chemistry: Peter Sykes
7. Organic Chemistry: Loudon: Oxford

Course outcomes:

At the end of the course, students will be able to

1. To enable students to identify, formulate, and solve complex chemical engineering problems by applying principles of engineering, science, and mathematics
2. To enable students to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. To enable students to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions
4. To enable students to recognize ethical and professional responsibilities in engineering situations
5. To enable students to acquire and apply new knowledge as needed, using appropriate learning strategies
6. To enable students to communicate effectively with a range of audiences
7. To enable students to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

MEEST 205 **WORKSHOP/MANUFACTURING PRACTICE**

Instruction Hours/Week: 3 (P) Credits: 1.5 Assessment : 40 + 60 marks II Semester

Course Objective:

COURSE OBJECTIVE:

- To understand the basic tools and operations in carpentry
- To understand the basic tools and operations in fitting & various types of joints.
- To understand the basic tools and operations in sheet metal trades.
- To understand the basic tools of house wiring & house wiring connections etc.
- To understand the basic tools and manufacturing processes in a foundry trade

1.Manufacturing Methods-casting, forming, machining, joining, advanced manufacturing methods
2. CNC machining, Additive manufacturing
3. Fitting operations & power tools
4. Electrical & Electronics
5. Carpentry
6. Plastic moulding, glass cutting
7. Metal casting
8. Welding(arc welding &gas welding), brazing
The above course content is learnt by online videos/ppt presentations**.**

Text/Reference Books:
(i) HajraChoudhury S.K.,Hajra ChoudhuryA.K.andNirjharRoyS.K.,"Elementsof Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and Publisher's private limited, Mumbai.
(ii)KalpakjianS.AndStevenS.Schmid,"ManufacturingEngineeringandTechnology",4thedition,PearsonEducationIndiaEdition,2002.
(iii) GowriP.HariharanandA. SureshBabu, "Manufacturing Technology–I" Pearson Education,2008.
(iv) RoyA. Lindberg, "Processes and Materials of Manufacture",4thedition, Prentice Hall India,1998.
(v) RaoP.N., "Manufacturing Technology", Vol.IandVol.II,TataMcGrawHillHouse 2017.

(ii)Workshop Practice:
1. Machine shop
2. Fitting shop
3. Carpentry
4. Electrical wiring
5. Weldingshop

6. Casting
7. Smithy
8. Plastic moulding & Glass Cutting

** choose any of the above Six for practice**

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

COURSE OUTCOMES:

CO1	Design and develop different types of wood joints based on the requirement
CO2	Design and develop different types of fittings as per requirement
CO3	Able to develop prototype models by using tin smithy tools.
CO4	Design and develop different moulds as per practical requirements.
CO5	Able to connect bulbs either series or parallel

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2		3									2
CO 2	2		3									
CO 3	2		3									
CO 4	2		3									
CO 5	2		3									

CSESP 206 **PROGRAMMING FOR PROBLEM SOLVING LAB**

Instruction Hours/Week: 3 (P) Credits: 1.5 Assessment : 40 + 60 marks II Semester

COURSE OBJECTIVES

- To make the student solve problems, implement algorithms using C language.
- To make the student solve problems, implement those using C & C++ programming languages.
- To strengthen the ability to identify and apply the suitable data structure for the given real world problem
- To organize the user's data for decision making and iterative processes.
- To apply structured programming approach to solve real time applications.

Assignments in C
Variable types and type conversions:

Simple computational problems using arithmetic expressions
Branching and logical expressions:

Problems involving if-then-else structures
Loops, while and for loops:

Iterative problems e.g., sum of series
1D Arrays: searching, sorting:

1D Array manipulation
2D arrays and Strings

Matrix problems, String operations
Functions, call by value

Simple functions
Numerical methods (Root finding, numerical differentiation, numericalintegration):

Programming for solving Numerical methods problems
Recursion, structure of recursive calls
Recursive functions
Pointers, structures and dynamic memory allocation
Pointers and structures
Assignments in C and JAVA
File handling
File operations

COURSE OUTCOMES:

CO1	Able to know concepts in problem solving
CO2	To do programming in C language
CO3	To write diversified solutions using C language
CO4	Implement Programs with pointers and arrays, perform pointer arithmetic, and use the pre-processor.
CO5	Able to develop programs for real world applications using Java

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	3										
CO 2	2		3									
CO 3	2	3	2									
CO 4	2		3									
CO 5	2	3										

CEMCT 207 **ENVIRONMENTAL SCIENCE**

Instruction Hours/Week: 4(L) Credits: 0 II Semester

Course Objectives:

1. To identify, formulate and solve environmental problems by utilizing the concept of environmental studies.
2. To avoid environmental pollution & Global Problems.
3. To understand human activities which are causing environmental degradation and the measures to be taken to avoid this problem.
4. To create awareness among people about protection of wild life & forests.
5. Conservation of natural resources, ecological balance and biodiversity to achieve sustainable development.

6. Understanding of environmental policies and regulations.

UNIT I

Environmental Studies and Natural Resources

Definition, Scope and importance of Environment, Environmental studies, Need for public awareness

Components of Environment- Atmosphere, Hydrosphere, Lithosphere.

Renewable and Non Renewable Resources and associated problems

Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems.

Forest resources: Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

Land resources: Land as a resource, land degradation, Man induced landslides, soil erosion and desertification.

Mineral resources: Use and overexploitation, Environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity, Case studies.

Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

Role of an individual in conservation of natural resources.

UNIT II

Ecosystem and Biodiversity

Ecosystem **-** Concept of an ecosystem, Structure and functions of an ecosystem. Producers, consumers and decomposers, Energy flow in the ecosystem and 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 ecosystem (ponds, streams, lakes, rivers, oceans, estuaries) Biodiversity and its conservation:

Definition, genetic species and ecosystem diversity.Biogeographically 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-spots of biodiversity.

Threats to biodiversity: habitat loss, poaching of wildlife, man – wildlife conflicts.

Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT – III

Environmental pollution and Global Effects
Definition, Causes, 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, earthquakes, cyclone, landslides, Tsunami.
Climate change-Global warming, Acid rain, Ozone depletion.

UNIT – IV

Environment Issues and Management

Environment and Human health – Epidemic diseases, HIV/AIDS, Aviation Flue, Water Borne Diseases.
Environmental Impact Assessment, Sustainable Development, Clean Production and Clean Development Mechanisms
Environment Legislation: Environmental Protection Act, Water Act, Air Act, Wild Life Protection Act, Forest Conservation Act, Public Liability & Insurance Act, Issues involved in Enforcement of Environmental legislation.

UNIT – V

Social Issues and the Environment

Population growth, Population Explosion, Population Control, Women and Child welfare.
Urbanization, Industrialization, Development projects, Resettlement and Rehabilitation of people – Problems concerned, Case studies.
Consumerism and Waste Products Conservation, Public Awareness, Water Conservation, Rain water harvesting, watershed management, Wasteland reclamation, Human Rights, Value education, Environmental ethics- Issues and possible solution.
Role of information Technology in Environment and Human Health.

Text Books / Reference Books :

1. AnubhaKaushik& C P Kaushik, Environmental studies, New age International Publishers, 2008
2. Benny Joseph, Environmental studies, Tata McGraw-Hill Publishers, 2005
3. M Chandra Sekhar, Environmental Science, Hi-Tech Publishers, 2004
4. Keerthinarayana and Daniel Yesudian, Principles of Environmental Sciences and Engineering , Hi-Tech Publishers, 2005

5. Amal K.Datta, Introduction to Environmental Science and Engineering, Oxford & IBH Publishing Co.Pvt.Ltd, 2000
6. Santhosh kumar Garg, Rajeshawri Garg and Rajni Garg, Ecological and Environmental studies, Khanna publishers, 2006
7. Gilbert M, Introduction to Environmental Engineering and Science, Masters Publication by Prentice –Hall of India Private Ltd., 1991
8. William P Cunningham and Mary Ann Cunningham, Principles of Environmental Science, Tata McGraw Hill Publishing Co. Ltd, 2002

Course Outcomes:

CO1	Able to understand the importance of the environment
CO2	Able to identify conservation concepts of natural resources
CO3	Able to identify problems due to human interactions in the environment
CO4	Able to understand the enforcement of environment acts in our constitution
CO5	Capable of managing social issues related to environment

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2						3					2
CO 2	3						2					1
CO 3	1						3					
CO 4							3					
CO 5	2						2					

B.TECH III SEMESTER CHEMICAL ENGINEERING

MABST 301 **MATHEMATICS - III**

Instruction Hours/Week: 3(L) Credits: 3Assessment : 40 + 60 III Semester

Course Educational Objectives:

- To gain the knowledge of mathematics & Engineering problems
- To model a wide range of engineering and practical problems as ordinary differential equations
- To train the students thoroughly in Mathematical concepts of ordinary differential equations, multiple integrals, Laplace Transforms and their applications.
- To prepare students for lifelong learning and successful careers using mathematical concepts of ordinary differential equations, multiple integrals, Laplace Transforms and their applications.
- To develop the skill pertinent to the practice of the mathematical concepts including the student abilities to formulate and modeling the problems, to think creatively and to synthesize information.

UNIT - I

Complex analysis - I: Analytical functions - Cauchy-Reimann equations – Construction of Analytic functions- Complex integration - Cauchy's theorem - Integral formula - Evaluation of integrals.

UNIT - II

Complex analysis - II**:** Taylor's and Laurents' series- Transformations- Conformal mapping - Bilinear transformations - Transformation of $1/z$, z^2, sin z and cos z.

UNIT - III

Complex Analysis –III: Singularities - Poles - Residues - Residue theorem – Contour integration- Evaluation of real integrals

UNIT - IV

Partial differential equations - I : Formation of differential equations - Classification - First order linear partial differential equations – Legranges' linear equation - Method of multipliers - first order non-linear partial differential equations - Charpits method.

UNIT- V

Partial differential equations - II: Method of separation of variables - One dimensional wave equation - Heat equation – Laplace's equation.

Text Books:

1. Grewal B S, Higher Engineering Mathematics, 40th Edition, Khanna Publications, 2007.
2. Venkataraman M K, Engineering Mathematics, Vol. I & II, National Publishing Company, 1993.
3. Venkataraman M K, Engineering Mathematics, National Publishing Company, 1995.
4. Grewal B S, Engineering Mathematics, 13th Edition, Khanna Publications.
5. Kreyszig E, Advanced Engineering Mathematics, 8th edition, Wiley, 1998.

