Amrita VishwaVidyapeetham  
Department of Sciences  
Amrita School of Arts and Science  
Mysuru Campus, Mysuru

BSc (Physics, Chemistry and Mathematics) Syllabus

Semester I

21ENG101 Communicative English 2 0 2 3

Objectives:
To help students obtain an ability to communicate fluently in English; to enable and enhance the students skills in reading, writing, listening and speaking; to impart an aesthetic sense and enhance creativity

<table>
<thead>
<tr>
<th>COs</th>
<th>Course Outcomes</th>
<th>Justification</th>
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<tbody>
<tr>
<td>CO 1</td>
<td>Demonstrate competency in all the four linguistic skills, viz. listening, speaking, reading and writing</td>
<td>Assignments, Reading Comprehension, Speaking and Listening Activities</td>
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<td>CO 2</td>
<td>Apply different styles of communication in professional context</td>
<td>Group Discussion, debates</td>
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<td>CO 3</td>
<td>Participate in different planned &amp; extempore communicative activities</td>
<td>Extempore speeches, presentations</td>
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<td>CO 4</td>
<td>Interpret and discuss facts and information in a given context</td>
<td>Reading Comprehension, writing tasks involving critical analysis</td>
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CO 5 | Develop an appreciation for human values | Literary Analysis and Discussion of Ethical Precepts

Unit I
Kinds of sentences, Word Order, usage of preposition, use of adjectives, adverbs for description, Determiners- Agreement (Subject – Verb, Pronoun- Antecedent) collocation

Unit II
Tenses
Reported speech
Active and passive Voice
Phrasal Verbs, Linkers/ Discourse Markers, Question Tags

Unit III
Paragraph writing – Cohesion - Development: definition, comparison, classification, contrast, cause and effect - Essay writing: Descriptive and Narrative

Unit IV
Reading Comprehension – Skimming and scanning- inference and deduction – Reading different kinds of material –Speaking: Narration of incidents / stories/ anecdotes- Current News Awareness

Unit V
Nirad C Chaudhuri “Indian Crowds” [Non-Detailed]
Dr S Radhakrishnan “The Shaping of my Character”[Detailed]
Charles Lamb” Dream Children” [Detailed]
Ruskin Bond “Night Train at Deoli” [Non-Detailed]
Rabindranath Tagore “Subha” [Non-Detailed]
Agra Gra “And you call me coloured” [Detailed]
Alfred Lord Tennyson “Ulysses” [Detailed]
CORE READING:

2. Syamala, V. *Speak English in Four Easy Steps*, Improve English Foundation Trivandrum: 2006
3. Online sources

References:

3. Murphy, Raymond, *Murphy’s English Grammar*, CUP, 2004

22ADM101  Foundations of Indian Heritage  2 0 1 2

Unit 1

Introduction to Indian Culture - Introduction to Amma’s life and Teachings – Symbols of Indian Culture.

Unit 2

Science and Technology in Ancient India - Education in Ancient India - Goals of Life – Purusharthas - Introduction to Vedanta and Bhagavad Gita.

Unit 3

Introduction to Yoga - Nature and Indian Culture - Values from Indian History – Life and work of Great Seers of India.

TEXTBOOKS:

1. *The Glory of India* (in-house publication)
2. *The Mother of Sweet Bliss, (Amma’s Life & Teachings)*
Course Objectives: To enable students to understand Newtonian mechanics and apply Newton’s laws to explain natural physical phenomena.

Course Outcomes (CO):

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<thead>
<tr>
<th>CO’s</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Explain the basic concepts of vector analysis and particle dynamics and its application.</td>
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<tr>
<td>CO2</td>
<td>Explain the basic knowledge of work power and energy and collision process.</td>
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<td>CO3</td>
<td>Explain gravitation and laws of planetary motion, centre of mass.</td>
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<tr>
<td>CO4</td>
<td>Explain the concepts of rotational kinematics and rigid body dynamics.</td>
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<td>CO5</td>
<td>Apply principles of fluid dynamics to solve real world problems.</td>
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<tr>
<td>CO6</td>
<td>Design experiments on mechanics and analyse the results obtained.</td>
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</tbody>
</table>

Unit - I
Vector Analysis: Integrals (line, surface, and volume), Physical significance of Gradient, Divergence and curl, statement of Gauss’s and Stroke’s theorems.

Particle dynamics: Review of the equations of motion, projectile motion, Newton’s First, Second and Third Law of Motion, Newton’s I Law as a basic kinematical law defining a frame of reference, Newton’s II Law as a basic dynamical law of mechanics and Newton’s III law as an interaction law, Frames of reference, inertial and non-inertial, pseudo forces, Force laws, weight and mass, Application of Newton’s law, importance of free body diagrams representing forces on the body in a free body diagram and frictional forces. Discussion of importance of friction in daily life.

Unit – II: Conservation Laws: Introduction, conservative forces, potential energy, complete solution for one-, two- and three-dimensional systems, non-conservative forces, conservation of energy, conservation of energy to be seen as a spreading out and appearing in different forms, mass, and energy.

Conservation of Linear Momentum: Centre of mass, motion of the center of mass, linear momentum of a particle, linear momentum of a system of particles, conservation of linear
momentum, some applications of momentum principle, systems of variable mass – Rocket equation.
Collisions: Elastic and Inelastic, Collision in one and two dimensions.

Unit – III: Gravitation: Historical Introduction, Newton’s law of Universal Gravitation, Universal Gravitation constant ‘G’, inertial and gravitational mass, variation in acceleration due to gravity with altitude and depth, motion of planets and satellites, gravitational field and potential, gravitational potential energy, potential energy for many particle systems, calculations of field and potential for (a) a spherical shell, (b) a sphere, energy consideration in the motion of planets and satellites.

Central Force: Kepler’s laws of planetary motion, the inverse square law, Rutherford’s problem, derivation of Kepler’s Law from Universal law of Gravitation.

Unit – IV: Rotational Kinematics Rotational variables, angular velocity, angular acceleration. Rotation with constant angular acceleration, Linear and angular variables, kinetic energy of rotation, rotational inertia, calculation of rotational inertia – of a rod, sphere and cylinder, torque, Newton’s laws of rotation, work, power and work – kinetic energy theorem.

Dynamics of Rigid bodies
Angular momentum and moment of inertia, Theorem on moment of inertia, moment of inertia for (i) solid cylinder, (ii) rectangular slab, (iii) solid sphere and (iv) circular hoop.


Practical:
(A minimum of ten experiments to be done from the list given below)
1 To Determine the Momentum of Inertia and Mass of a Flywheel.
2 Study of the motion of an air bubble.
3 Study of the motion of a freely falling body.
4 Study of the acceleration of a body subjected to different unbalanced forces.
5 Study of accelerations of different masses under a constant unbalanced force.
6 Study of conservation of energy and momentum in head-on-collision between two spheres of equal mass.
7 Conservation of momentum in an explosion.
8 Determination of Surface tension of liquid by capillary rise method.
9 To study the relation between length and time period of a simple pendulum.
10 Study of the rate of flow of water through a capillary tube under different pressure heads.
11 Momentum of inertia of a rod by torsional oscillation.
12 Determination of Acceleration due to Gravity and radius of gyration by Bar Pendulum.
Mapping of CO’s and PO’s:

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Textbooks:


References:

Course Objectives:
1. To understand parameterisation of curves and to find arc lengths.
2. To familiarise with calculus of multiple variables.
3. To use important theorems in vector calculus in practical problems.

Course Outcomes

<table>
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<tr>
<th>COs</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Recognize and determine infinite limits and limits at infinity and interpret with respect to asymptotic behavior.</td>
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<tr>
<td>CO2</td>
<td>Determine the derivative and higher derivatives of a function explicitly using differentiation formulas.</td>
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<td>CO3</td>
<td>Explain and apply the concepts extreme values and Lagrange multipliers for simple optimization problems.</td>
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<tr>
<td>CO4</td>
<td>Explain and apply the concepts line and double integrals to various problems including Green’s theorem for plane.</td>
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<td>CO5</td>
<td>Explain the concepts of surface integrals, divergence theorem and Stokes theorem.</td>
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CO-PO Mapping

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Syllabus

**Unit I:** The Precise definition of a Limit – One-Sided Limits and Limits at Infinity – Infinite Limits and Vertical Asymptotes – Continuity – Tangents and Derivatives.
(Sections 2.1, 2.3-2.7)

**Unit II:** Extreme values of Functions – The Mean Value Theorem – Monotonic Functions and the First Derivative Test – Concavity and Curve Sketching – Integration-Riemann Sum – Definite integrals – The Fundamental Theorem of Calculus.
(Sections 4.1-4.4, 5.2-5.4)

(Sections 14.1-14.8)

**Unit IV:** Line integrals – Vector fields, Work, Circulation and Flux – Path Independence, Potential Functions and Conservative Fields – Green’s Theorem in the Plane.
(Sections 16.1-16.4)

**Unit V:** Surface Areas and Surface Integrals – Parameterized Surfaces – Orientation of Surfaces – Stoke's Theorem and Divergence Theorem.
(Sections 16.5-16.8)

**TEXTBOOKS:**

**REFERENCES:**

**CHEMISTRY PAPER - 1**

21CHY106  ATOMIC STRUCTURE, CHEMICAL BONDING AND ANALYTICAL CHEMISTRY  

3-0-2  4

**OBJECTIVES:** To develop an understanding of principles of Atomic structure, Bonding and Analytical Chemistry. To develop an understanding of the Periodic trends and to relate the properties of compounds in terms of their chemical bonding.

**Course Outcome:**

| CO1 | Describe the atomic level structure of elements, and interaction between atoms and electromagnetic radiation. |
CO2 | Describe the periodic trends in the properties of elements and to explain these trends based on the principles of atomic structure.
CO3 | Apply theories of chemical bonding to explain and predict the structure, stability and properties of molecules.
CO4 | Distinguish the various techniques for quantitative analysis and analyse the accuracy of the results of these analyses.
CO5 | Identify and carry out quantitative analysis of the strength of solutions and composition of mixtures.

**Unit I**

**Atomic Structure:** Bohr model of hydrogen atom, Bohr’s equation for the energy of electron in hydrogen atom, the hydrogen spectrum, limitations of Bohr theory, photoelectric effect, idea of de Broglie matter waves, Heisenberg’s uncertainty principle and its significance, Schrödinger wave equation (derivation not expected), wave functions, significance of $\psi$ (psi) and $\psi^2$, atomic orbitals, Nodal planes in atomic orbitals, quantum numbers ($n$, $l$, $m$), Zeeman effect, Stern-Gerlac experiment, spin quantum number ($s$), shapes of $s$, $p$ and $d$ orbitals. Aufbau and Pauli’s exclusion principles, Hund’s rule, energy level diagram of a multielectron atom, concept of effective nuclear charge, Slater’s rules and applications, Electronic configuration of atoms.

**Unit II**


**Unit III**

**Chemical Bonding-I:** Ionic bond: Factors that favor the formation of ionic bonds, Lattice energy, Born-Lande’s equation (no derivation), Born-Haber cycle, setting up of Born-Haber cycle for 1:1 ionic solids. Numerical calculations of LE and EA based on Born-Haber cycle for 1:1 ionic solids, uses of Born-Haber cycle. Role of lattice energy and hydration energy and their importance in the context of stability and solubility of ionic solids. Covalent bond: Factors
favoring the formation of covalent bond (ionization energy, electron affinity, electronegativity, nuclear charge, inter nuclear distance and number of valence electrons). Valence bond approach – explanation with examples to illustrate valence bond approach. Sigma and Pi bonds. Fajan’s rules of polarization and their explanation. Bond length, bond order, bond energy and their significance, polarity of covalent bonds, polar and non-polar molecules, Dipole moment and polarity of molecules to be explained by taking HCl, CO₂, CCl₄ and H₂O as examples.

**Unit IV**

Chemical Bonding –II: Hybridization-directional property and geometry of sp, sp², sp³, sp³d and sp³d² hybrid orbitals with examples respectively. VSEPR theory. Coordinate bond: with examples. Molecular Orbital Theory: An elementary account of MOT, linear combination of atomic orbitals (no mathematical approach). Bonding and antibonding molecular orbitals, conditions for the combination, energy levels of molecular orbitals, Molecular orbital structures and bond orders of simple molecules and ions, prediction of magnetic properties .

**Unit V**

Analytical Chemistry

**TEXTBOOKS:**


**REFERENCES:**
1. C. N. R. Rao, University General Chemistry, Macmillan, India
6. G. D. Christian, Analytical Chemistry, John Wiley and Sons

PRACTICALS

VOLUMETRIC ESTIMATIONS
1. Estimation of Sodium Carbonate and Sodium Bicarbonate in a mixture.
2. Estimation of Ammonia in Ammonium Salt by Back Titration.
3. Estimation of Ferrous ions using Potassium Permanganate
4. Estimation of Oxalic acid using Potassium Permanganate
5. Estimation of Ferrous ions Using Potassium Dichromate with Internal & External Indicators.
7. Estimation of Copper in a Copper salt by Iodimetry
8. Standardisation of EDTA solution using Zinc Sulphate and determination of Mg or Ca

REFERENCE:

A Text Book of Quantitative Inorganic Analysis, A. I. Vogel

Mapping of CO’s and PO’s:

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21ENV200  Environmental Science and Sustainability  L-T-P-C: 3-0-0-3

Unit 1:
State of Environment and Unsustainability, Need for Sustainable Development, Traditional conservation systems in India, People in Environment, Need for an attitudinal change and ethics, Need for Environmental Education, Overview of International Treaties an Conventions, Overview of Legal and Regulatory Frameworks.

Environment: Abiotic and biotic factors, Segments of the Environment, Biogeochemical Cycles, Ecosystems (associations, community adaptations, ecological succession, Food webs, Food chain, ecological pyramids), Types of Ecosystems – Terrestrial ecosystems, Ecosystem Services, Economic value of ecosystem services, Threats to ecosystems and conservation strategies.

Biodiversity: Species, Genetic & Ecosystem Diversity, Origin of life and significance of biodiversity, Value of Biodiversity, Biodiversity at Global, National and Local Levels, India as a Mega-Diversity Nation (Hotspots) & Protected Area Network, Community Biodiversity Registers. Threats to Biodiversity, Red Data book, Rare, Endangered and Endemic Species of India. Conservation of Biodiversity. People’s action.

