DEPARTMENT OF CHEMISTRY
ANNA UNIVERSITY, CHENNAI

VISION
The Department of Chemistry at Anna University shall strive towards attaining world class status and recognition by producing students with sound knowledge, professional skills, high levels of integrity and ethical values. The Department shall provide an outstanding ambience for teaching, research and consultancy. The Department shall perform frontier research and create knowledge base in theoretical and applied chemistry, polymeric and catalytic materials, fuel and energy related processes and materials, environmental chemistry and other transdisciplinary areas of technological importance.

MISSION
The Department of Chemistry, Anna University shall contribute to the educational, economic and social development:

- By producing postgraduates and Doctorates who are equipped with thorough knowledge in Chemistry, analytical thinking, practical skills and ethics.
- By inspiring the students to be creative thinkers, inspirational role models and citizens with environmental and social consciousness.
- By introducing high quality academic and research programmes in Chemistry and enabling interaction with experts from around the world in the fields of Chemistry.
- By ensuring a supportive ambience in the Department with dynamic leadership and growth opportunities to meet the needs of the students, faculty and staff.
- By promoting the development of technologically and socially relevant processes and products in the fields of catalysis, polymers, corrosion resistance coatings and energy conversion through academic and sponsored research, in collaboration with global research groups.
- By sharing the intellectual resources and infrastructural facilities of the Department of Chemistry among the academic fraternity of the University campus and other Institutions, among the industrial research groups, funding agencies and the Government.
- By facilitating collaborative partnership with industries and other institutions and catalyse innovation, transfer of technology and commercialization towards fulfilling societal developments.
- By benchmarking the teaching-learning and research processes and their outcomes against the Global standards and improvising on them with a clear view towards continuous development.
1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Master of Science in Applied Chemistry curriculum is designed to impart Knowledge, Skill and Attitude on the graduates to:

1. Master the fundamental, advanced and applied aspects of chemistry and enable them to pursue research and career as a quality control, analytical and research scientist in the Chemical and allied industries.
2. Have fundamental knowledge and practical skills in the areas of synthesis, characterisation and applications of polymeric, catalytic, corrosion resistant and energy storage materials.
3. Contribute towards scientific development through academic research and industrial practices.
4. Practice their profession with good communication, leadership, ethics and social responsibility.
5. Graduates will adapt to evolving advancement in the inter-disciplinary areas of chemistry through life-long learning.

2. PROGRAMME OUTCOMES (POs):

After going through the two years of study, our Master of Science in Applied Chemistry graduates will exhibit the ability to:

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<td>1</td>
<td>Engineering/Scientific knowledge</td>
<td>Apply the knowledge of basic, advanced and applied chemistry to the solution of complex research and industrial chemistry problems.</td>
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<td>2</td>
<td>Problem analysis</td>
<td>Identify, formulate and solve challenges in the inter-disciplinary fields of chemistry using the principles of chemical sciences.</td>
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<td>3</td>
<td>Design/development of solutions</td>
<td>Design and develop chemical components, processes or materials suitable for applications in science and technology, that meet specified needs with appropriate significance for public health and safety, cultural, societal and environmental considerations.</td>
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<td>4</td>
<td>Conduct investigations of complex problems</td>
<td>Conduct investigation on chemical materials and their characteristics, including design of experiments, analysis &amp; interpretation of data and processing of information to provide valid conclusions, based on the principles of different fields of chemistry.</td>
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<td>5</td>
<td>Modern tool usage</td>
<td>Select and apply appropriate, advanced spectroscopic, thermal analysis, chromatographic, electron microscope and electro analytical techniques and resources for chemical and material formulations, characterization of novel materials and qualitative &amp; quantitative assessments, with an understanding of their limitations.</td>
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6. The Engineer and society
Apply reasoning informed by the contextual knowledge to assess societal and health issues and the consequent responsibilities relevant to the career in chemistry.

7. Environment and sustainability
Understand and evaluate the impact of chemical processes and materials in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics
Commit and conform to professional ethics, responsibilities and norms in their professional and societal interactions.

9. Individual and team work
Function effectively as an individual and as a member or a leader in diverse teams and in multi-disciplinary groups.

10. Communication
Communicate effectively on the challenges and solutions of chemical processes and materials among the fellow professionals and the society at large, through comprehension of facts, writing scientific reports, documentation and effective presentations.

11. Project management and finance
Demonstrate the knowledge and understanding of different aspects of chemistry, economic decision-making and apply these to manage individual as well as team-based projects.

12. Life-long learning
Recognize the need for, and engage in independent and life-long learning in the broadest context of scientific advancement.

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of the Master of Science in Applied Chemistry programme, the student will be able to:
1. Design and synthesize novel organic, inorganic, polymeric and nano materials as per needs and specifications of industrial and academic research.
2. Carry out elaborate qualitative and quantitative analysis of chemical materials as per standard procedures and testing protocols.
3. Utilize modern instrumental analytical tools and customize their use for advanced applications.
4. Prepare and execute projects for solving scientific challenges in the spheres of materials and environmental chemistry.

4. PEO / PO Mapping:

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### Mapping of Course Outcome and Programme Outcome of Programme & Open electives

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Total Credits: 0
## SUMMARY

### M.Sc. APPLIED CHEMISTRY (2 YEARS)

<table>
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<tr>
<th>Subject Area</th>
<th>Credits per Semester</th>
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<td>5. Non Credit/Audit course</td>
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**Total Credit** 21 22 21 18 82
OBJECTIVES
- To introduce basic concepts of data analysis methods to estimate and comparison of results.
- To formulate the students to know about on volumetric and gravimetric analysis.
- To facilitate the atomic spectroscopy for qualitative and quantitative analysis and also thermal techniques.
- To familiarize the operating principles, processes and applications of electro analytical methods.
- To make the student conversant with different separation techniques and its applications.

UNIT I  ANALYTICAL DATA ANALYSIS 9
INTRODUCTION-true value, precision, accuracy, error, deviation, standard deviation, significant figures- types of errors-evaluation and comparison of experimental results-standardisation of instrumental methods.

UNIT II  WET CHEMICAL METHODS OF ANALYSIS 9
Volumetric analysis – neutralization, precipitation, complexometric and redox titrations - theoretical titrations curves - theory of indicators; Gravimetric analysis - volatilization and precipitation methods - homogeneous precipitation.

UNIT III  ATOMIC SPECTROMETRIC METHODS AND THERMAL METHODS 9
Atomic spectroscopy – atomic absorption spectrometry; Emission spectroscopy - flame photometry and ICP-AES; Atomic fluorescence spectroscopy-Principles, instrumentation and analytical applications of spectral methods. Thermal analytical techniques – TGA, DTA and DSC – principles, instrumentation and applications.

UNIT IV  ELECTROANALYTICAL TECHNIQUES 9
Conductometry, Potentiometry, pH-metry, ion selective electrodes; Electrogravimetry and coulometry; Voltammetry – polarography, amperometric titrations principles, practice and applications.

UNIT V  SEPARATION TECHNIQUES 9
Solvent extraction and ion exchange techniques – principles and applications; Chromatographic techniques – adsorption chromatography, thin layer chromatography, gas chromatography, high performance liquid chromatography and size exclusion chromatography; Supercritical fluid chromatography.