COURSE OUTCOME:

1	Applying various statistical models and methods for drawing conclusions and making decisions under uncertainty in engineering contexts
2	Apply statistical and numerical methods in various computer science related projects, seminars and research
3	Apply the knowledge of iterative methods to solve algebraic and transcendental equations, simultaneous linear equations, ODE (ordinary differential equations)
4	Acquire knowledge of finite differences, interpolation, numerical differentiation and numerical integration
5	Demonstrate a basic knowledge of the techniques for accurate and efficient solution of models based on linear and nonlinear systems of equations, ordinary differential equations and partial differential equations.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1		3			2							
CO2		3			2							
CO3		3			2							
CO4		3			2							
CO5		3			2							

CEEST 302 ENGINEERING AND SOLID MECHANICS

Instruction Hours/Week: 2(L) +1(T) Credits: 3 Assessment : 40 + 60 III Semester

Objectives:

1. The course is designed to give fundamental knowledge of mechanics of deformable solids including stress, strain, stress – strain relations.
2. Theories of failure and energy methods.

UNIT I :

Introduction, Point Kinematics: Moving point in various coordinate systems (Cartesian,Cylindrical, Path) (3L+1T)

Rigid body kinematics: Translation and rotation, relative motion, angular velocity, General motion of a rigid body, General relative motion (6L+2T)

UNIT II :

Equivalent force systems, Resultant forces, Linear and Angular Momentum, Laws of motion(Euler's Axioms), Free Body Diagrams, Dynamics of point mass models of bodies. 6L+2T

Equilibrium of rigid bodies, distributed forces, Analysis of structures: Trusses, Forces in

UNIT III :

Beams: Shear Force and Bending Moment (9L+3T)

UNIT IV :

Frictional forces, Laws of Coulomb friction, impending motion (3L+1T)

Inertia tensor, Principal Moments of Inertia, Moment of momentum relations for rigid bodies,Euler's Equations of Motion (6L+2T)

UNIT V :

State of stress at a point, equations of motion, principal stress, maximum shear stress, Conceptof strain, strain displacement relations, compatibility conditions, principal strains, transformation of stress/strain tensor, state of plane stress/strain. (6L+2T)

Uniaxial stress and strain analysis of bars, thermal stresses, Torsion of circular bars and thinwalled members, Bending of straight/curves beams, transverse shear stresses, deflection of beams, Buckling of columns (6L+2T)

TEXT BOOKS :

(1) Engineering Mechanics, Strength of Materials and Elements of Structural Analysis – C.Venkataramaiah & A.V.Narasimha Rao

REFERENCES :

(1) Strength of Materials – I.B.Prasad.
(2) Strength of Materials – S.S.Bhavikatti.
(3) Mechanics of Structures Vol. I --- S.B. Junnarkar
(4) Strength of Materials part - I ----Stephen Timoshenko.

Course Outcomes :

At the end of this course students will be able to

1. Learn about the elastic and plastic behavior of material and evaluate stress invariants, principal stresses and their directions.
2. Euler's Axioms, Free Body Diagrams, Dynamics of point mass models of bodies.
3. Shear Force and Bending Moment
4. Principal Moments of Inertia, Moment of momentum relations for rigid bodies,Euler's Equations of Motion.
5. Concept of strain, strain displacement relations, compatibility conditions, Uniaxial stress and strain analysis of bars.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	2	1		2								
CO 2	2	1	2									
CO 3		1		2	2							
CO 4			2	2	1	1						
CO 5			1	1	2							

CHPCT303 CHEMICAL PROCESS CALCULATIONS

Instruction Hours/Week: 3(L) +1(T) Credits: 4 Assessment : 40 + 60 III Semester

Course Educational Objectives:

1. To understand different representations of mixture compositions and reaction stoichiometry.
2. To understand the ideal gas law and its applications.
3. To learn the concepts of vapor pressure and different representations of vapor presence in gas mixtures.
4. To understand and to apply the law of conservation of mass.
5. To understand and to apply the law of conservation of energy.
6. To analyze combustion operations, from material and energy perspective.

UNIT – I:

Basic concepts – Units & Dimensions - Graphical integration and differentiation - use of log-log, semi-log and triangular graphs, conversion of units.

Stoichiometric and composition relations - Stoichiometric relation, basis of calculation, method of expressing composition of mixture and solutions, density and specific gravity.
Behavior of ideal gases: Ideal gas law and applications, gaseous mixtures, gases in chemical reactions.

UNIT - II:
Mass balance without chemical reaction – Formulation – Mass balance calculations for unit operations like distillation, absorption, extraction, crystallization (single solute systems), drying, evaporation.

UNIT - III:
Mass balance with chemical reaction – Mass balance calculations for processes involving reactions – Mass balance calculations for systems involving recycle, purge and bypass

UNIT - IV :
Vapor pressure - Concept of vapor pressure, liquefaction and liquid state, vaporization, boiling point, effect of temperature on vapor pressure, vapor pressure plots, vapor pressure of immiscible liquids and solutions, Raoult's law and its limitations.
Humidity and saturation: Relative and percent saturation, dew point, wet and dry bulb temperatures, Humidity charts

UNIT - V:

Energy balance

Thermophysics - Concepts of energy, energy balance equation, heat capacity of gases, liquids and mixtures in energy balance problems, Kopp's rule, latent heat - heats of fusion and vaporization, Trouton's ratio, Kistyakowski equation.

thermochemistry - Heats of formation, combustion and reaction, Hess law, Calculation of heat of reaction from heat of formation / combustion data, Effect of temperature and pressure on heat of reaction, Adiabatic reaction temperature

fuels & combustion- Heating value, Theoretical and actual flame temperatures

TEXT BOOK:

1. Chemical Process Principles part - I, Material and Energy Balances by Hougen, O.A., Watson, K.M. and Ragatz, R.A. John Wiley and sons, 2nd ed.
2. Chemical Process Calculations - David Himmelblau

REFERENCES:

1.Stoichiometry (3 rd edition) - Bhatt and Vora , tata-McGraw-Hill Publication
2. Elementary Principles of Chemical Process , 3 rd edition – Richard M.Felder & Ronald W.Rousseau, Wiley - Eastern
3. Process Calculations by K.V.Narayanan and Lakshmi Kutty.

Course Outcomes:

1. To understand the dimension-unit systems and their inter relationships, to be able to represent mixture compositions in different forms and to be able to make calculations using reaction stoichiometry.
2. To be able to make mass balance calculations for different operations, without reaction, its mathematical form and its application to different operations and reactions.
3. To be able to make mass balance calculations for different operations, with reaction , its mathematical form and its application to different operations and reactions.
4. To have learnt the significance of vapor pressure and its dependence and to have learnt different representations of partial saturation and to apply ideal gas law in conjunction with variation in levels of saturation.
5. To be able to estimate parameters like oxygen requirement, flue gas analysis, energy released and flame temperatures.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1									
CO2	1			2	2							
CO3			2	3		1						
CO4		1		2								
CO5			2	2	1							

CHPCT 304 **MOMENTUM TRANSFER**

Instruction Hours/Week: 3(L) +1(T) Credits: 4 Assessment : 40 + 60 III Semester

Course Educational Objectives :

1. To learn dimensional analysis, fluid statics and its applications.
2. To understand the important phenomena observed in flowing fluids, basic quantitative laws and equations of fluid flow.
3. To form a firm idea of the flow of impressible and impressible fluid flow through pipes and in thin layers.
4. To understand the flow past solid surfaces, through packed bed and in fluidized beds and able to learn the settling characteristics of particles through fluids.
5. To learn the working and performance of pumps and impressors, valves and able to understood the instruction and operation of flow measuring devices.

UNIT - I:

Introduction: Units, Dimensions and Dimensional analysis, Fluid statics and its applications.

UNIT - II:

Fluid flow phenomena, kinematics, of flow, velocity field - streamlines - irrotational flow - Newton's law of viscosity - Non-Newtonian fluids - Laminar and turbulent flows,
Basic equations of fluid flow - continuity equation - Bernoulli's equation and its applications.

UNIT - III:

Flow of incompressible fluids in conduits and thin layers - Laminar and turbulent flows in pipes and closed channels - Universal velocity distribution - friction factor, effect of fittings and valves. Flow of compressible fluids - continuity equation, mechanical energy balances, Isentropic flow through nozzles (Theory only, OMIT adiabatic and isothermal friction flows).

UNIT - IV:

Flow pas immersed bodies, drag force and drag coefficient, friction in flow through bed of solids - motion of particles through fluids - free and hindered settling - Mechanism and pressure drop of fluidization and its applications - fundamental concepts of two – phase, gas liquid flow.

UNIT - V:

Transportation and metering of fluids, fluid moving machinery - classification and performance of pumps and compressors - selection and specifications - measurement of flowing fluids, storage and handling.

TEXT BOOKS:

1. Unit operations of Chemical Engineering (5th ed) Warren L.McCabe, Juliane Smith and Peter Harriott, McGraw Hill.

REFERENCES:

1. Chemical Engineering Vol.I by Coulson and Richardson, Pergamon Press.

Course Outcomes:

1. To be able to perform dimensional analysis of fluid flow problems and develop pressure drop equations for fluid static equipments in which fluid is at rest.
2. To have the knowledge on different types of flow regions in fluid flow, rheological properties of fluids, turbulence and boundary layers.
3. To be able to carry out macroscopic mass, momentum and energy balance to solve engineering problems related to fluid flow and to analyze flow past solid surface, through packed bed and in fluidized beds.
4. Determine the minimum fluidization velocity andterminal velocity of the fluid in Stokes and Newton's law regions.
5. The analysis of fluid flow measuring devices like Orifice meter, Venturimeter, Rotameter and Pitot tube, the construction and working of Centrifugal and reciprocating pumps. And also give the knowledge on different types of valve, selection of pipe and fittings.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1									
CO2	1			2	2							
CO3			2	3		1						
CO4		1		2								
CO5			2	2	1							

CHPCT 305 **MECHANICAL UNIT OPERATIONS**

Instruction Hours/Week: 3(L) +1(T) Credits: 4 Assessment : 40 + 60 III Semester

Course Educational Objectives:

1. To develop understanding of solids, their characterization, solid handling and mixing.
2. To develop understanding of the principles of comminution, milling and size reduction operations.
3. To understand separation of solid mixtures.
4. To understand the different techniques of separation of solid-liquid mixtures.
5. To understand on methods and effect of agitation and mixing of liquids.

UNIT - I: Characterization of particulate masses

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

UNIT - II: Size reduction

Principles of comminution, computer simulation of milling, Operations size reduction equipment -crushers, grinders, ultra fine grinders, cutting machines, equipment and operation.

UNIT - III:

Mechanical separations -I

Screening, screening equipment, Separations based on motion of particles through fluids, gravity settling processes and centrifugal settling processes, Gas cleaning. Flotation

UNIT – IV:Mechanical separations-II

Filtration – Cake filters - Centrifugal filters, principles of cake filtration and clarifying filters, liquid clarification, principles of clarification, cross flow filtration,

UNIT - V:

Agitation and mixing of liquids: agitation of liquids, circulation velocities, power consumption in agitated vessel, blending and mixing - suspension of solid particles, dispersion operation.

