Semester I [First Year]

CH 111 MATHEMATICS-I

Lectures	*:*	*2 hrs*	*Sessional Marks*	*:*	*30*
Tutorial	*:*	*1 hrs*	*Semester End Exam Marks*	*:*	*70*
Semester End Exam.	*:*	*3 hrs*	*Credits*	*:*	*3*

Course Objectives

i. The objective of this course is to familiarize the prospective engineers with techniques in matrices, multivariate calculus and integral transforms.
ii. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Outcomes

1) Know the basic linear algebraic concepts.
2) Solve multivariate calculus problems of double integrals and vector differentiation.
3) Find integration of vector functions and find Fourier series and transforms.
4) Find Laplace and inverse transforms of a function.

UNIT - I **CO: 1**

Rank of a matrix, Normal form, Inverse by Gauss Jordan method. System of linear equations: Non homogeneous, homogeneous systems.
Eigen values and Eigen vectors, Cayley-Hamilton Theorem (without proof), Diagonalization of matrices, reduction of quadratic form to canonical form.

UNIT – II **CO: 2**

Multiple Integrals - Double integrals (Cartesian and polar), Change of order of integration.
Change of variables: Cartesian to polar coordinates. Scalar and vector point functions, Gradient, directional derivative, divergence and curl, Del applied twice to point and product of point functions (without proofs).

UNIT – III **CO: 3**

Integration of vectors - Line integrals, surface integrals, Green's theorem in the plane (without proof), Stoke's theorem (without proof).
Fourier series - Half range cosine and sine series. Fourier transforms - Fourier transforms, Fourier sine and cosine transforms and inverse transforms.

UNIT – IV **CO: 4**

Laplace transforms - Introduction, properties of Laplace transforms, Evaluation of integrals by Laplace transforms.
Inverse Laplace transforms - Method of partial fractions, other method of finding inverse transforms t f(t)= L [- F(s)], Convolution theorem (without proofs).

LEARNING RESOURCES

TEXT BOOKS:

1) B.S.Grewal - Higher Engineering Mathematics, Khanna publishers, 42nd edition, 2017.

REFERENCE BOOKS:

1) Erwin Kreyszig - Advanced Engineering Mathematics, John Wiley & Sons, 2006.
2) N.P. Bali and Manish Goyal - A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2010.

WEB RESOURCES:

1) http://nptel.iitm.ac.in/courses/

CH 112 ENGINEERING PHYSICS

Lectures	*: 3 hrs*	*Sessional Marks*	*: 30*
Tutorial	*: - hrs*	*Semester End Exam Marks*	*: 70*
Semester End Exam.	*: 3 hrs*	*Credits*	*: 3*

Course Objectives

i. To understand about basic phenomena of light waves.
ii. To understand about Principle and applications of optical fiber and fundamentals of Laser, its types and applications.
iii. To understand development of Electromagnetic wave equations and various properties, applications of dielectric & magnetic materials.
iv. To understand Essential formulation of physics in the micro world by learning the prerequisite quantum physics.

Course Outcomes

1) Identify and illustrate wave phenomena such as interference in thin films, concept of diffraction, birefringence and production and detection of different polarized lights.
2) Understanding the basic concepts of lasers, fibers and their applications.
3) Acquire knowledge about the Maxwell's equations and various terms related to properties of materials such as permeability, polarization, etc.
4) Some of the basic laws related to quantum mechanics such as wave particle duality, uncertainty principle, Schrodinger wave equation & its applications etc.

UNIT - I **CO: 1**

Interference & Diffraction: Introduction, Stoke's principle, interference in thin films due to reflected light (cosine law), Newton's rings (formation, derivation for diameters of bright and dark rings). Concept of diffraction, distinguish between Fraunhofer and Fresnel diffraction, Fraunhofer diffraction at single slit(quantitative), theory of a plane transmission grating, dispersive Power & resolving power of a grating.

Polarisation: Introduction, double refraction, construction & working of a Nicol prism, quarter wave plate, production & detection of circular and elliptical polarizations (qualitative), optical activity (optical rotation & specific rotation).

UNIT – II **CO: 2**

Fiber Optics & Lasers:

Fibre Optics: Introduction, structure of optical fibre, principle of optical fibre, numerical aperture, types of optical fibres, Fiberoptic sensors (intensity modulated temperature sensor, displacement sensor, & liquid level detector), applications.

Lasers: characteristics, spontaneous & stimulated emissions, population inversion, pumping, optical resonant cavity, types of lasers: solid state (Nd:YAG) laser, Gas laser(He-Ne), Semiconductor laser (Ga-As), industrial & medical applications of lasers.

UNIT – III **CO: 3**

Electromagnetism, Dielectrics and Magnetic Properties of Materials:

Electromagnetism: induced electric fields, displacement current, Maxwell's equations-qualitative (integral & differential forms) - significance, velocity of an electromagnetic wave equation in free space.

Dielectrics & Magnetic Properties of Materials: Basic definitions, polar and non-polar dielectrics (qualitative), types of polarizations - electronic, ionic polarisations (quantitative), internal fields in solids, Clausius-Mossotti equation, applications of dielectrics.

Magnetization, permeability and susceptibility, origin of magnetic moment, classification of magnetic materials, hysteresis curve, soft & hard magnetic materials.

UNIT – IV **CO: 4**

Quantum Mechanics:

Introduction to quantum physics, blackbody radiation explanation using the photon concept (laws of black body radiation, Planck's radiation law-derivation), photoelectric effect (Einstein's equation), Compton effect (explanation, derivation). De-Broglie concept of matter waves, properties of matter waves, verification of matter waves (Davisson - Germer experiment), uncertainty principle-experimental verification (electron diffraction-single slit), Schrodinger time independent wave equation, physical significance of wave function, particle in box (one dimensional).

LEARNING RESOURCES

TEXT BOOKS:

1) A text book of Engineering Physics, M.N. Avadhanulu, P.G. Kshirasagar, S. Chand & Company Ltd., 9th edition, New Delhi, 2018.

2) Principles of Engineering physics-1, Md. Khan & S. Panigrahi - Cambridge University Press- 2016.

3) Engineering Physics, SL Kakani & Shubhra kakani – 3rd Edition, CBS Publications Pvt. Ltd., New Delhi. (UNITs III & IV)

4) Engineering Physics, D.K.Bhattacharya & Poonam Tandon, Oxford University Press-2015.

REFERENCE BOOKS:

1) Fundamentals of physics: D. Halliday, R. Resick and J. Walker 6th edition, John Wiley and sons, Inc., New York, 2001.

2) Engineering Physics: Hitender K. Mallick, A.K.Singh McGraw Hill Education (India) Pvt. Ltd., New Delhi.

3) Concepts of Modern Physics: Arthur Beiser 6th edition, Tata McGraw Hill Education Pvt Ltd., New Delhi.

4) Optics: A. Ghatak, McGraw Hill Education (India) Pvt. Ltd., New Delhi.

CH 113 ENGLISH FOR COMMUNICATION SKILLS

Lectures	*: 3 hrs*	*Sessional Marks*	*: 30*
Tutorial	*: ---hrs*	*Semester End Exam Marks*	*: 70*
Semester End Exam.	*: 3 hrs*	*Credits*	*: 3*

Course Objectives

i. To enable students improve their lexical and communicative competence and to equip students with oral and written communication skills.
ii. To help students understand and learn the correct usage and application of Grammar principles.
iii. To get them acquainted with the features of successful professional communication.
iv. To enable students acquire various specific features of effective written communication.

Course Outcomes

1) Use vocabulary contextually.
2) Compose effectively the various forms of professional communication.
3) Apply grammar rules efficiently in spoken and written forms.
4) Improve clarity to locate and learn the required information.

UNIT - I **CO: 1**

1.1 - Root words from foreign languages and their use in English.
1.2 - Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.3 - Synonyms, antonyms, and standard abbreviations.
1.4 - One word substitutes

UNIT – II **CO: 2**

2.1 - Proposal writing
2.2 - Letter-writing
2.3 - Techniques for writing precisely (précis writing)
2.4 - E-mail writing

UNIT – III **CO: 3**

Identifying Common Errors in Writing

3.1 - Subject-verb agreement
3.2 - Noun-pronoun agreement
3.3 – Articles
3.4 – Prepositions
3.5 – Tenses
3.6 – Redundancies

UNIT – IV **CO: 4**

Nature and Style of Sensible Writing

4.1 - Description & Narration (Paragraph Writing). [CO:1,2,3]
4.2 - Essay Writing (Expository Essay). [CO:1,2,3]
4.3 - Note-Making and Note-Taking. [CO:1,2,4]
4.4 - Methods of preparing notes. [CO:1,2,4]

LEARNING RESOURCES

TEXT BOOKS:

1) Communication Skills. Sanjay Kumar and Pushpa Lata. Oxford University Press.

REFERENCE BOOKS:

1) Remedial English Grammar. F.T. Wood. macmillan.2007
2) On Writing Well. William Zinsser. Harper Resource Book. 2001
3) Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press.2006.
4) Practical English Usage. Michael Swan. OUP. 1995Press

CH 114 PHYSICAL CHEMISTRY

Lectures	*: 3 hrs*	*Sessional Marks*	*: 30*
Tutorial	*: - hr*	*Semester End Exam Marks*	*: 70*
Semester End Exam.	*: 3 hrs*	*Credits*	*: 3*

Course Objectives

i. To develop scientific concepts, principles, problem solving skills, attitudes, appreciations and interests.
ii. To make them know the terms associated with thermodynamics, phase rule, kinetics and chemical equilibrium.
iii. To make them understand the mechanisms of catalysis.
iv. To learn to solve problems related to gas laws, thermodynamics, rate constants and equilibrium constants.

Course Outcomes

After successful completion of the course, the student will be able to

1) Apply the gaseous laws in solving industrial problems.
2) Calculate molar heat capacities and internal energy & work.
3) Arrive at the number of phases, components and degree of freedom and relate thermodynamic parameters to equilibrium constant and vapour pressure.
4) Calculate rate of reaction and select suitable catalysts for reactions.

UNIT - I **CO: 1**

Gas Laws-definition, mathematical representation, graphical representation and simple problems on Boyle's Law, Charles law, Gay lussac-Charles law, ideal gas equation, Avogadro's law, Dalton's law of partial pressures,

Amagat's law of partial volumes, Vander Waal's gas equation, Henry's law, and Raoult's Law, Critical phenomena, Andrew's isotherms.

UNIT – II **CO: 2**

Thermodynamics: Thermodynamic terms and basic concepts, Thermodynamic processes, reversible and irreversible processes, pressure volume work, Internal energy, First law, enthalpy, molar heat capacities, adiabatic and isothermal expansion of ideal gas.(simple problems on work done)

Spontaneous process, entropy, second law, entropy change for an ideal gas, entropy change accompanying phase change (problems), Physical significance of entropy, Trouton's rule

UNIT – III **CO: 3**

Free energy, work function, free energy change for ideal gas, Gibbs-Helmholtz equation, Clausius-Clapeyron equation, Equilibrium constant–Van't Hoff isotherm, third law of thermodynamics.

Chemical Equilibrium: Homogenous equilibrium, Heterogeneous equilibrium, Law of mass action, K_p, K_c and K_x-interrelation, Le-Chatelier principle and its applications.
Phase rule: Definition, explanation of the terms –phase, component, degrees of freedom, Phase diagram of water system, Two component system Pb-Ag, Application of eutectics.

UNIT – IV **CO: 4**

Chemical Kinetics: Order, Molecularity, activation energy, Specific reaction rate, first order and second order reactions. Half life period, Effect of temperature on reaction rate (simple problems on 1^{st}, 2^{nd} order reactions and half life periods), methods to determine order of reactions.

Catalysis: Homogeneous and Heterogeneous catalysis, Characteristics of Catalyst, promoter, negative catalyst, catalytic poison, adsorption theory of catalysis, enzyme catalysis, Industrial applications of catalysis.

LEARNING RESOURCES

TEXT BOOKS:

1) Essentials of Physical Chemistry, Bahl.B.S and Tuli, 18^{th} edition, 2010, S.Chand & Co., Delhi.

REFERENCE BOOKS:

1) Engineering chemistry by Jain and Jain, 15^{th} edition, 2008, Dhanpat Rai Publishing company, Delhi.

