SEMESTER I

21S101 CALCULUS AND ITS APPLICATIONS

3 2 0 4

FUNCTIONS, LIMITS AND CONTINUITY: Basic concepts - Functions and their graphs - Combining functions; shifting and scaling graphs – Limit of a function and limit laws – The precise definition of a limit - One – sided limits - Continuity - The derivative as a function - Functions of several variables - Partial derivatives (9+6)

DIFFERENTIALCALCULUS: Curvature - Radius of curvature - Circle of curvature - Evolute - Envelope - Extreme values and saddle points - Lagrange multipliers - Taylor's formula for two variables. (9+6)

INTEGRALCALCULUS: Double and iterated integrals – Double integral over general regions – Area by double integration - double integrals in polar form - Triple integrals in rectangular coordinates – Triple integrals in cylindrical and spherical coordinates (9+6)

IMPROPERINTEGRALS: Beta and Gamma functions-Relation connecting Beta and Gamma functions- Evaluation of definite integrals in termsof Beta and Gamma functions–Applications. (6+3)

VECTORCALCULUS: Vector and scalar functions and their fields - Gradient of a scalar field, directional derivative - Divergence of a vector field - Curl of a vector field- Line integrals of scalar functions - Vector fields and line integrals: work, circulation, and flux - Path independence, conservative fields and potential functions - Green's theorem in the plane - Surfaces and area - surface integrals - Stoke's theorem - The divergence theorem. (12+9)

Total:L45+T: 30=75

TEXT BOOKS:

1. Joel Hass, Christopher Heil, Maurice D. Weir, "Thomas' Calculus", Pearson, 2018
2. ErwinKreyszig,"AdvancedEngineering Mathematics", JohnWiley and Sons,2019.

REFERENCES:

1. Howard Anton, Irl Bivens, Stephen Davis, "Calculus", John Wiley & Sons, INC, USA, 2016.
2. Wylie C R and Barrett L C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
3. Michael D.Greenberg, "Foundations of Applied Mathematics", Dover Publications, INC, New York, 2013.
4. Gilbert Strang, "Calculus", Wellesley Cambridge Press, USA, 2017.

21S102 DIFFERENTIAL EQUATIONS

2 2 0 3

Ordinary Differential equation of first order: Basic Concepts - Modeling-Separable ODEs -Exact differential equations - Integrating factors – Linear differential equations- Bernoulli equations. Applicationsoffirstorderdifferentialequations– Mixing,chemicalreaction,Lawofcooling. (6+6)

Ordinary Differential equation of Second order: Homogeneous linear ordinary differential equations with constant coefficients – Differential operators – Non homogeneous ordinary differential equations – Existence and Uniqueness of solutions – Wronskian (6+6)

Application of second order differential equations: Euler-Cauchyequations –Method of variation of parameters– Applications second order differential equations – Electric circuits, Mass spring system. (6+6)

Series solutions of differential equations: Power series method, Legendre's equation–Frobenius Method-Bessel's equation-Sturm-Liouville problem. (6+6)

Partial Differential Equations: Formation of equations - eliminating arbitrary constants, arbitrary functions – Classification of first order partial differential equation – Solvable by direct integration – Solution of linear, semi linear, quasi linear equation. (6+6)

Total: L30+T30 =60

Text Book:

1. Erwin Kreyszig, "Advance Engineering Mathematics", John Wiley &Sons,New Delhi,2019.
2. Earl A Coddington , "An Introduction to Ordinary Differential Equations" , McGraw Hill Education.,2017.

References:

1. Dennis G Zill "Advanced Engineering Mathematics", Burlington, MA : Jones & Bartlett Learning,2016.
2. Ray Wylie and Louis C Barrett, "Advanced Engineering Mathematics", TataMcGraw-Hill,New Delhi, 2019.
3. Ian Sneddon, "Elements of Partial Differential Equations", Tata McGraw Hill, New Delhi,2006.
4. Wylie C R and Barrett L C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.

21S103 PROPERTIES OF MATTER AND ACOUSTICS

2 2 0 3

ELASTICITY: Modulus of elasticity - Stress-strain curve - Poisson's ratio - Determination of rigidity modulus using Torsion pendulum - Bending of beams, bending moment, Theory of cantilever, beam supported at its end and loaded in the middle, determination of Young's modulus by bending, I form girders (6+6)

VISCOSITY: Coefficient of viscosity - Poiseuille's method for coefficient of viscosity - Effect of temperature on viscosity - Rotation (Searle's) viscometer – viscosity of gases, Fluid mechanics: Pascal's principle, Archimede's principle- Streamline and turbulent motion- Ideal fluids in motion – Equation of continuity - Bernoulli's theorem - Applications: Venturimeter, Dynamic lifting. (6+6)

SURFACE TENSION: Cohesive and adhesive forces **-** Surface tension - Surface energy – Wetting and non-wetting surfaces - Difference of pressure across a curved surface –Liquid drop, bubble, hollow cylindrical film - Theory of capillary rise - Drop weight method - Applications of surface tension. (6+6)

ACOUSTICS: Musical sound and noise, characteristics of musical sound: Loudness, noise, quality and intensity. Requirements for acoustically perfect hall. Reverberation, time of reverberation, Sabine's formula for reverberation time Factors affecting the acoustics of a building, and their remedies. (6+6)

ULTRASONICS: Introduction, Production - magnetostriction generator, piezoelectric and inverse piezoelectric effect, piezoelectric generator. Detection, properties, Applications: Sound ranging, SONAR. Non destructive testing: Pulse echo method, through transmission and resonance method. Industrial applications: drilling, cleaning, welding and cutting.(6+6)

Total L 30 + T 30 : 60

TEXT BOOKS:

1. Brijlal, Subrahmanyam N and Jivan Seshan "Mechanics and Electrodynamics", S. Chand and Co., New Delhi, 2011.
2. Textbook of Sound by Brij Lal & Subramaniam. N, Vikas Publishing House, New Delhi, 1982.

REFERENCES:

1. Mendoza E and Flowers B H, "Properties of Matter", John-Wiley & Sons inc, 2000.
2. Michael De Podesta, "Understanding the Properties of Matter", Taylor and Francis, 2001.
3. Fundamentals of Physics, 6th Edition, by D. Halliday, R.Resnick and J.Walker, Wiley, NY, 2001.
4. Gaur R K and Gupta S L, "Engineering Physics", Dhanpat Rai and Sons, New Delhi, 2012

21S104 GENERAL CHEMISTRY

3 0 0 3

ELECTRONIC STRUCTURE OF ATOMS: Orbitalsandquantum numbers - principal, azimuthal, magnetic and spin quantum numbers and their significance. Shapes of atomic orbitals – energies of orbitals. Filling of orbitals in atom: Building-up principle, Pauli's exclusion principle and Hund's rule. Electron configuration of atoms: (n+*l*) rule – stability of half-filled and completely filled orbitals. (9)

PERIODIC PROPERTIES: Modern periodic table - periodic classification elements – electronic configuration of elements and the periodic table. Periodic variation of physical properties of elements: atomic, ionic radii, ionisation potential, electron affinity and electronegativity along the periods and groups. Electronegativity – Pauling scale and Mulliken scale – Applications of electronegativity.Periodic variation of physical properties of elements: Valency of elements, anamalaous properties of second period elements – periodic trends and chemical reactivity. (9)

CHEMICAL BONDING AND MOLECULAR GEOMETRY: Kossel-Lewis approach – octet rule, covalent bond and Lewis structure of simple molecules and limitations of octet rule.Ionic bond – ionic bond strength and lattice energy, calculation of lattice energy using Born-Haber cycle and its applications - Fajan's rules - calculation of percentage of covalent character in ionic bond.Molecular geometry: VSEPR theory - shapes of simple inorganic molecules containing ion pairs and bond pairs of electrons ($BeCl_2$, BF_3, PCl_5, SF_6, IF_7,SF_4, NH_3,H_2O, ClF_3, BrF_5, and XeF4), molecular shape and polarity, dipole moment and calculation of percentage of ionic character in covalent bond. Intermolecular forces: Dipole-dipole,dipole-induced dipole, dispersion forces and hydrogen bonding types and its consequences. (9)

PRINCIPLES OF VOLUMETRIC ANALYSIS: Terms used in volumetric analysis, primary and secondary standard solutes and solutions, ideal and non-ideal solutions, activity and activity coefficient of solutions and standardization of solutions. Concentration units: ppm, molality, formality,molarity, mole fraction, normality, weight percent and volume percent. Determination of equivalent weight of acids, bases, oxidant, reductant and simple salts. Types of volumetric titrations, acid-base, redox, precipitation and complexometric titrations.Indicators: effect of change in pH, neutralization, redox, adsorption and metal ion indicators. Oxidation and reduction reactions**:** balancing redox equations by oxidation number and ion-electron method. (9)

SURFACE CHEMISTRY: Types of adsorption, characteristics of physisorption and chemisorption, adsorption isotherms and its types, Freundlich and derivation and treatment of Langmuir isotherms – applications of adsorption. Surface active agents-orientation of surfactants on liquid and solid surfaces, micelle formation, detergency, wetting, water repellency, water conservation. Colloids – types, peptization and stability of colloids. (9)

Total L: 45

TEXT BOOKS:
1. Chang R, Overby J, "General chemistry: the essential concepts", Mc Graw Hill, New York, 2013.
2. Mahan B M, "University chemistry", Pearson Education, India, 2012.

REFERENCES:
1. Puri B R, Sharma L R and Kalia K C, "Principles of Inorganic chemistry," Vishal Publishing Co., 2013.
2. Madan R D, "Modern Inorganic Chemistry", S.Chand & Company Ltd., New Delhi, 2010.
3. Soni P L and Mohan Katyal, "Text book of Inorganic Chemistry", Sultan Chand & Sons, New Delhi, 2012.
4. Puri, B R, Sharma L R and Pathania M S, "Principles of Physical Chemistry", Vishal Publishing Company, New Delhi, 2012.

21S105 PHYSICAL CHEMISTRY I

2 2 0 3

GASEOUS STATE: Gas laws, ideal gas equation, kinetic molecular theory of gases – derivation of kinetic gas equation, distribution of molecular velocities, calculation of molecular velocities - collision properties. Van der Waals equation, liquefaction of gases. Law of corresponding states – methods of liquefaction of gases. (6+6)

FIRST LAW OF THERMODYNAMICS AND THERMOCHEMISTRY: Terminology. Frist law of thermodynamics, enthalpy of a system, molar heat capacities. Joule-Thomson effect. Adiabatic expansion of an ideal gas. Work done in adiabatic reversible expansion. **Thermochemistry** – enthalpy of a reaction, exothermic and endothermic reactions. Thermochemical equation – different types of heat of reaction or enthalpy of reaction, Hess's law of constant heat summation – applications. Bond energy – measurement of heat of reaction. (6+6)

SECOND AND THIRD LAW OF THERMODYNAMICS: Need for second law - different statements. Spontaneous process. Entropy – third law of thermodynamics. Numerical definition of entropy, units of entropy, standard entropy, standard entropy of formation. Carnot cycle – derivation of entropy from Carnot cycle – physical significance of entropy. Entropy change for an ideal gas, entropy change accompanying change of phase. Gibb's Helmholtz equations – applications. Clapeyron and Clausius-Clapeyron equation – applications. Free energy and work function, Maxwell's relationship. van't Hoff isotherm. Fugacity and activity – chemical potential – partial molar properties – Gibbs Duhem equation - physical significance. Variation of chemical potential with temperature and pressure. Zeroth law of thermodynamics. (6+6)

CHEMICAL EQUILIBRIUM: Reversible reactions, characteristics of chemical equilibrium, law of mass action, equilibrium constant – equilibrium law. Equilibrium constant expression in terms of partial pressures. Units of equilibrium constant. Heterogeneous equilibria. Le Chaterlier's principle. Conditions for maximum yield in industrial processes - synthesis of ammonia (Haber process), manufacture of sulphuric acid (contact process), manufacture of nitric acid (Birkeland-Eyde process). Nernst's Distribution law – explanation, limitation. Henry's law – determination of equilibrium constant from distribution coefficient – applications of distribution law. (6+6)

PHASE EQUILIBRIA: Terminology – phase, components, and degree of freedom. Derivation of the phase rule. One component system. Phase diagrams, polymorphism. Experimental determination of transition point – the water system, the sulphur system. Two-component system – the silver-lead system, the zinc-cadmium system, the potassium iodide-water system, the magnesium-zinc system, the ferric chloride-water system, the sodium sulphate-water system. (6+6)

Total L: 30 + T: 30 = 60

TEXT BOOKS:
1. Atkins P, de Paula J and Keeler J, "Atkins' physical chemistry", Oxford University press, 2017.
2. Levine I N, "Physical chemistry", McGraw-Hill education, 2014

REFERENCES:
1. Puri B R, Sharma L R and Pathania M S, "Principles of physical chemistry", Vishal publishing Co., 2020
2. Bahl B S, Bahl A and Tuli G D, "Essentials of physical chemistry", S.Chand & Co., 2020.
3. Cooksy A, "Physical chemistry: Thermodynamics, statistical mechanics and kinetics", Pearson, 2020.
4. Neeraj kumar, "Advanced problems in physical chemistry for competitive examinations", Pearson, 2015.

21S106 ENGLISH

3 0 0 3

VOCABULARY BUILDING: The concept of Word Formation: Compounding, Backformation, Clipping, Blending - Root words from foreign languages and their use in English - Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives - Synonyms, antonyms, and standard abbreviations: Acronyms (5)

GRAMMAR: Identifying Common Errors in English – Tenses – Modal auxiliary verbs - Subject-verb agreement - Noun-pronoun agreement - Articles – Prepositions – Word order - Different types of sentence: simple, compound, complex, Idioms and Phrases, Transformation of sentences: Active and Passive voice (6)

READING COMPREHENSION: Developing Reading Skills like Skimming and Scanning for information, Critical Reading, Inferential, Cognition, and analytical Skills- appropriate reading texts to be used from general, scientific, and literary genres. (9)

BASIC WRITING SKILLS: Importance of proper punctuation - Creating coherence: Arranging paragraphs & Sentences in logical order - Principles of paragraph writing - Sensible Writing: Describing, Defining, Classifying - Writing introduction and conclusion - Précis Writing - Essay Writing - Writing Letters: Formal, Informal - Writing Emails (9)

LISTENING SKILLS: Understanding listening - Listening Techniques - Listening short comprehension passages - Conversational practice in both social and professional contexts (6)

PRACTICALS: Oral presentation - Short speeches and conversation practice (10)
Listening integrated tasks

TOTAL HOURS: 45

TEXT BOOK:

1. Shoba, K N & Lourdes Joavani Rayen. “Communicative English: a workbook”. New Delhi: Cambridge University Press, 2021.

REFERENCES:

1. Sanjay Kumar, & Pushp Lata. “Communication Skills”. New Delhi: Oxford University Press, 2018.
2. Means, Thomas L. “English & Communication for Colleges”. Delhi: Cengage Learning India Private Limited, 2017.
3. Shoba, K N & D. Praveen Sam. “Technical English: a workbook”. New Delhi: Cambridge University Press, 2019.
4. Meenakshi Raman & Sangeeta Sharma. “Technical Communication: Principles and Practices”.New Delhi: Oxford University Press, 2018

21S107 PROPERTIES OF MATTER AND ACOUSTICS LABORATORY

0 0 4 2

1. Determination of Young's Modulus - Cantilever.
2. Determination of Young’s modulus - Uniform bending.
3. Determination of Surface tension - Capillary rise method.
4. Determination of Surface tension - Drop weight method.
5. Determination of Viscosity - Poiseuille's Flow.
6. Determination of Viscosity - Searle's method.
7. Determination of frequency of the tuning fork - Melde's apparatus
8. Determination of velocity of sound - Helmholtz Resonator

TOTALP: 60

TEXT BOOKS

1. Arora C.L., “Practical Physics”. S.Chand & Co, 19thEdition, 2007.
2. Srinivasan M. L. Balasubramanian S. and Ranganathan R., “A Text book of Practical Physics” Sultan Chand. New Delhi, 2007.

REFERENCE BOOKS

1. Govindarajan S.R. Sundarajan S., “Practical Physics” Rochouse & sons Pvt Ltd., 1959.
2. Dhanalakshmi A. Somasundaram S., “Practical Physics”, Apsara Publishers, 2010
3. Gupta S.L. Kumar V., “Practical Physics” Pragati Prakashan,Meerut, 20thEdition, 1999.
4. Lab Manual Physics Department of Applied Science

21S108 CHEMISTRY LABORATORY

0 0 4 2

1. Estimation of Na_2CO_3 by HCl using standard Na_2CO_3 solution.
2. Estimation of HCl by NaOH using standard oxalic acid solution.
3. Estimation of carbonate and hydroxide present together in a mixture.
4. Estimation of oxalic acid by KMnO4 using standard oxalic acid solution.
5. Estimation of FeSO4 by KMnO4 using standard Mohr’s salt solution.
6. Estimation of KMnO4 by thio using standard K2Cr2O7 solution.
7. Estimation of CuSO4 by thio using standard K2Cr2O7 solution.
8. Estimation of Ca (II) by EDTA method.
9. Preparation of primary, secondary standards, indicatorand special solutions/reagents used in volumetric titrations.
10. Determination of strength of commercial/laboratory samples (Acids/ bases/ hydrogen peroxide).

Total P: 60

TEXT BOOKS:
1. Corwin C, “Laboratory manual: Introductory chemistry concepts and critical thinking”, Pearson, 2019.
2. Laboratory manual prepared by the department of applied science. 2021.

REFERENCES:
1. Beran JA, “Laboratory manual for principles of general chemistry”, John Wiley & sons, 2014.
2. Venkateswaran V, Veeraswamy V, Kulandaivelu AR, “Basic principles of practical chemistry”, Sultan Chand & sons, 2012.
3. Williamson V and Peck L, “Experiments in general chemistry: Inquiry and skill building”, Cole internationsl, 2017.
4. Brescia F, Arents J, Meislich H, Turk A and Weiner E, “Fundamentals of chemistry laboratory studies”, academic press, London, 2012.

SEMESTER II

21S201 LINEARALGEBRA

2 2 0 3

SYSTEM OF LINEAR EQUATIONS: Systems of linear equations – Row reduction and Echelon forms – Vector equations – The matrix equation $Ax = b$ – Solution sets of linear systems – Applications of linear systems **–**Linear models in business, science and engineering. (6+6)

VECTOR SPACES: Real vector spaces – Subspaces - Linear independence - Coordinates and basis - Dimension – Change of basis - Row space, column space, and null space – Rank and nullity. (6+6)

INNER PRODUCT SPACES: Inner products - Angle and orthogonality in inner product spaces - Gram- Schmidt process; QR-decomposition - Best approximation; Least squares. (6+6)

LINEAR TRANSFORMATIONS: Matrix transformations from R^n to R^m - Properties of matrix transformations – Geometry of matrix operators on R^2 - General linear transformations - Matrices for general linear transformations. (6+6)

EIGENVALUES, EIGEN VECTORS AND SINGULAR VALUE DECOMPOSITION: Eigen values and Eigen vectors – Diagonalization - Orthogonal matrices–Orthogonal diagonalization– Quadratic forms– Singular valued decomposition. (6+6)

Total:L30+T: 30=60

TEXT BOOKS:
1. David C Lay, Linear Algebra And Its Applications, Pearson,2020.
2. Howard Anton, “Elementary Linear Algebra”, John Wiley,2017.

REFERENCES:
1. Gilbert Strang, Linear Algebra and its Applications, Cengage, New Delhi, 2016
2. Gareth Williams, Linear Algebra with Applications, Narosa Publishing House, New Delhi, 2017.
3. Jeffrey Holt, Linear Algebra with Applications, W.H.Freeman and Company, New York, 2016.
4. Kenneth Hoffman and Ray Kunze, Linear Algebra, Pearson, 2015.

21S202 C PROGRAMMING

3 0 0 3

PROBLEM SOLVING AND C LANGUAGE FUNDAMENTALS: Analyzing and Defining the Problem- Modular Design – Algorithm - Flow Chart - Types of programming language- Program Development Environment - C character set - Identifiers and Keywords - Data Types - Constants - Variables - Arrays - Declarations - Expressions - Statements - Symbolic constants - Operators and Expressions - Library Functions - Data Input and Output Functions. (9)

CONTROL STATEMENTS: AND FUNCTIONS While Statement - Do While Statement – For Loop – Nested Loop - If Else - Switch - Break - Continue - Comma Operator – Goto Statement - Defining Function - Accessing a Function - Passing Arguments to Functions - Specifying Arguments Data Types - Function Prototypes - Storage Classes - Auto - Static - Extern and Register Variables. (9)

ARRAYS AND POINTERS: Defining Array – Processing array - Passing array to a function - Multi dimensional array - Array and strings- Pointer Declaration - Pointers to a function - Pointers and one dimensional arrays - Operating a pointer - Pointer and multi dimensional arrays - arrays of pointers - passing functions to other functions. (9)

STRUCTURES AND UNIONS: Definition of Structure and Union - Processing a structure – Bit field representations - Structures and pointers - Passing structure to functions - Self referential structures – Nested structure. (9)

FILES AND PREPROCESSOR DIRECTIVES: File Structure concepts introduction - Definitions, concept of record, file operations: Storing, creating, retrieving, updating Sequential, relative, indexed and random access mode, Files with binary mode(Low level), performance of Sequential Files – Operations on Files – Types of Files, Various input and output functions on Files -#include Preprocessor Directive - #define Preprocessor Directive - Symbolic Constants, Macros and Conditional Compilation. (9)

Total L: 45

TEXT BOOKS:
1. Brian W Kernighan and Dennis Ritchie, "C Programming Language ", Pearson Education India, 2015.
2. Deitel H. M. and Deitel P. J., "C How to Program with an introduction to C++**",** Pearson Education,2016.

REFERENCES:
1. Herbert Schildt, "C The Complete Reference", Tata McGraw Hill, 2017.
2. Gottfried Byron," Programming With C", Tata McGraw Hill, 2011
3. R G Dromey, 'How to solve it by Computer', Pearson 2008.
4. Peter Prinz and Tony Crawford, 'C in a Nutshell', O'Reilly, 2016.

21S203 MATHEMATICAL PHYSICS

2 2 0 3

CURVILINEAR COORDINATES: Orthogonal coordinates $\mathbb{R}^3$; concept of a metric, spherical and cylindrical coordinates and their unit vectors (5+5)

TENSOR ANALYSIS: Covariant and contravariant vectors, contraction, covariant, contravariant, and mixed tensors of rank-2, transformation properties. The metric tensor (flat space-time only). Raising and lowering of indices with metric tensors. (Consistent use of any one convention --- diag(-1,1,1,1) or diag(1,-1,-1,-1).) Example of common four-vectors: position, momentum, derivative, current density, four-velocity. (5+5)

MATRICES: Hermitian, adjoint and inverse of a matrix; Hermitian, orthogonal, and unitary matrices; Eigenvalue and eigenvector (for both degenerate and non-degenerate cases); Similarity transformation; diagonalisation of real symmetric matrices. (5+5)

SPECIAL FUNCTIONS: Bessel, Legendre -spherical harmonics, Hermite and Laguerre: generating functions and simple recurrence relations, orthonormality conditions, Dirac delta function. (6+6)

FOURIER SERIES: Periodic function, Orthogonality of sine and cosine functions, Dirichlet conditions. Expansion of periodic function in a series of sine and cosine functions and determination of Fourier coefficients. Expansion of non-periodic functions over an integral. Parseval Identity. (5+5)

THEORY OF ERRORS: Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error. (4+4)

Total L:30 + T:30= 60

TEXT BOOKS:
1. ArfkenG ,Weber H Jand Harris F E, "Mathematical Methods for Physicists", Academic Press, SanDiego, 2013.
2. SathyaPrakash, "Mathematical Physics", Sultan Chand & Sons, 2014.

REFERENCES:
1 P. K. Chattopadhyay. Mathematical Physics, New Age International(P) Ltd., 1990
2 Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 2015
3. L.A.Pipes, L.R.Harvill. Applied Mathematics for Physicists and Engineers, third edition, Dover Publications, New York, 2014.
4. Nazrulislam, "Tensors and their Applications", New Age International,2009.

21S204 OSCILLATIONS, WAVES AND OPTICS

3 0 0 3

OSCILLATORY MOTION-I: Review of simple harmonic motion- Differential equation and graphical representation of SHM – Average kinetic energy of a vibrating particle – Total energy of a vibrating particle – Oscillation with one degree of freedom – Linearity and superposition principle – SHM of a mass between two springs –SHM of a loaded spring. (9)

OSCILLATORY MOTION-II: Frequency response, phase response and resonance. Analogy with LCR circuits and oscillators. Energy and energy loss. Damped oscillations. Significance in control systems, vibration and vibration isolation. (8)

WAVE MOTION: Waves and their Properties, Longitudinal and Transverse Waves, Wavelength, Period, Frequency, Wave Speed and Wave Intensity. Attenuation of waves. Representation of waves using complex numbers. Phase velocity. Phase and phase difference. Differential equation of a plane progressive wave and solution. Importance of spherical and plane wave fronts. (9)

GEOMETRICAL OPTICS: Convex lens - Principal foci and principal points - Thick lens formula - Power of a thick lens - Optic centre of a lens - Spherical aberration and lenses - Methods of minimizing spherical aberration - Condition for minimum spherical aberration in the case of two lenses separated by a distance - Chromatic aberration in lenses - Condition for achromatism of two thin lenses (in contact and out of contact) - coma - astigmatism - Curvature of the field - Huygen's and Ramsden's eye pieces. (9)

PHYSICAL OPTICS: Interference- Interference in transmitted and reflected light, air wedge, thickness of a wire. Michelson interferometer: Description and theory. Diffraction - Plane diffraction grating. Rayleigh criterion- resolving power of grating and telescope. Polarization- double image polarizing prism, quarter and half wave plates. Elliptically and circularly polarized light, Laurentz half shade polarimeter – Fiber optics- Principle, modes of propagation, numerical aperture, Classification based on materials, refractive index profile and modes, Splicing, Losses in optical fiber, Fiber optic communication and endoscopy. (10)

Total L: 45

TEXT BOOKS:

1. David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of physics", 11 edition, Wiley, 2018.
2. Stephen G Lipson, Henry Lipson, "Optical Physics" Cambridge University press, 3 edition, 2004.

REFERENCES:

1. Subrahmanyam N, Brij lal, "waves and Oscillations, 2 edition, vikas, 2018.
2. Ajoy Gharak, "Optics", McGraw Hill, 7th edition, 2020.
3. Jewett, John W., Serway, Raymond A," Physics for Scientists and Engineers with Modern Physics", Cengage Learning, 2019.
4. Young H D, Freedman R A, "University Physics with Modern Physics", 15th editon, Pearson, 2020.

21S205 PHYSICAL CHEMISTRY II

2 2 0 3

ELECTROCHEMISTRY I: Mechanism of electrolysis. Electrical units. Faraday's first and second law - importance. Conductance of electrolytes - measurement of electrolytic conductance – determination of the cell constant. Arrhenius theory of ionization – migration of ions, relative speed of ions. Transport number – determination – Hittorf's method, moving boundary method. Kohlrausch's law – applications. Conductometric titration – significance. Ionic equilibria: Ostwald's dilution law – experimental verification, limitations. Theory of strong electrolytes – Ghosh's formula, Debye-Huckel theory, Debye-Huckel-Onsager equation. The conductance at high fields (Wien effect) and high frequencies (Debye-Falkenhagen effect). Degree of dissociation, the common-ion effect – factors influencing degree of dissociation. Solubility equilibria and the solubility product – applications of solubility product principle in qualitative analysis. (6+6)

ELECTROCHEMISTRY II: Electrochemical cells – cell potential or emf – calculation of emf of cell – measurement of emf of a cell – relation between emf and free energy. The Nernst equation – calculation of half-cell potential, cell potential, equilibrium constant. Calomel electrode, glass electrode, quinhydron electrode. Determination of pH using glass electrode. Potentiometric titrations – acid-base titrations, oxidation-reduction titrations, precipitation titrations. Overvoltage or overpotential – emf of concentration cell. Concentration cell with and without transference. Polarography. (6+6)

CHEMICAL KINETICS AND CATALYSIS: Chemical kinetics – Reactions of various order. Arrhenius equation; collision theory; transition state theory, Lindemann's hypothesis – derivation of rate constant for a bimolecular reaction. Chain reactions – normal and branched. Catalysis: General characteristics of catalytic reactions - homogenous and heterogeneous catalysis - acid base catalysis – mechanism and kinetics of enzyme catalyzed reactions – Michaelis-Menton equation and its significance. (6+6)

IONIC EQUILIBRIA AND SOLUTIONS: Acids and bases – Bronsted-Lowry concept, Lewis concept. – Relative strength – calculation of K_b. The pH of solutions – measurement. Buffer solution – buffer capacity. Acid-base indicators – choice of suitable indicators. Determination of degree of hydrolysis. Solutions: Henry's law – solution of liquids in liquids – solubility of completely miscible liquids and partially miscible liquids – phenol-water system, triethanolamine-water and nicotine-water systems. Vapour pressures of liquid-liquid solutions – azeotropes. Theory of fractional distillation, steam distillation. Solutions of solid in liquids – solubility-equilibrium concept – determination of solubility – solubility of solids in solids. Colligative properties – Raoult's law – derivation -lowering of vapour pressure – elevation of boiling point – determination of molecular mass – measurement of boiling point elevation – Landsberger-Walker method – Cottrell's method. Freezing point depression – determination of molecular weight – Beckmann's method, Rast's Camphor method – colligative properties of electrolytes. (6+6)

PHOTOCHEMISTRY: Photochemical reactions – difference between photochemical and thermochemical reactions. Thermopile – photoelectric cell. Chemical actinometer. Laws of photochemistry – Grothus-Draper law, Stark-Einstein law of photochemical equivalence – quantum yield – calculation of quantum yield. Photosensitized reactions, photo physical processes – fluorescence, phosphorescence, and chemiluminescence. (6+6)

Total L: 30 + T: 30 = 60

TEXT BOOKS:

1. Atkins P, de Paula J and Keeler J, "Atkins' physical chemistry", Oxford University press, 2017.
2. Levine I N, "Physical chemistry", McGraw-Hill education, 2014

REFERENCES:

1. Puri B R, Sharma L R and Pathania M S, "Principles of physical chemistry", Vishal publishing Co., 2020
2. Bahl B S, Bahl A and Tuli G D, "Essentials of physical chemistry", S. Chand & Co., 2020.
3. Glasstone S, "An introduction to electrochemistry", Maurice press, 2011.
4. Neeraj kumar, "Advanced problems in physical chemistry for competitive examinations", Pearson, 2015.