TEXT BOOK:

1. Unit operations of Chemical Engineering (5th ed) Warren L.McCabe, Juliane Smith and Peter Harriott, McGraw Hill.

REFERENCE:

1. Chemical Engineering Vol.I & II, Coulson and Richardson , Pergamon Press.
2. Mechanical Operations for Chemical Engineers by Narayanan & Bhattacharya, Khanna Publishers

Course Outcomes :

1. To be able to determine the Volume surface mean diameter, mass mean diameter, number of particles and types of mixers.

2. To have the knowledge of different types of Crushers, grinders, ultrafine grinders, cutters, to be able to find the power requirement using three crushing laws.

3. To be able to calculate the screening effectiveness .To have understood settling processes and flotation technique.
4. To develop the rate equations for constant pressure and constant volume filtration techniques and also to solve the problems related to these techniques.To have acquired the construction and operation of different filtration, settling and clarifying equipment.
5. To understand the functioning of agitated vessels and to calculate the power consumption.To have the knowledge on different types of turbines, blending and mixing.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1									1			1
CO2						1	1		1			1
CO3						1	1	1	1			1
CO4						1	1	1	1			1
CO5		1			1				1			1

CHPCP 306 FLUID & PARTICLE MECHANICS LABORATORY

Instruction Hours/Week: 3(P) Credits: 1.5 Assessment : 40 + 60 III Semester

Any 10/12Experiments on

Flow Through Straight Pipe, Frictional losses Due To Fittings, Venturimeter , Orificemeter, Flow Through Helical Coil, Characteristics Of Centrifugal Pump, Flow Through Annulus, Frictional Loss Due To Sudden Expansion, Bernoulli's Experiment, Flow Through Packed Bed, Fluidization

Size Reduction, Sieve Analysis, Filtration, Cyclone Separation, Particle movement through a liquid column

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CHPCP 307 ANALYSIS LABORATORY

Instruction Hours/Week: 3(P) Credits: 1.5 Assessment : 40 + 60 III Semester

10 / 12 Experiments from

Chemical Analysis - Water(Hardness& total chlorides), Estimation Of Chromium, Analysis of Bleaching Powder, Estimation Of Phenol, Estimation Of Sugars, Analysis Of Vegetable Oils, Analysis Of Soda Ash, Analysis Of Pyrolusite, Analysis of Urea

Instrumental Analysis - .Flurometer, Refractometer, Polarimeter, Conductometric Titration, Viscosity And Flash Point Determination, .Measurement Of pH, Colourimeter, Potentiometric Titration, Fuel Characterization-Calorific Value, Flash And Cloud Points

B.TECH IV SEMESTER CHEMICAL ENGINEERING

MABST 402 PROBABILITY AND STATISTICS

Instruction Hours/Week: 2(L) +1(T) Credits: 3 Assessment : 40 + 60IV Semester

Course Objectives:

1. To To familiarize the students with the concept of probability distributions and statistics as indispensable tools for data analysis and decision making in engineering fields.
2. To introduce basic concepts of statistics, various distribution functions.
3. To explain the concept of estimation and t-test, F-test and Chi-square test.
4. To explain the objective of Correlation and Regression analysis.
5. To acquaint the students with different types Quality Control charts.

Unit – I

Probability: Introduction, axiomatic approach, conditional probability, Baye's theorem, stochastic process, Random variables, Discrete and Continuous distributions, expectation, variance, moments, moments generating functions.

Unit – II

Distributions: Binomial, Poisson, Normal, Uniform, Exponential and Gamma Properties and applications.

Unit – III

Estimator: Estimation of parameters by method of moments and maximum likelihood - Testing of hypothesis - small sample tests-t-test, f-test and chi-square test.

Unit – IV

Correlation: curve fitting by method of least squares - Linear, Quadratic and Exponential fitting – Correlation – Rank, Correlation - Regression analysis - Multiple correlation.

Unit – V

Quality Control: Concept of quality of a manufactured product - Causes of variation -Principles of Shewart control charts - X-chart, R-chart, p-chart, np-chart and C-chart.

Text Books:

1. S P Gupta, Statistical Methods, 38th Edition, Sultan Chand & Sons Educational Publishers, 2009.
2. Y K V Iyengar et al, Probability and Statistics 2nd Edition, S. Chand & Company Ltd, 2010.
3. S C Gupta and V K Kapur, Fundamentals of Applied Statistics, 3rd Edition, Sultan Chand & Sons Educational Publishers.

Course Outcomes: At the end of the course, students will be able to

1. To make use of the concepts of probability and their applications. Apply Probability theory to find the chances of happening of events.

2.To discuss Distributions and Properties and applications.

3. To measure the quantity of estimations.

4. Design the components of a classical hypothesis test. Infer the statistical inferential methods based on small and large sampling tests. Interpret the association of characteristics and through correlation and regression tools.

5.To acquire knowledge of Quality control charts.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**											
CO2		**2**			**2**							
CO3			**3**	**1**								
CO4			**1**									
CO5					**3**	**2**						

CHPCT 403 CHEMICAL ENGINEERING THERMODYNAMICS - I

Instruction Hours/Week: 3(L) +1(T) Credits: 4 Assessment : 40 + 60 IV Semester

Course Educational Objectives:

1. To understand the concepts of energy, forms of energy, equilibrium and reversibility
2. To learn and apply the first law of thermodynamics
3. To understand the P-V-T behavior of pure fluids
4. To learn the concept of entropy and to apply second law of thermodynamics
5. To study the feasibility of processes and able to learn thermodynamic analysis of refrigeration and different flow processes

UNIT - I:

Introduction – Scope, Dimensions and Units – Mass, mole, volume, force, temperature, pressure, work, energy, heat, internal energy.

The first law of thermodynamics, Energy balance for closed systems, Thermodynamic state and state functions, equilibrium, The phase rule, The reversible process, enthalpy, heat capacity, Mass and energy balances for open systems, Energy balances for steady state flow processes

UNIT - II:

Volumetric properties of pure substances: P-V-T behaviour, Virial expressions, The ideal gas, Applications of Virial equations , Cubic equations of state - vander walls and Redlich - Kwongg equations, Theorem of corresponding states, generalized correlation – Pitzer correlation.

UNIT - III:

Heat effects – Sensible and latent heat effects, Heats of formation , combustion and reaction, Temperature dependence, heat effects of industrial reactions .

UNIT - IV:

Second law – Statement, Heat engine, Thermodynamic Temperature scale, concept of entropy, mathematical statement of second law, Entropy changes of an ideal gas, Calculation of ideal work and lost work The Third Law of Thermodynamics

UNIT - V:

Refrigeration: The Carnot refrigerator, The vapor compression cycle, choice of refrigerant, cascade systems, absorption refrigeration, Heat pump, Liquefaction process.

Thermodynamics of flow processes- Duct flow of Compressible fluids – turbines – compression process

Production of power from heat– The steam power plant, Internal combustion engines, Jet engines .

TEXT BOOK:

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

REFERENCES:

1. Chemical Engineering Thermodynamics by Thomas E.Daubert
2. Chemical Engineering Thermodynamics, YVC Rao, University publications.

Course Outcomes:

1. To have learnt the fundamental ideas about energy, equilibrium and reversibility. To be able to apply first law to estimate heat and work effects in closed, open and flow systems.

2. To understand PV and PT phase diagrams, ideal gas law and its applications. To be able to estimate heat and work effects for different processes – isothermal, isobaric, isometric, and adiabatic processes.

3. To be to apply second law of thermodynamics to estimate efficiency of a cycle. To have understood the concept of entropy and its estimation.

4. To have learnt different refrigeration cycles and also to be able to calculate their COP.

5. To have learnt the thermodynamic analysis of flow processes.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1							1			1
CO2		2		1		1			1			1
CO3		1					1		1			
CO4	1	1							1			1
CO5		1				1	1		1			1

CHPCT 404 **HEAT TRANSFER**

Instruction Hours/Week: 3(L) +1(T) Credits: 4 Assessment : 40 + 60 IV Semester

Course Educational Objectives:

1. To understand different modes of heat transfer and their characterization
2. To understand the transfer mechanism of heat in fluids with and without phase change
3. To learn the principles of radiation heat transfer
4.. To design heat exchange equipment
5. To understand the principles of evaporation and the working of equipment and to learn the principles of crystallization

Unit I : Heat transfer by conduction

Fourier's law - one dimensional steady state conduction- compound resistances in series - plain wall, cylinder, sphere - critical thickness of insulation - Unsteady state heat conduction - one dimensional, semi infinite solid, infinite slab – lumped hat capacity systems

Unit II :Principles of Heat Flow

Principles of heat flow in fluids – heat exchange equipment – parallel and countercurrent flow – energy balances – calculation of overall heat transfer coefficient – log mean temperature difference – single and multiple heat exchangers – correction for LMTD – Fouling Factors – Effective Coefficients for Unsteady State conduction – NTU & Effectiveness Methods

Unit III : Heat transfer to fluids with out phase change

Concept of hydrodynamic and thermal boundary layers – Dimensional Analysis

Forced Convection in laminar flow over plates and in tubes – correlations for heat transfer in turbulent flow – Dimensional Analysis – Heat Transfer at High velocities

Analogy between heat and momentum transfer – Reynold's, Prandtl and Colburn analogies

Transfer to liquid metals

Natural Convection – Heat transfer over vertical plates and tubes, horizontal plates and tubes

Unit IV : Heat transfer to Fluids With Phase Change& Radiation

Heat transfer from condensing vapors - drop wise and film wise condensation - Nusselt assumptions and derivation of Nusselt equation – Condensation of superheated vapors - effect of non-condensable gases on rate of condensation - heat transfer to boiling liquids

Fundamentals of Radiation heat transfer – laws of black body radiation – radiation between surfaces – view factors – radiant heat exchange between black and non-black surfaces – combined heat transfer by conduction, convection and radiation – radiation shields

Unit V : Condensers & Evaporators

Condensers - boiler and calandria - heat transfer in agitated vessels, heat transfer in packed beds - scraped surface exchangers – Plate Type Heat exchangers – Extended Surfaces
Evaporation : types of evaporators – capacity and economy of evaporators - material and energy balances in single effect evaporators - multiple effect evaporators – methods of feeding

Text book

1. Unit Operations of Chemical Engineering by Warren L.McCabe and Julian C.Smith

Reference Book

1. Heat Transfer by J.P.Holman, McGraw-Hill Publications

Course Outcomes :

1. To be able to calculate the heat transfer flux in one-dimensional heat conduction .To have learnt the concepts of turbulence, boundary layer and analogies.

2. To have understood the construction and flow patterns in heat exchange equipment.

3. To be able to calculate heat flux in natural convection. To be able to estimate heat flux in forced convection.

4. To have understood the concepts of black body, view factors and to be able to calculate radiation heat flux. To be able to handle conduction-convection conduction-convection-radiation heat transfer.