2) Principles of Physical Chemistry, B.R Puri, L.R Sharma, Madan.S.Pathania, 46^{th} edition, 2013, Vishal publications, Jalandhar

Web references:

http://www.chem.arizona.edu/~salzmanr/103a004/nts004/nts004.html
http://www.cdeep.iitb.ac.in/nptel/Core%20Science/
http://www.wiziq.com/tutorial/
http://www.powerstream.com/BatteryFAQ.html#lec

CH 151 ENGINEERING PHYSICS LAB

Practicals	*: 3 hrs*	*Sessional Marks*	*:*	*30*
		Semester End Exam Marks	*:*	*70*
Semester End Exam.	*: 3 hrs*	*Credits*	*:*	*1.5*

Course Objectives

i. To give background in experimental techniques and to reinforce instructionin physical principles.
ii. To find measurement, data, error, or graphical analysis in addition to illustrating a physical principle.
iii. To give skills that can transfer critical thinking into problem solving methods, how to identify what data is important, how to collect that data and then draw conclusions from it.

Course Outcomes

1) Use CRO, Function generator, Spectrometer for making measurements
2) Test the optical instruments using principles of interference and diffraction.
3) Select in carrying out precise measurements and handling sensitive equipment.
4) Explain the concepts learned in the physics lab & apply conclusions from the data and develop skills in experimental design.

List of Experiments:

1) Some basic measuring instruments: Screw gauge, Vernier Callipers, Spherometer, Travelling Microscope etc., & General instructions.
2) Newton's rings - Measurement of radius of curvature of plano-convex lens.
3) Calibration of a given audio oscillator – Lissajous' Figures.
4) Optical fibers - Determination of Numerical Aperture and acceptance angle.
5) Interference fringes –Wedge method
6) Photocell – Characteristic curves.
7) Photo-Voltaic Cell - Determination of fill factor.
8) LCR – series resonance circuit - Determination of Q - factor.
9) Variation of magnetic field along the axis of a circular current carrying coil.
10) Sonometer – Determination of A.C. supply frequency.
11) Diffraction grating – Determination of wavelengths using diffraction grating.
12) To study the laser beam characteristics like wavelength using diffraction grating aperture divergence.

REFERENCE BOOK:

1) Students reference manual : Department of physics, RVR & JC College of Engg.
2) Engineering Physics Lab Manual; Dr. C.V.Madhusudhana Rao, V. Vasanth Kumar 3rd edition, Scitech publications (India) Pvt. Ltd. Chennai.
3) Engineering Physics Practicals: Dr.B. Srinivasa Rao, V.K.V.Krishna, K.S.Rudramamba, University Science Press, Daryaganj, New Delhi.

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CH 152 ENGLISH LANGUAGE COMMUNICATION SKILLS LAB

Practicals	*: 3 hrs*	*Sessional Marks*	*:*	*30*
		Semester End Exam Marks	*:*	*70*
Semester End Exam.	*: 3 hrs*	*Credits*	*:*	*1.5*

Course Objectives

i. To identify speaker's purpose and tone; make inferences and predictions about spoken discourse, discuss and respond to content of a lecture or listening passage orally and/or in writing.
ii. To acquaint the students with the Standard English pronunciation, i.e., Receive Pronunciation (RP), with the knowledge of stress and intonation.
iii. To develop production and process of language useful for social and professional life.
iv. To develop in them communication and social graces necessary for functioning.
v. Improve the dynamics of professional presentations.
vi. To develop critical reading and comprehension skills at different levels.

Course Outcomes

1) Comprehend relationships between ideas and make inferences and predictions about spoken discourse.
2) Speak English with a reasonable degree of accuracy in pronunciation with success.
3) Develop appropriate speech dynamics in professional situations.
4) Use effective strategies and social graces to enhance the value of communication.
5) Develop effective communication and presentation skills and using language effectively to face interviews.

List of Exercises / Activities:

Oral Communication
(This unit involves interactive practice sessions in Language Lab).

1) Listening Comprehension.
2) Pronunciation, Intonation, Stress and Rhythm.
3) Common Everyday Situations: Conversations and Dialogues.
4) Interviews.
5) Formal Presentations.
6) Reading Comprehension

REFERENCE BOOK(S):

1 Communication Skills. Sanjay Kumar and Pushpa Lata. Oxford University Press.
2 Practical English Usage. Michael Swan. OUP. 1995 Press
3 Exercises in Spoken English. Parts.I- III. CIEFL, Hyderabad. Oxford University
4 Technical English .M. Sambaiah, Wiley Publications, New Delhi

CH 153 ENGINEERING CHEMISTRY LAB

Practicals	*: 3 hrs*	*Sessional Marks*	*: 30*
		Semester End Exam Marks	*: 70*
Semester End Exam.	*: 3 hrs*	*Credits*	*: 1.5*

Course Objectives

i. To know the methods of determining hardness and chloride ion content of water sample.
ii. To learn the redox methods to determine Fe^{2+} ions present in solution.
iii. To know principles and methods involved in using instruments like conductivity bridge, spectrophotometer and potentiometer
iv. To know the molecular properties like surface tension, viscosity.

Course Outcomes

1) Estimate the Iron content of a sample.
2) Analyse chloride, hardness content of water and available chlorine in bleaching powder.
3) Use instruments to measure optical density, conductance of solutions and redox potentials of a cell.
4) Measure molecular properties such as surface tension, viscosity and determine physical parameters like saponification value, partition co-efficient and R_f value.

List of Experiments:

1)	Estimation of Mohr's salt using $KMnO_4$.	CO1
2)	Estimation of Mohr's salt using $K_2Cr_2O_7$.	CO1
3)	Determination of chloride ion content of water.	CO2
4)	Determination of available chlorine in bleaching powder.	CO2
5)	Determination of Hardness of water using EDTA method.	CO2
6)	Determination of Fe(II) strength using $K_2Cr_2O_7$ potentiometrically.	CO1,3
7)	Determination on strength of NaOH using HCI conductometrically.	CO3
8)	Determination of concentration of $KMnO_4$ using colorimeter/spectrophotometer.	CO3
9)	Determination of surface tension.	CO4
10)	Determination of Viscosity.	CO4
11)	Determination of Saponification/acid value of oil.	CO4
12)	Determination of partition co-efficient of I_2 in water.	CO4
13)	Determination of R_f value using TLC.	CO4

CH 154 ENGINEERING GRAPHICS & DESIGN LAB

Lectures		*1 hr*	*Sessional Marks*	*:*	*30*
Practicals	*:*	*4 hrs*	*Semester End Exam Marks*	*:*	*70*
Semester End Exam.	*:*	*3 hrs*	*Credits*	*:*	*3*

Course Objectives

i. Expose the students to standards and conventions followed in preparation of engineering drawings.
ii. Make them understand the concepts of orthographic and isometric projections.
iii. Develop the ability of conveying the engineering information through drawings.
iv. Make them understand the relevance of engineering drawing to different engineering domains.
v. Develop the ability of producing engineering drawings using drawing instruments.
vi. Enable them to use computer aided drafting packages for the generation of drawings.

Course Outcomes

1) Prepare engineering drawings as per BIS conventions mentioned in the relevant codes.
2) Produce computer generated drawings using CAD software.
3) Use the knowledge of orthographic projections to represent engineering information / concepts and present the same in the form of drawings.
4) Develop isometric drawings of simple objects reading the orthographic projections of those objects.
5) Convert pictorial and isometric views of simple objects to orthographic views.

(Units I to IV shall be taught in conventional drawing method and Unit V shall be taught with the aid of computer)

UNIT - I

General: Principles of Engineering Graphics and their significance, usage of drawing instruments, lettering.

Conic sections: Construction of Ellipse, Parabola, Hyperbola and Rectangular Hyperbola. (General method only).
Curves: Cycloid, Epicycloid, Hypocycloid and Involute and Scales.

UNIT – II

Method of Projections: Principles of projection - First angle and third angle projection of points, Projection of straight lines inclined to both planes. Traces of lines.

Projections of planes: Projections of planes inclined to both the planes, projections on auxiliary planes.

UNIT – III

Projections of Regular Solids: Projections of solids (Prism, Pyramid, Cylinder and Cone) with varying positions.
Sections of Solids: Sections of Prisms, Pyramids, cylinders and Cones. True shapes of sections. (Limited to the cutting plane perpendicular to one of the principal plane).

Development of surfaces: Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only).

UNIT – IV

Isometric Projections: Principles of Isometric projection-Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids.

Orthographic Projections: Conversion of pictorial views into Orthographic views and Vice-versa. (Treatment is limited to simple castings).
Perspective Projections: Introduction to Perspective Projection.

UNIT V

Over view of Computer Aided drafting (AutoCAD): Introduction, starting and customizing AutoCAD screen, usage of different menus, toolbars (drawing, editing, dimension, text, object properties..etc), tabs (Object, snap, grid, polar, ortho, otrack..etc) and command prompt. Setting units, limits, layers and viewports (Isometric, Top, Front, back..etc).

2D drawings of various mechanical and structural components, electrical and electronic circuits. Orthographic and Isometric views of mechanical castings and simple structures.

LEARNING RESOURCES

TEXT BOOKS:

1) Bhatt N.D., Panchal V.M. & Ingle P.R. - Engineering Drawing, Charotar Publishing House, 2014.

REFERENCE BOOKS:

1) Shah, M.B. & Rana B.C. - Engineering Drawing and Computer Graphics, Pearson Education, 2008.
2) Agrawal B. & Agrawal C. M. - Engineering Graphics, TMH Publication, 2012.
3) Narayana, K.L. & P Kannaiah - Text book on Engineering Drawing, Scitech Publishers, 2008.
(Corresponding set of) CAD Software Theory and User Manuals

CHMC1 CONSTITUTION OF INDIA

[MANDATORY NON-CREDIT COURSE]

Lectures	:	*2 hrs*	*Sessional Marks*	:	*100*
Semester End Exam.	:	---	*Credits*	:	---

COURSE OBJECTIVES:

To provide basic information about Indian Constitution.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Study guidelines for the State as well as for the Citizens to be followed by the State in the matter of administration as well as in making the laws. It also includes fundamental duties of the Indian Citizens in Part IV A (Article 51A).
2. Know how the State is administered at the State level and also the powers and functions of High Court.
3. Understand special provisions relating to Women empowerment and also children. For the stability and security of the Nation, Emergency Provision are Justified.
4. Understand election commission as an independent body with enormous powers and functions to be followed both at the Union and State level. Amendments are necessary, only major few amendments have been included.

UNIT I [CO:1]

Preamble to the Constitution of India Domicile and Citizenship. Fundamental rights under Part III, Leading Cases. Relevance of Directive Principles of State Policy under Part-IV, IV-A Fundamental duties.

UNIT II [CO:2]

Union Executive - President, Vice-President, Prime Minister, Union Legislature – Parliament and Union Judiciary - Supreme Court of India. State Executive - Governors, Chief Minister, State Legislature and High Court.

UNIT III [CO:3]

Semester II [First Year]

Special Constitutional Provisions for Scheduled Casters and Tribes, Women and Children and Backward Classes, Emergency Provisions.

UNIT IV [CO:4]

Electoral process, Centre State Relations (Amendment Procedure, 42nd, 44th, 74th, 76th, 86^{th} and 91st Constitutional amendments).

LEARNING RESOURCES:

TEXT BOOK:

Durga Das Basu: "Introduction to the Constitution of India" (student edition) Prentice - Hall EEE, 19th/20th Edition, 2001.

REFERENCE BOOK(s):

1. M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.

2. Brij Kishore Sharma, "Introduction to the Constitution of India", PHI, Learning Pvt.Ltd.,New Delhi, 2011.

CH 121 MATHEMATICS-II

Lectures	:	*2 hrs*	*Sessional Marks*	:	*30*
Tutorial	:	*1 hr*	*Semester End Exam Marks*	:	*70*
Semester End Exam.	:	*3 hrs*	*Credits*	:	*3*

Course Objectives

i. The objective of this course is to familiarize the prospective engineers with techniques in differential equations and to introduce the solution methodologies for second order Partial Differential Equations with applications in engineering.
ii. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes

1) Solve differential equations which model physical processes.
2) Solve physical problems using Bessel's and Legendre's functions.
3) Develop their attitude towards problem solving of PDEs.
4) Solve problems in engineering involving PDEs.

UNIT - I **CO: 1**

Differentials equations of first order - Linear equations, Bernoulli's equation, exact equations, equations reducible to exact equations.

Differentials equations of higher order - Second order linear differential equations with constant coefficients - Method of variation of parameters, Cauchy's homogeneous linear equation and Legendre's linear equation.

UNIT – II **CO: 2**

Series solution of differential equations - When x = 0 is an ordinary point, Frobenius method. Bessel equation, Bessel function, recurrence formulae for $J^n(x)$, expansions for J^0, J^1, $J^{1/2}$, $J^{-1/2}$, Generating function, Orthogonality of Bessel functions.

Legendre's equation, Rodrigue's formula, generating function for $P^n(x)$, recurrence formulae for $P^n(x)$, Orthogonality of Legendre's polynomials.

UNIT – III **CO: 3**

Partial differential equations - Introduction, Formation of partial differential equations, Equations solvable by direct integration, Linear equations of the first order.