Impacts, causes, effects, control measures, international, legal and regulatory frameworks of: Climate Change, Ozone depletion, Air pollution, Water pollution, Noise pollution, Soil/ land degradation/pollution

Unit 2:
Linear vs. cyclical resource management systems, need for systems thinking and design of cyclical systems, circular economy, industrial ecology, green technology. Specifically apply these concepts to: Water Resources, Energy Resources, Food Resources, Land & Forests Waste management.

Discuss the interrelation of environmental issues with social issues such as: Population, Illiteracy, Poverty, Gender equality, Class discrimination, Social impacts of development on the poor and tribal communities, Conservation movements: people’s movements and activism, Indigenous knowledge systems and traditions of conservation.

Unit 3:

Global and national state of housing and shelter, Urbanization, Effects of unplanned development case studies, Impacts of the building and road construction industry on the environment, Eco-homes/ Green buildings, Sustainable communities, Sustainable Cities.

Ethical issues related to resource consumption, Intergenerational ethics, Need for investigation and resolution of the root cause of unsustainability, Traditional value systems of India, Significance of holistic value-based education for true sustainability.

TEXTBOOKS/ REFERENCES:


Semester II

21ENG111 Professional Communication L-T-P-C: 1-0-2-2

Objectives: To convey and document information in a formal environment; to acquire the skill of self-projection in professional circles; to inculcate critical and analytical thinking.

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<tr>
<th>COs</th>
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<tbody>
<tr>
<td>CO 1</td>
<td>Demonstrate competency in oral and written</td>
<td>Presentation, writing assignment</td>
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<tr>
<td>CO 2</td>
<td>Apply different styles of communication in professional context</td>
<td>Business letters, circulars, memos, e-mails</td>
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<tr>
<td>CO 3</td>
<td>Participate in different planned &amp; extempore communicative activities</td>
<td>Presentation, speech</td>
</tr>
<tr>
<td>CO 4</td>
<td>Interpret and discuss facts and information in a given context</td>
<td>Group discussion</td>
</tr>
<tr>
<td>CO 5</td>
<td>Develop critical and analytical thinking</td>
<td>Essays, book reviews</td>
</tr>
</tbody>
</table>

**Unit I:** Vocabulary Building: Prefixes and Suffixes; One-word substitutes, Modal auxiliaries, Error Analysis: Position of Adverbs, Redundancy, modifiers (displaced, dangling etc)

**Unit II:** Instruction, Suggestion & Recommendation - Sounds of English: Stress, Intonation-Essay writing: Analytical and Argumentative

**Unit III:** Circulars, Memos – Business Letters - e-mails

**Unit IV:** Reports: Trip report, incident report, event report - Situational Dialogue - Group Discussion

**Unit V:** Mini Project and Presentation

**References**

Unit 1
1. Relevance of Sri Rama and Sri Krishna in this Scientific Age
2. Lessons from the Epics of India
3. Ramayana & Mahabharata

Unit 2
4. Who is a Wise Man?
5. A Ruler’s Dharma
6. The Story of King Shibi

Unit 3
7. Introduction to the Bhagavad Gita
8. Bhagavad Gita – Action without Desire

Unit 4
9. Role and Position of Women in India
10. The Awakening of Universal Motherhood

Unit 5
11. Patanjali’s Astanga - Yoga System for Personality Refinement
12. Examples of Heroism and Patriotism in Modern India

TEXTBOOKS:
Common Resource Material II (in-house publication)
Sanatana Dharma - The Eternal Truth (A compilation of Amma’s teachings on Indian Culture)
Objective: To enable students to see relation between linear and rotational motion and understand the production and propagations of waves in elastic media. And also understand the laws of thermodynamics and its applications.

Course Outcome:

<table>
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<th>CO’s</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Ability to explain the kinetic theory of gases.</td>
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<tr>
<td>CO2</td>
<td>To understand the basic concept of heat and first law of thermodynamics.</td>
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<tr>
<td>CO3</td>
<td>To gain the knowledge about Carnot’s engine. Second law of thermodynamics and its application.</td>
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<tr>
<td>CO4</td>
<td>Interpretation thermodynamic potential and Maxwell’s equation.</td>
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<td>To analyze the statistical interpretation of laws of thermodynamics</td>
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<td>CO6</td>
<td>Ability to do experiment on heat and thermodynamics.</td>
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Unit II: Heat and First Law of Thermodynamics: Thermal equilibrium, Zeroth law of thermodynamics, ideal gas temperature scale, heat as a form of energy, quantity of heat and specific heat, molar heat capacities of solids, the mechanical equivalent of heat, heat and work; First law of thermodynamics, Discussion on usefulness of First Law of Thermodynamics in Meteorology, some special cases of the first law of thermodynamics – (i) adiabatic process, (ii) isothermal process, (iii) isochoric process, (iv) cyclic process, (v) free expansion.

Unit III: Entropy and Second Law of Thermodynamics: Introduction, reversible and irreversible processes, the Carnot cycle, Carnot engine, Carnot theorem, absolute scale of temperature, second law of thermodynamics, efficiency of engines, the thermodynamic temperature scale, entropy in reversible and irreversible processes, entropy and the II law,
entropy and disorder, consequences of II and III law of thermodynamics, Second law of thermodynamics as a probabilistic statement.
Low temperature Physics – Porous Plug experiment, temperature of inversion, principle of regenerative cooling, liquefaction of air by Linde’s method.

**Unit IV: Thermodynamic potentials:** Internal Energy, Enthalpy, Helmholtz function, Gibbs function, relations among these functions, Gibbs-Helmholtz equations

**Maxwell's Thermodynamic Relations:** Derivation of Maxwell's thermodynamic relations, TdS equations, Internal energy equations, Heat capacity equations. Change of temperature during adiabatic process using Maxwell's relations

**Unit V: The Statistical Physics:** statistical basics of thermodynamics, probability distribution, micro and macro states, constraints, Distribution of particles and energy states. Statistical interpretation of second law of thermodynamics, Boltzmann’s canonical distribution law and its application.

**Practical:**

**(A minimum of ten experiments to be done from the list given below)**

1. Study of the oscillations of a column of water as a function of its length and study of damped oscillation.
2. To determine the velocity of sound at room temperature and the end correction by setting up a resonance column (first resonance length).
3. Study of torsional oscillations of a loaded wire and determination of the rigidity modulus of the material of the wire.
4. Verification of Stefan’s Boltzmann law using Potentiometer.
5. Study of Newton’s law of cooling.
7. Specific heat of a solid by the method of mixtures.
8. Determination of latent heat of fusion of ice by calorimetric method.
10. Study of transverse vibrations on a sonometer. To determine the frequency by (i) absolute method, (ii) Comparison method
11. Melde’s experiment – determination of frequency
12. Frequency of AC by a sonometer.

**Mapping of CO’s and PO’s**
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Textbooks:


References:


23MAT120       INTRODUCTION TO LINEAR ALGEBRA       3-1-0    4

OBJECTIVES:

- Understand the basic concepts of vector space, subspace, basis and dimension.
- Familiar the inner product space. Finding the orthogonal vectors using inner product.
- Understand and apply linear transform for various matrix decompositions.
- Understand basic concepts of eigenvalues and eigenvectors.
Course Outcomes:

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<th>CO1</th>
<th>Understand and apply the basic concepts of matrix theory in to problems.</th>
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<td>Understand the basic concepts of vector space, subspace, basis and dimension.</td>
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<td>CO3</td>
<td>Understand the basic concepts of inner product space, norm, angle, Orthogonality and projection and implementing the Gram-Schmidt process, to obtain least square solution.</td>
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<td>CO4</td>
<td>Understand the concept of linear transformations, the relation between matrices and linear transformations, kernel and range.</td>
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<td>Understand the concepts of eigenvalue and eigenvector and apply to diagonalization problems.</td>
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Unit I

(Sections: 1.1-1.7,2.1)

Unit II

**Vector Spaces:** Real Vector spaces – Sub spaces – Linear independence – Coordinates and Basis – Dimension – Change of Basis – Row Space – Column Space and Null Space – Rank and Nullity.
(Sections: 4.1 – 4.8)

Unit III

**Inner Product Spaces:** Inner products – Orthogonality – Gram Schmidt Process – QR Decomposition – Best Approximation – Least Squares.
(Sections 6.1 – 6.4)

Unit IV

**Eigen values and Eigen vectors:** Problems in Eigen Values and Eigen Vectors – Diagonalization – Orthogonal Matrices – Orthogonal Diagonalization – Quadratic Forms.
(Sections 7.1 – 7.3)
Unit V

**Linear Transformations:** General Linear Transformations – Relation between matrices and linear transformations – Kernel and range of a linear transformation – Isomorphisms – Compositions and Inverse Transformations – Matrices for General Linear Transformations – Similarity.

(Sections 8.1 – 8.5, 5.1-5.2)

**TEXTBOOKS:**


**REFERENCES:**


**Mapping of CO’s to PO’s**

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CHEMISTRY PAPER - II
21CHY116 NUCLEAR CHEMISTRY, STATES OF MATTER AND CHEMISTRY OF S AND P BLOCK ELEMENTS

OBJECTIVES: To enable students to develop an understanding of properties of Solids, Liquids and Gases, understand the shapes of molecules in terms of symmetries and to relate the properties of the matter in solid state to the structure, develop an understanding of the periodic trends, preparations, properties and uses of s and p block elements and their compounds.

Course Outcome:

| CO1 | Explain the principles of nuclear chemistry and their application to the fields of medicine, agriculture and industry. |
| CO2 | Apply the principles of physics to quantitatively describe the thermodynamic properties of ideal and real gases. |
| CO3 | Explain the physical and chemical properties of liquids and demonstrate the application of experimental methods for the quantitative analysis of these properties. |
| CO4 | Describe the structure of crystalline solids and explain the basic principles of heterogeneous catalysis. |
| CO5 | Apply principles of atomic structure and chemical bonding to describe physical and chemical properties of the compounds of s and p block elements. |
| CO6 | Apply qualitative analysis techniques to identify the chemical composition of inorganic salt mixtures. |

Unit I

Nuclear Chemistry: Nuclear particles, nuclear forces, nuclear size, nuclear density, stability of nucleus, binding energy, packing fraction, n/p ratio. Nuclear models – liquid drop model and shell model. Natural radioactivity, modes of decay, decay constant, half-life period, average life, radioactive equilibrium, Geiger-Nuttall rule, units of radioactivity, radiation dosage. Induced radioactivity, nuclear reactions induced by charged projectiles, neutrons and γ rays, fission reactions, fusion reactions, spallation reactions, preparation of transuranic elements, Q values of nuclear reactions. Fertile and fissile isotopes, chain reaction, stellar energy. Application of Radioactivity and Radio isotopes as tracers in analysis, Reaction mechanism through tracer chemistry in medicines, in biological field, in agriculture and industry.

Unit II

Gases: Kinetic molecular model of gases: pressure of an ideal gas, derivation of gas laws, Maxwell’s distribution of velocities – molecular velocities (average, root mean square and most


Unit III

Liquids: Intermolecular forces in liquids (qualitative idea only)- viscosity, the viscometer method

Unit IV

Solids: Elements of symmetry – plane, axis and centre, elements of symmetry in cubic crystals, law of rational indices – Weiss and Miller indices, lattice planes in cubic crystals. Crystal lattice and unit cell, types of Lattice – Bravais lattices, X-Ray diffraction and Bragg’s Law (to be derived), determination of crystal structure of rock salt by rotating crystal method using Bragg’s spectrometer, application of X-ray studies – distance between lattice planes, density of crystals, determination of Avogadro Number (numerical problems on applications).

Unit V

Chemistry of s and p block elements : General characteristics of elements- Electronic configuration, oxidation state, inert pair effect, melting points and boiling points, densities, metallic character, nature of bonds formed, hydration of ions and ionic conductance in solution (only alkali metals), flame colouration. Reactivity, electrode potentials and reducing properties, reaction with water. Compounds – Oxides and peroxides-formation and reaction with water, basic character of oxides and hydroxides. Carbonates-thermal stability. Reasons for anomalous
behaviour of Li and Be, diagonal relationship of Li and Mg. Hydrides- classification of boron hydrides, diborane-preparation from BCl₃, properties(reactions with ammonia and Lewis acid properties) and structure (based on VBT). Halides- comparison of Lewis acid character of boron trihalides. Catenation, allotropic forms of carbon- diamond, graphite and fullerenes (C₆₀) and their structures, carbon nanotubes (brief mention without structural details). Silicates- Classification, structures of ortho and pyrosilicates.

**TEXTBOOKS:**


**REFERENCES:**

1. R. Gopalan, Elements of Nuclear Chemistry, Vikas Publ. House
2. K. L. Kapoor, A Textbook of Physical chemistry, Volumes 1, Macmillan India Ltd
4. F. A. Albery and R J Silby, Physical Chemistry, 3 rdEdn, John Wiley

**PRACTICALS**

1 Systematic semi-micro qualitative analysis of a mixture of two simple salts (with no interfering radicals). Constituent ions in the mixture to be restricted to the following.

   Anions: HCO₃⁻, CO₃²⁻, SO₃⁻, Cl⁻, Br⁻, NO₃⁻, SO₄²⁻, BO₃³⁻, PO₄³⁻.

   Cations: Pb²⁺, Bi³⁺, Cd²⁺, Al₃⁺, Fe²⁺, Fe³⁺, Mn²⁺, Zn²⁺, Ba²⁺, Ca²⁺, Sr²⁺, Mg²⁺, K⁺, Na⁺ and Mg²⁺

   Note: Mixtures requiring elimination of borate and phosphate to be avoided. Combination of anions of 2nd group shall be avoided. The combination of two cations in the mixture should belong to different groups.

2 Determination of density by specific gravity bottle and viscosity of the given liquid by Ostwald’s viscometer

3 Determination of density by specific gravity bottle and surface tension of the given liquid by stalagmometer.

4 Determination of refractive index of pure liquids and mixtures.
Mapping of CO’s and PO’s

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21LAW200  INDIAN CONSTITUTION  2-0-0  2

OBJECTIVE: The preliminary objective is to ensure that every student has some knowledge about Indian Constitution.