TOTAL: 45 PERIODS

OUTCOMES
On completion of the course, the students will be able:
- To recognize and apply basic knowledge on different types of data analysis methods
- To identify and apply basic concepts of volumetric and gravimetric analysis
- To identify suitable spectroscopic technique for qualitative and quantitative analysis and apply them to handling the instrumentation.
- To recognize the characterization techniques for thermal properties of materials and apply them for suitable applications.
- To demonstrate the knowledge on operating principles of different electro analytical methods and apply for different applications.

REFERENCES
AC5102 CHEMICAL THERMODYNAMICS AND ELECTROCHEMISTRY  L T P C
3 0 0 3

OBJECTIVES
- To provide exposure to the students to understand concepts of chemical thermodynamics and partial molar quantities
- To familiarize the students with phase equilibria
- To make the students acquire basic concepts of electro chemistry and its applications.
- To understand the theories involved in electrochemical energy conversion.
- To impart knowledge on corrosion and its prevention.

UNIT I CONCEPTS OF CHEMICAL THERMODYNAMICS  9
First law of thermodynamics – Joule Thomson effect – second law of thermodynamics – free energy and work function - physical significance of free energy and work function - variation of free energy - pressure and temperature - variation of work function - temperature and volume – Maxwell’s relations – third law of thermodynamics - entropies of chemical reactions.

UNIT II PARTIAL MOLAR QUANTITIES  9
Partial molar properties – chemical potential – Variation of chemical potential with temperature and pressure - applications of chemical potential-Henry’s law-Nernst distribution law-Raoult’s Law-Van’t Hoff’s equation - Gibbs- Duhem equation.

UNIT III PHASE EQUILIBRIA  9
Gibb’s Phase rule- Reduced Phase rule -two component systems – classification – liquid-liquid and liquid vapour equilibria ( fractional distillation ) solid – gas(dehydration and rehydration of CuSO₄·5H₂O),solid-liquid systems (Bi-Cd benzene – picric acid systems)– three component systems involving liquid– liquid equilibria..

UNIT IV ELECTROCHEMISTRY  9

UNIT V APPLIED ELECTROCHEMISTRY  9

TOTAL: 45 PERIODS

OUTCOMES
- Will be in a position to identify spontaneous reaction along with its thermodynamic principles
- Will be able to understand influence of chemical potential
- Can solve Phase equilibria problems and recognize changes at the phase
- Can apply electrochemical principles to the benefit of mankind
- Will be conversant in the theories involved in batteries and its application.
REFERENCES

AC5103 CONCEPTS IN INORGANIC CHEMISTRY L T P C
3 0 0 3

OBJECTIVES
- To introduce the basic concepts and terms associated with each column and group of elements in the periodic table
- To impart knowledge on the nature of ionic bonding in molecules, their properties and energy involved in bond formation
- To introduce the structures of various crystal systems of ionic compounds and their applications in different fields
- To inculcate sound understanding of different types of bonding in diatomic and polyatomic covalent compounds
- To facilitate the understanding of the different solvents used for chemical reactions based on their properties

UNIT I ATOMIC STRUCTURE

UNIT II IONIC BONDS AND NON-VALENCE FORCES

UNIT III CRYSTAL STRUCTURE
Crystalline and amorphous solids; crystal systems; types of close packing - hcp and ccp, packing efficiency-Cubic,BCC& FCC. Radius ratio, structures of AX, AX₂, A₂X₃, ABX₃ and A₂BX₄ type solids. Layer structure - cadmium iodide. Covalent solids – diamond, graphite.

UNIT IV COVALENT BOND
Lewis structure-octet theory- Valence bond theory – hybridization and resonance – diatomic and polyatomic systems; VSEPR theory;molecular orbital theory – LCAO approximation for diatomic and polyatomic systems.

UNIT V AQUEOUS AND NON-AQUEOUS CHEMISTRY

TOTAL: 45 PERIODS
OUTCOMES

- To summarize and apply basic knowledge on the periodic table and its properties to understand Inorganic concepts for further studies.
- To analyze different types of bonding in chemical compounds and apply them to study new chemical compounds.
- To distinguish between the crystal structures of different ionic compounds and apply them for suitable industrial applications.
- To analyze the bonding in covalent compounds and correlate their properties to new compounds synthesized.
- To appraise the reactions involved in different types of solvents and select suitable solvents for chemical reactions in industries.

REFERENCES


AC5104 ORGANIC SYNTHESIS AND STEREOCHEMISTRY

OBJECTIVES

- To familiarise the basics of photochemistry, photochemical reactions of organic compounds and aromaticity.
- To provide understanding of the feasibility, mechanism and applications of pericyclic reactions for organic synthesis.
- To impart knowledge on various aspects of stereochemistry like optical and stereoisomerism, conformational analysis and asymmetric synthesis.
- To provide understanding of the reactions/methodologies used for the synthesis of organic molecules in multiple steps.
- To impart knowledge on various reagents available for carrying out various organic reactions like oxidation, reduction, substitution etc.

UNIT I PHOTOCHEMISTRY AND AROMATICITY


UNIT II PERICYCLIC REACTIONS

UNIT III  STEREOCHEMISTRY
Optical activity and chirality – chiral/asymmetric molecules - Newman, Sawhorse Wedge and Fischer projection formulae and interconversion - R,S nomenclature - diastereoisomerism in acyclic and cyclic systems - enantiotopic, homotopic and diastereotopic hydrogens and prochiral carbons - optical activity of biphenyls, allenes and spirans - stereospecific and stereoselective syntheses-asymmetric synthesis - Cram’s rule - Prelog’s rule - conformational analysis of cyclic and acyclic compounds - conformation and reactivity - conformation and stereochemistry of cis and trans decalins and 9-methyl decalin - E,Z- nomenclature - E,Z-isomerism of olefins containing one double bond and more than one double bond - determination of configuration of geometrical isomers using physical and chemical methods.

UNIT IV  MULTISTEP SYNTHESIS

UNIT V  REAGENTS IN organic SYNTHESIS
Diborane-lithium aluminium hydride- sodium borohydride – osmium tetroxide- phenyl isothiocyanate - N-bromosuccinimide (NBS) - lead tetraacetate - dicyclohexylcarbodiimide (DCC) – pyridinium chlorochromate (PCC) - Swern oxidation – ptoluenesulphonyl chloride - trifluoroacetic acid - lithium diisopropylamide (LDA) - 1,3-dithiane (reactive umpolung) - crown ethers - trimethylsilyl iodide - Gilman reagent - lithium dimethylcuprate – tri-n-butylin hydride - ditertbutoxydicarbonate - dihydropyran - phase transfer catalysts - Wilkinson’s catalysts – Peterson synthesis - and diethylaluminium cyanide- IBX.

TOTAL: 45 PERIODS

OUTCOMES
• Will a general understanding of photochemical processes and aromaticity and their significance.
• Will develop capability to predict the feasibility of pericyclic reactions
• Will be able to plan synthesis of complicated molecules using cycloaddition, sigmatropic reactions and electrocyclic rearrangements.
• Will be able to clearly understand the stereochemistry of organic reactions
• Will be conversant in applying available reagents in organic synthesis which will be useful for synthesis of important molecules in the industry/academia.