21S206 PROFESSIONAL ENGLISH

3 0 0 3

SOFT SKILLS: Process of Communication - Types: Intra & Interpersonal Communication, Cross – Cultural Communication - Barriers (6)

Verbal and Non-verbal Communication- Body language, Etiquette -Telephone conversation (4)

PRESENTATION SKILLS: Professional Presentation - Public Speaking - Group Communication -Case Study based Presentation- - Meetings - Interview Techniques (8)

READING SKILLS: Comprehension and Techniques for Good Comprehension – Focus on Syntax, Vocabulary use, Discourse Markers, and Variety of expression (6)

WRITING SKILLS: Professional Reports: Characteristics - Categories - Format and style and writing techniques, The 7Cs of Writing letters - Official and Business letters - Effective Email writing - Resume Writing practices (9)

PRACTICALS: Professional Presentations - Group Discussions and Meetings - Mock Interviews (12)

TOTAL HOURS: 45

TEXT BOOK

1. Meenakshi Raman, et al.,"Technical Communication:Principles and Practices", Oxford University Press, New Delhi, 2018

REFERENCES

1. Sabina Pillai & Agna Fernandez, "Soft Skills & Employability Skills", Cambridge University Press, New Delhi, 2018
2. Butterfield, Jeff, "Soft Skills for Everyone", Cengage Learning, Delhi, 2014.
3. Kumar, Satendra, "Professional Communication Skills", Yking Books, Jaipur, 2018.
4. Lina Muhkopadhyay, et al., "English for Jobseekers", Cambridge University Press, New Delhi, 2013.

21S207 OSCILLATIONS, WAVES AND OPTICS LABORATORY

0 0 4 2

1. Study of frequency of oscillation and determination of spring constant of spring-mass system.
2. Damped oscillations and resonance in RLC circuits – estimation of decay constant and damped oscillation frequency.
3. Determination of thickness of thin wire – air wedge.
4. Determination of resolving power of a plane diffraction grating.
5. Determination of refractive index – Brewster's law
6. Study of double refraction –calcite crystal.
7. Determination of refractive index of glass using diffraction grating.
8. Determination of wavelength and beam divergence of laser.

Total= P; 60

REFERENCE:

1. Laboratory manuals prepared by Department of Applied Science, PSG college of Technology, Coimbatore
   Arora C L, "Practical Physics", S. Chand, India

21S208 PHYSICAL CHEMISTRY LABORATORY

0 0 4 2

1. Determination of heat of neutralization of hydrochloric acid with sodium hydroxide.
2. Study of adsorption of oxalic acid on charcoal.
3. Construction of phase diagram for two-component simple eutectic system.
4. Determination of partition co-efficient of iodine between carbon tetrachloride and water.
5. Estimation of mixture of acids by conductometric method.
6. Estimation of ferrous ion by potentiometric method.
7. Estimation of a weak acid and determination of its dissociation constant by pH-metry.
8. Determination of cell constant of conductivity cell and solubility of a sparingly soluble salt by conductance measurements.
9. Determination of critical solution temperature (CST) of phenol-water system and study of effect of impurity.
10. Determination of rate constant of acid catalyzed hydrolysis of an ester.

Total P: 60

TEXT BOOKS:

1. Anand A and Rameshkumari, "Physical chemistry laboratory manual: An interdisciplinary approach", Wiley internationals, 2019.
2. Laboratory manual prepared by the department of applied science, 2021.

REFERENCES:
1. Rattan S, “Experiments in applied chemistry”, S.K. Kataria & sons, 2017.
2. Job G and Ruffler R, “Physical chemistry from a different angle”, Springer, 2016.
3. Garland C, Nibler J and Shoemaker D, “Experiments in physical chemistry”, McGraw Hill education, 2010.
4. Gupta and Renu, “Practical physical chemistry”, New age internationals, 2017.

21S209 C PROGRAMMING LABORATORY

0 0 4 2

1. Simple programs to understand the concepts of data types.
2. Familiarizing conditional, control and repetition statements.
3. Usage of single and double dimensional arrays including storage operations.
4. Implementation of functions, recursive functions.
5. Defining and handling structures, array of structures and union.
6. Implementation of pointers, operation on pointers dynamic storage allocation.
7. Creating and processing data files.

REFERENCES:
1. Yashavant Kanetkar, "Let us C", BPB Publication, 2017
2. Gottfried Byron,” Programming With C”, Tata McGraw Hill, 2010

SEMESTER III

21S301 REAL ANALYSIS

2 2 0 3

SEQUENCE: Sequence of real numbers, convergence of sequences, bounded and monotone sequences, convergence criteria for sequences of real numbers, Cauchy sequences, subsequences ,Bolzano-Weierstrass theorem. (6+6)

SERIES: Series of real numbers, absolute convergence, tests of convergence for series of positive terms – comparison test, ratio test, root test; Leibniz test for convergence of alternating series. (6+6)

METRIC SPACES: Metric spaces – open sets – Interior of a set – closed sets – closure – completeness – Cantor’s intersections theorem – Baire – Category theorem (6+6)

Continuity: Continuity of functions – Continuity of compositions of functions – Equivalentconditions for continuity – Algebra of continuous functions – homeomorphism – uniformcontinuity– connected subsets of R – Connectedness andcontinuity – Intermediate value theorem (6+6)

Compact: Compactness – open cover – compact metric spaces – Herni-Borel theorem - Compactness and continuity – continuous image of compact metric space is compact –Continuous function on a compact metric space in uniformly continuous – Equivalent formsof compactness – Every compact metric space is totally bounded – Bolano – Weierstrass property. (6+6)

Total: L30+T30 =60

TEXT BOOKS:
1. Richard R. Gold berg.” Methods of Real Analysis”, Oxford &IbhPubl, 2019.
2. Walter Rudin, “Principles of Mathematical Analysis”, Mc Graw Hill,2013.

REFERENCES:
1. Tom M Apostol, “Mathematical Analysis”, China Machine Press,2004
2. John M. Howie, “Real analysis”, Springer,2017.
3. Richard Johnsonbaugh, W.E. Pfaffenberger,” Foundations of Mathematical Analysis”,Dover Publications,2012.
4. RoberrtC.Bartle, Donald R.Sherbert,’ Introduction to Real Analysis’, John Wiley, 2014.

21S302 PROBABILITY AND STATISTICS

3 0 0 3

PROBABILITY AND RANDOM VARIABLES: Sample spaces and events - Interpretations and axioms of probability, Addition rules, Conditional probability, Multiplication and total probability rules, independence, Baye’s theorem, Random variables - Discrete random variables, Probability distributions andprobabilitymassfunctions,cumulativedistributionfunctions, Mean and variance of a discrete random variable (9)

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PROBABILITY DISTRIBUTIONS: Binomial, Poisson and Geometric distributions - Continuous random variables – Probability distributions and probabilitydensityfunctions, Cumulativedistributionfunctions,Mean and variance of continuous random variable, uniform, normal, and exponential distributions. (9)

Bivariate Distributions: Joint Probability mass functions -, Joint probability density functions - Independence of discrete

random variables - Independence of continuous random variables - Conditional Bi-variate Distributions (9)

ESTIMATION AND TESTS OF HYPOTHESES: Point estimation, Sampling distributions and the central limit theorem, General concepts of point estimation**-** Hypothesis testing, – testing of hypotheses for means – large, small samples and matched pairs tests – testing of hypotheses for proportions, chi square test for goodness of fit and independence of attributes. (9)

THE ANALYSIS OF VARIANCE: Designing engineering experiments, Completely randomized single-factor experiment, Randomized complete block design. (9)

TotalL: L:45

TEXT BOOKS:
1. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, Wiley India, Delhi,2019.
2. RichardA.Johnson,Miller&Freund"s,ProbabilityandStatisticsforEngineers,PrenticeHall,NewDelhi, 2018.

REFERENCES:
1. Saeed Ghahramani, Fundamentals of Probability with Stochastic Processes, Pearson2014.
2. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", Brooks/Cole, USA, 2015.
3. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, "Probability & Statistics for Engineers & Scientists, Pearson Education, New Delhi, 2016.
4. Sheldon M Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Academic press, USA, 2014.

21S303 ATOMIC AND NUCLEAR PHYSICS

3 0 0 3

ATOMIC STRUCTURE: Pauli's exclusion principle, explanation of periodic table – Vector atom model, various quantum numbers, angular momentum and magnetic moment – coupling schemes LS and JJ coupling, spatial quantization, Larmor precession, Bohr magnetron, Stern-Gerlach experiment. (9)

IONISATION POTENTIAL AND SPLITTING OF ENERGY LEVELS: Excitation and Ionization potential, Davis and Goucher's method, Zeeman effect –Larmor's theorem, Debye's explanation of normal Zemann effect, Anamalous Zeeman Effect, Lande's 'g' factor and explanation of splitting of D1 and D2 lines of sodium , Stark effect. (9)

X RAYS: X-ray – production, Auger effect, Polarisation of X-rays, Determination of the number of electron of atom,. Photoelectric effect, Moseley's law. Compton effect, Theory, experimental verification, pair production. (9)

NUCLEAR TRANSFORMATION: Radioactive decay, alpha, beta and gamma decay, half life, radioactive series, nuclear cross section, nuclear reactions, nuclear fission and nuclear fusion, nuclear reactors. Nuclear Detector: G-M counter, scintillation counter. (9)

ELEMENTARY PARTICLES: Interaction of charged particles, leptons and hadrons, elementary particle quantum number, quarks, fundamental interactions. (9)

Total L: 45

TEXT BOOKS:
1. Arthur Beiser, Shobhit Mahajan and Rai Choudhury S, "Concepts of Modern Physics", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2011.
2. Murugesan R and Kiruthica Sivaprasath,"Modern Physics", S Chand and Company Ltd, New Delhi, 2010.

REFERENCES:
1. Tayal D C, "Nuclear Physics", Himalaya Publishing House, Mumbai, 2012.
2. Bandevant J L, Michael Spiro and James Rich, "Fundamentals in NuclearPhysics: from Nuclear Matter to Fusion and Stellar Evaluation", Springer, 2005.
3. Raymond A Serway, Clement J Moses and Curt A Mayer "Modern Physics", Cengage Learning, 2005.
4. D.Griffiths, "IntroductiontoElementaryParticles",2ndEd.,Wily-Vch,2008

21S304 ELECTRICITY AND MAGNETISM

2 2 0 3

ELECTROSTATICS: Electric charge – Coulomb's law - Electric field - Electric field of a point charge- Electric dipole- Electric field lines and electric flux - Gauss law – Applying Gauss law in cylindrical symmetry, planar symmetry and spherical symmetry –Laplace equation- Electric potential- Applications of electrostatics: Xerography, Electrostatic painting, electrostatic actuators (6+6)

CAPACITORS AND ELECTRIC CIRCUITS : Electrostatic energy- Capacitance- Calculating the capacitance of A parallel plate capacitor, cylindrical capacitor and a spherical capacitor- Capacitance of capacitors in series and parallel – Energy stored

in an electric field- Capacitor with a Dielectric –Medical defibrillator- Electric current – Current density – Resistance and resistivity- Electric power- Electrical safety- Series and parallel resistors - Power in electric circuits (6+6)

MAGNETIC FIELDS: Magnetic force and field –Lorentz force – Charged particles in magnetic fields –Mass spectrometer - Force on charged particle in crossed fields - Cathode Ray Oscilloscope - Circular motion of charged particle – Cyclotron-Biot-Savart law, Ampere's law -Magnetic field of a solenoid and a toroid - Torque on a current loop in an external magnetic field. (6+6)

ELECTROMAGNETIC INDUCTION: Induced current- Faraday's law–Lenz law- Electric generator –Eddy current –Metal detector – Inductors and inductance – Inductance of a solenoid – Energy stored in a magnetic field - Self and Mutual induction - Principle of transformer (6+6)

ALTERNATING CURRENT CIRCUITS AND MAXWELL'S EQUATIONS: Alternating current – Circuit elements in AC circuits – Resistor, capacitor and inductor - LC, RC and RL circuits (qualitative only) – Simple RLC circuit – Displacement current – Gauss law for magnetic field - Maxwell's equations – Properties and production of electromagnetic waves – Energy transport and Poynting vector (6+6)

Total L: 30 + T: 30 = 60

TEXT BOOKS:

1. David Halliday, Robert Resnick, Jearl Walker, " Fundamentals of Physics", Wiley, United states, 2018
2. Richard Wolfson, " Essential university Physics" , Pearson, London, 2016,

REFERENCES:

1. Tewari K K, "Electricity and Magnetism", S. Chand and Co., 2011.
2. Gaur R K and Gupta S L, "Engineering Physics", Dhanpat Rai and Sons, 2012.
3. David. J Griffiths, " Introduction to Electrodynamics", 4th Edition, 2015, Pearson
4. Murugeshan R, " Electricity and magnetism", S. Chand and Co., 2018

21S305 ORGANIC CHEMISTRY I

2 2 0 3

BASIC CONCEPTS: Nomenclature of organic compound, IUPAC recommendations for naming simple aliphatic, alicyclic and aromatic compounds. Inductive, resonance, mesomeric, conjugation, electromeric and hypercojugative effects. Reactive intermediates: hemolytic and heterolytic cleavages-carbocations, carbanions, free radicals, nitrenes, benzynes, carbenes-stability, generation and fate. Aromataicity-huckel's rule-benzene and heterocyclic compounds. (6+6)

STEROCHEMISTRY-OPTICAL ISOMERISM: Stereoisomerism-definition-classification. Optical isomerism-optical activity-optical and specific rotations-conditions for optical activity-recemisation-methods of recemisation (by substitution and tautomerism) - resolution-methods of resolution (by mechanical, seeding, biochemical and conversion to diasteroisomers)-asymmetric synthesis (partial and absolute synthesis) - Walden inversion. Projection formulae-Fischer, flying wedge, Sawhorse and Newmann projection formulae- notation of optical isomers-Cahn-Ingold -Prelog rules. D/L and R/S nomenclature-erythro and thero representations. Optical activity in compounds without asymmetric carbon-biphenyls, allenes and spiranes. (6+6)

STEROCHEMISTRY-GEOMETRICAL ISOMERISM: Cis-Trans, Syn-anti and E-Z notations-geometrical isomerism in maleic and fumaric acids and unsymmetrical ketoximes-methods of distinguishing geometrical isomers using melting point, dipole moment, dehydration, cyclisation and heat of hydrogenation. Conformational analysis-introduction-formers, configuration, dihedral angel, torsional strain-conformational analysis of ethane and n-butane including energy diagrams-conformers of cyclohexane (chair boat and skew boat forms)-axial and equatorial. Bonds-ring flipping showing axial equatorial inter conversions-conformers of mono and substituted cyclohexanes-1:2 and 1:3 interactions. (6+6)

REACTION MECHANISM: Substitution reactions: Nucleophilic substitution-SN1 and SN2 Mechanisms. Aromatic electrophilic substitution: Nitration, sulphonation, Friedal-crafts alkylation and acylation. Addition reactions: Electrophilic addition to alkenes, dienes-Diel's–Alder reaction. Alkynes-acidity alkynes-formation of acetylides –addition of water with $HgSO_4$ catalyst. Markownikoff rule, peroxide effect, Nucleophilic addition to carbonyl group-cyanohydrin reaction, reduction with $LiAlH_4$, preparation of alkenes-Witting reaction, holoform reaction, Michael addition, Darzens reaction, Simmons-smith reaction, McMurry reaction, formation of Schiff base, aldol Condensation, Cannizzaro, Claisen-Schmidt, Reformatsky, benzoin condensation, Wolf-Kishner and MPV reduction. (6+6)

ELIMINATION AND REARRANGEMENT REACTIONS: E1 and E2 reactions-Hoffman and Saytzeff rules, dehydration of alcohols, dehydrohalogenation of alkyl halides. Molecular rearrangement reactions: Classifications –anisotropic, cationotropic and phototropic. Pinacol-pinacolone, dienone-phenol, Favorskii rearrangement, Wagner-Meerwein, Rearrangements to electron deficient nitrogen: Hofmann, Curtius and Beckmann (Mechanism only). Benzilic acid, schimidt, Lossen, Cope and Claisen rearrangements. Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation. Fries rearrangement. Reactive methylene compounds-malonic ester, acetoacetic ester and cyano acetic ester-preparation and synthetic applications. Tautomerism of acetoacetic ester. (6+6)

Total L: 30 + T: 30 = 60

TEXT BOOKS:

1. Morrison RT and Boyd RN "Organic Chemistry", Pearson education limited, Singapore, 2014.
2. Kalsi PS, "Stereochemistry conformation and Mechanism", Tenth Edition, New Age International Publishers, 2019

REFERENCES:
1. Bhal A and Bhal BS "Advanced Organic chemistry" S. Chand& company ltd., New Delhi, 2019.
2. T. W. Graham Solomons and Craig B. Fryhle, Scott A. Snyder, Organic Chemistry, Global Edition, 2017.
3. Smith MB and March J, "March's Advanced organic chemistry: Reactions, Mechanisms and Structure", John Wiley & Sons, 2016.
4. Tewari KS, Vishnoi NK and Mehrotra SN, A Text book of organic Chemistry, 2017

21S306 INORGANIC CHEMISTRY I

2 0 0 3

THEORIES OF CHEMICAL BONDINGS: Valence bond theory: Hybridization of atomic orbitals and molecular structure of the polyatomic molecules (sp, sp^2, sp^3, sp^3d, sp^3d^2 andsp^3d^3). Molecular orbital theory: Bonding and antibonding orbitals. MO diagrams of H_2, H_2^+,He_2, O_2, O_2^+, O_2^-, O_2^{2+}, N_2, F_2, CO and NO molecules and determination of bond order, magnetic and reactivity of molecules. Comparison of VB and MO bonding models. (9)

CONCEPTS OF ACIDS AND BASES: Arrhenius concept: Water system concept. Bronsted – Lowry concept: Protonic concept - Conjugate acid-base pairs -Amphiprotic substances; Levelling and differentiating solvents: LUX-Flood concept - solvent system concept - Lewis concept - Hard and Soft acids and bases - Pearson's concept - HSAB principle and it's a significance.(9)

NUCLEAR CHEMISTRY: Stability of the nuclei: Nuclear belt stability, magic numbers, packing fraction and nuclear binding energy curve - calculation of nuclear binding energy. Nuclear Reactions: Artificial radioactivity, transmutation of elements, fission, fusion and spallation. Nuclear energy and power generation - atomic power projects in India. Separation of radioactive isotopes. Radio chemical methods: principles of determination of age of rocks and minerals - radio carbon dating. (9)

COMPOUNDS OF BORON, CARBON, AND NITROGEN GROUP ELEMENTS: Boron sesquioxide, borates, borax, boron nitride, boranesand borohydrides. Carbon and silicon:Allotropes of carbon - structure and properties of graphite, diamond, fullerenes and carbon nanotubes. Silicatesand Silicones: Classification, structures and properties silicates – glass – silicones and silanes.Nitrogen and phosphorous:Nitrogen cycle- nitrogen activation – important hydrides, oxides and oxoacids of nitrogen and phosphorous. (9)

COMPOUNDS OF OXYGEN AND HALOGEN GROUP ELEMENTS: Types of oxides – oxygen and ozone. Important oxides and oxoacids of sulphur. Types of halides – important hydrides, oxides and oxyacids of halogens. Chemistry of bleaching powder and bleaching action. Interhalogen compounds (ClF_3& ICl preparation, properties, structure and uses only) and poly halides – pseudo halogens and pseudo halides. (9)

Total L: 45

TEXT BOOKS:
1. Lee J, "Concise ofInorganicChemistry", Blackwell Science, London, 2018.
2. Puri B R., Sharma L R and Kalia K C, "Principles of Inorganic chemistry," Vikas Publishing Co., 2017.

REFERENCES:
1. Arnikar, H.J., "Essentials of nuclear chemistry", New age international publishing limited, 2011.
2. Madan R D., "Modern Inorganic Chemistry", S.Chand & Company Ltd., New Delhi, 2008.
3. Soni P L., Mohan Katyal, "Text book of Inorganic Chemistry", Sultan Chand & Sons, New Delhi, 2007.
4. Shriver, D. F. and Atkins, P. W. "Inorganic Chemistry", W. H. Freeman and Co, London, 2009.

21S307 MATHEMATICAL COMPUTING LABORATORY

0 0 4 2

1. Plot 2D and 3Dfunctions.
2. Programs on differentiation andintegration.
3. Solving system of Linearequations.
4. Determination of Vector space under givenoperations.
5. Determination of linear independence and basis.
6. Finding Row space, Column space and nullspace.
7. ProgramsforLineartransformsonR2.
8. Covert a standard basis into an orthonormalbasis.
9. Compute Eigen values and Eigen bases for a givensystem.
10. Apply the orthogonal Diagonalization technique to reducing a Quadraticform.
11. ProgramsonsolvingdifferentialequationbyusingLaplacetransform
12. Finding Fourier series and Fourier transform for the givenfunctions

REFERENCES:
1. Stormy Attaway, MATLAB: A Practical Introduction to Programming and Problem Solving, Butterworth-Heinemann, 2018.
2. Amos Gilat , MATLAB: An Introduction with Applications, John Wiley & Sons Inc, 2016
3. Stephen J. Chapman, MATLAB Programming for Engineers, Cengage Learning, 2019

21S308 ELECTRICITY AND MAGNETISM LABORATORY

0 0 4 2

1 Determination of resistivity using Carey Foster bridge.
2 Determination of M and B for a bar magnet.
3 Determination of capacitance using LCR bridge.
4 Determination of figure of merit of a galvanometer.
5 Determination of magnetic field along the axis of a coil.
6 Determination of self-induction of a coil using Anderson's method.
7 Calibration of an ammeter and voltmeter (low range) using potentiometer.
8 Construction and study of thermoelectric thermometer using potentiometer.

Total P: 60

Reference books:
1. S. L. Gupta and V. Kumar, " Practical Physics- Volume I", Pragati Prakashan Publishers, India, 2017
2. Department manual, Department of Applied Science.

21S309 INROGANIC CHEMISTRY LABORATORY

0 0 4 2

I. **Inorganic qualitative analysis:**
Semi-micro analysis of inorganic mixture containing two cations and two anions (one of which will be an interfering ion).
Anions: Carbonate, sulphide, sulphate, chloride, nitrate, fluoride,borate, oxalate andphosphate.
Cations:Lead, copper, tin, cadmium, bismuth, aluminum, iron, manganese, zinc, cobalt, nickel, calcium, strontium, barium, magnesium and ammonium.

II.**Preparation of inorganic compounds:**
a)Mohr's salt b) Tetramine copper (II) sulphate c) Calcium tartrate tetrahydrate

III. **Inorganic quantitative analysis:** Estimation of nickel as Ni-DMG by gravimetric method.

Total P: 60

TEXT BOOKS:
1. Rao P and Haque MA, "Practical inorganic chemistry lab manual", Notion press, 2019.
2. Lab manual prepared by department of applied science.2021.

REFERENCE:
1. Venkateswaran V, Veeraswamy V, Kulandaivelu AR, "Basic principles of practical chemistry", Sultan Chand & sons, 2012.
2. Svehla G, Sivasankar B, "Vogels Inorganic qualitative Analysis", Pearson Education India, 2012
3. Nath M, "Inorganich chemistry: A laboratory manual", Alpha science international limited, 2016.
4. Girolami GS, Rouchfess TB and Angelici RJ, "Synthesis and technique in inorganic chemistry: A laboratory manual", Wiley, 2018.

SEMESTER IV

21S401 COMPLEX VARIABLES AND TRANSFORMS

2 2 0 3

COMPLEX VARIABLES: Derivative – Analytic function - Cauchy - Riemann equations – Laplaces equations (6+6)

COMPLEX INTEGRATION: Line integral in the complex plane - Cauchy's integral theorem - Cauchy's integral formula - Laurent series - Singularities and zeros - Residue integration method. (6+6)

LAPLACE TRANSFORMS: Laplace transform – Linearity – First shifting theorem - Transforms of derivatives and integrals – ODEs - Unit step function – Second shifting theorem – Short impulses - Dirac's delta function – Partial fractions - Convolution – Integral equations - Differentiation and integration of transforms – ODEs with variable coefficients – Systems of ODEs (6+6)

FOURIER ANALYSIS: Fourier series –Arbitrary period – Even and odd functions - Half range expansions. Fourier integral - Fourier cosine and sine transforms- Fourier transform. (6+6)

Z-TRANSFORM: Introduction of Z-transform, Inverse transform, difference equation, application of Z-transform to solve difference equations. (6+6)

Total L: 30+ T:30 =60

TEXT BOOKS:
1. ErwinKreyszig,"AdvancedEngineering Mathematics", JohnWiley and Sons,2019.
2. Wylie C. R. and Barrett L. C., "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.

REFERENCES:
1. Dennis G Zill and Patrick D Shanahan, "A first course in Complex Analysis with applications", Jones and Bartlett Pvt Ltd, New Delhi, 2015.
2. Mathews J H and Howell R W, "Complex Analysis for Mathematics and Engineering", Narosa Publishing House, New Delhi, 2012.
3. Peter V.O Neil, "Advanced Engineering Mathematics", Cengage, New Delhi, 2016.
4. Dennis G Zill, "Advanced Engineering Mathematics", Jones & Bartlett Pvt Ltd, New Delhi, 2017

21S402 DATA STRUCTURES

2 2 0 3

INTRODUCTION: Data Structures,Abstract Data Types,PrimitiveDataStructures,Algorithmanalysis,Asymptotic Notations. Arrays**:** Operations, Implementation of Single and Multi dimensional arrays, Sparse Matrices - Operations and applications. (6+6)

STACKS AND QUEUES: Primitive Operations, Array Implementation , Applications: Infix, Postfix and Prefix Expressions,,Evaluation, Recursion –Towers of Hanoi - Primitive Operations , Array Implementation , Circular queues , Dequeues, PriorityQueues- Applications (6+6)

LISTS: SinglyLinkedList,Operations,LinkedImplementationofStacks,Queues,CircularLists,DoubleLinkedLists,Operations, Applications. (6+6)

TREES : Binary Trees , Operations , Threaded Binary Tree , Tree Traversals. Applications: The expression tree and Huffman Algorithm. (6+6)

SORTING & SEARCHING: Insertion sort, Selection sort, Bubble sort, Heap sort, Quick sort, Merge sort. Linear search,Binarysearch. (6+6)

TotalL:30+T:30=60

TEXT BOOKS:
1. Robert Kruse, C.L Tondo and Bruce Leung, "Data structures and Program design in C", Pearson Education,2013.
2. Aaron M Tanenbaum, Moshe J Augenstein and YedidyahLangsam, "Data Structures using C and C++", Pearson Education, 2012.

REFERENCES:
1. SahniSartaj , "Data Structures , Algorithms and Applications in C++", Silicon Press.,2011.
2. Mark Allen Weiss , " Data Structures and Algorithm Analysis in C", Pearson Education,2014.
3. Tremblay and Sorenson, "An Introduction to Data Structures with Applications", McGraw Hill Education, 2017.
4. Michael T. Goodrich, Roberto Tamassia and David Mount, 'Data Structures and Algorithms in C++', John Wiley, 2011.

21S403 ANALOG AND DIGITAL ELECTRONICS

3 0 0 3

P-N JUNCTIONS: Semiconductor basics, Diode theory, forward and reverse-biased junctions, reverse-bias breakdown, applications of pn junction diode - Limiters, clippers, clampers, voltage multipliers, rectifiers, half wave & full wave rectification, Zener diode, Zener voltage regulators, IC regulators. (9)

BIPOLAR JUNCTION TRANSISTORS (BJT): Transistor fundamentals and its types, transistor configurations, characteristics in CB, CE, CC modes, DC operating point, Bipolar Junction Transistor characteristics & parameters, fixed bias, potential divider lines bias with and without emitter bias, Single stage RC coupled amplifier, Transistor Oscillator**,** Astable Multivibrator. (9)

FIELD-EFFECT TRANSISTORS (FET) : Static Characteristics of a FET, JFET-working principles-JFET as an amplifier-current-voltage characteristic, parameters of JFET. MOSFET – Depletion, Enhancement modes - MOSFET as Switch, UJT, SCR - Construction, working, V-I characteristic (9)

OPERATIONAL AMPLIFIERS (Op Amp): Op-Amp Basics, Ideal characteristics of Op-Amp, practical Op-Amp circuits, differential and common mode operation, Inverting & Non-Inverting Amplifier, Op-Amp as Adder, Subtractor, Integrator and Differentiator. (9)

DIGITAL ELECTRONICS: Number systems - Decimal, binary, octal, hexadecimal,and interconversion, excess three codes, Gray codes, 1^s and 2^s complement codes, binary arithmetic. Boolean relations - Laws and theorems - Simplifications – Sum of Products, Product of Sum, Karnaugh maps, two, threeand four variable, Logic gates, Combinational logics circuits. (9)

Total L : 45

TEXT BOOKS:
1. Paul Horowitz & Winfield Hill, Cambridge University Press, 2016
2. V.K Mehta&Rohit Mehta " Principles of Electronics" S.Chand & Company., 2010.

REFERENCES:
1. Malvino. A.P.and Leach DP, "Digital Principles & Applications", Tata McGraw Hill,Delhi 2011.
2. Thomas L. Floyd, "Digital Fundamentals", Pearson Company Ltd., 11th Edition 2015.
3. Jacob Millman and Christos C Halkias, 'Electron Devices', Mc Graw Hill Publishing Co., 3rd Edition 2010.
4. Robert F.Coughlin, Frederick. F. Driscoll, "Operational Amplifier and Linear ICs", Prentice Hall of India, 6th Edition 2012.