Unit I

Meaning and Importance of Constitution, Preamble and Salient Features of the Constitution.

Unit II

Fundamental Rights, Right to Equality, Right to Freedom, Right against exploitation, Right to freedom of religion, Cultural and Educational Rights, Right to Constitutional Remedies and Duties, Directive Principles of State Policy.

Unit III

Union Government – LokSabha and RajyaSabha Composition, Powers and functions: The President, The Prime Minister and Supreme Court: Role Position and Powers/ functions.

Unit IV

State Government - Legislative Assembly and Legislative Council: Composition, Powers and functions: The Governor, Chief Minister and High Court: Role, Position and Powers/ functions.

Unit V

Local self-Government, Panchayat Raj System in India; Election Commission; Public Service Commissions, Role, powers and function

24
Skill development Activities:
• Court Visit & Report Presentation
• Group discussion (Fundamental rights and duties)

REFERENCES:
1. Introduction to The constitution of India – M V Pylee, Vikas publishing house Pvt LTD
2. Introduction to The constitution of India – Dr. Durga das Basu, 19th edition Reprint 2007

Semester III

AMRITA VALUES PROGRAMME - I 1-0-
0 1

AMRITA VALUES PROGRAMME - II 1-0-
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Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Students shall have to register for any two of the following courses, one each in the third and the fourth semesters, which may be offered by the respective school during the concerned semester.

22AVP201 Amma’s Life and Message to the modern world

Amma’s messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma’s guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.
22ADM211  Leadership from Ramayana

Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

22ADM201  Strategic Lessons from Mahabharatha

Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

22AVP204  Lessons from the Upanishads

Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, SatyakamaJabala, Aruni, Shvetaketu.

22AVP205  Message of the Bhagavad Gita


22AVP206  Life and Message of Swami Vivekananda

Brief Sketch of Swami Vivekananda’s Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji’s life.

22AVP207  Life and Teachings of Spiritual Masters India

Sri Rama, Sri Krishna, Sri Buddha, Adi Shankaracharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri Ramana Maharshi, Mata Amritanandamayi Devi.

22AVP208  Insights into Indian Arts and Literature
The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

22AVP209  Yoga and Meditation

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali’s Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

22AVP210  Kerala Mural Art and Painting

Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

Course on Organic Farming and Sustainability

Organic farming is emerging as an important segment of human sustainability and healthy life. Haritamritam’ is an attempt to empower the youth with basic skills in tradition of organic farming and to revive the culture of growing vegetables that one consumes, without using chemicals and pesticides. Growth of Agriculture through such positive initiatives will go a long way in nation development. In Amma’s words “it is a big step in restoring the lost harmony of nature”.

22AVP212  Introduction to Traditional Indian Systems of Medicine

Indian medicinal systems are one of the most ancient in the world. Even today society continues to derive enormous benefits from the wealth of knowledge in Ayurveda of which is recognised as a viable and sustainable medicinal tradition. This course will expose students to the fundamental principles and philosophy of Ayurveda and other Indian medicinal traditions.

22AVP213  Traditional Fine Arts of India
India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is “Unity in Diversity” and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

22AVP214    Principles of Worship in India

Indian mode of worship is unique among the world civilisations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realisation of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

22AVP218    Insights into Indian Classical Music

The course introduces the students into the various terminologies used in Indian musicology and their explanations, like Nadam, Sruti, Svaram – svara nomenclature, Stayi, Graha, Nyasa, Amsa, Thala, Saptatalas and their angas, Shadangas, Vadi, Samavadi, Anuvadi. The course takes the students through Carnatic as well as Hindustani classical styles.

22AVP219    Insights into Traditional Indian Painting

The course introduces traditional Indian paintings in the light of ancient Indian wisdom in the fields of aesthetics, the Shadanga (Sixs limbs of Indian paintings) and the contextual stories from ancient texts from where the paintings originated. The course introduces the painting styles such as Madhubani, Kerala Mural, Pahari, Cheriyal, Rajput, Tanjore etc.

22AVP220    Insights into Indian Classical Dance

The course takes the students through the ancient Indian text on aesthetics the Natyasastra and its commentary the AbhinavaBharati. The course introduces various styles of Indian classical dance such as
Bharatanatyam, Mohiniyatton, Kuchipudi, Odissy, Katak etc. The course takes the students through both contextual theory as well as practice time.

22AVP221  Indian Martial Arts and Self Defense

The course introduces the students to the ancient Indian system of self-defense and the combat through various martial art forms and focuses more on traditional Kerala’s traditional KalariPayattu. The course introduces the various exercise technique to make the body supple and flexible before going into the steps and techniques of the martial art. The advanced level of this course introduces the technique of weaponry.

Social Awareness Campaign

The course introduces the students into the concept of public social awareness and how to transmit the messages of social awareness through various media, both traditional and modern. The course goes through the theoretical aspects of campaign planning and execution.

22AVP215  Temple Mural Arts in Kerala

The traditional percussion ensembles in the Temples of Kerala have enthralled millions over the years. The splendor of our temples makes art enthusiast spellbound, warmth and grandeur of color combination sumptuousness of the outline, crowding of space by divine or heroic figures often with in vigorous movement are the characteristics of murals.

The mural painting specially area visual counterpart of myth, legend, gods, dirties, and demons of the theatrical world, Identical myths are popular the birth of Rama, the story of Bhīma and Hanuman, Shiva, as Kirata, and the Jealousy of Uma and ganga the mural painting in Kerala appear to be closely related to, and influenced by this theatrical activity the art historians on temple planes, wood carving and painting the architectural plane of the Kerala temples are built largely on the pan-Indians almost universal model of the vasthupurusha.

Organic Farming in Practice
Organic agriculture is the application of a set of cultural, biological, and mechanical practices that support the cycling of farm resources, promote ecological balance, and conserve biodiversity. These include maintaining and enhancing soil and water quality; conserving wetlands, woodlands, and wildlife; and avoiding use of synthetic fertilizers, sewage sludge, irradiation, and genetic engineering. This factsheet provides an overview of some common farming practices that ensure organic integrity and operation sustainability.

**Ayurveda for Lifestyle Modification:**

Ayurveda aims to integrate and balance the body, mind, and spirit which will ultimately leads to human happiness and health. Ayurveda offers methods for finding out early stages of diseases that are still undetectable by modern medical investigation. Ayurveda understands that health is a reflection of when a person is living in harmony with nature and disease arises when a person is out of harmony with the cycles of nature. All things in the universe (both living and non-living) are joined together in Ayurveda. This leaflet endow with some practical knowledge to rediscover our pre-industrial herbal heritage.

**22AVP218 Yoga Therapy and Lessons**

Yoga therapy is the adaptation of yogic principles, methods, and techniques to specific human ailments. In its ideal application, Yoga therapy is preventive in nature, as is Yoga itself, but it is also restorative in many instances, palliative in others, and curative in many others. The therapeutic effect comes to force when we practice daily and the body starts removing toxins and the rest is done by nature.

**23PHY206 ELECTRICITY AND MAGNETISM**

**Objective:** To enable students to acquire a broad conceptual framework of electromagnetic phenomena.

**Course Outcome:**

| CO1 | To demonstrate basic knowledge in electrostatics and electric dipole. |
| CO2 | Apply the basic principles of electrostatics solve the problems of Dielectric constant and polarizability. |
| CO3 | Analysis of different laws of magneto statics. |
| CO4 | Ability to implement basic principles of electromagnetic induction. |
| CO5 | Explain the basic concepts of alternating current and filters. |
| CO6 | Ability to do experiments on electricity and magnetism. |
Unit I

**Electrostatics:** Electrical pressure on a charged surface. The path traced by a charged particle in a transverse electric field. The attracted disc electrometer – construction, theory and applications.

Review of concept of electric field and electric field due to point charge. Electric field due to (i) electric dipole, (ii) line of charge and (iii) charged disc

A dipole in an electric field, torque on a dipole in uniform and non-uniform E fields, potential energy of an electrical dipole.

Unit II

**Electric Fields in matter:** Capacitance, parallel plate capacitor, calculation of capacity of a spherical and cylindrical capacitor, energy stored in a capacitor, capacitor with dielectric, atomic view of dielectrics, polarization, electric field due to a polarised material, Gauss’s law in dielectrics, Dielectric constant, Energy density of an electrostatic field (with and without dielectric). Polarisability and susceptibility – Frequency dependence of polarisability, Clausius-Mossotti equation.

Unit III

**Magneto statics:** Review of Ampere’s law, B near a long wire, Magnetic lines of induction, force between two parallel conductors, definition of ampere, B for a solenoid, Biot-savart’s law, and applications of Biot-savart’s law. The magnetic field, Lorentz force and definition of magnetic field, magnetic induction, magnetic force on a current element, circulating charges, Cyclotron resonance frequency, Cyclotron. Magnetisation, magnetization current density, magnetic field intensity, magnetic susceptibility and permeability.

Unit IV

**Electromagnetic Induction:** Review of Faraday’s law, Faraday’s experiment, Lenz’s law, Time varying magnetic fields, Application in betatron.

**Inductance:** Self-inductance, LR circuit, energy in a magnetic field, magnetic energy density.

**Alternating current and filter:** R M S values, Response of LR, CR and LCR circuits to sinusoidal voltages (discussion using the j symbol), Series and parallel resonance, Half-power frequencies, bandwidth and Q-factor, Power in electrical circuits, power factor, Maximum power transfer theorem (with proof).
Unit V

**Electromagnetic Theory And Maxwell’s Equations (12 hrs.)** : Displacement current, Setting up of Maxwell’s equations in SI units, Hertz experiment, Travelling electromagnetic wave, Wave equations (qualitative and quantitative) – Energy transport and Poynting vector, Poynting theorem. A radiation pressure (Normal and Oblique incidence). Concept of electric dipole, magnetic dipole, expression for energy radiated by a dipole (No derivation)

**PRACTICALS**

*(A minimum of ten experiments to be done from the list given below)*

1. Determination of Q factor by series resonance
2. Determination of Q factor by parallel resonance
3. Determination of self-inductance of a coil using Anderson’s Bridge
4. Determination of capacitance by measuring impedance of RC circuit
5. Determination of Inductance by measuring impedance of RL circuit
6. De Sauty’s Bridge.
7. Determination of resistivity of a material using low resistance
8. Study of decay of current in LR and RC circuit
9. Measurement of B by current balance
10. To show that the behavior of an inductance in an AC circuit is analogous to that of a resistor which obeys Ohm’s Law and hence to measure inductance.
11. High pass filter.
12. Low pass filter.

**Mapping of CO’s and PO’s**

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</table>

**TEXTBOOKS:**
1. Electricity and Magnetism, Fewkes and Yarwood.
2. Electricity and Magnetism: A N Matveev, Mir Publishers, Moscow.
3. Electricity and Magnetism, F.W.Sears, Addison Wesley Co.

REFERENCES:


23MAT219 DIFFERENTIAL EQUATIONS 3-1-0 4

Objectives: To enable students to develop the knowledge of standard concepts of ordinary differential equations and apply analytical techniques to compute solutions to various differential equations.

Course Outcomes:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Understand and apply the basic concepts of differential equations in to problems.</th>
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<tbody>
<tr>
<td>CO2</td>
<td>Solve basic application problems described by second order linear differential equations with constant coefficients.</td>
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<tr>
<td>CO3</td>
<td>Create and analyze mathematical models using higher order differential equations to</td>
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solve application problems

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<tr>
<th>CO4</th>
<th>Understand the concept of Lagrange’s linear equation, Methods to solve the first order partial differential equations</th>
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<tbody>
<tr>
<td>CO5</td>
<td>Understand the concepts of homogeneous and non-homogeneous linear partial differential equations of higher order.</td>
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</table>

**Unit I**


(Part I: 1.1-1.9, 2.12-2.22)

**Equations of first order but of higher degree:** Equations solvable for \( \frac{dy}{dx} \), y, x, equations in Clairaut's form – equations reducible to Clairaut’s form.

(Part I: 4.1-4.11)

**Unit II**


(Part I: 5.1-5.5, 6.1-6.3, 1.12,1.13, 5.26-5.27, 7.1-7.5)

**Unit III**


(Part I : 8.1-8.3, 2.1- 2.7)

**Partial Differential Equations**
Review of partial differential equations (order, degree, linear, nonlinear).

**Unit IV**
Formation of equations by eliminating arbitrary constants and arbitrary functions.

**Solutions of partial differential equations:** General – particular and complete integrals – Lagrange’s linear equation – Charpit’s method – Methods to solve the first order partial differential equations of the forms \( f(p,q) = 0 \), \( f(z,p,q) = 0 \), \( f_1(x,p) = f_2(y,q) \) and Clairut’s form \( z = px + qy + f(p,q) \) where \( p = \frac{\partial z}{\partial x} \) \( \land q = \frac{\partial z}{\partial y} \).

(Part III: 1.1 – 1.5, 2.3-2.12, 3.1-3.2, 3.7-3.8, 3.10-3.18)

**Unit V**

Classification of partial differential equations of second order – Homogeneous linear partial differential equations with constant coefficient of higher order – Non-homogeneous linear partial differential equations of higher order.

(Part III: 8.1, 4.1-4.12)

**TEXTBOOKS:**


**REFERENCES:**


**Mapping of CO’s to PO’s**

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**CHEMISTRY PAPER - III**

21CHY206 HYDROCARBONS, ALKYL AND ARYL HALIDES 3-0-2 4
OBJECTIVES: To enable students to develop an understanding of chemistry of hydrocarbons and their halogenated derivatives.