Applications of partial differential equations - Introduction, Method of separation of variables. Solution of the one-dimensional wave equation.

UNIT – IV **CO: 4**

Solution of one-dimensional heat flow equation.

Solution of Laplace's equation.

LEARNING RESOURCES

TEXT BOOKS:

1) B.S.Grewal - Higher Engineering Mathematics, Khanna publishers, 42nd edition, 2017.

REFERENCE BOOKS:

1) Erwin Kreyszig - Advanced Engineering Mathematics, John Wiley & Sons, 2006
2) N.P. Bali and Manish Goyal - A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

CH 122 ORGANIC CHEMISTRY

Lectures	*:*	*3 hrs*	*Sessional Marks*	*:*	*30*
Tutorial	*:*	*0 hr*	*Semester End Exam Marks*	*:*	*70*
Semester End Exam.	*:*	*3 hrs*	*Credits*	*:*	*3*

Course Objectives

i. To learn the various factors involved in reactivity of organic compounds and make them know the reaction mechanisms and basics of isomerism.
ii. To give insights on different reagents and products to obtain various organic compounds.
iii. To study the acidic and basic nature of various organic compounds and stability effects due to derivatization.
iv. To know the chemical composition, structure of Bio molecules, drugs, and their importance in human life.

Course Outcomes

1) Understand the stability of organic compounds based on their chemical reactivity.
2) Predict stereochemistry of simple organic compounds and explain the influence of substituent on reactivity of aromatic compounds.
3) Understand the mechanism of different named reactions and predict the products formed.
4) Explain the acidic and basic strength of different organic compounds, importance of drugs and other biomolecules.

UNIT - I **CO: 1**

Electron displacements in a molecule: Inductive, Mesomeric and Electromeric effects, hyperconjugation. Reaction mechanisms of SN^1, SN^2, E^1 and E^2 reactions.

Reactive intermediates: Structure and Stability of carbocation, carbanion, and free radicals.
Alkenes: Preparation by dehydration of alcohols, dehydrohalogenation of alkyl halides (Saytzeff's rule), Addition reactions –Markownikoff's rule and anti-Markownikoff's rule, 1,2-and 1,4-additions in dienes(Diels-Alder reaction).

UNIT – II **CO: 2**

Stereo chemistry: Basics of optical and geometrical isomerisms – Enantiomers, Diastereomers, Meso compounds, Sequence rules- R and S, E and Z configuration, Keto-enol tautomerism
Conformational Analysis: Conformations of ethane and n- butane, Stability of cycloalkanes, Bayer's Strain theory, Conformation analysis of cyclohexane and di-substituted cyclohexanes.
Benzene: Resonance, aromaticity, Huckel's rule, Molecular Orbital description of aromaticity, Electrophilic aromatic substitution, Mechanism of nitration, Friedal–Crafts alkylation.

UNIT – III **CO: 3**

Heterocyclic Compounds: Synthesis and properties of Furan, Thiophene, Pyrrole, Pyridine and Indole.
Hydroxy Compounds: Preparation methods of alcohols-phenols–acidity comparison with alcohols–differences between phenols and alcohols. Reactions of Phenols–Reimer-Tiemann reaction, Kolbe's reaction.
Carbonyl compounds: Aldehydes and Ketones–Preparation–Grignard reagents. Nucleophilic addition reactions of carbonyl compounds-Cannizaro reaction, Aldol condensation, Perkin reaction, Claisen condensation, Wolf-Kishner reduction.

UNIT – IV **CO: 4**

Carboxylic acids: Acidity, Influence of substituents on acidity, Functional derivatives of carboxylic acids-acid halides, amides, anhydrides and esters.

Aliphatic and Aromatic amines: 1^0, 2^0, 3^0 amines-Distinguishing tests, Preparation by Hofmann's degradation of amides, basicity of amines, Diazonium salts-preparation and synthetic importance-Sand Mayer reaction.

Bio molecules: Nomenclature, Classification of Carbohydrates, Structure and general reactions of Glucose and Fructose, muta rotation. Amino acids and their classification

Drugs:

Synthesis of anti-bacterial drugs: Sulphanilamide, Sulphapyridine

Synthesis of anti-malarial drugs**:** Isopentaquine, Chloroquine.

LEARNING RESOURCES

TEXT BOOKS:

1) Text Book of Organic Chemistry, B.S.Bahl and Arun Bahl, 20th Edition (Unit-I,II,and III) (2011) S.Chand & Co., Delhi.

2) Text Book of Organic Chemistry, Vol.2, I.L. Finar, 5th Edition, Pearson education (Unit-IV) (2007).

REFERENCE BOOKS:

1) Text Book of Organic Chemistry, R.T.Morrison and R.N.Boyd, 6th edition, PHI, Delhi.(2008)

2) Principles of Organic Chemistry, M.K. Jain, 9th edition. S. Nagin & Co.

3) Fundamentals of Biochemistry, J.L. Jain.

Web references:

www.chemguide.co.uk/
www.adichemistry.com/
www.research.cm.utexas.edu/nbauld/
www.chem.ucla.edu/harding/tutorials/

ME/CH – 123 :: BASIC ELECTRICAL & ELECTRONICS ENGINEERING

Lectures	*:*	*3 hrs*	*Sessional Marks*	*:*	*30*
Tutorial	*:*	*--- hr*	*Semester End Exam Marks*	*:*	*70*
Semester End Exam.	*:*	*3 hrs*	*Credits*	*:*	*3*

Course Objectives:

The main objectives of this course are

1. To introduce fundamental laws, basic electrical elements, sources and their characteristics.
2. To develop the ability to apply circuit analysis to AC circuits.
3. To provide students with fundamental concepts on the construction and operation of transformers and electrical machines.
4. To know the principle of operation and characteristics of diode, transistors and oscillators.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

1. Analyse the concepts of basic electrical circuits and batteries.
2. Solve problems on basic AC circuits.
3. Summarize the operation of electrical machines.
4. Describe the operating principles and characteristics of diodes, transistors and oscillators.

UNIT – I [CO1]

DC Circuits: Batteries: Lead-acid, Nickel-iron, Nickel-Cadmium batteries (Operation only). Elementary calculations for energy consumption. DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems.

UNIT-II [CO2]

AC Circuits: Representation of sinusoidal waveforms, peak and rms values of sinusoidal waveform, phasor representation. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), real power, reactive power, apparent power, power factor. Three phase balanced circuits, voltage and current relations in star and delta connections (balanced loads only). Working principle of single phase transformer, ideal and practical transformer

UNIT-III [CO3]

Electrical Machines: Construction, working principle of DC generator and motor (Elementary treatment only), torque-speed characteristic of separately excited dc motor. Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Construction and working of synchronous generators.

UNIT - IV [CO4]

Semiconductor Diodes: Semiconductor diode, Zener diode, Half-Wave Rectifier, Full-Wave rectifier, Bipolar Junction Transistor: Transistor operation, Common base configuration, Common emitter configuration, Common collector configuration. Feedback and Oscillator Circuits: Feedback concepts, Barkhausen criteria, Phase-Shift oscillator, Wien bridge oscillator, Hartley oscillator, Colpitts oscillator.

TEXT BOOKS:

1.A.Sudhakar and Shyam Mohan SP, "Circuits and Networks: Analysis and Synthesis", 5th Edition, TMH, 2017. (Unit 1,2)

2. M.S.Sukhija, T.K.Nagasarkar, "Basic Electrical & Electronics Engineering", Oxford press, 2012. (Unit 1,2,3,4)

REFERENCE BOOKS:

1. Mahmood Nahvi and Joseph Edminister, Electric Circuits, 5th Edition, Schaum's outline series, TMH, 2017.
2. V.K. Mehta, "Principles of Electrical Engineering and Electronics", S.Chand, 2010.
3. S.Salivahanan, A.Vallavaraj, "Electronic Devices and Circuits", Tata McGraw Hill Publishers, 2011.
4. B.L.Theraja& A.K.Theraja – "Textbook of Electrical technology"- S.Chand & Co, 2014.

CH 124 PROGRAMMING FOR PROBLEM SOLVING

Lectures	*:*	*3 hrs*	*Sessional Marks*	*:*	*30*
Tutorial	*:*	*---hrs*	*Semester End Exam Marks*	*:*	*70*
Semester End Exam.	*:*	*3 hrs*	*Credits*	*:*	*3*

Course Objectives

The objectives of the course are, to make the students understand:

i. Basic problem solving process using Flow Charts and algorithms.
ii. Basic concepts of control structures in C.
iii. Concepts of arrays, functions, pointers and Dynamic memory allocation in C.
iv. Concepts of structures, unions, files and command line arguments in C.

Course Outcomes

After successful completion of the course, the students will be able to

1) Develop algorithms and flow charts for simple problems.
2) Use suitable control structures for developing code in C.
3) Design modular programs using the concepts of functions and recursion.
4) Develop code for complex applications using structures, pointers and file handling features.

UNIT - I **CO: 1**

Introductory Concepts: Block Diagram of Computer, Computer Characteristics, Hardware vs Software, how to Develop a Program, Software Development Life Cycle, Structured Programming,Types of Programming Languages, Introduction to C program, Program Characteristics.

Introduction to C Programming: Character set, Identifiers and Keywords, Data types, Constants, type qualifiers, Declaration and Initialization of variables.

Operators & Expressions: Arithmetic Operators, Unary Operators, Relational and Logical Operators, Assignment Operators, Conditional Operator, Input/ Output functions.

UNIT – II **CO: 2**

Control Statements: Branching, Looping, Nested Control Structures, Switch Statement, Break Statement, continue Statement, and Goto Statement

Arrays: Defining an Array, Processing an Array, Multidimensional Arrays & Strings.

UNIT – III **CO: 3**

Functions: Defining a Function, Accessing a Function, Function prototypes, Passing Arguments toa Function, Passing Arrays to Functions, Recursion, Storage Classes

Pointers: Fundamentals, Pointer Declarations, Passing Pointers to a Function, Pointers and Arrays,Dynamic memory allocation, Operations on Pointers, Arrays of Pointers.

UNIT – IV **CO: 4**

Structures and Unions: Defining a Structure, Processing a Structure, User-Defined Data Types,Structures and Pointers, Passing Structures to Functions, Self-Referential Structures, Unions.

Files Handling: Opening and Closing a Data File, Reading and Writing a Data File, Processing a Data File, Unformatted Data Files, Accessing the File Randomly. Command line arguments, C-preprocessor directives.

LEARNING RESOURCES

TEXT BOOKS:

1) Programming with C (Schaum's Outlines) by Byron Gottfried, Third Edition, Tata McGraw-Hill.

REFERENCE BOOKS:

1) Programming in C by Stephen G. Kochan, Fourth Edition, Pearson
2) C Complete Reference, Herbert Sheildt, TMH., 2000.
3) Programming with C by K R Venugopal & Sudeep R Prasad, TMH., 1997.
4) The C Programming Language by Brian W. Kernighan & Dennis M. Ritchie, Second Edition,Prentice Hall.
5) A Structured Programming Approach Using C by Behrouz A. Forouzan, Richard F. Gilberg,Third Edition, Cengage 2007.

WEB RESOURCES:

1) http://cprogramminglanguage.net/
2) http://lectures-c.blogspot.com/
3) http://www.coronadoenterprises.com/tutorials/c/c_intro.htm
4) http://vfu.bg/en/e-Learning/Computer-Basics--computer_basics2.pdf

CH 161 : ANALYSIS AND PREPARATION OF CHEMICAL COMPOUNDS LAB

Practicals	*3 hrs*	*Sessional Marks*	*: 30*
		Semester End Exam Marks	*: 70*
Semester End Exam.	*: 3 hrs*	*Credits*	*: 1.5*

Course Objectives

i. To know how various types of reactions can be applied in organic compound preparations.
ii. To acquire knowledge about the qualitative analysis of organic compounds.
iii. To learn how the yield of an organic compound can be determined.
iv. To learn the preparation of suitable derivatives of organic compounds.

Course Outcomes

After successful completion of the course, the student will be able to

1) Prepare organic compounds using suitable reactions.
2) Confirm the identity of organic compounds using suitable methods.
3) Analyze and identify the nature and type of a given organic compound.

List of Experiments:

1)	Preparation of Aspirin	CO1&2
2)	Preparation of Benzanilide	CO1&2
3)	Preparation of m-dinitrobenzene	CO1&2
4)	Preparation of p-bromo acetanilide	CO1&2
5)	Preparation of Phenol Formaldehyde resin.	CO1&2
6)	Detection of Extra elements.	CO2
7)	Analysis of compound -1	CO2&3
8)	Analysis of compound - 2	CO2&3
9)	Analysis of compound - 3	CO2&3
10)	Analysis of compound - 4	CO2&3
11)	Analysis of compound - 5	CO2&3
12)	Analysis of compound – 6	CO2&3

Note: Analysis of organic compound with single functional groups containing phenol, aldehyde, ketone, carboxylic acid, amides, amines, monosaccharides with two derivatives.