REFERENCES
OBJECTIVES
To facilitate the understanding of the concepts and impart practical training on:
  • Quantitative inorganic analysis of ores, alloys and industrial chemical products.
  • Calculation of compounds present in cement
  • Analysis of important water quality parameters such as hardness, dissolved oxygen, COD and BOD so as to enable complete quality assessment of water for domestic and industrial use.
  • Qualitative inorganic semi-micro analysis and preparation of complexes.
  • Qualitative estimation of familiar and less familiar elements in the periodic table

UNIT I  QUANTITATIVE INORGANIC ANALYSIS  42
(i) Ores: carbonate ores (dolomite)
(ii) Alloys: ferrous and nonferrous alloys (brass and solder)
(iii) Spectrophotometry- estimation of copper, nickel, iron and manganese

UNIT II  ESTIMATION OF INDUSTRIAL PRODUCTS  42
(i) Analysis of cement - silica, mixed oxide – Fe₂O₃, Al₂O₃&CaO/MgO
(ii) Analysis of stainless steel - Chromium, manganese and nickel

UNIT III  WATER ANALYSIS  24
(i) Carbonate and non-carbonate hardness by EDTA
(ii) Dissolved oxygen by Winkler’s method
(iii) Chemical oxygen demand and Biological oxygen demand

UNIT IV  PREPARATION OF TYPICAL INORGANIC COMPLEXES  36
Tris- thiourea copper (I) sulphate, bisthiocyanato pyridine copper (II) sulphate, tris (ethylene diamine) copper (II) sulphate, chloropentammine cobalt (III) chloride

UNIT V  QUALITATIVE INORGANIC SEMI-MICRO ANALYSIS  36
Detection of at least four cations (2 common and 2 uncommon) in a mixture of salts.

TOTAL: 180 PERIODS

OUTCOMES
  • To design different types of alloys to be used for industrial and domestic applications
  • To use right combination of ingredients of cement material for different environment
  • To estimate water quality parameters and apply their usage and design properly at chemical industries
  • To identity right and appropriate coordination complexes for biological and chemical applications
  • To predict the nature of elements present qualitatively and use them for further studies

REFERENCES
OBJECTIVES

- To introduce the geometries of different coordination compounds and their structural characteristics
- To teach the various theoretical treatments of bonding in coordination compounds
- To facilitate the understanding of the spectral, magnetic and thermodynamic properties of transition metal complexes through energy correlations.
- To instruct on the different reactions of complexes and their mechanistic aspects.
- To familiarize about the biologically important coordination compounds and their applications.

UNIT I COORDINATION COMPOUNDS

Coordination complex-ligands-classification. Nomenclature; coordination geometry – three, four, five, six, seven and higher coordinate complexes; Isomerism – structural and stereoisomerisms; absolute configuration – ORD and CD spectra; stability of complexes – successive and overall formation constants – thermodynamic aspects.

UNIT II THEORIES OF METAL LIGAND BOND

Werner theory – Sidgwick’s theory – EAN rule - Valence bond theory – hybridization; crystal field theory – crystal field splitting, crystal field stabilization energy – applications - colour and magnetic characteristics. Jahn-Teller effect, Ligand field theory – pi bonding.

UNIT III SPECTRAL CHARACTERISTICS OF COORDINATION COMPOUNDS

Spectral characteristics - Free ion terms, transformations in crystal field, energy diagrams in weak and strong field cases – Tanabe-Sugano diagrams, selection rules; magnetic properties – Van Vleck equation. Magnetic susceptibility - Guoy and Faraday methods. IR and ESR spectra of transition metal compounds.

UNIT IV REACTIONS OF COORDINATION COMPOUNDS

Inert and labile complexes; substitution reactions in square-planar and octahedral complexes – factors affecting reactivities; electron transfer reactions- outer sphere and inner spheremechanisms; photochemical reactions of coordination compounds – substitution, red-ox and rearrangement reactions.

UNIT V EXPERIMENTAL METHODS AND BIOLOGICAL SIGNIFICANCE

Preparation of coordination compounds, Measurement of successive and overall formation constants of complexes by polarography and potentiometry; Biological significance of complexes – hemoglobin and myoglobin in oxygen transport, enzyme catalysis, photosynthesis, chemotherapy.

TOTAL : 45 PERIODS

OUTCOMES

- To identify the nomenclature and isomerism of different coordination compounds
- To analyze the bonding in coordination compounds and interpret their magnetic and spectral properties
- To interpret the influence of different ligands on the geometry of the complexes and study their spectral properties
- To recall the chemical reactions of the complexes and use them for different applications
- To devise different methods of preparation of biologically important complexes

REFERENCES

OBJECTIVES

- To make the student conversant with the biomedical application of dyes.
- To teach the student to appreciate the use of food preservatives.
- To impart the knowledge on pesticide toxicology.
- To understand the properties of important industrial inorganic chemicals such as fuels and industrial gases.
- To develop an understanding of the sugar technology and bulk sweeteners.

UNIT I - DYES

Structure and properties, Natural food colours and their health aspects, Biomedical applications of dyes: Photodynamic therapy, Dyes in bioanalysis and medical diagnostics, DNA sequencing, Cancer detection, activity with diazonium salts, Dyes as therapeutic agents.

UNIT II - FOOD PRESERVATIVES

Objectives and techniques of food preservation; Structure, properties and use of foods preservative: chemical preservative, bio preservative, safety concerns of food preservatives, analytical methods for determination of preservative residues.

UNIT III - PESTICIDE CHEMISTRY AND TOXICOLOGY

Pesticides, classification, chemical characteristics of pesticides, organochlorine, organo phosphorus, carbamate, pyrethroid, plant origin pesticides, biopesticides, neonicotinoids and nitrogenous pesticides, Toxicity classification of pesticides, NOEL and ADI tolerance level, Measurement of toxicity, LD₅₀ and related parameters.

UNIT IV - FUEL AND INDUSTRIAL GASES


UNIT V - SUGAR TECHNOLOGY

Introduction to sugar industry, Specification of raw sugar, Refining quality of raw sugar – evaluation, calculation of raw value, By-products and co-products of sugar industry. Sweeteners, Classification, Reduced calorie bulk sweeteners, Sorbitol and Mannitol.

TOTAL : 45 PERIODS

OUTCOMES

- Will appreciate the apt usage of dyes.
- Will obtain awareness about food preservatives.
- Will understand the toxic effect of pesticides.
- Will be appreciative of the utility of various fuel and industrial gases.
- Will be aware of a variety of by-products in sugar industry.

REFERENCES

OBJECTIVES

- To acquaint the students with the types and mechanisms of organic reactions.
- To make the students knowledgeable in addition, substitution and elimination reactions.
- To provide comprehensive knowledge on name reactions and rearrangements.
- To learn the involvement of reactive intermediates and understand their structure and reactivity through various organic reactions.
- To learn and understand the orbital interactions in concerted reactions.
- To learn to apply concerted and stepwise reactions in organic synthesis.

UNIT I  ADDITION REACTIONS
Reactive intermediates - formation and stability of carbonium ions, carbanions, carbenes and carbenoids, nitrenes, radicals and arynes - addition to carbon-carbon and carbon-hetero multiple bonds - electrophilic, nucleophilic and free radical additions - stereochemistry of addition to carbon-carbon multiple bonds - orientation and reactivity - addition to conjugated systems and orientation -addition to , -unsaturated carbonyl compounds.

UNIT II  SUBSTITUTION REACTIONS
Aliphatic nucleophilic substitutions - SN1, SN2 and SNi mechanisms - effects of substrate, attacking nucleophile, leaving group and solvent - stereochemistry of nucleophilic substitution reactions -mechanism of ester hydrolysis (BAC2, AAC2 and AAL1) - alkylation of active methylene compounds - substitutions at carbonyl, bridgehead, vinylic and allylic carbons - neighbouring group participation- labelling and kinetic isotope effects – norbornyl cation and other non-classical carbocations, ambident nucleophiles - O versus C alkylation - aromatic nucleophilic substitution - mechanisms -effects of substrate, structure, leaving group and attacking nucleophile - various methods of benzyne generation and reactions of benzyne, reactions of aryl diazonium salts – various nucleophilic substitution (VNS) - aromatic electrophilic substitution reactions and mechanisms.

UNIT III  ELIMINATION REACTIONS
E1, E2 and ElcB mechanisms - stereochemistry of E2 elimination - Hofmann and Saytzeff rule - competition between elimination and substitution reactions - orientation effects in elimination reactions - effects of substrate structures, attacking base, leaving group and medium on E1 and E2 reactions - pyrolytic eliminations - Bredt’s rule.

UNIT IV  NAME REACTIONS

UNIT V  REARRANGEMENTS

TOTAL: 45 PERIODS

OUTCOMES

- Apply the knowledge of basic as well as advanced and applied chemistry to the solution of complex research problems
- Identify industrial chemistry problems and give solutions
- Identify, formulate and solve challenges in the inter-disciplinary fields of chemistry
• Design and develop chemical compounds, and make new synthetic methodology for new molecules.
• Identify and create inter-disciplinary fields of chemistry using various chemical reaction mechanisms.

REFERENCES

AC5204 QUANTUM CHEMISTRY AND STATISTICAL THERMODYNAMICS

OBJECTIVES
• To impart knowledge on basics of quantum chemistry and group theory.
• The student will be familiar with wave equation and its solution.
• To develop the students understanding of molecular symmetry and groups.
• To make the student conversant with the statistical thermodynamics and separation of partition functions and quantum statistics.
• To facilitate the understanding of non-equilibrium thermodynamics.

UNIT I QUANTUM CHEMISTRY

UNIT II MOLECULAR SYMMETRY AND GROUP THEORY

UNIT III STATISTICAL THERMODYNAMICS

UNIT IV SEPARATION OF PARTITION FUNCTIONS AND QUANTUM STATISTICS
UNIT V NON-EQUILIBRIUM THERMODYNAMICS

Steady state–conservation of energy and mass-entropy production and entropy flow in open system–fluxes and forces– transformation of properties of rates and affinity – microscopic reversibility and Onsager reciprocal relation, thermokinetic effect.

TOTAL: 45 PERIODS

OUTCOMES

- Will know the basics of quantum chemistry.
- Will have the ability to derive wave equation.
- Can apply symmetry operations to a given molecule.
- Will have the potential to derive the classical thermodynamics of materials in terms of the properties of their constituent particles and their interaction.
- With the help of quantum mechanical principles can have a general perception of quantum statistics.

REFERENCES


AC5211 ORGANIC CHEMISTRY LABORATORY

OBJECTIVES

- To make the student conversant with the quantitative organic analysis and also qualitative analysis of two component mixtures.
- To acquaint the student with purification of solvents and reagents and also organic preparations.
- To teach the students, the identification of organic compounds by instrumental methods.
- Apply principles of separation and isolation techniques in organic reactions. Analyze NMR, IR and Mass spectra of organic compounds.

UNIT I QUANTITATIVE ORGANIC ANALYSIS

Percentage purity of aniline, phenol, acetone, glucose and glycerol. Determination of acid value, saponification value and iodine value of oils. Determination of fatty acid content, total alkali content and moisture content of soap.

UNIT II QUALITATIVE ANALYSIS OF TWO-COMPONENT MIXTURES

Separation of two component mixture, analysis for hetero atoms, functional group analysis, derivative preparation and confirmatory tests.

UNIT III PURIFICATION OF SOLVENTS AND REAGENTS

Purification of liquids by distillation Purification of solids by recrystallization Determination of melting point Determination of boiling point by capillary method Analysis with thin layer and column chromatographic techniques.
UNIT IV ORGANIC PREPARATIONS
Preparation of dimethylaminopropiophenone hydrochloride by Monnicer reaction. Two-stage preparation of a few organic compounds. Phase transfer catalysis. Synthesis of azo dyes

UNIT V IDENTIFICATION OF ORGANIC COMPOUNDS BY INSTRUMENTAL METHODS
UV, IR, NMR, Mass spectroscopy and TGA

TOTAL: 180 PERIODS

OUTCOMES
• Will be able to analyze and quantify any given organic compound.
• Will be competent in separation and purification technique.
• Will be able to separate and purify any organic compounds
• Will be able to analyze the molecule with spectroscopic techniques
• Will be able to handle the instruments in the laboratory

REFERENCES
6. Microscale, Publisher: Wiley India Pvt Ltd (18 March 2011).

AC5301 ADVANCED ORGANIC SYNTHESIS

OBJECTIVES
• To provide comprehensive information about the synthesis of heterocyclic compounds
• To give overall exposure and detailed reaction and synthesis of biomolecules like alkaloids, proteins, nucleic acids
• To impart thorough knowledge on the synthesis and structural elucidation of terpenoids, steroids and vitamins.
• To learn various organic reactions and reagents used in them as tools applied in the art of organic synthesis.
• To introduce advanced level study in organometallic reagents and their uses in organic synthesis.
UNIT I  HETEROCYCLIC COMPOUNDS  
Synthesis and reactivity of furan, thiophene, pyrrole, thiazole, pyridine, indole and their derivatives, quinoline, isoquinoline, pyrimidine, purine and flavone - Skraup synthesis - Fischer indole synthesis and Pachmanncoumarin synthesis.

UNIT II  PROTEINS AND NUCLEIC ACIDS  
Classification - structure and synthesis of amino acids – peptides – Merrifield solid phase peptide synthesis - structure determination - peptide sequence and synthesis of - primary, secondary, tertiary and quaternary structures- Merrifield solid phase peptide synthesis - nucleic acids - structure and synthesis of DNA - structure and synthesis of RNA-WC Model.

UNIT III  BIOMOLECULES  

UNIT IV  OXIDATION AND REDUCTION REACTIONS  
Oxidation with Cr and Mn reagents – oxidation with LTA, DDQ and SeO₂ – oxidation using DMSO either with DCC or Ac₂O or oxalyl chloride, oxidaion using Dess – Martin reagent – vicinal hydroxylation of olefinic double bonds – Woodward and Prevost procedures – epoxidation using peracids including Sharpless procedure, ozonolysis. Reduction using various reagents – hydrogenation, hydration of carbon – carbon double and triple bonds – asymmetric reduction of carbonyl functions.

UNIT V  ORGANOMETALLIC CHEMISTRY FOR ORGANIC SYNTHESIS  
Fundamental concepts in transition metal chemistry for organic synthetic transformations – metal carbenes, synthesis, reactivity, cycloaddition reactions of metal carbenes, synthesis of fused ring systems, Dotz reaction, mechanism of ring formation, application of cobalt carbonyls in organic synthesis, Pauson Khand reacion, Volhardt reaction, Pearson reaction, use of Organoiiron complexes for stereo specific synthesis of substituted cyclic compounds.