Course Outcome:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Explain the mechanism of organic reactions and to predict the products formed in a reaction.</th>
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<td>CO2</td>
<td>Recognize and assign stereo chemical designations of organic compounds.</td>
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<td>CO3</td>
<td>Describe the formation, physical and chemical properties of aliphatic hydrocarbons.</td>
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<td>CO4</td>
<td>Apply the concept of aromaticity to explain the structure, stability and properties of aromatic hydrocarbons.</td>
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<td>CO5</td>
<td>Describe chemical reactions involving alkyl and aryl halides and their synthetic applications.</td>
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<td>CO6</td>
<td>Apply qualitative methods for identification of mono functional organic compounds.</td>
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Unit I


Unit II

Stereochemistry of Organic Compounds: Optical Isomerism: Structural changes responsible for properties: elements of symmetry, molecular chirality, enantiomers, stereogeniccentre, optical activity, properties of enantiomers, chiral and achiral molecules with two

Unit III


Unit IV


Unit V


TEXTBOOKS:


REFERENCES:


PRACTICALS

COURSE CONTENT:

Acids
Alcohols
Aldehydes
Amides
Amines
Halogenated hydrocarbons
Hydrocarbons
Ketones
Nitro compounds
Phenols

Mapping of CO’s to PO’s

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21SSK201                                      LIFE SKILLS I                                      1-0-2  2

Soft skills and its importance: Pleasure and pains of transition from an academic environment to work-environment. Need for change. Fears, stress and competition in the professional world. Importance of positive attitude, self-motivation and continuous knowledge upgradation.

Self Confidence: Characteristics of the person perceived, characteristics of the situation, Characteristics of the Perceiver. Attitude, Values, Motivation, Emotion Management, Steps to like yourself, Positive Mental Attitude, Assertiveness.

Presentations: Preparations, Outlining, Hints for efficient practice, Last minute tasks, means of effective presentation, language, Gestures, Posture, Facial expressions, Professional attire.

Vocabulary building: A brief introduction into the methods and practices of learning vocabulary. Learning how to face questions on antonyms, synonyms, spelling error, analogy etc. Faulty comparison, wrong form of words and confused words like understanding the nuances of spelling changes and wrong use of words.

Listening Skills: The importance of listening in communication and how to listen actively.
Prepositions and Articles: A experiential method of learning the uses of articles and prepositions in sentences is provided.

Problem solving; Number System; LCM & HCF; Divisibility Test; Surds and Indices; Logarithms; Ratio, Proportions and Variations; Partnership; Time speed and distance; work time problems;

Data Interpretation: Numerical Data Tables; Line Graphs; Bar Charts and Pie charts; Caselet Forms; Mix Diagrams; Geometrical Diagrams and other forms of Data Representation.

Logical Reasoning: Family Tree; Linear Arrangements; Circular and Complex Arrangement; Conditionalities and Grouping; Sequencing and Scheduling; Selections; Networks; Codes; Cubes; Venn Diagram in Logical Reasoning.

TEXTBOOKS:


REFERENCES:

1. Quantitative Aptitude, by R S Aggarwal, S Chand Publ.
3. Data Interpretation, R S Aggarwal, S Chand Publ.
4. Nova GRE, KAPAL GRE, Barrons GRE books;
5. Quantitative Aptitude, The Institute of Chartered Accountants of India.
7. The BBC and British Council online resources
8. Owl Purdue University online teaching resources
9. www.thegrammarbook.com online teaching resources
10. www.englishpage.com online teaching resources and other useful websites.
OBJECTIVE: IT is revolutionizing the way, in which we live and work. It is changing all aspect of our life and lifestyle. The digital revolution has given mankind the ability to treat information with mathematical precision, to transmit it at very high accuracy and to manipulate it at will; to survive in this information world one must keep pace with these changes.

Unit I


Unit II


Unit III

Through Her extra ordinary acts of love and self-sacrifice, Amma has endeared Herself
to millions. Tenderly caressing everyone who comes to Her, holding them close to Her heart in a
loving embrace, Amma shares Her boundless love with all. Be they young or old, sick or poor
everyone who comes to her receives the same unconditional love.

Amma’s compassion has given rise to a vast network of charitable and spiritual
activities, which is drawing attention throughout the world. At the root of these services lies
Amma’s teaching that the divine exists in everything—in every person, plant and animal.
Perceiving this unity is the essence of spirituality and the means by which to end all suffering. It is
through this simple, yet powerful message that Amma is transforming our world, one embrace
at a time.

2 Insert a table containing 6 rows and 7 columns: Headings—Student No, name, Mark1, Mark2,
Mark3, Total, and Average.
   a. Enter the details of 5 students.
   b. Calculate Total & Average using ‘Formula’ option.
   c. Sort the details of students in the order of Average.

3. Generate 10 copies of interview letters to candidates from different states informing the place
and time of interview. (Mail Merge)
Unit II MS Excel for data analysis exercises:

1. Open a new work book and enter the details:
   Employee No  Name  Basic Pay  DA  HRA  PF  Net Pay
   E001  Anu  6000
   E002  Anju  8000
   E003  Pavan  4500
   E004  Jyothy  7600
   E005  Manu  6500
   Calculate DA as 7.5% of Basic Pay, HRA as 5% of Basic Pay PF as 6% of Basic Pay and Net Pay = Basic Pay + DA + HRA – PF.
2. Create a series using AutoFill handle.
3. Save the workbook & give suitable title in the Header and date in the Footer, Preview the file.
4. Create a name for a range of cells in the work sheet.
5. Practice Rows, columns, Cells and work sheet format options.
6. Clear the formats of 5 the row.
7. Delete the last sheet of the workbook
8. Make a copy of the first sheet and rename it.
9. Practice paste special options.

Spread Sheet Application – MS Excel:

1. Find the Sum of Net Pay using function.
2. Write a function to find the count of employees in G20 cell.
3. Insert comments in different cells and practice hyperlinks.
4. Create your own style for worksheets.
5. Create a database having the headings Roll No, Name, Mark1, Mark2, Mark3 and Total. Before entering data give validation rules:
   a. For roll no – Enter numbers between 1 and 50
   b. For name – Enter names that have text length between 3 and 15.
   c. For marks – Enter marks between 0 and 99
6. Insert records and Sort the records.
7. Create a chart for the above details.
8. Create a pie chart for the student with highest mark.

Unit III MS Power-point for business presentation and Communications:
1. Open a new Presentation and insert a new slide.
2. Apply appropriate slide transition to it.
3. Insert a number 4 more slides and set up the show for all.
4. Text and Word art into slides and apply custom animations.
5. Format the text and word art in the slides and apply design templates to slides.
6. Hyper link the slides (use text for link).
7. Use action buttons for hyperlink.
8. Create a PowerPoint presentation that contains News Headlines for a TV channel.
9. Create a presentation with minimum 5 slides regarding the programmes on Annual Day celebrations.
10. Create a presentation with minimum 5 slides regarding various products offered by a particular company.

TEXTBOOKS:

2. Photoshop® CS3 Layers Bible by Matt Doyle (Author), Simon Meek (Author)

REFERENCE BOOKS:

1. Microsoft Office 2000 Complete, BPB publications

Semester IV

23PHY214       OPTICS       3 -0 -2  4

Objective: To enable students to understand that light is a wave phenomenon and apply the understanding of wave phenomenon to light.

Course outcomes:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Ability to understand and analyze the wave nature of light and interference.</th>
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<tbody>
<tr>
<td>CO2</td>
<td>Gain the knowledge about classification of diffraction and its application.</td>
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<tr>
<td>CO3</td>
<td>Understand the basic concept of polarization and its devices.</td>
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<tr>
<td>CO4</td>
<td>Understand the basic phenomenon of scattering of light with different examples.</td>
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</table>
CO5 | Study laser and its applications are to import knowledge and to develop skills and to use modern instruments in the day-to-day life.

CO6 | Ability to do experimentation on wave optics.

Unit I


Unit II

Diffraction: Fraunhoffer and Fresnel: Diffraction, Diffraction at a single slit, double slit, Diffraction by multiple slits, Diffraction grating, Resolving power – Rayleigh’s criterion, Resolving power of a grating and telescope. Fresnel diffraction, half period zone, zone plate, diffraction at a circular aperture and at a straight edge (qualitative treatment only).

Unit III

Polarization: Polarization by reflection, Brewster’s law, Mau’s law, Double refraction, Production and detection of linearly, circularly and elliptically polarized light, Quarter and half wave plates, Polaroid’s, Discussion on use of Polaroid sheets in preparing tinted sunglasses, Optical activity.

Unit IV

Scattering of Light: A brief discussion on Tyndall effect, Rayleigh scattering and Raman effect. Blue of the sky and ocean. A qualitative account of fluorescence and phosphorescence. Raman effect: Classical and quantum theory of Raman effect, experimental method for studying Raman spectra, Raman spectrum, study of Raman effect using Lasers, intensity of Raman lines, Polarization of Raman lines, characteristic properties of Raman lines, applications of Raman effect.
**Introduction to Lasers:** Spontaneous and stimulated emission, density of states, Einstein’s A and B coefficients. Ratio of stimulated to spontaneous transitions in a system in thermal equilibrium, condition for amplification, population inversion, methods of optical pumping, energy level schemes of He-Ne and Ruby Laser. Properties and uses of Lasers. Basic concepts of holography – construction of hologram – Discussion on the use of holograms in daily life - Recording and reproduction of holograms.

**PRACTICALS:**

1. Determination of wavelength of mercury spectral lines using Diffraction Grating by normal incidence method
2. Determination of the refractive index of the material of a prism by minimum deviation method
3. Determination of Cauchy’s constants using a prism, grating and spectrometer
4. Determination of the resolving power of a telescope
5. Determination of wave length of monochromatic light source using Bi-Prism
6. Resolving power of a grating
7. Wavelength and wavelength difference using a Michelson’s interferometer
8. Determination of the thickness of paper by interference at a wedge
9. Determination of the radius of curvature of the lens by Newton’s Rings
10. Determination of the refractive index of a liquid by Newton’s rings
11. Verification of Brewster’s Law
12. Refractive index of a prism by i-d curve

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**TEXTBOOKS:**

REFERENCES:

3. Khanna and Bedi: Sound

23MAT211 MODERN ALGEBRA L-T-P-C: 3-1-0-4

Course Objectives:
- To understand the fundamental concepts of algebra.
- To apply results from elementary group theory to solve contemporary problems.

Course Outcomes:

<table>
<thead>
<tr>
<th>COs</th>
<th>Description</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Effectively write abstract mathematical proofs in a clear and logical manner</td>
</tr>
<tr>
<td>CO2</td>
<td>Locate and use theorems to solve problems in number theory and theory of polynomials over a field</td>
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<tr>
<td>CO3</td>
<td>Demonstrate ability to think critically by interpreting theorems and relating results to problems in other mathematical disciplines</td>
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</table>
Demonstrate ability to think critically by recognizing patterns and principles of algebra and relating them to the number system

CO-PO Mapping

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Syllabus:

**Unit I:**
(Chapters 1-3)

**Unit II**
(Chapters 4-6)

**Unit III**
(Chapters 7, 9, 10)

**Unit IV**
(Chapters 12, 13)

**Unit V**
Quotient Rings and Ideals – Homomorphism of rings and rings of polynomials.
(Chapters 28-30)
(Chapters 14-16)

TEXTBOOKS:


REFERENCES:


CHEMISTRY PAPER - V

21CHY217 THERMODYNAMICS, CHEMICAL EQUILIBRIUM AND ELECTROCHEMISTRY 3-0-2 4

OBJECTIVE: To develop an understanding of Thermodynamics, Chemical Equilibrium and Phase Equilibria, Solutions and Electrochemistry.

Course Outcome:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Explain the basic principles of classical thermodynamics and apply these principles in the context of chemical and physical processes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Apply the principles of chemical equilibrium and chemical thermodynamics to analyze the phase diagram of one and two component systems.</td>
</tr>
<tr>
<td>CO3</td>
<td>Apply principles of thermodynamics to explain the properties of solutions.</td>
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<tr>
<td>CO4</td>
<td>Describe the fundamental principles of electrochemistry and their application to calculate properties of electrochemical systems.</td>
</tr>
<tr>
<td>CO5</td>
<td>Explain the laws of thermodynamics and describe the concepts of photosensitized reaction using a molecular perspective.</td>
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<tr>
<td>CO6</td>
<td>Measure changes in thermodynamic properties accompanying chemical reactions.</td>
</tr>
</tbody>
</table>
Apply concepts of physical chemistry for experimental study of the properties of chemical systems.

Unit I


Unit II

Chemical Equilibrium and Phase Equilibria: Recognising a system at Chemical Equilibrium. Attributes of Chemical Equilibrium, Thermodynamic derivation of law of mass action, Equilibrium constant and free energy. Factors that affect the chemical equilibrium and Le Chatelier’s principle. Calculations involving equilibrium constant, Ionic equilibria in aqueous solutions, sparingly soluble salts, solubility product common ion effect, selective precipitation, applications in qualitative analysis. Ionisation of water, pH scale, weak acids and bases, hydrolysis, buffer solutions, acid Base indicators, acid base titrations and multi stage equilibria. Reaction isotherm and reaction isochore. Statement and meaning of the terms – phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system – water, CO₂ and S systems. Phase equilibria of two component system – solid-liquid equilibria – simple eutectic – Pb-Ag.

Unit III
**Solutions:** Solutions of Gases in liquids. Henry’s law and its applications, solutions of solids in liquids. Distribution law, application of distribution law to association, dissociation and extraction.

Dilute Solution: Colligative properties, Osmosis, Osmotic pressure, Vant Hoff Theory, Lowering of Vapour Pressure, Depression in Freezing point and Elevation in Boiling Point, Vant Hoff Factor.


**Unit IV**

**Electrochemistry:** Migration of ions Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald’s dilution law, its uses and limitations.


**TEXTBOOKS:**

**REFERENCES:**
PRACTICALS
1. Determination of heat of neutralization of acids and bases.
2. Verification of Hess’s law of constant heat summation.
3. Determination of solubility of sparingly soluble salt at various temperature, calculation of enthalpy of solution.
4. pH titration of acid versus base (observation of change in pH).
5. Determination of dissociation constant of a weak acid.
6. Determination of solubility product constant (Ksp) of a sparingly soluble salt.
7. Determination of percentage composition of NaCl by critical solution temperature method (phenol-water system).
8. Determination of distribution coefficient of benzoic acid between water and toluene or acetic acid between water and 1-butanol.

Mapping of CO’s to PO’s

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CHEMISTRY PAPER - IV

21CHY216 PHOTOCHEMISTRY AND PERICYCLIC REACTIONS
3-0-0 3

OBJECTIVES: To develop an understanding of reaction mechanism through photochemistry.

Course Outcome:

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</thead>
<tbody>
<tr>
<td>Explain the basic concepts of photochemistry.</td>
<td>Apply the principles of photochemistry to study the different chemical processes during chemical reaction.</td>
<td>Apply principles of photochemistry to explain the reaction mechanism.</td>
</tr>
</tbody>
</table>
Describe the different reactions in photochemistry.