21S404 MECHANICS AND THEORY OF RELATIVITY

2 2 0 3

PROJECTILE, IMPULSE & IMPACT PROJECTILE: Path of a projectile, Range on a inclined plane, Impulse-Impact – Impulsive force –Laws of impact –Impact of a smooth sphere on a horizontal plane –Direct & oblique impact –Loss of kinetic energy –Motion of two interacting bodies. (6+6)

ANGULAR MOMENTUM AND FIXED AXIS ROTATION: Introduction, Angular momentum of a particle, sliding block and conical pendulum, Fixed axis rotation - moment of inertia, parallel axis theorem, Torque, torque and angular momentum, dynamics of fixed axis rotation, pendulum motion and fixed axis rotation, motion involving translation and rotation, torque on a moving body, work energy theorem and rotational motion. (6+6)

RIGID BODY MOTION: Introduction, vector nature of angular velocity and angular momentum, Gyroscope – examples of rigid body motion, conservation of angular momentum, angular momentum and the tensor of inertia, principle axis, rotational kinetic energy of a rigid body, rotation about a fixed point, torque-free precession – the earth wobbles. (6+6)

GRAVITATION AND CENTER OF GRAVITY: Newton's law of gravitation –Gravitational potential and Field due to a spherical shell –Determination of G Boy's method –C.G. of solid cone and tetrahedron –C.G. of arc and sector of a circle. (6+6)

THEORY OF RELATIVITY: Galilean-Newtonian relativity, Galilean frames formations-Michelson Morley. Experiment and its importance –Einstein's postulates –Lorentz transformation, Lorentz - Fitzgerald contraction –, time dilation, Relativity of space and time –Addition of velocities –Variation of Mass with velocity –Mass-Energy equivalence-Physical significance. (6+6)

Total L:30 +T:30=60

TEXT BOOKS:
1. David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of physics", 11 edition, Wiley, 2018.
2. Kleppner D, Kolenkow R, "An Introduction to Mechanics, 2 edition, Cambridge University press, 2013.

REFERENCES:
1. Mathur D S, "Mechanics" S.Chand & Company Ltd, New Delhi, 1990.
2. R.Resnick, "Introduction to Special Relativity", John Wiley and Sons, 2005.
3. Jewett, John W., Serway, Raymond A," Physics for Scientists and Engineers with Modern Physics", Cengage Learning,2019.
4. Young H D, Freedman R A, "University Physics with Modern Physics", 15th editon, Pearson, 2020.

21S405 ORGANIC CHEMISTRY II

3 0 0 3

CARBOHYDRATES: Classification- constitution of glucose and fructose. Reactions of glucose and fructose-osazone formation. Mutarotation and its mechanism. Cyclic structure. Determination of ring size. Haworth projection formula, configuration of monosaccharaides, epimerization, chain lengthening and chain shortening of aldoses. Inter conversion of aldoses and ketoses. Disaccharides- reactions and structure of sucrose. Structure and properties of starch and cellulose.(6+6)

HETEROCYCLIC COMPOUNDS: Aromaticity of heterocyclic compounds-preparation, properties and uses of pyrrole, furan and thiophene-synthesis, reactions of pyridine and piperidine-comparative study of basicity of pyrrole, pyridine and piperidine with amines. Synthesis and reactions of quinolone, isoquinoline and indole with special reference to Skraup. Bischler-Napieralski and Fisher indole synthesis. Preparation of pyrazoles and imidazoles. (6+6)

AMINO ACIDS AND PEROTEINS: Classification of amino acids. Essential and nonessential amino acids, preparation of alpha amino acids, properties and reactions. Zwitter ions, isoelectric points-peptide synthesis- structure determination of polypeptides and group analysis. Proteins-classification based on physical and chemical properties and on physiological functions primary and secondary structure of proteins. Helical and sheet structures (elementary treatment only). Denaturation of proteins, nucleic acids-types-RNA and DNA, polynucleotide chain components-biological functions-synthesis of purines, pyrimidines and nucleotides. (6+6)

TERPENES, ALKALOIDS AND VITAMINES: Terpenes-isoprene rule. Structural elucidation- geraniol, menthol and alpha terpineol. Alkaloids-general methods of isolation. Structure determinations of conine, piperine and nicotine. Vitamins-

Classification-structural elucidation of pyridoxine and ascorbic acid. (6+6)

DYES AND PHOTOCHEMISTRY: Dyes-theory of colour and constitution. Preparation and uses of i) azo dye-methyl orange, ii) triphenyl methane dyes-malachite green, iii) phthalein dye-phenolphthalein, iv) vat dye-indigo and v) anthraquinone dye-alizarin. Fluorescent brightening agents. Organic photochemistry-photochemical elimination reduction, oxidation, Cis-trans isomerization reactions. Concerted intermolecular cyclo-additions. (6+6)

Total L: 30 + T: 30 = 60

TEXT BOOKS:
1. Finar IL, Organic chemistry, "Vol I and Vol II, Pearson education limited, Singapore, 2013.
2. Bhal A and Bhal BS "Advanced Organic chemistry" S. Chand & company ltd., New Delhi, 2019.

REFERENCE:
1. Tewari KS, Vishnoi NK and Mehrotra SN, A Text book of organic chemistry, Vikas Publishing house, New Delhi, 2017
2. Clyden J, Greeves N & Warren S, "Organic Chemistry", Oxford publishing, 2014.
3. Morrison RT and Boyd RN, "Organic Chemistry", Pearson education limited, Singapore, 2014.
4. Soni PL and Chawla HM, " A text book of organic chemistry" Sultan Chand and sons, New Delhi, 2012

21S406 INORGANIC CHEMISTRY II

3 0 0 3

COORDINATION CHEMISTRY: Introduction - Double salts and coordination compounds. Ligands types and chelation effect. IUPAC nomenclature of coordination complexes. Theories of the coordination complexes: Werner theory and Sidgwick's theory – EAN rule and stability of complex.Valence bond theory-hybridization and geometry of inner and outer orbitals complexes. Crystal field theory - crystal field effects, crystal field splitting in octahedral and tetrahedral, high-spin and low-spin complexes, crystal field stabilization energy (CFSE), factors influencing the magnitude of crystal field splitting, spectrochemical series. Applications of crystal field theory - colour and magnetic properties of complexes. John-Teller theorem. (9)

ISOMERISMS AND SYNTHESIS OF COORDINATION COMPOUNDS: Isomerism in coordination complexes: ionization, hydrate, linkage, linkage and coordination isomerisms. Stereoisomerisms: Geometrical and optical isomerism in four and six coordinated complexes. Trans effect: Trans effect series – Ligand substitution reactions in square planar complexes – uses of Trans effect. (9)

BIOINORGANIC CHEMISTRY AND METAL CARBONYL - METAL NITROSYL CHEMISTRY: Essentials and trace elements of life; basic reactions in the biological systems and the role of metal ions,especially Fe^{2+}, Fe^{3+}, Cu^{2+}, and Zn^{2+}.Structure and functions ofHemoglobin and myoglobin–carbon monoxide poisoning. Metal enzyme: structure and function of carbonic anhydrase. Synthesis, structure and bonding of Ni $(CO)_4$, $Fe(CO)_5$ and sodium nitroprusside. (9)

SOLID STATE CHEMISTRY:Crystalline and amorphous solids, crystal system, Bravais lattice, unit cell, law of rationalindices (Weiss indices) Miller indices, Symmetry elements in crystals (for cubic system only in detail).X-ray diffraction by crystals - derivation of Bragg's equation - Bragg method -powder method. Crystal structure of NaCl, CsCl, Wurzite, CaF_2 and TiO_2- radius ratio rules and packing in crystals. (9)

TRANSITION AND INNER TRANSITION ELEMENTS: General characteristics of transition and inner transition elements. Metallurgical processes: Types of ores – concentration of ores, calcinations, roasting, reduction and refining of metals. Extraction of Ti, Fe and W from its ores. Chemistry of extraction of thorium and uranium. Alloying of metals: substitutional and interstitial alloy- Hume Rothery rules. (9)

Total L: 45

TEXT BOOKS:
1. House JE, "Inorganic chemistry", Academic press Elseiver, 2010.
2. Sudarsan Guha , J. D. Lee, Wiley India Pvt. Ltd., Year: 2019

REFERENCES:
1. Huheey, J. E., Kieter, E. A and Keiter, R. L., "Inorganic Chemistry", Pearson Education, 2006.
2. Madan R D., "Modern Inorganic Chemistry", S.Chand & Company Ltd., New Delhi, 2008.
3. Puri B R., Sharma L R and Kalia K C, "Principles of Inorganic chemistry," Vishal Publishing Co., 2013
4. Sodhi, G.S., "Textbook of inorganic chemistry", Viva books, 2013.

21S407 ANALOG AND DIGITAL ELECTRONICS LABORATORY

0 0 4 2

1. Diode and Zener characteristics – DC load line analysis.
2. Regulated power supply using Zener diode and IC regulator.
3. BJT and FET characteristics.
4. Single stage RC amplifier.
5. Multivibrator – Astable using BJT.
6. UJT and its characteristics.

7. SCR and its characteristics.
8. Operational amplifier (741) - inverting and non-inverting modes, integrator and differentiator.
9. Study of basic Logic gates and realization of logic gates using universal gates.
10. Half and full adder, Half and full subtractor.

TEXT BOOKS / MANUAL:
1. Analog and Digital Electronic Laboratory manuals, Department of Applied Science, PSG college of Technology, Coimbatore

21S408 ORGANIC CHEMISTRY LABORATORY

0 0 4 2

I. **Qualitative analysis of an organic compounds**:
   a. Characterization of functional groups
   b. Confirmation by preparation of solid derivatives/characteristic colour reactions.
II. **Preparation of organic compounds (single stage only):**
   a. Preparation of methyl orange.
   b. Preparation of aspirin.
   c. Preparation of soap/hand rub sanitizer.
III. **Determination of melting point of organic compounds.**

Total P: 60

TEXT BOOKS:
1. Isac-Gracia J Dobado JA, Calvo Fores and Martinex Grazia H, “Experimental organic chemistry”, Elsevier, 2016.
2. Lab manual prepared by the department of applied science, 2021.

REFERENCE:
1. Mumtazuddin S, “Organic chemistry: A laboratory manual”, Alpha science, 2014.
2. Ahuluwalia VK, Bhagat P and Aggarwal P, “Laboratory techniques in organic chemistry”, IK international publishing house, 2014.
3. Sethi A, “Systematic lab experiments in organic chemistry”, New age internationals, 2010.
4. Hart H, Craine LE,Hart D and Vinod TK, “Laboratory manual organic chemistry a short course”, Houghton Mifflin, 2006.

SEMESTER V

21S501 OPERATIONS RESEARCH

2 2 0 3

LINEAR PROGRAMMING: Formulation of Linear programming problem- Graphical method – central problems of Linear Programming – Definitions –SimplexAlgorithm –Artificialstartssolution:M-method,twophaseSimplexMethod. (6+6)

Duality and Post-Optimal Analysis: Definition of the Dual problem - Dual and Primal relationships – Economic interpretation of Duality - Dual Simplex Method – Sensitivity Analysis: Change in the righthandside (6+6)

Transportation Model: Definition of the Transportation model - Transportation problem and its solution by Modi method – Assignment problem and its solution byHungarianmethod. (6+6)

CPM AND PERT: Calculations of critical path on networks, various floats for activities, critical path, time estimates, earliest expected time, latest allowable occurrence time and slack of events, calculations of critical path on PERT networks, probability of meeting scheduled date of completion of project.- Linear programming formulationofCPM. (6+6)

DYNAMIC PROGRAMMING: Introduction- Recursive nature of computations in dynamic programming- Forward and Backward recursion - Tabular method of solution, for deterministic dynamic programming problem – Short route in network- Cargo loading problems - linear programmingproblems. (6+6)

Total L: 30 + T:30 = 60

TEXT BOOKS:
1. F.Hillier and G.J.Lieberman, “ Introduction to Operations Research”, McGraw Hill,New Delhi,2018.
2. HamdyA.Taha, “Operations Research - An Introduction”, Pearson, New Delhi,2018.

REFERENCES:
1. Ravindran, Phillips,Solberg,”Operations Research: Principles and Practice”, wiley 2007.
2. Michael W. Carter, Camille C. PriceOperations ResearchA Practical Introduction, CRC press 2017.
3. Singiresu S Rao, “Engineering Optimization Theory and Practice”, New Age International, New Delhi,2016.
4. Kambo N S, “Mathematical Programming Techniques”, East-West Press, 2012.

21S502 ABSTRACT ALGEBRA

2 2 0 3

GROUP THEORY: Definition of a group – Some examples of groups – Some preliminary lemmas – Subgroups – A counting principle. (6+6)

GROUP HOMOMORPHISM: Normal subgroups – Quotient groups – Homomorphism – Automorphism – Cayley'stheorem – permutation groups. . (6+6)

GROUPS AND CODING: Coding of Binary information and error detection – Group codes – Deciding anderror correction (6+6)

RING THEORY : Definition and examples of Rings – Some special classes of Rings – Homomorphisms – Ideals and Quotient Rings - Ring of Quaternions (6+6)

EUCLIDEAN RING: Euclidean rings – A particular Euclidean ring - Polynomials Rings – Polynomials over the Rational field – Polynomial Rings over commutative Rings. (6+6)

TotalL:30+T: 30=60

TEXT BOOKS:
1. Herstein I N., "Topics in Algebra", Wiley,2017.
2. Joseph A. Gallian, "Contemporary Abstract Algebra", CRC Press,2021.

REFERENCES:
1. Artin,M.,Algebra, Pearson,2015.
2. Dummit, D. S. and Foote, R. M., Abstract Algebra, Wiley,2011.
3. W. Keith Nicholson , Introduction to Abstract Algebra, John Wiley & Sons,2012
4. Ron M. Roth, "Introduction to Coding Theory", Cambridge University Press, 2016.

21S503 SOLID STATE PHYSICS

3 0 0 3

CRYSTAL PHYSICS: Distinction Lattice points and Space lattice, Basis and Crystal structure, Unit cell and Primitive cell, Lattice parameters, Crystal systems and Crystal symmetry, Space groups, Bravais space lattice, packing density, relation between density of materials and lattice constants in a cubic lattice, Directions, Planes and Miller Indices,Linear and Planar density, Imperfections in crystals, (9)

MECHANICAL PROPERTIES: Atomic model of **e**lastic behaviour, Rubber like elasticity, Viscoelastic behaviour- Spring and Dashpot model, Plastic deformation- Tensile stress strain curve, Plastic deformation by slip, Shear strength of perfect and real crystals, Stress to move a dislocation, Factors affecting strength of a material, Strengthening Mechanisms, Creep-Mechanism, creep resistant materials, Fatigue fracture (9)

ELECTRICAL PROPERTIES OF METALS: Classical free electron theory, drawbacks. Quantum free electron theory. Fermi-Dirac statistics and electronic distribution in solids, Density of energy states and Fermi energy, Fermi distribution function, Electrical conductivity from quantum mechanical considerations, electron scattering and sources of resistance in metals, Band theory of solids, Electron in a periodic field of a crystal (Kronig-Penney model -rigorous derivation not included), Brillouin zones, Distinction between metals, Insulators and Intrinsic Semiconductors. Hall Effect. (9)

MAGNETIC MATERIALS AND SUPERCONDUCTIVITY: Origin of magnetism, Diamagnetism and Paramagnetism, Susceptibilities of dia and para magnetic materials, Ferromagnetism,Spontaneous magnetization in ferromagnetic materials, Curie-Weiss law, Internal field and exchange interaction, Domain theory, Hysteresis, Hard and soft magnetic materials and applications, Antiferromagnetism, Ferrimagnetism- structure and applications.Superconductors,BCS theory, Effects of magnetic field, Critical currents, Isotope effect, Mechanical effect, Josephson Tunnelling, Applications. (9)

DIELECTRIC MATERIALS: Qualitative study of various polarization mechanism, Clausius-Mosotti Relation, The static dielectric constants of solids and liquids, Effect of temperature and frequency on dielectric constant. Dielectric loss. Breakdown mechanisms., ferroelectric materials, piezoelectric materials, applications of ferroelectric and piezoelectric materials. (9)

Total L : 45

TEXT BOOKS:
1. Charles Kittel, Introduction to Solid State Physics", John Wiley & Sons , 2018.
2. S.O. Pillai, "Solid State Physics", New Age International Publishers, New Delhi, 2020.

REFERENCES:
1. William D. Callister Jr., David G. Rethwisch, "Materials Science and Engineering: An Introduction", John Wiley & Sons, USA, 2018.
2. V.Raghavan, "Materials Science and Engineering: A First Course" , PHI Learning Private Limited, Delhi, 2015.
3. A,J.Dekker, " Solid state Physics", Prentice Hall, 1970.
4. N. W. *Ashcroft*, N. D. ***Mermin*** Holt, "Solid State Physics", Rinehart and Winston, New York, 1976.

21S504 QUANTUM MECHANICS

2 2 0 3

ORIGIN OF THE QUANTUM THEORY: Limitation of classical physics- Planck`s quantum hypothesis- Einstein`s theory of photoelectric effect t- Compton effect- quantum theory of specific heat - Bohr theory of Hydrogen atom- existence of stationary states - the correspondence principle- The Stern – Gerlach experiment - Inadequacy of quantum theory (6+6)

WAVE MECHANICAL CONCEPTS: De Broglie waves – Waves of probability – General formula for waves – the principle of superposition-wave packet - Group and phase velocities – Electron microscope- Particle diffraction – Davisson – Germer experiment - The uncertainty principle – Applying the uncertainty principle (6+6)

GENRAL FORMALISM OF QUANTUM MECHANICS: Linear operator – Eigenfunction and eigenvalues - Hermitian operator- postulates of quantum mechanics - simultaneous measurability of observables- Interpretation of wave function - commutative properties, Operator for Momentum, Kinetic Energy and Total Energy – Postulates of Quantum Mechanics - Expectation value of physical variable (6+6)

SCHRODINGER WAVEEQUATION: Time dependent Schrödinger equation and time independent Schrödinger equation. Solution of time independent Schrödinger equation for simple quantum mechanical systems: Particle in one, two and three dimensional box, One dimensional harmonic oscillator (Assuming $H_n(y)$ for various states), discussion of the eigen values and eigen states, Quantum tunneling- transmission and reflection coefficient. (6+6)

QUANTUM THEORY OF THE HYDROGEN ATOM: Schrodinger's equation for the hydrogen atom- Separation of variables - Quantum numbers – Orbital quantum number – Magnetic quantum number – Zeeman effect – Electron spin – Spin- orbit coupling – Total angular momentum (6+6)

Total L: 30 +T: 30=60

TEXT BOOKS:

1. Arthur Beiser, Shobhit Mahajan, S Rai Choudhary, "Concepts of Modern Physics", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2016.
2. Aruldhas G, "Quantum Mechanics", PHI learning Pvt Ltd., New Delhi, 2009.

REFERENCES:

1. B. H. Bransden, C. J. Joachain, "Quantum Mechanics", Pearson, London, 2004.
2. R Murugesan , "Modern Physics", S.Chand and Co , 2016
3. J.L. Powell and B. Crasemann, "Quantum Mechanics" , Dover publications, United states of America , 2015.
4. P.M.Mathews and K.Venkatesa, " A Text book of Quantum Mechanics" , Tata Mc Graw Hill India Pvt Ltd., India, 2010

21S505 APPLIED CHEMISTRY

3 0 0 3

FUELS AND EXPLOSIVES: Solid fuels– types, Analysis of coal - proximate and ultimate analysis and their importance - ASTM classification. GCV and NCV – determination by bomb calorimeter, Dulong's formula, fluidized bed combustion, HTC and LTC cokes -Otto-Hoffmann by-product oven method. Liquid fuels – crude oil - principles of petroleum refining – synthetic oils – Bergius process, knocking in petrol engines – octane number – its improvement – cetane number – significance. Calculation of theoretical air for combustion.Gaseous fuels – natural gas as fuel, other carbon based fuel gases, explosion limit. Explosives: Characteristics – classification – oxygen balance – rocket propellants. (9)

CORROSION AND PREVENTION: Chemical and electrochemical corrosion – mechanisms, Types of electrochemical corrosion. Factors influencing corrosion. Corrosion prevention and control - material selection and design - cathodic protection – sacrificial anode and impressed current method - corrosion inhibitors. Electroplating of metals and alloys – electroplating of Cu, Ni, and Cr and its applications. Anodising – characteristics of anodic film in aluminium – industrial applications. (9)

LUBRICANTS, OILS AND PAINTS: Tribology – classification of lubricants - mechanism of lubrication – viscosity, viscosity index, flash and fire points – oiliness – cloud and pour points – aniline point (determination not included) – lubricants additives.Greases – types and uses. Solid lubricants – graphite and MoS_2. Synthetic lubricants. Oils: Chemical constituents – distinction between oils and fats, chemical analysis of oils and fats – acid, saponification and iodine values – definitions, determination and its significance. Paints: Constituents and their functions – drying mechanism. Emulsion paints – special paints: Luminescent paints, water repellent paints, heat resistant paints, fire retardant paints and acid resistant paints. (9)

INDUSTRIALLY IMPORTANT MATERIALS: Polymers – introduction, degree of polymerization - molecular weight, classification of polymers. Thermoplastics and thermosetting plastics. Properties and uses of PVC, Teflon, polycarbonates, polyurethane, thermocole and Nylon. Compounding of plastics. Moulding methods – compression, injection, extrusion and blow moulding. Abrasives – classification, important abrasives and its uses. Refractories – classification, properties and uses. Adhesives – adhesive action – factors influencing adhesive action. (9)

WATER CHEMISTRY: Water quality parameters **-** hardness – types - estimation of hardness by EDTA method, alkalinity, DO, COD and BOD – significance.Boiler feed water – scale, sludge, priming and foaming, boiler corrosion, and caustic embrittlement. Principles of internal conditioning – phosphate, calgon and carbonate conditioning. External conditioning – removal of oils and silica, zeolite and demineralization process. Desalination, electrodialysis and reverse osmosis. Requisites of

potable water – municipal water treatment. Disinfection of water - removal of micro-organisms - break point chlorination, ozonisation and UV treatment. (9)

Total L: 45

TEXT BOOKS:
1. Roussak O V and Gesser, H D, "Applied chemistry: A textbook for engineers and technologists", Springer, London, 2016.
2. Kuriacose JC and Rajaram J, "Chemistry in engineering and technology", Vol I & II, Tata McGraw Hill, 2016.

REFERENCES:
1. Acharya A & Samantray B, "Textbook on applied chemistry", Pearson, New Delhi, 2016.
2. Sharma,BK, "Industrial chemistry", Goel publishing house, Meerut. 2014.
3. Gowarikar VR, Viswanathan NV and Sreedhar. J., "Polymer Science", New Age International (P) Ltd., New Delhi, 2003.
4. Gesser H D, "Applied chemistry: A textbook for engineers and technologists", Kluwer publishing, Newyork, 2008.

21S506 ANALYTICAL CHEMISTRY

2 2 0 3

ULTRA VIOLET–VISIBLE SPECTROSCOPY: Nature of electronic excitations – Beer–Lambert's law - origin of UV band structure – principle of absorption spectroscopy. Instrumentation – presentation of spectra, solvents – chromophores – conjugation. The Woodward-Fieser rule – alkenes, dienes, and carbonyl compounds. Visible spectra – colour in compounds. (6+6)

INFRARED AND RAMAN SPECTROSCOPY: The infrared absorption process – uses of infrared spectrum. The modes of stretching and bending, bond properties and absorption trends. The infrared spectrometer – dispersive infrared spectrometers, Fourier Transform spectrometers. Preparation of sample for infrared spectroscopy – correlation charts and tables – method of analyzing a spectrum. Hydrocarbons, aromatic rings, alcohols and phenols, ethers, carbonyl compounds, amines, nitrocompounds, alkyl and aryl halides. Raman spectroscopy – Rayleigh and Raman scattering – selection rule – Raman shift – stokes and anti-stokes lines. Differences between Raman and IR spectroscopy. Advantages of using laser in Raman spectroscopy – applications. (6+6)

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY: Nuclear spin states, nuclear magnetic moments, absorption of energy – the mechanism of absorption – population densities of nuclear spin states – the chemical shift and shielding. The nuclear magnetic resonance spectrometer – the continuous wave (CW) instrument, the pulsed Fourier Transform (FT) instrument. Chemical equivalence, integrals and integration. Chemical environment and chemical shift. Local diamagnetic shielding – electronegativity effects, hybridization effects, acidic and exchangeable protons: hydrogen binding. Magnetic anisotropy, spin-spin splitting (n+1) rule – origin of spin-spin splitting – the ethyl group. Pascal's triangle, the coupling constant. A comparison of NMR spectra at low and high field strengths. ^{1}H NMR absorption spectra – hydrocarbons, alkyl halides, alcohols, ethers, amines, aldehydes, ketones, esters, carboxylic acids, amides, nitro alkanes. (6+6)

MASS SPECTROMETRY: The mass spectrometer, gas chromatography-mass spectrometry, the mass spectrum, determination of molecular weight. Determination of molecular formulas – metastable ion peak – precise mass determination – nitrogen rule, isotope ratio data. Fragmentation patterns – alkanes, cycloalkanes, alkenes, alkynes, aromatic hydrocarbons, alcohols, phenols, ethers, aldehydes, ketones, esters, carboxylic acids, amines. (6+6)

CHROMATOGRAPHIC TECHNIQUES: Separation techniques – principle, classification. Column chromatography - principle, types of adsorbents, preparation of the column, elution, and recovery of substances - applications. Thin layer chromatography - principle, choice of adsorbent and solvent, preparation of chromatoplates, Rf values - factors affecting the Rf values - significance. Ion exchange chromatography - principle, resins used, action of resins - applications. Paper electrophoresis - separation of amino acids - applications. High pressure liquid chromatography (HPLC) - Principle, instrumentation - applications. (6+6)

Total L: 30 + T: 30 = 60

TEXT BOOKS:
1. Pavia D L, Lampman G M, Kriz G S and Vyvyan J A, "Introduction to spectroscopy", Cengage learning India private limited, 2018.
2. Field L D, Li H L, Magill A M, "Organic structures from spectra", Wiley, 2020.

REFERENCES:
1. Sharma Y R, "Elementary organic spectroscopy", S.Chand & Company Ltd., New Delhi, 2018.
2. Holler J F, Crouch SR, "Skoog West Fundamentals of Analytical Chemistry", Cengage learning, New York, 2013.
3. Vitha M F, "Chromatography principle and instrumentation", Wiley, 2016
4. Khopkar S M, "Basic concepts of analytical chemistry", New Age Publications, New Delhi, 2009.

21S507 SOLID STATE PHYSICS LABORATORY

0 0 4 2

1. Determination of lattice constant - Analysis of powder diffraction pattern.
2. Determination of Hall Coefficient of a semiconductor crystal

3. Determination of resistivity of metallic and alloy wire-Carey Foster's Bridge.
4. Band Gap determination of Germanium – Reverse saturation current.
5. Magnetic hysteresis-Determination of hysteresis loss.
6. Susceptibility of a paramagnetic sample using Quinck's tube method.
7. Determination of dielectric constant of a dielectric solid.
8. Determination of dielectric constant of a dielectric liquid.
9. Determination of tensile strength of a material
10. Determination of shear strength of a material

Total = P: 60

REFERENCE:
1. Solid State Physics Laboratory Manual prepared by Department of Applied Science, PSG College of Technology, Coimbatore

21S0508 APPLIED CHEMISTRY LABORATORY

0 0 4 2

1. Estimation of total, temporary, permanent, calcium and magnesium hardness of water.
2. Determination of different types of alkalinities, TDS, pH and conductivity of water sample.
3. Determination of available chlorine in commercial bleaching powder.
4. Determination of percentage of moisture and ash content of a coal sample.
5. Determination of acid, saponification andiodine values of an oil sample.
6. Study of viscosity of lubricating oil using Saybolt / Redwood viscometer.
7. Determination of corrosion rate and inhibitor efficiency of mild steel in acid media by weight loss method.
8. Industrial electrochemical processes:
    i. Anodising of aluminium and determination of thickness of anodic film.
    ii. Electroplating of nickel and determination of cathodic efficiency.
9. Estimation of iron by photocolorimetry and sodium by flame photometry.
10. Chromatographic separation of plant pigments.

Total P: 60

TEXT BOOKS:
1. Corwin C, "Laboratory manual: Introductory chemistry concepts and critical thinking", Pearson, 2019.
2. Laboratory manual prepared by the department of applied science. 2021.

REFERENCES:
1. Beran JA, "Laboratory manual for principles of general chemistry", John Wiley & sons, 2014.
2. Venkateswaran V, Veeraswamy V, Kulandaivelu AR, "Basic principles of practical chemistry", Sultan Chand & sons, 2012.
3. Williamson V and Peck L, "Experiments in general chemistry: Inquiry and skill building", Cole internationsl, 2017.
4. Brescia F, Arents J, Meislich H, Turk A and Weiner E, "Fundamentals of chemistry laboratory studies", academic press, London, 2012.

SEMESTER VI

21S601 ENVIRONMENTAL SCIENCE

3 0 0 3

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES: Definition of environment-scope and importance of environmental studies. Forest resources: Uses and overexploitation of forest – deforestation. Water resources: water footprint -use and over utilization of surface and ground water – conflicts over water – dams-benefits and problems. Land resource: Land degradation – soil erosion – desertification -waste land reclamation. Energy resources: Growing energy needs – renewable and non renewable energy resources – alternate energy resources .Role of an individual in conservation of natural resources. (12)

ECOSYSTEM AND BIODIVERSITY: Concept of ecosystem– food chain and food web – energy flow –characteristic features, structure and function of the forest, grassland and aquatic ecosystem. Biodiversity – types, values and threats to biodiversity – conservation of biodiversity. (9)

ENVIRONMENTAL POLLUTION: .Definition – causes, types and effects of air pollutants on materials, plants, animals and humans- control methods. Water pollution - sources - classification of pollutants - effects of water pollution. Composition of domestic and industrial waste water. Waste water analysis – Self purification of rivers – Standards for discharge of effluents into water bodies – Waste water treatment methods. Thermal pollution – causes and control methods. Soil pollution – causes, effects and control methods. Solid waste Management – types, causes and effects. Solid waste disposal methods. Definition – causes, effects and control methods of noise and marine pollution. (12)

SOCIAL ISSUES AND THE ENVIRONMENT: Population growth, variation among nations – population explosion.From unsustainable to sustainable development – Sustainable Development Goals-Urban problem related to energy - water conservation, rain water harvesting –water shed management. Environmental ethics – issues and possible solutions. Global

warming, green house effects, ozone layer depletion, climate change and acid rain. Human health and environment. Process of EIA - ISO 14000 - environment protection act. (12)

Total L : 45

TEXT BOOKS:
1. Girrad, J., "Principles of environmental chemistry", Jones & Bartlett learning, 2014.
2. Deswal. S. and Deswal. A., "An introduction to environmental science", Dhanpat Rai & Co Pvt. Ltd.2006.