5. To be able to design heat exchangers and condensers. To have understood the functioning of evaporators.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**1**	**1**	**1**	**1**	**1**						**1**
CO2		**1**	**1**	**2**		**1**	**2**					
CO3					**1**	**1**						
CO4				**1**				**1**	**1**			
CO5										**1**		

CHPCT 405 **MASS TRANSFER OPERATIONS - I**

Instruction Hours/Week: 3(L) +1(T) Credits: 4 Assessment : 40 + 60 IV Semester

Course Educational Objectives :

1. To understand the mechanisms of mass transfer – diffusive and convective transport
2. To synthesize the overall resistance for transfer from individual phase resistances
3. To develop the frame work for the design of equipment for staged and continuous contacting devices
4. To learn the construction, operation and inoperable conditions in gas-liquid contacting devices
5. To understand the equilibrium considerations in the operations – absorption / drying / humidification

UNIT - I:

Introduction: Scope of Mass Transfer Operations - Classification of Mass Transfer Operations - Choice of Separation method - Methods of conducting Mass Transfer Operations - design principles.

Diffusion In Fluids : Molecular diffusion - The equation of continuity - Steady state molecular diffusion of Fluids at rest and in laminar flow - Diffusivity of gases and liquids - Applications of molecular diffusion.

Eddy Diffusion - Mass transfer coefficients - Mass transfer coefficients in laminar flow and turbulent flow - mass transfer theories - Mass, Heat and Momentum Transfer Analogies - Mass Transfer data for simple situations.

UNIT - II:

Inter Phase Mass Transfer: Equilibrium – Overall mass transfer coefficients – gas phase & liquid phase controlled situations

Equipment for gas-liquid contact – Description of continuous and stage wise contact equipment – packing for packed columns liquid distribution – mass transfer coefficients in packed columns - inoperable conditions – stage , ideal stage, Point, plate and column efficiency – comparison of plate and packed columns

UNIT - III

Gas Absorption: Equilibrium solubility of gases in liquids - choice of solvent for absorption- Co-current and Counter current flow (one component transferred) – material balance, Minimum liquid - gas ratio for absorbers, Dilute gas mixtures, Absorption factor – Kremser-Brown equations - Determination of number of transfer units and height of transfer unit

UNIT - IV:

Humidification Operations: Vapor - liquid Equilibrium and Enthalpy for a pure substance - vapor gas mixtures, Air-water system - Adiabatic saturation curves, wet bulb

temperature – Psychrometric charts – humidification and dehumidification – Operating lines and design of packed humidifiers, dehumidifiers - cooling towers - spray chamber - Evaporative cooling.

UNIT - V:

Drying : Equilibrium - Insoluble solids - Soluble solids - Drying Operations - Batch Drying - Mechanisms of Batch Drying-Thorough Circulation Drying - Continuous Drying - Equipment - Rate of drying

TEXT BOOK:

1. Mass Transfer Operations - Robert E.Treybal (3rd Ed.) McGraw Hill, Kogakusha.

REFERENCE :

1. Principles of Mass transfer and Separation Processes – B. K.Datta - PHI

Course Outcomes :

1. To be able to calculate the flux in cases involving diffusive transfer. To appreciate the contribution of turbulence to transfer and to calculate coefficients and from them, the flux.
2. To be able to differentiate different representations of resistances and to properly integrate them to obtain the overall resistance. To be able to estimate the process parameters like solvent requirement, number of theoretical stages, height and diameter of columns.
3. To understand equilibrium relevant to absorption and to calculate the number of stages, number and height of transfer units.
4. To understand the equilibrium concerned to humidification, various methods of conducting the operation and to design a cooling tower.
5. To understand the mechanism of drying operation and to calculate the time of drying.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**1**	**1**	**1**	**1**	**1**						**1**
CO2		**1**	**1**	**2**		**1**	**2**					
CO3					**1**	**1**						
CO4				**1**				**1**	**1**			
CO5										**1**		

CHPCT 406 **CHEMICAL TECHNOLOGY**

Instruction Hours/Week: 3(L) Credits: 3 Assessment : 40 + 60 IV Semester

Course Educational Objectives :

1. To know the difference between unit operations and unit processes
2. To learn principles of different unit operations
3. To learn to understand flow sheet representation of a manufacturing process
4. To know the industrial production of different organic compounds sugars, alcohol, paper, oils, soaps, paints, plastics, and rubbers
5. To learn the thermodynamic considerations, engineering problems and economic factors in the production of various products

UNIT - I

Water Technology: Sources of water - methods of treating fresh water - Desalination - Activated Sludge Process

Fuel and Industrial gases: Natural gas, LPG, Carbon dioxide, Hydrogen, Nitrogen and Synthesis gas.

Chlor-Alkali Industry: Manufacture of Soda Ash , Caustic Soda& Chlorine

UNIT - II

Nitrogen Industries - Synthetic Ammonia, Urea, Nitric acid .

Phosphorous Industries: Super Phosphate & Triple Super Phosphate, Phosphoric acid

Sulfur and Sulfuric acid

UNIT - III

Cement- Types and manufacture.

Pulp And Paper Industry - Methods of pulping, Production of sulphate and sulphite pulp, production of paper - wet process.

Sugar And Starch Industry - Manufacture Of Cane Sugar, Production Of Starch From Maize

UNIT IV

Oils, fats and waxes: Edible oil - extraction of vegetable oils- Hydrogenation of oils - Methods of production of essential oils .

Soaps and detergents- manufacture of soaps, detergents and glycerin

Manufacture of Industrial alcohol, acetone and butanol, acetic acid, vinegar, Penicillin.

UNIT - V

Synthetic fibers: Manufacture of Rayon, Nylon and polyester fibers.

Plastics: Classification-types of synthetic resins and plastics and their manufacture - Thermosetting resins-thermoplastic resins, oil soluble and modified resins-laminated Plastics.

Rubbers: Classification, natural rubber, monomers for synthetic rubber, manufacture of SBR.

TEXT BOOK:

1. Chemical Process Industries by R.N.Shreve and J.A.Brink Jr. McGraw Hill 5th ed.

REFERENCE:

1. Dryden's Outlines of Chemical Technology by Gopal Rao and Marshall sitting. -
- Boca Raton

Course Outcomes:

1. Able to differentiate unit operations and unit processes. To Know the basic principles of different unit operations. Able to know constituents of petroleum, and the extraction of petroleum compounds petrol, diesel
2. Can understand the raw materials and production of Ammonia, Urea, Phosphorus industries.
3. Can understand the raw materials, pulp and paper industry, reactions involved and the production of sugar, starch.
4. Get knowledge about alcohol, soaps, edible oils, hydrogenation of oils and extraction of vegetable oils.
5. Can understand the difference between paints and varnishes and about the production. Know the classification of plastics, industrial production of plastics and rubbers.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1									
CO2	1			2	2							
CO3			2	3		1						
CO4		1		2								
CO5			2	2	1							

CHBST 407 **FUNDAMENTALS OF BIOTECHNOLOGY**

Instruction Hours/Week: 2(L) Credits: 2 Assessment : 40 + 60 IV Semester

OBJECTIVES

1) To learn about micro organisms and classification , different cell types
2) To understand about chemicals of life and their primary characteristics
3) To learn about the classification and functions of protiens
4) To know thermodynamic principles and different metabolic path ways
5) To Understand fermentation process, bio chemical mechanisms, basics of microbial genetics

UNIT I : Basic Microbiology

Microorganisms : Discovery & Classification of Microorganisms

Prokaryotic cells – Morphological and structural characteristics - biosynthetic capabilities

Eukaryotic cells - Morphological and structural characteristics – biosynthetic capabilities

Nutrient and Energy requirement of microbes

UNIT II : Chemicals of Life – I

Carbohydrates – classification – structure – properties – biological importance of polysaccharides like starch, cellulose, chitin, alginic acids, pectins

Lipids– building blocks of lipids – classification –physico-chemical properties of fatty acids - salient features of bacterial lipids

Nucleic Acids – types and classification – DNA and RNA

Vitamins, Growth hormones and regulators

UNIT III : Chemicals of Life – II

Proteins –Classification and physico-chemical properties of amino acids, peptide bond, properties and functions of peptides – protein classification – structure (primary, secondary, tertiary and quaternary) – structure-function relationship

Catalytic Proteins – classification, nomenclature, composition and structure – enzymes as biocatalysts – denaturation and renaturation

UNIT IV : Cell Metabolism

Bioenergetics **–** Concepts of free energy and thermodynamic principles in biology – energy transformation – Adenosine phosphates – redox potentials – free energy changes in redox potentials – photosynthesis

Metabolic Pathways – Utilization of sugars (EMP – ED – HMP) - Respiration (TCA cycle and respiratory chain) - amphibolic nature of pathways – Metabolic organization and regulation

UNIT V : Microbial Technology

Fermentation **-** Nature of fermentation - Oxygen requirement for growth and fermentation – Description of a typical fermentation process

Basics of Microbial Genetics – Genomes, genes, plasmids, transposans, genetic recombinations – rDNA technology as tools, cloning strategies, transgenics.

REFERENCES:

1. Microbiology(1999) 3 rd edition by Prescott et al ., Wm. C. Brown Publications.

2. Principles of Microbiology (1997) 2 nd edition by R.A.Atlas Wm. C. Brown Publications.
3. Principles of Biochemistry (2000) by A.H.Lehinger
4. Microbial Genetics (1995) by David Freifelder, Narosa Publishing House
5. Molecular Biotechnology(1994) Glick & Pasternak, Freeman and Co
6. Gene Biotechnology by Jogdand, Viva Publications

Cource Outcomes:

1. Able to know about structures of yeast,bacteria, molds and their growth .Able to understand about structures of prokaryotic and eukaryotic cells with examples
2. Can know the classification, structure and properties of carbohydrates, lipids and nucleic acids
3. Able to know the types of proteins, structures and their functional relationship
4. Get knowledge of cell metabolism, concepts of bio energetic and different bio chemical fermentation processes
5. Can understand about the nature of fermentation, oxygen requirements and biochemical mechanisms of lactic acid, ethanol.Can understand about genomes and plasmids, rDNA technology and cloning

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1									
CO2	1			2	2							
CO3			2	3		1						
CO4		1		2								
CO5			2	2	1							

CHPCP 408 HEAT TRANSFER LABORATORY

Instruction Hours/Week: 2(P) Credits: 1 Assessment : 40 + 60 IV Semester

Any 8/10 experiments on Double Pipe Heat Exchanger, Heat Transfer through Composite Wall, Thermal Conductivity of Insulating Powder, Heat Transfer from Pin Fin Apparatus, Heat Transfer through Natural Convection, Heat Transfer through Forced Convection, Critical Heat Flux Apparatus, Heat Transfer in Agitated Equipment, Condensation of Steam on Vertical Copper Tube, Radiation heat Transfer

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B.TECH V SEMESTER CHEMICAL ENGINEERING

MABST 501 NUMERICAL METHODS FOR CHEMICAL ENGINEERING

Instruction Hours/Week: 2(L) Credits: 2 Assessment : 40 + 60 V Semester

Course Objectives:

1. This course aims at providing the student with the knowledge on Various numerical methods for solving equations, interpolating the polynomials.
2. Evaluation of Finite Differences And Difference Equations **.**

3. To acquaint the students with different types of numerical methods to solve transcendental equations, derivatives and integrals.
4. To provide suitable and effective methods called Numerical Methods, for differential equations.
5. Evaluation of iterative methods and Finite Difference approximation to derivatives, solutions of Laplace, Poisson equations by iterative methods.

Unit I :

Finite Differences And Difference Equations

Finite Difference, the Difference Operator - properties of Difference Operators - Difference Tables - other Difference Operators

Difference Equation - formation, linear Difference Equations, Complementary Function and particular integral, Difference Equations reducible to linear forms, simultaneous Difference Equations with constant coefficients

Unit-II :

Numerical Interpolation, Integration & Differentiation **-** Newton's forward & backward interpolation formula - Lagrange's interpolation formula - Numerical differentiation by Richardson's extrapolation - Numerical integration by Romberg method

UNIT - III:

Solutions of Algebriac & Transcendental Equations: Determination of roots of non - linear equations by iterative methods - Falsi position method - Newton Raphson method - Multiple roots by Newton Raphson method - Complex roots by Mueller's method.

UNIT - IV:

Solution Of Linear And Non-Linear Algebraic Equations **-** iterative methods - Gauss elimination with pivotal condensation - Triangular factorization methods – ill condition systems - Gauss Seidal & Newton Raphson iterative methods - Comparison of convergence properties of GS & NR iterative techniques.

UNIT - V:

Solution Of Ordinary & Partial Differential Equations - Euler's method - Euler's modified method - Runge Kutta second & fourth order methods - Runge Kutta Gill method - Milne's predictor and corrector methods for first order equations.
Finite Difference approximation to derivatives, solutions of Laplace, Poisson equations by iterative methods.

TEXT BOOK:

1.Higher Engineering Mathematics – B.S.Grewal
2. Numerical methods by E. Balagurusamy, Tata McGraw-Hill Publishing Co.
3. Numerical Methods for Scientific and Engineering Computation 3 rd edition by Jain, New Age International

Course Outcomes: At the end of the course, students will be able to

1. After the completion of course, students will be able to Apply numerical methods to solve all type of equations. Finite Differences And Difference Equations
2. Derive interpolating polynomials using interpolation formulae.
3. Analyse the data and develop skills to solve Algebraic & Transcendental Equations.
4. To find the Solution Of Linear And Non-Linear Algebraic Equations.
5. Derive numerical methods solution of Ordinary & Partial Differential Equations .

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**											
CO2		**2**			**2**							
CO3			**3**	**1**								
CO4			**1**									
CO5					**3**	**2**						

CHPCT 502 **CHEMICAL ENGINEERING THERMODYNAMICS - II**

Instruction Hours/Week: 3(L) +1(T) Credits: 4 Assessment : 40 + 60 V Semester

Course Educational Objectives :

1. To develop frame work to estimate thermodynamic properties of fluids
2. To systematize the synthesis of mixture properties from pure component properties
3. To develop equilibrium criterion and examine its various forms
4. To study phase equilibria
5. To study chemical reaction equilibria.

Unit I :

Thermodynamic properties of fluids

Property relations for homogeneous phases - Residual properties - Two phase systems - Thermodynamic diagrams - Tables - Properties from virial equations - Properties from equations of state - Properties from Pitzer-type correlations

UNIT – II :

Solution thermodynamics

Fundamental property relations - Chemical potential as a criterion for phase equilibrium - Partial properties -Ideal gas mixtures - Fugacity and fugacity coefficient for pure species and component in solutions - Ideal solutions - Excess properties, Liquid phase properties from VLE data, models for excess Gibb's energy, property changes of mixing.

UNIT – III

VLE at low to moderate pressures

Nature of equilibrium - Phase rule, Duhem's theorem, qualitative behaviour, the gamma/phi formulation of VLE, Dewpoint and bubble point calculations, flash calculations.

UNIT – IV

Topics in Phase Equilibria:

VLE from cubic equations of state, VLE from k-value correlations - Equilibrium and stability - liquid-liquid equilibrium (LLE), vapor-liquid-liquid equilibrium (VLLE)

UNIT - V:

Chemical Reaction Equilibria

Reaction coordinate - application of equilibrium criterion to chemical reactions - standard Gibb's energy change and the equilibrium constant - effect of temperature on equilibrium constant - Evaluation of equilibrium constant - relation to composition - equilibrium conversion for single reactions - phase rule and Duhem's theorem for reacting systems.

TEXT BOOK:

1. J.M.Smith and H C Van Ness, Introduction to Chemical Engineering Thermodynamics 5th ed. McGraw Hill 1996.

REFERENCES:

1. Chemical Engineering Thermodynamics by Thomas E.Daubert
2. Chemical Engineering Thermodynamics, YVC Rao, University publication

Course Outcomes :

1.To be able to develop and use expressions for property estimation. To be able to calculate property values from equations of state.

2. To have learnt the concepts of residual, excess, partial molar properties and property changes of mixing**.** To have understood concepts of ideal solutions, fugacity and activity coefficient.

3. To be able to use modified forms of Raoult's law for non-ideal systems, Dewpoint and bubble point calculations.

4. To be able to make phase equilibrium calculations using Raoult's law. To have learnt the concepts of LLE and VLLE.

5. To have learnt the concept of equilibrium constant and its calculation. To be able to estimate equilibrium conversion of single and simple multiple reactions.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1									
CO2	1			2	2							
CO3			2	3		1						
CO4		1		2								
CO5			2	2	1							

CHPCT 503 **MASS TRANSFER OPERATIONS – II**

Instruction Hours/Week: 3(L) +1(T) Credits: 4 Assessment : 40 + 60 V Semester

Course Educational Objectives :

1. To understand VLE and to learn the design of plate and packed columns suitable for distillation
2. To understand LLE and to learn the design of staged columns for liquid-liquid and solid-liquid extraction. Also to learn the construction and operation of different equipment for the said operations
3. To understand the mechanism of adsorption and to estimate the process parameters
4. To get a fundamental understanding of membrane separations
5. To understand the mechanism of ion exchange and leaching processes

UNIT – I : Distillation – I

Vapor- Liquid Equilibria - P-x-y and t-x-y diagrams – x-y and H-x-y diagrams - ideal solutions - Raoult's Law, positive and negative deviations from ideality, Minimum and Maximum boiling azeotropes Steam distillation - Flash vaporization - Differential Distillation – batch distillation with reflux.

UNIT – II : Distillation – II

Continuous Fractionation - Binary systems, Multistage towers - The method of Ponchan and Savarit - The method of McCabe-Thiele - Feed tray location, total reflux, minimum reflux ratio, optimum reflux ratio, use of open steam, multiple feeds, partial and total condensers - Packed bed distillation. – Principles of azeotropic and Extractive Distillation.

UNIT - III: Liquid - Liquid Extraction

Liquid Extraction - Fields of usefulness - Liquid Equilibria - Equilateral Triangular coordinates - Rectangular coordinates - Rectangular coordinates on solvent free basis - Systems of three liquids - One pair partially soluble, two pairs partially soluble - Effect of temperature, choice of solvent. Single stage Extraction - Multistage cross current extraction and continuous counter current multistage extraction with out and with reflux - Insoluble liquids – Equipment for solvent extraction - agitated vessels, Emulsions and Dispersions, Mixer - settler cascades, sieve tray towers. Continuous contact (Differential)contactors - Spray towers - packed towers - Mechanically agitated counter current extractors, Rotating Disc contactors, centrifugal Extractors.

UNIT IV: Leaching

Preparation of the solid - Temperature of Leaching - unsteady - state operation - in-place Leaching, Heap leaching, percolation tanks - Counter current multiple contact (the

shanks system), percolation in closed vessels, Filter - press leaching Agitated vessels. –Batch settling - Steady - stage (continuous) operation - Leaching during grinding, Agitated vessel, Thickeners, continuous counter current Decantation, Hydro cyclones, continuous leaching of course solids, classifiers, leaching of vegetable seeds.

Basics of Membrane Separations – classification – capillary and solution diffusion models – retention coefficient – concentration polarization – fouling – membranes (operational requirement – structure and preparation) – components of a typical membrane separation plant – micro filtration – ultrafiltration – reverse osmosis – dialysis – electro dialysis - pervaporation

UNIT – V:Adsorption

Types of adsorption - Nature of Adsorbents - Adsorption equilibrium - single gases and vapors, vapor and gas mixtures, liquids. Adsorption operations - Stage wise operation - Multistage cross current and counter current operation, application of the Freundlich equation, Equipment - Agitated vessels, Fluidized beds, Steady state fixed bed absorbers, adsorption wave, Ion Exchange - Principles of ion exchange, Techniques and applications, Equilibrium Rate of ion exchange.

Text Book:

1. Mass Transfer Operations - Robert E Treybal (3rd ed.) McGraw Hill, Kogakusha.

Reference Books :

1. Bioseparations – Principles and Techniques – B.Sivasankar
2. Principles of Mass transfer and Separation Processes – B. K.Datta - PHI

Course Outcomes:

1. To be able to analyze different phase diagrams – pxy, txy, hxy, bimodal solubility curve and Nxy representations. To be able to calculate flash calculations. To be able to apply Rayleigh's equation (differential distillation).
2. To be able to calculate the number of ideal stages using Ponchon-Savarit and McCabe-Theile procedures. To acquire a fundamental understanding of azeotropic and extractive distillation.
3. To be able to calculate the solvent requirement and number of stages for different contacting patterns like single stage, cross current and countercurrent modes.
4. To be familiar with different constructions of equipment suitable for extraction and leaching.
5. To be able to explain the equilibrium of adsorption and to calculate the material requirement and number of stages for different contacting schemes. To have visualized fixed and moving bed adsorption and regeneration.

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3	1	1				2	1			1
CO2	1	2	1	1					1			1
CO3	1		1		1			3	1			1
CO4	1		1		1			3	1			1
CO5	1		1		1			3	1			1

CHPCT 504 **CHEMICAL REACTION ENGINEERING - I**

Instruction Hours/Week: 3(L) +1(T) Credits: 4 Assessment : 40 + 60 V Semester

Course Educational Objectives :

1. To provide knowledge on different types of reactions, reaction rate and mechanism
2. To provide knowledge on collection and analysis of batch reactor data for homogeneous reactions
3. To provide knowledge of different types of ideal reactors and to derive their design equations
4. To teach about different reactor configurations, their selection and performance analysis
5. To provide a foundation on deriving rate expressions for multiple reactions
6. To teach about the heat effects during the reaction and finding the rate of reaction

UNIT - I:

Introduction: Performance equation, Classification of Reactions, Variables affecting the rate of reaction, Definition of Reaction rate.

Kineticsof Homogeneous Reaction: Concentration - dependent term of a rate equation - Temperature dependent term of Rate equation, Searching for a mechanism.

UNIT - II:

Interpretation of Batch Reactor Data: Constant - Volume Batch Reactor - Integral method and differential method of Analysis of Data. Variable - Volume Batch Reactor - differential and integral methods of analysis of Data. Temperature and Reaction Rate, the search for a rate equation.

Single Ideal Reactor Design - Ideal Batch Reactor - Steady state mixed flow Reactor - Steady state plug flow Reactor - Space time, Space velocity, holding time in flow systems.

UNIT - III:

Design for Single Reactions: Size comparison of Single Reactions - Batch Reactors - Mixed Vs.Plug flow Reactors - First and Second order Reactions - Variations of Reactant ratio for second order reactions - General graphical procedure. Multiple Reactor systems - plug flow Reactors in series and/ or in parallel, Equal size mixed Reactors in series and/or in parallel, mixed reactors of different sizes in series - reactors of different types in series, Recycle reactor (omit auto catalytic reactions).

UNIT - IV:

Design for Multiple Reactions: Reactions in Parallel - in series - successive first order reactions - first order followed by zero order reaction - zero order followed by first order reaction successive irreversible reactions of different orders. Reversible reactions; series/parallel reactions and applications.

UNIT - V:

Temperature and Pressure Effects: Single Reactions - Heats of Reactions from Thermodynamics, Equilibrium constant from Thermodynamics, General Graphical Design Procedure, Optimum temperature progression. Heat effects, Adiabatic and Non-adiabatic operations, comments and Extensions. Exothermic Reactions in Mixed Reactors - A special problem.

TEXT BOOK:

1. Chemical Reaction Engineering (3rd Ed) Octave Levenspiel.

REFERENCES:

1. Chemical Engineering Kinetics (3rd ed) J M Smith.
2. Elements of Chemical Reaction Engineering (2nd) - H.Scott Foggler

Course Outcomes :

1. To be able to write rate expressions for elementary reactions and to study the temperature dependence of reactions.
2. b. To be able to apply analytical procedures (integral, differential, fractional life, initial velocity methods) to convert batch reactor data in to kinetic expression.
3. d. To be able to make performance analysis of multiple reactor systems – PFR in series and parallel, CSTRs in series and in parallel, mixed reactors in series.
4. e. To be able to analyse multiple reactions – series, parallel and series-parallel. To be able to suggest reaction controls for desired product distribution.
5. g. To be able to estimate heat effects of industrial reactions. To be able to suggest optimum temperature progression.

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1			2			1			3
CO2	1	1	1	1	1	2		1	1			2
CO3	1	1	1	1	1	2		1	1			1
CO4	1	1	1	1	1	2		1	1			2
CO5	1	1	1	1	1	2		1	1			3

CHT 06 INDUSTRIAL EFFLUENT TREATMENT

Instruction: 3 hr/week **Credits : 3**

Course Educational Objectives:

1. Develop and apply high performance structural materials ,systems and Improve the reliability, performance, and disaster-resistance of water supplies, treatment processes, and distribution systems
2. Create new engineering materials to improve the performance of infrastructure and Characterize and mitigate natural and man-made hazards
3. Improve fundamental knowledge of the inter-relationships between the built environment and natural systems
4. Develop the technological innovations needed to safeguard, improve, and economize infrastructure and society
5. Pursue lifelong learning through continuing education and/or advanced degrees in environmental engineering or other related fields.

UNIT - I:

INTRODUCTION TO ENVIRONMENT - Environmental pollution - causes and effects - Legislation for environmental pollution control - water act 1974 and clean air act 1981.Waste water sources - domestic, municipal and industrial - characterization - treatment requirements, Analysis of pollutants.

UNIT - II:

WASTE WATER TREATMENT - Removal of BOD- biological treatment- activated sludge process, aerobic and anaerobic processes, Neutralization and clarification, etc., special separations such as adsorption, ion exchange, reverse osmosis, electro dialysis.

UNIT - III:

POLLUTION CONTROL FOR SPECIFIC POLLUTANTS – Removal of Chromium, phenolic effluents, particulate matter, sulfur dioxide, oxides of nitrogen, Pollution control aspects of fertilizer industries, petroleum refinery and petrochemical units and miscellaneous industries.

UNIT -IV:

AIR POLLUTION - Types of pollutants and their effect on vegetation and materials - meteorological factors - air quality - control methodologies for air pollution, Solid waste management - Characteristics of municipal solid waste and hazardous materials - collection and transportation - treatment methods - land filling, incineration - recovery and disposal.

UNIT - V :

HAZARD WASTE TREATMENT: Types - Sources, properties of hazardous waste. Primary, secondary & tertiary treatment for liquid wastes, treatment of gaseous wastes. Conventional/modern unit operations for separations, bio-remediation. Physico chemical and biological treatment. Case studies; CN, HCN, phenolics.

REFERENCES:

1. S.P. Mahajan ,Pollution Control in process Industries Tata McGraw Hill
2. E.B.Beseheivre, M.Schwartz, Treatment of Industrial Wastes McGraw Hill.
3. Pollution control in Process Industries, Mahajan by C.S.Rao Wiley Eastern Ltd., (1992).
4. Environmental pollution control Engg by C.S.Rao Wiley Eastern.
5. Industrial Effluent Treatment Vol.1 J.K.Walters and A.Wint.
6. Industrial Effluent Treatment Vol.2 J.K.Walters & A.Wint Applied Science publishing Ltd.
   London.
6. Treatment of Hazardous wastes Noyes Data corp. NJ (1983).

COURSE OUTCOMES :

1. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability.
2. An ability to recognition of the water treatment processes and control methodologies for air pollution. An ability to use different techniques for hazard waste treatment. Able to understand about removal of BOD, Chromium and Particulate matter.
3. An ability to know about the main sources of different types of pollutions and control methods, Student can reach to reduce the pollution control aspects of fertilizer industries, petroleum refineries.
4. An ability to know types of air pollution and their effect on vegetation, control methodologies for air pollution. Characteristics of municipal solid waste, its treatment methods.

5. An ability to apply knowledge of biological treatment methods and case studies for hazard waste treatments like CN, HCN and heavy metals. An ability to design the equipment for removal of particulate matter from effluent gases.

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1						1	1	1			
CO2	1				1			1	1			
CO3	1				1			1	1			
CO4	1				1			1	1			
CO5	1				1			1	1			

CHPCP 507 MASS TRANSFER OPERATIONS LAB

Instruction : 3 hr/ week Credits:1.5 Assessment: 40 + 60 V Semester

10 / 12 experiments from

1. Diffusion In Still Air
2. .Diffusion Through Porous Wall
3. Surface Evaporation
4. Wetted Wall Coloumn
5. Vapour- Liquid Equilibrium
6. Liquid-Liquid Equilibrium
7. Humidification/Dehumidification In Packed Column
8. Continuous Drying
9. Differential Distillation
10. Absorption In Bubble Column
11. Spray Extraction Column
8. Ion-Exchange Column
12. Absorption In Packed Tower

CHPCP 508 COMPUTATIONAL TECHNIQUES LAB

Instruction : 3 hr/ week Credits: 1.5 Assessment: 40 + 60 V Semester

Exposure to MAT Lab with the following

1. Euler's Method
2. Runge-Kutta Fourth Order Method
3. Regular Falsi Method
4. Newton Raphson Method

5. Newton Raphson Multiple Roots Method
6. Newton Forward Interpolation Method
7. Newton Backward Interpolation Method
8. Lagranges Interpolation Method
9. Jacobi Iteration Method
10. Gauss-Siedel Iteration Method

B.TECH VI SEMESTER CHEMICAL ENGINEERING

CHPCT601 **CHEMICAL REACTION ENGINEERING - II**

Instruction hours /week : 3 (L) + 1 (T) Credits: 4 Assessment: 40 + 60 VI Semester

Course Educational Objectives:

1. To develop a general methodology of combining reaction chemistry and chemical engineering concepts,
2. To optimize variety of systems where modeling or engineering of reactions is needed.
3. To understand the suitability and performance characteristics of different types of reactors like packed bed reactors, mixed reactors
4. To teach various types of flows like Ideal flow, Non-Ideal flow and mixing of fluids
5. To understand the mechanism of solid Catalyzed reactions and fluid –fluid reactions.

UNIT - I: Non Ideal Flow

Residence time Distribution of fluid in Vessels - E curve, the age distribution of fluid leaving in Vessel, Experimental methods, the F curve the C curve Relations among F, C and E curves, mean time for closed vessels, useful mathematical tools, ways of using Age distribution information. Conversion directly from Tracer information - linear process. Models for Non ideal flow - Segregation model, Dispersion Model, Tanks in series Model, Diagnosing ills of operating Equipment. Chemical reaction and dispersion. Mixing of fluids - self mixing of a single fluid and Mixing of two miscible fluids.

UNIT - II: Heterogeneous processes, catalysis and adsorption:

Heterogeneous Processes - Global Rates of Reaction, types of heterogeneous reactions. Catalysis - The nature of catalytic reactions, the mechanism of catalytic reactions.

Adsorption - Physical adsorption and Chemical Adsorption. Adsorption Isotherms, Rates of Adsorption. Solid catalysis - Determination of physical properties - Surface Area, Void volume, solid density, pore volume distribution. Classification of catalysts - Catalyst preparation - promoters and inhibitors, Catalyst deactivation.

UNIT - III : Solid - Catalyzed Reactions:

The Rate Equation Rate of Adsorption, Desorption, Surface Reaction, Rate of equations in terms of Fluid - phase concentrations at the catalyst surface - film resistance controls, surface phenomenon controls, Qualitative analysis of rate equation, qualitative predictions from Active - site theory, Quantitative interpretation of kinetic data, pore diffusion resistance important, diffusion in single cylindrical pores, diffusion porous catalysts, heat effects during reaction, combination of resistances for isothermal particles. Experimental methods for finding rates - Comparison of Experimental Reactors, Determination of controlling resistances and the rate equation.

UNTI - IV : Fluid- Fluid Reactions:

The rate equation, kinetic regimes for Mass Transfer and Reaction, Rate equations for instantaneous fast, slow, intermediate and infinitely slow reactions. Hatta number and enhancement factor for first order reactions, tower reactor design.

UNIT - V : Fluid particle non-catalytic reactions;

selection of a model - unreacted core model for spherical particles of unchanging size - diffusion through gas film controls - diffusion through ash layer controls - chemical reaction controls - rate of reaction for shrinking spherical particles - chemical reaction controls - gas film diffusion controls - determination of the rate - controlling step - application to design.

Text Books:

1. Levenspiel O Chemical Reaction Engineering 3rd ed. John Willey
2. 2. Smith J.M. Chemical Engineering Kinetics 3rd ed. McGraw Hill Newyork

Reference Books:

1. Elements of Chemical Reaction Engineering by H Scott Fogler, 2nd ed. PHI 1992

Course Outcomes:

1. Residence time Distribution of fluid in Vessels, the F curve the C curve Relations. Formulate a residence time distribution from tracer experiment results and use it to predict conversion in a non-ideal reactor.
2. Write reaction rate equations for common types of homogeneous and heterogeneous reactions. Physical adsorption and Chemical Adsorption.
3. Identify the mechanisms involved in a heterogeneous reaction and formulate an effective rate equation.
4. Calculate the impact of changing solid (or fluid) properties on the conversion of a heterogeneous reaction.
5. Fluid particle non-catalytic reactions. unreacted core model for spherical particles, chemical reaction controls.