Explain the molecular orbital symmetry and Frontier orbital concepts.

Explain pericyclic reactions.

**Unit I**


**Unit II**

Basic concepts of photosensitized reactions – photosynthesis, dissociation of hydrogen molecule, isomerization of 2-butene, and chemiluminescence.

**Unit - III**

Molecular orbital symmetry, frontier orbitals of ethylene, 1,3 Butadiene, 1,3,5-Hexatriene,allyl system, classification of pericyclic reactions FMO approach, Wooldrd- Hoffman correlation diagram method and perturbation of molecular (PMO) approach for the explanation of pericyclic reactions under thermal and photochemical conditions.

**Unit – IV**

Cycloadditions: Antarafacial and suprafacial additions, notation of cycloadditions, (4n) and (4n+2) systems with a greater emphasis on (2+2) and (4+4) - cycloadditions, (2+2) - additions of ketones secondary effects of substitutes on the rates of cycloadditions and chelotropic reactions.

**TEXTBOOKS:**


**REFERENCE:**

21SSK211    LIFE SKILLS II    1-0-2   2


Group Discussions: Advantages of Group Discussions, Structured GD – Roles, Negative roles to be avoided, Personality traits to do well in a GD, Initiation techniques, How to perform in a group discussion, Summarization techniques.

Listening Comprehension advanced: Exercise on improving listening skills, Grammar basics: Topics like clauses, punctuation, capitalization, number agreement, pronouns, tenses etc. Reading Comprehension advanced: A course on how to approach middle level reading comprehension passages.

Problem solving – Money Related problems; Mixtures; Symbol Based problems; Clocks and Calendars; Simple, Linear, Quadratic and Polynomial Equations; Special Equations; Inequalities; Functions and Graphs; Sequence and Series; Set Theory; Permutations and Combinations; Probability; Statistics.

Data Sufficiency: Concepts and Problem Solving.
Non-Verbal Reasoning and Simple Engineering Aptitude: Mirror Image; Water Image; Paper Folding; Paper Cutting; Grouping Of Figures; Figure Formation and Analysis; Completion of Incomplete Pattern; Figure Matrix; Miscellaneous.

Special Aptitude: Cloth, Leather, 2D and 3D Objects, Coin, Match Sticks, Stubs, Chalk, Chess Board, Land and geodesic problems etc., Related Problems

TEXTBOOKS:

REFERENCES:
1. Quantitative Aptitude, by R S Aggarwal, S Chand Publ.
5. The BBC and British Council online resources
6. Owl Purdue University online teaching resources
7. www.thegrammarbook.com online teaching resources
8. www.englishpage.com online teaching resources and other useful websites.

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**Semester V**

**23PHY304 BASIC ELECTRONICS 3 -1 -0 4**

**Objective:** To enable students to understand the physics of semiconductors and their applications in basic electronic circuits.

**Course outcomes:**

<table>
<thead>
<tr>
<th>CO1</th>
<th>Understand the basic concept of semiconductors its characteristics and application.</th>
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<tbody>
<tr>
<td>CO2</td>
<td>Apply different configuration of transistor to study its uses.</td>
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<tr>
<td>CO3</td>
<td>Ability to understand and apply different type of sinusoidal oscillator.</td>
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<tr>
<td>CO4</td>
<td>Understand basic logic gates and OP-AMP and its application.</td>
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</table>
Understand the basic process in communication electronics.

Unit I


Unit II

Transistors and Applications: Bipolar junction transistor (PNP and NPN) transistors, different configurations and characteristics, current components in CE configuration, large signal and small signal dc current gains, transistor biasing – self bias circuit, Load line and operating point. Transistor as an amplifier: Transistor as a two port device, h-parameters and analysis of CE amplifier using h parameter equivalent circuit, simplified h-parameter circuit, stabilization of voltage gain in CE amplifiers, Two stage amplifiers, RC coupling, frequency response of CE amplifier. Comparison of transistor configurations. Emitter follower circuit and its use. Transistor as Power amplifier. FET construction and its characteristics – MOSFET characteristics. Concept of feedback in amplifiers and advantages of negative feedback.

Unit III


Unit IV

Digital Electronics: Binary to decimal and decimal to binary conversion, Binary addition and subtraction, Octal number system, Hexadecimal system and conversions.

Unit V


Mapping of CO’s and PO’s

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TEXTBOOKS:

1. V.K. Mehta: Electronics.

REFERENCES:

2. Resnick: Special theory of relativity
3. A.P French: Special relativity
5. C. Kittel: Introduction to solid state physics
Objective: To gain hands-on experience with the basic electronic equipment

Course outcomes:

CO1: To analyze experimental I-V characteristics of different diodes, transistors and oscillators.

CO2: To analyze op-amp characteristics by constructing different logical circuits.

CO3: To verify inverse square law using phototransistor.

(A minimum of ten experiments to be performed from the following list)

1. Junction diode characteristics
2. Zener diode characteristics
3. Junction Transistor characteristics
4. FET characteristics
5. Wien Bridge Oscillator.
6. UJT characteristics.
7. Full adder using AND, OR and XOR gates
8. Study of op-amp characteristics.
9. Measurement of efficiency and output power of LED.
10. Verification of the inverse square law for light intensity using a phototransistor.
13. Amplitude demodulator.
Logic gates – AND, OR, NOT, NOR and XOR using IC 7402

Mapping of CO’s and PO’s

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23MAT301   REAL ANALYSIS   L-T-P-C: 3-1-0-4

Course Objectives:
1. To understand the basic properties of the field of real numbers
2. To understand notation of continuous functions and their properties.

Course Outcomes:

<table>
<thead>
<tr>
<th>COs</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Explain the concept of Absolute value and the concept of supremum</td>
</tr>
<tr>
<td>CO2</td>
<td>Explain concept of Convergence, Divergence and Oscillatory sequence</td>
</tr>
<tr>
<td>CO3</td>
<td>Explain the concept of continuous function, discontinuity, uniformly continuous.</td>
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<tr>
<td>CO4</td>
<td>Apply Taylor’s theorem and Maclaurin’s theorem to solve problems</td>
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<tr>
<td>CO5</td>
<td>Apply the concept Riemann integral to analyze problems.</td>
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CO-PO Mapping

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</table>
Syllabus:

Unit I
Chapter-1 (Sec.1.1-1.3), Chapter-2 (Sec.2.1-2.5)

Unit II
Chapter-3 (Sec.3.1-3.7), Chapter-9 (Sec.9.1-9.3)

Unit III
Limits and Continuous Functions: Limits of Functions – Limit Theorems – Some Extensions of the limit concept – Continuous Functions – Combinations of Continuous Functions – Continuous Functions on Intervals – Uniform Continuity.
Chapter-4 (Sec.4.1-4.3), Chapter-5 (Sec.5.1-5.4)

Unit IV
Chapter-6 (Sec.6.1-6.4)

Unit V
Chapter-7 (Sec.7.1-7.4)

TEXTBOOKS:

REFERENCES:
23MAT308 DISCRETE MATHEMATICS AND ITS APPLICATIONS
2-1-0 3

Objectives: To enable students to understand the basics of logic, permutations and combinations and use effectively algebraic techniques to analyze basic discrete structures and algorithms

Course Outcomes:

<table>
<thead>
<tr>
<th>CO1</th>
<th>To understand the basic concepts of Mathematical reasoning, set and functions.</th>
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<tbody>
<tr>
<td>CO2</td>
<td>To understand various counting techniques and principle of inclusion and exclusions.</td>
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<tr>
<td>CO3</td>
<td>Understand the concepts of various types of relations, partial ordering and equivalence relations.</td>
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<tr>
<td>CO4</td>
<td>Apply the concepts of generating functions to solve the recurrence relations.</td>
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<tr>
<td>CO5</td>
<td>Familiarize the fundamental concepts of graph theory and shortest path algorithm.</td>
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</table>

Unit I


Chapter-1 (Sections: 1.1.-1.7)

Unit II


Chapter-5 (Sections: 5.1-5.3)

Unit III

Advanced Counting Techniques and Relations: Recurrence Relations – Solving Linear Recurrence Relations – Solutions of Homogeneous Recurrence Relations.

Chapter-6 (Sections: 6.1-6.2)

Unit IV

Relations and Their Properties: Representing Relations – Closure of Relations – Equivalence Relations – Partial Ordering.
Chapter-7 (Sections: 7.1, 7.3-7.6)

Unit V

Graph Theory: Introduction to Graphs – Graph Operations – Graph and Matrices – Graph Isomorphism – Connectivity – Euler and Hamilton Paths – Shortest Path Problems.

Chapter-8 (Sections: 8.1, 8.3-8.6)

TEXTBOOKS:


REFERENCES:


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CHEMISTRY PAPER - VI

21CHY306 TRANSITION ELEMENTS, COORDINATION COMPOUNDS, CHEMICAL KINETICS AND SPECTROSCOPY 3-0-0 3

OBJECTIVES: To develop an understanding of Transition elements, Coordination compounds, Chemical kinetics, Spectroscopy and Surface Phenomena.

Course Outcome:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Explain the general characteristics, physical and chemical properties of d and f block elements.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Apply various bonding theories to explain the structure and properties of coordination compounds.</td>
</tr>
<tr>
<td>CO3</td>
<td>Explain the various metallurgical processes and their application in the extraction of metals.</td>
</tr>
</tbody>
</table>
CO4 | Apply the concepts of chemical kinetics to determine the order and rate of reactions from analysis of experimental data.

CO5 | Apply concepts of collision theory and activation energy to study the kinetics of chemical reactions.

CO6 | Describe the fundamental principles and applications of spectroscopic techniques and their applications to obtain qualitative and quantitative information about molecules.

**Unit I**

**Chemistry of d and f Block Elements:** General characteristics of d-block elements with special reference to electronic configuration, oxidation states, variable valency, metallic character, color, magnetic properties, catalytic properties and ability to form complexes. Comparison of the properties of second and third transition series with first transition series. Chemistry of lanthanides – electronic structure, oxidation states, lanthanide contraction, consequences of lanthanide contraction, magnetic properties, spectral properties and separation of lanthanides by ion exchange and solvent extraction methods (Brief study). Chemistry of actinides – electronic configuration, oxidation states, actinide contraction, position of actinides in the periodic table, comparison with lanthanides in terms of magnetic properties and spectral properties (Brief study). Extraction of Thorium, Uranium and Plutonium from burnt nuclear fuels.

**Unit II**

**Coordination Compounds:** Werner’s coordination theory and its experimental verification, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. Limitations of VBT. Elementary treatment of crystal field theory, splitting of d-orbitals in square planar, tetrahedral and octahedral complexes, factors affecting crystal field parameters, Explanation of magnetic behaviour and colour of complexes using CFT, effective atomic number concept. Metal carbonyl, 18 electron rule, Preparation, structure and reactions of Ni(CO)₄, Fe(CO)₅ and V(CO)₆, nature of bonding in metal carbonyls

**Unit III**

**Metallurgy:** Types of metallurgy: Pyrometallurgy - Extraction of Nickel from sulphide ore – general metallurgy followed by Mond’s process (purification), manganese from oxide ores – reduction by the Aluminothermite process – refining by electrolytic process. Hydrometallurgy: Extraction of gold from native ore by cyanide process and refining. Electrometallurgy: Extraction of lithium by fusion method followed by electrolysis of lithium chloride. Powder metallurgy: Importance,
metal powder production and applications, production of tungsten powder. Extraction of (1) Thorium from monazite sand – purification by iodine method, (2) uranium from pitch blende – production of $\text{U}_3\text{O}_8$ by carbonate method, $\text{U}_3\text{O}_8$ to $\text{UO}_2$ by reduction, $\text{UO}_2$ to $\text{U}$ by fluoride method.

**Unit IV**

**Chemical Kinetics**: Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light, catalyst. Concentration dependence of rates, mathematical characteristics of simple chemical reactions – zero order, first order, second order, pseudo order, half life and mean life. Determination of the order of reaction – differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects

**Unit V**

**Spectroscopy**: UV and Visible spectroscopy: Introduction, absorption laws, instrumentation, formation of absorption bands, types of electronic transitions, chromophores, auxochromes, absorption and intensity shifts, solvent effects, Woodward – Fieser rules for calculating absorption maximum in dienes and $\alpha,\beta$-unsaturated carbonyl compounds. IR spectroscopy: Introduction, theory of molecular vibrations, vibrational frequency, factors influencing vibrational frequencies, finger print region and applications of IR spectroscopy. NMR spectroscopy: Introduction, instrumentation, number of signals, position of signals (Chemical shift),shielding and deshielding effects, factors influencing chemical shifts- inductive effect, anisotropic effect and hydrogen bonding. Splitting of signals, spin-spin coupling, chemical exchange and coupling constant. Structural determination of simple organic compounds using UV, IR and NMR spectral data.

**TEXTBOOKS:**


**REFERENCES:**


21CHY386 CHEMISTRY PAPER-VII PRACTICALS 0-0-2 1

Course Outcome:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Apply principles of electrochemistry to measure the properties of electrolyte solutions.</th>
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<tbody>
<tr>
<td>CO2</td>
<td>Conduct volumetric analysis of solutions by applying principles of electrochemistry.</td>
</tr>
<tr>
<td>CO3</td>
<td>Conduct quantitative estimation of elements by applying the principle of gravimetric analysis.</td>
</tr>
<tr>
<td>CO4</td>
<td>Perform synthesis of simple metal complexes and analyze the properties of these complexes.</td>
</tr>
<tr>
<td>CO5</td>
<td>Practice the application of concepts in physical chemistry for quantitative analysis.</td>
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</tbody>
</table>

1. To study the effect of dilution on Molar Conductivity of weak and strong electrolytes.
2. Conductometric titrations
3. Potentiometric is titrations.
4. Acid Hydrolysis of Ester
5. Base Hydrolysis of an Ester by Titration and Conductometry
7. Gravimetric estimation of Barium as barium sulphate.