REFERENCES:
1. Rao, M.V.R.K., "Energy resources: conventional & non-conventional "BSP publications, 2006.
2. Masters. G.M., "Introduction to environmental engineering and science", Prentice hall of India, 2004
3. Sethi M. S., "Environmental chemistry", Shri sai printographers, New Delhi, 2012.
4. De, A.K., "Environmental chemistry", New age publications (Academic), India. 2010.

PROFESSIONAL ELECTIVES (PE)

MATHEMATICS AND COMPUTER SCIENCE CLUSTER

21S001 NUMERICAL METHODS

3 0 0 3

LINEAR ALGEBRAIC EQUATIONS: Errors, approximations and round-off errors - truncation errors **-** Gauss-elimination method, Crout,s method, Gauss–Seidel method, eigenvalues and eigenvectors - power method. (9)

NONLINEAR EQUATIONS: False-position method, Newton-Raphson method, Bairstow's method. (9)

INTERPOLATION, DIFFERENTIATION AND INTEGRATION: Lagrange interpolating polynomials, equally spaced data – Newton's forward and backward interpolating polynomials, numerical differentiation – evenly spaced data, numerical integration – Newton -Cotes formulae, Trapezoidal rule, Simpson's rules. (9)

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS: Taylor-series method, Euler method, 4th order Runge-Kutta method, multi step method – Milne's method. (9)

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS: Finite difference: elliptic equations - Laplace equation, Poisson equation – Liebmann's method, parabolic equations – heat conduction equation – Crank Nicolson's method, hyperbolic equations – vibrating string. (9)

Total L = 45

TEXT BOOKS
1. Steven C Chapra and Raymond P Canale, Numerical Methods for Engineers, McGraw Hill Education, New Delhi, 2018.
2. Curtis F Gerald and Patrick O Wheatly, Applied Numerical Analysis, Pearson Education, New Delhi, 2017.

REFERENCES
1. Richard L Burden and Douglas J Faires, "Numerical Analysis", Thomas Learning, New York, 2017.
2. G. Miller, "Numerical Analysis for Engineers and Scientists", Cambridge University Press, UK, 2014.
3. Amos Gilat and Vish Subramaniam, "Numerical Methods for Engineers and Scientists", Wiley India, New Delhi 2014.
4. Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Cengage learning, USA, 2018

21S002 GRAPH THEORY

3 0 0 3

INTRODUCTION TO GRAPH MODELS: Graphs and digraphs - degree sequence, handshaking lemma, Havel-Hakimi theorem (statement and concepts) - Common families of graphs, Graph modeling applications - Walks and distance – paths cycles and trees - Graph isomorphism – Subgraphs - Matrix Representations – adjacency and incidence matrices. (9)

TREES and SPANNING TREES: Characterizations and properties of trees – Rooted trees, ordered trees, and binary trees – counting labeled trees - Cayley's formula - Matrix tree theorem (statement and problems only). Depth-first and breadth-first search, minimum spanning tree – Prim's and Kruskal's algorithms, shortest-path problem – Dijkstra's algorithm. (9)

EULERIAN AND HAMILTONIAN GRAPHS: Eulerian graphs – Konigsberg bridge problem; Eulerian tour algorithm, characterization of Eulerian graph, optimal postman tour. Hamiltonian graphs - non Hamiltonian graphs, sufficient conditions for Hamiltonian graphs (only statements and concepts).Travelling salesman problem - nearest neighbor algorithm. (9)

GRAPH COLORING: Vertex-colorings – minimization problem for vertex-colorings – modeling applications as vertex-coloring problems - sequential vertex coloring algorithm - chromatic number of a graph, Brooks's theorem - largest degree first algorithm, applications - scheduling problem, assignment of radio frequencies, fast register allocation for computer

programming. (9)

NETWORK FLOWS AND APPLICATIONS: Flows and cuts in networks, solving the maximum - flow problem – characterization of maximum flow (Max-flow Min-cut Theorem), algorithms – outline for maximum flow, finding an augmenting path, FFEK – maximum flow and examples. (9)

Total L: 45

TEXTBOOKS
1. Jonathan L. Gross and Jay Yellen, Graph Theory and its Applications, CRC Press, New York, 2018.
2. Douglas B West, Graph Theory, Prentice Hall, New Delhi, 2018.

REFERENCES
1. Robin J Wilson, Introduction to Graph theory, Prentice Hall, 2010.
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall, New Delhi 2018.
3. Fred Buckley, Marty Lewinter, A friendly introduction to graph theory, Pearson, 2002.
4. Gary Chatrand, Linda Lesniak, Ping Zhang, Graphs and Digraphs, Chapman and Hall/CRC, 2015.

21S003 DISCRETE MATHEMATICS

3 0 0 3

MATHEMATICAL LOGIC: Propositional Logic- propositional equivalences- predicates and quantifiers- rules of inference- normal forms. (9)

PROOF TECHNIQUES: Introduction to proofs – Proof methods and strategy, Mathematical induction – Strong induction and well ordering. (9)

RELATIONS: Relations and their properties – n-ary relations and their properties - representing relations - equivalence relations- partial orderings. (9)

COUNTING TECHNIQUES: The basis of counting - The pigeonhole principle - Permutations and combinations Binomial coefficients, Generalized permutations and combinations - Generating permutations and combinations. (9)

ADVANCED COUNTING TECHNIQUES: Recurrence Relations - Solving linear recurrence relations – Divide and conquer algorithms and recurrence relations. (9)

Total L : 45

TEXT BOOKS:
1. Kenneth H Rosen and Kamala Krithivasan, “Discrete Mathematics and its Applications”, Tata McGraw Hill, 2018.
2. TremblayJPandManoharR,“DiscreteMathematicalstructureswithapplicationtoComputerScience”,TataMcGrawHill,2017.

REFERENCES:
1. Ralph P Grimaldi, “Discrete and Combinatorial Mathematics - An Applied Introduction”, Pearson, Addison Wesley, 2017.
2. Herstein I N, “Topics In Algebra”, Wiley India, New Delhi, 2017.
3. Bernard Kolman, Robert C Busby and Sharon Cutler Ross, “Discrete Mathematical Structures”, Prentice Hall, 2015.
4. Liu C.L, Mohapatra D.P, “Elements of Discrete Mathematics: A computer oriented approach”, Tata McGraw Hill, 2017

21S004 OPTIMIZATION TECHNIQUES

3 0 0 3

CLASSICAL OPTIMIZATION TECHNIQUES: Introduction - Single -Variable Optimization - Multivariable Optimization with no Constraints - Multivariable Optimization with Equality Constraints: Solution by Direct Substitution, Solution by the Method of Constrained Variation, Solution by the Method of Lagrange Multipliers- Multivariable Optimization with Inequality Constraints: Kuhn–Tucker Conditions, ConstraintQualification- ConvexProgrammingProblem. (9)

NONLINEAR PROGRAMMING ONE-DIMENSIONAL MINIMIZATION METHOD: Introduction - Unimodal Function – Elimination methods: Unrestricted Search - Exhaustive Search - Interval Halving Method - Fibonacci Method - Golden SectionMethod. (9)

NONLINEAR PROGRAMMING UNCONSTRAINED OPTIMIZATION TECHNIQUES: Introduction - Direct Search Methods: Univariate Method, Powell"s Method - Indirect Search Methods: Steepest Descent (Cauchy) Method, Conjugate Gradient (Fletcher–Reeves) Method. (9)

Integer Linear programming: Introduction – types of integer programming problems - Integer programming algorithms: Branch and bound algorithm, Cutting Plane algorithm – Traveling Salesperson problem: Branch and bound algorithm, Cutting Plane algorithm (9)

DECISION ANALYSIS AND GAME THEORY: Decision making under Risk**:** Decision Tree based expected value criterion, Variations of the expectedvaluecriterion–Decisionunderuncertainty – Gametheory:Optimalsolutionoftwo-personzero-sum games, solutions of mixed strategy games. (9)

TEXT BOOKS:
1. HamdyA.Taha, "Operations Research - An Introduction", Pearson, New Delhi,2018.
2. Singiresu S Rao, "Engineering Optimization Theory and Practice", New Age International, New Delhi,2016

REFERENCES:
1. Ravindran, Phillips,Solberg, Operations Research: Principles and Practice, wiley , 2007.
2. Michael W. Carter, Camille C. PriceOperations ResearchA Practical Introduction, CRC press 2017.
3. F.Hillier and G.J.Lieberman, " Introduction to Operations Research", McGraw Hill, New Delhi,2018.
4. Kambo N S, "Mathematical Programming Techniques", East-West Press, 2012.

21S005 STOCHASTIC PROCESSES

3 0 0 3

Stochastic Process: Introduction – Classification of Stochastic Processes – Markov Chain: Introduction -Transition Probability Matrices – Chapman Kolmogorov Equations - Classification of States – Limit Theorems – Branching Processes – Time Reversible Markov chains – Markov Decision Processes - Applications. (9)

Continuous Time Markov Chains: Introduction – Poisson Process - Birth and Death Processes – Kolmogorov Differential Equations – Pure Birth Process - Pure Death Process - Applications. (9)

RENEWAL THEORY: Introduction – Distribution - Renewal Theorems - Residual and Excess Life Times -Alternating Renewal Process - Renewal Reward Processes – Regenerative Processes. (9)

GENERAL QUEUEING MODELS: Single and Multiserver Poisson Queues - Single Server Queue with Poisson input and general service M / G/1 – General input and exponential service – G/M/1 Queueing model. (9)

Brownian motion: First passage time distribution – The maximum of a Brownian motion – The zeros of Brownian motion – Brownian motion with drift – GeometricBrownianmotion. (9)

Total L:45

TEXT BOOKS:
1. Roy D Yates and David J Goodman, "Probability and Stochastic Processes – A friendly Introduction for Electrical and Computer Engineers", John Wiley, 2014.
2. Sheldon M Ross, "Introduction to Probability Models", Academic Press, 2014.

REFERENCES:
1. Sheldon M Ross, "Stochastic Processes", John Wiley, 2008..
2. Roy D.Yates and David J Goodman, Probability and Stochastic Processes – A friendly Introduction for Electrical and Computer Engineers, John Wiley & Sons, New Delhi, 2014.
3. Medhi J, Stochastic Processes, New age international publishers, 2014.
4. Saeed Ghahramani, Fundamentals of probability with Stochastic processes, Pearson,2014.

21S005 MACHINE LEARNING

3 0 0 3

INTRODUCTION: Machine learning – Types – Supervised learning, unsupervised, Reinforcement learning, semi supervised learning - Regression – Linear – Polynomial – Multiple regression – Evaluation measures – Bias –variance – over fitting – under fitting – Regularization (9)

CLASSIFICATION: Maximum Likelihood Estimation – Maximum a Posteriori – Multivariate methods – naive Bayes' classifier – k nearest neighbour classifier - Linear classification - Optimization - Loss functions for classification and regression - Gradient descent – variants – Logistic regression –– Perceptron - Support Vector Machines – Linear, Soft margin (9)

DECISION TREES : Introduction – Purity measures – Entropy, cross entropy, information gain, gain ratio, Gini Index – ID3 – Regression trees - Pruning – Model selection – Bootstrapping and cross validation – Model evaluation – Performance Measures –Receiveroperatingcharacteristic curve (ROC) (9)

UNSUPERVISED LEARNING : Clustering –Types - K-means – EM - Mixture of Gaussians – Cluster validity measures – Applications : image segmentation – Image compression –Outlier analysis (9)

N**EURAL NETWORKS** : Multilayer perceptron - Back propagation – Training - DIMENSIONALITY REDUCTION: Classification- linear discriminant analysis – Unsupervised learning:Principal components analysis (9)

Total L: 45

TEXT BOOKS:
1. Christopher M Bishop, "Pattern Recognition and Machine Learning", Springer, 2016.
2. Alpaydin Ethem, "Introduction to Machine Learning", MIT press, 2020.

REFERENCES:
1. David Barber, “Machine Learning: A Probabilistic Approach”, http://www.idiap.ch/~barber, 2006.
2. Trevor Hastie, Robert Tibshirani and Jerome Friedman, “The Elements of Statistical Learning”, Springer, 2013.
3. Richard O Duda, Peter E Hart and David G Stork, “Pattern Classification (Digitized)”, John Wiley, 2012.
4. Yoshua Bengio, Learning Deep Architectures for AI, Foundations & Trends in Machine Learning, 2009.

21S007 ARTIFICIAL INTELLIGENCE

3 0 0 3

INTRODUCTION: The foundations of AI - The History of AI - Intelligent agents - Agent based system- Problem solving**:** State Space models - Searching for solution - Uninformed/Blind search - Informed/ Heuristic search - A* search - Hill-climbing search - Meta Heuristic: Genetic Algorithm - Adversary based search : Minimax – Expectimax – Alpha Beta pruning – Constraint satisfaction problem - Backtracking search (9)

KNOWLEDGE REPRESENTATION AND REASONING: Knowledge representation - Logic - inference - Fuzzy logic: membership - Fuzzy rules and reasoning - Fuzzy inference (9)

UNCERTAIN KNOWLEDGE AND PROBABILISTIC REASONING: Uncertainty - Probabilistic reasoning - Semantics of Bayesian network - Exact inference in Bayesian network- Approximate inference in Bayesian network - Dynamic Bayesian Networks (9)

DECISION-MAKING: Basics of utility theory, Utility functions - Sequential decision problems - Markov decision process - Value iteration - Policy iteration - Decisions in Multi agent system: Multi agent decision theory - Group decision making. (9)

LEARNING: Learning from observation – Supervised Learning - Unsupervised - Reinforcement learning. Robotics - Introduction. (9)

Total L: 45

TEXT BOOKS:
1. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Pearson Education, 2020.
2. David Pool and Alan Mackworth, “Artificial Intelligence: Foundations of Computational agents”, Cambridge University Press, 2017.

REFERENCES:
1. Christopher M.Bishop, “Pattern Recognition and Machine Learning”, Springer, 2013.
2. Nils J. Nilsson, “The Quest for Artificial Intelligence: A History of Ideas and achievements”, Cambridge University Press, 2010.
3. Daphne Koller and N Friedman, “Probabilistic Graphical Models - Principles and Techniques”, MIT press, 2009.
4. Tsang and Edward, “Foundations of Constraint Satisfaction: The Classic Text”, BoD–Books on Demand, 2014.

21S008 CYBER SECURITY

3 0 0 3

FOUNDATIONS OF CYBER SECURITY CONCEPTS: Security concepts –Threats- Attacks, Services and Mechanisms - attacks and defenses on Computer systems – Counter measures. Cyber Threats- Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage. CRYPTOGRAPHY AND CRYPTANALYSIS:Introduction to cryptography, Basic encryption and decryption – Substitution, Transposition - Data Encryption Standard (DES). Public key cryptosystem: RSA cryptosystem –El Gamal cryptosystem- Key management – Difference–Hellman Key exchange- Digital Signatures-Digital signature standard(DSS). (9)

PROGRAM SECURITY: Secure Programs, non malicious program errors – Buffer overflows – Malware – viruses and other malicious code – Targeted Malicious code –Defense Mechanism. (9)

OS SECURITY: Memory and Address protection – Access Control –file protection mechanisms –User authentication –models of security –Trusted OS design. (9)

NETWORK SECURITY: Security at application layer: email security – PGP – key rings – PGP certificates. Security at transport layer: SSL protocol. Security at network layer: firewalls – intrusion detection system – IPsec (9)

WEB SECURITY: Overview, various types of web application vulnerabilities, Reconnaissance, Authentication, Authorization (Fuzzing and Privilege Escalation), Session Management, Cross Site Scripting (XSS),Cross Site Request Forgery (CSRF), SQL Injection and Blind SQL Injection. (9)

Total L: 45

TEXT BOOKS:
1. Charles P Fleeger, Shari Lawrence P Fleeger, “Security in Computing”, Pearson Education, 2004.
2. Behrouz A Forouzan, DebdeepMukhopadhyay, “Cryptography and Network Security”, Tata Mc-Graw Hill, 2017.

REFRENCES:
1. William Stallings, "Cryptography and Network Security",7th Edition, Prentice Hall, 2017
2. Roberta Bragg, Mark Rhodes, Keith Strass Berg J, "Network Security- The Complete Reference", Tata McGraw Hill, 2006.
3. Brian Sullivan, Vincent Liu, "Web Application security: A beginner's guide, Tata McGraw Hill, 2012.
4. Jacobs Jay and Bob Rudis, "Data Driven Security Analysis, Visualization, and Dashboards", John Wiley & Sons, 2014.

21S009 NUMBER THEORY

3 0 0 3

THE FUNDAMENTAL THEOREM OF ARITHMETIC : Introduction –Divisibility-Greatest common divisor-Prime numbers-The fundamental theorem of arithmetic-The Euclidean algorithm- Least Common Multiple - Linear DiophantineEquations (9)

CONGRUENCES: Definition and basic properties of congruences - Linear Congruences - Congruence Applications**-** Divisibility Tests- Modular Designs**-**CheckDigits. (9)

SIMULTANEOUSLINEARCONGRUENCES-TheChineseremaindertheorem**-**Wilson'sTheorem-Fermat'sLittleTheorem-Euler'sTheorem. (9)

ARITHMETICALFUNCTIONS:Introduction-TheMobiusfunction$\mu(n)$–TheEulertotientfunction$\varphi(n)$– Arelationconnectingφandμ-A productformulafor$\varphi(n)$–TheDirichleproductofarithmeticalfunctions. (9)

QUADRATIC CONGRUENCES : Quadratic Residues- The Legendre Symbol , Quadratic Reciprocity- TheJacobiSymbol (9)

Total L:45

TEXT BOOKS:
1. Thomas koshy, "Elementary Number Theory with Applications" ,Academic Press,2007.
2. K.C Chowdhury , "First Course in Number Theory", Asian Books Pvt Ltd,2012.

REFERENCES:
1. Kenneth H Rosen, "Elementary Number Theory And Its Applications" , Addison-Wesley,2005.
2. Tom M. Apostol, "Introduction to Analytic Number Theory" , Narosa Publishing House1998
3. Victor Shoup, "A Computational introduction to Number Theory and Algebra", Cambridge university Press,2009.

PHYSICS CLUSTER

21S016 LASER PHYSICS AND APPLICATIONS

3 0 0 3

LASER INTRODUCTION: Quantum transitions in absorption and emission of light: Energy levels of atoms and molecules, spontaneous and stimulated emission. Active medium, Population inversion. Pumping mechanisms, Einstein's coefficients and relation. Three level and Four level laser systems. Optical amplifier, resonator cavity and various types. (12)

LASER CHARACTERISTICS: Basic characteristics, Spatial and temporal coherence, Beam quality and output characteristics. Beam divergence and focusing using optical system. Types of laser based on output beam: continuous, pulsed lasers, ultra short pulses. (10)

GAS AND LIQUID LASERS: He-Ne Laser, CO_2 laser, Excimer and dye laser, construction, energy level diagram, excitation mechanisms and output characteristics. (8)

SOLID STATE LASERS: Introduction, Nd: Glass, Nd: YAG laser and semiconductor diode lasers, construction, energy level diagram, excitation mechanisms and output characteristics. (8)

LASER APPLICATIONS: Industrial applications: laser welding, laser heat treatment, laser cutting and drilling. Holography: Holography in data storing systems. Lasers in communication, Lasers in medicine, Laser in Ranging and Measurement. (7)

Total L: 45

TEXT BOOKS:
1. Principles of Lasers, Orazio Svelto, Springer Science & Business Media, 2010.
2. Laser Physics, Simon Hooker and Colin Webb, Oxford, 2010.

REFERENCES:
1. Laser Physics and Applications, Tarasov L, Mir Publishers, 1986.
2. Application of Laser and Laser Systems, AlenShotwell, Prentice Hall, 1993
3. Lasers and Non-Linear Optics, Laud B B, Wiley-Eastern Ltd., 2000.
4. Laser Physics, P. W. Milonni, J. W. Eberly; John Wiley and Sons, 2010

21S017 SEMICONDUCTOR PHYSICS AND DEVICES

3 0 0 3

ELECTRICAL CONDUCTION: Band theory of solids- allowed and forbidden energy bands- formation of bands. The Kronig - Penney model -the k-space diagram. Electrical charge carriers in semiconductors- electrons and holes. The E-k diagram. Electron effective mass. Holes in semiconductors (9)

STATISTICAL THERMODYNAMICS: The density of states function - mathematical derivation – application to semiconductors. Fermi Dirac distribution and the Fermi level, charge carriers concentration in intrinsic semiconductors - equilibrium distribution of electrons and holes. Fermi level in intrinsic semiconductors. (9)

EXTRINSIC SEMICONDUCTORS: Dopant atoms and ionization energies -group III and V semiconductors- equilibrium distribution of electrons and holes – degenerate and non degenerate semiconductors. Complete ionization of donor and acceptor states. Compensated semiconductors – equilibrium electron and hole concentrations. Position of Fermi level – variation with doping concentration and temperature. (9)

CHARGE CARRIER TRANSPORT: Drift current density, mobility and conductivity. Velocity saturation. Diffusion current density, total current density. Graded impurity distribution-induced electric field. The Einstein relation. Hall effect. (9)

SEMICONDUCTOR DEVICES: Physics of pn junction diode under forward and reverse bias. The Bipolar Junction Transistor Biasing of the junctions - minority carrier injection and current gain. The Junction Field Effect Transistor (JFET) – construction and mechanism of operation. The Metal Oxide Semiconductor Field Effect Transistor (MOSFET) – construction and mechanism of operation. (9)

Total L: 45

TEXT BOOKS

1. Donald A N eaman, “Semiconductor physics and Devices- Fourth edition, McGraw Hill, India, 2017.
2. Jyoti Prasad Banerjee, Suranjana Banerjee, “Physics of Semiconductors and Nanostructures”, CRC Press, USA, 2019.

REFERENCES:

1. Jacob Millman, “Integrated Electronics”, Tata McGraw Hill Publishing Co. Ltd., 2002.
2. Sze,S.M., “Semiconductor Devices – Physics and Technology”, John Wiley and Sons, 2002.
3. Jasprit Singh “Semiconductor Devices -Basic principles” - John Wiley and Sons ,USA, 2007.

21S018 HEAT AND THERMODYNAMICS

3 0 0 3

3D HEAT FLOW: Differential equation for three-dimensional heat flow. Solution of differential equation, thermal conductivity tensor. Anisotropic thermal conductivity in materials. Temperature distribution. point and planar heat sources. Applications to anisotropic and isotropic media. (9)

HEAT AND INTERNAL ENERGY: Heat capacity, specific heat capacity. Decline of the caloric theory of heat. Difference between thermal equilibrium and steady state. Work and energy. Internal energy and the first law of thermodynamics. Applications to ideal gases. Equations of state. (9)

ENTROPY AND SECOND LAW OF THERMODYNAMICS: Statistical view of entropy. Entropy and disorder. Free energy and material equilibrium, Phase equilibrium. Driving force in phase transitions. Super-saturation and super-cooling. Nucleation and crystal growth. Applications to spherical and cylindrical nuclei , calculation of critical size of nuclei (9)

PHASE TRANSITIONS IN SOLIDS: First and second order transitions-examples. Free energy of transitions. Allotropy and polymorphism. Thermodynamics of solid-state phase transitions -enthalpy, entropy and free energy changes. Solid state transitions in quartz and barium titanate. Free energy and nucleation. Glass transitions. Stability of phases. (9)

REAL GASES: Behavior of Real Gases- Deviations from the ideal gas equation. The Virial equation. Andrew’s eon CO_2 gas. Critical constants. Continuity of liquid and gaseous state. Vapour and gas. Boyle Temperature. Van der Waal’s equation of state for real gases. Values of critical constants. Law of corresponding states. Role of carbon dioxide in green chemistry. (9)

Total L : 45

TEXT BOOKS:

1. Ira N. Levin,”Physical Chemistry”, McGraw Hill Education, 2011
2. C. N. R. Rao and K. J. Rao,” Phase transitions in solids “, McGraw-Hill New York,1978

REFERENCES:

1. R A Swalin,”Thermodynamics of Solids”, Wiley-VCH, 1972.
2. Mark Waldo Zemansky, Richard Dittman, “Heat and Thermodynamics: An Intermediate Textbook”, McGraw-Hill, 1981

21S019 CHARACTERIZATION TECHNIQUES IN MATERIALS SCIENCE

3 0 0 3

X-RAY DIFFRACTION ANALYSIS: Crystal systems and symmetry elements in crystals- Detection of X rays- Basic principle of X ray diffraction of crystalline materials – Bragg's law - Diffraction methods – X-ray diffractometer- Standard X ray diffraction pattern – X ray diffraction analysis- Phase identification- Crystallite size. (9)

VIBRATIONAL SPECTROSCOPY: Raman spectroscopy – Basic principles – Instrumentation- Raman spectroscopic analysis. Fourier transform Infrared spectroscopy (FTIR)- Basic principles- Instrumentation-qualitative and quantitative analysis. (9)

IMAGING TECHNIQUES: Scanning electron microscopy (SEM) – physical basis of operation – sample requirements – applications, Transmission electron Microscopy (TEM) – resolution – sensitivity- TEM operation- diffraction mode – specimen preparation, Scanning Transmission Electron Microscopy (STEM). – Imaging – common analysis modes – sample requirements. (9)

SCANNING PROBE MICROSCOPY : Instrumentation, Scanning Tunneling Microscopy, Tunneling current, probe tips and working environments, operational modes, typical applications, Atomic Force Microscopy, near field forces, force sensors, operational modes, applications (9)

ELECTRON EMISSION SPECTROSCOPY: X ray photoelectron spectroscopy – Basic principle – photoelectron process of spectrum- elemental analysis-Instrumentation and applications- Auger electron spectroscopy- Basic principle- Auger electron spectrum - Information in Auger spectrum. (9)

Total L: 45

TEXT BOOKS:

1. Richard Brundle C, Charles A. Evans Jr, Shaun Wilson, "Encyclopedia of Materials Characterization" Manning Publications Co, United States, 1992.
2. Yang leng "Materials Characterization- Introduction to Microscopic and Spectroscopic Methods" John Wiley & Sons, United States, 2013.

REFERENCES:

1. Surender Kumar Sharma, "Handbook of materials characterization" Springer, United States, 2018.
2. Cullity B D, "Elements of X-ray Diffraction", Addison Wesley Publishing Co., United States, 1978.
3. P. C. Angelo, "Materials characterization", Cengage Learning, United States, 2016
4. Sam Zhang, Lin Li, Ashok Kumar, "Materials Characterization Techniques", United States, 2008

21S020 LINEAR INTEGRATED CIRCUITS

3 0 0 3

OPERATIONAL AMPLIFIER BASICS: Ideal OP-AMP characteristics, Open-loop voltage gain, input offset, slew rate, unity gain voltage follower, DC characteristics, AC characteristics differential amplifier, frequency response of OP-AMP, Inverting and Non-inverting Amplifiers-V to I and I to V converters (10)

CIRCUITS FOR MATHEMATICAL OPERATIONS: Inverting summing amplifier, solving simultaneous equation, logarithmic and anti-logarithmic amplifier. (7)

AMPLIFIERS FOR MEASUREMENTS: Common mode rejection ratio, bridge amplifier, considerations. Instrumentation amplifier – working, principle, expression for voltage gain, characteristics and applications. (8)

SPECIAL PURPOSE AMPLIFIERS: Input impedance, inputs offset and drift. FET input amplifiers, applications to high impedance measurements. Isolation amplifiers, Chopper stabilized amplifiers – principle, characteristics and applications. (12)

ACTIVE FILTERS: First-order Low pass, high pass, band pass and band reject filters. Frequency response and cut-off frequencies, applications. (8)

Total L: 45

TEXT BOOKS:

1. J.Milman, C.C Halkias, "Integrated Electronics –Analog and digital circuit systems", Tata McGraw-Hill Publishing, 2013
2. William D.Stanley, Operational Amplifiers with Linear Integrated Circuits, Pearson Education, 2010.

REFERENCES:

1. Sergio Franco, Design with operational amplifiers and analog integrated circuits, 3rd Edition, Tata McGraw-Hill, 2007.
2. Ramakant A.Gayakwad, OP-AMP and Linear ICs, Prentice Hall / Pearson Education, 4th Edition, 2010.
3. D.RoyChoudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 3rd Edition 2013.
4. Robert F.Coughlin, Frederick. F. Driscoll, "Operational Amplifier and Linear ICs" , Prentice Hall of India, 6th Edition 2001.

21S021 NANOMATERIALS AND APPLICATIONS

3 0 0 3

INTRODUCTION AND CLASSIFICATION OF NANOMATERIALS: Classification of nanostructures, nanoscale architecture – effects of the nanometer length scale – effects of nanoscale dimensions on various properties – structural, chemical, mechanical, magnetic, optical and electronic properties. (10)

PREPARATION OF NANOMATERIALS: Fabrication methods – top down processes – milling, Lithography, machining process – Bottom up process – vapour phase deposition methods, plasma assisted deposition process – methods for templating the growth of nanomaterials – ordering of nanostystems, self assembly and self organization. (10)

CHARACTERISATION OF NANOMATERIALS: Classification of characterization methods– Analytical and imaging techniques –Scattering physics- Microcopy techniques –Image magnification and resolution- Transmission electron microscopy-Field ion microscopy- AFM –Raman spectroscopy. (8)

NANOTUBES AND NANOWIRES: Carbon nanotubes – structure of CNT's – Growth mechanism of CNT's - Electronic properties, Vibrational properties, Mechanical properties of CNTs – application of CNT's. Nanowires – growth of nanowires-Lithography -Vapor-Liquid-Solid (VLS) method, template assisted method – application. (8)

NANO DEVICES AND THEIR APPLICATIONS: Nanomagnetic materials – particulate nanomagnets and geometrical nanomagnets – organic FET and LEDs – organic photovoltaic's, injection lasers and quantum cascade lasers –applications.(9)

Total L : 45

TEXT BOOKS:

1. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology",John Wiley & Sons Ltd, 2005.
2. Bharat Bhushan, "Springer Handbook of nanotechnology", Springer-Verlog, Berlin, 2004.

REFERENCES:

1. Harisingh Nalwa, "Handbook of Nanostructural Materials and Nanotechnology", Academic Press, 2000.
2. Mark Ratner, Daniel Ratner, "Nanotechnology a Gentle Introduction to the Next Big Idea", Pearson, 2003.
3. William Goddard, Donald W Brenner, "Handbook of Nanoscience Engineering and Technology", CRC Press, 2004.