TOTAL : 45 PERIODS

OUTCOMES

• Apply the knowledge of basic, advanced and organic chemistry to the solution of complex research and industrial chemistry problems.
• Identify, formulate and solve challenges in the inter-disciplinary fields of chemistry using the advanced organic chemistry.
• Design and develop chemical compounds, which are suitable for applications in chemical science and biology
• Conduct investigation on chemical compounds and their analogues, including synthetic methods, analysis & interpretation of data in different fields of chemistry.
• Understand the evaluate the impact of advanced organic chemistry in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

REFERENCES

OBJECTIVES:

- To make the student conversant with kinetics and mechanism of gas phase reactions.
- To provide exposure to the students to understand surface phenomena and heterogeneous catalysis.
- To help the students to gain knowledge about surface phenomena.
- To make the student aware of surface reactions.
- To expose the students to various characterization technique.

UNIT I  CHEMICAL KINETICS


UNIT II  MECHANISM OF GASPHASE REACTIONS


UNIT III  SURFACE PHENOMENA

Structure of clean surfaces, notation of surface structure, structure of adsorbate layers, stepped surface, surface relaxation and reconstruction, Dynamics and energetics of surfaces.

UNIT IV  SURFACE REACTIONS


UNIT V  CHARACTERIZATION TECHNIQUES

Principles and Applications - XRD,XPS,AES,DRSUV-Vis, MAS-NMR, ESR, Raman, FT-IR spectroscopy, Electron microscopy (SEM,TEM and AFM) and, probe molecule characterizations(pyridine, ammonia, NO and CO adsorption) - TPD,TPR, DRIFT.

OUTCOMES

- Will be competent in analyzing the rates of chemical reactions
- Will be familiar with the significant mechanisms and its theories.
- Understands the concepts of surface chemistry and the methods of analysis.
- Will be familiar with adsorption and adsorption isotherms.
- Will have the ability to understand the mechanism of unimolecular and bimolecular surface reaction.

REFERENCES

OBJECTIVES

- To make the students realize molecular spectroscopy as an important tool to understanding molecular structure and its characteristics
- acquire a basic idea of different electromagnetic regions and instrumentation of various modern spectrometers
- demonstrate an understanding of the rotational, vibrational and electronic spectroscopy of diatomic and polyatomic molecules
- acquire the skill to determine the functional groups present in unknown molecules using vibrational (IR) spectra and to calculate maximum (λ maximum) absorption of molecules in Electronic (UV-Visible) region using Woodward-Fischer rule
- identify the magnetic properties of electrons and nucleus of atoms and free radicals, using spin angular momentum with the help of nuclear magnetic resonance and electron spin resonance spectra
- identify the unknown molecular formula of fragmented metastable ions of organic Compounds
- identify and analyse the hyperfine interactions of nuclei present in a molecule

UNIT I  ELECTROMAGNETIC RADIATION AND ROTATIONAL SPECTROSCOPY  9

UNIT II  ABSORPTION SPECTROSCOPY  9

UNIT III  SPIN RESONANCE SPECTROSCOPY  9

UNIT IV  MASS SPECTROMETRY  9

UNIT V  MOSSBAUER SPECTROSCOPY  9

TOTAL : 45 PERIODS

OUTCOMES

- To apply the theoretical knowledge of the various spectroscopic methods on the basis of the examples from the science and industry
- To recognize the modern spectrometers and methods, which are applied in industrial and scientific laboratories in the field of synthesis and structural determination.
- Identify and use technologies/instrumentation to collect and analyze data.
- To recognize basic light-matter interactions in molecules.
- Quantitatively analyze absorption and scattering spectra of simple molecules, and extract the relevant molecular parameters.
REFERENCES

AC5304 ORGANOMETALLIC, SOLIDSTATE AND PHOTOCHEMISTRY L T P C
3 0 0 3

OBJECTIVES
- To introduce the basic concepts of bonding and structure in organometallic compounds.
- To impart knowledge on the reactions and industrial catalytic applications of organometallic compounds.
- To instruct on the basic principles of preparation and characterization of inorganic solids.
- To teach defects-property correlation in solids and explore their electrical, magnetic, spectral and thermoelectric characteristics.
- To inculcate sound understanding of the laws of photochemistry, photo processes and their applications.

UNIT I BASIC ORGANOMETALLIC CHEMISTRY 9
18 electron rule, ligands, bonding, and electron count; structure, bonding and stereo-chemical nonrigidity; Metal carbonyls and nitrosyls: Synthesis, bonding and structure – vibrational spectra of metal carbonyls and nitrosyls; Metal alkyl, allyl and aryl complexes; Synthesis and reactivity of metal carbonyls; Metallocene.

UNIT II REACTIONS AND APPLICATIONS OF ORGANOMETALLIC COMPOUNDS 9
Reactions of organometallic compounds: Substitution, oxidative addition, reductive elimination, Insertion, Elimination, nucleophilic and electrophilic attack on coordinated ligands; Catalysis by organometallic compounds - hydrogenation, hydroformylation, stereoregular polymerization, Wacker and Monsanto processes, water gas shift reaction, alkene metathesis.

UNIT III SOLIDS- DEFECTS, PREPARATION AND CHARACTERISATION 9
Defects in solids – origin and types of defects, non-stoichiometry; Defect-property correlation in solids; Preparatory methods – solvothermal, ceramic, sol-gel, co-precipitation, intercalation, chemical vapour deposition, chemical vapour transport, electrochemical deposition, laser ablation and ion-exchange methods. Characterisation – XRD, electron microscopy.
UNIT IV PROPERTIES OF SOLIDS
Physical properties – polymorphism, anisotropy; Electrical properties: Band theory of solids – conductors, semiconductors and insulators; Solid electrolytes; Superconductivity – BCS theory, types of superconductors, applications; Thermoelectric properties: Thomson, Peltier, Seebeck and Hall effects; Dielectric properties: ferroelectric, ferrielectric, pyroelectric and piezoelectric materials and their applications; Magnetic properties, magnetic ordered solids – soft and hard materials. Optical and mechanical properties of solids.

UNIT V PRINCIPLES AND CONCEPTS IN PHOTOCHEMISTRY
Relevance of photochemistry; Thermal Vs Photochemical processes; Electronic transitions - electronic energy levels, selection rules for electronic transitions, Franck-Condon principle; Laws of photochemistry – quantum efficiency; Chemical actinometry; Photophysical processes – Jablonski diagram; Luminescence, chemiluminescence, photosensitization and photoquenching; Spontaneous and stimulated emission of radiation, LASER – principle, Construction and working of Ruby laser, applications; Solar energy – thermal and photoconversion.

OUTCOMES
• To analyse the bonding and structure in organometallic compounds.
• To identify and formulate suitable organometallic catalysts for industrial reactions.
• To design appropriate methods for the preparation and characterization of inorganic solids.
• To explore the electrical, magnetic, spectral and thermoelectric characteristics for proposing practical applications of solids.
• To identify the photophysical and photochemical processes in solids and solutions.

REFERENCES

AC5311 PHYSICAL CHEMISTRY LABORATORY

OBJECTIVES
• To impart hands-on training on electrochemical analysis techniques.
• To make the students conversant with the experimental methods for kinetics and phase equilibria.
• To acquire the skills to determine the molecular weight of polymers.
• To make the student conversant in spectroscopic analysis.
• To enable the application of the theoretical principles to adsorption, optical property, thermal methods and molecular weight determinations.
UNIT I CONDUCTOMETRY

UNIT II POTENTIOMETRY AND pH-METRY
EMF measurement - Potentiometric titrations – red-ox and precipitation titrations; pH measurement, pH-metric titrations – acid-base reactions.