21SSK301 LIFE SKILLS III 1-0-2 2

Team Work: Value of Team work in organizations, Definition of a Team, Why Team, Elements of leadership, Disadvantages of a team, Stages of Team formation. Group Development Activities: Orientation, Internal Problem Solving, Growth and Productivity, Evaluation and Control. Effective Team Building: Basics of Team Building, Teamwork Parameters, Roles, Empowerment, Communication, Effective Team working, Team Effectiveness Criteria,
Common characteristics of Effective Teams, Factors affecting Team Effectiveness, Personal characteristics of members, Team Structure, Team Process, Team Outcomes.

Facing an Interview: Foundation in core subject, Industry Orientation/ Knowledge about the company, Professional Personality, Communication Skills, activities before interview, upon entering interview room, during the interview and at the end. Mock interviews.

Advanced Grammar: Topics like parallel construction, dangling modifiers, active and passive voices, etc.

Syllogisms, Critical reasoning: A course on verbal reasoning. Listening Comprehension advanced: An exercise on improving listening skills.

Reading Comprehension advanced: A course on how to approach advanced level of reading, comprehension passages. Exercises on competitive exam questions.

Specific Training: Solving campus recruitment papers, National level and state level competitive examination papers; Speed mathematics; Tackling aptitude problems asked in interview; Techniques to remember (In Mathematics). Lateral Thinking problems. Quick checking of answers techniques; Techniques on elimination of options, Estimating and predicting correct answer; Time management in aptitude tests; Test taking strategies.

Semester VI

23PHY314        ATOMIC AND MOLECULAR PHYSICS                 3-1-0    4

Objective: To enable students to apply the basic knowledge of classical and quantum mechanics at the atomic and molecular level.

| CO1  | To understand the basic idea of X-ray spectrum and its usage in analyzing different types of crystals. |
| CO2  | To understand the different aspects of studying the structure of an atom and to know different types of methods to find the charge of an electron. |
| CO3  | To acquire the knowledge of Zeeman effect and its classical and quantum approach. |
| CO4  | To understand the basic idea of molecular spectra and to acquire the knowledge about different types of molecular spectra. |
Unit I

Unit II
Atomic Spectra
The Electron: Determination of e/m of an electron by Thomson method, Determination of charge of an electron by Millikan’s oil drop method.

Unit III

Unit IV
Molecular Spectra (10 hrs): Molecular formation, the H molecular ion, H₂ – molecule. Salient features of molecular spectra. Rotation, vibration and electronic spectra of molecules, associated quantum numbers and selection rules. Theory of pure rotation and rotation-vibration spectra, Raman and IR spectra, simple applications.

Unit V
NMR Spectroscopy: Introduction to NMR spectroscopy, Chemical shifts and J-coupling One-dimensional proton NMR One dimensional NMR of X-nuclei (13C, 15N, 31P and 19F) Homonuclear 2D NMR Heteronuclear 2D NMR Structure determination of molecules

Mapping of CO’s and PO’s

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</table>

TEXTBOOKS:

1. Atomic and nuclear physics - Littlefield and T.V. Thorley
2. Molecular spectra – G Herzberg
3. Fundamental university physics, vol. 3 – Aloson and Finn

REFERENCES:

1. Perspectives of Modern Physics Beiser.
2. Electromagnetism, Reitz and Milford.
4. Introduction to modern Physics- F.R. Richtmeyer. E.H. Kennard and T. Lauritsen
5. Lasers – A K Gatak
6. Modern Physics - K.S. Krane
7. Introduction to modern Physics – H S Mani and G K Mehta

23PHY384 ATOMIC AND MOLECULAR PHYSICS - PRACTICAL
0-0-2 1
Objective: To gain the knowledge of analyzing different types of optical spectrum and spectral response of electronic devices.

Course outcome:
CO1: To examine Hydrogen spectrum and to calculate Rydberg constant.
CO2: To analyze different spectrum of different molecule.
CO3: To examine the spectral response of Photocell and Photodiode.

(A minimum of eight experiments from the following)
1. Determination of Rydberg constant by studying the Fraunhoffer spectrum
2. Analysis of powder X ray photograph
3. Study of the characteristics and spectral response of a photocell (selenium photocell)
4. Study of hydrogen spectrum
5. Analysis of band spectrum of PN molecule.
6. Analysis of rotational spectrum of nitrogen.
7. Analysis of rotational vibrational spectrum of a diatomic molecule (HBr).
8. Absorption spectrum of KMnO₄
9. Determination of dipole moment of an organic liquid

Mapping of CO’s and PO’s

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</table>

23MAT311         COMPLEX ANALYSIS         L-T-P-C: 2-1-0-3

Course Objectives
1. To obtain knowledge of theory of complex functions of a complex variable.
2. To get acquainted with different methods and techniques of series.
3. To get acquainted with different methods and techniques of bilinear transformations.
Course Outcomes:

<table>
<thead>
<tr>
<th>COs</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>CO1</td>
<td>To understand the concepts of Analytic function, Cauchy- Riemann equations and Harmonic function.</td>
</tr>
<tr>
<td>CO2</td>
<td>Applying the concept of mapping like translation, rotation, magnification and inverse.</td>
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<tr>
<td>CO3</td>
<td>Apply and analyze to solve problem using contour integral.</td>
</tr>
<tr>
<td>CO4</td>
<td>Application of Taylor’s series, Laurent’s series to solve problems.</td>
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<tr>
<td>CO5</td>
<td>Evaluating using the concept of Singularities, poles, residue theorem.</td>
</tr>
</tbody>
</table>

CO-PO Mapping

<table>
<thead>
<tr>
<th>PO/PSO CO</th>
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</tbody>
</table>

Syllabus:

Unit I
Definition – Algebra of complex numbers – polar forms – regions – Limits – continuity – differentiability – CR equations – Analytic Functions – Harmonic Functions. (Chapters 1 & 2)

Unit II
Conformal mappings – bilinear transformations – Special bilinear transformations – fixed points. Chapter-9 (Sections: 9.1-9.4)

Unit III
Introduction to complex Integration – Contour integral – Primitives – Cauchy-Goursat theorem – Winding number – Cauchy’s integral formula. Chapter-4 (Sections: 4.1-4.4, 4.6, 4.7)

Unit IV
Unit V
Chapter-7 (Sections: 7.1-7.3)
Classification of Singularities – Residues – Poles and zeroes.
Chapter-7 (Sections: 7.1-7.3)

TEXTBOOKS:

REFERENCES:

23MAT314 INTRODUCTION TO PROBABILITY AND STATISTICS
3-1 0 4
Objectives: To enable students to understand the properties of probability and probability distributions and apply wide variety of specific statistical methods.

Course Outcomes:

<table>
<thead>
<tr>
<th>CO</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Understand the basic concepts of probability and probability modelling.</td>
</tr>
<tr>
<td>CO2</td>
<td>Gain in depth knowledge about statistical distributions, properties and real time applications.</td>
</tr>
<tr>
<td>CO3</td>
<td>Find measures of central tendency for distribution of sample statistics</td>
</tr>
<tr>
<td>CO4</td>
<td>To understand the concept of theory of estimation</td>
</tr>
<tr>
<td>CO5</td>
<td>Ability to make decisions under uncertainties using statistical testing of hypothesis</td>
</tr>
</tbody>
</table>

Unit I

(Sections: 2.1 – 2.7)

**Unit II**


(Sections: 3.1-3.7, 3.9)

**Unit III**

**Continuous Random Variables and Distributions:** Continuous Random Variables – Probability Distributions and Probability Density Functions – Cumulative Distribution Functions – Mean – Variance – Continuous Uniform Distribution – Exponential Distribution – Normal Distribution – Chebyshevs Inequality – Moment-Generating Functions.

(Sections: 4.1-4.6,4.9)

**Unit IV**


(Sections:5.1, 5.3, 5.5)

**Unit V**

**Point Estimation of Parameters:** GeneralConcept of Point Estimation – Methods of Point Estimation – Sampling distributions – Chi-square, t and F distributions (only definitions and use) – Central Limit Theorem.

**Simple Linear Regression:** Empirical Models – Simple Linear Regression.

(Sections:7.1-7.5, 4.10.2, 8.3.1, 10.5.1, 11.1, 11.2)

**TEXTBOOKS:**

REFERENCES:

Chemistry Paper - VIII

21CHY316    FUNCTIONAL GROUPS, HETEROCYCLIC COMPOUNDS AND NATURAL PRODUCTS  
3-1-0    4

OBJECTIVES: To develop an understanding of Natural Products, Alcohols and Phenols, Carbonyl Compounds, Organic Compounds of Nitrogen and Heterocyclic Compounds.

Course Outcome:

<table>
<thead>
<tr>
<th>CO1</th>
<th>To explain the formation, structure, bonding and chemical properties of alcohols and phenols.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>To explain the synthesis and properties of carbonyl compounds.</td>
</tr>
<tr>
<td>CO3</td>
<td>To describe the formation and properties of organic compounds containing nitrogen.</td>
</tr>
<tr>
<td>CO4</td>
<td>To explain the formation, structure and chemical properties of heterocyclic compounds.</td>
</tr>
<tr>
<td>CO5</td>
<td>To describe the basic characteristics, classification, nomenclature and structure of natural products.</td>
</tr>
</tbody>
</table>

Unit I


Unit II


Unit III

reactions of amines with nitrous acid. Synthetic transformations by aryl diazonium salts, azo coupling.

**Unit IV**

**Heterocyclic Compounds:** Introduction, methods of formation of five membered heterocycles – furan, thiophene and pyrrole. Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and their chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Six membered heterocycles: methods of formation of pyridine, mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed five and six-membered heterocycles, preparation and reactions of Indole, quinoline and isoquinoline with special reference to Fischer indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

**Unit V**


**TEXTBOOKS:**


**REFERENCES:**
Chemistry Paper IX

21CHY387 PRACTICALS 0-0-2 1

Course Outcome:

<table>
<thead>
<tr>
<th>CO1</th>
<th>Demonstrate the experimental procedure for important organic preparations and determination of melting point of organic compounds.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Apply experimental techniques for the quantitative estimation of the properties of organic compounds.</td>
</tr>
<tr>
<td>CO3</td>
<td>Apply various chromatographic approaches for separation and identification of components of a mixture.</td>
</tr>
</tbody>
</table>

i.1 Organic preparations:

Recrystallisation and determination of melting point and its importance may be mentioned

(a) Acetylation: Preparation of acetanilide from aniline
(b) Oxidation: Preparation of benzoin acid from benzaldehyde
(c) Nitration: Preparation of m-dinitrobenzene from benzene
(d) Hydrolysis: preparation of benzoic acid from ethyl benzoate

2. Quantitative organic analysis (Any four)

(a) Estimation of aniline by bromate-bromide method
(b) Estimation of glucose by Fehlings method
(c) Determination of iodine value of an oil by Vij’s method
(d) Determination of saponification value of an ester / oil
(e) Estimation of amino acid by formal titration method
(f) Estimation of ascorbic acid in Vitamin C tablets by Volumetry
(g) Estimation of Paracetamol by titrimetric and photo spectrometric methods.
(h) Gravimetric Analysis of Lead, Iron and Nickel

i. Chromatographic Techniques (Any two)
(i) Thin Layer Chromatography
Determination of Rf values and identification of organic compounds:
(a) Separation of green leaf pigments (spinach leaves may be used)
(b) Separation of mixture of dyes
(ii) Paper Chromatography Determination of Rf values and identification of organic compounds:
(iii) Column Chromatography: Separation of ortho and para nitroanilines

21SCI399 PROJECT Credit – 6

To allow students to gain research experience in experimental and theoretical areas of basic sciences and to enhance their skills in scientific and technical writing and communication. Through the project, student will gain exposure to current and recent literature in physics, chemistry and interdisciplinary areas and will be trained to propose novel research problems and develop methodologies to solve them.

Students with an inclination towards physics will be encouraged to work on problems in both fundamental and applied branches of physics employing experimental as well as theoretical/computational techniques.

Students opting for chemistry will apply experimental and theoretical techniques to solve problems in inorganic, organic and physical chemistry and their application in the areas of industry, biology, medicine, energy and environment.

Besides topics on pure physics and chemistry, students will also be encouraged to work in interdisciplinary areas such as nanosciences, medicinal chemistry, material science, modeling and simulation etc.
ELECTIVES – MATHEMATICS

21MAT431 OPERATIONS RESEARCH 3-0-0 3

OBJECTIVES:
To enable students to
• Understand the concept of linear programming and its problems
• Apply the knowledge of networks

Unit I


Unit II

Transportation Models: Introduction to transportation - mathematical formulation of transportation problem, methods for initial basic feasible solution methods, MODI method for optimal.

Unit III


Unit IV

Queuing Theory: Introduction to queuing theory, characteristics of queuing theory, single channel queuing models with finite and infinite size, solution to single channel queuing models.

Unit V
CPM and PERT: Network logic, concepts and definition, network scheduling by critical path method, program evaluation and review technique.

TEXTBOOKS AND REFERENCES:


23MAT331 INTEGRAL TRANSFORMS AND FOURIER SERIES 3 0 0 3

Objectives: To enable students to

- Acquaint with the knowledge of fourier analysis and Laplace transforms
- Solve the linear ordinary differential equations

Unit – I
Fourier Analysis: Fourier series, Complex Form of Fourier Series, Parseval’s Identity,

Unit – II
Fourier Integrals, Fourier integral theorem.

Unit-III
Infinite Complex Fourier Transforms, Sine and Cosine Transforms, Properties, Convolution theorem and Parseval’s theorem.

Unit – IV
Laplace Transforms: Laplace Transforms, Inverse Transforms, Properties, Transforms of Derivatives and Integrals, Second Shifting Theorem, Unit Step Function and Dirac-Delta Function, Differentiation and Integration of Transforms.
Unit – V
Convolution, Initial and Final Value Theorems, Periodic Functions, Solving Linear Ordinary Differential Equations with Constant Coefficients, System of Differential Equations and Integral Equations.

Text books:


References:


Stanley J Farlow,’ Partial Differential Equations for Scientists and Engineers’ Dover Book on Mathematics, 1993

23MAT332 APPLIED STATISTICS 3 0 0 3

Objectives: To enable students to

- Understand the concept of statistical inference of two samples
- Apply statistical techniques in quality control

Unit – I

Sections: 9.1-9.9

Unit – II
Statistical Inference for Two Samples: Inference on the Difference in Means of Two Normal Distributions, Variance Known and Unknown, A nonparametric tests for difference in Two means, Paired t test, Inference on the variances of the Two Normal Distributions.