21S022 SCIENCE OF COLOUR

3 0 0 3

LIGHTAND COLOUR: Physical properties of colours-Spectrum and wave theory, light sources. Conventional materials Transmission, Absorption, Surface Scattering, Internal Scattering, Terminology – Dyes Versus Pigments, Spectral Characteristics of Conventional Materials. Fluorescent materials. Gonioapparent materials-Metallic, Pearlescent, Interference and Diffraction Materials (9)

COLOUR VISION AND VISUAL SPECIFICATION: Trichromacy, Light and chromatic adaptation, compression, opponency, spatial vision observer variability. Colour specification-one-dimensional scale, hue, lightness, chromatic intensity. Three dimensional systems -geometricities, natural colour systems, Munsell colour system other colour order systems. Colour mixing systems (9)

NUMERICAL SPECIFICATION AND COLORIMETRY : Colour matching. Derivation of the standard observers - Theoretical Considerations, The Color-Matching Experiment,The 1924 CIE Standard Photopic Observer, The 1931 CIE Standard Colorimetric Observer,The 1964 CIE Standard Colorimetric Observer,Cone-Fundamental-Based Colorimetric Observer , calculating tristimulus values for materials, approximately uniformly spaced systems, L* lightness, u ′ v ′ Uniform-Chromaticity Scale Diagram, CIELUV, CIELAB (12)

LIGHTING AND METAMERISM: Standard illuminants , luminance, illuminance and luminous efficacy,l correlated colour temperature. Metamerism terminology, producing metamerrs. Indices of metamerism -Special Index of Metamerism, General Index of Metamerism, Using Indices of Metamerism, (8)

COLOUR IMAGING: Analysis and synthesis , colour management, additive Vs subtractive mixing, displays and encoding. Printing. Digital cameras, Colorimetric Accuracy, Spectral Accuracy. Spectral colour reproduction. (7)

Total **L: 45**

TEXT BOOKS:

1. Roy S. Berns , Principles Of Color Technology, Fourth edition, 2015, John Wiley and sons, USA
2 Steven A Shevell , Science of colour , Second edition, 20003, Elsevier UK

REFERENCES :

1. Volz HG. "Industrial Colour Testing –Fundamentals and Techniques", VCH,1994.
2. Lucas.J., "Colour Measurement–Fundamentals–Vol. I"Eurotex,1996.
3. McDonaldR," ColourPhysics forIndustry",WoodheadPublishing Limited, Cambridge,1997.

CHEMISTRY CLUSTER

21S031 POLYMER CHEMISTRY

3 0 0 3

BASICS OF POLYMERS: Genesis and classification of polymers. Monomers – functionality and its significance. Chemical and geometrical structure-stereo chemistry of polymers, tacticity.Polymer crystals-crystalline and amorphous combinations. Homo and copolymers – types and advantages. (9)

MECHANISM AND KINETICS OF POLYMERISATION: Chain polymerisation – mechanisms of free radical, ionic and coordination polymerization - kinetics of free radical polymerization. Step growth polymerisation – kinetics of polyesterification. Mechanism of ring opening polymerisation. Controlled radical polymerization-reversible addition fragmentation chain transfer(RAFT) and atom transfer radical (ATR) polymerizations (9)

POLYMERISATION TECHNIQUES AND POLYMER DEGRADATION: Addition polymerisation – bulk, solution, suspension and emulsion. Condensation polymerisation – melt, solution and interfacial. Polymer degradation – thermal, mechanical, photo, oxidative and hydrolytic degradations. Bio-degradable polymers – environmental importance. Thermal properties of polymers:Glass transition temperature (T_g) – factors affecting T_g. (9)

MOLECULAR WEIGHT:Number and weight average molecular weights- molecular weight distribution-significance- Poly Dispersity Index - degree of polymerization. Determination of molecular weight –end group analysis, osmometry, light scattering, viscometry and Gel Permeation Chromatography. (9)

POLYMER PROCESSING and ENVIRONMENTAL ISSUES: Compounding-plasticisers, anti-oxidant, UV stabilizers, fillers, flame retardants and colorants. Moulding techniques – compression, injection, extrusion and blow mouldings, film castings andcalendering. Fibers – criteria for fiber forming, fiber spinning – melt, dry & wet spinnings. Management of plastic waste-recycling, incineration and bio degradation-bio degradable polymers. (9)

Total L: 45

TEXT BOOKS:

1. Charles E. Carraher Jr. “Carraher’s Polymer Chemistry”, CRC press, 2017.
2. Fred W. Billmeyer Jr, “Textbook of polymer science”, John Wiley and Sons, 2011.

REFERENCES:

1. Gowarikar.V R, Viswanathan.N V and Sreedhar J, ‘Polymer science’, New Age International (P) Ltd., 2015.
2. Fried J R., ‘Polymer science and technology’ Prentice-Hall of India Pvt. Ltd’. 2014.
3. Odian G, “Principles of polymerisation”, John Wiley & Sons, New York, 2012.
4. J A Brydson, “Plastic Materials” Butterworth Heinemann Ltd. Oxford, 2013.

21S032 ENVIRONMENTAL CHEMISTRY

3 0 0 3

STRUCTURE AND COMPOSITION OF ATMOSPHERE: Environment - definition, scope and importance of environmental study - The atmosphere of earth – composition of atmosphere - global temperature – global energy balance - Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Thermo-chemical and photochemical reactions in the atmosphere. (9)

ENVIRONMENTAL POLLUTION: Pollution – Definition - Air pollution: sources – classification - effect of air pollutants on materials, plants, animals and humans. Water pollution: Sources - classification of pollutants and their effects – DO, BOD, COD - oxygen demanding wastes, nutrients, pesticides, heavy metals, hydrocarbons. Soil pollution: Sources - salinity by irrigation, heavy metals, hydrocarbons, toxic organics, industrial chemicals - movement of pollutants through soil - consequences of soil pollution. (9)

CHEMICAL METHODS FOR POLLUTION CONTROL: Filtration and separation - principles, processes, applicability, evaporation, thermal treatment – incineration. Precipitation – processes: Hydroxide, sulphide - solidification and stabilization - chemical oxidation and reduction – pyrolysis - waste minimization and recycling. (9)

SOCIAL ISSUES AND THE ENVIRONMENT: From unsustainable to sustainable development. Population growth, variation among nations – population explosion. Global warming, ozone layer depletion and climate change. Human health and environment. Water conservation and rain water harvesting. Value Based Education. Process of EIA - ISO 14000 - environment protection act. (9)

ENVIRONMENTAL MONITORING: Indian standards for pollution levels (concentrations) with respect to air and water. Measurement techniques for water quality: pH, conductivity, temperature, turbidity, chlorides, sulphates, sulphides, nitrates, nitrides, phosphates, fluoride and phenolic compounds. Measurement techniques for air quality: Particulate matter, oxides of sulphur and nitrogen, un-burnt hydrocarbons, carbon dioxide, carbon monoxide and ozone. (9)

Total L: 45

TEXT BOOKS:
1. Girrad J, "Principles of environmental chemistry", Jones & Bartlett learning, 2014.
2. De A K, "Environmental chemistry", New age publications (Academic), India. 2016.

REFERENCES:
1. Rao, M V R K, "Energy resources: Conventional & non-conventional "BSP publications, 2017.
2. Masters G M, "Introduction to environmental engineering and science", Prentice hall of India, New Delhi, 2014.
3. Sethi M S, "Environmental chemistry", Shri sai printographers, New Delhi, 2012.
4. Deswal S and Deswal A, "An introduction to environmental science", Dhanpat Rai & Co Pvt. Ltd.2011.

21S033 APPLIED ELECTROCHEMISTRY

3 0 0 3

ELECTROCHEMICAL ENERGY SOURCES: Batteries – characteristics - voltage, current, capacity, electricity storage density, power, discharge rate, cycle life, energy efficiency, shelf life. Primary and secondary batteries – dry cell, lead- acid battery, Ni - Cd and lithium ion batteries - applications. (9)

FUEL CELLS: Classification, working principle, components, applications and environmental aspects of solid oxide, molten carbonate, direct methanol and proton exchange membrane fuel cells. Hydrogen as a fuel – the role of chemistry in overcoming the challenges in the production, storage and utilization of hydrogen. (9)

ELECTROCHEMICAL SENSORS: Chemical sensors – gas sensors – ion selective electrodes – solid state membranes – liquid membranes. Biosensors – electrochemical biosensors – glucose biosensors. (9)

METAL FINISHING AND COATINGS: Electroplating of Cu, Ni, and Cr - applications. Fundamentals of electroless deposition – Ni and Cu electroless plating. Anodizing – characteristics of anodic film on aluminium - determination of thickness of anodic film. Surface conversion coatings: phosphating and chromating - applications. (9)

INDUSTRIAL ELECTROCHEMICAL PROCESSES: Plated through hole PCB's, electroforming - fabrication of CD stampers and wave guides. Electropolishing,electrochemical machining, electrochemical etching of Cu from PCBs, electrochemical etching of semiconductors. (9)

Total L: 45

TEXT BOOKS:
1. Pletcher. D., "Industrial Electrochemistry", Springer Science & Business media, 2013.
2. Chawla,S., "A Text Book of Engineering Chemistry", Dhanpat Rai and Company, New Delhi, 2005.

REFERENCES:
1. Scibioh.A .and Viswanathan, B., "Fuel Cells – Principles and Applications", University Press, Hyderabad, 2006.
2. Grundler, P. "Chemical Sensors – An Introduction for Scientists and Engineers", Springer, New York, 2007.
3. Electroplating, Anodizing and Metal treatment", Hand book, NIIR board, Delhi, 2004.

21S034 CHEMISTRY OF NANOMATERIALS

3 0 0 3

INTRODUCTION TO NANOMATERIALS: Colloids - concepts of nanomaterials, size and confinement effects. Quantum dots, wires and wells. Size induced metal to insulator transition, fraction of surface atoms, specific surface energy and surface stress, effect on the lattice parameter, effect on the phonon density of states. Properties - electronic, optical, magnetic, thermal, mechanical and electrochemical properties. (9)

TYPES OF NANOMATERIALS: Metal, semiconductor, oxide nanoparticles, polymer nanoparticles, micro, meso and nanoporous materials. Organic-inorganic hybrids, intercalation compounds, zeolites, nanocomposites, mueller systems - self-assembled monolayers, gas phase clusters, semiconductor quantum dots, magnetic nanoparticles, core-shell structures, nanoshells, nanofibers, supramolecular nanostructures - molecular nanomachines. Carbon nanotubes (CNTs) – structure and properties, fullerenes. (9)

CHEMICAL SYNTHESES: Nucleation – mechanism of homogeneous and heterogeneous nucleation. Synthesis of metallic nano particles - Turkevich reduction, ligand stabilized nanoparticles - thiol-stabilized nanoparticles, phosphine-stabilized nanoparticles, electrochemical synthesis, reactions in micelles, emulsions, dendrimers, photochemical and radiation chemical reduction, ionic liquids, sonochemical synthesis, biological synthesis - shape control with biomolecules and microbial synthesis. (9)

SOL-GEL TECHNIQUES: Aqueous sol-gel synthesis, nonaqueous sol-gel synthesis - surfactant directed approaches - hot-injection method, heating-up method, solvothermal synthesis, microwave technique, seed-mediated growth, solvent-controlled approaches - reaction of metal halides with alcohols, reaction of metal alkoxides, acetates and acetylacetonates with alcohols, reaction of metal alkoxides with aldehydes and ketones, reaction of metal acetyl acetonates with amines and nitriles. (9)

APPLICATIONS OF NANOMATERIALS: Organic thin film transistors, organic light-emitting diodes, conducting polymer based electrochemical transistors, electroluminescent devices, electrochromic devices, photoelectrochromic devices, printed and

flexible devices. Electro-spinning – Nylon-6 nano composite – nano finishing in textiles – UV resistant, antibacterial, hydrophobic, self-cleaning, flame retardant finishes. (9)

Total L: 45

TEXT BOOKS:
1. Cao G, "Nanostructures and nanomaterials: Synthesis, properties and applications", ICP, London, 2012.
2. Sergeev G B and Klabunde K J, "Nano chemistry", Elsevier, Netherlands, 2013.

REFERENCES:
1. Ozin G A and Arsenault A C, "Nanochemistry: A chemical approach to nanomaterials", RSC, 2014.
2. Pradeep T, "Nano: The essentials", Tata Mcgraw Hill, New Delhi, 2012.
3. Klabunde K J and Richards R M, "Hand book of Nanoscale materials in chemistry", Wiley, New York, 2012.
4. Ramsden J J, "Nanotechnology: An introduction", Willaim Andrew publishers, UK, 2016.

21S035 PHARMACEUTICAL CHEMISTRY

3 0 0 3

INTRODUCTION TO PHARMACEUTICAL CHEMISTRY: Definition - drug, pharmacophore, pharmacology, pharmacopeia, pharmacodynamics, bacteria, virus and vaccine. Causes, symptoms and drugs for anemia, jaundice, cholera, malaria and filarial. Indian medicinal plants and uses – tulasi, neem, kizhanelli, mango, semparuthi, adadodai and thoothuvalai. Blood-grouping, composition, Rh-factor, blood - pressure, hypertension and hypotension. (9)

ANTIBIOTICS, ANTISEPTICS AND ANALGESIS: Antibiotics - definition - action of penicillin, streptomycin, ehloramphenicon, crythromycin, tetracyclines and SAR of chloramphenical only. Antiseptics and disinfectants – definition and distinction – phenolic compounds, chloro compounds, cationic surface active agents. Analgesis: Definition and actions – narcotic and non-narcotic – morphine and its derivatives, pethidine and methadone – disadvantages and uses. (9)

ANAESTHETICS: Definition – local and general – volatile – nitrous oxide, ether, chloroform, cyclopropane – uses and disadvantages – non-volatile-intravenous, thiopental sodium, methohexitone and propanidid. Drugs affecting CNS – definition, distinction and examples for tranqualizers, sedatives, hypnotics, psychedelic drugs, LSD, hashish and their effects. Causes, medicines and their mode of action for the treatment of cancer, antineoplastics, diabetics and hypoglycemic agents. AIDS – AZT, DDC. (9)

ANTIBACTERIALS AND ANTIPYRETICS: Antibacterials - sulpha drugs – examples and actions – prontosil, sulphathiazole and sulphafurazole. Antipyretics and anti-inflammatory agents – salicylic derivatives, paracetamol and ibuprofen. Cardio vascular drugs – cardiac glycosides, antiarrhythemic drugs, antihypertension drugs, antianginal agents and vasodilators. (9)

CHEMOTHERAPHY: Introduction, chemotherapeutic agents: Phenyl butazone, β-lactam pencilin, ampicillin, chloramphenicol and streptomycin. (9)

Total L : 45

TEXT BOOKS:
1. Patrick G, "An introduction to medicinal chemistry", Oxford university press, 2018.
2. Roche V F, Zito S W, Lemke T L and Williams D A, "Foye's Principles of medicinal chemistry", Wolters Kluwer, 2019.

REFERENCES:
1, Satoskar R S,"Pharmacology and pharmatherapeutics", Elseiver, 2015.
2. Kar A, "Medicinal chemistry" New Age International Publishers.2018.
3. Cairns D, "Essentials of pharmaceutical chemistry", Pharmaceutical press, 2018.
4. Ghosh J, "A text book of pharmaceutical chemistry"S. Chand Company Ltd., 2012.

21S036 TEXTILE CHEMISTRY AND TEXTILE CHEMICAL PROCESSING

3 0 0 3

CHEMISTRY OF TEXTILE FIBRES: Molecular structure, polymeric aspects, reactivity and morphology of natural, regenerated and synthetic fibers – cotton, jute, wool, silk, viscose, lyocell, polyester, nylon, acrylic, lycra, and polypropylene fibers. Physical and chemical properties of textile fibers and their uses. . (9)

PREPARATORY PROCESSES ON TEXTILES: Sequences of processes in textile chemical processing. Singeing – types, methods of singeing. Desizing – types, methods of desizing. Scouring – principle and mechanism. Bleaching – types, methods of bleaching, hypochlorites and hydrogen peroxide. Mercerization – concept and application. Degumming, degreasing, decatizing. (9)

COLOURATION ON TEXTILES: Types of dyes used for cellulosic, protein and synthetic textiles – methods of dyeing of these fibres, machineries used for dyeing. Methods and styles of printing, printing of cellulosic fabric with reactive dyes, protein fabric with acid dyes and polyester fabric with disperse dyes. Pigment printing, transfer printing, flock printing, tie and dye – screen printing, rotary screen printing, roller printing – steaming and curing. (9)

FINISHING ON TEXTILES: Object of finishing, types of finishing – methods of application for cotton, silk, wool and synthetics. Water repellent/proof, fire repellent, mildew/moth proof, anti-static, soil release, miscellaneous finishes. Wrinkle free finish, wash-n-wear, denim finish, stone wash and acid wash. Stain removal techniques. (9)

EFFLUENTS AND ECO-FRIENDLY PROCESSING: Effluents from different wet processing units, chemicals and dyes creating pollution, causes of pollution, criteria in effluent treatment plant (ETP), methods followed in ETP to avoid pollution - German ban on listed dyes and chemicals. Natural dyes - history, background and application techniques – eco-friendly processing and eco-label. (9)

Total L: 45

TEXT BOOKS:
1. Chakraborty J N, "Fundamentals and practices in colouration of textiles", WPI India, 2015.
2. Clark M, "Handbook of textile and industrial dyeing: Principles, processes and types of dyes" – volume I & II, Woodhead publishing, Cambridge, 2011.

REFERENCES:
1. Harper H, "Introduction to textile chemistry", Chizine publications, USA, 2018.
2. Hauser P J, "Advances in treating textile effluent", Janeza trdine, Rijeka, Croatia, 2011.
3. Datya K V and Vaidya A A, "Chemical processing of synthetic fibres and blends", John Wiley & Sons, New York, 2005.
4. Best J, "Colour design: Theories and applications", Woodhead publishing, UK, 2017.

21S037INDUSTRIAL CHEMISTRY

3 0 0 3

ABRASIVES & ADHESIVES: Moh's scale of hardness, types of abrasives, properties and applications. Adhesives, mechanism, factors influencing adhesives – physical and chemical, bonding process, classification – significance. (9)

PIGMENTS & PAINTS: Inorganic and organic pigments, dyes, metallic and pearl pigments**,** testing of pigments**,** latent solvents and non-solvents. Binder ratio, dilution ratio and dilutability. Classification of paints, constituents and properties of paints. Additives: Definition, types of additives. Special paints – fire retardant paints, water repellent paints, temperature indicating paints - composition and applications. (9)

CERAMICS: Classification, traditional ceramics, white wares, refractories, glasses – manufacture and types, ceramic composites, cermet's, advanced ceramics. (9)

CEMENT: Classification, chemical composition, setting and hardening. Plaster of paris - applications. Special cements - high alumina cement, sorel cement, white Portland cement and water proof cement - manufacture of Portland cement, concrete and RCC, decay of concrete. (9)

COMPOSITE MATERIALS: Classification – constituents of composites, roll of interface in composite performance and durability, fiber reinforced composites(FRC), failure of FRC, short fibre reinforced composites, particle reinforced composites, particulate composite and structural composites - advantages and applications. (9)

Total L: 45

TEXT BOOKS:
1. Roussak O V and Gesser, H D, "Applied chemistry: A textbook for engineers and technologists", Springer, 2016.
2. Heaton A, "An introduction to industrial chemistry", Springer, UK, 2006.

REFERENCES:
1. Sharma B K,"Industrial chemistry", Goel Publishing House, Meerut. 2011.
2. Kuriacose J C and Rajaram J, "Chemistry in engineering and technology", Vol I & II, Tata McGraw Hill, 2016.
3. Gowarikar V R, Viswanathan N V and Jayadev Sreedhar, "Polymer science", New Age International (P) Ltd., New Delhi, 2003.
4. Trimm H H and Hunter W, "Industrial chemistry: New applications, processes and systems", Apple academic press, Canada, 2013.

21S038 BIOCHEMISTRY

3 0 0 3

CHEMISTRY OF CARBOHYDRATES: Carbohydrates – definition. Monosaccharides – occurrence, structures, physical and chemical properties, linear and ring forms (Haworth formula) for pentose and hexose. Disaccharides – occurrence, structure, physical and chemical properties of sucrose and lactose. Polysaccharides – occurrence, structure, physical and chemical properties of starch, cellulose. Carbohydrate metabolism – glycolysis and citric acid cycle. (9)

CHEMISTRY OF AMINO ACIDS AND PROTEINS: Classification of amino acids. Reaction with ninhydrin, common properties of amino acids, amphoteric nature, isoelectric point, isoelectdric pH and Zwritter ion. Proteins – classification based on solubility, shape and size. Physical properties – salting in and out, denaturation, peptide bond. Structure of protein – primary, secondary, tertiary and quaternary structure. Nucleic acids – structure and functions of DNA and RNA (9)

CHEMISTRY OF LIPIDS: Definition, classification and functions of lipids. Occurrence, chemistry and biological functions of simple lipids, compound lipids (e.g. phospholipids) and derived lipids. Steroids (e.g. cholesterol). Physical property – emulsification. Chemical property – saponification. Functions of bile acids and bile salts. (9)

CHEMISTRY OF NUCLEIC ACIDS AND ENZYMES: Definition – nucleoside, nucleotide and polynucleotide. Double helical model of DNA and its biological functions. Structure, types and functions of RNA, tRNA, mRNA and r RNA. Differences between DNA and RNA. Enzymes: Classification of enzymes – general properties, active sites, Enzyme inhibition – competitive and non-competitive inhibitors. Industrial applications of enzymes. Bioenergetics, thermodynamic considerations, redox potentials. Catabolism and anabolism - enzymes involved, catalytic mechanism and regulatory steps in glycolysis, mitochondrial electron transport and oxidative phosphorylation. (9)

METABOLISM: Catabolism and anabolism. Bioenergetics, thermodynamic considerations, redox potentials. Catalytic mechanism and regulatory steps in glycolysis, mitochondrial electron transport and oxidative phosphorylation. Coenzymes – NAD^+, NADH, FMN, FAD – structure and functional activities. Coenzymes a universal carrier of acyl groups. (9)

Total L: 45

TEXT BOOKS:

1. Nelson N and Cox M M, “Lehninger principles of biochemistry, McMillan learning, 2019.
2. Rodwell V W, Mayes P A, Granner D K and Murray R K, “Harper’s illustrated biochemistry”, McGraw-Hill education, 2018.

REFERENCNES:

1. Dugas H and Penny C, “Bioorganic chemistry: A chemical approach to enzyme action”, Springer science and business media, 2019
2. Garret R H and Grisham C M, “Biochemistry”, Cengage learning, 2016.
3. Sathyanarayana U and Chakrapani U, “Biochemistry”, Elsevier health sciences, 2018.
4. Voet D and Voet J, “Fundamentals of biochemistry: Life at the molecular level”, Wiley internations, 2018.

21S039 INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

3 0 0 3

ELECTROANALYTICAL CHEMISTRY: Conductometry - principle, instrumentation – measurement of conductance - application of conductometric method. Conductometric titration apparatus. Potentiometry – principle, instrumentation – potentiometric measurement of pH, factors affecting pH measurement – advantages and limitations of glass electrode. Determination of pKa value of weak acid. (9)

THERMOANALYTICAL TECHNIQUES: Introduction – thermogravimetric analysis – types – principle and method – instrumentation – factors affecting the results – applications. Differential thermal analysis – principle – simultaneous TGA and DTA curves – applications. (9)

FLAME EMISSION AND ATOMIC ABSORPTION SPECTROSCOPY: Introduction – principle – variation of emission intensity with the flame – flame temperature – chemical reactions in flames – emission spectra for various metal ions – effect of organic solvents - Instrumentation – flame spectrophotometer – applications. Determination of sodium ions in different samples. Atomic absorption spectroscopy – introduction – measurement of atomic absorption spectra – instrumentation - advantages and limitations of atomic absorption spectroscopy. Relation between atomic absorption and flame emission spectra. (9)

X-RAY DIFFRACTION TECHNIQUE: introduction **–** Mosley’s law – continuous and discontinuous spectra from electron beam source – instrumentation – emission methods – qualitative and semi-quantitative analysis – applications. Advantages and limitations. Laue method of X-ray analysis – Bragg’s law – diffraction of X-rays – production and detection of X-rays – Debye-Scherrer method – sample preparation for powder X-ray diffraction pattern. (9)

ELECTRON SPIN RESONANCE SPECTROSCOPY: Introduction – factors affecting ‘g’ value – limitation of ESR. Difference between ESR and NMR. Instrumentation – electron nucleus interaction. Hyperfine interaction – isotropic and anisotropic splitting. Quantitative analysis – application of ESR – study of free radicals. Electron structure and hyperfine splitting – spin density and McConnell relationships. Triplet state, zero field splitting and Kramer’s degeneracy – analytical applications. (9)

Total L: 45

TEXT BOOKS:

1. Rouessac F and Rouessac E, “Chemical analysis: Modern instrumentation methods and techniques”, John-Wiley and sons, 2018.
2. Mabbot G A, “Electroanalytical chemistry: Principles, best practices and case studies”, Wiley internationals, 2020

REFERENCES:

1. Alfassi Z B, “Instrumental multi-element chemical analysis”, Springer science & business meida, 2016.
2. Sharma B K, “instrumental method of chemical analysis”, Krishna prakashan media private limited, 2014.
3. Chatwal G R and Anand S K, “instrumental methods of chemical analysis”, Himalaya publishing house, 2016.
4. Wertz J, “Electron spin resonance: Elementary theory and practical applications”, Springer science & business meida, 2019.

21S040 GREEN CHEMISTRY

3 0 0 3

INTRODUCTION TO GREEN CHEMISTRY: Definition – principles and concepts of green chemistry – green chemistry and sustainable developments. Atom economy: Atom economic reactions, rearrangement reactions and addition reactions - atom un-economic reactions, substitution reactions, elimination reactions and Witting reactions. Reducing toxicity – measuring toxicity. Need of green chemistry for day today life. Design and development of environmentally friendly chemical pathways.(9)

MEASURING AND CONTROLLING ENVIRONMENTAL PERFORMANCE OF GREENER PRODUCTS: Importance of measurement – lactic acid production, safer gasoline. Introduction to life cycle assessment (LCA) – carbon footprint - green processes metrics – environmental management systems – ISO 14001 – eco labels – legislation – integrated pollution prevention and control (IPPC).Catalysis – environmental friendly catalysts - bio-catalysts, biodegradable polymers, alternative solvents and ionic liquids. (9)

RENEWABLE RESOURCES: Renewable feedstock's – applications of renewable materials: Biodegradable plastics – compostable chemicals**.** Biomass energy: Production of ethanol from biomass – production of biodiesel. Bio refinery chemicals from fatty acids - polymer from renewable resources – some other natural chemical resources. Hydrogen generation from algae biological pathways – storage and transportation. (9)

GREEN TECHNOLOGY FOR ENERGY PRODUCTION: Growing energy needs – renewable and non-renewable energy sources from unsustainable to sustainable development, urban problems related to energy. Rain water harvesting, watershed management. Green and brown energy resources – solar energy, wind energy, hydropower – tidal energy – ocean thermal energy – geothermal energy. Fuel cells - hydrogen as a fuel. (9)

GLOBAL ATMOSPHERIC CHANGE & GREEN FUNDAMENTALS: The atmosphere of earth – global temperature – global energy balance. Greenhouse effect. Environmental issues and green computing. Electronic waste management. Environment and society – producer responsibility legislation – waste electrical and electronic equipment (WEEE) directive. Materials composition of WEEE. Mobile phones – television, washing machines – current and new electronic waste recycling technology – future perspectives of electronic scrap. (9)

Total L: 45

TEXT BOOKS:

1. Lancaster M, "Green chemistry: An introductory text", The royal society of chemistry, 2016.
2. Marteel-Parrish E A and Abraham M A, "Green chemistry and engineering: A pathway to sustainability", John Wiley & Sons, Inc., Hoboken, New Jersey, 2013.

REFERENCES:

1. Mcdilda M G, "The everything green living book", Adams media, 2007.
2. Jimenez-gonazalez C and Constable D J C, "Green chemistry and engineering-A practical approach", John-Wiley and sons, 2011.
3. Deswal S and Deswal A, "An introduction to environmental science", Dhanpat Rai & co pvt. ltd.2012.
4. Rao M V, "Energy resources: conventional & non-conventional" BSP publications, 2017.

SKILL ENHANCEMENT COURSES (SEC)

MATHEMATICS AND COMPUTER SCIENCE CLUSTER

21S055 MATHEMATICAL MODELLING

2 2 0 3

Modelling change: Introduction - Mathematical models - Modeling change with difference equations – Approximating change with difference equations – Solution to dynamical systems – system of difference equations - Modeling using proportionality – Modeling using Geometric similarity (6+6)

Model Fitting: Introduction –– Fitting models to data graphically – Analytic methods of model fitting – Least-square method – Higher order polynomial models – low order polynomials – cubic spline models (6+6)

Population Models: Basic concepts, Exponential growth model, formulation , solution, interpretation and limitations. Compensation and depensation, Logistic growth model, formulation, solution, interpretation and limitations. Lotka- Volterra model of two competing species, formulation, solution, interpretation and limitations (6+6)

Epidemic Models: Basic concepts, Simple epidemic model, formulation, solution, interpretation , and limitation, General epidemic model, formulation, solution, interpretation and limitations . (6+6)

Economic models: Production and supply functions, price-elasticities, utility of consumption and consumer surplus, pure competition, competitive equilibrium , monopoly versus competition, duopoly, oligopoly, conjectural variation, theory of production, production function , Cobb- Douglas production function and its properties , Costs of production and related models. (6+6)

TEXT BOOKS
1. Mark M. Meerschaert, Mathematical Modeling, Academic Press, New Work, 2013
2. Frank R Giordano; William P Fox; Steven B Horton, A First Course in Mathematical Modeling, Cengage Learning , 2014.

REFERENCES
1. Kenrad E. Nelson & Carolyn Masters Williams. *Infectious Disease Epidemiology: Theory and Practice*. Second Edition. Jones and Bartlett Publishers, 2006.
2. Otto, Sarah P., and Troy Day. A biologist's guide to mathematical modeling in ecology and evolution. Vol. 13. Princeton University Press, 2007.
3. Seyed M. Moghadas, Majid Jaberi-Douraki, Mathematical Modelling, Wiley, 2018
4. Christoffersen P, "Elements of Financial Risk Management", Academic Press, 2012.