CH 162 BASIC ELECTRICAL & ELECTRONICS ENGINEERING LAB

Practicals	*: 3 hrs*	*Sessional Marks*	*: 30*
		Semester End Exam Marks	*: 70*
Semester End Exam.	*: 3 hrs*	*Credits*	*: 1.5*

Course Objectives

i. To conduct experiments on electrical circuits.
ii. To design experimental setups for theorems.
iii. To learn Diode characteristics, and basic diode applications as rectifiers and regulators.
iv. To learn BJT characteristics and Oscillators.

Course Outcomes

1) Get an exposure to common electrical components and their ratings.
2) Make electrical connections by wires of appropriate ratings.
3) Understand the usage of common electrical measuring instruments.
4) Verify the network theorems.
5) Design Zener voltage regulator to meet the specifications.
6) Verify experimentally popular BJT applications such as Amplification.

List of Experiments:

1) Familiarization of Electrical Installations and Electrical Testing Equipment: Miniature circuit breakers (MCBs), Moulded Case Circuit Breakers (MCCBs), Earth-leakage circuit breakers (ELCBs), Fuses, Types of Wires, Wire Gauges, continuity test, megger, Cables and Earthing.
2) Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, wattmeter, multi-meter, oscilloscope, measurement of basic parameters.
3) Verification of KVL& KCL.
4) Verification of Superposition Theorem.
5) Verification of Thevenin's Theorem.
6) Verification of Norton's Theorem.
7) Determination of choke coil parameters.
8) Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
9) Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
10) Speed control of dc motor.
11) Torque-Slip Characteristics of an induction motor
12) Characteristics of Silicon, Germanium diodes.
13) Characteristics of Zener diode.
14) Half Wave Rectifier and Full Wave Rectifier.
15) Transistor Characteristics in CE configuration.
16) Wein Bridge Oscillator.
17) Colpitt's Oscillator.

Note: A minimum of 10 (Ten) experiments have to be performed and recorded by the candidate to attain eligibility for Semester End Practical Examination.

CH 163 PROGRAMMING FOR PROBLEM SOLVING LAB

Practicals	*: 3 hrs*	*Sessional Marks*	*: 30*
		Semester End Exam Marks	*: 70*
Semester End Exam.	*: 3 hrs*	*Credits*	*: 1.5*

Course Objectives

i. To understand the basic problem solving process using Flow Charts and algorithms.
ii. To understand the basic concepts of control structures in C.
iii. To learn concepts of arrays, functions, pointers and Dynamic memory allocation in C.
iv. To use the concepts of structures, unions, files and command line arguments in C.

Course Outcomes

1) Develop algorithms and flow charts for simple problems.
2) Use suitable control structures for developing code in C.
3) Design modular programs using the concepts of functions and recursion.
4) Develop code for complex applications using structures, pointers and file handling features.

List of Exercises / Activities:

[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.]

1 **Tutorial 1: Problem solving using computers:**
Lab1: Familiarization with programming environment
2 **Tutorial 2: Variable types and type conversions:**
Lab 2: Simple computational problems using arithmetic expressions
3 **Tutorial 3: Branching and logical expressions:**
Lab 3: Problems involving if-then-else structures.
4 **Tutorial 4: Loops, while and for loops:**
Lab 4: Iterative problems e.g., sum of series.
5 **Tutorial 5: 1D Arrays: searching, sorting:**
Lab 5: 1D Array manipulation.
6 **Tutorial 6: 2D arrays and Strings:**
Lab 6: Matrix problems, String operations.
7 **Tutorial 7: Functions, call by value:**
Lab 7: Simple functions.
8 **Tutorial 8 & 9: Numerical methods (Root finding, numerical differentiation, numerical integration):**
Lab 8 and 9: Programming for solving Numerical methods problems.
9 **Tutorial 10: Recursion, structure of recursive calls:**
Lab 10: Recursive functions.
10 **Tutorial 11: Pointers, structures and dynamic memory allocation:**
Lab 11: Pointers and structures
11 **Tutorial 12: File handling:**
Lab 12: File operations.

CH 164 ENGINEERING WORKSHOP PRACTICE

Lectures	*:*	*1 hrs*	*Sessional Marks*	*:*	*30*
Practicals	*:*	*4 hrs*	*Semester End Exam Marks*	*:*	*70*
Semester End Exam.	*:*	*3 hrs*	*Credits*	*:*	*3*

Course Objectives

i. Engineers, whatever be their line of activity, must be proficient with all aspects of manufacturing, however it should not be forgotten that practice without theory is blind and the theory without practice is lame.

ii Students involved in acquiring manufacturing skills must have balanced knowledge of theory as well as practice.

iii Imparts basic knowledge of various tools and their use in different sections of manufacture such as fitting, carpentry, tin smithy, moulding, casting, welding, electrical wiring, PCB work on electronic circuits and practice with machine shop tools & equipments.

Course Outcomes

1) Will gain knowledge of the different manufacturing processes which are commonly employed in the industry to fabricate components using different materials.

List of Experiments:

1) Welding shop (both arc &gas welding)
-Square butt joint
-Lap joint
-Single v butt joint
-Gas welding & Cutting

2) Fitting Shop& Casting
-Inclined fit
-Half round fit
-V fit
-Moulding and casting of Hand wheel

3) Practice on electrical wiring and Electronic circuit boards
-One bulb controlled by one switch &one bulb controlled by two switches
-Two bulbs controlled by one switch (Stair case connection)
-Tube light connection
-Measurement of resistance, voltage and current with the help of a multi-meter & soldering on an electronic PCB circuit.

4) Machine Shop
-Practice of machining operations on Lathe, Milling, Shaping, Drilling and Slotting Machines.

5) Carpentry
-Lap joint
-Cross lap joint
-Dovetail joint
-Turning on wood turning Lathe

5) Tin Smithy
-Rectangular tray
-Funnel
-Pipe joint
-Rectangular Scoop
-Plastic mounding and glass cutting

Plastic moulding and glass cutting

Note: A minimum of 2 (two) from each trade – Total 12 (twelve) experiments – have to be performed and recorded by the candidate to attain eligibility for Semester End Practical Examination.

CHMC2 ENVIRONMENTAL SCIENCE

Lectures	*: 2 hrs*	*Sessional Marks*	*:*	*100*
Tutorial	*: 0 hr*	*Semester End Exam Marks*	*:*	*--*
Semester End Exam.	*:*	*Credits*	*:*	*--*

COURSE OBJECTIVES: To enable the students to

1) Understand that humans are an integral part of environment and hence their activities reflect on the environment.
2) Realize and appreciate the importance of ancient practices and their importance in the present times
3) Appreciate the contribution of individuals for the upkeep of environmental standards, in turn help the humans live better.
4) Describe and discuss the environmental pollution implications with related environmental acts and relevant case studies.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1) Evaluate the implications of human activities and thereby promote ecofriendly technologies.
2) Promote awareness among the members of the society for a sustainable environment.
3) Include and give priority to environmental protection in all developmental projects.
4) Understand the causes, effects and controlling measures of different types of environmental pollutions with some case studies.

A. AWARENESS ACTIVITIES - SMALL GROUP MEETINGS

I. Source of water for human consumption/activities:

a. collection of information pertaining to water resources and consumption in Andhra Pradesh
b. Water resource on campus: General / Laboratory use and
c. Drinking water - understand the background and adopt judicious management.
d. Recycled water for Gardening - Particularly Lawns.
e. Cut down wastage of electricity in class rooms / labs / hostels etc. by avoiding misuse.

II. After the group meetings and exposure to the local issues and healthy practices, students motivated to make:

a. Posters
b. Slogans/One liners for promoting awareness

III. Lectures from Experts (at least 2 in the course duration)

IV. A walk in the neighborhood to promote a chosen theme on environmental consciousness.

B. ACTUAL ACTIVITIES

1. Plantation on Campus and on the sides of approach road.
2. Distribution of saplings to the local colony dwellers and encourage plantation.
3. Development of Kitchen garden on campus - Cultivation of atleast leafy vegetables and creepers like cucumber etc. for use in college canteen/hostels etc.
4. Adoption of "NO PLASTICS" on campus.
5. Field trip to gain knowledge of biodiversity, water shed, mining, pollution and other local issues.

6. Preparation of working models for energy generation/transformation etc.

C. THEORY SYLLABUS FOR ASSESSMENT
Part-I

1. Introduction to Environmental Studies, Scope and Importance.
2. Natural resources Renewable and Non-Renewable; Definition and importance of the following resources in detail: a. Forest b. Water c. Land d. Energy
3. Sustainable development - Concept and Measures.
4. Biodiversity - Definition, Types of Biodiversity, Values and threats to Biodiversity, Conservation of biodiversity, IUCN classification: Endangered, Threatened, Vulnerable, Rare species; Endemic and Exotic species.
5. Climate change - Global warming, Ozone depletion and Acid rain.

Part-II

6. Water shed, water shed management in detail.
7. Solid wastes and Solid waste management.
8. Environmental Legislation, Environmental acts - Wild life protection act, Water act, Forest conservation act, Air act and Environmental protection act.
9. Case studies: Chernobyl nuclear disaster, Bhopal gas tragedy, Narmada bachao andolan, Silent valley, Story of Tuvalu, Story of Ganga.
10. 10.Earth summit and Kyoto protocol; Measures at individual level for conservation of natural resources and sustainable development.

Text Books

1. Anubha Kaushik and C.P.Kaushik - Environmental Studies, 3rd Edition, New Age International Publishers, New Delhi., 2012.
2. R. Rajagopalan - Environmental studies from crisis to cure, 3rd Edition, Oxford University press, 2012.

ASSESSMENT 1. Two assessments each of 40 marks will be done in the semester. The split up of each assessment is as follows:
a. Two internal theory examinations will be conducted for 18 marks each.
b. Evaluation of the prepared activity sheets and working models will be done for 12M (continual evaluation) twice in the semester in line with the theory examination.
c. 5 Marks for attendance and 5 marks for oral test.

Note: Weightages for a, b & c will be taken as per the assessment guidelines of the R-20 curriculum and projected to 100 marks.

CH 211 PROBABILITY AND STATISTICS

Lectures	*: 2 hrs*	*Sessional Marks*	*: 30*
Tutorial	*: 1-hrs*	*Semester End Exam Marks*	*: 70*
Semester End Exam.	*: 3 hrs*	*Credits*	*: 3*

Course Objectives

i. To familiarize the students with statistical techniques.
ii. To equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

Course Outcomes

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

1) Understand the concepts of probability
2) Apply the knowledge of distribution theory to both software and hardware design problems.
3) Interpret an experimental data using curve fitting.
4) Test the hypothesis for large and small samples.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1								1	1	1
CO2	3	3	2	2								2	1	2
CO3	3	3	2	3								2	3	2
CO4	3	3	2	3								2	2	2

UNIT - I **CO: 1**

Basic Probability:

Discrete random variables and their properties, Expectation of Discrete Random Variables, Continuous random variables and their properties, Expectation of Continuous Random Variables, Distribution functions and densities.

UNIT – II **CO: 2**

Discrete and Continuous Probability Distributions:

Binomial distribution, Poisson distribution, Normal distribution, Exponential distribution and Gamma distribution.

UNIT – III **CO: 3**

Applied Statistics:

Correlation and regression – Rank correlation. Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas and more general curves.

UNIT – IV **CO: 4**

Small and large sample tests:

Small sample test for single mean, difference of means, Chi-square test for goodness of fit for Binomial and Poisson Distributions, and independence of attributes.

Large sample test for single mean, difference of means.

LEARNING RESOURCES

TEXT BOOKS:

1) Miller & Freund's Probability and Statistics for Engineers – Richard A. Johnson

REFERENCE BOOKS:

1 S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan & Chand Company.

2 B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

3 Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

4 P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003

5 S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

CH212 MATERIAL SCIENCE & ENGINEERING

Lectures : 3hrs *Sessional Marks : 30*
Semester End Exam Marks : 70
Semester End Exam. : 3 hrs *Credits : 3*

Course Objectives

i. To provide the background knowledge about the structure and properties of various metallic and Non-metallic materials of construction starting from fundamentals.
ii. To develop the understanding of present-day materials demand a thorough knowledge of basic Engineering and scientific principles, including heat treatment techniques, elastic and plastic behavior.
iii. To understand the various types of materials with an emphasis on structure-property relationships and materials selection.
iv. To graduate the students who contribute to their profession and society through engineering practice, research and development.