Sections: 10.1-10.6

Unit – III


Sections: 13.1-13.4

Unit – IV

Design of Experiment with several factors: Introduction – Latin Square Design – statistical model for LSD, computation of sum of squares – two factor factorial experiment – main and interaction effects, data and statistical model- computation of sum of squares.

Sections : 14.1-14.5

Unit – V

Statistical Quality Control: Quality improvement and statistics, Introduction to control limits - control charts for variables – X-bar chart, R-chart, S chart for individual observations- attribute control charts – Control charts for Proportions and for defects per unit.

Sections : 15.1-15.6

Text books:


References:


23MAT333 NUMBER THEORY 3 0 0 3
Objectives: To enable students to

- Understand the concept of divisibility, congruencies and arithmetical functions
- Understand the concept of primitive roots and Diophantine equations

Unit I:

Divisibility: Definition, properties, division algorithm, greatest integer function (Sec 1.1)

Primes: Definition, Euclid's Theorem, Prime Number Theorem (statement only), Goldbach and Twin Primes conjectures, Fermat primes, Mersenne primes. The greatest common divisor: Definition, properties, Euclid's algorithm, linear combinations and the GCD - The least common multiple: Definition and properties. The Fundamental Theorem of Arithmetic: Euclid's Lemma, canonical prime factorization, divisibility, gcd, and lcm in terms of prime factorizations. Primes in arithmetic progressions: Dirichlet's Theorem on primes in arithmetic progressions (statement only) (Sec 1.2 to 1.5)

Unit II:

Congruences: Definitions and basic properties, residue classes, complete residue systems, reduced residue systems - Linear congruences in one variable, Euclid's algorithm - Simultaneous linear congruences, Chinese Remainder Theorem - Wilson's Theorem - Fermat's Theorem, pseudoprimes and Carmichael numbers - Euler's Theorem (Sec 2.1 to 2.6).

Unit III:

Arithmetic functions: Arithmetic function, multiplicative functions: definitions and basic examples - The Moebius function, Moebius inversion formula - The Euler phi function, Carmichael conjecture - The number-of-divisors and sum-of-divisors functions - Perfect numbers, characterization of even perfect numbers (Sec 3.1 to 3.6).

Unit IV:

Quadratic residues: Quadratic residues and nonresidues - The Legendre symbol: Definition and basic properties, Euler's Criterion, Gauss' Lemma - The law of quadratic reciprocity (Sec 4.1 to 4.3).

Unit V:

Primitive roots: The order of an integer - Primitive roots: Definition and properties - The Primitive Root Theorem: Characterization of integers for which a primitive root exists (Sec 5.1 to 5.3).

Diophantine Equations
Linear Diophantine Equations - Pythagorean triples – Representation of an integer as a Sum of squares (Sec 6.1, 6.3, 6.5).

Text book:

References:

23MAT334 SPECIAL FUNCTIONS 3 0 0 3

Objectives: To enable students to
- Understand gamma and beta functions
- Solve the Legendre equations using various techniques

Unit I
Gamma and Beta Functions and Elliptic Functions
Part II: 4.1 – 4.11

Unit II
Special functions, power series solution of differential equations, ordinary point; Solution about singular points, Frobenius method. Bessel’s equation, solution of Bessel’s equation, Bessel’s functions $J_n(x)$.
Part II: 8.5-8.6, 8.8- 8.10, 11.1, 11.2.

Unit III
Recurrence Formulae, Equations reducible to Bessel’s equation, orthogonality of Bessel’s Functions, A generating function for $J_n(x)$.

Part II: 11.8, 11.10, 11.11.

**Unit IV**
Legendre’s equation, Legendre’s polynomial $P_n(x)$, Legendre’s function of the second kind [$Q_n(x)$], General solution of Legendre’s equation, Rodrigue’s formula, Legendre polynomials, A generating function of Legendre’s polynomial.

Part II: 9.1-9.4.

**Unit V**
Orthogonality of Legendre polynomials, Recurrence formulae for $P_n(x)$ Green's function – Green’s Identities – Generalized functions


**Textbooks:**

**References:**
2. N. N. Lebedev - Special Functions and Their Applications, PHI.

---

**23MAT335 MULTIVARIATE STATISTICS L-T-P-C: 3 0 0 3**

To enable students to understand various multivariate data analysis tools and techniques to analyze real-world problems involving multivariate data sets.

**Course Outcomes**

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<td>To exhibit the basics of multivariate random variables and sampling distributions.</td>
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To apply multivariate techniques for classification of distributions.

To apply the concept of PCA and its application in clustering analysis.

To gain knowledge on simple linear regression, estimation, and testing of model parameters.

To gain knowledge on multiple linear and nonlinear regression and estimation of model parameters.

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**CO-PO Mapping**

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**Syllabus:**

**Unit-I:**

Multivariate Random variables and Distribution functions – Variance - covariance matrix – correlation - Bivariate normal distribution, Multivariate normal density and its properties - Definition of Wishart matrix and its properties, Mahalanobis Distance. Sampling distributions of X and S, Large sample behaviour of X and S.

**Unit-II:**

Classification for two populations, classification with two multivariate normal populations

**Unit-III:**

Principal components analysis, Dimensionality reduction, Factor Analysis- factor loadings using principal component analysis.

**Unit-IV:**


**Text Books:**

85

References:

ELECTIVES – PHYSICS

23PHY351 MEDICAL PHYSICS 3-0-0 3

OBJECTIVE: To enable students to provide Medical Physics support with the goal of improving the effectiveness and safety in the use of Physics and technologies in medicine.

Course outcomes:

1. Ability to describe the mechanism of the body.
2. To explain the acoustics of the body.
3. Ability to explain the application of X-rays in medical field.
4. Ability to explain the application of radiation in medical field.
5. Ability to explain the protection given to patient, staff and public from radiation.

UNIT I:


UNIT II:

Acoustics of the body: Nature and characteristics of sound, Production of speech, Physics of the ear, Diagnostics with sound and ultrasound. Optical system of the body: Physics of the eye. Electrical system of the body: Physics of the nervous system, Electrical signals and information transfer.

UNIT III:

X-RAYS: Electromagnetic spectrum, production of x-rays, x-ray spectra, Bremsstrahlung, Characteristic x-ray. X-ray tubes & types: Coolidge tube, x-ray tube design, tube cooling stationary mode, Rotating anode x-ray tube, Tube rating, quality and intensity of x-ray. X-ray
generator circuits, half wave and full wave rectification, filament circuit, kilo voltage circuit, types of X-Ray Generator, high frequency generator, exposure timers and switches, HT cables, HT generation.

UNIT IV:


UNIT V:


Mapping of CO’s and PO’s

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**TEXT BOOKS:**


REFERENCES:
1) Christensen’s Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins (1990)

23PHY352 RENEWABLE ENERGY AND ENERGY HARVESTING 3-0-0 3

OBJECTIVE: To enable students to understand the use of different sources of energy.

Course outcomes:

1. Understand the need of energy conversion and the various methods of energy storage.
2. Explain the field applications of solar energy.
3. Identify Winds energy and Tidal energy as alternate form of energy and to know how it can be tapped.
4. Ability to explain the Geothermal and Hydro energy, its mechanism of production and its applications.
5. Ability to explain the electro-magnetic energy harvesting and its application.

UNIT I:

UNIT II:

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.

UNIT III:


UNIT IV:


Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power

UNIT V:

Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications.

Carbon captured technologies, cell, batteries, power consumption

Environmental issues and Renewable sources of energy, sustainability.

Mapping of CO’s and PO’s

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REFERENCES:

1) Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2) Solar energy - M P Agarwal - S Chand and Co. Ltd.
6) J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
7) http://en.wikipedia.org/wiki/Renewable_energy

23PHY353    INTRODUCTION TO NANOPHYSICS AND APPLICATIONS
            3-0-0    3

Objective: To enable students to provide knowledge about nanotechnology and its applications in Physics by focusing on different areas.

Course outcomes:

1. To acquire the knowledge of nano-size and its aspects different fields of sciences
2. To explain the properties of nanomaterials and size-effect.
3. To explain different approaches in fabricating nanomaterials and to understand the basics knowledge of quantum confinement in fabricating nanomaterials.
4. To explain how nanomaterials are characterized using different instruments and their principle of working.
5. To apply the applications of nanomaterials in different fields of physics.
UNIT I:
Introduction: relation of nano to other sciences - chemistry, biology, astronomy, geology, nano in nature.

UNIT II:
Properties of nano-materials: size effect, particle’s size, shape, and density, melting point, surface tension, gettability, surface area and pore, composite structure, crystal structure, surface characteristics; mechanical, electrical, properties, and optical properties.

UNIT III:

UNIT IV:
Characterization of nanoparticles: X-Ray diffraction, examples of XRD, Debye-Scherzer formula; FTIR: principle, methodologies and accessories; SEM: basics and primary mode of operation, applications; TEM: basic principles; STM: basic principles and instrumentation; AFM: basics, modes of operation and applications; Photoluminescence: basic principles.

UNIT V:
Application of nanophysics: Carbon nanostructures: Fullerenes, CNTs and their applications; MEMS and NEMS devices; Quantum Cascade Lasers, Smart materials, GMR and Spintronic, multifarious.

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REFERENCES:
4. S.V. Gaponenko, P.L Knight & A. Miller, Optical Properties of Semiconductor Nanocrystals, CUP, 1E, 2005
5. T Pradeep, Nano: The Essentials, TMH, 1E, 2007

23PHY354 PHYSICS OF THE ATMOSPHERE 3-0-0 3

OBJECTIVE: To enable students to understand the atmosphere of Earth and the climate change.

Course outcomes:

1. Be able to describe the basic structure of an atmosphere and the climate system.
2. Be able to use fundamental thermodynamics to derive expressions for the variation of temperature, pressure, and air density with height.
3. Be able to explain fundamental fluid dynamics involved in atmosphere.
4. Be able to explain stratospheric chemistry approach involved in atmosphere.
5. Be able to describe the detailed explanation of climate change.

UNIT I:
Earth - Atmosphere system – Introduction, Composition and structure, Radiative equilibrium, Energy budget, General circulation, Historical perspectives, Weather & Climate

UNIT II:
Atmospheric thermodynamics – Ideal gas law, First law of thermodynamics, Atmospheric composition, Hydrostatic balance, Entropy & potential temperature, Parcel concepts, Available potential energy, Moisture in the atmosphere, Saturated adiabatic lapse rate, Tephigram, Cloud formation

Atmospheric radiation – Basic physical concepts, Radiative transfer equation, basic spectroscopy of molecules, Transmittance, Absorption by atmospheric gases, Heating rates, Greenhouse effect revisited, Simple scattering model.

UNIT III:
Basic fluid dynamics – Mass conservation, material derivative, alternative form of continuity equation, equation of state for the atmosphere, Navier-Stokes equation, Rotating frames of reference, equations of motion in coordinate form, geostrophic and hydrostatic approximation,
Pressure coordinates and geopotential, Thermodynamic energy equation; Atmospheric fluid dynamics – vorticity and potential vorticity, Boussinesq approximation, Quasi-geostrophic motion, Gravity waves, Rossby waves, Boundary layers, Instability

UNIT IV:

Stratospheric chemistry – Thermodynamics and chemical reactions, Chemical kinetics, Bimolecular reactions, Photo-dissociation, Stratospheric ozone, Transport of chemicals, Antarctic ozone hole.

Atmospheric remote sounding – Observations, remote sounding from space and ground; Atmospheric modeling – Hierarchy of models, Numerical methods, Uses of complex numerical models, Lab models

UNIT V:

Climate change – Introduction, energy balance model, some solutions of the linearised energy balance model, Climatic feedbacks, Radiative forcing due to increase in Carbon dioxide.

Projects based on Modules 4 and 5 (Reading a journal paper & reproducing calculations, Numerical modeling and / or data analyses)

TEXTBOOKS/REFERENCES

3. Holton JR: An introduction to Dynamic Meteorology, 4E, AP, 2004

Mapping of CO’s and PO’s

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OBJECTIVE: To enable students to study the selected biological phenomena using physical principles.

Course outcomes:

1. Ability to explain the basics laws in physics and chemistry, various techniques to study biomolecules.
2. Be able to apply various spectroscopic methods to study biomolecules.
3. Ability to explain fundamentals of molecular modelling and macromolecular structure.
4. Be able to apply the neuro science as application in biophysics.

UNIT I:

UNIT II:
Spectroscopy: UV spectroscopy, circular dichroism, Fluorescence spectroscopy, IR, Raman and Electron spin spectroscopy, NMR spectroscopy.

UNIT III:
Molecular Modeling & Macromolecular Structure: building the structure of H₂O₂, nucleic-acid structure, monomers, polymers, double helical structure of DNA, Polymorphism and nanostructure of DNA, structure of RNA, protein structure: amino acids, virus structure

UNIT IV:

UNIT V:


TEXTBOOKS:


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23PHY356 SPACE PHYSICS 3-0-0 3

OBJECTIVE: To enable students to study in detail about physics and kinematics of the planetary bodies.

Course outcomes:

1. Be able to brief about the history of solar-terrestrial physics.
2. Be able to explain about space plasma physics.
3. Be able to explain solar winds and Interplanetary Magnetic Field.
4 Be able to explain the interaction of solar winds with magnetized planets.
5 Be able to brief about magnetosphere.

UNIT I:
Brief history of solar-terrestrial physics – The variables Sun and the heliosphere. Earth’s space environment and upper atmosphere.

UNIT II:

UNIT III:
Solar wind & Interplanetary Magnetic Field(IMF), Shocks and Instabilities in space.

UNIT IV:
Solar wind interactions with magnetized planets – Introduction, planetary magnetic fields, spherical harmonic expansions, geomagnetic field and its measurements, variations in Earth’s field.

UNIT V:
Magnetosphere – Dynamics, Sw-Magnetosphere interactions; Ionosphere, Currents in space and Ionosphere; Neutral – Dynamics.

REFERENCES:

Mapping of CO’s and PO’s

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23PHY358 Modern Physics 3 0 0 3

Course objective: Understanding of the scientific method of work and the evolution of physics from the classical to its modern era.