21S056 ANALYTICAL GEOMETRY

2 2 0 3

Coordinates in space: Direction cosines of a line in space-angle between lines in space – equation of a plane in normal form - Angle between planes – Distance of a plane from a point. (6+6)

Straight lines in space: Line of intersection of planes – plane containing a line. Coplanar lines – skew lines and shortest distance between skew lines- length of the perpendicular from point to line. (6+6)

Sphere: General equation of a sphere-Section of sphere by plane-tangent planes –condition of tangency-system of spheres generated by two spheres - System of spheres generated by a sphere and plane. (6+6)

Cone: The equation of surface – cone – intersection of straight line and quadric cone – tangent plane and normal (6+6)

Plane: Condition for plane to touch the quadric cone - angle between the lines in which the plane cuts the cone - Condition that the cone has three mutually perpendicular generators- Central quadrics – intersection of a line and quadric – tangents and tangent planes – condition for the plane to touch the concord. (6+6)

TEXT BOOKS
1. Wallace Alvin Wilson, Analytic Geometry, Palala Press, 2015.
2. William H. McCrea, Analytical Geometry of Three Dimensions, Dover Publications, 2016

REFERENCES
1. Joel Hass, Christopher Heil, Maurice D. Weir, "Thomas' Calculus", Pearson, 2018
2. Richard A. Silverman, Modern Calculus and Analytic Geometry, Dover Publications, 2012
3. Vittal. P.R, "Analytical Geometry 2D and 3D", Pearson Education, Chennai, 2013.
4. Judith L. Gersting, Technical Calculus with Analytic Geometry, Dover Publications, 2012

21S057 BUSINESSSTATISTICS

3 0 0 3

FREQUENCY DISTRIBUTION: Grouping and displaying data to convey meaning: Raw data, arranging data, constructing a frequency distribution, graphing a frequency distribution, Measures of central tendency, measures of dispersion. (9)

SAMPLING AND SAMPLING DISTRIBUTIONS: Sampling, random sampling, design of experiments, sampling distributions, sample size and standard error. (9)

ESTIMATION: Introduction, point estimates, interval estimates: basic concepts, interval estimates and confidence intervals, calculating interval estimates of the mean from large samples, calculating interval estimates of the proportion from large samples. (9)

REGRESSION AND CORRELATION: Estimation using the regression line, correlation analysis, making inferences about population parameters, limitations, errors, and caveats, multiple regression and correlation analysis, finding the multiple regression equation, the computer and multiple regression, making inferences about population parameters, modeling techniques. (9)

TIME SERIES AND FORECASTING: Variations in time series, trend analysis, cyclical variation, seasonal variation, irregular variation, a problem involving all four components of a time series, time series analysis in forecasting. (9)

Total L: 45

TEXT BOOKS
1. Richard I. Levin, David S. Rubin, Statistics for Management, Pearson, 2017.
2. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, Wiley India, Delhi,2019.

REFERENCES:
1. Richard A.Johnson, Miller & Freund"s, Probability and Statistics for Engineers, Prentice Hall, NewDelhi, 2018.
2. Jay L. Devore, Probability and Statistics for Engineering and the Sciences, Brooks/Cole, USA,2012.

3. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability & Statistics for Engineers & Scientists, Pearson Education, New Delhi, 2007.
4. Robert S. Witte and John S. Witte, Statistics, wiley, 2017

21S058 STATISTICAL QUALITY CONTROL AND RELIABILITY

2 2 0 3

STATISTICAL PROCESS CONTROL: Chance and assignable causes of quality variation, statistical basis of the control charts - basic principles, choice of control limits, analysis of patterns on control charts. (6+6)

CONTROL CHARTS: $\bar{X}$ chart, R chart, $s2$ chart, p chart, np chart, c chart, and u chart. (6+6)

ACCEPTANCE SAMPLING: Types of sampling plans, lot formation, single sampling plans for attributes, double, multiple and sequential sampling plans, acceptance sampling by variables, chain sampling, continuous sampling, skip lot sampling plans. (6+6)

BASIC RELIABILITY MODELS: The failure distribution, the reliability function, mean time to failure, Hazard rate function, bathtub curve, conditional reliability. Constant failure rate model: Exponential reliability function. Time-dependent Weibull failure model, Time - dependent normal failure model. (6+6)

RELIABILITY OF SYSTEMS: Serial configuration, parallel configuration, combined series, parallel systems - k out of n: system -system structure function, minimal cuts, minimal paths, common mode failures, three state devices. (6+6)

Total L: 45

TEXT BOOKS

1. Douglas C Montgomery, Introduction to Statistical Quality Control, Wiley India, New Delhi, 2012.
2. Charles E. Ebeling, Introduction to Reliability and Maintainability Engineering, Overseas press, New Delhi, 2017.

REFERENCES

1. Eugene L Grant, Richard S Leavenworth, Statistical Quality Control, Tata Mc- Graw Hill, New Delhi, 2015.
2. Dale H Besterfield, Quality Control, Pearson Education, New Delhi, 2018.
3. Birolini Alessandro, Reliability Engineering: Theory and Practice, Springer, 2017.
4. John Bentley, Introduction to reliability and quality engineering, Pearson, 2011.

21S059 OBJECT ORIENTED PROGRAMMING

2 2 03

OBJECT ORIENTED PROGRAMMING: Introduction –classes – inheritance – abstraction – polymorphism. Java Programming Basics**:** Data Types - Operators - Declarations - Control Structures - Arrays and Strings – Input using scanner. Classes**:**Java Classes - Methods - Constructors - this keyword – various uses of this keyword (6+6)

INHERITANCE: Reusability – various types of inheritance – super keyword – various uses of super keyword. Abstraction and Polymorphism: static polymorphism - method overloading - abstract classes – abstract methods – runtime polymorphism Packages : Access protection – default modifier – creating a package - importing a package (6+6)

INTERFACES: Defining interface - Implementing Interface –runtime polymorphism using interface. Exception Handling**:** Fundamentals - Exception types - Using Try and Catch - Multiple catch blocks - Nested Try statements - Throw - Throws -built-in exceptions–user defined exceptions. (6+6)

MULTI THREADED PROGRAMMING: Java thread model - Priorities - Synchronization - Messaging - Thread class and runnable Interface - Main thread - Creating the Thread - Synchronization – Inter-thread Communication - Deadlock (6+6)

I/O STREAMS: I/O basics - Stream - Stream Classes - Reading / Writing into a file. Applets**:** Applet fundamentals - GUI Components – Layouts – Event handling. (6+6)

Total L: 30 + T: 30 = 60

TEXT BOOKS:

1. Herbert Schildt, "JAVA - The Complete Reference", McGraw Hill Education, 2017.
2. Cay Horstmann, “Core Java”, Pearson, 2020.

REFERENCES:

1. Harvey M. Deiteland Paul J. Deitel, "JAVA: How to Program", Prentice Hall, 2013.
2. William Stanek and Peter Norton, "Peter Norton's Guide to Java Programming", Tech Media, 2008.
3. Paul Deitel, Harvey Deitel, “Java for Programmers”, Pearson Education, 2012.
4. Joyce Farrell , “Java Programming”, Cengage Learning, 2019

21S60 DATABASE MANAGEMENT SYSTEM

2 2 0 3

BASIC CONCEPTS: Introduction to databases – Conventional file processing – Purpose of database system – Characteristics of database approach – Advantages of using DBMS – Database concept and architecture – Data Abstraction – Data Models – Instances and Schema – Data Independence – Schema Architecture – Components ofaDBMS (6+6)

DATA MODELING: Introduction – Data associations – Entities, attributes, relationships – Type role and structural constraints – Weak and Strong entity types – Design of Entity Relationship data models (ERD) – Generalization – Aggregation – Conversion of ERD into tables – Applications (6+6)

FILE ORGANIZATION AND RELATIONAL DATA MODEL: Storage device characteristics – Constituents of a file – Operations on file – Serial files – Sequential files – Index sequential files – Direct files-Introduction to Relational Data Model – Basic concepts – Enforcing Data Integrity constraints – RelationalAlgebraOperations. (6+6)

SQL :Introduction to Structured Query Language (SQL) – SQL Commands for defining Database, Constructing database, Manipulations on database – Basic data retrieval operations – Updates in SQL – ViewsinSQL. (6+6)

DATA BASE DESIGN AND SECURITY THREATS: Data base design process – Relational Database Design – Relation Schema – Anomalies in a database – Functional dependencies – Axioms – Normal forms based on primary keys – Second Normal form, Third Normal form, introduction to transaction Processing.-Security andIntegritythreats (6+6)

Total L: 30 + T:30 =60

TEXT BOOKS :

1. Elmasri R and Navathe SB, “Fundamentals of Database Systems”, Pearson Education, 2016.
2. Silberschatz A, KorthH andSudarshan S, “Database System Concepts”, McGraw Hill, 2011.

REFERENCES:

1. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom, ”Database Systems: The Complete Book,”, Pearson Education, 2011.
2. Raghu Ramakrishnan and Johannes Gehrke, “Database Management System”, McGraw Hill, 2011
3. Atul kahate, Introduction to Database Management Systems. Pearson India, 2004.
4. P.S. Gill, Database management system, Wiley, 2011.

21S061 WEB DESIGNING

2 2 0 3

INTRODUCTION: WWW – presentation / business logic layer-Browser architecture – HTTP architecture, Methods, Web Server Architecture - Basic Structure of HTML – HTML tags – Tables – Forms – Links – Frames – DOM – Styling Tags. (6+6)

CSS: Introduction – Types (Where to place CSS) – Rules – Selectors – Styling Fonts – Layouts – Positioning – Boot Strap. (6+6)

JavaScript: Scripting Languages – Syntax – Variables – Data Types – Operators – Expressions – Conditional Statements – Loops – Arrays – Functions – Event Handling – Enhancing HTML Documents with JavaScript – AngularJS. (6+6)

PHP: Evaluation of PHP – Basic Syntax – Variables – Constants – Data Types – Operator – Expression – Form Processing – Looping – Functions – Arrays – Strings – PHP Global Array - Sessions – Cookies – NodeJS. (6+6)

WEB PUBLISHING / HOSTING: Host Registration – Domain Registering – Server FTP Upload – AJAX – JSON - MySQL.(6+6)

Total L: 30 + T:30 = 60

TEXT BOOKS:

1. Elizabeth Castro and Bruce Hyslop, “Visual Quickstart Guide: HTML5 and CSS3”, Peachpit Press, 2014.
2. David Flanagan, “JavaScript: The Definitive Guide”, O'Reilly Media, 2020.

REFERENCES:

1. Larry Ullman, “PHP for the Web”, Peachpit Press, 2016.
2. Luke Welling and Laura Thomson, “PHP and MySQL Web Development”, Pearson Education, 2016.
3. Robin Nixon, Learning PHP, MySQL & Java Script, O’Reilly, 2018
4. Jennifer Niederst Robbin, Learning Web Design, O’Reilly, 2018.

21S062 ENTERPRISE COMPUTING

2 2 0 3

DISTRIBUTED SYSTEM COMPUTING : Types of UI – CSS – Client Side Scripting- Operating System Services for Client – Server Types – Server Side Scripting – Operating System Services for Server – Client and Server Software Requirements. (6+6)

DISTRIBUTED MULTI-TIER COMPUTING: Basis of Distributed Computing – Decomposition Approaches – Layers and Tiers Component Based Software Development for Enterprise – Enterprise Architectural Overview – Java Enterprise System - EJB. (6+6)

COMMUNICATION: Message Passing - Features and Issues – Synchronization – Buffering – Process addressing – Failure handling – Remote Procedure Call: Model – Implementation – Stub generation – RPC messages – Marshaling –Server management – Call semantics – IDL – UUID. (6+6)

MIDDLEWARE: Architecture – Classification of Middleware – Architecture of Middleware – Communication Middleware – ODBC – JDBC – Connection – Statement - Transaction Middleware – Isolation – Interfacing –RMI - COM- DCOM - CORBA. (6+6)

ENTERPRISE WEB COMMUNICATION AND FRAMEWORKS: – Java Servlets – Packages - Generic Servlets - HTTP Servlet – Session Management - JSP – Elements of JSP – Directives - Java Beans in JSP – JSTL - Libraries.Introduction to Frameworks – Spring – Hibernate - Laravel (6+6)

Total L: 30 + T: 30 = 60

TEXT BOOKS:

1. Robert Orfali, Dan Harkey and Jeri Edwards, “Client / Server Survival Guide”, Wiley, 2011.
2. Liu M L, “Distributed Computing: Principles and Applications”, Pearson Education, 2013.

REFERENCES:

1. George Reese, “Database programming, with JDBC and Java", O’Reilly, 2013.
2. Bruce W. Perry, "Java Servlet and JSP Cookbook", Shroff Publisher, 2013.
3. Jim Keogh, “J2EE: The Complete Reference”, Tata McGraw Hill, 2011.
4. Dustin R. Callaway, "Inside Servlets", Pearson Education, 2009

21S063 MOBILE APPLICATION DEVELOPMENT

2 2 0 3

INTRODUCTION: Introduction to mobile applications - Importance of mobile applications – Strategies and challenges – Software and hardware requirements for developing mobile applications – Types of mobile applications – Benefits of creating mobile applications – Marketing and advertising mobile applications – Mobile devices overviewandclassification. (6+6)

MOBILE USER INTERFACE DESIGN: Mobile application users – Social aspect of mobile interfaces - Accessibility – Design patterns – Designing for the various mobile platform - Adaptive Mobile Websites – DedicatedMobileWebsites. (6+6)

MOBILE APPLICATIONS ARCHITECTURE: Smart Client – Smart Client Architecture – Messaging Architecture – The Model-View-Controller Model- Delegate Pattern- Building Smart Client Applications-Design, Development, implementation, testing and deployment phase- MVVM mobilearchitecturedesign. (6+6)

MOBILE APPLICATION DEVELOPMENT: Introduction to Android Platform – Android architecture overview - Application life cycle - UI design for Android - UI fragments - Different types of layouts – Widgets – List view – View pager-Dialogs, (6+6)

DATABASE : Files and database – SQLite on Android – Loading asynchronous data - Map API to RunTracker – Showing user"s location on Map. (6+6)

Total L: 30 + T:30 = 60

TEXT BOOKS:

1. Jeff McWherter and Scott Gowell , “Professional Mobile Application Development”, John Wiley & Sons,2012.
2. BillPhilips,KristinMarsicanoandChrisStewart,“AndroidProgramming:ThebigNerdRanchguide”,O"Reilly,2017.

REFERENCES:

1. Ronan Schwarz, Phil Dutson, James Steele and Nelson To, “The Android Developer's Cookbook -Building Applications with the Android SDK”, Addison Wesley,2013.
2. Mark Murphy, “The Busy Coder's Guide to Android Development”, Commons Ware,2009.
3. Martyn Mallick, “Mobile and Wireless Design Essentials”, Wiley,2003
4. Dawn Grimths and David Grimths, Head First Android Development, O'Reilly, 2015.

21S064 OPERATING SYSTEMS

2 2 0 3

INTRODUCTION AND PROCESS CONCEPTS: Abstract view of an operating system - Operating Systems Objectives and Functions – Evolution of Operating Systems - Dual-mode operation - System calls- Structure of Operating System- Process concepts - Process Creation – Process Termination - Process states - Process Description – Process Control.-Relationship between process and threads – Thread States – Thread Synchronization – Types of Thread – Multithreading model. (6+6)

PROCESS SCHEDULING AND SYNCHRONIZATION: Scheduling basics - CPU-I/O interleaving- (non-)preemption - context switching- Types of Scheduling – Scheduling Criteria - Scheduling Algorithms – Algorithm evaluation – Real-time scheduling.- Concurrent Process – Principles of Concurrency – Race Condition - Mutual Exclusion – Critical section problems – Software support – Hardware Support – Operating System Support: Semaphore, Monitor – Classical problems of synchronization – Synchronization examples. (6+6)

DEADLOCK AND MEMORY MANAGEMENT:Principles- Characterization – Methods for handling deadlock - Deadlock prevention, Avoidance, Detection, and recovery-Memory hierarchy –Memory Management requirements - Memory partitioning: Fixed partitioning, Dynamic partitioning, Buddy systems – Simple paging – Page table structures – Simple Segmentation – segmentation and aging. (6+6)

VIRTUAL MEMORY AND I/0 MANAGEMENT: Need for Virtual Memory management – Demand Paging –Copy on write -Page Fault handling - Page replacement - Frame allocation- Thrashing - working set model. Organization of I/O function – Evolution of I/O function – Types of I/O devices – Logical Structure of I/O functions - I/O Buffering - Disk I/O - Disk Scheduling algorithms - RAID - Disk Cache. (6+6)

FILE SYSTEM MANAGEMENT: Files – Access methods - File system architecture – Functions of file management –Directory and disk structure -Mounting - File sharing –File system implementation – Directory implementation - File Allocation – Free space management. (6+6)

Total L: 30 + T: 30 = 60

TEXT BOOKS:

1.Silberschatz A, Galvin, PB. and Gagne, G. “Operating System Concepts Essentials”, John Wiley,2016.
2.William Stallings, “Operating Systems”, Pearson Education, 2015.

REFERENCES:

1. Elmasri, E., Carrick A.G. and Levine, D. “Operating Systems: A Spiral Approach”, McGraw Hill, 2012.
2. McHoes, AM and Flynn, I.M. “Understanding Operating Systems”, Cengage Learning, 2013.
3. Dhamdhere D M, “Operating Systems: A Concept-based Approach”, Tata McGraw-Hill, 2012.
4. Andrew S Tanenbaum, "Modern Operating System", Prentice Hall, 2015.

21S065 ADVANCED DATA STRUCTURES

2 2 0 3

INTRODUCTION: Algorithm – analysis of algorithms – best case and worst case complexities, analysis of recursive algorithm – Master’s theorem (6+6)

BINARY SEARCH TREES AND AVL TREES: Searching – Insertion and deletion of elements – Analysis- AVL Trees-Definition – Height – searching – insertion and deletion of elements, AVL rotations–Analysis. (6+6)

MULTIWAY SEARCH TREES: Indexed Sequential Access – m-way search trees – B-Tree – searching, insertion and deletion - B+ trees -Tries. (6+6)

HASHING: Hashfunction–Separatechaining–openaddressing–Linearprobing–quadraticprobing–Doublehashing. (6+6)

GRAPHS: Representations – adjacency matrix, linked adjacency list – graph search methods – Breadth First search and Depth First search – Applications. (6+6)

Total L: 30 + T: 30 =60

TEXT BOOKS:

1. Alfred V. Aho, John E. Hopcraft,Jeffrey D. and Ullman, “Data structures and Algorithms”, Pearson Education,2009.
2. Michael T. Goodrich, “Data Structures and Algorithms in C++”, John Wiley & Sons,2011.

REFERENCES:

1. SahniSartaj, “Data Structures, Algorithms and Application in C++”, Universities Press,2011.
2. Robert L. Kruse, Clovis L. Tondo, Bruce P. Leung and shashiMogalla, “Data Structures and Program design in C”, Pearson Education, 2009.
3. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Pearson Education,2009.
4. Narasimha Karumanchi, “Datat Structures and Algorithms, Careermonk Publications, 2016.

PHYSICS CLUSTER

21S070 COMPUTERISED MEASUREMENTS WITH OPEN SOURCE TOOLS

2 2 0 3

THE ExpEYES SYSTEM: Open source hardware and software measurement platform. Hardware- block diagram, input and output terminals and their functions, classification into digital and analog sections. The Graphical User Interface (GUI) – options for text input and output display. Analog voltage input and output using the GUI and the hardware terminals. ExpEYES17 oscilloscope interface and context based help system and manuual . (7+7)

EXPERIMENTS USING THE ExpEYES SYSTEM: Temperature measurement using PT100 resistive sensor and LM35 electronic temperature sensor. Differential equation of a capacitor charge and discharge through a resistor- study of the RC charge and discharge characteristics using ExpEYES and ExpEYES17 system system. Fourier analysis of waveforms. (7+7)

ExpEYES HARDWARE: Commands- one byte, two byte and three byte commands. Communicating the commands from PC to the microcontroller- text based communication over the USB physical interface- the virtual serial port. Generating commands using a PC – software requirements. Flow chart of the software for identifying the ExpEYES hardware signature code (7+7)

PYTHON PROGRAMMING FOR THE ExpEYES INTERFACE: Special packages required and their purpose- expeyes, scipy, numpy, pyserial. Importing expeyes and other functions into the python environment. Basic python library for generating ExpEYES commands over the USB interface. Python commands for the ExpEYES17 system. Display of measured outputs in text format. (7+7)

ExpEYES17 Oscilloscope : Hardware, terminals and functions- performance improvements. The oscilloscope interface- python library for basic functions. Measurement of voltages and display of waveforms- waveform analysis experiments using the oscilloscope interface. (2+2)

Total L:30 + T:30 = 60

TEXT BOOK:

1. Python for Education, Ajith Kumar B.P IUAC publications New Delhi,110067 – 2010

REFERENCES:

1. Expeyes User Manual , BP ajith kumar, IUAC publications New Delhi, 2011
2. Expeyes17 User Manual , BP ajith kumar, IUAC publications New Delhi, 2017
3. Expeyes Programmers manual, BP ajith kumar, IUAC publications, New Delhi, 2011
4. System hardware and software source files and other resources available online under OGL at http://expeyes.in

21S071 THERMAL PROPERTIES

2 2 0 3

Thermal Conductivity: Definitions, values of thermal conductivity of common substance. Measurement techniques and considerations for determining thermal conductivity of bulk materials – Steady state method, Radial flow method, Laser-Flash diffusivity, Pulse power. Applications – Metals, polymers and ceramics. (6+6)

Heat Capacity: Definitions, values of heat capacity of common substance. Differential thermal analysis and differential scanning caloriemetry. Apparatus – sensor, furnace, reference material. Calibration. Applications – Chemical reactions, Inorganic compounds and complexes. (6+6)

Thermogravimetry: Definitions. Thermogravimetry analysis. Apparatus- Balance, furnace, samples, atmosphere. Temperature calibration, Applications: Analysis of mixtures, oxidation and reduction studies, polymer blends, fuel additives and drugs. (6+6)

Thermoelectrics: Thermoelectric phenomena, Conversion efficiency and figure of merit. Thermoelectric transport theory. Calculation of Peltier device performance, measurement of electrical and thermal properties. Methodology for testing thermoelectric materials and devices. (6+6)

The Measurement of Temperature: Temperature Scales, The Ideal-Gas Thermometer, Temperature Measurement by Mechanical Effects, Temperature Measurement by ElectricalEffects, Temperature Measurement by Radiation, Effect of Heat Transfer on Temperature Measurement , Transient Response of Thermal Systems (6+6)

Total L : 30+t:30 =60

TEXT BOOK:

1. Terry M. Tritt, “Thermal Conductivity: Theory, Properties and Applications”, Springer, 2004.
2. Jack P. Holman, “Experimental methods for engineers”, McGraw-Hill 7th Edition 2001.

REFERENCES:

1. Haines P J., “Thermal Methods of Analysis: Principles, Applications and Problems”, Blackie Academic and professional, 1995.
2. Rowe D M., “CRC Handbook of Thermo electrics”, CRC Press, 1995.

3. Kenneth E. Wilkes, Ralph B. Dinwiddie and Ronald S. Graves, “Thermal conductivity 23” 1st Edition by Taylor and Francis group CRC Press,1996.
4. Alain Degiovanni and Yves Jannot, “Thermal Properties Measurement of Materials”, Wiley, 2018.

21S072 OPTICAL MEASUREMENTS

2 2 0 3

INTERFEROMETRY : Principle of interferometry. Principles of the Michelson’s Interferometer and Fabrey-perot interferometer and their suitability for mechanical measurements. Advantages of laser interferometry, applications in metrology and Computer Numerical control. Measurement of thickness of thin films. (6+6)

ANEMOMETRY: Fluid flow velocity measurements by flow seeding. Laser Doppler anemometry. Shadowgraphy and Schlieren Photography. Interferometric flow measurement Mach-Zehnder interferometer . (6+6)

PULSE TECHNIQUES: Non-contact dimension measurements. Laser ranging. Astronomical measurements. Correction of atmospheric turbulence effects using adaptive optics. (6+6)

Force, Torque, and Strain Measurements : Mass Balance Measurements,Elastic Elements for Force,Measurements,Torque Measurements,Stress and Strain, Strain Measurements,Electrical-Resistance Strain Gages, Measurement of Resistance Strain-Gage Outputs, Temperature Compensation, Strain-Gage Rosettes, The Unbonded Resistance Strain Gage (6+6)

OPTICAL SPECTROSCOPY: Measurement of optical absorption and emission spectra, Fibre-optic spectrophotometer-computer based measurements. Definition of colour. Additive and subtractive colour mixing. Determination of colour using optical spectrophotometry. (6+6)

Total L :30+T:30 =60

TEXT BOOKS:

1. Francis Jenkins and Harvey White, “Fundamentals of Optics”, McGraw-Hill Science, 2001.
2. Jack P. Holman, “Experimental methods for engineers” , McGraw-Hill,2001.

REFERENCE:

1. M.L. Gulrajani (ed), “Colour Measurement”, Woodhead Publishing, 2010.
2. Arthur McClelland and Max Mankin, “Optical Measurements for Scientists and Engineers”, Cambridge University Press, 2018.
3. Richard Leach, “Optical Measurement of Surface Topography”, Springer Berlin Heidelberg 2011.
4. Dieter Mewes and Markus Lehner. “Applied Optical Measurements”, Springer, 2012.

21S073 ELECTRICAL MEASUREMENTS

2 2 0 3

PHILOSOPHY OF MEASUREMENT: Methods of Measurement, Measurement System, Classification of instrument system, Characteristics of instruments & measurement system, Errors in measurement & its analysis. (6+6)

ANALOG MEASUREMENT OF ELECTRICAL QUANTITIES: Electrodynamic, Thermocouple, Electrostatic & Rectifier type Ammeters and Voltmeters, Electrodynamic Wattmeter, Three Phase Wattmeter, Power in three phase system, errors & remedies in wattmeter and energy meter. (6+6)

INSTRUMENT TRANSFORMERS: Instrument Transformer and their applications in the extension of instrument range, Introduction tomeasurement of speed, frequency and power factor. (6+6)

DIGITAL MEASUREMENT OF ELECTRICAL QUANTITIES: Digital Multi-meter: Block diagram, Accuracy of measurement, Electronic Voltmeter: Transistor Voltmeter, Block diagram, various types of electronic voltmeter. Digital Frequency meter: Block diagram, principle of operation. (6+6)

MEASUREMENT OF PARAMETERS: Includes the modern methods of measuring current, resistance by two probe and four probe method, electromotive force, capacity, and hysteresis of iron and losses for different kinds of steel. (6+6)

Total L :30+T:30=60

TEXT BOOKS:

1. E.W. Golding & F.C. Widdis, “Electrical Measurement & Measuring Instrument”, A.W. Wheeler& Co. Pvt. Ltd. India 2004.
2. A.K. Sawhney,“Electrical & Electronic Measurement & Instrument”, Dhanpat Rai & Sons , India 2015.

REFERENCES:

1. Forest K. Harries,“Electrical Measurement”,Willey Eastern Pvt. Ltd. India 2014 .
2. M.B. Stout ,“Basic Electrical Measurement” Prentice hall of India,India 1965.
3. W.D.Cooper,” Electronic Instrument & Measurement Technique “ Prentice Hall International 1985.
4. Rajendra Prashad ,“Electrical Measurement &Measuring Instrument” Khanna Publisher, 2005.

21S074 MAGNETIC MEASUREMENTS

2 2 0 3

ODUCTION TO MAGNETISM: Basic concepts- Magnetic field, Magnetic field strength, Magnetic force, Biot - Savart law, Ampere's circuital law, Magnetic flux, Magnetic induction, Magnetic dipole, magnetic moment, magnetization, Laws of electromagnetic induction, Self and mutual induction, unit systems in magnetism. (6+6)

MAGNETIC MATERIALS: Types of magnetic materials such as dia-, para-, ferro-, antiferro andferromagnetic materials. **Magnetic domains and hysteresis loops -**Demagnetization effects, magneto-static, magnetic anisotropy and exchange energies. Magnetostriction and magnetoelastic energy. **Soft and hard magnetic materials.** (6+6)

PRODUCTION OF MAGNETIC FIELDS: Permanent and electromagnets- Magnetic field at the centre of a long thin solenoid, magnetic field due to circular coil: field on the axis and off the axis, Magnetic field due to two coaxial coils: in superposition and in opposition, Magnetic field due to thin finite and thick finite solenoids. (6+6)

MAGNETIC FIELD AND MAGNETIZATION MEASUREMENTS: Induction methods- Stationary coil method moving coil (extraction method), Rotating coil method, Principle of working, design and method of measurement of Vibrating coil magnetometer, Vibrating sample magnetometer (VSM), Fluxgate magnetometer, and Super Conducting Quantum Interference Device (SQUID) magnetometer, AC susceptometer and hall magnetometer. (6+6)

MAGNETIC METHODS FOR MATERIALS EVALUATION: Methods for evaluation of intrinsic properties- Magnetic Barkhausen effect (MBE), Magneto acoustic emission (MAE), Magnetic hysteresis, Residual field and remanent magnetization. Magnetic method for detection of flaws and inhomogeneities: Magnetic particle inspection (MPI), Magnetic flux leakage, Eddy current inspection. (6+6)

Total L:30 + T:30 =60

TEXT BOOKS:

1. David Jiles, "Introduction to Magnetism and magnetic materials", Chapman & Hall, United Kingdom, 1994.
2. B.D.Cullity and C.D. Graham, "Introduction to magnetic materials", Wiley, United states, 2008

REFERENCE BOOKS:.

1. David Halliday, Robert Resnick, Jearl Walker, " Fundamentals of Physics", Wiley, United States, 2018.
2. Richard Wolfson, " Essential university Physics", Pearson, London, 2016,
3. Willaim D Callister Jr, "Materials Science and Engineering: An introduction", John Wiley & Sons Inc, United States, 2007
4. SlawomirTumanski, "Handbook of Magnetic Measurements" CRC Press- Tayler and Francis, United Stars, 2011.

21S075 PLASMA PHYSICS AND APPLICATIONS

2 2 0 3

GASES AND COLLISION PROCESS: Masses and Number of atoms, kinetic energy and temperature, mean speed , pressure, Avogadro's Laws, number density of gases, impingement flux, monolayer formation time, mean free path, probability of collision, energy transfer and collision frequency. Gas flow types. Ionization, excitation, relaxation, recombination, dissociation, electron attachment, Ion-neutral collisions, Metastable collisions. (7+7)

GLOW DISCHARGE: Plasma species, Electron and Ion temperature, plasma potential. Glow discharges: DC discharges, RF discharges, Microwave discharges, Dielectric barrier discharges**.** Low temperature plasma generation sources. (6+6)

PLASMA DIAGNOSTICS: Plasma diagnostics: Electrical probe techniques, spectroscopic methods, Optical emission Spectroscopy, Magnetic diagnostics. (6+6)

SUBSTRATE SURFACE INTERACTION WITH PLASMA: Etching effects of Plasma on Substrate Surface, Radical Formation on Substrate Surface, Chain Scission of Surface Molecules on Polymer Substrate, Cross-linking Formation, Functionalization on Polymer Surface by Gas Plasma Treatment, (7+7)

PLASMA ASSISTED DEPOSITION TECHNIQUES: Physical vapor deposition. Plasma enhanced chemical vapor deposition. Process optimization. (4+4)

Total L: 30 + T:30 = 60

TEXT BOOKS:

1. Edited by Gang Sun " Antimicrobial Textiles" , Woodhead Publishing in association with the Textile Institute, UK, 2016.
2. Brian Chapman, "Glow Discharge Processes : Sputtering and Plasma Etching", John Wiley and Sons, US, 1980, Kindle edition, Wiley and InterScience, USA, (2008)

REFERENCES:

1. M. Konuma, "Plasma Techniques for Film Deposition", Alpha Science International Ltd, Verlag, 2005.
2. Milton O'Ring, "Materials Science of Thin Films", Academic Press, 2002.
3. Edited By Paul K. Chu,XinPei Lu, " Low Temperature Plasma Technology: Methods and Applications", CRC Press, 2020

21S076 CRYSTAL GROWTH TECHNIQUES

2 2 0 3

FUNDAMENTALS OF CRYSTAL GROWTH: Materials preparation: Liquid – liquid extraction, ion exchange, gas and liquid chromatography. The crystalline state – classification of crystal growth methods – Generation of reactants – Transport of reactants to the growth surface – Theories of nucleation – Classical theory –Nucleation – homogeneous and heterogeneous nucleation. (6+6)

THEORIES OF CRYSTAL GROWTH : Surface energy theory, Diffusion theory and Adsorption layer theory – concepts of Volmer theory, Bravais theory, Kossel theory and Stranski's treatment – nucleation – Mononuclear, Polynuclear and Modified Birth and Spread models. (6+6)

MELT GROWTH TECHNIQUES: Basics of melt growth – Heat and mass transfer – Conservative growth processes: Bridgman – Stockbarger method – Czochralski pulling method – Kyropolous method – Non-conservative processes: Zone-refining – Vertical and horizontal float zone methods (6+6)

SOLUTION GROWTH TECHNIQUES: Growth from low temperature solutions: Selection of solvents and solubility – Meir's solubility diagram – Saturation and supersaturation – Metastable zone width – Growth by restricted evaporation of solvent, slow cooling of solution and temperature gradient methods - Crystal growth in Gel media: Chemical reaction and solubility reduction methods – Growth from high temperature solutions: Flux growth Principles of flux method – Choice of flux – Growth by slow evaporation and slow cooling methods – Hydrothermal growth method. (6+6)

VAPOUR GROWTH TECHNIQUES: Basic principles – Physical Vapour Deposition (PVD): Vapour phase crystallization in a closed system – Chemical Vapour Deposition (CVD): Advantages and disadvantages – growth by chemical vapor transport reaction: Transporting agents, Sealed capsule method, Open flow systems – Temperature variation method: Stationary temperature profile, Linearly time varying temperature profile and Oscillatory temperature profile. (6+6)

Total L: 30 + T: 30 =60

TEXT BOOKS:

1. Crystals: Growth, Morphology and Perfection, Ichiro Sunagawa, Cambridge University Press, Cambridge, 2007.
2. Crystallization, Mullin J W, Elsevier Butterworth-Heinemann, 2001.

REFERENCE:

1. Crystal growth processes,Brice J C, John Wiley and Sons, 1986.
2. Crystal Growth , B.R. Pamplin, Elsevier Science, 2014
3. Crystal Growth: Principles and Progress, A.W .Vere, Springer US, 1987

21S077 CERAMICS AND COMPOSITES

2 2 0 3

CERAMIC STRUCTURES: Introduction, properties, type of bonds in ceramics, applications of ceramics, advanced and traditional ceramics, refractories, cement, glass and glass ceramics, types of ceramics, classification by composition, processing technique, properties and applications, crystal structure structural rules, common ceramic structures, rocksalt structure, zinc blend structure, corundum, silicate structures, glass, etc., ceramic raw materials, synthesis of powders, powder characteristics, effect of impurities (6+6)

CERAMIC PROCESSING: Sol –Gel Process: Hydrolysis & condensation of silicates and non-silicates – particulate sol & gel – gelation – aging of gel – drying – structural evolution during consolidation – comparison of gel derived and conventional ceramics. Agglomeration Process: Agglomeration Theories – Agglomeration Technologies: Tumble/Growth Agglomeration, Pressure Agglomeration, Agglomeration by Heat / Sintering – Engineering Criteria and Development (6+6)

PROPERTIES AND APPLICATIONS OF CERAMIC MATERIALS: Dielectric properties – Dielectric constant – Dielectric strength and dielectric loss factor. Mechanical properties – Fracture toughness, strength of ceramics. Ceramic cutting tools. Thermal properties – Thermal stress, thermal shock and thermal conductivity. (5+5)

COMPOSITES: Particle reinforced composites, fiber reinforced composites – influence of fiber length, orientation and concentration. Fiber phase, matrix phase, metal matrix composites, polymer matrix composites, ceramic matrix composites, carbon – carbon composites, hybrid composites and structural composites. (3+3)

MANUFACTURING METHODS : Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface, mechanical. Measurement of interface strength. Characterization of systems; carbon fibre/epoxy, glass fibre/polyester. (6+6)

Total L : 30 + T :30 = 60

TEXT BOOKS:

1. Michel W Barsoum, "Fundamentals of Ceramics", McGraw Hill Book Co., 2002.
2. Krishnan . K. Chawla "Composite Materials: Science and Engineering", Springer, 2010.

REFERENCES:
1. Kingery W.D. Bowen H.K and Uhlmann D.R., "Introduction to Ceramics", John Wiley and Sons, 2004.
2. R. M. Jones, Mechanics of Composite Materials, CRC Press, 1998
3. M. Mukhopadhyay, Mechanics of Composite Materials, University Press, 2004

CHEMISTRY CLUSTER

21S085 CHEMISTRY OF WATER TECHNOLOGY

2 2 0 3

PHYSICO-CHEMICAL CHARACTERISTICS OF NATURAL WATER: Introduction – water quality – drinking water supplies – water for irrigation – saline water – organic load – chemical parameters governing water quality – classification of water quality – examples of surface water quality in india. Water quality standards IS 10500. Water quality for municipal supply - disinfection – hypochlorites, chlorine, chloramines, ozone and UV treatment. (6+6)

PROPERTIES OF WATER AT HIGH TEMPERATURE AND PRESSURE: Thermochemical and thermo physical properties – properties of water below 100 °C and above 100 °C – ionic product of water – effect of temperature. Corrosion in aqueous system – solubility of magnetite (Fe_3O_4) – zeta potential. (6+6)

NATURAL WATER FOR INDUSTRIAL COOLING SYSTEM: Materials in a cooling water circuit – use of inhibitors – cooling water treatment - role of alkalinity in steam water circuits – deaeration – biofouling in natural waters. (6+6)

DETERMINATION OF HARDNESS: Lime soda process – limitations, Demineralisation - ion-exchange method – ion exchange resins – properties – demineralization of water – mixed-bed treatment – regeneration methods. Quality of demineralised water - soap titration and complexometric methods. Desalination by electro-dialysis and reverse osmosis. (6+6)

WATER QUALITY REQUIREMENT FOR BOILERS AND TURBINES: Boiler types – water quality limits for boiler feed water – chemical regimes for boiler feed water, boiler water and condensate. High pressure turbines – quality of steam. (6+6)

Total L: 30 + T: 30 = 60

TEXT BOOKS:
1. Benjamin M M, "Water chemistry", Waveland press, 2014.
2. Brezonik P L and Arnold W A, "Water chemistry: An introduction to the chemistry and natural engineering aquatic systems", Oxford university press, 2011.

REFERENCES:
1. Sharma B K, "Industrial chemistry", Goel publishing house, Meerut. 2009.
2. Kuriacose J C and Rajaram J, "Chemistry in engineering and technology", Vol I & II, Tata McGraw Hill, 2012.
   Gray N, "Water science and technology: An introduction", CRC press, 2017.
3. Roussak O V and Gesser H D, "Applied chemistry: A textbook for engineers and technologists", Springer, London, 2016

21S086 POLYMER SCIENCE AND TECHNOLOGY

2 2 0 3

POLYMERS: Basic concepts and definitions. Classification – natural vs synthetic – polymer structure (linear, branched, cross linked) – amorphous and crystalline – homo and copolymer. Fibers, plastics and elastomers. Nomenclature of polymers, distinction among plastics, elastomers, fibers, thermosets and thermoplastics. Polymerization mechanisms: Chain reaction – ionic – coordination – step growth – ring opening polymerization. (6+6)

THERMAL AND MECHANICAL PROPERTIES OF POLYMERS: Glass transition temperature- theories of glass transition and measurement of Tg-Differential Scanning Calorimeter. Thermal Stability-thermo gravimetric analysis. Mechanical properties: Stress-strain relations –rheology- deformation of polymers - mechanical properties –tensile strength, compression strength, impact strength, hardness-determination. (6+6)

ENGINEERING AND SPECIALITY POLYMERS: Synthesis, properties and applications – ABS, Polyamides, polycarbonates, polyimides, silicones, fluoropolymers, thermoplastic elastomers, polyurethanes and ionomers. Polymer for membrane applications-mechanism of transport and membrane preparation. Polymers for biomedical applications-artificial organs-controlled drug delivery, hemodialysis and hemofiltration. Polymers for electronic applications-conductive polymers, electronic shielding. (6+6)

POLYMER BLENDS AND COMPOSITES: Polymer blends-toughened plastics and phase separated blends, interpenetrating network-applicationsPolymers composites-classifications, reinforcements and matrixes-fillers and coupling agents – wettability and interface bonding. Fabrication-hand layup,compression and injection moulding, vacuum bag moulding, pressure bag moulding, autoclave moulding, filament winding and pultrusion. (6+6)

IDENTIFICATION AND TESTING OF POLYMERS: Natural rubber, synthetic rubber, chlorine containing polymers, nitrogen containing polymers. FTIR, X-ray, thermal analysis, flammability and chemical resistance. (6+6)

Total L: 30 + T: 30 = 60

TEXT BOOKS:
1. J A Brydson, "Plastic Materials" Butterworth Heinemann Ltd. Oxford, 2017.
2. Friend J R, 'Polymer science and technology' Prentice-Hall of India private limited, 2014.

REFERENCES:
1. Carraher C E Jr, "Carraher's polymer chemistry", CRC press, 2017.
2. Seymour R B, "Pioneers in polymer science", Kluwer academic press, 2016.
3. Sperling L H, "Introduction to physical polymer science:, CRC press, 2016.
4. Gowarikar V R, Viswanathan N V and Sreedhar J, 'Polymer Science', New Age International private limited, 2013.

21S087 FOOD CHEMISTRY

2 2 0 3

FOODS, NUTRITION AND HEALTH: Introduction- definition, types and functions of food. Specific nutrients in foods - composition and its functions. Food as a source of nutrients. Malnutrition –nutrition deficiency diseases. Food guide -basic five food groups, usage and their nutrition contribution. Food pyramid, principle and its significance- concept of balanced diet. Nutrient dietary requirements and reference values. Carbohydrates in food: Composition, classification, sources, functions and chemistry of mono, di, oligo and polysachharides - caramelization. Starches in food: Nutritive value – chemistry of amylase, amylopectin and gels. (6+6)

CEREAL PRODUCTS AND PROTEINS: Definition – composition and structure of cereal grains -. Common cereal grains and their uses: Wheat, rice, corn, barley, millet, oats and rye - nutritive value. Effect of nutrient content on parboiling and milling of cereals. Malting of cereals. Processed cereal products: Whole wheat flour – maida- semolina-macaroni – rice bran- puffed rice-rice flakes- corn oil-popcorn- corn starch. Fermented cereal products and its advantages- advantages of including a combination of cereals in the menu. Proteins in foods: Reactions and properties of proteins – denaturation- maillard browning. Pulses: definition - classification - processing - structure of pulses - composition and nutritive value - toxic constituents in pulses –germination and its advantages. (6+6)

FRUITS, VEGETABLES AND BEVERAGES: Fruits -classification - composition–flavour constituents – ripening of fruits – enzymatic oxidative browning. Vegetables – classification – colour pigments- flavor – effect of heat on vegetables –vegetarian food choices – nutritive value of vegetables and fruits. Beverages – tea, coffee, chocolate, soups, water and fruit juices – synthetic fruit flavoured drinks- carbonated drinks- alcoholic beverages and cirrhosis of liver and social problems. (6+6)

FOOD ADDITIVES: Definition – classification and their functions. Antioxidants and radical scavengers – emulsifiers- stabilizers, gums, thickeners and gelling agents. Sweeteners: classification – properties -artificial sweeteners – sugar alcohols. Food flavorings: classification and chemistry of flavourings. Food acids and acid regulators: Types and uses. Food colour and colour retention agents: classification and chemistry of food colourants. Anticaking agents: Mechanisms of caking. Humectants and its functions. Antifoaming and Glazing agents and its functions. (6+6)

FOOD PRESERVATION AND QUALITY CONTROL: Importance of food preservation – food spoilage. Preservation principles-methods of food preservation-bacteriostatic-dehydration-sun drying- smoking-mechanical drying-addition of salt or sugar- uses of oil and spices- use of acid- use of chemical preservatives examples – low and high temperatures(pasteurization)- boiling and canning- food irradiation. Quality specifications and standards: PFA, FPO, FDA, drug license, WHO standards and ISI specifications. (6+6)

Total L: 30 + T: 30 = 60

TEXTBOOKS:
1. Meyer. L.H., "Food Chemistry" CBS Publishers & Distributors, 2004.
2. Msagati, Titus AM. The chemistry of food additives and preservatives. John Wiley & Sons, 2012.

REFERENCES:
1. Sri Lakshmi.B. "Food Science" New Age International Publications, 2005.
2. Sumathi, M.R. and Raja gopal, M.V. "Fundamentals of Foods and Nutrition" - Wiley Eastern Ltd., Madras. 2005.
3. Potter. N.N., "Food Science", Springer Science, New York, 2013.
4. Lean, M.E.J.,"Fox and Cameron'sFood Science, Nutrition and Health", Hodder Arnold,London. 2006.

21S088 CHEMISTRY OF INDUSTRIALLY IMPORTANT MATERIALS

2 2 0 3

INTRODUCTION TO MATERIALS: Types of materials – historical perspective – role of chemistry in materials science. Solid state materials, amorphous and crystalline. Ionic solids, metallic solids, molecular solids and covalent network solids. Mining and processing of metals – powder metallurgy. Extraction of iron. Alloys of iron – hardening mechanism of steel – stainless steel. Non-ferrous metals and alloys – magnetism in metals and alloys. Hydrogen storage metals. (6+6)

POLYMERIC AND COMPOSITE MATERIALS: Classification – nomenclature – properties related to structure and applications – conducting polymers (ionic and electronic) – inorganic polymers – dendrimers and hyper branched polymers – polymer liquid crystals – coordination polymers – photoresist – textile polymers. Composite materials: polymeric, fiber, metal and ceramic composites – applications. (6+6)

LIQUID CRYSTALS: Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases, smectic – nematic transition and clearing temperature - homeotropic, planer and schlieren textures, twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic B phasesopoptical properties of liquid crystals, dielectric susceptibility and dielectric constants. Lytropic phases and their description of ordering in liquid crystals. (6+6)

IONIC CONDUCTORS: Types of ionic conductors, mechanism of ionic conduction, interstitial jumps (Frenkel); vacancy mechanism, diffusion superionic conductors; phase transitions and mechanism of conduction in superionic conductors, examples and applications of ionic conductors. (6+6)

ORGANIC SOLIDS, FULLERENES AND MOLECULAR DEVICES: Organic conductors, organic superconductors, magnetism in organic materials. Fullerenes - dopped, fullerenes as superconductors. Molecular rectifiers and transistors, artificial photosynthetic devices, optical storage memory and switches- sensors. Nonlinear optical materials; nonlinear optical effects, second and third order - molecular hyperpolarisability and second order electric susceptibility, materials for second and third harmonic generation. (6+6)

Total L: 30 + T: 30 = 60

TEXT BOOKS:
1. Gray. G.W., "Thermotropic Liquid crystals"John Wiley.2010
2. Allcock H R, "Introduction to materials chemistry", John Wiley & Sons, 2011.

REFERENCES:
1. Callister. W.D., "Material Science and Engineering - An Introduction", Wiley.2009.
2. Keer. H.V. "Principles of the Solid State", New age international publications, New Delhi.2005.
3. Anerson,K.D., Leaver,J.M., Leevers. P. and Rawlings. R.D., "Materials Science", CRC Press, 2004.
4. Fahlman B D, "Materials chemistry", Springer, 2010.

21S089 CORROSION SCIENCE AND ENGINEERING

22 0 3

CORROSION THERMODYNAMICS: Need for corrosion education, corrosion electrochemistry, corrosion thermodynamics – free energy, standard electrode potentials, Nernst equation. Three electrode system. Potential-pH diagram – E-pH diagram of water, E-pH diagrams of Fe and Al. (6+6)

KINETICS OF AQUEOUS CORROSION: Corrosion current density and corrosion rate, exchange current density. Polarization - activation control, Tafel equation, mass transport control, mixed potential theory and behavior of galvanic couples in acidic environments, effect of oxidizer, combined polarization, factors affecting polarizations and rate of corrosion. Passivity, potentiostatic polarization curves, factors affecting passivity - mechanism of action of passivators (6+6)

FORMS OF CORROSION: General corrosion - atmospheric corrosion, galvanic corrosion, general biological corrosion. Localized corrosion - filiform corrosion, crevice corrosion, pitting corrosion, localized biological corrosion. Metallurgically influenced corrosion -inter granular corrosion and de-alloying. Mechanically assisted corrosion: Erosion corrosion, fretting corrosion and corrosion fatigue. Environmentally induced cracking – mechanisms of stress corrosion cracking and hydrogen embitterment. (6+6)

PREVENTION AND CONTROL OF CORROSION: Corrosion control by design. Selection of corrosion resistant materials – alloying, stainless steel and brass. Oxidation resistant materials, control of high temperature oxidation. Cathodic and anodic protection methods. Use of inhibitors – types and its applications. Corrosion in cold water pipes - Langalier saturation index. (6+6)

CORROSION MONITORING AND TESTING: Introduction - on-stream monitoring – electrical resistance, linear polarization and corrosion coupons. Off-stream monitoring equipment's – eddy current inspection, eddy current test, microscopic examination. Weight charge – specimen preparation, evaluation of results for overall corrosion. Electrochemical techniques – Tafel extrapolation and AC impedance spectroscopy (EIS). (6+6)

Total L : 60 + T:30 = 60

TEXT BOOKS:
1. Roberge P R, "Handbook of corrosion engineering", McGraw-Hill education, 2019.
2. Fontana M G, "Corrosion engineering", Tata McGraw Hill Company limited, 2017.

REFERENCES:
1. Yang L, "Techniques for corrosion monitoring", Elsevier, 2020.
2. Jones D A, "Principles and prevention of corrosion", Pearson education limited. 2013.
3. Knudsen O O, Forsgren A, "Corrosion control through organic coatings", CRC press, 2017.
4. Marcus P, "Corrosion mechanisms in theory and practice", CRC press, 2017

21S090 CERAMIC MATERIALS

2 2 0 3

CERAMICS: Definition – physics, chemistry and materials engineering. Powders – sintering. Chemistry of ceramics – classification, structures and microstructures, specificity of ceramics. Clays – Neolithic era – Chinese stoneware and porcelains – industrialization. Sintering and microstrucutre of ceramics – thermodynamic and kinetic aspect, experimental aspects of sintering, interface effects, matter transport – viscous flow of vitreous phase, atomic diffusion in crystallized phase, grain size distribution. Solid phase sintering – grain growth. Sintering with liquid phase – vitrification. Sintering additives. (6+6)

SILICATE CERAMICS AND PROCESSING: Raw materials – enamel and decorations, terra cotta products, earthenwares, stonewares, porcelains, vitreous china, Crockery – introduction – applications. Ceramic forming processes – ceramic powders – chemical and physical characteristics, particle packing, surface charge of oxides in water – oxide/solution interface – measurement of zeta potential, stearic and electrostatic stabilization. Casting – slip casting, pressure casting, tape casting. Pressing – granulation, uniaxial pressing, isotatic pressing, semi-isotatic pressing, roller compressing. Deposition techniques – vacuum deposition (RIC 94), thermal spray deposition (FAU 00). (6+6)

GLASS: Definition of glass, basic concepts of glass structure, types of glasses – raw materials. Batch materials and minor ingredients and their functions. Elementary concept of glass manufacturing process - applications. (6+6)

CEMENT AND CONCRETE: Classification of cement - concept of hydraulic materials, basic raw materials, manufacturing process, basic compositions of OPC. Compound formation, setting and hardening. Tests of cement and concrete. (6+6)

SOL-GEL SYNTHESIS: Physico-chemistry of gels – sols and silica gels, growth and structure of sol-gel polymers. Sol-gel process for multi-elemental oxides – metallo-organic molecular precursors. Optical properties of sol-gel thin layers – planar optical waveguides, development and method of analysis of planar sol-gel wave guides – applications of sol-gel coatings. (6+6)

Total L: 30 + T: 30 = 60

TEXT BOOKS:

1. Carter C B and Norton M G, “Ceramic materials”, Springer, New York, 2013.
2. Singer F and Singer S S, “Industrial ceramics”, Oxford and IBH Publishing Company, 2013.

REFERENCES:

1. Basu B and Balani K,”Advanced structural ceramics”, John Wiley and sons publication, Canada, 2011.
2. Ryan W, “Properties of ceramic raw materials”, Elsevier, 2013.
3. Pfaender H G., “Schott guide to glass”, Springer Science, 2012.
4. Tiwari A, Gerhadt R A, Szutkowska M, “Advanced ceramic materials”, John Wiley and sons publication, Canada, 2016.

OPEN ELECTIVES

MATHEMATICS AND COMPUTER SCIENCE

21OS01 PYTHON PROGRAMMING

3 0 0 3

INTRODUCTION: Development Tools (IDE) – Python shell - Python Basics – Data types - Control flow. (9)

CORE PYTHON LANGUAGE: Lists - Tuples - Dictionaries - Strings – Regular expressions - Functions - File input/output – Exception handling. (9)

OBJECT-ORIENTED DESIGN: Inheritance – Polymorphism. (9)

PACKAGING AND DISTRIBUTION: Modules – Packages – Python standard libraries - pip. (9)

STANDARD PACKAGES: NumPy – Matplotlib – Pandas. (9)

Total L: 45

TEXTBOOKS:

1. Mark Lutz, “Learning Python”, O’Reilly Media, 2013.
2. Tony Gaddis, “Starting out with Python”, Pearson, 2017.

REFERENCES:

1. Christian Hill, “Learning Scientific Programming with Python”, Cambridge University Press, 2016.
2. Allen Downey, ‘Python for Software Design”, Cambridge University Press, 2009.
3. David Beazley and Brian K. jones, Python Cookbook, O’Reilly Media, 2016.
4. Zachary Radtka and Donald Miner, Hadoop with python, O’Reilly Media, 2015

LAB PROGRAMS:

1. Exercises to test basic coding skills in Python using data types, control statements and iteration.

2. Programs to implement Python data structures like lists, tuples, dictionaries, and sets.
3. Programs covering general programming concepts such as functions, strings, regular expressions, reading / writing files and exceptions.
4. Standalone programs to implement object oriented concepts.
5. Packaging their programs into reusable libraries.
6. Write programs to use libraries for numerical programming and data visualization.

21OS02 DESIGN AND ANALYSIS OFALGORITHMS

3 0 03

INTRODUCTION: Fundamentals of algorithmic problem solving, deciding an appropriate data structure and algorithm design technique – Methods of specifying an algorithm – analyzing an algorithm, Asymptotic notations, Recursive algorithms (9)

DIVIDEAND CONQUER STRATEGYAND GREEDYMETHOD: Quicksort,Merge sortStrassen'smatrixmultiplication.Minimumcost spanning tree (KruskalandPrim's algorithms),topologicalsorting, Huffmancodesand datacompression. (9)

DYNAMIC PROGRAMMING: Principles of dynamic programming – 0/1 knapsack problem, all pairs shortest path problem (9)

BACK TRACKING: Method - n- queens problem, Graph coloring problem (9)

BRANCH AND BOUND AND NP PROBLEMS: Method **-** Assignment problem , Traveling salesman problem - NP Problems-Basic concepts – Polynomialtimereductions,efficientcertificationandNP,NPhardandNPcompleteproblems (9)

Total L: 45

TEXT BOOKS:
1. Thomas H. Cormen, Charles E Leiserson, and Ronald LRivest, "Introduction to Algorithms", MIT Press, 2015
2. Jon Kleinberg and Eve Tardos, "Algorithm Design", Pearson Education, 2013.

REFERENCES:
1. AnanyLevitin, " Introduction to design and analysis of algorithm", Pearson Education, 2014.
2. Parag H Dave, Himanshu B Dave, "Design and Analysis of Algorithms", Pearson Education, 2014
3. EllisHorowitz,SartajSahni and Sangerthevar Rajasekaran, "Fundamental soft computer algorithms", Universities Press Private Ltd, 2009.
4. Michael T. Goodrich, Roberto Tamassia, "Algorithms Design, Foundations, analysis and Internet Examples", Willey, 2013.

21OS03 MATHEMATICAL FINANCE

3 0 0 3

A SIMPLE MARKET MODEL: Basic Notions and Assumptions - No-Arbitrage Principle - One-Step Binomial Model - Risk and Return - Forward Contracts - Call and Put Options - Managing RiskwithOptions. (9)

RISK-FREE ASSETS: Time Value of Money - Simple Interest - Periodic Compounding - Streams of Payments - Continuous Compounding - Money Market - Zero-Coupon Bonds - Coupon Bonds - MoneyMarket Account. (9)

RISKY ASSETS: Dynamics of Stock Prices - Return - Expected Return - Binomial Tree Model- Risk-Neutral Probability - Martingale Property - TrinomialTreeModel. (9)

DISCRETE TIME MARKET MODELS: Stock and Money Market Models- Investment Strategies - The Principle of No Arbitrage - Application to the Binomial Tree Model - Fundamental Theorem ofAssetPricing. (9)

PORTFOLIO MANAGEMENT : Risk - Two Securities - Risk and Expected Return on a Portfolio - Several Securities - Risk and Expected Return on a Portfolio - Efficient Frontier - Capital AssetPricingModel. (9)

TEXT BOOKS:
1. M. Capinski and T. Zastawniak, An Introduction to Financial Engineering, springer,2010.
2. H. Lang, Lectures on Financial Mathematics, Harald Lang,2012.

REFERENCES:
1. Sheldon M. Ross, An Elementary Introduction to Mathematical Finance, Cambridge University Press,2011
2. R. Durrett. Probability: Theory and Examples. Thomson Learning, 2010
3. Robert R. Reitano, Introduction to Quantitative Finance, MIT Press Cambridge, Massachusetts,2010.
4. Mark S. Joshi, The Concepts and Practice of Mathematical Finance, Cambridge University Press, 2008.

PHYSICS

21OS11 CONDENSED MATTER PHYSICS

3 0 0 3

BONDING IN SOLIDS: Forces between atoms, Ionic bonding, Covalent bonding, metallic bonding, Vander Waals bonding and hydrogen bonding: Characteristics and stability considerations. Concepts of atomic and ionic radii. (9)

LATTICE VIBRATIONSAND PHONONS: Concept of lattice mode of vibration. Phase and group velocities. Vibrations of one dimensional monoatomic linear lattice. Concept of phonons. Momentum of phonons. Inelastic scattering of photons, X-rays and neutrons by phonons. (9)

THERMAL PROPERTIES OF SOLIDS: Specific heat of gases and solids -Einstein and Debye theories of specific heat of solid –Gruneisen's constant- Anharmonicity- Thermal expansion- Thermal conductivity of solids. (9)

FERROELECTRICITY: Basic properties of ferroelectric materials. Classification of ferroelectric crystals. Changes in crystal structure during polarization- Ferroelectric domains-. Ferroelectric domains. Antiferroelectricity. (9)

LIQUID CRYSTALS: Introduction – Fundamental characteristics- Liquid crystal phases – Characterization of liquid crystals- Anisotropy. (9)

Total L: 45

TEXT BOOKS:

1. Elements of Solid State Physics , J.P.Srivastava, 4th Prentice Hall of India, New Delhi, 2014
2. Solid State Physics, Saxena Gupta And Saxena Mandal, A Pragati Edition, 2013.

REFERENCE BOOKS:

1. Solid state physics, Pillai S.O., New Academic Science 8th edition, 2017
2. Solid State Physics: Structure and Properties of Materials, A.M.Wahab , 3rd Edition, Narosa Publishing house, New Delhi, India, 2015.
3. Condensed Matter Physics, Michael P. Marder John Wiley & Sons, 2nd edition, 2010
4. Introduction to Solid State Physics. Charles Kittel. John Wiley & Sons, 8th .Edition, 2012

21OS12 CLASSICAL MECHANICS AND STATISTICAL PHYSICS

3 0 0 3

BASIC CONCEPTS OF CLASSICAL MECHANICS: Mechanics of single and system of particles, conversion law of linear momentum, angular momentum and mechanical energy for a particle and a system of particles, centre of Mass and equation of motion, constrained Motion, degrees of freedom and generalized coordinates, transformation equations, generalized displacement, velocity, acceleration, momentum, force and potential. (9)

LAGRANGIAN FORMULATION: Generalized coordinates, Principle of virtual work, D'Alembert's principle and Lagrangian equations, applications of Lagrangian formulation: linear harmonic oscillator, simple pendulum, particle moving under central force, Atwood machine, electrical circuits. (9)

HAMILTONIAN FORMULATION: Hamilton's principle, Lagrange's and Hamilton's equations from Hamilton's principle, physical significance of Hamiltonian, principle of least action, applications - linear harmonic oscillator, simple pendulum, particle moving under central force, Atwood machine, Poisson bracket. (9)

CLASSICAL STATISTICAL MECHANICS: Link between entropy and probability – Boltzmann'sequation - elementary ideas about three different statistics - classical statistics – Maxwell - Boltzmann statistics – classical Ideal gas equation – equipartition theorem. (9)

QUANTUM STATISTICAL MECHANICS: Basics for quantum statistics, system of identical indistinguishable particles, symmetry of wave functions, bosons, fermions - Bose-Einstein statistics, Fermi-Dirac statistics. (9)

Total L: 45

TEXT BOOKS:

1. Goldstein H, Poole C and Safko J, "Classical Mechanics", Pearson Education, New Delhi, 2002.
2. Reif F, "Fundamentals of Statistical and Thermal Physics", International Students Edition, Tata McGraw-Hill ,1988.

REFERENCES:

1. SrinivasaRao K N, "Classical Mechanics, University press", 2003.
2. Gupta S L, Kumar V and Sharma H V, "Classical Mechanics", PragatiPrakashan, Meerut, 2003.
3. Huang K," Statistical Mechanics", Wiley Eastern, 1991.

21OS13 MEASUREMENT AND INSTRUMENTATION

3 0 0 3

BASIC CONCEPTS OF MEASUREMENTS: Measurement methods: Generalized measurement system and its functional elements, Static characteristics: Range, span, accuracy, error, calibration, hysteresis, sensitivity, threshold and resolution, precision, linearity. Dynamic characteristics: Speed of response, dead time and dead zone. Analysis of data: Causes and types of experimental errors. Random errors, systematic errors. Statistical analysis of data (9)

TRANSDUCERS: Transducer classification: Variable resistance transducer, capacitative and piezoelectric transducer, photodiode, photomultiplier tube, Hall effect transducer, Digital displacement transducer (9)

SIGNAL CONDITIONING AND DATA TRANSMISSION: Mechanical amplifiers (lever only), fluid amplifiers, optical amplifiers-optic levers. Mechanical transmission, hydraulic transmission, magnetic transmission, electrical transmission. (9)

PRESSURE AND TEMPERATURE MEASUREMENTS: Pressure units. Measuring instruments: Bourdon gauge, Pirani gauge, thermocouple gauge. Ionization gauge- cold and hot cathode types. Temperature measurement: Temperature scales-Temperature measuring instrument: Liquid in glass thermometers, thermocouples, resistance thermometers, thermistors and pyrometers. (9)

FLOW AND STRAIN MEASUREMENTS: Classification of fluid flow measurement techniques- Nutating disc meter, rotary vane flow meter, hot wire anemometer, electromagnetic flow meter. Strain measurement:Resistance strain gauge, bonded and unbonded strain gauges, metal foil gauge, wire strain gauge (9)

Total L: 45

TEXT BOOKS:

1. Kumar D S, “Mechanical Measurements and Control”, Metropolitan Book Company Pvt Ltd, India, 2015.
2. Holman J P, "Experimental Methods for Engineers", McGraw Hill, United states, 2011.

REFERENCES:

1. Beckwith T G, Marangoni and Lienhard J H, ”Mechanical Measurements”, Prentice Hall, United States, 2006.
2. Doebelin E O, "Measurement Systems: Application and Design", McGraw Hill College, United States, 2003.
3. D. V. S. Murthy , “Transducers and Instrumentation” Prentice Hall of India , India, 2010.
4. E.O. Doebalin, “Measurement System Applications and Design”, McGraw Hill International, United States, 2007

CHEMISTRY

21OS21 BIOINORGANIC CHEMISTRY

3 0 0 3

METALS AND NON-METALS IN BIOLOGICAL SYSTEMS: Essential and trace elements- role of different metal ions in biological systems - biological ligands, structural models; siderophores, porphyrins, corrin and chlorin. General classifications of metallobiomolecules. Sodium-potassium pumps. Functional role of elements Ca, Mg, P and F in biological systems. (9)

HEME AND NON-HEME PROTEINS: Oxygen transport and storage: structure and functions of hemoglobin, myoglobin, Bohr effect, synthetic models. Importance of 2,3- diphosphoglycerate, CO and CN^- poisoning, hematin formation. Hemerythrin and hemocyanin. (9)

ELECTRON TRANSFER IN BIOLOGICAL SYSTEMS: Structure and functions of electron transfer proteins; Iron-sulphur proteins (Ferredoxins, rubredoxin) and cytochromes (classification and oxygen activation using cytochrome C oxidase)– synthetic models. Blue copper proteins (azurin and plastocyanin). (9)

METALLOENZYMES: Structure and functions of carboxy peptidase-A and carbonic anhydrase – superoxide dismutase (SOD) — xanthine oxidase - nitrogenase – vitamin B12 co-enzyme. (9)

APPLICATIONS IN MEDICINE: Chemotherapy: cis-platin,- mode of action, side effects, gold containing drugs as anti- rheumatic agents and their mode of action. lithium in pschycopharmocological drugs -radio diagnostic agents- MRI scanning - chelating agents (with special reference to EDTA) and therapy based on in vivo chelation of radio nucleotides - dosage and toxicity. (9)

Total L: 45

TEXT BOOKS

1. J. E. Huheey, "Inorganic Chemistry"; Harper & Row Publishers, Singapore, 2018.
2. A. K. Das, "Bioinorganic Chemistry", Books and Allied Ltd. Kolkatta, 2016

REFERENCE BOOKS

1. F.A Cotton, G. Wilkinson, "Advanced Inorganic Chemistry", 6th Ed., Wiley Interscience Publication, John Wiley & Sons, New York, USA, 2017.
2. I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, "Bioinorganic Chemistry"; University Science Books, Mill Valley, CA, USA, 2016.
3. S. J. Lippard, J.M. Berg, "Principles of Bioinorganic Chemistry", Panima Publishing Company, New Delhi, 2019.
4. W. Kaim, B. Schewederski, A. Klein Bioinorganic Chemistry: "Inorganic Elements in the Chemistry of Life", John Wiley & Sons, 2013.

21OS22 SURFACE FINISHING AND COATING TECHNOLOGY

3 0 0 3

Surface preparation and Coatings Parameters: Faradays laws- plating parameters- anodic and cathodic current efficiencies- electrode potential - Nernst equation, reference electrodes – polarisation of electrodes and over voltage. Throwing power- Hull cell experiment- plating current densitiy-Metal discharge from simple and complex salts. pre-treatment – mechanical – polishing -buffing wheels - design - operation - belt polishing- – ultrasonic cleaning- surface pretreatment- mechanical polishing-electropolishing-pickling-electropickling-degreasing-chemical and solvent degreasing- Plating bath constituents – types of formulations - operating conditions- current densities, temperature and addition agents- testing of electro deposits for thickness, adhesion, stress, corrosion, porosity, hardness, ductility and solderability. (9)

Coating technology: Electroplating of copper, nickel, chromium, tin and precious metals (gold and silver). electroforming - electroless deposition of copper and nickel- brush plating of gold. Anodizing of aluminium- various baths- sulphuric acid bath-chromic acid process- decorative and protective anodizing, effect of impurities, analysis for free acid and aluminium content - coloring and sealing - Testing of anodic film thickness by Eddy current method and stripping method, coating weight- coating ratio- Hard anodizing- Passivity of stainless steel-coloring of stainless steel- galvanizing and tinning- hot dipping - Zn and Sn (9)

Functional Coatings: Hydrodynamics of a free surface- Wetting and dewetting- Analysis of surface morphology by AFM and XPS- Introduction to superhydrophobicity and self cleaning surfaces,-methods of fabrication of super hydrophobic polymers and binders- self-healing coating-based active corrosion protection, conductive polymer coatings, active anticorrosion conversion coatings, protective coatings with inhibitor doped matrix, cladding and calendaring. (9)

Paints Technology: Colloidal chemistry of coatings, thioxtropy- surface chemistry of pigments, Pigment dispersion and wetting, flushing of pigments, effect of pigment volume concentration on paint properties, Paint additives, solvents- Preparation of powder coatings, dry distempers, cement paints, oil based distempers and paints, putties- special effect pigments (IR Reflective, anticorrosive, thermo chromic, pearlescent)- traffic paints- antisettling, antiskinning, antisagging additives, odourants. Vitreous enamel coating- varnishes-lacquers-wood polishing-wood finishing- antiwetting-antisticking-deicing coatings. (9)

Automotive and Coil Coatings: Surface treatments of multimetals in automotives- Topcoats for automobiles- Industrial coatings: OEM and refinishing- Heat resistant coatings- Luminescent coatings-Intumescing coatings- Applications- Electrical insulating materials- Gaskets-automotive glasses- Sound insulating materials- Introduction to coil coatings, requirements – metal pre-treatment processes- types- PVC- PET, PTFE coatings and protective coatings - curing –applications (9)

Total L : 45

TEXT BOOKS

1. Swaraj Paul, “Surface coatings: Science and technology, Wiley internationals, 2016.
2. Gabe DR, “Principles of metal surface treatment and protection”, Pergamon press, 2019.

REFERENCES

1. Runge Jr, “The Metallurgy Of Anodizing Aluminum: Connecting Science To practice”, Springer International Publishing, 2018
2. MellorBG, “Surface coatings for protection against wear”, Wood head publishing,2016
3. Lambourne R,Strivens TA, “Paint and surface coatings: Theory and practice (Woodhead publishing series in metals and surface engineering, Woodhead publishing limited, 2017.
4. Niku Iari, “Advances in surface treatments: technology and applications, effects”, Elsevier, 2018.

21OS23 CHEMICAL SENSORS AND BIOSENSORS

3 0 0 3

CHEMICAL SENSORS: Introduction – components, characteristics and parameters, classification and types. Transduction principles – general aspects, chemical effects – thermal, electrochemical, optical, mechanical and magnetic effects.Kinetic modeling for biosensors.Performance factors. (9)

BIOCHEMICAL AND IMMUNO SENSORS: Sensing elements – ionic and molecular recognition. Biological recognition agents – enzyme, antibody, tissue, nucleic acids and receptors. Immobilization of biological components - coupling of enzyme reactions and mass transfer in immobilized layers, amplification and filtering of chemical signals.Immuno sensors – antibodies and antigens in sensing. (9)

ELECTROCHEMICAL SENSORS: Electrochemical Sensors – specific features, potentiometry, amperometry, conductometry, solid state sensors, electronic conductance and capacitive sensors, field effect and gas sensors. Modified elctrodes and screen printed electrodes. Enzyme based biosensors – potentiometric and amperometric. Glucose biosensors. (9)

OPTICAL SENSORS: Transduction principles of absorbance, fluorescence, phosphorescence, chemiluminescence, bioluminescence.Determination of ATP, NADH and H_2O_2. Fluorescence anisotropy based determination of metal ions. Fluorescence based fiberoptics in sensors–singleanalyte detection using an enzymatic sensing layer. (9)

MATERIALS FOR ADVANCED SENSOR APPLICATIONS: Semiconductor metal oxides, hydrogel, dendrimeric

materials,carbon nanotubes, graphene, metal nanoparticles, polymers and nanocomposites, Nanoparticle based sensors - antibody in nano particle conjugates, Nucleotides and DNA.Nanowire based electrical detection of single viruses and biomolecules - ultrasensitive detection of pathogenic biomarkers and single bacteria.Transdermal andwearable sensors. (9)

Total L: 45

TEXT BOOK:

1. Eggins BR, “Chemical Sensors and biosensors”, John-Wiley, 2019..
2. Jonathan M Cooper and Anthony EG. Cass, "Biosensors: A practical approach", Oxford University Press, 2020.

REFERENCES:

1. Gopel W, Jones, TA, Kleitz M,Lundstrom J, and Seiyama T, “Sensors – a comprehensive survey, Volume 2/3, Chemical and biochemical sensors, Part – I/II”, VCH Publishers Inc., New York, 2017.
2. KouroshKalantar – Zadeh& Benjamin Fry, “Nanotechnology- Enabled Sensors”, Springer, 2019.
3. Rajmohan Joshi, “Biosensor”, Isha Books, 2016.
4. Tiwari A. and Demir M.M., "Advanced Sensor and Detection Materials", John Wiley and Sons, 2019.

21OS24 CHEMISTRY OF CONCRETE

3 0 0 3

CONCRETE: Components - cement – composition, hydration – hydration products -phase composition, morphology. Properties – workability and water demand, bleeding, air entrainment, setting time, pore structure, interfacial transition zone, shrinkage – chemical, autogeneous shrinkage, drying shrinkage, mechanical properties. Factors influencing concrete durability – permeability, thermal cracking – delayed ettringite formation, corrosion of steel reinforcement – mechanisms, chloride ingress, carbonation, alkali-silica reaction, sulphate attack. (9)

SUPPLEMENTARY CEMENTING MATERIALS (SCMs): Need for new materials, ASTM specifications for SCMs - physical and chemical requirements. Source and compositions of fly ash, Ground Granulated Blast furnace Slag (GGBS), silica fume, and rice husk ash. Cementing efficiency, chemical reactions of SCMs in concrete – pozzolanic reactions, hydration of slag, effect on hydration of Portland cement, pore solution composition.Effect of SCMs on concrete – microstructure, properties, durability- standard tests- bulk diffusion and rapid chloride permeability test, de-icer salt scaling test, accelerated mortar bar tests. (9)

CHEMICAL ADMIXTURES: Water reducing agents, super plasticizers, air entraining agents, concrete damp proofers, accelerators, special purpose admixtures – alkali-aggregate expansion reducing, antifreeze, anti-washout, corrosion inhibiting, calcium sulfoaluminate based expanding, shotcrete and shrinkage reducing admixtures. Effect of admixtures on properties of plastic and hardened concrete. Applications of admixtures. (9)

CHARACTERISATION OF CEMENT HYDRATION: Sampling – Grinding, blending, storage, shelf life, mixing, casting and curing of pastes and mortars, hydration stoppage. Characterization Techniques –calorimetry – isothermal conduction calorimetry, semiadiabaticcalorimetry - sample preparation, principle and applications - determination of heat of hydration, influence of temperature and water-cement ratio on hydration kinetics, correlation with setting and strength development, reactivity of supplementary cementitious materials, cement–admixture interactions.Characterization of cement hydration - measurement of chemical shrinkage – dilatometry, gravimetry, pycnometry. (9)

MICROSTRUCTURE CHARACTERISATION:X-ray diffraction –principle, sample preparation, data collection and analysis.Thermogravimetric analysis – principle and applications. Electron microscopy – principle - Scanning Electron Microscopy (SEM) – imaging methods - secondary electrons, backscattered electrons, characteristic X-rays - C-S-H - Scatter plots and average composition. Backscattered electron imaging -applications – image analysis of common cementitious materials, hydration, fly ash characterization, and degradation reactions - sulfate attack, alkali–silica reaction. Transmission electron microscopy –principle – applications. Mercury intrusion porosimetry – principle and applications. (9)

TotalL: 45

TEXT BOOKS:

1. Kurdowski W, “Cement and concrete chemistry”, Springer, New York, 2014.
2. Scrivener K, Snellings R andLothenbach B, “Apractical guide to microstructural analysis of cementitious materials”, CRC press, Florida, 2016.

REFERENCE:

1. Rixom R and Mailvaganam N, “Chemical admixtures for concrete”, E &FN Spon, London, 2016.
2. Hewlett PC, “Lea's chemistry of cement and concrete”, Elsevier, UK, 1998.
3. Thomas M, “Supplementary cementing materials in concrete”, CRC Press, Florida, 2013.
4. Hewlett PC, “Lea’s chemistry of cement and concrete”, Elsevier, 2013.

21OS25 BIOMATERIALS

3 0 0 3

INTRODUCTION TO BIO-MATERIALS: Definition, sources and classification of bio-materials, biocompatibility. Mechanical, visco- elasticity, electrical and thermal properties of biomaterials. (9)

METALLIC AND CERAMIC BIOMATERIALS: Metallic implants - stainless steels, Co-based alloys, Ti-based alloys, nickel-titanium alloy, and magnesium based biodegradable alloys, nanostructured metallic implants, degradation and corrosion. Bio ceramics – alumina, zirconia, calcium phosphate ceramics, bio inert, bioactive glasses, nanostructured bio ceramics. (9)

POLYMERIC BIOMATERIALS: Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Biopolymers: collagen, elastin and chitin. Medical textiles, materials for ophthalmology: contact lens, intraocular lens. Membranes for plasma separation and blood oxygenation. Carbon biomaterial – carbon products as coating materials. (9)

TISSUE REPLACEMENT IMPLANTS: Interaction – biomaterial surface and tissue. Softtissue replacements, sutures, surgical tapes, adhesive, skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, dental implants, tissue scaffolding and its chemistry. Nano and microarchitecture of biomaterial surfaces. (9)

TESTING OF BIOMATERIALS: Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity tests, In-vitro and In-vivo testing; Sterilizations of implants and devices, effects of sterilization. (9)

TOTAL L: 45

TEXT BOOKS

1. Hasirci V and Hasirci N, “Fundamentals of biomaterials”, Springer, New York USA, 2018.
2. Ramakrishna S, Ramalingam M, Sampath Kumar TS and Winston O. Soboyejo, ”Biomaterials: A nano approach”, CRC Press, 2017.

REFERENCES

1. Park J.B, “Biomaterials science and engineering”, Plenum press, 2004.
2. Myer K, “Standard handbook of biomedical engineering & design”, McGraw Hill, 2013
3. Wong JY, Bronzino JD, “Biomaterials”, CRC press, Taylor & Francis Group, USA, 2017.
4. Balani K, Varma V, Agarwal A and Roger Narayan, “Bio surfaces”, The American ceramic society, John Wiley, USA, 2015.

21OS26 COMPOSITE MATERIALS

3 0 0 3

INTRODUCTION TO COMPOSITE MATERIALS: Definitions, classification. Role of matrix and reinforcements. Matrix-polymers, metals and ceramics. Reinforcements – fibre, flake and particulate. (9)

CERAMIC AND METAL MATRIX COMPOSITES: Ceramics- SiC/Alumina, zirconia-toughened alumina, LiAl-SiO2/Alumina. Properties and applications of CMCs. MMCs-particle, whisker and continous fiber reinforced. Metallic matrices-aluminum, titanium, magnesium and copper alloys. Properties and applications of MMCs. (9)

POLYMER MATRIX COMPOSITES: Thermoplastic matrices - PEEK, polysulfones, polyimides.Thermoset matrices - polyesters, epoxies, phenolics, vinyl esters, cyanate ester. Reinforcements used in PMCs- glass, carbon, aramids, boron, natural fibres and speciality fibres. Fibre-matrix interactions. Polymer-carbon nanotubes composites. Properties and applications of PMCs. Laminates- Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates-applications of PMC in aerospace, automotive industries. (9)

PARTICULATE, FIBER FILLED AND CONTINOUS FIBER COMPOSITES: Function of matrix, function of fibres, polymer-fibre interface, factors influencing the composite, coupling and bonding agents, short fibre composites, analysis of long fiber composites, longitudinal behavior of unidirectional composites, nanoparticle dispersions in polymerization, Nano clay composites. Factors influencing longitudinal and transverse strength and stiffness. Multidirectional reinforced carbon-carbon composites. (9)

PROCESSING AND MANUFACTURING TECHNIQUES: Ceramics: processing-cold pressing and sintering, hot pressing, reaction bonding, infiltration, direct oxidation and chemical vapour deposition. Metal: processing -liquid state and sold state processes. Carbon-carbon composites- processing. Manufacturing technique: Hand lay-up, filament winding, pultrusion, resin transfer molding, process steps for production. (9)

Total L: 45

TEXT BOOKS

1. Chawla KK, “Composite materials -Science and engineering”, Springer, USA, 2019.
2. Strong. BA, “Fundamentals of composite manufacturing-materials, methods and applications”, Society of manufacturing engineers, USA, 2018.

REFERENCES

1. Chawla N, Chawla KK, ”Metal matrix composites”, springer, USA, 2017.
2. Seferis J.C., Nicolais L., “The role of the polymeric matrix in the processing and structural properties of composite materials, Plenum press, New York 2003.
3. Ajayan P.M, Schaller. L, Braun.P.V, “Nano composite science and technology”, Wiley VCH, Germany, 2013.
4. Mathews F L and Rawlings R D "Composite materials: Engineering and science", CRC Press and Woodhead Publishing Limited., UK, 2018.

21OS27 PRINCIPLES OF CERAMIC TECHNOLOGY

3 0 0 3

WHITEWARE: Introduction-raw materials, body composition, preparation, forming-slip casting, plastic forming, pressing, finishing, drying, firing, glazing and decoration. White wares at home –tableware, kitchenware, flame resistant ware, art ware, containers, construction –floor tile, wall tiles, sanitary ware, electrical–low tension insulators, high tension insulators, high frequency low loss insulators, industrial use –abrasion resistance, chemical resistance, heat resistance. (9)

CERAMIC COATINGS: Introduction, classification, glaze – raw materials, glaze preparation and application, firing, glaze defects. Enamels –substrate preparation, enamel preparation, enamel coatings. Natural fluxes –feldspar group, nepheline syenite, Cornish stone. (9)

GLASS: Introduction, classification, preparation–raw materials, mixing, charging, melting, processing, manufacture of glass products-flat ware and hollow ware. Properties of glasses- Thermodynamic & thermal properties –density, surface tension, thermal expansion, specific heat, thermal conductivity. Mechanical properties –viscosity, elastic properties, hardness, strength. Electrical & Transport properties –electrical conductivity, dielectric property, ionic diffusion. Other properties –refractive index, dispersion, chemical durability. (9)

REFRACTORIES: Introduction, classification- silica refractories - raw materials & composition -manufacturing process steps – phase transformation of quartzite – uses. Aluminosilicate refractories - raw materials -types –manufacturing steps –properties & applications.Basic refractories- raw materials –types,properties and uses of magnesite, forsterite, dolomite and chrome based refractories. Special refractories - carbide& nitride refractories -carbon and carbon based refractory – zirconia -fused cast refractories. (9)

ADVANCED CERAMICS: Introduction, properties and applications of oxides – silica, alumina,zirconia,titania and mullite. Carbides - silicon carbide, boron carbide, tungsten carbide, titanium carbide, Nitrides- silicon nitride, boron nitride, titanium nitride, aluminum nitride. Advanced ceramic products – carbon compounds, silicides, sialon and cermets, high temperature superconducting oxides. Ceramic fibers, ceramic composites- cermet, ceramic polymers. (9)

Total L: 45

TEXT BOOKS

1. Singer F and Singer S,“Industrial ceramics”, Oxford and IBH Publishing Co., 2013.
2. Ryan W, “Properties of ceramic raw materials”, Pergamon press, 2014..

REFERENCE BOOKS

1. Sudhir S, “Ceramic white ware”, Oxford & IBH Publishing Co., New Delhi, 2012.
2. Tailor J.R and Bull A.C, “Ceramic glaze technology”, Pergamon press, NY, 2014.
3. Heinz GP, “Schott Guide to Glass”, Chapman and Hall, 2014.
4. Nandi D.N, “Handbook of refractories”, Tata McGraw –Hill Publishing Co., New Delhi, 2011.

21OS28 ADVANCED OXIDATION PROCESSES FOR WASTEWATER TREATMENT

3 0 0 3

PHOTOSCIENCE: Introduction- Interaction of UV/VIS radiation with matter- electromagnetic spectral ranges of interest in photochemistry- photonenergies, bond dissociation energies, threshold wavelengths and absorption onset of molecules. Beer–Lambert relationship- the nature of electronically excited states. Jablonski diagram -absorption of UV/VIS radiation by solids-UV/VIS radiation as a specific reagent: quantum yield, quantum efficiency, actinometry. (9)

PHOTOCHEMISTRY OF AUXILIARY CHEMICALS: Electronic structures of oxygen species -UV absorption properties of auxiliary oxidants, catalysts and of reactive intermediates. Physio-chemical properties of ozone and hydrogen peroxide-photochemistry of hydrogen peroxide photocatalysts, quantum yields. Primary and secondary reactive species: Hydrated electrons, hydrogen atoms, hydroxyl radicals, oxidative degradation of organic matter by hydroxyl radicals- rate law and rate constants of hydroxyl radical reaction kinetics. (9)

PHOTO-INITIATED OXIDATIONS: Radiant sources and their characteristics-types of lamps used in AOP - specific properties of mercury arc lamps development of incoherent excimer lamps -typical photon flow of VUV or UV lamps -the sun as radiation source. Methods of hydroxyl radical production -photooxidation reactions -photocatalytic reactions - general reaction schemes-photolysis of water. (9)

PHOTOCATALYSIS: Introduction-process fundamentals- Porphyrins, phthalocyanines and semiconductor as photo catalysts in photolysis reactions - generation of hydrogen by photocatalysts - photocatalytic break down of water and harnessing solar energy - photocatalytic degradation of dyes - environmental applications, issues – slurry supported catalyst – reuse. Photolytic ozonation (O_3 /UV) hydrogen peroxide and ultraviolet radiation (H_2O_2/UV)- Fenton and photo Fenton’s oxidation- electro fenton. Sonolysis-principles of sonochemistry-oxidative properties of ultrasound in water. (9)

ELECTROCHEMICAL PROCESSES OF WATER TREATMENT: Electro dialysis – electrocoagulation-electroflotation-electroFenton technique-electroreduction of pollutants-photoelectrocatalytic techniques-electroozonation- electrooxidant generations-hybrid advanced oxidation process-disinfection methods with chlorine dioxide, ozone, H_2O_2, wet electrolytic oxidation of organics and their sludge. (9)

Total L: 45

TEXT BOOKS:
1. Oppenländer T, 'Photochemical purification of water and air', Wiley-VCH publishers, Germany,2013.
2. Mihaela IS, 'Advanced oxidation processes for water treatment: Fundamentals and applications',IWA publishers, London,2018.
3. Simon P, 'Advanced oxidation processes for water and wastewater treatment', IWA publishers, London, 2014.

REFERENCE BOOKS:
1. Culp RL, Wesner GM, Culp GL. 'Handbook of advanced wastewater treatment', Van Nostrand Reinhold Co. Ltd., 2008.
2. Syed R. Qasim, Guang Zhu, 'Wastewater treatment and reuse, Theory and design examples, principles and basic treatment', CRC Press, 2018.
3. Rao DG, Senthilkumar R, Anthony JB andFeroz S,'Wastewater treatment', Taylor & Francis,2012.
4. Riffat R, "Fundamentals of wastewater treatment and engineering", CRC press, 2019.

ENGLISH

21OS31 ENGLISH AND SOFT SKILLS FOR EMPLOYABILITY

3 0 0 3

SELF MANAGEMENT AND ATTITUDES: Intrapersonal Communication - Self Concept, Stress management, Positive attitude, Influential Skills, Initiative, Empathy, Social Etiquette (8)

COMMUNICATION STYLES : Presentation Skills, Interpersonal Communication Skills, Interviewing Skills, Verbal and Nonverbal (body language) skills, Active Listening, Professional Writing, Effective email writing (12)

TEAM WORK AND TEAM BUILDING: Working in groups and Teams, Exploring Team Roles and Processes, Building and developing teams, Leading a team and Managing meetings (5)

LEADERSHIP SKILLS: Empowerment, Planning, Establishing Credibility, Vision & direction, Supervision, Mentoring, Decision-making, Creativity and Flexibility (5)

MANAGING TIME AND PRESSURES: Managing Change and Time management (5)

EFFECTIVE AND EXCELLENT CUSTOMER SERVICE: Understanding customer service basics - Communication with the customer empathetically- telephonic and online services, Managing conflicts or Challenging communication, Building customer confidence, Growing customer relationship, Opportunity management, Developing team approach to meet customer needs, Working with customers with disabilities, Technology @ work: Internet Monitoring. (10)

TOTAL HOURS: 45

TEXTBOOK
1. Sabina Pillai & Agna Fernandez, "Soft Skills & Employability Skills", Cambridge University Press, New Delhi, 2018

REFERENCES
1. Butterfield, Jeff, "Soft Skills for Everyone", Cengage Learning, Delhi, 2014.
2. Kumar, Satendra, "Professional Communication Skills", Yking Books, Jaipur, 2018.
3. Rao M S, "Soft Skills –Enhancing Employability- Connecting Campus with Corporate", IK International Publishing House, New Delhi, 2010.
4. Simon Sweeney, "English for Business Communication", Cambridge University Press, New Delhi, 2012.

21OS32 ENGLISH FOR COMPETITIVE EXAMINATIONS

3 0 0 3

ENGLISH GRAMMAR: Tenses, Parts of Speech - Auxiliaries, Subject Verb agreement, Modifiers, Parallelism, Redundancy, Active and Passive Voice, Question Tag, Phrases and Clauses
VOCABULARY: Synonyms and Antonyms, One word substitute, Words often misspelled, Commonly confused words, Idioms and Phrases (10)

READING: Structure and Organization of a text, Reading Techniques: skimming for main idea(s), Distinguishing facts from opinions, Distinguishing main ideas from specific details, Scan for details, Making use of contextual clues to infer meanings of unfamiliar words from context, Cloze test, Reading Comprehension passages (10)

WRITING: Writing strategies, Paragraph Writing, Summarizing, Essay Writing: Independent and Integrated Essay writing practice (10)

LISTENING: Listening and Note- taking, Identifying and distinguishing the main ideas from supporting details, infer meanings of unfamiliar words from context, Discussing about and responding to the content of a lecture or listening passage orally and/or in writing (6)

SPEAKING: Spoken discourse markers of familiar topics - Conversation practice - Oral Presentation techniques - Short speeches and Informal discussions (9)

TOTAL HOURS:45

TEXT BOOK

1. Thorpe, Edgar and Showick Thorpe, “Objective General English for Competitive Examinations”, 7th Edition, New Delhi: Pearson India Limited, 2021

REFERENCES

1. Vijay Pal Singh, “Objective General English”, Delhi: PHI Learning Pvt. Limited, 2015.
2. Mac Carthy, Micahel and Felicity O’ Dell, “English Vocabulary in Use Elementary Book“, 2nd Edition, Cambridge University Press India Private Limited, Cambridge, 2012.
3. Bailey, S, “Academic Writing: A handbook for International Students”, London and New York: Routledge, 2015.
4. Gupta, S.C., “Practical English Grammar & Composition”, New Delhi: Arihant Publications (India) Limited, 2018.