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	1		1	1	1			2
CO2	1		2	2	2				2			2
CO3			2	3		1			1			2
CO4		1	3	2					2			2
CO5			2	2	1				2			2

CHPCT 602 **TRANSPORT PHENOMENA**

Instruction hours /week : 3 (L) + 1 (T) Credits: 4 Assessment: 40 + 60 VI Semester

Course Educational Objectives

1. Study the fluid dynamics, heat transfer and mass transfer together at the introductory level.
2. Carry out macroscopic mass, momentum and energy balance to solve engineering problems related to fluid and heat flow laminar flow.
3. Give an idea about simple flow problems involving Non-Newtonian models and turbulent flows.
4. Perform dimensional analysis of equation of motion and energy, time smoothed operations.
5. Analyze flow past solid surface, through packed bed and in fluidized beds and they can able to Focus on diffusivity and mechanism of mass transport, diffusion through a stagnant gas film and falling film

UNIT - I: Introduction to momentum transport - viscosity and the non-Newtonian fluids - pressure and temperature dependence of viscosity of liquids and gases. Viscosity distribution in laminar flow, shell momentum balances and boundary conditions, flow of a falling film - flow through circular tube and annulus - adjacent flow of two immiscible liquids.

UNIT - II: Equations of continuity and motion - Application of Navier Stokes equation and Euler equation for laminar - steady flow problems, tangential annular flow of a newtonian fluid - shape of the surface of a rotating liquid - dimensional analysis of the equation of change

- Velocity distribution in turbulent flow, fluctuations and time smoothed quantities - time smoothing of equations of change for an incompressible fluid ,logarithmic distribution law for tube flow (far from wall).

UNIT - III: Inter-phase transport in isothermal systems, friction factors for flow in tube - pressure drop calculations, friction factors for flow around spheres - packed columns. Macroscopic mass, momentum and mechanical energy balances, Estimation of friction loss - pressure rise and friction loss in a sudden expansion, performance of a liquid - liquid ejector - power requirements for a pipe line flow.

UNIT - IV: Energy transport by steady state conduction - Thermal conductivity mechanism of energy transport - Fourier's law - effect of temperature and pressure on thermal Conductivity. Temperature distribution in solids and in laminar flow, shell energy balances - boundary conditions, heat conduction with an electrical heat source - viscous heat source - heat conduction through composite wall, addition of resistances - forced convection and free convection. Heat transfer coefficients - forced convection in tubes and around submerged objects - heat loss by free convection from a horizontal pipe - condensation of pure vapors on a solid surface.

UNIT - V: Diffusivity and mechanism of mass transport, definition of concentration, velocities and mass fluxes-Fick's law of diffusion -temperature and pressure dependence of mass diffusivity, shell mass balances, boundary conditions and applications diffusion through a stagnant gas film - diffusion with heterogeneous and homogeneous chemical reactions. Diffusion into falling- liquid film.

Text Books:

1. Transport Phenomena by R.B.Bird, Warren E stewart and Edwin N Light foot, Wiley International Editors, Chemical Engineering Series.

Course Out comes:

1. Have the knowledge of derivations of the momentum, heat, mass flux distributions and also velocity, temperature, concentration distributions for various systems.
2. Able to Solve continuity, Navier-Stokes and energy equations to analyze engineering problems related to Newtonian fluid flow laminar flow,Perform dimensionless forms of three transport phenomena.
3. Educate about the formation and calculation of fluid friction in pipes, conduits and around sphere.
4. Know the different types of heat transfer coefficients and performance of liquid – liquid ejector.Have the knowledge of temperature, pressure dependence of viscosity, thermal conductivity and mass diffusivity.
5. Understand the diffusion with homogeneous and heterogeneous chemical reaction.

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	2								1
CO2	1	2	3	2	2							1
CO3		2	2	3		1						1
CO4		1	3	2								1
CO5		2	2	2	1							1

CHPCT 603 PROCESS DYNAMICS AND CONTROL

Instruction hours /week : 3 (L) + 1 (T) Credits: 4 Assessment: 40 + 60 VI Semester

Course Educational Objectives:

1. To introduce the fundamental principles of system dynamics and response, with emphasis on process systems
2. To introduce the basic features of different controllers and control elements
3. To develop and analyze feedback control loops for stability
4. To introduce the features of advanced control strategies
5. To train the students in the basic approach of modeling a physical process

UNIT I:

Response of first order systems: Physical examples of first order systems, Response of first order systems in series.

UNIT II:

Higher Order Systems: Characteristics, response and transportation lag,

Control systems: controllers and final control elements, Block diagrammatic representation.

UNIT III:

Closed loop transfer functions, Transient response of simple control systems

Stability, Routh Criterion.

UNIT - IV:

Root Locus : Transient response from locus, Application of root locus to control systems

Introduction To Frequency Response: control systems design by frequency response.

UNIT - V:

Advanced Control Strategies : Cascade control, feed forward control, ratio control, Smith predictor, internal model control, Controller tuning and process identification, control valves.

TEXT BOOK:

1. Process systems Analysis and process Control by D R Coughanowr, 2nd ed. McGraw Hill.

REFERENCES:

1. Chemical Process Control by G.Stephanopolous, Prentice Hall 1998.
2. Computer Control of Industrial Processes, Emenule, S.Savas, McGraw-Hill, London.

Course Outcomes :

1. To be able to model physical systems/processes like thermometer / level systems / manometer. To have acquired the ability to study the response behavior of systems.
2. To be able to suggest an appropriate controller for an application.To develop feed back control loops and reduce it to single block representation for further analysis.
3. To be able to construct and analyze Routh array.
4. To be able to obtain the locus of roots of a characteristic equation. To be able to make stability analysis-based frequency response (Bode plots) approach.
5. To have learnt the basics of advanced control strategies. To have learnt controller tuning rules.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1		1	1	1	2				1			1
CO2		1	1	1	2				2			1
CO3		1	1	1	2				2			1
CO4		1	1	1	1				2			1
CO5		1	1	1	1				2			1

MEHST 604 INDUSTRIAL MANAGEMENT

Instruction hours /week: 3 (L) Credits: 3 Assessment: 40 + 60 VI Semester

Course Objectives:

1. To understand the concept of management, administration, organization, objectives, nature, scope, role, responsibilities & approaches of a management.
2. Enable the students to be educated with planning/production and plant layouts, studying about strategies of material handling and equipment's, selection of site locations andStudy PPC through PERT/CPM.
3. Able to familiarize the basic cost concepts, allocation and control of various costs and methods of costing, purchasing, inventory control systems, EOQ models, etc.
4. Understand the concept of control charts, TQM concepts towards improvement of quality through quality improvement techniques.
5. Gain personal and professional insight intoplant Maintenance in an Industry, personnel management, exposure to the industrial relations and related aspects prevailing in industries and various Labor Legislations applicable to businesses.

UNIT:I

Administration, Management and Organisation, Scientific management, functions of management, principles of management, types of organization/Principles for organization, enterpreneurship - Concept, need development of enterpreneual talents, pitfalls and steps for successful enterpreneurship.

UNIT - II:

Plant location, location factors, plant layout, objectives, types of lay outs, material handling, objectives, equipment and factors influencing their selection.

Production planning and control - objectives and functions, types of production systems - project scheduling: Introduction to PERT/CPM Techniques,

Marketing management – introduction and functions.

UNIT - III:

Elements of cost - methods of allocation of overhead charges - outlines of financial cost and cost accounting - methods of costing and control - sources of finance.

Purchasing - objectives, source selection and vendor rating - stores management - inventory management, basic EOQ model and inventory control systems – ABC Analysis

UNIT - IV:

Quality – Control charts – Control charts for Variables (X and R charts) – Control charts for attributes (p and C charts only) - acceptance sampling plans(single sampling only) - OC curve and its characteristics – Reliability - Total Quality Management - Quality costs – Quality Circles – Six-sigma concept – Quality improvement techniques – Introduction to ISO-9000

UNIT - V:

Plant Maintenance – need and Objectives – types of maintenance – safety in industries – principles of accident prevention in chemical industries

Personnel Management - functions - role of personnel manager -concepts of job evaluation and merit rating- Factories act - Industrial disputes - Collective bargaining - labor participation in management .

Text Books:

1. Management for business and industry - Claude S George Jr.
2. Industrial Engineering and Management - O.P.Khanna

Reference Books:

1. Production Control - Moore
2. Production -operation Management - Adam & Eberts.
3. Operations management - Joseph G. Marks.

Course Outcomes:

Course Outcomes:

1. Understand the evolutionary development of management thought, general principles of management and conceptof entrepreneurship.
2. Able to identify and design plant location, plant layout, material handling systems and apply forecasting and PPC techniques to production systems.
3. To realize the importance of significance of quality, manage quality improvement teams and identify requirements of quality improvement programs for various industries.
4. Able to construct an operating characteristic curve for various sampling plans, construct and interpret various charts and apply quality improvement techniques in real world situations.
5. Understand the philosophy and basic concepts of quality improvement, design, use, and interpret control charts for variables, attributes, and quality improvement techniques.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1									
CO2	1			2	2							
CO3			2	3		1						
CO4		1		2								
CO5			2	2	1							

CHT 07 MATERIAL TECHNOLOGY

Instruction : 3 hr/ week **Credits: 3**

Course Educational Objectives:

1) To have fundamental knowledge on Engineering materials.
2) To study Phase diagrams and its applications.
3) To learn different Heat treatment processes.
4) To have knowledge on Ceramic and composite materials.
5) To study Corrosion, its nature and its prevention
6) To learn a basic view of Nano materials.

UNIT - I: **ENGINEERING MATERIALS**

Classification - levels of structure - properties Mechanical, thermal, electrical, and magnetic properties) - structure - property relationship. Structure of solids - crystalline and non crystalline state - Inorganic solids - Crystal Imperfections (point defects, line defects and surface imperfections, Grain boundaries).

UNIT - II: **METALS AND ALLOYS**

Elastic and Plastic deformations - Re-crystallization - cold and hot working - creep, fatigue and Fracture.

Phase diagrams and their applications - phase rule - completely soluble, partially soluble, Insoluble in solid phase, peritectic phase diagrams. Iron - Iron carbide phase diagram.

Heat treatment processes - Annealing - quenching and tempering - Age hardening.

UNIT – III :

CERAMIC PHASES AND THEIR PROPERTIES - Structure of ceramics - Mechanical and electrical properties. Abrasives - silicon carbide various silicates - structure of quartz - uses. Piezo and Ferroelectric material - $BaTiO_3$.

COMPOSITE MATERIALS - Fiber, particle and Plastic reinforced composites. Whiskers. Porosity - Bulk characteristics. Agglomerated materials - concrete - Asphalt and Asphalt mixtures.