Course Outcomes:

1 To apply the basic ideas of Lagrangian mechanics to solve classical problems.
2 To explain the failures of Classical mechanics and the origin of Quantum mechanics.
3 To explain the dual nature of light and uncertainty principle and apply it in answering curious question.
4 To apply the advancement in Quantum mechanics in problem solving.

Unit-1


Unit-2

Quantum Theory: Origin of Quantum theory, Black body Radiations, Distribution of energy in the Spectrum of black body Radiation, Photoelectric effect, Laws of photoelectric emission, Ritz combination principle, Planck’s radiation.

Unit-3

Unit-4

Schrodinger Equation and its Application: Concept of Wave function \( \Psi \), Schrodinger Equations- Time dependent form, Expectation Value, Operators, Time Independent Schrodinger equation (Steady State form), Particle in one dimensional box, energy Quantization, Wave function.

Reference Books:-

- Classical Mechanics – J.C. Upadhayaya – 1\(^{st}\) edition 1999
- Perspective of Modern Physics – Bezier 6\(^{th}\) edition 2003
- Modern Physics – J. B. Rajam – 2004
- Introduction to Quantum Mechanics - David J. Griffiths – 1994

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23PHY357 SEMICONDUCTOR PHYSICS 3 0 0 3

Course objective: Understanding the physics of semiconductors materials and to discuss their functionalities in modern electronic and optoelectronic devices.

Course outcome:

1. To apply the ideas of semiconductors and explain the concept of Brillouin zone
2. To explain the concept doping and to apply it to solve problems on fermi energy and DoS
3. To explain the concept of electron-hole pair generation
To apply the concept of semiconductors in constructing electronic devices

Unit 1:

**Introduction to solid state materials:** crystal structure - Reciprocal lattice - Brillouin zone and rules for band (k - space) representation. Dynamics of electrons in periodic potential: Kronig - penny and nearly free electron models - Real methods for band structure calculations; Bandgaps in semiconductors - Holes and effective mass concept - Properties of conduction and valance bands.

Unit 2:

**Carriers and doping:** Fermi distribution and energy - Density of states - Valance and conduction band density of states - intrinsic carrier concentration - intrinsic Fermi level. Extrinsic semiconductors: n and p type doping - Densities of carriers in extrinsic semiconductors and their temperature dependence - extrinsic semiconductor Fermi energy level - Degenerate and non - degenerate semiconductors - Bandgap engineering

Unit 3:

**Optical Transport:** Electron - hole pair generation and recombination: band to band (direct and indirect band gap transitions) and intra band (impurity related) transitions, free - carrier & phonon transitions. Excitons: Origin, electronic levels and properties Radiative and nonradiative recombination (Shockley - Read - Hall and Auger) processes. Carrier transport - continuity equations. Optical constants: Kramers - Kronig relations.

Unit 4:

**Semiconductor as device:** Processing of Semiconductor devices (Brief), p - n and Semiconductor junctions - Homo and hetero Junctions. Semiconductors Quantum structures, Density of states and excitons, Semiconductor photonic structures: 1D, 2D and 3D photonic crystals.

Reference books:

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ELECTIVES – CHEMISTRY

21CHY531       ENVIRONMENTAL CHEMISTRY       3-0-0   3

OBJECTIVES: To study environmental management and impact assessment and the toxic effects of pollutants.

Unit I

Chemical toxicology: Toxicity - effects, toxic chemicals in the environment, impact of toxic chemicals on enzymes, biochemical effects of As, Cd, Pb, Hg, Co, NOx, SO2, O3, PAN, CN, pesticides, carcinogenic substances.

Unit II

Air pollution: Primary pollutants, hydrocarbons-photochemical smog, particulates, radioactivity, effects of atmospheric pollution - acid rain, ozone layer depletion. Indoor air pollution. Effect of electric and magnetic fields in the environment Air pollution accidents – Bhopal and Chernobyl.


Unit III

Water pollution: Pollution of fresh water, ground water and ocean. Thermal pollution. Sampling and measurement of water quality – odour, colour, EC, turbidity, TDS, salinity, COD, BOD, DO, coliform, pH, acidity, CO2, alkalinity, hardness, NO3-, NO2-, NH3, phosphate, fluoride, chloride,
cyanide, sulphide, sulphate and metals- As, Cd, Fe, Pb, Hg, SAR, WQI. Water quality parameters and standards. Waste water treatment techniques.

Unit IV


Unit V


TEXTBOOKS:

1. A. K. De, Environmental Chemistry, New age International Ltd.
2. S. S. Dara, A Textbook of Environmental chemistry and pollution control, S.Chand& Company Ltd.

REFERENCES:


21CHY532 CHEMISTRY OF TOXICOLOGY  3-0-0  3

OBJECTIVES:
To understand about the pros and cons of using processed food stuff.
To understand the difference between the various types of soaps, synthetic detergents and cosmetics.
To understand the about the environmental hazards of plastics.
To understand about different bio pesticides.

Unit I

Unit II

Unit III

Unit IV

Unit V
Drugs: Chemotherapy - types of drugs - analgesics, antipyretics, antihistamines, antacids, tranquillisers, sedatives, antibiotics.

TEXT BOOKS:

1) A. K. De, Environmental Chemistry, New age International Ltd.
2) S. S. Dara, A Textbook of Environmental chemistry and pollution control, S.Chand & Company Ltd.

REFERENCES:

3. B.K. Sharma. Industrial Chemistry
4. CNR Rao- Understanding chemistry, Universities Press.
9. P.C Pall, K. Goel, R.K Gupta, Insecticides, pesticides and agro based industries.
10. Singh, V.K Kapoor, Organic Pharmaceutical Chemistry

21CHY533 FORENSIC SCIENCE 3-0-0 3

OBJECTIVES:
To learn Crime investigation through diagnosis of poisoning and post mortem.
To acquire knowledge about explosions, the causes (gelatin sticks, RDX etc) and the security measures.
To understand the methods of detecting forgery in bank and educational records.
To understand the chemical methods used in crime investigation. (Medical aspects).
Unit I

Poisons: Poisons-types and classification-diagnosis of poisons in the living and the dead – clinical symptoms - postmortem appearances. Heavy metal contamination (Hg, Pb, Cd) of sea foods-use of neutron activation analysis in detecting Arsenic in human hair. Treatment in cases of poisoning - use of antidotes for common poisons.

Unit II


Unit III

Forgery and Counterfeiting Documents: Different types of forged signatures-simulated and traced forgeries - inherent signs of forgery methods - writing deliberately modified uses of ultraviolet rays - comparison of type written letters - checking silver line water mark in currency notes - alloy analysis using AAS to detect counterfeit coins - detection of gold purity in 22 carat ornaments - detecting gold plated jewels - authenticity of diamond.

Unit IV

Tracks and Traces: Tracks and traces - small tracks and police dogs-foot prints - casting of foot prints residue prints, walking pattern or tyre marks - miscellaneous traces and tracks - glass fracture - tool markpaints – fibres. Analysis of biological substances - blood, saliva, urine and hair- Cranial analysis (head and teeth) DNA. Finger printing for tissue identification in dismembered bodies -Detecting steroid consumption in athletes and race horses.

Unit V

TEXTBOOK:

1. T.H.James, Forensic Sciences, Stanley Thornes Ltd.

REFERENCE:


21CHY534 NANOCHEMISTRY AND NANOTECHNOLOGY 3-0-0 3

OBJECTIVES: To study History, terminology and scales of nano systems, Synthesis and characterisation of nano systems Electrical and optical properties of nano systems and Applications of nanomaterials.

Unit I

History: Terminology- scales of nano-systems- nanoparticles: introduction-atoms to molecules-quantum dots-shrinking of bulk materials to quantum dots. Different types of nanoparticles: metal nanoparticles and monolayer substituted nanoparticles- fullerenes

Unit II


Unit III

Characterisation of nanomaterials: Important methods for the characterisation of nanomaterials – electron microscopy (SEM), transmission electron microscopy (TEM), scanning tunneling electron microscopy (STEM), environmental transmission electron microscopy (ETEM), scanning probe electron microscopy (SPL), secondary ion mass spectrometry (SIMS)- photoelectron spectroscopy (UPES and XPES).

Unit IV

Electrical and optical properties of nanomaterials
Electrical and optical properties of nanoparticles- electrical and optical properties of carbon nanotubes- nanocatalysis nanolithography- nanochemical devices- optoelectronic devices- photodetectors- LEDs and lasers.

**Unit V**

**Applications of nanomaterials**: Nanocrystals- immunology labelling- applications in medical diagnosis- nanobased drug delivery- applications in biotechnology- nanosensor based on quantum size effects- nano biosensors nano medicines- destructive applications of nanomaterials- nanomaterials in war.

**TEXTBOOKS:**


**REFERENCES:**

2. V. S. Muraleedharan and A. Subramania, Nanoscience and nanotechnology, Ane Books Pvt. Ltd. New Delhi, 2009
4. R. Booker and , E. Boysen, Nanotechnology, Wiley India Pvt Ltd, 2008

**21CHY535 PHARMACEUTICAL CHEMISTRY 3-0-0 3**

**OBJECTIVES:**

To understand the common diseases and the cure
To know the terms of pharmacology
To understand the mechanism of drug action
To acquire knowledge about chemotherapy and the antibiotics
To understand the drugs used for diabetes, hypertension, cholesterolemia
To acquire knowledge about various health promoting drugs

Unit I

Unit II

Unit III
Common body ailments: Diabetes - Causes, hyper and hypoglycemic drugs - Psychedelic drugs, hypnotics, sedatives (barbiturates, LSD) - Blood pressure - Systolic & Diastolic Hypertensive drugs - Cardiovascular drugs – anti arrhythmic, antianginals, vasodilators – CNS depressants and stimulants – Lipid profile - HDL, LDL cholesterol, lipid lowering drugs.

Unit IV
Health promoting medicines: Nutraceuticals-Vitamins A B C D E and K (structure) micronutrients such as Na, K, Ca, Cu, Zn, I - Medicinally important inorganic compounds of Al, P, As, Hg, Fe

Unit V
Organic Pharmaceutical acids and bases: Organic Pharmaceutical acids; Agents for kidney function (Aminohippuric acid); Agents for liver function (Sulfobromophthalein); Agents for pituitary function (metyrapone) - Organic pharmaceutical bases - antioxidants, treatment of ulcer and skin diseases.

TEXTBOOKS:


REFERENCES:

21CHY536 SUPRAMOLECULAR CHEMISTRY 3-0-0 3

OBJECTIVES: To understand the molecular to supramolecular chemistry

Unit I
Introduction to Supramolecular Chemistry: From molecular to supramolecular chemistry: Factors leading to strong binding, hydrogen bonding and stacking interactions, Bottom-up approach, Top-Down Approach, Energy and Signals, photo switching devices, electro switching devices, mechanical switching processes,

Unit II
Processing of Energy and Signals by Molecular and Supramolecular system: Fundamental principles of photo induced electron and energy transfer, Molecular electronics, Molecular photonics, Molecular Chemionics, Molecular electro photonics, Molecular Photochemionics.

Unit III

Unit IV
Electrochemistry of Supramolecular Systems: Electroluminescent systems as sensors and devices, Redox controlled molecular switches, Biohybrid electrochemical devices, Dendrimers as multielectron storage devices.

Unit V
Molecular Scale Mechanical Devices: Introduction to mechanical devices, Spontaneous mechanical like motions, Allosteric movements, Tweezers and Harpoons, A natural proton pump, Twisters, Molecular valves, Molecular Muscles.

TEXTBOOKS:


REFERENCES:


21CHY537 GREEN CHEMISTRY 3-0-0 3

OBJECTIVES: To understand the Green chemical approach of preparation of chemical and nanomaterials.

Unit-I

Green Chemistry: Introduction-Definition of green Chemistry, need of green chemistry, basic principles of green chemistry. Green synthesis-Evaluation of the type of the reaction (i) Rearrangements (100% atom economic), (ii) Addition reaction (100% atom economic). Organic reactions by Sonication method: apparatus required examples of sonochemical reactions (Heck, Hundsdiecker and Wittig reactions).
Unit-II

Selection of solvent:

i) Aqueous phase reactions  
ii) Reactions in ionic liquids, Heck reaction, Suzuki reactions, epoxidation.  
iii) Solid supported synthesis

Super critical CO2:
Preparation, properties and applications, (decaffeination, dry cleaning)

Unit-III

Microwave and Ultrasound assisted green synthesis:
Apparatus required, examples of MAOS (synthesis of fused anthroquinones, Leukart reductive amination of ketones) -Advantages and disadvantages of MAOS. Aldol condensation-Cannizaro reaction-Diels-Alder reactions-Strecker's synthesis.

Unit-IV

Green catalysis:
Heterogeneous catalysis, use of zeolites, silica, alumina, supported catalysis-biocatalysis: Enzymes, microbes Phase transfer catalysis (micellar/surfactant)

Unit-V

Examples of green synthesis / reactions and some real world cases:
1. Green synthesis of the following compounds: adipic acid, catechol, disodium imino di acetate (alternative Strecker’s synthesis).  
3. Ultrasound assisted reactions–sonochemical Simmons –Smith reaction (ultrasonic alternative to iodine).

TEXTBOOKS:

15  Real world cases in Green Chemistry M.C. Cann and M.E. Connelly.  

REFERENCE:

i.1 Principles and practice of heterogeneous catalysis, Thomas J.M., Thomas M.J., John Wiley.
Course Objectives:

Understand the basic concepts of classical statistical mechanics, ensembles, partition functions and ensemble averages.

Unit I

Classical statistical mechanics, elementary concepts of temperature, ensembles and fluctuations, partition function, ensemble averaging, ergodicity.

Unit II


Unit III

Molecular Dynamics Simulations in different Ensembles, Temperature Control, Pressure Control, Estimation of Pure Component Properties, Radial Distribution Function, Molecular Dynamics Packages.

Unit IV

Enhanced Sampling, Molecular Dynamics Simulation of Rare Events in Chemistry - Umbrella Sampling, Metadynamics, Applications of enhanced sampling techniques.
Unit V

Simple application of modelling and simulations: Study of assembly of atoms or molecules, Study of nucleation and crystal growth, application in the study of processes such as protein folding, ion channels (Discuss case study from recent literature for each application.)

TEXTBOOKS:


REFERENCES:
