DEPARTMENT OF CHEMICAL ENGINEERING
SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
R-20 – Scheme of Instruction effective from the academic year 2020-2021

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I Semester (First Year)

Course Code	Category	Course Title	Scheme of Instruction,Hrs/Week				Credits	Scheme of Evaluation, Marks		Total Marks
			L	T	P	Total		Internal	End Sem	
MA101	Basic Sci.	Mathematics - I	3	1	-	4	4	40	60	100
CY102	Basic Sci.	Chemistry for Chemical Engg.-1	3	1	-	4	4	40	60	100
EN103	Humanities	English	2	-	-	2	2	40	60	100
EE104	Basic Engg.	Basic Electrical and Electronics Engineering	3	1	-	4	4	40	60	100
ME105	Basic Engg.	Engineering Graphics and Design	2	-	3	3	3.5	40	60	100
EN106	Humanities Lab	English Communication Lab	-	-	3	3	1.5	40	60	100
		TOTAL	**13**	**3**	**6**	**2**	**19**	**360**	**640**	**1000**

II Semester (First Year)

Course Code	Category	Course Title	Scheme of Instruction,Hrs/ Week				Credits	Scheme of Evaluation, Marks		Total Marks
			L	T	P	Total		Internal	End Sem	
MA 201	Basic Sci.	Mathematics - II	3	1	-	4	4	40	60	100
PY 202	Basic Sci.	Engineering Physics	3	1	-	4	4	40	60	100
CS 203	Basic Engg.	Program for Problem Solving	2	1	-	3	3	40	60	100
CY 204	Basic Sci.	Chemistry for Chemical Engg.-II	3	1	-	4	4	40	60	100
ME 205	Basic Engg. Lab	Workshop/Manufacturing Practices	-	0	3	3	1.5	40	60	100
CS 206	Basic Engg. Lab	Program for Problem Solving Lab	-	0	3	3	1.5	40	60	100
CE 207	Audit	Environmental Science	4	0	-	4	0	40	60	100
		TOTAL	**15**	**4**	**6**	**25**	**18**	**360**	**540**	**900**

DEPARTMENT OF CHEMICAL ENGINEERING
SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI-517502
R-20 – Scheme of Instruction effective from the academic year 2020-2021
III Semester (Second Year)

Course Code	Category	Course Title	Scheme of Instruction,Hrs/Week				Credits	Scheme of Evaluation, Marks		Total Marks
			L	T	P	Total		Internal	End Sem	
MA301B	BSC	Mathematics - III	3	0	0	3	3	40	60	100
CH302E	ESC	Engineering and Solid Mechanics	3	0	0	3	3	40	60	100
HS303C	HSS	Managerial Economics and Accountancy	3	0	0	3	3	40	60	100
CH304C	PCC	Chemical Process Calculations	3	0	0	3	3	40	60	100
CH305C	PCC	Momentum Transfer	3	0	0	3	3	40	60	100
CH306C	PCC	Chemical Engineering Thermodynamics - I	3	0	0	3	3	40	60	100
CH307L	PCC Lab	Momentum Transfer Lab	0	0	3	3	1.5	40	60	100
CH308L	PCC Lab	Analysis Lab	0	0	3	3	1.5	40	60	100
CH309S	SOC	Computer Skills	1	0	2	3	2	40	60	100
MC310A	MC	Constitution of India	2	0	0	2	0	0	100	100
		TOTAL	**20**	**0**	**8**	**28**	**23**	**360**	**640**	**1000**

IV SEMESTER

Course Code	Category	Course Title	Scheme of Instruction,Hrs/ Week				Credits	Scheme of Evaluation, Marks		Total Marks
			L	T	P	Total		Internal	End Sem	
CH401B	BSC	Mathematics - IV	3	0	0	3	3	40	60	100
CH402C	PCC	Particle and Fluid Processing	3	0	0	3	3	40	60	100
CH403C	PCC	Chemical Engineering Thermodynamics - II	3	0	0	3	3	40	60	100
CH404C	PCC	Heat Transfer	3	0	0	3	3	40	60	100
CH405C	PCC	Mass Transfer Operations - I	3	0	0	3	3	40	60	100
CH406C	PCC	Chemical Technology	3	0	0	3	3	40	60	100
CH407L	PCC Lab	Particle and Fluid Processing Lab	0	0	3	3	1.5	40	60	100
CH408L	PCC Lab	Heat Transfer Lab	0	0	3	3	1.5	40	60	100
CH409S	SOC	Python Programming	1	0	2	3	2	40	60	100
		TOTAL	**19**	**0**	**8**	**27**	**23**	**360**	**540**	**900**

I Semester MA 101MATHEMATICS –I

(I Semester - Common for all branches)

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

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
2. apply differential equations to engineering problems.
3. Use transformation to convert one type into another type presumably easier to solve.
4. use shift theorems to compute the Laplace transform, inverse Laplace transform and the solutions of second order, linear equations with constant coefficients.
5. solve an initial value problem for an n^{th} order ordinary differential equation using the Laplace transform.
6. expand functions as power series using Maclaurin's and Talor's series
7. optimize the problems related to OR, Computer science, Probability and Statistics
8. draw an approximate shape by the study of some of its important characteristics such as symmetry, tangents, regions enclosing curve tracing method to find length, area, volume.
9. 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**						

I & II Semesters CY 101/ CY 202 ENGINEERING CHEMISTRY

(I Semester - CY 101 for Civil & Mechanical Engg) (II Semester -CY 202 for EEE, ECE & CSE)

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

UNIT I

Atomic and molecular structure (12 lectures)

Postulates of quantum chemistry. Schrodinger equation. Particle in a box solutions, Molecular orbitals of diatomic molecules and plots of the multicenter orbitals, Equations for atomic and molecular orbitals, Energy level diagrams of diatomics, Pi-molecular orbitals of butadiene and benzene. Band structure of solids and the role of doping on band structures

UNIT II

Spectroscopic techniques and applications

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclearmagnetic resonance and magnetic resonance imaging, surface characterization techniques.

UNIT III

Chemical equilibria, Intermolecular forces and potential energy surfaces

Use of free energy in Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cellpotentials, the Nernst equation and applications.

Use of free energy considerations in metallurgy through Ellingham diagram. Equations of state of real gases and critical phenomena.

UNIT IV

Periodic properties

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and

bases, molecular

geometries, Born- Haber cycle, The use of reduction potentials, Properties of ionic and covalent compounds.

UNIT V

Stereochemistry, **Organic reactions and synthesis of a drug molecule**

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings Synthesis of a commonly used drug molecule.

Reference/Textbooks

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A.
Plane 3.Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistryby P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Ed.
7. Principles of physical chemistry, Puri, Sharma and Pattania

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

1. analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. rationalize bulk properties and processes using thermodynamic considerations.
3. distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
4. rationalize periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
5. list major chemical reactions that are used in the synthesis of molecules.

Mapping of Course Outcomes with Program Outcomes:

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

I & II Semesters **EN 103/ EN 203 ENGLISH**

(I Semester - EN 103 forChE,CE & ME)

(II Semester - EN 203 for EEE, ECE & CSE)

Instruction: 2(L) **Credits: 2** **Assessment: 40 + 60**

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 Common Errors in Writing

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

UNIT IV Nature and Style of sensible Writing

Describing - Defining - Classifying –Providingexamples or evidence –Writingintroductionand conclusion

UNIT V Writing Practices

Comprehension - Précis Writing –EssayWriting

Reference/Textbooks:

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 KumarandPushpalata. 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.

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								

I Semester **EE104BASIC ELECTRICAL AND ELECTRONICS ENGG.**

(I Semester – for ChE, CE & ME)

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

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).

Textbooks:

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

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

1. understand the basic concepts of D.C. single phase and 3- phase supply and circuits and solve basic electrical circuit problems
2. understand the basic concepts of transformers and motors used as various industrial drives

3. understand the concept of power factor improvement for industrial installations and concepts of most economical power factor
4. understand the operation and characteristics of diodes, transistors, integrated circuits and digital circuits.

Mapping of Course Outcomes with Program Outcomes:

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

I & II Semesters

ME 105 / ME 205ENGINEERING GRAPHICS AND DESIGN

(I Semester - ME105 for ChE, CE & ME)
(II Semester - ME205 for EEE,ECE & CSE)

Instruction: 2(L) +3 (Drg) /week Credits: 3.5 Assessment: 40 + 60

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;

Question Paper
Modular – 4 questions from
Units I t0 IV, 15 marks each

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, Charotar Publishing House
2. Shah,M.B.&RanaB.C.(2008),EngineeringDrawingandComputerGraphics,PearsonEducation
3. Agrawal B. & Agrawal C.M.(2012),Engineering Graphics, TMH Publication
4. Narayana, K.L. &P Kannaiah(2008),Text book on Engineering Drawing, Scitech Publishers
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.

   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
CO1	2	1	1			1	1					
CO2	2	1				1	1					
CO3		2		2		2						1
CO4			1	2			1					
CO5		1		2		3						

I & II Semesters EN 106 / EN 206 ENGLISH COMMUNICATION LAB

(I Semester - EN 106 for ChE, CE & ME) (II Semester - EN206 for EEE, ECE & CSE)

Instruction: 0(L) +3(Lab) /week Credits: 1.5 Assessment: 40 + 60

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. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. LizHamp– Lyons and Ben Heasly. Cambridge Univ. Press. 2006
5. Communication Skills. Sanjay Kumar and Pushpalata. Oxford Univ. Press.2011
6. Exercises in Spoken English. PartsI-III.CIEFL, Hyderabad. Oxford Univ. Press

Course Outcomes:

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

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								

II Semester MA 201MATHEMATICS II

(II Semester - for all branches)

Instruction: 3(L) +1(T) /week Credits: 4 Assessment: 40

+ 60 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.
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. use ranks of matrices to decide whether the system of linear equations is consistent or not
2. use Cayley-Hamilton theorem to find inverses or powers of matrices.
3. use Eigen values and vectors to reduce Quadratic forms to normal form.

4. to analyze motion problems from real lines to curves and surfaces in 3-D and use tools such as divergence and curl of vector and gradient, directional derivatives that play significant roles in many applications.
5. use Green's theorem to evaluate line integrals along simple closed contours on the plane
6. use Stokes' theorem to give a physical interpretation of the curl of a vector field
7. use the divergence theorem to give a physical interpretation of the divergence of a vector field.
8. find the Fourier Series to represent a function as a series of constants times sine and cosine functions of different frequencies in order to observe periodic phenomenon.
9. Evaluate certain improper integrals to make them simple with introduction of Gamma and Beta functions.
10. 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	2	2		2	1						
CO2	1	1		2	2							
CO3		1		2	2							
CO4		2		2	2							
CO5		1	2	2								

II Semester **PY 202ENGINEERING PHYSICS**

(II Semester - for ChE, CE& ME)

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

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

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.

Mechanics of Continuous Media

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" TataMCGraw Hill Education Pvt.Ltd., New Delhi
4. M.N.Avadhanulu and P.G.Kshirsagar ``A Textbook 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.RamachandraRao 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 behavior 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 applicationsunderstand the principles in electrostatics and electromagnetics and magnetic properties of materials.
5. understand size depended properties of nano-dimensional materials and their effective utilization in making nano- and micro-devices for further microminiaturization of electronic devices.
6. think and participate deeply, creatively, and analytically in emerging areas of engineering technology.
7. Learnthe basics of instrumentation, design of laboratory techniques, measurement, data acquisition, interpretation, and analysis.
8. provide multidisciplinary experiences throughout the curriculum.

OUTCOMES WITH PROGRAM OUTCOMES:

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

I & II Semesters CS 103 / CS203 PROGRAMMING FOR PROBLEM SOLVING

(I Semester –CS 103 for EEE, ECE & CSE)
(II Semester –CS 203 for ChE, CE & ME)

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

Course Objectives:

1. To acquire problem solving skills
2. To be able to develop flowcharts and algorithms for the given problem
3. To learn how to write modular programs in C
4. To enable 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

Problem Solving : Problem solving techniques, Computer as a problem solving tool, Programming Languages – Machine Language, Assembly Language, Low and High-Level Languages, Procedural and Object-Oriented Languages. Algorithm definition, Features, Criteria, Flowchart definition, Basic symbols, Sample flowcharts, Problem solving aspects, Efficiency of algorithms.

Basics of C: Structure of a C program, C tokens, Keywords, Identifiers, Basic data types and sizes, Constants, Variables, Operators in C, Operator Precedence and Associativity, Expressions, Type conversions, Basic input/output statement, Sample programs.

UNIT-II

Conditional Statements: Selection statements, Decision making within a program, Simple if statement, if-else statement, Nested if-else, if-else ladder and switch-case. Iterative statements: while-loop, do-while loop, for loop, Nested loops, Infinite loops, goto, break and continue statements, Sample programs.

Functions: Introduction to modular programming and functions, Basics, Standard Library of C functions, Prototype of a function, Parameter passing, User defined functions, Recursive functions, Passing arguments to a function: Call by reference, Call by value, Storage Classes in a single source file, Scope rules, Header files, C Pre-processor.

UNIT-III

Arrays: Introduction to arrays, Definition, Declaration, Storing elements, Accessing elements, One dimensional arrays: Array manipulation; Searching, Insertion, Deletion of an element from an array, Two dimensional arrays, Addition/Multiplication of two matrices, Transpose of a square matrix, Passing array to functions, String fundamentals, String manipulations, Standard library string functions.

Pointers: Definition of pointer, pointer type declaration, pointer assignment, pointer initialization, Pointer

arithmetic, Functions and Pointers, Dangling memory, Character pointers and functions, Pointers to pointers, Arrays and Pointers, Pointer arrays, Pointers and structures, Dynamic memory management functions.

UNIT-IV

Structures: Structures declaration, Structure variables, Initialization of structures, Accessing structures, Nested structures, Arrays of structures, Structures containing arrays, Structures and functions, Pointers to structures, Self-referential structures, Unions, Typedef, Bit-fields.

File Processing: Concept of Files, Text files and binary files, File opening in various modes and closing of a file, Reading from a file, Writing onto a file.

UNIT V

Introduction to Object-Oriented Programming (OOP): Need for OOP, Principles of OOP, Basics of C++ Programming, Operator Overloading, Function Overloading, Inheritance: Derived classes, Protected access specifier, Derived class constructors, Overriding member functions, Class hierarchies, Public and Private inheritance, Multiple inheritance.

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

1. Develop and test programs in C and 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 files to perform read and write operations.
6. Handle programming assignments based on class,abstraction, encapsulation, overloading and inheritance.

Text Books

1. Ashok N Kamthane, Amit Ashok Kamthane, Programming in C, 3rd Edition, Pearson Education, 2019.
2. Scheldt H, C: The Complete Reference, 4th Edition, Tata McGraw-Hill, 2002.
3. R.G. Dromey, How to solve it by Computer, Pearson Education, 2019.
4. Hanly J R &Koffman E.B, “Problem Solving and Program design in C”, Pearson Education, 2019.
5. Herbert Schildt,The Complete Reference C++, 4th Edition, Tata McGraw-Hill.

Reference Books

1. C Programming-A Problem Solving Approach, Forouzan, Gilberg, Cengage.
2. Programming with C, Bichkar, Universities Press.
3. Programming in C, ReemaThareja, OXFORD.
4. C by Example, Noel Kalicharan, Cambridge.
5. The C++ Programming Language, Bjarne Stroustrup, 3rd Edition, Pearson Education.
6. Problem solving with C++: The Object of Programming, 9th Edition, Walter Savitch, Pearson Education.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES:

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

I & II Semesters CE 104 / CE 204 ENGINEERING MECHANICS

(I Semester –CE 104 for EEE)

(II Semester –CE 204 for CE & ME)

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

UNIT I

STATICS : Basic concepts – System of force, Concurrent and non-concurrent coplanar and non- coplanar forces – Resultant – Moment of force and its application – Couples and resultant of force systems – Equilibrium of systems of forces – Free body diagrams, Equations of equilibrium of coplanar systems and spatial systems.

UNIT II

Analysis of plane trusses: Types of supports – Types of trusses – Analysis of trusses using method of joints and method of sections.

UNIT III

CENTRE OF GRAVITY AND MOMENTS OF INERTIA: Theory of Pappus – Centroids of composite figures – Areas of gravity of bodies – Moment of inertia – Parallel and perpendicular axis theorems – Moments of inertia of composite areas (rolled and built up sections) – Radius of gyration of areas.

UNIT IV

SIMPLE STRESES AND STRAINS : Elasticity and plasticity – Types of stresses and strains – Hooke's law – Stress-strain diagram for mild steel – Working stress – Factor of safety.

Lateral strain – Poisson's ratio and volumetric strain – Elastic moduli and relationship between elastic constants – Bars of varying section – Composite bars – Temperature stresses.

UNIT V

STRAIN ENERGY: Gradual, sudden and impact loading – Endurance limit principles of virtual work and its applications.

TEXTBOOKS:

1. Ghose D.N. – Applied Mechanics and Strength of Materials.
2. Timoshenko & Young – Engineering Mechanics.
3. Junarkar SB – Mechanics of Structures – Vol. I.
4. Junarkar SB – Elements of Applied Mechanics.

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

1. apply the basic knowledge of force system.
2. know the types of supports occur in civil engineering structures
3. know the geometrical properties of different cross sections.
4. understand different types of stresses and strains, elastic constants.
5. understand the behavior of different internal forces under different types of loading.
6.
7. **MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES:**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO 1		3										
CO 2		3										
CO 3		3							2			1
CO 4									3			1
CO 5			3						1			

I & II Semesters ME 105 / ME 205 WORKSHOP/MANUFACTURING PRACTICE

(ME 105 for EEE, ECE & CSE)

(ME 205 for ChE,CE & ME)

Instruction: 0(L) +3 (lab)/week Credits: 1.5 Assessment: 40 + 60

Workshop Practice: Five practices among

1. Machine shop 2.Fittingshop 3.Carpentry 4.Electrical wiring

5. Welding shop 6.Casting 7.Smithy 8.Plasticmoulding&GlassCutting

Examinations could involve the actual fabrication of simple components, utilizing one or

More of the techniques covered above.

Detailed Contents

1. ManufacturingMethods-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/ReferenceBooks:

1. HajraChoudhury S.K., HajraChoudhury A.K.andNirjharRoy S. K., Elements of Workshop Technology", Vol. I 2008and Vol. II 2010, Media promoters and Publishers private limited, Mumbai.
2. Kalpakjian S. and Steven S. Schmid ManufacturingFngineeringand Technology", 4th edition, PearsonEducationIndiaEdition,2002.
3. GowriP.Hariharanand A. SureshBabu, Manufacturing Technology–I" Pearson Education,2008.
4. Roy A. Lindberg, Processes and Materials of Manufacture",4 th edition, Prentice Hall India,1998.

5. RaoP.N., “ManufacturingTechnology”,Vol. I & II,TataMcGrawHillHouse, 2017

Laboratory Outcomes

- Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- By assembling different components, they will be able to produce small devices of their interest.

Course Outcomes : Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry to fabricatecomponents using different materials.

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									

& II Sem CS 106/ CS206 PROGRAMMING FOR PROBLEM SOLVING LAB

(CS 106 for EEE, ECE & CSE)
(CS 206 for ChE, CE & ME)

Instruction: 0(L) +3 (Lab)) /week Credits: 1.5 Assessment: 40 + 60

Course Objectives:

1. To provide exposure to problem-solving through programming
2. To train the student on the concepts of the C- Programming language

The following programs shall be developed and executed in Programming Language C.

1. Programs on conditional control constructs.
2. Programs on iterative statements (while, do-while, for).
3. Programs on recursive procedures
4. Programs on arrays, matrices (single and multi-dimensional arrays).
5. Programs using user defined functions, demonstrating parameter passing methods viz. call by value and call by reference.
6. Programs using different library functions viz. ctype.h, math.h, stdio.h, stdlib.h, string.h, conio.h and pre-processor directives.
7. Programs using pointers (int pointers, char pointers) and pointer arrays.
8. Programs on structures and unions
9. Programs on File Processing.
10. Programs on Pointers to structures and Self-referential structures

Course Outcomes: After Completion of this course the student would be able to

1. Develop the C code for the given algorithm.
2. Understand, debug and trace the execution of programs written in C language.

Reference Books:

1. Scheldt H, C: The Complete Reference, 4th Edition, Tata McGraw-Hill, 2002.
2. Hanly J R &Koffman E.B, “Problem Solving and Program design in C”, Pearson Education, 2019.
3. R.G. Dromey, How to solve it by Computer, Pearson Education, 2019.
4. Behrouz A. Forouzan& Richard F. Gilberg, Computer Science: A Structured Programming Approach Using C, Third Edition, Cengage Learning

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										

CE 107 / CE 207 **ENVIRONMENTAL SCIENCE** ***Audit Course***

(CE 107 for EEE, ECE &CSE) ***No Univ.Exam***

(CE 207 for ChE, CE & ME)

Instruction: 4(L) **Credits: 0(Zero)** **Assessment: 40 + 60**

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, dam 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, 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. AmalK.Datta, Introduction to Environmental Science and Engineering, Oxford & IBH Publishing Co.Pvt.Ltd, 2000
6. SanthoshkumarGarg,RajeshawriGarg and RajniGarg, 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:

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

1. acquire knowledge in
    - diverse components of environment and natural resources
    - ecosystem and biodiversity & its conservation methods
    - population growth and human health
    - green technology
2. identify and resolve the issues related to sources of different types of pollutions
3. provide solutions to individuals, industries and government for sustainable development of natural resources
4. apply environmental ethics in protection of diversified ecosystems.

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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

MA 301 B **MATHEMATICS – III**III semester

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

Course Objectives:

1. This course aims at providing the student to acquire the knowledge on the calculus of functions of complex variables.

2. To understand power series and expansion of analytic function.

3. To understand Laurent Series, poles, singular points, Residue theorem and its applications.
4. The aim is to analyze the solutions of partial differential equations.

5. To discuss the boundary value problems, one dimensional wave equation, heat equation and Laplace Equation.

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						

CH302E ENGINEERING AND SOLID MECHANICSIII semester

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

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)

Rigid body kinematics: Translation and rotation, relative motion, angular velocity, General motion of a rigid body, General relative motion

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.

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

Unit III :

Beams: Shear Force and Bending Moment

Unit IV :

Frictional forces, Laws of Coulomb friction, impending motion

Inertia tensor, Principal Moments of Inertia, Moment of momentum relations for rigid bodies,Euler's Equations of Motion

Unit V :

State of stress at a point, equations of motion, principal stress, maximum shear stress, Concept of strain, strain displacement relations, compatibility conditions, principal strains, transformation of stress/strain tensor, state of plane stress/strain.

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

TEXT BOOKS :

1. Engineering Mechanics, Strength of Materials and Elements of Structural Analysis – C.Venkataramaiah&A.V.NarasimhaRao

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							

HS303C MANAGERIAL ECONOMICS AND ACCOUNTANCY

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

Detailed Syllabus:

Unit -I

Introduction to Engineering Economics, Fundamental concepts, Time value of money, Cash flow and Time Diagrams, choosing between alternative investment proposals, Methods of Economic analysis (pay back, ARR,NPV,IRR and B/C ratio), The effect of borrowing on investment, Equity vs Debt Financing, concept of leverage, Income tax leverage.

Unit -II

Depreciation and methods of calculating depreciation (straight line, sum of the years digit method, Declining balance method, Annuity method, Sinking fund method), National income accounting Methods of estimation, Various concepts of National Income, Significance of National income Estimation and its limitations.

Unit -III

Inflation: Definition, Process and Theories of inflation and Measure of control. New Economic Policy 1991(Industrial Policy, Trade Policy, Fiscal Policy), Impact on Industry.

Unit -IV

Accounting Principles, procedure, Double entry system, Journal, ledger, Trial balance, Cashbook, preparation of Trading and Profit and Loss account, Balance sheet.

Unit -V

Cost Accounting: Introduction, Classification of costs, Methods of costing, Techniques of costing, Cost sheet and preparation of cost sheet, Break-even Analysis, Meaning and its application, Limitation.

Reading Text Books:

1. Henry Malcom Steiner, Engineering Economics Principles, 2nd Edition, McGraw Hill Education, 1996.
2. Dewett. K.K., Modern Economic Theory, Sultan Chand and Co., 2006.
3. A.N.Agarwal, Indian Economy, Wiley Eastern Limited, New Delhi.
4. Jain and Narang, Accounting Part-I, Kalyani Publishers, 2011.
5. Arora, M.N. Cost Accounting: Principles and Practice, 12th Edition, Vikas Publication, 2012.

6. **Course Outcomes:** After the completion of the course the student will be able to:

CO1	Understand Macro Economic environment of the business and its impact on enterprise.
CO2	Identify various cost elements of the product and its effect on decision making.
CO3	Understand the concepts of financial management and smart investment.
CO4	Prepare the Accounting records and interpret the data for Managerial Decisions.

Mapping of course outcomes with program outcomes:

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

CH304C CHEMICAL PROCESS CALCULATIONS

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

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.

	PO1	**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							

CH305C **MOMENTUM TRANSFER**

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

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 and total energy balances, velocity of sound, ideal gas equation, stagnant temperature.

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 (7th ed) Warren L.McCabe, Juliane Smith and Peter Harriott, McGraw Hill.

REFERENCES:

1. 1. Chemical Engineering Vol.I by Coulson and Richardson, Pergamon Press.
2. Solved Examples in Chemical Engineering by G.K.Roy
3. "Fluid Mechanics" 2nd edition by Noel de Nevers, Mc Graw Hill

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.

	PO1	**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							

CH306C CHEMICAL ENGINEERING THERMODYNAMICS –I

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

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

6. 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.

	PO1	**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

CH307L MOMENTUM TRANSFER LABORATORY

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

Any 10/12 experiments on

Flow Through Straight Pipe, Frictional losses Due To Fittings, Venturi meter , Orifice meter, 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.

CH308L ANALYSIS LABORATORY

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

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.

CH309S COMPUTER SKILLS

Instruction Hours/week: 1(L) + 2(P) Credits :2Assessment : 40 + 60

Course Educational Objective (CEOs)

1. Identify basic terms, concepts, and functions of computer system components.
2. To enable the student to use MSWORD.
3. To acquaintwith MSEXCEL and MSPOWERPOINT
4. To familiarizewith browsing the INTERNET and EMAIL

- MS WORD: Text Basics, Text Formatting and saving file, working with Objects.
- MS WORD: Header & Footers, Working with bullets and numbered lists, Tables.
- MS WORD: Styles and Content, Merging Documents, Sharing and Maintaining Document
- MS WORD: Sharing and Maintaining Document, : Proofing the document, Printing
- MS EXCEL: Introduction to Excel, Formatting excel work book
- MS EXCEL: Perform Calculations with Functions, Sort and Filter Data with Excel
- MS EXCEL: Create Effective Charts to Present Data Visually,Analyze Data Using PivotTables and Pivot Charts,Protecting and Sharing the work book
- MS EXCEL: Use Macros to Automate Tasks, Proofing and Printing, Preparation of various data collection forms, Mathematical Calculations using Spreadsheet
- MS POWER POINT: Setting Up PowerPoint Environment, Creating slides and applying themes,Working with bullets and numbering,Working with Objects,Slide show option and print
- INTERNET AND EMAIL: What is Internet, Types of internet networks , Receiving Incoming Messages , Sending Outgoing Messages, Email addressing , Email attachments, Browsing, Search engines , Text chatting, Job Searching.

Course Outcomes (COs)

After completion of the course the student will:

a) The study and use of MS WORD, MS EXCEL , POWER POINT AND Google Forms with their utilization in Chemical engineering project works and personal works

MC310A **CONSTITUTION OF INDIA**

Instruction Hours/Week: 2(L) Credits: 0 Assessment: 0 + 100

Course Objectives: Students will be able to

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in

the early years of Indian nationalism.

3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution

Unit-I

History of Making of the Indian Constitution: History

Drafting Committee, (Composition & Working)

Philosophy of the Indian Constitution: Preamble

Salient Features

Unit-II

- **Contours of Constitutional Rights & Duties:**
- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

Unit-III

- **Organs of Governance:**
- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

Unit-IV

- **Local Administration:**
- District's Administration head: Role and Importance,

- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
- Pachayati raj: Introduction, PRI: ZilaPachayat.
- Elected officials and their roles, CEO ZilaPachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

Unit-V

- **Election Commission:**
- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.

Institute and Bodies for the welfare of SC/ST/OBC and women

Text Books/References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

a) Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
b) Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

c) Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
Discuss the passage of the Hindu Code Bill of 1956.

B. Tech. IV semester Chemical Engineering

CH401B **MATHEMATICS - IV**

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

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 :

Curve fitting by the method of least squares, Fitting of (i) Straight line (ii) Second degree parabola (iii) Exponential curves, Solutions of Algebraic & Transcendental Equations: Determination of roots of non - linear equations by iterative methods - Falsi position method - bisection method - Newton Raphson method - Multiple roots by Newton Raphson method - Complex roots by Mueller's method.

Solution Of Linear And Non-Linear Algebraic Equations - iterative methods - Gauss elimination with pivotal condensation - Gauss Seidal & Jacobi iterative methods.

Unit-II :

Numerical Interpolation, Integration & Differentiation - Newton's forward & backward interpolation formula - Lagrange's interpolation formula. Numerical differentiation with forward and backward differences, Numerical Integration with Trapezoidal rule, Simpson's 1/3 rule and Simpson's 3/8 rule andRomberg method.

UNIT - III:

Solution Of Ordinary & Partial Differential Equations - Taylor series method - 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.

UNIT - IV:

Random variables, Discrete and Continuous distributions, expectation, variance. Distributions: Binomial, Poisson, Normal and Exponential Properties and applications.

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

UNIT - V:

Testing of Hypothesis –Null and alternate hypothesis, level of significance and critical region-Z-test for single mean and difference of means, single proportion and difference of proportions - t-test for single mean and difference of means - F-test for comparison of variances, Chi-square test for goodness of fit

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.
4. S P Gupta, Statistical Methods, 38th Edition, Sultan Chand & Sons Educational Publishers, 2009.
5. K V Iyengar et al, Probability and Statistics 2nd Edition, S. Chand & Company Ltd, 2010.
6. 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. After the completion of course, students will be able to apply numerical methods to solve all type of equations.
2. Derive interpolating polynomials using interpolation formulae.
3. Solve integral equations numerically.
4. Analyse the data and develop skills to solve Algebraic & Transcendental Equations.
5. Derive numerical methods solution of differential equations.To find the Solution of Linear And Non-Linear Algebraic 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							

CH402C PARTICLE AND FLUID PROCESSING

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

Course Educational Objectives :

1. To develop understanding of solids, their characterization, solid handling and mixing.
2. To develop understanding of the principles of communition, 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.

Syllabus:

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.

	PO1	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

CH403C CHEMICAL ENGINEERING THERMODYNAMICS - II

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

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

Syllabus

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

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.

	PO1	**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							

2. Chemical Engineering Thermodynamics, YVC Rao, University publication

CH404C **HEAT TRANSFER**

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

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

Syllabus

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 – 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 in Transition region

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.

	PO1	**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**		

CH405C MASS TRANSFER OPERATIONS – I

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

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.

	PO1	**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**		

CH406C CHEMICAL TECHNOLOGY

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

Course Educational Objectives:

1. To know the difference between unit operations and unit processes.
2. To learn principles of different unit operations like screening, filtration, size reduction, mixing.
3. To learn how to draw flow sheet for a process.
4. To know the industrial production of cements, industrial gases, nitrogen, sulphur phosphorous, glass and ceramic industries.
5. To learn the thermodynamic considerations, engineering problems and economic factors in the production.

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 Gop al 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.

	PO1	**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							

CH407L PARTICLE AND FLUID PROCESSING LAB

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

EXPERIMENTS:

1.Sieve Analysis 2.Roll Crusher

3.Ball Mill 4.Rod Mill

5.Pulverizer 6.Cyclone Separator

7.Crystallizer 8.Plate And Frame Filter Press

9.Leaf Filter 10.Hydro Classifier

11.Motion Of Particles Through A Fluid 12.Disk Grinder

CH408L HEAT TRANSFER LABORATORY

Instruction Hours/Week: 3 hr/week Credits: 1.5 Assessment: 40 + 60

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.

CH309S **PYTHON PROGRAMMING**

Instruction Hours/Week: 3(L) Credits: 2 Assessment : 40 + 60

Course Objectives:

The objective of the course is to impart to the students:

1. Python syntax and semantics and be fluent in the use of Python flow control and functions.
2. The concepts of Object-Oriented Programming as used in Python.
3. Exposure to various problems solving approaches of computer science in various Domains.
4. Various data structures like lists and dictionaries using python.
5. Introduce Python third- Party Tools for various domains.

UNIT I

Introduction to Python: Features and History of Python, Print and Input Functions, Variables, Keywords, Comments

Types: Numerical Types (int, float, complex), Strings, Boolean, Type Conversion Operators: Arithmetic, Relational, Logical, Bitwise, Assignment, Identity, Membership.

Control Flow: Indentation, if-elif-else, while, for, break, continue, pass, else-with loops.

UNIT II

Functions: Introduction, Required Arguments, Default Arguments, Keyword Arguments, Variable Number of Arguments, Variable Scope and Lifetime, Global Variables, Lambda Functions, Command Line Arguments.

Object-Oriented Programming: Classes and Objects, Built in Class Methods and Attributes, Self, Constructor, Destructor, Inheritance, Data Hiding, Overriding Methods and Overloading Operators.

UNIT III

Data Structures, Files and Exception Handling:

Lists, Nested Lists, List Comprehensions, Tuples and Sequences, Sets, Dictionaries. File I/O: Opening, Closing, Reading and Writing Handling Exceptions, Multiple Except Blocks, Multiple Exceptions in a Single Block, Except Block without Exception, The Else Clause, Raising Exceptions, Built-in and User-Defined Exceptions, The FinallyBlock.

UNIT IV

Modules, Packages and Standard Library:

Introduction Modules, Import and From-Import, Packages in Python, Used Defined Modules and Packages, PIP. The Python Standard Library: Numeric and Mathematical Modules, String Processing, Date & Time, Calendar, Operating System, Web Browser.

Python Third- Party Tools:

Survey of The Most Common 3rd Party Packages: Requests, Numpy/Scipy, Matplotlib/ Pyplot, Pandas, Pillow, Flask/Django/Twisted, Pep8, Scikit-Learn/Nltk, Stanford-Corenlp, Bcrypt, Beautiful Soup, and More.

UNIT V

GUI, Graphics and Applications:

GUI Design with Tkinter: Button, Canvas, Check Button, Entry, Frame, Label, List Box, Menu, Menu Button, Message, Radio Button, Scale, Scrollbar, Text Graphics with Turtle: Motion Control, Pen, Colour, Fill, Multiple Turtles, Reset and Clear.

Text Books:

1. ReemaThareja, Python Programming using problem solving approach, First Edition, Oxford University Press, 2017
2. Mark Lutz,Learning Python, fifth Edition, O‟Rielly,2016

Reference Books:

1. Mark Lutz, Programming Python, Fourth Edition, O‟ReillyMedia,2010.

2. John V.Guttag,Introduction to Computation and Programming Using Python with Applicationto Understanding, PHI.
3. Allen Downey, Think Python: How to think like a Computer Scientist, Green TeaPress.
4. Paul Barry,Head First Python: A Brain-Friendly Guide, Second Edition, O‟Reilly.
5. The Python Standard Library,Python 3.6.5 documentation(Web Resource)https://docs.python.org/3/library/.

Course Outcomes

Having successfully completed this course the students will be able to:

a) Understand the structure, syntax, and semantics of the Python language.
b) Interpret the concepts of Object-Oriented Programming as used in Python.
c) Demonstrate proficiency in handling Strings and File Systems.
d) Implement desktop/Web-based applications using the Python programming language.
e) Boost hireability through innovative and independent learning.

f) 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										

SRI VENKATESWARA UNIVERSITY :: TIRUPATI

Department of Mechanical Engineering

S.V. University College of Engineering:: Tirupati

R – 20 Scheme of Instruction and Syllabi of III & IV – Semesters (2nd Year) B. Tech Programme

in

Mechanical Engineering

Effective from the batches admitted in

2020 – 21 onwards

PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineeringproblems reaching substantiated conclusions using first principles of mathematics, natural sciences,andengineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and designsystem components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of theinformationto providevalid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with anunderstandingofthelimitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to theprofessionalengineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions insocietal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineeringcommunity and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineeringand management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SRI VENKATESWARA UNIVERSITY

COLLEGE OF ENGINEERING: TIRUPATI 517 502

R-20 – Scheme of Instruction effective from the academic year 2020-2021

B.Tech. (Chemical Engineering)

I Semester

Code	Category	Course Title	Scheme of Instruction (hr/Week) Lecture	Tutorial	Practical	Total Instruction	Credits
MA101	Basic Sci.	Mathematics – I	3	1	-	4	**4**
CY 101	Basic Sci	Engg Chemistry	3	1	-	4	**4**
EN103	Humanities	English	2	-	-	2	**2**
EE104	Basic Engg	Basic Electrical and Electronics Engineering	3	1	-	4	**4**
ME105	Basic Engg	Engineering Graphics and Design	2	-	3	5	**3.5**
EN 106	Humanities	English Communication Lab	-	-	3	3	**1.5**
		TOTAL	13	3	6	22	**19**

II Semester

Code	Category	Course Title	Scheme of Instruction (hr/Week) Lecture	Tutorial	Practical	Total Instruction	Credits
MA201	Basic Sci.	Mathematics – II	3	1	-	4	**4**
PY 202	Basic Sci	Engineering Physics	3	1	-	4	**4**
CS 203	Basic Engg	Programming for Problem Solving	2	1	-	3	**3**
CE 204	Basic Engg	Engineering Mechanics	3	1	-	4	**4**
ME 205	Basic Engg. Lab	Workshop / Manufacturing Practices	-	-	3	3	**1.5**
CS 206	Humanities Lab	Programming for Problem Solving Lab	-	-	3	3	**1.5**

CE 207	Audit	Environmental Science	4	-	-	4	**0**
		TOTAL	13	3	6	22	**18**

- All courses - 40 marks (Internal) + 60 marks (Univ. Semester End)
- Audit Course – 100 marks (Internal) - Zero Credits

B.TECH. I SEMESTER CHEMICAL ENGINEERING

MABST 101 **MATHEMATICS -I**

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

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
2. Applydifferential equations to engineering problems.
3. Use transformation to convert one type into another type presumably easier to solve.
4. Use shift theorems to compute the Laplace transform, inverse Laplace transform and the solutions of second order, linear equations with constant coefficients.
5. Solve an initial value problem for an n^{th} order ordinary differential equation using the Laplace transform.
6. Expand functions as power series using Maclaurin's and Talor's series
7. Optimize the problems related to OR, Computer science, Probability and Statistics
8. Draw an approximate shape by the study of some of its important characteristics such as symmetry, tangents, regions etc using curve tracingmethodto find length, area, volume.
9. Use multiple integral in evaluating area and volume of any region bounded by the given curves.

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): Stereodescriptors – 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. To enable students to plan and conduct experiments, as well as to examine and interpret data
2. To enable students to apply knowledge of basic sciences, and engineering
3. To enable students to design a system, component, or procedure to meet required needs within practical constraints such as budget, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
4. To enable students to work on multidisciplinary teams
5. To enable students to identify, formulate, and solve engineering problems
6. Awareness of professional and ethical responsibility
7. To enable students to communicate effectively
8. The broad learning is required to understand the impact of engineering solutions in a global, economic, environmental, and societal context
9. A recognition of the need for, and an ability to engage in life-long learning
10. A knowledge of contemporary issues
11. To enable students to use the techniques, skills, and modern engineering tools necessary for engineering practice

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.

EEEST 104BASICS 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 Outcomes:

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

1. Understand the basic concepts of D.C. single phase and 3- phase supply and circuits and solve basic electrical circuit problems
2. Understand the basic concepts of transformers and motors used as various industrial drives
3. Understand the concept of power factor improvement for industrial installations and concepts of most economical power factor
4. Understand the operation and characteristics of diodes, transistors, integrated circuits and digital circuits

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.

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 Outcomes:

The student will acquire basic proficiency in English including reading and listening comprehension, writingandspeakingskills.

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
2. UseCayley-Hamilton theorem to find inverses or powers of matrices.
3. Use Eigen values and vectors to reduce Quadratic forms to normal form.
4. Analyze motion problems from real lines to curves and surfaces in 3-D and use tools such as divergence and curl of vector and gradient, directional derivatives that play significant roles in many applications.
5. Use Green's theorem to evaluate line integrals along simple closed contours on the plane
6. Use Stokes' theorem to give a physical interpretation of the curl of a vector field
7. Use the divergence theorem to give a physical interpretation of the divergence of a vector field.
8. Find the Fourier Series to representa function as a series of constants times sine and cosine functions of different frequencies in order to observe periodic phenomenon.
9. Evaluate certain improper integrals to make them simple with introduction of Gamma and Beta functions.
10. Study certain special functions that arise in solving certain ordinary differential equations to model many physical phenomena.

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:

To familiarize students with wood working, sheet metal operations, fitting and electrical house wiring skills

Workshop Practice: Any five of the following

Machineshop - Fittingshop - Carpentry - Electrical wiring - Welding shop - Casting - Smithy - Plastic moulding &GlassCutting

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

Detailed contents online videos / ppt presentations.

Manufacturing Methods-casting, forming, machining, joining, advanced manufacturing methods ; CNC machining, Additive manufacturing ; Fitting operations &power tools ; Electrical &Electronics ; Carpentry ; Plastic moulding, glass cutting ; Metal casting ; Welding(arc welding&gas welding), brazing

Text/ReferenceBooks:

1. HajraChoudhuryS.K.,HajraChoudhuryA.K.andNirjharRoyS.K.,"Elementsof Workshop Technology", Vol. I 2008and Vol. II 2010, Media promoters and Publishersprivatelimited,Mumbai.
2. KalpakjianS.AndStevenS.Schmid,"ManufacturingEngineeringandTechnology", 4th edition,PearsonEducationIndiaEdition,2002.
3. GowriP.HariharanandA.SureshBabu,"ManufacturingTechnology–I" Pearson Education,2008.
4. RoyA.Lindberg,"ProcessesandMaterialsof Manufacture",4th edition,PrenticeHall India,1998.
5. RaoP.N., "ManufacturingTechnology",Vol.IandVol.II,TataMcGrawHillHouse, 2017

Laboratory Outcomes : students will be able to

1. Fabricate components with their own hands. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes. By assembling different components, they will be able to produce small devices of their interest.

Course Outcomes : Students will gain knowledge of the different manufacturing processes which are commonly employed in the industry to fabricatecomponents using different materials.

CSESP 206 PROGRAMMING FOR PROBLEM SOLVING LAB

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

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: Students will be able to develop Programming concepts to
1. Formulate simple algorithms for arithmetic and logical problems.
2. Translate the algorithms to programs (in C language).
3. Test and execute the programs and correct syntax and logical errors.
4. Implement conditional branching, iteration and recursion.
5. Decompose a problem into functions and synthesize a complete program using divide and conquer approach.
6. Use arrays, pointers and structures to formulate algorithms and programs.
7. Apply programming to solve matrix addition and multiplication problems and searching and sorting problems and to apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration

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

1. Acquire knowledge in
    - diverse components of environment and natural resources
    - ecosystem and biodiversity & its conservation methods
    - population growth and human health
    - green technology.
2. Identify and resolve the issues related to sources of different types of pollutions
3. Provide solutions to individuals, industries and government for sustainable development of natural resources
4. Apply environmental ethics in protection of diversified ecosystems.

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B. Tech. III semester Chemical Engineering

MA 301 B **MATHEMATICS – III**III semester

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

Course Objectives:

1. This course aims at providing the student to acquire the knowledge on the calculus of functions of complex variables.
2. To understand power series and expansion of analytic function.
3. To understand Laurent Series, poles, singular points, Residue theorem and its applications.
4. The aim is to analyze the solutions of partial differential equations.
5. To discuss the boundary value problems, one dimensional wave equation, heat equation and Laplace Equation.

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

a) After the completion of course, students will be able to Understand the analyticity of complex functions and conformal mappings.
b) Apply Cauchy's integral formula and Cauchy's integral theorem to evaluate improper integrals along contours.
c) Describe basic properties of complex integration and having the ability to compute such integrals.
d) Describe conformal mappings between various plane regions.
e) Apply the concepts of Complex Analysis in many branches of Engineering, including the branches of hydrodynamics, thermodynamics, and particularly quantum mechanics.
f) Compute the residue of a function and use the Residue Theory to evaluate a contour integral or an integral over the real line.
g) Formulate/solve/classify the solutions of Partial differential equations.
h) Identify linear and nonlinear PDE and solve nonlinear PDE by Charpit's method.
i) Apply Variables separable methods to solve boundary value problems.
j) Find the solution of one dimensional wave equation, heat equation and Laplace equation.

CH302E ENGINEERING AND SOLID MECHANICS III semester
Instruction Hours/Week: 3(L) Credits: 3 Assessment : 40 + 60

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)
Rigid body kinematics: Translation and rotation, relative motion, angular velocity, General motion of a rigid body, General relative motion

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.

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

Unit III :

Beams: Shear Force and Bending Moment

Unit IV :

Frictional forces, Laws of Coulomb friction, impending motion
Inertia tensor, Principal Moments of Inertia, Moment of momentum relations for rigid bodies,Euler's Equations of Motion

Unit V :

State of stress at a point, equations of motion, principal stress, maximum shear stress, Concept of strain, strain displacement relations, compatibility conditions, principal strains, transformation of stress/strain tensor, state of plane stress/strain.
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

Course Outcomes (COs):

At the end of this course students will be able to

a) Learn about the elastic and plastic behavior of material and evaluate stress invariants, principal stresses and their directions.
b) Determine strain invariants, principal strains and their directions.
c) Develop constitutive relationships between stress and strain for linearly elastic solid.
d) Analyze theories of failure and design components for safe operation.
e) Examine the properties of ideally plastic solid and apply the concepts of energy methodsin solving structural problems.

TEXT BOOKS :

1. Engineering Mechanics, Strength of Materials and Elements of Structural Analysis – C.Venkataramaiah&A.V.NarasimhaRao

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.

HS303C MANAGERIAL ECONOMICS AND ACCOUNTANCY

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

Course Outcomes: After the completion of the course the student will be able to:

CO1	Understand Macro Economic environment of the business and its impact on enterprise.
CO2	Identify various cost elements of the product and its effect on decision making.
CO3	Understand the concepts of financial management and smart investment.
CO4	Prepare the Accounting records and interpret the data for Managerial Decisions.

Mapping of course outcomes with program outcomes:

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

Detailed Syllabus:

Unit -I

Introduction to Engineering Economics, Fundamental concepts, Time value of money, Cash flow and Time Diagrams, choosing between alternative investment proposals, Methods of Economic analysis (pay back, ARR,NPV,IRR and B/C ratio), The effect of borrowing on investment, Equity vs Debt Financing, concept of leverage, Income tax leverage.

Unit -II

Depreciation and methods of calculating depreciation (straight line, sum of the years digit method, Declining balance method, Annuity method, Sinking fund method), National income accounting Methods of estimation, Various concepts of National Income, Significance of National income Estimation and its limitations.

Unit -III

Inflation: Definition, Process and Theories of inflation and Measure of control. New Economic Policy 1991(Industrial Policy, Trade Policy, Fiscal Policy), Impact on Industry.

Unit -IV

Accounting Principles, procedure, Double entry system, Journal, ledger, Trial balance, Cashbook, preparation of Trading and Profit and Loss account, Balance sheet.

Unit -V

Cost Accounting: Introduction, Classification of costs, Methods of costing, Techniques of costing, Cost sheet and preparation of cost sheet, Break-even Analysis, Meaning and its application, Limitation.

Reading Text Books:

1. Henry Malcom Steiner, Engineering Economics Principles, 2nd Edition, McGraw Hill Education, 1996.
2. Dewett. K.K., Modern Economic Theory, Sultan Chand and Co., 2006.
3. A.N.Agarwal, Indian Economy, Wiley Eastern Limited, New Delhi.
4. Jain and Narang, Accounting Part-I, Kalyani Publishers, 2011.
5. Arora, M.N. Cost Accounting: Principles and Practice, 12th Edition, Vikas Publication, 2012.

CH304C CHEMICAL PROCESS CALCULATIONS

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

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:

a) To understand the dimension-unit systems and their inter relationships.
b) To be able to represent mixture compositions in different forms.
c) To be able to make calculations using reaction stoichiometry.
d) To be able to apply ideal gas law equation and to calculate volume, pressure, mass temperature, as the case may be.
e) To have learnt the significance of vapor pressure and its dependence.
f) To have learnt different representations of partial saturation and to apply ideal gas law in conjunction with variation in levels of saturation.
g) To have acquired a perfect understanding of law of conservation of mass, its mathematical form and its application to different operations and reactions.
h) To have acquired a thorough understanding of law of conservation of energy.
i) To be able to make mass and energy balance calculations for different operations, with and without reaction.
j) To be able to estimate parameters like oxygen requirement, flue gas analysis, energy released and flame temperatures.

		OUTCOMES									
		a	b	c	d	e	f	g	h	i	j
OBJECTIVES	1	*	*	*							
	2				*						
	3					*					
	4		*	*	*	*	*	*	*	*	*
	5		*	*	*	*	*	*	*	*	*
	6							*	*	*	*

CH305C MOMENTUM TRANSFER

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

Course Educational Objectives :

To learn dimensional analysis, fluid statics and its applications.

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 incompressible and compressible fluid flow through pipes and in thin layers.
4. To understand the flow past solid surfaces, through packed bed and in fluidized beds.
5. To learn the settling characteristics of particles through fluids.
6. To learn the working and performance of pumps and compressors, valves.
7. To understand the construction 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 and total energy balances, velocity of sound, ideal gas equation, stagnant temperature.

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 (7th ed) Warren L.McCabe, Juliane Smith and Peter Harriott, McGraw Hill.

REFERENCES:

1. 1. Chemical Engineering Vol.I by Coulson and Richardson, Pergamon Press.
2. Solved Examples in Chemical Engineering by G.K.Roy
3. "Fluid Mechanics" 2nd edition by Noel de Nevers, Mc Graw Hill

Course Outcomes:

a) To be able to perform dimensional analysis of fluid flow problems.

b) To develop pressure drop equations for fluid static equipments in which fluid is at rest.

c) To have the knowledge on different types of flow regions in fluid flow, rheological properties of fluids, turbulence and boundary layers.

d) To be able to carry out macroscopic mass, momentum and energy balance to solve engineering problems related to fluid flow.

e) Educate about the formation and calculation of fluid friction in pipes and conduits.

f) Analyze flow past solid surface, through packed bed and in fluidized beds.

g) Determine the minimum fluidization velocity andterminal velocity of the fluid in Stokes and Newton's law regions.

h) The analysis of fluid flow measuring devices like Orifice meter, Venturimeter, Rotameter and Pitot tube.

i) The construction and working of Centrifugal and reciprocating pumps. And also give the knowledge on different types of valve, selection of pipe and fittings.

	OUTCOMES									
		a	b	C	d	e	f	g	h	i
	1	*	*							

OBJECTIVES	2		*	*	*	*				
	3			*	*	*				
	4						*	*		
	5							*		
	6									*
	7								*	

CH306C CHEMICAL ENGINEERING THERMODYNAMICS –I

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

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
6. 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:

a. To have learnt the fundamental ideas about energy, equilibrium and reversibility.
b. To be able to apply first law to estimate heat and work effects in closed, open and flow systems.
c. To understand PV and PT phase diagrams, ideal gas law and its applications.
d. To be able to estimate heat and work effects for different processes – isothermal, isobaric, isometric, and adiabatic processes.
e. To have understood the concept of entropy and its estimation.
f. To be to apply second law of thermodynamics to estimate efficiency of a cycle.
g. To have learnt to comment on the feasibility of a process.
h. To have learnt different refrigeration cycles and also to be able to calculate their COP.
i. To have learnt the thermodynamic analysis of flow processes.

	OUTCOMES									
		a	b	C	d	e	f	g	h	i
OBJECTIVES	1	*	*	*	*	*	*	*		
	2	*	*		*					
	3			*	*					
	4					*	*	*		
	5					*		*		
	6								*	*

CH307L MOMENTUM TRANSFER LABORATORY

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

Any 10/12 experiments on

Flow Through Straight Pipe, Frictional losses Due To Fittings, Venturi meter , Orifice meter, 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.

CH308L ANALYSIS LABORATORY

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

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.

CH309S COMPUTER SKILLS
Instruction Hours/week: 1(L) + 2(P) Credits :2Assessment : 40 + 60
Course Educational Objective (CEOs)

1. Identify basic terms, concepts, and functions of computer system components.
2. To enable the student to use MSWORD.
3. To acquaintwith MSEXCEL and MSPOWERPOINT
4. To familiarizewith browsing the INTERNET and EMAIL

- MS WORD: Text Basics, Text Formatting and saving file, working with Objects.
- MS WORD: Header & Footers, Working with bullets and numbered lists, Tables.
- MS WORD: Styles and Content, Merging Documents, Sharing and Maintaining Document
- MS WORD: Sharing and Maintaining Document, : Proofing the document, Printing
- MS EXCEL: Introduction to Excel, Formatting excel work book
- MS EXCEL: Perform Calculations with Functions, Sort and Filter Data with Excel
- MS EXCEL: Create Effective Charts to Present Data Visually,Analyze Data Using PivotTables and Pivot Charts,Protecting and Sharing the work book
- MS EXCEL: Use Macros to Automate Tasks, Proofing and Printing, Preparation of various data collection forms, Mathematical Calculations using Spreadsheet
- MS POWER POINT: Setting Up PowerPoint Environment, Creating slides and applying themes,Working with bullets and numbering,Working with Objects,Slide show option and print
- INTERNET AND EMAIL: What is Internet, Types of internet networks , Receiving Incoming Messages , Sending Outgoing Messages, Email addressing , Email attachments, Browsing, Search engines , Text chatting, Job Searching.

Course Outcomes (COs)
After completion of the course the student will:

a) The study and use of MS WORD, MS EXCEL , POWER POINT AND Google Forms with their utilization in Chemical engineering project works and personal works

MC310A **CONSTITUTION OF INDIA**

Instruction Hours/Week: 2(L) Credits: 0 Assessment: 0 + 100

Course Objectives: Students will be able to

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution

Unit-I

History of Making of the Indian Constitution: History
Drafting Committee, (Composition & Working)

Philosophy of the Indian Constitution: Preamble
Salient Features

Unit-II

- **Contours of Constitutional Rights & Duties:**
- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

Unit-III

- **Organs of Governance:**
- Parliament
- Composition
- Qualifications and Disqualifications

- Powers and Functions
- Executive
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

Unit-IV

- **Local Administration:**
- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
- Pachayati raj: Introduction, PRI: ZilaPachayat.
- Elected officials and their roles, CEO ZilaPachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

Unit-V

- **Election Commission:**
- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.

Institute and Bodies for the welfare of SC/ST/OBC and women

Text Books/References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

a) Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
b) Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
c) Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

Discuss the passage of the Hindu Code Bill of 1956.

B. Tech. IV semester Chemical Engineering

CH401B **MATHEMATICS - IV**

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

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 :

Curve fitting by the method of least squares, Fitting of (i) Straight line (ii) Second degree parabola (iii) Exponential curves, Solutions of Algebraic & Transcendental Equations: Determination of roots of non - linear equations by iterative methods - Falsi position method - bisection method - Newton Raphson method - Multiple roots by Newton Raphson method - Complex roots by Mueller's method.
Solution Of Linear And Non-Linear Algebraic Equations **-** iterative methods - Gauss elimination with pivotal condensation - Gauss Seidal & Jacobi iterative methods.

Unit-II :

Numerical Interpolation, Integration & Differentiation **-** Newton's forward & backward interpolation formula - Lagrange's interpolation formula. Numerical differentiation with forward and backward differences, Numerical Integration with Trapezoidal rule, Simpson's 1/3 rule and Simpson's 3/8 rule andRomberg method.

UNIT - III:

Solution Of Ordinary & Partial Differential Equations - Taylor series method - 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.

UNIT - IV:
Random variables, Discrete and Continuous distributions, expectation, variance. Distributions: Binomial, Poisson, Normal and Exponential Properties and applications.
Correlation: curve fitting by method of least squares - Linear, Quadratic and Exponential fitting – Correlation – Rank, Correlation - Regression analysis - Multiple correlation.
UNIT - V:
Testing of Hypothesis –Null and alternate hypothesis, level of significance and critical region-Z-test for single mean and difference of means, single proportion and difference of proportions - t-test for single mean and difference of means - F-test for comparison of variances, Chi-square test for goodness of fit

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.
4. S P Gupta, Statistical Methods, 38th Edition, Sultan Chand & Sons Educational Publishers, 2009.
5. K V Iyengar et al, Probability and Statistics 2nd Edition, S. Chand & Company Ltd, 2010.
6. 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

a) After the completion of course, students will be able to apply numerical methods to solve all type of equations.
b) Derive interpolating polynomials using interpolation formulae.
c) Solve integral equations numerically.
d) Analyse the data and develop skills to solve Algebraic & Transcendental Equations.
e) Derive numerical methods solution of differential equations.
f) To find the Solution of Linear And Non-Linear Algebraic Equations.

CH402C PARTICLE AND FLUID PROCESSING

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

Course Educational Objectives :

1. To develop understanding of solids, their characterization, solid handling and mixing.
2. To develop understanding of the principles of communition, 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.

Syllabus:

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 :

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

b) To be able to calculate the screening effectiveness.
c) To be able tofind the power requirement using three crushing laws.
d) To have the knowledge of different types of Crushers, grinders, ultrafine grinders, cutters.
e) To have understood settling processes and flotation technique.
f) To develop the rate equations for constant pressure and constant volume filtration techniques and also to solve the problems related to these techniques.
g) To have acquired the construction and operation of different filtration, settling and clarifying equipment.
h) To understand the functioning of agitated vessels and to calculate the power consumption.
i) To have the knowledge on different types of turbines, blending and mixing.

	OUTCOMES									
		a	b	c	d	e	f	g	h	i
OBJECTIVES	1	*								*
	2		*			*		*	*	
	3		*	*						
	4				*	*				
	5						*	*		

CH403C CHEMICAL ENGINEERING THERMODYNAMICS - II

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

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

Syllabus

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 :

a. To be able to develop and use expressions for property estimation
b. To be able to calculate property values from equations of state
c. To have learnt the concepts of residual, excess, partial molar properties and property changes of mixing
d. To have understood concepts of ideal solutions, fagacity and activity coefficient

e. To be able to make phase equilibrium calculations using Raoult's law

f To be able to use modified forms of Raoult's law for non-ideal systems

g. To have learnt the concepts of LLE and VLLE

h. To have learnt the concept of equilibrium constant and its calculation

i. To be able to estimate equilibrium conversion of single and simple multiple reactions

		OUTCOMES								
		a	b	c	d	e	f	g	h	i
OBJECTIVES	1	*	*							
	2			*	*					
	3				*			*		
	4				*	*	*	*		
	5								*	*

CH404C HEAT TRANSFER

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

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
6. To learn the principles of crystallization

Syllabus

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 – 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 in Transition region

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 :

a) To be able to calculate the heat transfer flux in one-dimensional heat conduction
b) To have learnt the concepts of turbulence, boundary layer and analogies
c) To be able to calculate heat flux in natural convection
d) To be able to estimate heat flux in forced convection
e) To have understood the concepts of black body, view factors and to be able to calculate radiation heat flux
f) To be able to handle conduction-convection conduction-convection-radiation heat transfer
g) To have understood the phenomena of boiling and condensation
h) To have understood the construction and flow patterns in heat exchange equipment
i) To be able to design heat exchangers and condensers
j) To have understood the functioning of evaporators
k) To have learnt the mechanism of crystallization and the general features of crystallizers

	OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k
OBJECTIVES	1	*	*	*	*	*	*					
	2		*	*	*		*	*				
	3					*	*					
	4				*				*	*		
	5										*	
	6											*

CH405C MASS TRANSFER OPERATIONS – I

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

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 :

a) To be able to calculate the flux in cases involving diffusive transfer
b) To appreciate the contribution of turbulence to transfer and to calculate coefficients and flux
c) To be able to differentiate different representations of resistances and to properly integrate them to obtain the overall resistance
d) To be able to write mass balance equations for different contacting patterns
e) To learn the concept of transfer units
f) To be able to estimate the process parameters like solvent requirement, number of theoretical stages, height and diameter of columns
g) To understand the working of gas continuous-liquid-dispersed and gas –dispersed liquid – continuous contacting equipment
h) To understand equilibrium relevant to absorption and to calculate the number of stages, number and height of transfer units
i) To understand the equilibrium concerned to humidification, various methods of conducting the operation and to design a cooling tower
j) To understand the mechanism of drying operation and to calculate the time of drying.

		OUTCOMES									
		a	b	c	d	e	f	g	h	i	j
OBJECTIVES	1	*	*	*							
	2		*	*							
	3				*	*	*		*	*	*
	4							*			
	5						*		*	*	*

CH406C CHEMICAL TECHNOLOGY

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

Course Educational Objectives:

1. To know the difference between unit operations and unit processes.
2. To learn principles of different unit operations like screening, filtration, size reduction, mixing.
3. To learn how to draw flow sheet for a process.
4. To know the industrial production of cements, industrial gases, nitrogen, sulphur phosphorous, glass and ceramic industries.
5. To learn the thermodynamic considerations, engineering problems and economic factors in the production.

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 Gop al Rao and Marshall sitting. – Boca Raton

Course Outcomes:

a) Able to differentiate between unit operations and unit processes in industrial processes.
b) Know various equipments used for chemical processes in different industries.
c) Can understand the sources of water and different water treatment methods.
d) Know types of cements and raw materials, production of different types of cements.
e) Able to know the raw materials used , reactions involved and different methods for the production nitrogen, phosphorous, sulphur.
f) Knows different types of glasses, raw materials and production process.
g) Understand about basic raw materials, production process of different ceramic products and about refractories.

h) Able to understand temperature, pressure effects of process, about the materials for construction of equipments, furnaces and economic problems in process industries.

	OUTCOMES								
		a	b	c	d	e	f	g	h
OBJECTIVES	1	*	*	*	*	*	*		
	2	*	*	*	*	*	*		
	3	*	*	*	*	*	*		
	4	*	*	*	*	*	*	*	
	5								*

CH407L PARTICLE AND FLUID PROCESSING LAB

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

EXPERIMENTS:

1.Sieve Analysis
2.Roll Crusher
3.Ball Mill
4.Rod Mill
5.Pulverizer
6.Cyclone Separator
7.Crystallizer
8.Plate And Frame Filter Press
9.Leaf Filter
10.Hydro Classifier
11.Motion Of Particles Through A Fluid
12.Disk Grinder

CH408L HEAT TRANSFER LABORATORY

Instruction Hours/Week: 3 hr/week Credits: 1.5 Assessment: 40 + 60

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.

CH309S PYTHON PROGRAMMING

Instruction Hours/Week: 3(L) Credits: 2 Assessment : 40 + 60

Course Objectives:

The objective of the course is to impart to the students:

1. Python syntax and semantics and be fluent in the use of Python flow control and functions.
2. The concepts of Object-Oriented Programming as used in Python.
3. Exposure to various problems solving approaches of computer science in various Domains.
4. Various data structures like lists and dictionaries using python.
5. Introduce Python third- Party Tools for various domains.

UNIT I

Introduction to Python: Features and History of Python, Print and Input Functions, Variables, Keywords, Comments

Types: Numerical Types (int, float, complex), Strings, Boolean, Type Conversion Operators: Arithmetic, Relational, Logical, Bitwise, Assignment, Identity, Membership.

Control Flow: Indentation, if-elif-else, while, for, break, continue, pass, else-with loops.

UNIT II

Functions: Introduction, Required Arguments, Default Arguments, Keyword Arguments, Variable Number of Arguments, Variable Scope and Lifetime, Global Variables, Lambda Functions, Command Line Arguments.

Object-Oriented Programming: Classes and Objects, Built in Class Methods and Attributes, Self, Constructor, Destructor, Inheritance, Data Hiding, Overriding Methods and Overloading Operators.

UNIT III

Data Structures, Files and Exception Handling:

Lists, Nested Lists, List Comprehensions, Tuples and Sequences, Sets, Dictionaries. File I/O: Opening, Closing, Reading and Writing Handling Exceptions, Multiple Except Blocks, Multiple Exceptions in a Single Block, Except Block without Exception, The Else Clause, Raising Exceptions, Built-in and User-Defined Exceptions, The FinallyBlock.

UNIT IV

Modules, Packages and Standard Library:

Introduction Modules, Import and From-Import, Packages in Python, Used Defined Modules and Packages, PIP. The Python Standard Library: Numeric and Mathematical Modules, String Processing, Date & Time, Calendar, Operating System, Web Browser.

Python Third- Party Tools:

Survey of The Most Common 3rd Party Packages: Requests, Numpy/Scipy, Matplotlib/ Pyplot, Pandas, Pillow, Flask/Django/Twisted, Pep8, Scikit-Learn/Nltk, Stanford-Corenlp, Bcrypt, Beautiful Soup, and More.

UNIT V

GUI, Graphics and Applications:

GUI Design with Tkinter: Button, Canvas, Check Button, Entry, Frame, Label, List Box, Menu, Menu Button, Message, Radio Button, Scale, Scrollbar, Text Graphics with Turtle: Motion Control, Pen, Colour, Fill, Multiple Turtles, Reset and Clear.

Course Outcomes

Having successfully completed this course the students will be able to:

a) Understand the structure, syntax, and semantics of the Python language.
b) Interpret the concepts of Object-Oriented Programming as used in Python.
c) Demonstrate proficiency in handling Strings and File Systems.
d) Implement desktop/Web-based applications using the Python programming language.
e) Boost hireability through innovative and independent learning.

Text Books:

1. ReemaThareja, Python Programming using problem solving approach, First Edition, Oxford University Press, 2017
2. Mark Lutz,Learning Python, fifth Edition, O‟Rielly,2016

Reference Books:

1. Mark Lutz, Programming Python, Fourth Edition, O‟ReillyMedia,2010.
2. John V.Guttag,Introduction to Computation and Programming Using Python with Applicationto Understanding, PHI.
3. Allen Downey, Think Python: How to think like a Computer Scientist, Green TeaPress.
4. Paul Barry,Head First Python: A Brain-Friendly Guide, Second Edition, O‟Reilly.
5. The Python Standard Library,Python 3.6.5 documentation(Web Resource)https://docs.python.org/3/library/.

B.Tech. Honors in Chemical Engineering Syllabus

CHHN01 PETROLEUM AND PETROCHEMICALS

Instruction : 4 hr/week Credits : 4 Assessment : 40 + 60

Course Objectives:

1. To make a thorough understanding of the availability of petroleum resources, technical and financial constraints of all the elementary problems.
2. To know the development of petrochemical industries and methodolically furnishes the conversion of petroleum feedstock's to chemical and intermediates.

UNIT - I: Origin, composition and Formation of Petroleum. Outlines of crude oil exploration methods.

UNIT - II: Refinery products, and testing methods - physical properties of crude petroleum and its products.

UNIT - III: Types of distillation – Batch distillation, continuous distillation, vacuum distillation, Azeotropic and Extractive distillation - stabilization.-Super fractionation – LPG

UNIT - IV: Treatment of Petroleum Products – Caustic Soda Treatment, Mercaptan Removal and Oxidation Process- treatment with Sulfuric acid – Treatment with Hydrogen – Solvent Extraction – Udex Process, Edeleanu Process and Furfural Extraction process

UNIT - V: Thermal and catalytic cracking. Polymerization and isomerization.

Text Books:

1. Petroleum Refining and Petrochemicals by N.K Sinha
2. Modern Petroleum Refining Processes by B.K.Bhaskara Rao
3. Petroleum Refinery Engineering by Nelson, McGraw Hill.

Course Outcomes:

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

a) Understand Petrochemical industry-Feedstock, various important Chemicals produced from ethylene and C3, C4 and higher carbon atoms.
b) Explain the methods of polymerization: high pressure polyethylene (LDPE) low pressure polyethylene (HDPE),
c) Explain the production of Petroleum aromatics, synthetic fibers, Synthetic rubber, Plastics and Synthetic detergents.
d) Understand all the production processes along with safety measures and hazards in industry and remedial methods to arrest the accidents immediately in industries..

CHHN02 **AIR POLLUTION CONTROL**

Instruction : 4 hr/week **Credits : 4** **Assessment : 40 + 60**

Course Objectives:

1. Focus on classification of air pollutants – Sources, causes, effects
2. To learn Plume behavior and Air pollution control methods
3. Need of environmental Legislation.
4. To know the environmental and health impacts of air pollution
5. To study the characteristics of air pollutants

Syllabus

UNIT-I:

Impact of man on the Environment: The Bio Sphere, hydrological cycle and The Nutrient Cycles, Energy Problem.

Air Pollution sources and effects: Classification and properties of air pollutants, Emission sources, Global sources, Anthropogenic Sources, Behavior and fate of air Pollutants, Effects of air pollution on health, Vegetation and material damage in India.

UNIT-II:

Metrological Aspects of Air Pollutant Dispersion: Temperature Lapse rate and stability, Wind velocity and turbulence, Plume of air Pollutants, Solutions to the Atmospheric dispersion Equation

UNIT-III:

Air Pollution sampling and measurement: Air Pollution Act, Legislation, Environmental Protection Act

Types of pollutant sampling and measurement: Ambient air sampling, Collection of gaseous air pollutants, Collection of particulate pollutants, stack sampling, Analysis of air pollutants(, SOx, NOx, COx, CHx, Oxidants and Ozone, Particulate matter)

UNIT-IV:

Air Pollution Control Methods and Equipment: Control methods, Sources of correction methods, Cleaning of gaseous Effluents, Particulate emission control: Gravitational Settling Chambers, Cyclone Separators, fabric Filters, Electrostatic Precipitators, Wet Scrubbers, Selection of particulate Collectors, Control of gaseous emissions.

UNIT-V:

Case studies of Industries: Ammonia Plant Effluents, Ammonium Sulphate Plant, Characteristics of Liquid Effluent, Refinery Liquid Waste- Treatment Methods. Process and Characterization of Liquid Effluent from pulp and paper industries, Pollution Control for Liquid Effluents

TEXT BOOKS:

1. Environmental Pollution Control., by C.S.Rao, wiely eastern ltd.
2. S.P.Mahajan., Pollution control in process Industries, Tata McGraw hill publishing company.

Course Outcomes:

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

a) Identify the sources, effects and analysis of air/ solids pollutants
b) Evaluate the preventive measures for the control of air pollutants,/ particulate matter
c) Importance of environmental legislation and air pollution act

d) Propose control measures of pollutants emitted from different industries like Paper and pulp, fertilizer, petrochemical and petroleum refinery,

CHHN03 ADVANCED HEAT TRANSFER
Instruction: 4 hr/week Credits : 4 Assessment : 40 + 60

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

6. To learn the principles of crystallization

UNIT I :

Process heat transfer: Introduction, Steady state conduction in multiple dimensions, Principles of convection, Radiation Heat Transfer-Physical mechanism, radiation properties, radiation shape factor and relations between shape factors.

Unit II :

Heat-Transfer Equipment: Introduction, Basic design procedure and theory, Overall heat-transfer coefficient, Fouling factors, Shell and tube exchangers: construction details, Mean temperature difference (temperature driving force).

Unit III:

Shell and Tube Exchangers: general design considerations, Tube-side heat-transfer coefficient and pressure drop (single phase),Shell-side heat-transfer and pressure drop (single phase), Flow pattern, Design methods, Kern's method, Bell's method, Shell and bundle geometry, Effect of fouling on pressure drop, Pressure-drop limitations.

Unit IV:

Design of Condensers, Reboilers and Vaporizers.

Unit V:

Design of Plate heat exchangers: Gasketed plate heat exchangers, Welded plate, Plate-fin, Spiral heat exchangers, Direct-contact heat Exchangers, finned tubes, Double-pipe heat exchangers, Air-cooled exchangers, Fired heaters (furnaces and boilers), Heat transfer to vessels.

References:

1. Chemical Engineering Design by Coulson & Richardson's,Volume 6 Fourth Edition.
2. Heat Transfer" by J.P.Holman, Ninth Edition.
3.Process Heat Transfer by Donald Q. Kern.

Course Outcomes:

a) To be able to calculate the heat transfer flux in one-dimensional heat conduction

b) To have learnt the concepts of turbulence, boundary layer and analogies

c) To be able to calculate heat flux in natural convection

d) To be able to estimate heat flux in forced convection

e) To have understood the concepts of black body, view factors and to be able to calculate radiation heat flux

f) To be able to handle conduction-convection conduction-convection-radiation heat transfer

g) To have understood the phenomena of boiling and condensation

h) To have understood the construction and flow patterns in heat exchange equipment

i) To be able to design heat exchangers and condensers

j) To have understood the functioning of evaporators

k) To have learnt the mechanism of crystallization and the general features of crystallizers

	OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k
OBJECTIVES	1	*	*	*	*	*	*					
	2		*	*	*		*	*				
	3					*	*					
	4				*				*	*		
	5										*	
	6											*

CHHN04 ADVANCED MASS TRANSFER

Instruction : 4 hr/week Credits : 4 Assessment : 40 + 60

Course Objectives:

1. To develop skills in the process design of mass transfer operations
2. To understand problems involving mass transfer using the principles of material andenergy balances.

Syllabus

Unit -I

Flux Definition: Mass and molar transport by convection, Summary of mass and molar fluxes,Fick's law. Differential Equations of Mass transfer: Differential equation for mass transfer, Boundary conditions. Molecular diffusivities: Diffusivities in gases, Diffusivities in liquids.

Unit -II

Molecular diffusion :Steady state molecular diffusion, Steady-State Equimolal counter diffusion in gases, Steady state Equimolal unidirectional diffusion in gases, Molar diffusion in liquids, Diffusion through a stagnant gas film, Diffusion with a moving interface, Diffusion through a Nonisothermal Spherical film.

Unit -III

Diffusion with a homogeneous Chemical reaction, Diffusion with a slow Heterogeneous Chemical reaction, Diffusion with a Heterogeneous Chemical reaction, Unsteady state diffusion in a slab, Unsteady state diffusion in a Cylinder, Unsteady state diffusion in a sphere, Mass Transfer coefficients Individual Mass transfer coefficients, Overall Mass Transfer coefficients.

Unit-IV

Mechanism of Mass transfer, the two-film theory, the penetration theory, the theory of penetration with Random surface renewal. Mass transfer in Laminar Flow: Mass transfer in the laminar boundary layer on a flat plate (Integral Solution), Mass transfer in laminar Natural convection on a vertical plate, Mass transfer in a falling liquid film in a laminar flow, Mass transfer between a gas phase and a falling liquid film (gas absorption), Mass transfer between an inclined plate and a falling liquid film (Solid dissolution), Gas absorption with rapid reaction

Unit -V

Mass Transfer in turbulent flow:Mass transfer in the turbulent boundary layer on a flat plate, Mass transfer in turbulent Natural convectionon a vertical plate, Mass transfer between inclined plate and a falling liquid film inturbulent flow. Analogies between momentum, heat and mass transfer: Reynolds analogy, Prandtl analogy, Von Karman analogy, Analogies in terms of j factor.

TEXTBOOKS:

1. "Transport phenomena" R. Byron Bird, Warren E. Stewart and E.N. Light foot, Wiley & Sons, Inc., New York.
2. 'Mass Transfer Operations' Robert E. Treybal, third edition, Mc Graw-Hill International Edition, Chemical Engineering Series.

REFERENCE BOOKS:

1. "Transport Processes and separation Processes Principles" Geankoplis, Prentice-Hall of India, New Delhi
2. Fundamentals of Momentum, Heat and Mass Transfer" James R. Welty, Charles E. Wicks and Robert E. Wilson, John Wiley & Sons, Inc., New York.
3. "Principles of Mass Transfer and Separation Processes" Dutta B.K, Prentice-Hall of India, New Delhi

Course Outcomes:

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

a) Design process equipment for various mass transfer operations.
b) Demonstrate the use of equations of change for multi-component systems.
c) Solve problems of mass transfer in laminar and turbulent regimes.
d) Solve problems of interphase transport in non-isothermal systems.

CHHN 05 TRANSPORT PHENOMENA-II

Instruction : 4 hr/week Credits : 4 Assessment : 40 + 60

Objectives:

1. To familiarize the student with basic concepts of transport phenomena and brief review of mathematics.
2. To enable students to understand the equations of change for isothermal flow and for non-isothermal flow.
3. To introduce them details of equations of change for multi component systems.
4. To give them insight into properties of two-dimensional flows and aspects of dimensional analysis

Unit-1: Equations of Change for Isothermal Systems: Equation of Continuity, Equation ofMotion,Equation of Mechanical Energy, Equations of Change in terms of the Substantial Derivative, Use of the Equations to solve Flow Problems, Dimensional Analysis of the Equations of Change.Velocity Distributions with more than one Independent Variable: Time Dependent Flow of Newtonian Fluids. Velocity Distributions in Turbulent Flow -Comparisons of Laminar and Turbulent Flows, Time Smoothed Equations of Change for Incompressible Fluids, Time Smoothed Velocity Profile near a wall, Empirical Expressions for the Turbulent Momentum Flux, Turbulent Flow in Ducts.

Unit-2: Macroscopic Balances for Isothermal Systems: The Macroscopic Mass Balance, TheMacroscopic Momentum Balance, The Macroscopic Mechanical Energy Balance, Estimation of the Viscous loss, Use of the Macroscopic Balances for Steady-State Problems, Derivation of the Macroscopic Mechanical Energy Balance.
Equations of Change for Non-Isothermal Systems: The Energy Equation, Special forms of the Energy Equation, The Boussine sq Equation of Motion for Forced and Free Convection, Use of the Equations of change to Solve Steady-State Problems, Dimensional Analysis of the Equations of Change for Non-Isothermal Systems.

Unit-3: Temperature Distributions in Solids and in Laminar Flow: Heat Conduction with anElectrical Heat Source, Heat Conduction with a Viscous Heat Source. Temperature Distributions with more than One Independent Variable - Unsteady Heat Conduction in Solids, Steady Heat Conduction in Laminar, Incompressible Flow. Temperature Distributions in Turbulent Flow - Time-Smoothed Equations of Change for Incompressible Non-Isothermal Flow, Time-Smoothed Temperature Profile near a Wall, Empirical Expressions for the Turbulent Heat Flux Temperature Distribution for Turbulent Flow in Tubes.

Unit-4: Macroscopic Balances For Non-Isothermal Systems: Macroscopic Energy Balance,Macroscopic Mechanical Energy Balance, Use Of The Macroscopic Balances To Solve Steady State Problems With Flat Velocity Profiles, Concentration Distributions in Solids and in Laminar Flow: Shell Mass Balances Boundary Conditions, Diffusion through a Stagnant Gas Film, Diffusion with a Heterogeneous Chemical Reaction. Concentration Distributions with more than One Independent Variable: Time-Dependent Diffusion, Steady-State Transport in Binary Boundary Layers, Concentration Distributions in Turbulent Flow - Concentration Fluctuations and the Time-Smoothed Concentration, Time-Smoothing of the Equation of Continuity of A, Semi-Empirical Expressions for the Turbulent Mass Flux, Enhancement of Mass Transfer by a First-Order Reaction in Turbulent Flow.
Unit -5: Interphase Transport in Multi-Component Systems: Definition of Transfer Coefficients inOne Phase, Analytical Expressions for Mass Transfer Coefficients, Correlation of Binary Transfer Coefficients in One Phase, Definition of Transfer Coefficients in Two Phases, Mass Transfer and Chemical Reactions. Macroscopic Balances For Multi-Component Systems: Macroscopic Mass Balances, Macroscopic Momentum, Use of the Macroscopic Balances to solve Steady-State Problems.

References

1. Thomson W. J., Transport Phenomena, Pearson education, Asia, 2001.
2. Geankopolis C. J., Transport Processes and Unit Operations, 4th Ed., Prentice Hall (India) Pvt. Ltd., New Delhi. 2004.
3. Bird R. B., Stewart W. E. and Light Foot E. N., Transport Phenomena, Revised 2nd Edition, John Wiley & Sons, 2007.

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

a) Understand the mechanism of momentum, heat and mass transport for steady and unsteady flow.
b) Perform momentum, energy and mass balances for a given system at macroscopic and microscopic scale.

c) Solve the governing equations to obtain velocity, temperature and concentration profiles.
d) Model the momentum, heat and mass transport under turbulent conditions.
e) Develop analogies among momentum, energy and mass transport.

CHHN 06 CHEMICAL REACTOR THEORY
Instruction : 4 hr/week Credits : 4 Assessment : 40 + 60

Course Educational Objectives:
1. The emphasis of this course is on the fundamentals of chemical reaction kinetics and chemical reactor operation.
2. The overall goal of this course is to develop a critical approach toward understanding complex reaction systems and elucidating chemical reactor design.
3. Integrate concepts from science & engineering to constitute a basis for the design of chemical reactor, a key element in the design of chemical process.
4. Provide a foundation on Non-ideal reactors and RTD
5. Impart knowledge about heterogeneous catalytic reactors

UNIT I
Isothermal Reactor design: Design structure for isothermal reactors - Scale-up of liquid phase batch reactor data to the design of a CSTR - Tubular reactors - Pressure drop in Reactors - Reversible reactions - unsteady state operation of reactors -Simultaneous reaction and Separation.
UNIT-II
Analysis of Non ideal Reactors - RTD - Measurement and characteristics of RTD- RTD in ideal reactors - Reactor modeling with the RTD - Zero and One parameter models - Two-Parameter model - Modeling real reactors with combinations of ideal reactors - Testing a model and determining it's parameters - Other models of non ideal reactors using CSTRs and PFRs

UNIT-III
External diffusion Effect on Heterogeneous Reactions - Binary diffusion - External resistance to mass transfer - the shrinking core model.

Diffusion and reaction in Porous Catalyst – Diffusion and reaction in spherical pellets - Internal Effectiveness factor - Falsified Kinetics - Overall effectiveness factor - Estimation of diffusion and reaction limited regimes - Mass transfer and reaction in a packed bed, CVD reactors.

UNIT-IV

Internal Transport Processes-Reaction and Diffusion in porous catalysts:

Intra pellet mass transfer and intra pellet heat transfer, Mass transfer with reaction, Mass and Heat transfer with reaction, effect of internal transport on selectivity and poisoning.

UNIT-V

Design of heterogeneous Catalytic Reactors: Fixed bed reactors and isothermal and adiabatic fixed-bed reactors, non isothermal, non adiabatic fixed bed reactors, Two phase model, Fluidized-Bed reactors, Operating characteristics of FBRs. Mass Transfer in Fluidized Beds: Gas-Solid Mass Transfer, Mass Transfer between the Fluidized-Bed Phases, Reaction in Fluidized Bed. Trickle bed reactor Models, Slurry reactor models.

Text Books

1. J.M.Smith "Chemical Engineering Kinetics" 3rd ED., Mc Graw Hill, New York 1980
2. Fogler H. S., Elements of Chemical Reaction Eng.", 3rd Ed., Prentice Hall, 1999
3. Levenspiel, O., "Chemical Reaction Eng." John Wiley & Sons 1972.

Course Outcomes : Student will be able to

a) learn the importance of RTD and Non-ideal flow in reacting vessels.
b) Calculate the conversions based on segregated flow model, dispersion model and tanks-in-series models.
c) Understand the diffusion and reaction in a porous catalyst.
d) Learn the factors influencing catalyst decay, the role of pore diffusion on catalyst activity rate.
e) Understand the design of heterogeneous catalytic reactors.

CHHN 07 SEPARATION PROCESSES
Instruction : 4 hr/week Credits : 4 Assessment : 40 + 60

Objectives:
1) Understand the classification of separation processes
2) To learn the fundamental concepts of rate governed processes
3) To impart the basic concepts of multistage separation processes
4) Understand the design of distillation column using different methods
5) Understand the energy requirements of different separation processes

UNIT I
Use and Characteristics of Separation Processes – Importance and variety of Separations – Characteristics of separation Processes- Inherent separation factors for equilibrium and rate Governed Processes
Simple equilibrium processes: Equilibrium calculations- Checking phase conditions for a mixture- Analysis of simple equilibrium separation-processes for binary and multi component systems - Computational and Graphical Approaches.

Unit II
Additional Factors Influencing Product Purities – Incomplete Mechanical Separation of Product Phases – Flow Configuration and Mixing Effects – Batch Operations – Methods of Regeneration – Mass and Heat Transfer Limitations – Stage Efficiencies

Multistage Separation Processes: Increasing product purity - Reducing consumption of separating agent - co-current, crosscurrent and countercurrent flow - Other separation processes - Fixed bed processes.

Unit-III:
Binary Multistage Separations - Distillation: Binary Systems - Equilibrium stages and McCabe-Thiele Diagram - design and other problems – Multistage batch distillation - Straight operating lines and curved operating lines.

UNIT IV
Patterns of Change: Binary and Multi component multistage separations
Group Methods - Linear stage-exit relationships and constant flow rates- non linear stage –Exit Relationships and varying flow rates.
Capacity of contacting devices: factors limiting capacity and factors influencing efficiency.

UNIT V
Energy Requirements of separations processes:
Thermodynamic efficiency - single stage and multistage separation processes - reduction of energy consumption**.**
Selection of Separation processes: Factors influencing the choice of separation
Process - solvent extraction and Illustrative examples

TEXT BOOKS:

1. Separation Processes - C.Judson King,, McGraw – Hill, 1982

REFERENCE BOOKS

1. Separation Process Principles - J.D.Seader and E.J.Henley, , John Wiley, 1998.
2. Mass Transfer Operation - R.E. Treybal, , 3rd edition - McGraw – Hill 1980
3. Transport Processes and Unit Operations – Geankoplis C.J. 4th ed – PHI Pvt. Ltd

Course Outcomes: Student will be able to

a) Applies the concepts of diffusion mass transfer, mass transfer coefficients, convective mass transfer, inter-phase mass transfer, equipment for gas-liquid operations
b) Suggest and design equipment for various mass transfer operations
c) Study of the stage wise mass transfer operations, principles of various stage wise contact processes like distillation
d) Student will be able to select a separation process for a particular system.
e) Able to understand the energy requirements of separation processes

CHHN08 CORROSION ENGINEERING

Instruction : 4 hr/week Credits : 4 Assessment : 40 + 60

The main objectives are to provide:

1. Basic aspects of electrochemistry relevant to corrosion phenomena,
2. Importance and forms of corrosion.
3. Knowledge on corrosion rate expressions and measurement techniques.
4. Knowledge on factors influencing corrosion of iron and steel exposed to atmospheric, soil and aqueous medium.
5. Basic knowledge on remedial measures for corrosion.

Syllabus:

Unit -I

Introduction and scope:

Corrosion definition, wet and dry corrosion, mechanism, electrochemical principles and aspects of corrosion, Faradays laws, resistance, specific resistance, conductance, specific conductance, transport numbers, ionic mobility.

Unit-II

Corrosion rate expressions, calculation of corrosion rates, thermodynamic aspects of corrosion, equilibrium potential, Nernst equation for electrode potential, EMF series, over voltage, application of Nernst equation to corrosion reactions.

Unit-III

Polarisation and corrosion potentials:

References electrodes for corrosion measurements, types of polarisation, concentration, activation and resistance polarizations, Tafel constant, Evans diagrams, anodic control, cathodic control, mixed control, Pourbaix-diagram for Fe-H_2O system.

Unit-IV

Various forms of corrosion:

Uniform attack, galvanic corrosion, crevice corrosion, pitting corrosion, intergranular corrosion, selective leaching (dezincification), cavitation damage, fretting corrosion, erosion corrosion, and stress corrosion and remedial measures.

Unit-V

Prevention techniques:

Modification of the material by alloying, appropriate heat treatment, chemical and mechanical methods of surface treatment, metallic, non-metallic linings, inhibitors, passivity, Cathodic protection and anodic protection.

TEXT BOOKS:

1. 'Corrosion Engineering' by Mars G. Fontana, Tata McGraw Hill Publishing Company, New Delhi
2. Corosion and Corrosion Control' by H.H.Uhllg, John Wiley & Sons Inc., America

REFERENCE BOOKS:

1. Electrochemistry' by Samuel Glasstone, Litton Educational Publishing Company
2. 'Electrochemistry, Principles & Applications' by Edmond C.Potter, Cleaver Hume Press Limited

Outcome:

a) Acquires knowledge on basic principles of electrochemistry, importance of corrosion, corrosion tendency and electrode potentials.
b) Able to identify the nature of corrosion and form in which it attacks Uniform attack, Galvanic Corrosion, Crevice Corrosion, Pitting, Intergranular Corrosion, Selective Leaching, Erosion Corrosion and Stress Corrosion. Hydrogen damage .

c) By acquiring knowledge on polarization and its influence on corrosion rates will be able to measure corrosion rates and analyze.
d) Acquires knowledge on mechanism and propose viable remedial measures.

CHHN09 ADVANCED CONTROL SYSTEMS
Instruction : 4 hr/week Credits : 4 Assessment : 40 + 60

Course Educational Objectives ; Students will have to learn the following

1. Learn the Concepts of Advanced Control Strategies
2. Understand the Multi Input and Multi Output controlling
3. Understand the Purpose of Digital Data Acquisition and Control
4. Develop Discrete Time Models & Their Dynamic Response
5. Design the Digital Controllers

Unit I :

Feed Forward and Ratio Control – Introduction, Feed forward controller design based on steady state and dynamic models, tuning and configuration of feed forward control
Advanced Control Strategies – Cascade control, time delay compensation and inferential control, selective and override systems, adaptive control, statistical process control

Unit II :
Control of Multi Input, Multi-Output Systems – Process interactions and control loop interactions, pairing of controlled and manipulated variables, strategy for reducing interactions, decoupling, multivariable control techniques
Supervisory Control – Basic requirements, applications, formulation and solution of optimization problems, unconstrained and constrained optimization

Unit III :
Digital Computer Control – Digital control systems in process control, distributed instrumentation and control systems, general purpose digital data acquisition, digital control hardware and software, table driven PID controller, Programmable logic controllers and batch process control

Sampling and Filtering of Continuous Measurements – Sampling and signal reconstruction, selection of sampling period, signal processing and data filtering, comparison of analog and digital filters, effect of filter selection on control system performance

Unit IV :

Development of Discrete Time Models – Finite difference models, exact discretization for linear systems, higher order systems, fitting discrete time equations to process data

Dynamic Response of Discrete –Time Systems – The z-Transform, inversion, pulse transfer function, relating pulse transfer functions to difference equations, effect of pole and zero locations, conversion between laplace and z- transforms

Unit V :

Analysis of Sampled – Data Control Systems – Open loop block diagram analysis, development of closed loop transfer functions, stability of sampled data control systems

Design of Digital Controllers – Digital PID controller, selection of controller parameters, direct synthesis methods, digital feed forward control, combined load estimation and time delay compensation

Text Books:

1. Process Dynamics and Control – D.E.Seborg, T.F.Edgar and D.A.Mellichamp, John Wiley &
Sons
2. Chemical Process control – An Introduction to Theory and Practice - George Stephanopoulos, Prentice hall 1990.

Course Objectives : Students will be able to understand and analyze

a) Feed Forward, Ratio Controls and Advanced Controllers
b) Control Loop Interactions & Optimization
c) Digital Computer Control, selection of sampling period, comparison of analog and digital filters
d) Finite Difference Models, Z-Transforms, Pulse Transfer Functions
e) Samples and Data Control Systems

CHHN10 COMPUTATIONAL FLUID DYNAMICS

Instruction : 4 hr/week Credits : 4 Assessment : 40 + 60

Unit I :

Philosophy of CFD – CFD - CFD as a research tool – CFD as a design tool – Examples **Governing Equations of Fluid Dynamics** – Introduction – Models of Flow – The sustainable derivative- Divergence of Velocity – Continuity Equation – Momentum Equation – Energy Equation – Physical boundary conditions – Forms of Governing equations suited to CFD

Unit II :

Mathematical Behaviour of Partial Differential Equations (PDEs) – Classification of quasi linear PDEs – General Method of determining the classification of PDEs – General Behavior of different classes of PDEs

Unit III :

Discretization – Basic aspects – Finite Differences – Difference equations – Explicit and Implicit approaches – Errors and analysis of stability

Unit IV :
Grids with appropriate transformations – General transformation of equations **–** Metrics and Jacobians – Form of governing equations suited to CFD – Stretched grids – boundary fitted coordinate systems – adaptive grids – modern developments in grid generation, finite volume mesh

Unit V :
Simple CFD Techniques - The Lax – Wendroff Technique – MacCormack's technique - Viscous Flows, Conservation form and space marching **–** Relaxation Technique – Aspects of numerical dissipation and dispersion – Alternating – Direction- Implicit technique – Pressure correction technique

Text Book :
1. CFD : The Basics with Applications – John D. Anderson Jr. TMH Publication

Reference
1. Introduction to CFD – Pradip Niyogi, S K Chakrabarthy, M K Laha , Pearson Edu.:

B.Tech. Minor in Chemical Engineering Syllabus

CHMN01MOMENTUM TRANSFER

Instruction : 4 hr/week **Credits : 4** **Assessment : 40 + 60**

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 incompressible and compressible fluid flow through pipes and in thin layers.
4. To understand the flow past solid surfaces, through packed bed and in fluidized beds.
5. To learn the settling characteristics of particles through fluids.
6. To learn the working and performance of pumps and compressors, valves.
7. To understand the construction 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 and total energy balances, velocity of sound, ideal gas equation, stagnant temperature.

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 (7th ed) Warren L.McCabe, Juliane Smith and Peter Harriott, McGraw Hill.

REFERENCES:

1. Chemical Engineering Vol.I by Coulson and Richardson, Pergamon Press.
2. Solved Examples in Chemical Engineering by G.K.Roy.
3. "Fluid Mechanics" 2nd edition by Noel de Nevers, Mc Graw Hill

Course Outcomes:

a) To be able to perform dimensional analysis of fluid flow problems.
b) To develop pressure drop equations for fluid static equipments in which fluid is at rest.
c) To have the knowledge on different types of flow regions in fluid flow, rheological properties of fluids, turbulence and boundary layers.

d) To be able to carry out macroscopic mass, momentum and energy balance to solve engineering problems related to fluid flow.
e) Educate about the formation and calculation of fluid friction in pipes and conduits.
f) Analyze flow past solid surface, through packed bed and in fluidized beds.
g) Determine the minimum fluidization velocity andterminal velocity of the fluid in Stokes and Newton's law regions.
h) The analysis of fluid flow measuring devices like Orifice meter, Venturimeter, Rotameter and Pitot tube.
i) The construction and working of Centrifugal and reciprocating pumps. And also give the knowledge on different types of valve, selection of pipe and fittings.

	OUTCOMES									
		a	b	c	d	e	f	g	h	i
OBJECTIVES	1	*	*							
	2		*	*	*	*				
	3			*	*	*				
	4						*	*		
	5							*		
	6									*
	7								*	

CHMN02 PARTICLE AND FLUID PROCESSING
Instruction : 4 hr/week Credits : 4 Assessment : 40 + 60

Course Educational Objectives :

1. To develop understanding of solids, their characterization, solid handling and mixing.
2. To develop understanding of the principles of communition, 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.

Syllabus:
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 :

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

b) To be able to calculate the screening effectiveness.

c) To be able tofind the power requirement using three crushing laws.

d) To have the knowledge of different types of Crushers, grinders, ultrafine grinders, cutters.

e) To have understood settling processes and flotation technique.

f) To develop the rate equations for constant pressure and constant volume filtration techniques and also to solve the problems related to these techniques.

g) To have acquired the construction and operation of different filtration, settling and clarifying equipment.

h) To understand the functioning of agitated vessels and to calculate the power consumption.

i) To have the knowledge on different types of turbines, blending and mixing.

		OUTCOMES								
		a	b	c	d	e	f	g	h	i
OBJECTIVES	1	*								*
	2		*			*		*	*	
	3		*	*						
	4				*	*				
	5						*	*		

CHMN03 CHEMICAL ENGINEERING THERMODYNAMICS –I
Instruction : 4 hr/week Credits : 4 Assessment : 40 + 60

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
6. 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:

a. To have learnt the fundamental ideas about energy, equilibrium and reversibility.
b. To be able to apply first law to estimate heat and work effects in closed, open and flow systems.
c. To understand PV and PT phase diagrams, ideal gas law and its applications.
d. To be able to estimate heat and work effects for different processes – isothermal, isobaric, isometric, and adiabatic processes.
e. To have understood the concept of entropy and its estimation.
f. To be to apply second law of thermodynamics to estimate efficiency of a cycle.
g. To have learnt to comment on the feasibility of a process.
h. To have learnt different refrigeration cycles and also to be able to calculate their COP.
i. To have learnt the thermodynamic analysis of flow processes.

	OUTCOMES									
		a	b	C	d	e	f	g	h	i
OBJECTIVES	1	*	*	*	*	*	*	*		
	2	*	*		*					
	3			*	*					
	4					*	*	*		
	5					*		*		
	6								*	*

CHMN04 HEAT TRANSFER

Instruction : 4 hr/week Credits : 4 Assessment : 40 + 60

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
6. To learn the principles of crystallization

Syllabus

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 – 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 in Transition region

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 :

a) To be able to calculate the heat transfer flux in one-dimensional heat conduction.
b) To have learnt the concepts of turbulence, boundary layer and analogies.
c) To be able to calculate heat flux in natural convection
d) To be able to estimate heat flux in forced convection
e) To have understood the concepts of black body, view factors and to be able to calculate radiation heat flux
f) To be able to handle conduction-convection conduction-convection-radiation heat transfer
g) To have understood the phenomena of boiling and condensation
h) To have understood the construction and flow patterns in heat exchange equipment
i) To be able to design heat exchangers and condensers
j) To have understood the functioning of evaporators
k) To have learnt the mechanism of crystallization and the general features of crystallizers

	OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k
OBJECTIVES	1	*	*	*	*	*	*					
	2		*	*	*		*	*				
	3					*	*					
	4				*				*	*		
	5										*	
	6											*

CHMN05 MASS TRANSFER OPERATIONS – I
Instruction : 4 hr/week Credits : 4 Assessment : 40 + 60

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 :

a) To be able to calculate the flux in cases involving diffusive transfer
b) To appreciate the contribution of turbulence to transfer and to calculate coefficients and flux
c) To be able to differentiate different representations of resistances and to properly integrate them to obtain the overall resistance
d) To be able to write mass balance equations for different contacting patterns
e) To learn the concept of transfer units
f) To be able to estimate the process parameters like solvent requirement, number of theoretical stages, height and diameter of columns
g) To understand the working of gas continuous-liquid-dispersed and gas –dispersed liquid – continuous contacting equipment
h) To understand equilibrium relevant to absorption and to calculate the number of stages, number and height of transfer units
i) To understand the equilibrium concerned to humidification, various methods of conducting the operation and to design a cooling tower
j) To understand the mechanism of drying operation and to calculate the time of drying

	OUTCOMES										
		a	b	c	d	e	f	g	h	i	j
OBJECTIVES	1	*	*	*							
	2		*	*							
	3				*	*	*		*	*	*
	4							*			
	5						*		*	*	*

CHMN06 CHEMICAL TECHNOLOGY

Instruction : 4 hr/week Credits : 4 Assessment : 40 + 60

Course Educational Objectives:

1. To know the difference between unit operations and unit processes.
2. To learn principles of different unit operations like screening, filtration, size reduction, mixing.
3. To learn how to draw flow sheet for a process.
6. To know the industrial production of cements, industrial gases, nitrogen, sulphur

phosphorous, glass and ceramic industries.

5. To learn the thermodynamic considerations, engineering problems and economic factors in the production.

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 Gop al Rao and Marshall sitting. -
- Boca Raton

Course Outcomes:

a) Able to differentiate between unit operations and unit processes in industrial processes.

b) Know various equipments used for chemical processes in different industries.

c) Can understand the sources of water and different water treatment methods.

d) Know types of cements and raw materials, production of different types of cements.

e) Able to know the raw materials used , reactions involved and different methods for the production nitrogen, phosphorous, sulphur.

f) Knows different types of glasses, raw materials and production process.

g) Understand about basic raw materials, production process of different ceramic products and about refractories.

h) Able to understand temperature, pressure effects of process, about the materials for construction of equipments, furnaces and economic problems in process industries.

	OUTCOMES								
		a	b	c	d	e	f	g	h
OBJECTIVES	1	*	*	*	*	*	*		
	2	*	*	*	*	*	*		
	3	*	*	*	*	*	*		
	4	*	*	*	*	*	*	*	
	5								*

CHMN07 PROCESS DYNAMICS AND CONTROL

Instruction : 4 hr/week Credits : 4 Assessment : 40 + 60

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

Syllabus
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 systemsIntroduction 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 :

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

	OUTCOMES										
		a	b	c	d	e	f	g	h	i	j
OBJECTIVES	1	*	*	*							
	2			*	*						
	3					*	*	*	*	*	
	4										*

	5	*	*	*	*						

CHMN08 PLANT DESIGN AND PROCESSECONOMICS

Instruction : 4 hr/week Credits : 4 Assessment : 40 + 60

Course Educational 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

Syllabus

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 :

a) Students will have knowledge to understand design considerations and engineering ethics
b) Students able to understand plant location, plant lay out ,plant operation and control in a profitable way
c) Students able to design process flow diagrams , piping and instrumentation diagrams and vessel and piping layout
d) Students will have the knowledge on interest, time value of money and cash flow patterns useful for cost estimation
e) Students will have an idea on analysis of cost estimation involves capital investments, estimation of revenue, and cost indexes
f) Students will come to know factors affecting investment and production costs
g) They will able to find out the alternate investments and replacements

h) It will also helps the students to understand profitability standards and methods for calculating profitability

		OUTCOMES							
		a	b	c	d	e	f	g	h
Objectives	1	*							
	2		*						
	3			*					
	4				*				
	5					*	*		
	6							*	*

CHMN09 **OPTIMIZATION TECHNIQUES**

Instruction : 4 hr/week **Credits : 4** **Assessment : 40 + 60**

Objectives

1. To Teach finding the best design with the available resources is the goal of design optimization. Many of the design problems in aerospace systems (and also other areas) can be cast as optimization problems.
2. To Teach These problems can then be solved using the optimization techniques.
3. One can model the problems well only with a good understanding of the theory behind optimization.
4. In this course we will deal with continuous optimization methods with emphasis upon nonlinear programming.

Syllabus

Unit I : Introduction :

Formulation of objective function, fitting models to data, classification of functions, necessary and sufficient conditions for optimum, unimodel & multi model functions, analytical methods, Lagrange multiplier method

Unit II : Numerical methods :

Unimodel functions, Newton, quasi-Newton, secant methods, region elimination methods, polynomial approximation, quadratic and cubic interpolation technique for optimum,

multimodel functions, direct methods, random, grid, hooke's nelder and mead methods, powell's technique, indirect methods, gradient and conjugate gradient methods, secant method

Unit III : Linear and Non-Linear Programming :

Review of basic concepts of LP Formulations, simplex method, integer, quadratic, geometric and dynamic programming

Unit IV : Applications- I :

Heat transfer and energy conservation, separation processes, fluid flow systems, reactor design and operation, large scale operations

Unit V : Applications – II

Optimal pipe diameter, optimal residence time for maximum yield in an ideal batch reactor, chemostat, optimization of a thermal cracker using linear programming

Text Book :

1. Optimization of Chemical Process by T F Edgar and D M Himmelblau, McGraw Hill 1998

References :

1. Reklaitis,G.V., Ravindran A., Ragsdell K.M. Engineering Optimization, John Wiley NY 1980.
2. Bile,W.E., Swain J.J., Optimization and Industrial Experimentation, Inter Science,NY 1980.
3. Seinfeld J.H., Lapidus L., Process Modeling, Estimation and Identification, Prentice Hall,Engelwood Cliffs, New Jersey,1974
4. Beveridge,C.S., Schechter,R.S., Optimization Theory and Practice McGraw Hill, NY 1970
5. Plant Design & Economics for Chemical Engineers, 5 th Ed – Max S.Peters, KlausD.Timmerhaus and Ronald E.West, McGraw Hill

Outcomes:

a) An ability to apply knowledge of mathematics, science, and engineering,
b) An ability to design and conduct experiments, as well as to analyze and interpret data.
c) Become familiar with optimization methods Mathematical modeling of optimization problems
d) Implementation of the algorithms discussed and solve realistic design problems
e) The student should master most of the issues in numerical optimization
f) An ability to succeed in the graduate competitive examinations and pursue higher studies in chemical engineering or lateral disciplines.
g) Develops ability to obtain data and information necessary to formulate and to solve problems related to Chemical Engineering with or without the support of software8.
h) This course introduces you to the optimization theory and tells you how it can be applied to solve design problems.

objectives		Outcomes

		a	b	c	d	e	f	g	h
	1	*							
	2		*	*					
	3				*	*			
	4						*	*	*

CHMN10 **FUNDAMENTALS OF NANOTECHNOLOGY**

Instruction : 4 hr/week **Credits : 4** **Assessment : 40 + 60**

Unit – I

Introduction: Importance of Nanotechnology emergence of nanotechnology, size range of nano particles - Thermodynamics and properties of nano scale materials, classification of nano structured materials - Bottom-up and top-down approaches- challenges in nanotechnology. Future of nanotechnology in chemical and Biochemical engineering.

Unit – II

Synthesis of nano particles and processing**:** Methods for creating nano structures – processes for producing ultra fine powders – Mechanical grinding – wet chemical synthesis of nano materials – sol-gel emulsion processes-liquid-solid reactions- Gas phase synthesis of nano materials – Furnace, flame assisted ultra sonic spray pyrolysis – Gas condensation (CVC) – cold plasma methods- particle precipitation aided CVD.

Unit – III:

Characterization of nano systems**:** Sample preparation and characterization techniques of nano structured materials – scanning electron microscopy (SEM) – Transition election microscopy and X-Ray photo electron and Auger electron spectroscopy (XPS, AES) – Scanning tunneling microscopy (STM), atomic force microscopy (AFM) – powder X-ray difractometry (XRD).

Unit – IV:

special nano materials**:** Carbon fullerences and nanotubes – onions – carbon fullerrence-formation, properties and uses – Porous silicon preparation methods-Nano particles of SiC, alumina and zirconia and their sintering techniques – Wafer preparation, wafer cleaning techniques – lithography – etching – Mechanical attrition and nano composites.

Unit – V:

Nano – Engineering applications**:** Micro electromechanical systems (MEMS) and nano electromechanical systems (NEMS), sensors, microfluidic devices – nano pump – molecular motors – Nano bots – nano medicine – drug delivery systems – catalyis by gold nano particles – wear resistance coatings – weapons – battery and fuel cell electrodes – thermal management – automotive and aerospace components. Environmental impact of nano-particles – ethical, legal and social issues.

Text Books:

1. Introduction to nanotechnology, by Charles P.Poole and Frank Jowens, John wiley (2003)
2. Nanotechnology Research and perspectives, MIT Press (1992)

References:

1. understanding of Nano science and technology, poori Dutta & Sushmita Gupta, Global vision, New Delhi – (2006)