UNIT III KINETICS
Determination of order - acetone-iodine reaction; Study of primary salt effect on the kinetics of ionic reaction

UNIT IV HETEROGENEOUS EQUILIBRIA
Determination of CST in phenol-water system; Phase diagram of a ternary system-nitrobenzene–acetic acid–water or water- acetic. Two component solid solutions – eutectic formation, Transition Temperature determination.

UNIT V THERMODYNAMICS
Activity coefficients of weak or strong electrolyte by solubility method. Determination of activity coefficients of an electrolyte at different molalities.

UNIT VI SPECTROPHOTOMETRIC AND FLAME PHOTOMETRIC METHODS
Determination of molar absorbptivity – verification of Beer-Lambert equation – Simultaneous estimation of Mn and Cr in solutions containing KMnO4 and K2Cr2O7. Photometric titration of Fe(III) by EDTA; Estimation of Na/K by flame photometer.

UNIT VII ELECTRO-CHEMICAL METHODS
Cyclic voltammetric (CV) studies of redox systems, Corrosion rate determination of materials using Tafel extrapolation method.

UNIT VIII OPTICAL METHODS
Polarimetry - Determination of sucrose content in cane sugar / cane juice Kinetics of hydrolysis of sucrose - effect of acid strength. Abbe’s refractometer- Percentage composition of binary mixtures

UNIT IX ADSORPTION STUDIES
Verification of Freundich isotherm – adsorption of acetic acid, oxalic acid on carbon–determination of surface area of a solid by BET method.

UNIT X MISCELLANEOUS
Molecular weight of a polymer by viscometry, Demonstration experiments-TGA and DTA, Atomic absorption spectrometry, G.C, HPLC, TOC analyser, FT-IR spectrophotometer, X-Ray Diffraction SEM, NMR and GPC

TOTAL : 180 PERIODS

OUTCOMES:
- Will attain excellent experimental skills.
- Will have the capability to determine the corrosion rate.
- Will be able to apply the theoretical concepts in the lab.
- Will appreciate the importance of instrumental methods available for analysis.
- Will have the ability to operate various sophisticated instruments

REFERENCES:

AC5001 INDUSTRIAL CATALYSIS

OBJECTIVES

- To provide basics of catalyst preparation and characterization techniques.
- To explain the principles and operations of catalytic reactors.
- To impart thorough knowledge on the environmental and industrial applications of catalytic processes.

UNIT I INTRODUCTION TO CATALYSIS
Homogeneous and Heterogeneous catalysis- definitions - catalysts, promoters and inhibitors, activation energy, catalytic activity, conversion, selectivity, contact time, time on stream. Autocatalysis, phase transfer catalysis, enzyme catalysis, photo catalysis, acid-base catalysis, catalysis by transition metal ions and their complexes.

UNIT II CATALYST PREPARATION AND CATALYTIC REACTORS
Synthesis of micro porous and meso porous materials (Sol-gel, Hydrothermal, Solvothermal, Co-precipitation, Impregnation, Adsorption and Ion-exchange methods), Reactors: batch reactor, flow reactor, trickle bed and fluidized bed and high pressure down flow reactor.

UNIT III CATALYST DEACTIVATION & REGENERATION
Poisons, fouling, coking, attrition, sintering of catalysts - Pore mouth plugging and uniform poisoning models - catalyst regeneration.

UNIT IV PETROLEUM PROCESSING
Crude oil distillation/separation, Catalysts and process for high quality fuels: Hydro treating, hydrodesulphurization, Hydrode nitrogenation - Hydrode oxygenation and hydro demetallation. Hydro cracking, reforming, alkylation and isomerization.

UNIT V BIOMASS CONVERSION

TOTAL: 45 PERIODS

OUTCOMES

- Will have in-depth knowledge about the catalyst available and their application.
- Will know the characterization techniques.
- Will be able to define conditions of catalytic activity in the industrial environment.
- Will have the knowledge about industrial biomass conversion process.
- Will attain a brief knowledge about petroleum and its refining processes.

REFERENCES
AC5002 BIO-ORGANIC CHEMISTRY

OBJECTIVES

- To make the students conversant with biomacromolecules and their interactions.
- To make the students conversant with biomolecular cell structures and functions.
- To impart knowledge about structure and functions of proteins, nucleosides and nucleic acids.
- To facilitate correlation between the properties of biomolecules and bioenergetics.
- To make the students aware of enzymes, lipids and membranes.

UNIT I CELL STRUCTURE AND FUNCTION

Cell structure and function: Molecular logic of living matter, Origin of biomolecules, cell structure—structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells.

UNIT II INTRODUCTION TO BIOMOLECULES

Introduction to biomolecules: Examples of biomolecules, building blocks of biomacromolecules, Nature of biomolecular interactions. Types of reactions occurring in cells.

UNIT III PROTEINS, NUCLEOSIDES AND NUCLEIC ACIDS

Proteins, Nucleosides and nucleic acids: Primary structure of proteins, end group determination, secondary structure of proteins, tertiary structure, oligomeric proteins, ribonucleotides and deoxyribonucleotides, RNA and DNA, Base pairing, double helical structure of DNA and genetic code, transcription, Ribosomes.

UNIT IV ENZYMES LIPIDS AND MEMBRANES

Enzymes lipids and membranes: Enzymes categorization catalysis, kinetics—single substrate enzyme catalysed reactions, Inhibition, common class of lipids, self-association of lipids, Formation of micelles, membranes, bilayer and hexagonal phases. Membrane bound proteins structure, properties and transport phenomena.

UNIT V BIOENERGETICS

Bioenergetics: Basic principles, glycolytic pathways, kreb’s cycle, oxidative phosphorylation, hydrolysis of esters and amids, c–c and c=c bond formation, oxidation, reduction, decarboxylation, biomimetic reactions, drug design.

TOTAL: 45 PERIODS

OUTCOMES

- Will be familiar with concepts of bioprocess principles and enzyme technology.
- Will gain the knowledge of microbial processes, their kinetics and action in general.
- Will understand product recovery and purification operations in industries.
- Will have the knowledge about Proteins, nucleosides & nucleic acids.
- Will be familiar with enzymes, lipids and membranes.
REFERENCES

AC5003 BIO-PROCESS TECHNOLOGY L T P C 3 0 0 3

OBJECTIVES
- To facilitate the understanding of bioprocess principles and enzyme technology.
- To make the student conversant with the microbial processes, product recovery and purification operations in industries
- To be acquainted with fundamentals of bioreactor and their types.
- To be proficient in product recovery and purification operations.
- To make the student abreast with bioprocess and enzyme technology.

UNIT I BIOPROCESS PRINCIPLES
Bioprocess principles – components and objectives; microorganisms – bacteria, yeasts and molds, animal and plant cells – cell structure, biomolecules, cellular organization, metabolic processes, stoichiometry and energetics elementary aspects of molecular genetics.

UNIT II ENZYME TECHNOLOGY
Enzyme technology – classification of enzymes, enzyme activity; kinetics of enzyme catalysis; modulation and regulation; immobilization of enzymes; applied enzyme catalysis.

UNIT III MICROBIAL PROCESSES

UNIT IV PRODUCT RECOVERY AND PURIFICATION OPERATIONS
Product recovery and purification operations–principles of filtration, centrifugation, cell disruption, extraction, adsorption, precipitation, membrane separation, chromatographic and affinity technique.

UNIT V BIOPROCESSES AND ENZYME TECHNOLOGY IN INDUSTRIES
Bioprocesses and enzyme technology in industries-fuel generation ethanol and methane production; industrial enzymes; food production and processing-SCP, fermented foods, and beverages, dairy products, vegetable fruit products-pharmaceuticals – antibiotics and monoclonal antibodies.

TOTAL: 45 PERIODS

OUTCOMES
- Will be familiar with concepts of bioprocess principles and enzyme technology.
- Will gain the knowledge of microbial processes, their kinetics and action in general.
- Will understand product recovery and purification operations in industries.
- Will know about purification operations in product separation.
- Will have the ability to generate fuel from enzyme bioprocesses.
REFERENCES

AC5004 CHEMICAL PROCESS EQUIPMENT AND INSTRUMENTATION

OBJECTIVES
- To provide basic understanding of chemical reactor.
- To familiarize the students with equipments.
- To expose the students about measuring devices.
- To impact knowledge on physical properties.
- To make the conversant with computer instrumentation.

UNIT I CHEMICAL REACTOR

UNIT II PROCESS EQUIPMENT

UNIT III MEASURING DEVICES

UNIT IV PHYSICAL PROPERTIES

UNIT V COMPUTER INSTRUMENTATION

TOTAL: 45 PERIODS

OUTCOMES
- Will have a basic understanding of the engineering concepts involved in the chemical industry.
- Will familiar the process equipment
- Knows the importance of heat and mass transfer in the industrial operations.
- Can associate the reactions that one has already learnt with the actual process in the industry.
REFERENCES

AC5005 PHARMACEUTICAL CHEMISTRY L T P C 3 0 0 3

OBJECTIVES
- To make the student conversant with the principles of drug design.
- To impart knowledge on the role of chemistry in clinical process
- To provide basic knowledge on the preparation and pharmaceutical properties of classes of drugs such as, antibiotics, antibacterial agents.
- To provide knowledge base on the importance of synthesis of anesthetics and its effects to the health
- To familiarize the students with drug discovery process through enzyme inhibition method

UNIT I DRUG DESIGN

UNIT II CLINICAL CHEMISTRY

UNIT III ANTIBIOTICS AND ANTIBACTERIALS

UNIT IV ANESTHETICS
UNIT V DRUG DISCOVERY VIA ENZYME INHIBITION


TOTAL: 45 PERIODS

OUTCOMES

- To be familiar with principles of drug design.
- To understand the various clinical methods used for biological systems.
- To be gain the knowledge of preparation and pharmaceutical properties of various drugs.
- To be acquainted with antibiotics and antibacterial agents and its uses
- To know the importance of enzyme inhibition in drug discovery process

REFERENCES


AC5006 ENVIRONMENTAL CHEMISTRY

OBJECTIVES

- To introduce the basic concepts of chemistry usedin environmental studies and the causes of pollution.
- To impart knowledge on the applications of environmental chemistry in managing environmental problems related to atmosphere.
- To create awareness of the current environmental issues and toxic effects on plants and animals.
- To familiarize the analytical and characterization methods adopted for air, water and soil based on the standard methods like APHA, NAAQS etc. to know their discharge limits.
- To inculcate the various applications of treatment systems for pollutant removal in different streams such as air, water and soil.

UNIT I CHEMISTRY AND THE ENVIRONMENT


UNIT II ATMOSPHERIC CHEMISTRY


UNIT III TOXIC EFFECTS OF POLLUTANTS

Toxic effects of pollutants - toxicity - carcinogenicity - mutagenecity- teratogenicity - Classification of metals (Speciation) - biochemical effects of arsenic, cadmium, lead, mercury, carbon monoxide, nitrogen oxides, sulphur dioxide, ozone and pan, cyanide, pesticides, asbestos.
UNIT IV  POLLUTANT ANALYSIS
Water pollution - water quality parameters-Significance and monitoring - turbidity, colour, pH, alkalinity, solids, hardness, chlorides, DO, BOD, COD, nitrogen –Analysis of air pollutants-In-Situ ozone and carbon dioxide, Pararosaniline spectrophotometric method for SO2 determination – Monitoring particulate emissions by XRF spectrometry- Soil pollution –heavy metals by x-ray fluorescence-Agricultural chemicals in soil-Reclamation of contaminated land; salt by leaching-Heavy metals by electrokinetic remediation.

UNIT V  REMEDIATION CHEMISTRY

OUTCOMES
- To gain competency and understanding the significance of chemical reactions in environmental problems and solutions.
- To identify the atmospheric pollutants and air pollution monitoring.
- To identify the environmental issues and identify the solutions based on theoretical knowledge.
- To perform the suitable technique for the analysis of wastewater and spectroscopic technique for heavy metal analysis.
- To recognize the application of various treatment systems in context with different streams of pollution.

REFERENCES

AC5007  CHEMISTRY OF NANO-MATERIALS

OBJECTIVES
- To impart knowledge to the students on nanotechnology and types of synthesis.
- To aculate the size dependence property of nanomamaterials with diff synthetic troubles.
- To make the student conversant with the nanotube,nanowires and nanocomposites.
- To comprehend the synthetic with fabrication of nanostructured materials.
- To familiarize the student with applications of nanomaterials. instrumentation.

UNIT I  INTRODUCTION TO NANOSCIENCE
Nanoscience–scopeandemergingtrends-bottom-upandtop-downapproaches; chemistry of solid surfaces–surface energy –chemical potential of curved surfaces; stabilization of colloidal dispersions by electrostatic and steric interactions; different types of nanomaterials.

UNIT II  SYNTHESIS OF NANOPIRCELES
General methods of synthesis of zero-dimensional nanoparticles –homogeneous nucleation and heterogeneous nucleation, growth of nuclei and factors of importance; synthesis and properties of metallic, semiconductor and metal oxide nanoparticles.
UNIT III NANOTUBES: SYNTHESIS AND PROPERTIES
Nanotubes - carbon nanotubes, BNNT – synthetic methods; Chemical properties hybridization, solubility, stability and functionalization; physical properties-optical, mechanical, magnetic and electrical properties, quantum size effects, Inorganic nanotubes– synthesis and properties.

UNIT IV NANOWIRES AND NANOCOMPOSITES
One-dimensional Nanowires and nanorods, two-dimensional thin films, nano composites and nano-structured polymers, nanocatalysts, nano clusters – preparation and properties.

UNIT V APPLICATIONS OF NANO MATERIALS
Physical techniques for fabrication of nanostructures – photolithography, electron beam lithography and related techniques – Applications of nanomaterials in catalysis, sensors, medicine, electronics, solar and optoelectronic devices.

OUTCOMES
- Will be aware of the synthetic methods of nanomaterials.
- Will be familiar with nanotube, nanowires and nanocomposites.
- Will interact nanotechnologies in various fields where nanotechnology can be applied.
- Will acquaint information of nanoscience of nonmaterial.
- Will be able to correlate the influence of size and the properties of nano materials.

REFERENCES
1. G. Cao, “Nanostructures and Nanomaterials: Synthesis, Properties and Applications” Imperial College Press, 2004

AC5008 CORROSION AND CORROSION CONTROL L T P C
3 0 0 3

OBJECTIVES
- To make the student understand the types and mechanism of corrosion.
- To impart knowledge to students on various factors that influence corrosion process
- To familiarize the student with corrosion testing methods.
- To make students be familiar with accelerated corrosion monitoring techniques such as EIS.
- To update the students on latest coating techniques.