Course Outcomes

1) Predict the properties of simple metals and alloys based on their phase diagrams, phase transitions and Metal forming process.
2) Apply and integrate knowledge from the major elements of the field structure, properties, processing and performance to solve materials selection and design problems
3) Use the techniques, skills and modern engineering tools necessary engineering practice to identify the reasons for the failure of metals and alloys.
4) Identify the methods to mitigate various types of corrosion and Select the materials used for various applications in chemical process industry

Course Articulation Matrix:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	2	3	3	2								3	2
CO2	2	3	3	3									3	3
CO3	2	2	3	3	3								2	3
CO4	3	2	2	3		2							3	3

UNIT - I **CO: 1**

Phase diagrams: The phase rule, single component systems, binary phase diagrams, micro structural changes during cooling, summary of phase diagram rules.

Forming Processes: General aspects, Cold & Hot processing, Rolling, Forging, Extrusion, and Drawing.

UNIT – II **CO: 2**

Strengthening of metals and alloys: Introduction, Strengthening Grain refinement, strain hardening, solid solution strengthening, precipitation or age hardening, dispersion hardening, Particulate Strengthening, Phase transformation Harding, Strain ageing.

Heat treatment process: Annealing, Normalizing, Hardening, tempering.

UNIT – III **CO: 3**

Deformation of Metals: Deformation, Slip, Critical resolved shear stress, twinning, difference between slip and twinning.

Creep: Definition, Mechanism of creep, methods to reduce Creep in materials.

Fracture: Ductile fracture, Brittle fracture, methods of protection against fracture.

UNIT – IV **CO: 4**

Semiconductors: Characteristic of semiconductors, Examples of semiconducting materials, intrinsic and extrinsic semiconductors, doping, p-type and n-type semiconductors, Applications of semiconductor materials, difference between semiconductor, conductor and insulator.

Corrosion: General aspects, Factors influenced in corrosion, General types of corrosion, Various types of corrosion, Control and prevention of corrosion, Criteria of selection of materials in process industry.

LEARNING RESOURCES

TEXT BOOKS:

1) Material Science and Engineering by R. K. Rajput, 3rd edition S.K. Kataria & Sons, Delhi (2005).

2) Material Science and Engineering by V. Raghavan, 5th edition, Prentice Hall of India Pvt. Ltd., New Delhi (2009).

REFERENCE BOOKS:

1) Material Science and Metallurgy - V.D.Kodgire, Everest Publishers, 2008.

2) Material Science for Engineering, D.CallistersJr, Weily& Sons, New Delhi (2006).

3) Elements of Material Science and Engineering by Van Vlock, L.H, 6 th edition., PHI, New Delhi(1989).

CH 213 CHEMICAL PROCESS CALCULATIONS

Lectures	*: 2 hrs*	*Sessional Marks*	*: 30*
Tutorial	*: 1 hrs*	*Semester End Exam Marks*	*: 70*
Semester End Exam.	*: 3 hrs*	*Credits*	*: 3*

Course Objectives

i. Understand the stoichiometric approach to chemical reactions.
ii. Designs the humidification and dehumidification operations.
iii. Comprehends and solves the material balances in a chemical operation with or/and without by pass, recycle and purge.
iv. Solves the energy balance in unit operations and processes.

Course Outcomes

1) Evaluate Physico-chemical quantities from one system units to another.
2) Estimate the composition of the given vapour-gas mixture using the principles of vapour pressure.
3) Solve material balances on chemical operations & processes including bypass, recycle and purge.
4) Evaluate energy balances on unit operations and processes.

Course Articulation Matrix:

PO / CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	1	2	3	2							2		3	1
CO2	2	3	3	2							1		2	2
CO3	3	2	2	3							3		2	3
CO4	1	2	3	3							2		2	2

UNIT - I **CO: 1**

Stoichiometric and composition relationships:

Units and dimensions, Conservation of mass, Stoichiometric relations, Basis of calculations, methods of expressing the composition of mixtures and solutions, density and specific gravity**.**

Behavior of ideal gases:

Introduction, Applications of the Ideal-gas law, gaseous mixtures, volume changes with changes in composition, Gases in Chemical reactions.

UNIT – II **CO: 2**

Vapor Pressures:

Introduction, Effect of temperature on vapor pressure, vapor pressure plots, vapor pressure of immiscible liquids, solutions.

Humidity and Saturation:

Introduction, vaporization process, condensation, wet-bulb and dry-bulb-thermometry, psychometric chart.

UNIT – III **CO: 3**

Material Balances for unit operations:

Material balances without chemical reaction, inert, tie component, Calculations involving condensation, evaporation drying, dissolution and crystallization.

Material Balances for unit Processes:

Material balances with chemical reaction, recycle, bypass and purge.

UNIT – IV **CO: 4**

Thermo Physics:

Introduction, Energy, energy balances, heat capacity of gases, heat capacities of solids, heat capacity of liquid and solutions, latent heats, heat of vaporization

Thermo Chemistry:

Introduction, Thermo chemistry of solution, Effect of pressure on heat of reaction, Heat of reaction at constant pressure and at constant volume, Effect of temperature on heat of reaction, temperature of reaction, theoretical flame temperature, actual flame temperature.

LEARNING RESOURCES

TEXT BOOKS:

1) Chemical process Principles Part–1, Material and Energy Balances by O.A.Hougen, K.M. Watson, and R.A.Ragatz, 2nd Edition, John Wiley & Sons(2004).

2) Basic Principles and Calculations in Chemical Engineering by David M. Himmelblau and James B.Riqqs, 7th edition, Prentice Hall India (2003).

REFERENCE BOOKS:

1) Stoichiometry by B. Bhatt and S. Vora, fourth edition, Tata McGraw Hill (2004).

2) Stoichiometry and Process Calculations by K. V. Narayanan and B. Lakshmikutty, Prentice-Hall of India Private Limited, New Delhi.

3) Elementary Principles of Chemical Processes, Felder, R. M.; Rousseau, R. W., third Edition, John Wiley & Sons, 2000.

4) Process Calculations, V. Venkataramani, N. Anantharaman, Begum, K. M. Meera Sheriffa, Second Edition, Prentice Hall of India.

5) Chemical Process Calculations, D. C. Sikdar, Prentice Hall of India.

CH 214 MOMENTUM TRANSFER

Lectures	*:*	*3 hrs.*	*Sessional Marks*	*:*	*30*
Tutorial	*:*	*---hrs.*	*Semester End Exam Marks*	*:*	*70*
Semester End Exam.	*:*	*3 hrs.*	*Credits*	*:*	*3*

Course Objectives

i. To introduce basis and models for fluids.
ii. To provide an understanding about Quantitative laws and equation of fluid flow for laminar and turbulent flows.
iii. To work with compressible fluids and flow past immersed bodies.
iv. To handle important engineering tasks for transporting and measuring of flow in various conduits.

Course Outcomes

1) Solve problems related to manometers and decanters using the principles of fluid statics and apply dimensional analysis.
2) Determine the pipe size / flow rate / power requirements under laminar and turbulent flow conditions from material and energy balances.
3) Solve problems involving motion of particles in fluid, fluid–solid operations in packed beds and fluidized beds
4) Select appropriate fluid moving machinery and valves for a given flow problem and estimate flow rate using head and area meters such as Venturi meter, Orifice meter and Pitot tube.

Course Articulation Matrix:

PO → / ↓ CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	3	2	2							1	2	3
CO2	3	3	3										2	3
CO3	3	3	3	2	2	1							1	2
CO4	2	2	1	1		1	1			1		1	1	2

UNIT - I **CO: 1**

Introduction: Unit operations, unit systems, dimensional analysis, basic concepts. Fluid statics and its applications-hydrostatic equilibrium, applications of fluid statics- manometers and decanters.

Fluid Flow Phenomena: Laminar flow, Shear rate, Shear stress, Rheological properties of fluids, Turbulence, flow in boundary layers, its formation and growth in tubes and on plates.

UNIT – II **CO: 2**

Basic Equations of Fluid Flow: Mass balance in a flowing fluid; Continuity, differential momentum balance; equations of motion, macroscopic momentum balances, Mechanical energy equations.

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

UNIT – III **CO: 3**

Flow of compressible fluids: definitions and basic equations, processes of compressible flow, isentropic flow through nozzles, adiabatic frictional flow and isothermal frictional flow.

Flow past immersed bodies: drag and drag coefficient, flow through bed of solids, motion of particles through fluids, fluidization and applications of fluidization.

UNIT – IV **CO: 4**

Transportation of fluids: Introduction to: pipe and tubing, joint and fittings, gate valves and globe valves, plug cocks and ball valves, check valves. Pumps: Types, Selection, Applications, Performance characteristics of centrifugal and reciprocating pumps, Constructional features and working principle of jet ejectors, compressors.

Metering of fluids: Constructional features and working principles of: venturi meter, orifice meter, Rota meters, Pitot tube, target meters, vortex-shedding meter, turbine meter, magnetic meters.

LEARNING RESOURCES

TEXT BOOKS:

1) Unit Operations of Chemical Engineering, Warren L.McCabe, Julian C.Smith, Peter Harriot, 7thEdition, McGraw Hill.

REFERENCE BOOKS:

1) Perry's Chemical Engineers Hand Book, Robert H. Perry, 8th edition, McGraw Hill (2007).

2) Coulson & Richardson's Chemical Engineering, Volume-1, J.F. Richardson, J. H. Harker and J.R. Backhurst. R.

WEB RESOURCES:

1) https://nptel.ac.in/courses/103/103/103103165/

CH215 MECHANICAL OPERATIONS

Lectures : 3hrs *Sessional Marks : 30*
Semester End Exam Marks : 70
Semester End Exam. : 3 hrs *Credits : 3*

Course Objectives

i. To make the students exposed to different geometrical sizes of raw materials used in the industries, area of calculation of the particles w.r.t their sizes.
ii. To get familiarity with the different laws of grinding.
iii. To do the power consumption calculations.
iv. To learn different separation process on their physical properties.

Course Outcomes

1) Identify the role of mechanical unit operations in chemical industries.
2) Select suitable size reduction equipment based on performance and power requirement.
3) Evaluate solid-fluid separation equipment.
4) Determine the power required for agitation, blending and mixing

Course Articulation Matrix:

PO → / CO ↓	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	1	1	1	1									1	
CO2	1		1	1									1	
CO3		1	1	1	1								1	1
CO4	1	1	1	1									1	1

UNIT - I **CO: 1**

Properties and Handling of Particulate Solids:

Characterization of solid particles: shape and size, mixed particle size analysis, specific surface of mixtures, average particle size, number of particles in mixture, screen analysis and standard screen series, size measurements with fine particles. Properties of masses of particulate, storage and conveying of solids.

Size Reduction:

Characteristics of comminuted products, energy and power requirements in comminution, crushing laws and work index. Equipment for size reduction; crushers, grinders, ultra-fine grinders and cutting machines. Equipment operation; Open circuit and closed circuit operation, energy consumption, size enlargement.

UNIT – II **CO: 2**

Mechanical Separations:

Screening, screening equipment; stationary, grizzlying, gyratory, vibrating, revolving screens. Comparison of ideal and actual screens, material balances over screen, Capacity and effectiveness of screens.

Materials Separation:

Magnetic separators, Electro- static separators and froth flotation.

UNIT – III **CO: 3**

Filtration:

General consideration, cake filters, centrifugal filters, filter media, filter aids.

Principles of Cake filtration: Pressure drop calculations, constant rate filtration, constant pressure filtration.

Clarifying filters; liquid clarification, gas cleaning, principle of clarification.

UNIT – IV **CO: 4**

Gravity Sedimentation Processes:

Gravity classifiers, sorting classifier; sink and float methods, differential settling methods, clarifiers and thickeners. Centrifugal sedimentation processes; cyclones, hydro-cyclones, centrifugal decanters, jigging and tabling.

Agitation and Mixing Liquids:

Purpose of agitation, agitation vessels, power consumption in agitated vessels. Blending and mixing. Mixing of Solids: Measures of mixer performance, mixers for non-cohesive solids, and mixers of cohesive solids.

LEARNING RESOURCES

TEXT BOOKS:

1) Unit operations of Chemical Engineering, Warren,L., McCabe, Julian C.Smith, Peter Harriot, 7th Edition, McGraw Hill(2008).

REFERENCE BOOKS:

1) Chemical Engineering, vol.-II, J.H.Coulson and Richardson, 5th edition,Elsevier India (2006).

2) Mechanical Operations for Chemical Engineers, C. M. Narayana and B.C.Bhattacharyya, Khanna Publishers (1992).

3) Perry's Chemical Engineers Hand Book, Perry Rober H, 8th edition, McGraw Hill (2007).

CH251 MOMENTUM TRANSFER LAB

Practicals	*:*	*3 hrs*	*Sessional Marks*	*:*	*30*
			Semester End Exam Marks	*:*	*70*
Semester End Exam.	*:*	*3 hrs*	*Credits*	*:*	*1.5*

Course Objectives

i) Experimentation, observation and analysis of physical phenomena in Fluid Mechanics.
ii) Training students in measurement of the physical properties of fluids.
iii) Provide experience in collection, analysis, interpretation and presentation of experimental data & Precision analysis and equipment limitations.
iv) To measure the frictional losses in laminar and turbulent pipe flows.

Course Outcomes

1) Collect quality raw data from an operation.
2) Compare observed with predicted performance.
3) Communicate the results of their analysis effectively in written and oral reports.
4) Function effectively in a lab team.

Course Articulation Matrix:

PO → / CO ↓	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	3	3	2							1	2	3
CO2	3	3	3										2	3
CO3	3	3	3	2	2	1			2	3	3	1	1	2
CO4	2	2	1	1		1	1		3	3	3	1	1	2

List of Experiments:

1) Determination of Friction factor CO:
2) Determination of Minor losses CO:
3) Determination of Orifice coefficient CO:
4) Determination of Venturi coefficient. CO:
5) Open Orifice CO:
6) V-Notch CO:
7) Rectangular Notch CO:
8) Study the Characteristics of Centrifugal Pump CO:
9) Reciprocating Pump Characteristics CO:
10) Determine the fluid flow using Reynolds Apparatus CO:
11) Study the characteristics of Packed Bed CO:
12) Study the characteristics of fluidized bed. CO:
13) Determination of local velocity using Pitot Tube CO:

CH 252 MECHANICAL OPERATIONS LAB

Practicals	*: 3 hrs*	*Sessional Marks*	*: 30*
		Semester End Exam Marks	*: 70*
Semester End Exam.	*: 3 hrs*	*Credits*	*: 1.5*

Course Objectives

i. To have sound knowledge on properties of solids and size reduction principles.
ii. To use the screening methods and settling methods.
iii. To understand the best separation techniques.
iv. To learn the effective solid-liquid separation methods.

Course Outcomes

1) Understand the properties of solids and different types of size reduction principles
2) Acquire the knowledge to determine the crushing efficiency of different size reduction equipments like crushers and grinders
3) Able to decide the best separation operation needed in chemical process industries
4) Acquaint with theories of sedimentation and to study settling characteristics of batch settling.

List of Experiments:

1) Sampling by Riffle, Cone & Quartering and Bulk method
2) Grindability index (G.I.) of coal
3) Ball Mill
4) Sink and float
5) Optimum time of sieving
6) Verify the laws of crushing
7) Effectiveness of a given screen by hand sieving
8) Effectiveness of a given screen using vibrating/Rotap sieving
9) Magnetic separator
10) Terminal settling velocity in viscous medium
11) Plate & Frame filter press
12) Centrifugal separator
13) Mixing Index
14) Cyclone Separators

Note:**
LEARNING RESOURCES:

TEXT BOOK:
Laboratory Manual

CH253 COMPUTATIONAL PROGAMMING LAB

Practicals	*:*	*3 hrs*	*Sessional Marks*	*:*	*30*
			Semester End Exam Marks	*:*	*70*
Semester End Exam.	*:*	*3 hrs*	*Credits*	*:*	*1.5*

Course Objectives

i. To understand how to apply the numerical methods to solve non-linear algebraic equations, transcedental , linear algebraic and ordinary differential equations

ii. To understand the concepts of regression analysis, interpolation, numerical differentiation and numerical integration

iii. To study about the application of numerical methods to solve chemical engineering problems

Course Outcomes

CO1 Determine roots of non-linear algebraic equations, transcedental , linear algebraic and ordinary differential equations by using computer simulator
CO2 Solve problems using regression analysis, interpolation, and numerical differentiation and numerical integration by using computer simulator
CO3 Solve chemical engineering problems involving material & Energy balances, fluid flow operations, and mechanical unit operations using numerical methods
CO4 Solve chemical engineering problems involving thermodynamics, and chemical reaction engineering using numerical methods

Course Articulation Matrix:

↓CO PO→	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	2	1	3	-	-	1	2	2	1	2	2	2
CO2	3	3	2	1	3	-	-	1	2	2	1	2	2	2
CO3	3	3	3	2	3	-	-	1	2	2	1	2	3	3
CO4	3	3	3	2	3	-	-	1	2	2	1	2	3	3

Detailed Syllabus:

S.No.	Title	CO
1.	Programme to determine the roots of Non-linear Algebraic/Transcedental Equation by using Bisection Method	CO1
2.	Programme to determine the roots of Non-linear Algebraic/Transcedental Equation by using Regula-Falsi Method	CO1
3.	Programme to determine the roots of Non-linear Algebraic/Transcedental Equation by using Newton-Raphson Method	CO1
4.	Programme to perform Regression Analysis to fit a curve with examples	CO2
5.	Programme to Interpolate the data with and without equal intervals	CO2
6.	Programme for the Numerical integration by using Trapezoidal and Simpson's Rules	CO2
7.	Programme for the Solution of Ordinary Differential Equations by using Euler Method	CO1
8.	Programme for the Solution of Ordinary Differential Equations by using R-K fourth order Method	CO1
9.	Programme for the Application of Numerical Methods to solve problems involving Fluid flow operations	CO3
10.	Programme for the Application of Numerical Methods to solve problems involving mechanical unit operations	CO3

11.	Programme for the Application of Numerical Methods to solve problems involving material and energy balances	CO3
12.	Programme for the Application of Numerical Methods to solve problems involving chemical engineering thermodynamics	CO4
13.	Programme for the Application of Numerical Methods to solve problems involving chemical reaction engineering	CO4

CHSL1 (CH 254) COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING

Lectures : 1 hrs *Sessional Marks : 100*
Practicals : 2hrs *Credits : 2*

Course Objectives

i. To make students understand the concepts of numerical and computer simulation.
ii. To introduces a range of numerical methods for the approximate solution of mathematical equations in Chemical Engineering.
iii. To know how to interpolate the data and also to understand the numerical differentiation and integration concepts.
iv. To develop a 'C' program for solving the roots of Algebraic and transdental equations.

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

1) Apply the numerical methods to solve the linear and non-linear algebraic equations.
2) Apply the regression and interpolation techniques to solve the problems.
3) Solve the problems involving differentiation, integration and ordinary differential equations by applying numerical methods.
4) Solve the problems using C language by applying numerical methods.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		3		3									2
CO2	3		3	2	3									2
CO3	3		3	2	3									2
CO4	3		3		3									2

List of Programs:

1. Roots of nonlinear equations iterative methods:
a. Bisection method. b. False position method.
c. Newton Raphson method. d. Secant method.
2. Direct solution for set of linear equations:
a. Gauss Elimination Method. b. Gauss-Jordan method
c. Matrix inversion method d. Triangular Factorization
3. Iterative solution for set of linear equations:
a. Jocabi's method. b. Gauss Seidal method
4. Regretion Analysis:
a. Fitting Linear equation
b. Fitting Transdental equation
c. Fitting a polynomial function
5. Interpolation:
a. Newton's interpolation
b. Lgrange's interpolation
6. Numerical integration:
a. Trapezoidal rule
b. Simpson's 1/3 Rule
c. Simpson's $3/8^{th}$ Rule
7. Numerical solution of ordinary differential equations:
a. Taylor series method b. Euler's method
c. Runga-Kutta method
8. Predictor and Corrector methods:
a. Milne-Simpson method b. Adam Bash forth method

LEARNING RESOURCES

TEXT BOOKS:

1) Numerical methods in Engineering & Science by B.S.Grewal, 7th edition Khanna Publishers (2005) (All UNITs)

2) Introduction to Numerical Methods in Chemical Engineering by Pradeep Ahuja, PHI Learning.(UNITs I & II)

REFERENCE BOOKS:

1) Gupta, S. K., "Numerical Methods for Engineers, New Academic Science, 2012

2) S.C. Chapra & R.P. Canale, "Numerical Methods for Engineers with Personal Computer Applications", McGraw Hill Book Company, 1985.

CHMC3 DESIGN THINKING AND PRODUCT INNOVATION

Lectures : 2 hrs. *Sessional Marks : 100*

Course Objectives

i. Identify the design thinking processes and methods
ii. Plan research activities to gather and empathize from a user's viewpoint
iii. Ideate techniques to help arrive at the best solution and evaluation
iv. Identify design thinking approaches for business challenges

Course Outcomes

1) Interpret the concepts of Design thinking.
2) Investigate a problem to determine its root cause.
3) Take part in group thinking and experiment with different solutions
4) Develop innovative thinking and creative problem solving

Course Articulation Matrix:

PO → / CO ↓	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	**3**	**3**		**2**								**2**	**3**	**3**
CO2		**3**	**3**	**2**				**2**				**2**	**3**	**3**
CO3		**3**	**3**	**2**				**2**				**2**	**3**	**3**
CO4				**3**	**3**	**3**	**3**					**2**	**3**	**3**

UNIT - I **CO:1**

Introduction to Design Thinking – Origin of Design Thinking, Features & Principles of Design Thinking, Applications of Design Thinking, Role of Research in Design Thinking.

UNIT – II **CO:2**

Modules of Design Thinking – Inspiration – methods & tools used in Explore and Empathize phases of Design Thinking, Case study-activity.

UNIT – III **CO:3**

Modules of Design Thinking – Ideation & Implementation – methods & tools used in Experiment, Engage and Evolve phases of Design Thinking, Case study-activity.

UNIT – IV **CO:4**

Design Thinking applied in Business & Strategic Innovation – Ten Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization, Creative Culture, Strategy & Organization – Design Thinking approaches.

LEARNING RESOURCES

TEXT BOOKS:

1) "Design Thinking for Entrepreneurs and Small Businesses" by Beverly Rudkin Ingle, Apress. [UNIT -1]
2) "Change by design", Tim Brown, Harper Collins, 2009 [UNIT -1]
3) "Design Thinking- The Guide Book" – Facilitated by the Royal Civil service Commission, Bhutan. [UNIT –II & III]
4) Idris Mootee, "Design Thinking for Strategic Innovation", John Wiley & Sons (2013). [UNIT - IV]

REFERENCE BOOKS:

1) Design Thinking Business Innovation, Rio de Janeiro – 2012 1st edition, MJV press.
2) Design Thinking- Understanding How Designers Think and Work by Nigel Cross, Berg publishers.

WEB RESOURCES:

1) IDEO: Design Thinking for Educators toolkit https://designthinkingforeducators.com/.

2) https://dschool.stanford.edu/resources/a-virtual-crash-course-in-design-thinking

3) https://dschool-old.stanford.edu/groups/designresources/wiki/4dbb2/ (wallet Project)

Semester IV (Second Year)

CH 221 PROCESS ECONOMICS & INDUSTRIAL MANAGEMENT

Lectures	*:*	*3 hrs*	*Sessional Marks*	*:*	*30*
Tutorial	*:*	*---hrs*	*Semester End Exam Marks*	*:*	*70*
Semester End Exam.	*:*	*3 hrs*	*Credits*	*:*	*3*

Course Objectives

i. To provide the student with an insight on the various principles, concepts and functions of General Management and economics with thrust on Industrial Management, to enable him/her to take up employment or pursue higher education.
ii. To provide students with an ability to integrate knowledge about various production systems, functions and controlling techniques etc.
iii. To enable the student to demonstrate a thorough working knowledge about Industrial Management and various functional areas of management.
iv. To motivate the student for entrepreneurship activities.

Course Outcomes

1) Gain insight on contemporary issues in General and Industrial Management.
2) Identify, analyze and interpret various concepts of Finance, systems of production to enable the student to meet the needs of Industry.
3) Understand the impact of various Industrial Management solutions and techniques with focus on economic, environmental and societal context.
4) Recognition of the need and ability to engage in perpetual learning.

UNIT - I **CO: 1**

Interest & Depreciation: Time value of money, interest discrete and continuous, Depreciation and depletion.

Cost: Cost concepts, capital costs for process plants, estimation of production cost, cost indices, cost accounting and process costing –profit and loss account and balance sheet. Break even analysis.

Profitability: Profitability analysis, comparison of alternative investments and replacements: Accounting for inflation and technological advancement.

UNIT – II **CO: 2**

Production system:

Operation Manager's activities, types of operations, classification of production system, manufacturing and service units, mass production and batch production systems.

Work: Work study, motion study and work measurement.

Production: Production Planning and control, forecasting, controlling and intermediate production system, functions under PPC.

UNIT – III **CO: 3**

Management: Principles and functions of management.

Forms of Business Organizations: Sole trader, partnership, company form of business organization.

Organization: Organization chart, principles of organization, types of organization, line and staff functions.

UNIT – IV **CO: 4**

Inventory control: Reasons for inventory control, analytical treatment and Inventory control techniques.

Operations Research: Problem formulation, linear programming, simplex and graphical solutions. Introduction to Marketing Management.

LEARNING RESOURCES

TEXT BOOKS:

1) Plant Design and Economics for Chemical Engineers, Peters. M. S. and Timmerhaus, K.D., 5th edition, McGraw Hill, (Unit - I).

2) Industrial Management and Operations Research, K. K. Ahuja, Khanna Publishers, New Delhi (Unit II – IV).

REFERENCE BOOKS:

1) Engineering Economics, Paneerselvam, PHI

2) Essentials of Management, Koontz and O'Donnel, McGraw Hill.

3) Works Organization and Management, K.C. Sahu, N.K.Dutta, Oxford publications.

CH 222 MASS TRANSFER OPERATIONS – I

Lectures	*: 2 hrs*	*Sessional Marks*	*: 30*
Tutorial	*: 1hrs*	*Semester End Exam Marks*	*: 70*
Semester End Exam.	*: 3 hrs*	*Credits*	*: 3*

Course Objectives

i. To impart the principles of mass transfer.
ii. To learn the concepts of mass transfer coefficient and its estimation.
iii. To understand the principles of various mass transfer equipment.
iv. To describe the drying and humidification processes.

Course Outcomes

1) Estimate the rate of material transfer in different mass transfer operations.
2) Calculate mass transfer coefficients at interfaces of multiphase mass transfer systems.
3) Appraise different types of equipment and their operation for gas-liquid separations and design of the absorption tower.
4) Design the drying and humidification.

UNIT - I **CO: 1**

Molecular Diffusion: Steady state diffusion into fluids at rest and in laminar flow, continuity equation, Fick's law, diffusion coefficient, diffusion in binary gas mixtures–one component stagnant.

Diffusion in binary gas mixtures–equimolar counter diffusion, non-equimolar counter diffusion, estimation of diffusivities in liquids and gases, diffusion in solids.

UNIT – II **CO: 2**

Mass transfer coefficient: Mass transfer into a single phase: notation for mass transfer coefficients for liquids and gases, mass transfer from gas into a flat falling liquid film, Sherwood number, Peclet number, Schmidt number, Reynolds number, mass transfer coefficient correlations for laminar and turbulent flow in circular pipes, film theory, penetration theory, surface renewal theory, analogy between mass, heat and momentum transfer.

Interphase Mass Transfer: Diffusion on both sides of an interface, relationship of overall mass transfer coefficient with either side mass transfer coefficient**. Material Balances (theory only):** Steady – state co current process, Steady – state counter current process, Cross flow cascades and Countercurrent cascades.

UNIT - III **CO: 3**

Equipment for Gas-Liquid Operations: Gas dispersed: Sparged vessels – diameter of gas bubbles, gas hold up, specific interfacial area, mass transfer coefficient, Tray towers – bubble cap trays. **Liquid dispersed:** Venturi scrubbers, wetted wall tower, spray tower, packed tower, types of packing, mass transfer coefficient in packed tower.

Gas Absorption: Solubility of gases in liquids, ideal liquid solutions, non-ideal liquid solutions, choice of solvent for absorption. Single component absorption material balance - counter current multi stage operations in plate tower, absorption of one component in packed tower, HETP concept.

UNIT - IV **CO: 4**

Drying: Batch drying, rate of batch drying, time of drying, mechanism of batch drying,

equipment for batch and continuous drying operations.

Humidification: Vapor-gas mixtures, absolute humidity, dry bulb temperature, relative saturation, percentage saturation, dew point, enthalpy, psychrometric charts, air-water system, wet bulb temperature, Lewis relation, Adiabatic operation – design of water cooling with air, Non-adiabatic operation – evaporative cooling.

LEARNING RESOURCES

TEXT BOOKS:

1) Mass Transfer Operations, Robert E. Treybal, 3rd edition, International Edition, McGraw Hill (1981).

REFERENCE BOOKS:

1) Unit Operations of Chemical Engineering, Warren, L., McCabe, Julian C. Smith, Peter Harriot, 7th Edition, McGraw Hill (2008).
2) Transport process and separation process principles, Christie John Geankoplis, 4th edition, PHI (2009).
3) Separation Process Principles, J D Seader and E J Henly, 2nd Edition, John Wiley & sons (2006).
4) Principles of Mass Transfer and Separation Processes, Binay K. Dutta, 2nd edition, Prentice Hall of India, 2007
5) Diffusion - Mass Transfer in Fluid Systems, E.D. Cussler, Cambridge University Press, Cambridge 1984.
6) Principles of Unit Operations, S. Foust, 2nd Edition, Wiley, New York, 1980.

WEB RESOURCES:

1) *https://nptel.ac.in/courses/103/103/103103145/*
2) *https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ch31/*

CH 223 PROCESS HEAT TRANSFER

Lectures	*: 2 hrs*	*Sessional Marks*	*: 30*
Tutorial	*: 1-hrs*	*Semester End Exam Marks*	*: 70*
Semester End Exam.	*: 3 hrs*	*Credits*	*: 3*

Course Objectives

i. To describe formulae for steady/ unsteady rate of heat transfer by conduction problems in simple geometries
ii. To teach how to estimate the heat transfer coefficients for different flow geometries
iii. To impart knowledge on the phenomenon of natural convection & radiation and involving phase change operations
iv. To explain the working and design of double pipe, shell and tube heat exchangers and evaporators

Course Outcomes

1) Solve steady state and un-steady heat conduction problems in simple geometries
2) Determine heat transfer coefficients in laminar and turbulent flow conditions and in forced convection
3) Estimate heat transfer from natural convection & radiation and involving phase change operations
4) Design heat exchange equipment such as double pipe & shell and tube heat exchangers used in chemical industry and estimate the performance of a given single/multiple effect evaporators

Course Articulation Matrix

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	1	1	2	3	-	2	3	1	1	3	3
CO2	3	2	3	1	1	2	3	-	2	3	1	1	3	3
CO3	3	2	3	1	2	2	3	-	2	3	1	1	3	3
CO4	3	2	3	1	2	2	3	-	2	3	1	1	3	3

UNIT - I **CO: 1**

Introduction: Modes of heat transfer, basic laws of heat transfer.

Heat Transfer by Conduction: Fourier law of heat conduction, thermal conductivity, steady state conduction in plane & composite walls, compound resistances in series, heat flow through a cylinder & spheres.

Unsteady state heat conduction: One-dimensional heat flow with constant surface temperature and variable surface temperature, total heat transferred. Semi-infinite solid.

UNIT – II **CO: 2**

Principles of heat flow in fluids : Typical heat exchange equipment, energy balances, heat flux and heat transfer coefficients, electrical analogy, critical radius of insulation**.**

Heat Transfer to Fluids without Phase change : Regimes of heat transfer in fluids, boundary layers, heat transfer by forced convection in laminar flow, heat transfer by forced convection in turbulent flow, heat transfer in transition region, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes.

UNIT – III **CO: 3**

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

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

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

UNIT – IV **CO: 4**

Heat-Exchange Equipment: General design of heat exchange equipment, shell and tube heat exchangers, heat exchanger effectiveness (NTU method), plate-type exchangers, extended surface equipment, heat pipes, scrapped surface exchangers, scraped surface heat exchangers, condensers & vaporizers, heat transfer in agitated vessels, heat transfer in packed beds.

Evaporation: Types of evaporators, performance of tubular evaporators (capacity and economy), Multi effect evaporators; methods of feeding, vapor recompression.

LEARNING RESOURCES

TEXT BOOKS:

1) Unit Operations of Chemical Engineering, Warren L.McCabe, Julian C.Smith, Peter Harriot, 7th edition, McGraw Hill, New Delhi (2008).

REFERENCE BOOKS:

1) Heat Transmission by H. William and Mc Adams, McGraw Hill (1954).
2) Process Heat Transfer by Donald, Q.Kern, McGraw Hill (2001).
3) Process Heat Transfer–Principles and Applications by Robert W Serth, 7th edition, Elsevier Science & Technology Books (2007).

CH 224 CHEMICAL ENGINEERING THERMODYNAMICS

Lectures	:	*2 hrs.*	*Sessional Marks*	:	*30*
Tutorials	:	*1 hrs.*	*Semester End Exam Marks*	:	*70*
Semester End Exam.	:	*3 hrs.*	*Credits*	:	*3*

Course Objectives

i. To understand the thermodynamic system, properties, first law and Second law concepts
ii. To understand the PVT behaviour of pure substances, and to know how to estimate the volumetric properties of ideal gas, virial and cubic equations of state
iii. To study about the heat effects involved in industrial processes
iv. To derive the thermodynamic property relations for pure substances, gas mixtures and solutions
v. To estimate the bubble point and dew point temperature and pressure for ideal binary systems
vi. To understand the phase and chemical reaction equilibria concepts

Course Outcomes

1) Apply the first law and second law of thermodynamics to chemical processes
2) Compute the volumetric and thermodynamic properties of ideal and real gas mixtures
3) Evaluate the efficiency of thermodynamic and flow processes
4) Calculate the VLE composition for ideal & non-ideal systems and estimate the bubble point T&P and dew pint T&P for binary systems
5) Determine the equilibrium and composition of product mixture for single reactions

Course Articulation Matrix:

PO → / CO ↓	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	-	-	-	-	2	2
CO2	2	3	3	3	1	-	-	-	-	-	-	-	2	3
CO3	2	3	3	3	2	-	-	-	-	-	-	-	2	3
CO4	3	2	2	3	2	-	-	-	-	-	-	-	3	3
CO5	3	2	2	3	2	-	-	-	-	-	-	-	3	3

UNIT - I **CO: 1,2**

First Law of Thermodynamics: Thermodynamic Equilibrium, Constant Volume and Constant Pressure Processes, Energy Balances for closed system and open systems.

PVT behaviour of Pure Substances, Ideal gas equations for process calculations, virial equations of state and its applications, cubic equations of state (Vanderwal's equation and Redlisch-Khwang equation only), generalized correlations for gases and liquids

UNIT – II **CO: 1,2,3**

Second law of thermodynamics: Statements of second law, heat engines, thermodynamic temperature scales, entropy changes of an ideal gas, mathematical statement of second law, efficiency of compression and expansion of flow processes

Thermodynamic properties of fluids: Fundamental property relations, Maxwell's Equations, Residual Properties, thermodynamic diagrams

UNIT – III **CO: 4**

Solution Thermodynamics: Fundamental property Relation, Chemical Potential, Partial Properties, ideal gas mixture model, fugacity and fugacity coefficient, ideal solution model, excess properties, liquid phase properties from VLE data, excess gibb's energy, models for excess gibb's energy, property changes of mixing

VLE at low to moderate pressures: The nature of equilibrium, Criteria of equilibrium, The

phase rule, Duhem's theorem, Raoult's law, Henry's law, Modified Raoults's law, Dew point and bubble point calculations

UNIT – IV **CO: 5**

Phase Equilibria: Equilibrium and Stability, liquid-liquid equilibrium (LLE), vapor- liquid–liquid equilibrium (VLLE), solid-liquid equilibrium (SLE), solid vapor equilibrium (SVE)

Chemical Reaction Equilibria: The reaction coordinate, Equilibrium criteria to chemical reactions, Gibbs free energy change, Equilibrium constant, Effect of temperature on equilibrium constant, Evaluation of equilibrium constants, Relation of equilibrium constant to composition, Equilibrium conversions for single reactions, Phase rule and Duhem's theorem for reacting systems

LEARNING RESOURCES

TEXT BOOKS:

1) Introduction to Chemical Engineering Thermodynamics by J.M.Smith, H.C.Vanness and M.M. Abbott 8th Edition (In SI units), Tata McGraw Hill.

REFERENCE BOOKS:

1) Milo D. Koretsky, Engineering and Chemical Thermodynamics, Wiley, 2009.
2) Y.V.C.Rao, "Chemical Engineering Thermodynamics", University Press, Hyderabad,1997
3) K. V. Narayanan, Chemical Engineering Thermodynamics, Prentice Hall of India Pvt. Ltd., 2009.

CH 225 CHEMICAL TECHNOLOGY

Lectures	*:*	*3 hrs*	*Sessional Marks*	*:*	*30*
Tutorial	*:*	*---hrs*	*Semester End Exam Marks*	*:*	*70*
Semester End Exam.	*:*	*3 hrs*	*Credits*	*:*	*3*

Course Objectives:

i. To impart the knowledge of Unit operations unit processes involved in manufacture of widely employed inorganic chemicals like Chlor-alkalis, cements, Glasses and industrial gases.
ii. To provide the knowledge of Unit operations unit processes involved in manufacture of Fertilizers like Ammonia, Urea, Nitric acid, Phosphoric acid and superphosphates.
iii. To impart the knowledge of Unit operations unit processes involved in manufacture of organic chemicals like Rubbers, fibres, plastics and soaps.
iv. To impart the knowledge of Unit operations unit processes involved in manufacture of organic chemicals like Papers, Sugars, Fermentation products and Petroleum refining.

Course Outcomes:

1. Demonstrate chemical technologies used in the manufacturing of Chlor-alkalis & Cements, Glasses and Industrial gases.
2. Interpret manufacturing process for Nitrogen, phosphorous fertilizers, Sulphuric acid and Hydrochloric acid.
3. Describe organic chemical technologies involved in Industrial Processes such as phenol-formaldehyde, Styrene - Butadiene Rubber polymerizations, Synthetic fibres , oils ,soaps and detergents manufacture.
4. Interpret the manufacturing operations and processes for the production of natural products (sugar, pulp and paper, Fermentation industry) and Petroleum refining.

UNIT I **[CO:1]**

Introduction: Objectives, unit processes and unit operations. General Fundamentals.
Alkali Industries: Soda ash, Caustic soda and Chlorine.
Cement: Raw materials, types, manufacture, special Cements.

Glass: Raw materials, manufacture, special Glasses.
Industrial gases: Nitrogen, Carbon dioxide, Hydrogen and Oxygen.

UNIT II **[CO:2]**

Nitrogen industries: Synthetic Ammonia, Urea, Nitric acid.
Phosphate Industries: Phosphoric Acid, Calcium phosphate and Super phosphate

Sulfur and sulfuric acid: Manufacture of Sulfur and Sulfuric acid.
Hydrochloric acid: Manufacture of Hydrochloric acid.

UNIT III **[CO:3]**

Synthetic Fibres: Classification, manufacture of Nylon 6,6, Polyester Fibre, Viscose rayon Fibre.
Plastic industry: Classification of plastics, Manufacture of phenols (From Cumene, Toluene), Formaldehyde, Vinyl Chloride .Manufacture of phenol-formaldehyde resin and PVC.

Rubbers: Classification, Natural Rubber, monomers of Synthetic Rubber, manufacture of

SBR.

Oils, soaps and detergents: Definitions, extraction and expression of vegetable oils, Hydrogenation of oils, continuous process for the production of Fatty acids and Soap, production of Detergents.

UNIT IV **[CO:4]**

Petroleum Refining: Constituents of petroleum, Products of Refining, petroleum refining process- Cracking, Reforming, Polymerization, Alkylation, Isomerization, Hydro-cracking.

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.

Fermentation industry: Manufacture of Alcohol from molasses, manufacture of Penicillin.

LEARNING RESOURCES

TEXT BOOKS:

1) Dryden's Outlines of Chemical Technology for 21st Century by M.Gopal Rao and M.Sittig,3rd edition, East West Press(2010).

2) Shreve's Chemical Process Industries byG.T. Austin, McGraw Hill, 5th edition (1984)

REFERENCE BOOKS:

1) A Text Book of Chemical Technology (Volume I&II), G.N.Panday, Vikas Publishers

2) Chemical Process Technology by Jacob A.Moulijin, MIchielMakkee and Annelies Van Diepen, John Wiley & Sons(2001)

CH 261 MASS TRANSFER OPERATIONS-I LAB.

Practicals	*: 3 hrs*		*Sessional Marks*	*:*	*30*
			Semester End Exam Marks	*:*	*70*
Semester End Exam.	*: 3 hrs*		*Credits*	*:*	*1.5*

Course Objectives:

i. To determine the diffusion coefficient in binary systems of liquids and gases.
ii. To understand surface evaporation in stationary surfaces.
iii. To study hydrodynamics column.
iv. To determine the kinetic and equilibrium parameters of drying of wet solids.

Course Outcomes:

1) Estimate the diffusivity of material in mass transfer operations.
2) Predict the mass transfer coefficients.
3) Prepare the characteristic curves of drying.
4) Predict the mass transfer coefficients in humidification and dehumidification.

List of Experiments:

1)	Diffusivity for liquid-liquid system.	CO: 1
2)	Diffusivity coefficient for given vapor-gas system.	CO: 2
3)	Mass transfer coefficient for Surface evaporation of a liquid.	CO: 2
4)	Hydrodynamics of single drop extraction.	CO: 1
5)	Hydrodynamics of perforated plate tower.	CO: 1
6)	Mass transfer coefficient in a wetted wall tower.	CO: 2
7)	Mass transfer coefficient in a Packed bed absorption.	CO: 2
8)	Mass transfer coefficient in a perforated plate tower.	CO: 2
9)	Batch drying.	CO: 3
10)	Humidification.	CO:4
11)	Dehumidification.	CO: 4
12)	Mutual solubility curve.	CO:1

CH 262 PROCESS HEAT TRANSFER LAB

Practicals	*: 3 hrs*	*Sessional Marks*	*:*	*30*
		Semester End Exam Marks	*:*	*70*
Semester End Exam.	*: 3 hrs*	*Credits*	*:*	*1.5*

Course Objectives

i. To apply the concepts of heat transfer, fluid dynamics and thermodynamics to the design and operation of heat transfer experiments.
ii. To develop practical understanding of common heat transfer equipment.
iii. To develop skills in experimental design and troubleshooting.
iv. To develop skills in data collection, analysis and interpretation.

Course Outcomes

1) Collect quality raw data from an operation.
2) Compare observed with predicted performance.
3) Communicate the results of their analysis effectively in written and oral reports.
4) Function effectively in a lab team.

List of Experiments:

1) Thermal conductivity of a metal rod.
2) Natural convective heat transfer coefficient on a vertical surface.
3) Temperature distribution along a pin fin under natural convection and forced convection.
4) Heat transfer coefficient in forced convection.
5) Overall heat transfer coefficient for a fluid in parallel and counter flow in double pipe heat exchanger.
6) Stefan- Boltzmann constant.
7) Heat transfer coefficient for a fluid through a lagged pipe.
8) Temperature distribution through composite walls.
9) Overall heat transfer coefficient for a fluid flow in a shell and tube heat exchanger.
10) Unsteady state heat transfer in a rod.
11) Overall Heat transfer coefficient for a fluid flow in agitated vessels.
12) Overall Heat transfer coefficient for a fluid flow in a jacketed kettle.
13) Rate of evaporation in single effect evaporator.
14) Heat flux for a fluid flow through heat pipe.

CH 263 CHEMICAL TECHNOLOGY LAB

Practicals	*: 3 hrs*	*Sessional Marks*	*: 30*
		Semester End Exam Marks	*: 70*
Semester End Exam.	*: 3 hrs*	*Credits*	*: 1.5*

Course Objectives

i. To instill students with the fundamental principles and concepts of Inorganic and Organic Chemical Technology.
ii. To provide students with the fundamental aspects of chemical process technology and professional knowledge in selected areas of Inorganic and Organic chemical technology.
iii. To provide knowledge in soap manufacturing, analysis and estimation.
iv. To provide knowledge in oil (testing), analysis and estimation of glucose and sugar.

Course Outcomes

1) Demonstrate knowledge on fundamental principles of chemistry, Inorganic chemical technology and on contemporary applications.
2) Design and conduct experiments, as well as critically analyze and interpret experiment results.
3) Demonstrate the principles of organic chemical technology and other applications.
4) Design a component process or system to meet the required product quality.

List of Experiments:

1) Determination of total dissolved solids and pH of water
2) Determination of chloride in tap water.
3) Determination of Sulphate in tap water.
4) Preparation of copper pigment
5) Preparation of chrome yellow
6) Preparation table salt
7) Proximate analysis
8) Estimation of nitrogen content in urea
9) Estimation of Glucose
10) Estimation of Cane sugar.
11) Preparation of soap by semi boiled process
12) Total fatty matter in soaps

CHSL2 (CH264) PYTHON PROGRAMMING

Lectures	:	*1 hrs.*	*Sessional Marks*	:	*100*
Practicals	:	*2 hrs.*	*Credits*	:	*2.0*
Semester End Exam.	:	--			

Course Objectives

vii To introduce the fundamentals of Python Programming language
vii To make the students process files, mutable and immutable data.
ix. To impart knowledge of Object – Oriented Programming using Python

Course Outcomes

6) Illustrate the fundamentals of Python programming language
7) Create user defined functions to solve problems
8) Write programs to manipulate the data structures lists, tuples, sets and dictionaries
9) Use Exception handling and Object – Oriented programming features of Python in solving real-world problems.

Course Articulation Matrix:

PO → / CO ↓	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	2	1	1	3	1	-	-	-	-	-	1	-	2
CO2	3	3	3	3	3	1	-	-	-	-	-	1	-	2
CO3	3	3	1	3	3	1	-	-	-	-	-	1	-	1
CO4	3	3	3	3	3	1	-	-	-	-	-	1	-	1

Detailed Syllabus:

Theory **CO: 1,2,3,4**

Variables, expressions and statements, Functions, Conditionals and recursion, Fruitful functions, Iteration, Strings, Files
Lists, Dictionaries, Tuples, Classes and objects, Classes and methods, Inheritance

Programmes **CO: 1,2,3,4**

1. Simple Programs to demonstrate Input - Output operations
2. Programs to demonstrate the behaviour and use of various operators
3. Programs to emphasize the usage of Conditional Control Statements
4. Programs to emphasize the usage of Iterative control statements
5. Programs on the usage of Built-in functions
6. Programs to demonstrate the creation and usage of User Defined Functions
7. Programs to demonstrate Recursion
8. Programs on creation and importing of modules
9. Programs on Lists and its operations
10. Programs on List Processing. (Sorting, Searching, Permutations...)
11. Programs to demonstrate Exception Handling
12. Programs to demonstrate OOP concepts

LEARNING RESOURCES

TEXT BOOKS:

1) Think Python: How to Think Like a Computer Scientist, Allen Downey, Green Tea Press, Version 2.0.17

REFERENCE BOOKS:

1) Introduction to Computer Science Using Python: A Computational Problem-Solving Focus by Dierbach, Wiley

2) Fundamentals of Python Programming : Richard L. Halterman by Southern Adventist University

CHMC4 **ETHICS & HUMAN VALUES**

Lectures : 2 hrs. *Sessional Marks : 100*

COURSE OBJECTIVES:

1. To create awareness to specific set of morals, values and ethics the professional must know and abide by, including work ethics, integrity and commitment etc.
2. To realize the importance of moral autonomy, professional ideals and Ethical theories
3. To study safety/risk aspects, welfare of the public and about employee rights
4. Know about the global issues and code of ethics of professional bodies

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Have basic understanding of how a prospective engineer should behave in his chosen field and society.
2. Realize the importance of moral autonomy, professional ideals and Ethical theories.
3. Know about the safety/ risk, welfare of the public and employee rights
4. Gain exposure to global issues and codes of some professional bodies

UNIT I *Text Book - 2* [CO:1] **(12)**

Human Values : Morals, Values And Ethics - Work Ethics - Service Learning - Caring - Valuing Time -Co-Operation - Empathy - Self-Confidence - Stress Management - Spirituality-living peacefully.

UNIT II *Text Book - 1,2* [CO:2] **(12)**

Senses of Engineering Ethics - Moral Dilemmas - Moral Autonomy - Kohlberg`s Theory - Gillian`s Theory -Theories about Right Action-virtue ethics, utilitarianism, duty ethics, and right ethics-. Case studies like The Space Shuttle Challenger, Bhopal gas tragedy, Chernobyl disaster etc.

UNIT III *Text Book - 1,2* [CO:3] **(12)**

Engineering as Experimentation - Engineers as Responsible Experimenters- Safety, Assessment of Safety and Risk -Risk Benefit Analysis .The nature and characteristics of a profession- Collegiality and Loyalty - Collective Bargaining - Conflicts Of Interest - Occupational Crime - Intellectual Property Rights (IPR) - Discrimination.

UNIT IV *Text Book - 1,2* [CO:4] **(12)**

Multinational Corporations - Environmental Ethics - Computer Ethics - Engineers As Managers - Consulting Engineers - Codes Of Ethics -Sample Code Of Ethics Like ASME, ABET, IEEE, Institution of Engineers (India), Indian Institute of Materials Management Etc.,

LEARNING RESOURCES:

TEXT BOOK(s):

1. Mike martin and Ronald Schinzinger, "Ethics in Engineering" McGraw-Hill, New York 1996
2. Govindarajan M, Natarajan S, Senthil Kumar V.S., "Engineering Ethics", PHI, New Delhi

REFERENCE BOOK(s):

1. Charles D,Fleddermann, "Engineering Ethics", Pearson / PHI, New Jersey 2004 (Indian Reprint)
2. Charles E Harris, Michael S.Protchard and Michael J Rabins, "Engineering Ethics - Concepts and Cases" Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available)
3. John R Boatright, "Ethics and the conduct of business" Pearson, New Delhi, 2003.

4. Edmund G.Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers" Oxford University Press, Oxford, 2001.