UNIT - IV: **CORROSION**

Definition - Electrochemical principles - Environmental effects - oxidizers, Temperature, Agitation(velocity) and polarization. Passivity. Eight forms of corrosion(brief) - Galvanic, Crevice corrosion, Selective leaching, Erosion and Hydrogen damage. Corrosion of metals and Alloys due to sulfuric, hydrochloric nitric, phosphoric and acetic acids. Corrosion prevention and control - Selection of materials - Design principles - Inhibitors - Alteration of environment - Anodic protection. Inorganic and Metallic coatings. Organic coatings.

UNIT - V : **NANOMATERIALS**

Evolution of nanotechnology - Electron Microscopy – Priniciples of SEM, TEM, SPM and STM - Manipulation of atoms (manipulator – tweezer – nanodots – self assembly – nanolithography) - Nano materials - Plasma arcing - Chemical Vapor Deposition - Sol gel - Electrodeposition - Ball milling - Applications of Nanomaterials

TEXT BOOKS:

1. Elements of material science by Van Vlack L.R. Addison Wesley Publishing Co.
2. Corrosion Engineering by Mars G.Fontana
3. Nanotechnology : Basic Science and Emerging Trends – Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard Reguse, Overseas Press

REFERENCES :

1. Material science and Engineering by V.Raghavan.
2. Material Science by William Smith

Course Outcomes:

1. Able to understand classification, properties and the structures of Engineering materials. Able to have knowledge on Crystal imperfections.
2. To learn various deformations regarding Creep, Fracture, Cold and Hot working.Able to understand Phase diagram and its applications. To learn various heat treatment process regarding Annealing, Quenching and Tempering.
3. Able to understand the Mechanical and Electrical properties of Ceramic materials. Able to understand various forms of Composites.
4. Able to learn various forms of Corrosion. Able to have knowledge on Corrosion prevention and control.
5. Able to have knowledge on Evolution of Nanotechnology, Electron Microscope and its applications.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1								1				1
CO2		`1						1	1			
CO3		1						1	1			
CO4						1		1	1			1
CO5	1	1						1	1			1

CHPCP 607 CHEMICAL REACTION ENGINEERING LAB

Instruction hours /week : 3 (P) Credits: 1.5 Assessment: 40 + 60 VI Semester

1. Study of Temperature Dependence of Reaction
2. Kinetics Study under Pseudo Behaviour Conditions
3. Kinetics Study in a Mixed Flow Reactor
4. Kinetics Study in Adiabatic Batch Reactor
5. Modeling of a Mixed Flow Reactor
6. Flow Characterization of a Plug Flow Reactor
7. Modeling of a Packed Bed Reactor
8. Residence Time Distribution in Tanks in Series Assembly
9. Kinetics of Saponification in a Batch Reactor
10. Effect of Mass Transfer on Reaction

CHPCP 608 PROCESS DYNAMICS AND CONTROL LAB

Instruction hours /week : 3 (P) Credits: 1.5Assessment: 40 + 60 VI Semester

1. Characteristics of Control Valves
2. Dynamics of Liquid Filled Manometer
3. Dynamics of Mixing Process
4. Study of Two Interacting Liquid Level Systems
5. Characterization of Liquid Level System
6. Dynamics of Stirred Tank with Heat Transfer
7. Study of Temperature Control Loop
8. Characteristics of I/P Converter
9. Response of Pressure Vessels
10. Dynamics of Thermometer

B.TECH VII SEMESTER CHEMICAL ENGINEERING

CHPCT 701 **PLANT DESIGN AND PROCESS ECONOMICS**

Instruction hours / week : 2 hr/week Credits : 2 Assessment : 40 +60 VII Semester

Course Objectives:

1. To understand the general overall design considerations and practical design considerations
2. To understand the plant location ,plant layout, plant operation and control and patent considerations
3. To understand the process design development
4. Gives an idea on time value of money and cash flow patterns
5. It gives an idea on analysis of cost estimation
6. To determine profitability, alternative investments and replacements

UNIT - I :
Introduction – Chemical Engineering Plant Design-General Overall Design Considerations – Practical Considerations in Design - Engineering Ethics
General Design Considerations – Health and Safety hazards – Loss Prevention – Environmental Protection Plant Location – Plant Layout – Plant Operation and Control – Patent Considerations

UNIT - II :
Process Design Development – Development of Design database – Process Creation – Process Design – Process Flow Diagrams – Piping and Instrumentation Diagrams – Vessel and Piping layout – Equipment Design and Specifications

UNIT - III :
Interest, Time Value of Money, Taxes , and Fixed Charges – Interest – Cost of Capital – Time Value of Money – Cash Flow Patterns – Compounding and Discounting factors – Income taxes – Fixed Charges

UNIT - IV:
Analysis of Cost Estimation – Cash flow for industrial Operations – Factors affecting investment and production costs – capital investment – Estimation of capital investment – Cost Indexes – Cost components in Capital Investment – Methods for estimating capital investment – estimation of revenue – Gross Profit, Net profit and cash flow - contingencies.

UNIT - V:

Profitability, Alternative investments and Replacements – Profitability Standards – Methods for calculating Profitability – Alternative Investments – Replacements – Practical factors in alternative investment and replacement analysis

Text Books:
Plant Design and Economics for Chemical Engineers , 5 th Ed. – Max S.Peters and Klaus D. Timmerhaus and Ronald E.West – McGraw Hill

References :
1. Chemical Engineering Plant Design by Vilbrandt and Dryden, McGraw Hill Intl.
2. Process Engineering Economics by H.E. Schweyer McGraw Hill Co.

Course Outcomes:

1. Students will have knowledge to understand design considerations and engineering ethics. Students able to understand plant location, plant lay out, plant operation and control in a profitable way.
2. Students able to design process flow diagrams, piping and instrumentation diagrams and vessel and piping layout.
3. Students will have the knowledge on interest, time value of money and cash flow patterns useful for cost estimation.
4. Students will have an idea on analysis of cost estimation involves capital investments, estimation of revenue, and cost indexes, students will come to know factors affecting investment and production costs.
5. They will able to find out the alternate investments and replacements, it will also helps the students to understand profitability standards and methods for calculating profitability.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1		1	2			1			1
CO2	1			2	2	1			2			1
CO3			2	3	1	1			1			1
CO4		1		2	1	2			1			1
CO5			2	2	1	1			1			1

CHE 01 A PETROLEUM REFINING PROCESSES

Instruction : 3 hr/week **Credits : 3**

Course Educational Objectives:

1) To have a fundamental knowledge on origin, composition and formation of petroleum.
2) To learn different Refinery products and testing methods.
3) To study types of Distillation.
4) To have knowledge on treatment of petroleum products.
5) To study different Cracking processes in petroleum industry and to have knowledge on Polymerization and Isomerization.

UNIT I :

Origin, Formation and Composition of Petroleum: Origin and Formation of Petroleum, Reserves and Deposits of World, Petro Glimpses and Petroleum Industry in India, Composition of Petroleum

Petroleum Processing Data: Evaluation of Petroleum, Thermal Properties of Petroleum Fractions.

UNIT II :

Important Products – Properties and Test Methods

UNIT III :

Fractionation of Petroleum: Dehydration and Desalting of Crudes, Heating of Crude-Pipe Still Heaters, Distillation of Petroleum, Blending of Gasolines.

UNIT IV :

Treatment Techniques: Fractions-Impurities, Gasoline Treatment, Treatment of Kerosene, Treatment of Lubes, Wax and Purification.

UNIT V:

Thermal and Catalytical Processes : Cracking ,Catalytic Cracking, Catalytic Reforming- Introduction and Theory, Naptha Cracking ,Coking, Hydrogen Processes, Alkylation, Isomerization Processes, Polymer Gasolines

Asphalt Technology : Source of Asphalt , Air Blowing of Bitumen, Upgradation of Heavy Crudes

Text Book

Modern Petroleum Refining Processes by B.K.Bhaskara Rao

Reference Books:

1. Petroleum Refining and Petrochemicals by N.K Sinha
2. Petroleum Refinery Engineering by Nelson, McGraw Hill.

Course outcomes

1. Able to to study about and manufacturing of the petrol, origin and formation
2. Able to understand the test methods and the properties of the petroleum
3. Understanding to deal with the by product of the petroleum and learning about the hydration , distillation of the petroleum
4. Understating in dealing with the treatment of the other petroleum group elements
5. Able to understand about cracking, reforming of the petroleum production

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1					1		1	1	1			1
CO2					1							1
CO3					1		1		1			1
CO4					1		1		1			1
CO5					1				1			1

CHHST 704 **ENGINEERING ETHICS**

Instruction hours /week: 2 Credits – 2 Assessment : 40 + 60 VII Semester

COURSE OBJECTIVES:

1. Instill the moral values that ought to guide their profession.
2. Resolve the moral issues in the profession.
3. Infer moral judgment concerning the profession.
4. Correlate the concepts in addressing the ethical dilemmas.
5. Judge a global issue by presenting an optimum solution.

UNIT-I

Human values - Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage – Empathy – Self-Confidence – Character

Engineering ethics - Senses of 'Engineering Ethics' - variety of moral issues - 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-II

Engineering as social experimentation Engineering as experimentation - engineers as responsible experimenters – Research Ethics - codes of ethics – Industrial Standards - A balanced outlook on law - the challenger case study

UNIT-III

Safety, responsibilities and rights - Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk – Government regulator's approach to risk - the three mile island, Chernobyl and Bhopal case studies.

UNIT IV

Responsibilities and rights - Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination

UNIT V

Global issues -Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – SampleCode ofConduct

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York , 1996.

2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004

COURSE OUTCOMES:

1. Distinguish between ethical and non ethical situations. Practice moral judgment in conditions of dilemma.
2. Relate the code of ethics to social experimentation.
3. Risk benefit analysis and reducing risk
4. Resolve moral responsibilities in complications.
5. Defend one’s views in supporting the moral concerns. Apply risk and safety measures in various engineering fields.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1									
CO2	1			2	2							
CO3			2	3		1						
CO4		1		2								
CO5			2	2	1							

CHPCP 705 PROCESS EQUIMENT DESIGN & DRAWING

Practice, hours / week : 3 Credits : 3 Assessment : 40 + 60 VII Semester

Introductory topics like PFD & PID , welding symbols, materials of construction, headers and closures, nozzles and supports

Design calculations and preparation of Engineering drawing of Process equipment like Heat exchangers, Plate Columns, Packed Columns, Evaporator, Reactor, Dryer, Storage Vessels……

CHPCW 708 PROJECT WORK - Phase I

Practice, hours / week : 6 Credits : 3

Evaluation : As detailed in the Regulations

Definition of Topic and Scheme of Work, 30 % of execution

CHPCW 803 PROJECT WORK - Phase II VIII Semester

Practice, hours / week : 18 Credits : 9

Evaluation : As detailed in the Regulations

Balance 70 % of Project, Documentation and Submission

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