UNIT I CORROSION

UNIT II FORMS OF CORROSION
UNIT III  CORROSION TESTING  9

UNIT IV  FACTORS INFLUENCING CORROSION  9

UNIT V  CORROSION CONTROL  9

TOTAL : 45 PERIODS

OUTCOMES
• Have gained knowledge on corrosion mechanism and their preventive methods.
• Understand the various factors that influence corrosion
• Apply the concepts of EIS to corrosion prevention and control.
• Understand the significance of organic and inorganic coatings for corrosion prevention
• Realize the importance of design factors towards corrosion control.

REFERENCES

AC5009  INDUSTRIAL ELECTRO CHEMISTRY  L T P C
3 0 0 3

OBJECTIVES
• To impart knowledge about the general principle and processes in chloralkali industry.
• To provide overall information on the processes, practices and significance of electrochemical operations in industries.
• To familiarize the students about metal finishing techniques.
• To make the student conversant in electro synthesis.
• To provide comprehensive knowledge about industrial electrochemical processes.
UNIT I CHLORALKALI INDUSTRY

UNIT II ELECTROMETALLURGY
Introduction to Metal extraction and refining – Electrowinning – Limitations of electrowinning - Electrowinning of aluminum, sodium, lithium and magnesium – Electro refining – aqueous and molten salt electro refining- Hydrometallurgical processes – Advantages and Disadvantages.

UNIT III METAL FINISHING

UNIT IV ELECTRO SYNTHESIS
Electrosynthesis of inorganic compounds – fluorine – KMnO4 – K2Cr2O7 – Cuprous Oxide – Manganese dioxide – Sodium and Potassium per Chlorates- Sodium hypochlorite –. Electrosynthesis of organic compounds – Hydromerisation of acrylonitrile – Monsanto process- Anthraquinone.

UNIT V INDUSTRIAL ELECTROCHEMICAL PROCESSES
Water treatment and environmental protection – metal ion removal and metal recovery – electrofiltration of particulates from gases – electro dialysis – desalination – electro floation.

TOTAL: 45 PERIODS

OUTCOMES
- Will know about the general principle and processes in chloralkali industry.
- Will be familiar about the electrometallurgical process.
- Will have basic information on the processes, practices and significance of electrochemical operations in industries.
- Will have the ability to synthesize organic and inorganic chemicals by applying electric current.
- Will be able to develop formulations for corrosion protection of metals.

REFERENCES

AC5010 WATER AND WASTEWATER TREATMENT

OBJECTIVES
- To impart knowledge on water pollution and wastewater treatment.
- To provide basic understandings about the requirements of water, its preliminary treatment.
- To make the student conversant with the water treatment methods in industries.
- To impart knowledge on adsorption and advance oxidation process for wastewater treatment.
- To know the students about Sludge handling and disposal.
UNIT I  REQUIREMENTS OF WATER AND PRELIMINARY TREATMENT

UNIT II  INDUSTRIAL WATER TREATMENT

UNIT III  TREATMENT METHODS

UNIT IV  WASTEWATER TREATMENT

UNIT V  ADSORPTION AND OXIDATION PROCESSES

TOTAL: 45 PERIODS

OUTCOMES
- To gain idea about various methods available for water treatment.
- To appreciate the necessity of water and acquire knowledge of preliminary treatment.
- To identify the physical and chemical properties of wastewater.
- To familiar with the steps involved in wastewater treatment process.
- To have knowledge about adsorption and oxidation process.

REFERENCES
OBJECTIVES

- To make students be conversant with the preparation and properties of various classes of polymers and elastomers.
- To impart knowledge to students on applications of characterization techniques for polymer testing and characterization.
- To make students to understand principle and practice polymer process moulding techniques.
- To provide students a comprehensive knowledge on the characterization of polymeric materials and correlation to the properties.

UNIT I PLASTICS MATERIALS 9

UNIT II ELASTOMERS 9

UNIT III MOULDING TECHNIQUES 9

UNIT IV CHARACTERIZATION AND TESTING 9

UNIT V POLYMER PROPERTIES 9
Effect of structure on mechanical, chemical, thermal, electrical and optical properties.

TOTAL : 45 PERIODS

OUTCOMES

- Have acquired knowledge on plastics, elastomers and composites for technological applications.
- Have gained knowledge on structure-property relationship of polymers.
- Be aware of characterization of polymers by spectral, thermal, electrical and mechanical tests.
- Be able to methodically discuss moulding operations and techniques.
- Have acquired knowledge on the influencing effect of polymer structures on mechanical, chemical, thermal, electrical and optical properties.

REFERENCES

OBJECTIVES

- To introduce the possibilities of explosion, different types of detectors, analysis of body parts and cranial analysis.
- To impart knowledge on the various contaminants in food and neutron analysis for poison detection.
- To understand the accidents caused by drunk and drive, techniques to detect and defuse live bomb and pain analysis.
- To familiarize the methods to detect forgery cases in cheques, currency notes and purity of expensive ornaments by employing various analysis.
- To understand briefly about AIDS and the concepts of procedures in plastic surgery using chromatographic techniques.

UNIT I  CRIME DETECTION  9

UNIT II  FOOD ADULTRATION  9
Contamination of wheat, rice, dhal, milk, butter, etc. With clay, sand, stone, water and toxic chemicals (e.g. Kasser dhal with mentanil yellow). Food poisons: natural poisons (alkaloids, nephrotoxins), pesticides (DDT, BHC, Follidol), Chemical poisons (KCN). First aid and Antidotes for poisoned persons. Heavy metal (Hg, Pb, Cd) Contamination of Sea food. Use of neutron activation analysis in detecting poisoning (e.g., As in human hair).

UNIT III  TRANSPORTATION  9
Drunken driving: breath analyzer for ethanol. Incendiary and timed bombs in road and railway tracks. Defusing live bombs. Hit-and-go traffic accidents: paint analysis by AAS. Soil of toxic and corrosive chemicals (e.g., conc. acids) from tankers.

UNIT IV  FORGERY AND COUNTERFEITING  9

UNIT V  MEDICAL ASPECTS  9

TOTAL: 45 PERIODS

OUTCOMES

- To recognize the crime scene in bomb explosion and rape case.
- To identify the contaminants present in the food and chemical poisoning.
- To identify the way to defuse the live bomb and possible cause of accidents in roads.
- To detect the forgeries in cheques, academic certificates, currencies and detection of impurities in precious elements.
- To have knowledge on AIDS

REFERENCES

OBJECTIVES

- To make the students conversant with the properties of textile fibres and their processing.
- To explain the significance and practice of dyeing, printing and finishing operations.
- To impart knowledge on the preparation of textile materials for processing.
- To expose the students to the machineries and processing techniques used in dyeing, printing and finishing operations.
- To make the students conversant about the textile material finishing.

UNIT I  PROPERTIES OF TEXTILE MATERIALS
Classification of textile fibres – chemical structure, physical and chemical properties of textile fibers – cotton, wool, silk, viscose, rayon, synthetic fibres.

UNIT II  PREPARATORY PROCESSES
Brief outline on desizing, singeing and mercerization, scouring – bleaching with hypochlorite’s and peroxides.

UNIT III  DYING

UNIT IV  PRINTING

UNIT V  FINISHING
Finishing of textile materials – scotching, calendaring, starching, creeping, anti-shrinking, crease-proofing, wool-finishing and other finishes.

TOTAL : 45 PERIODS

OUTCOMES

- Will be aware of the preparation and properties of fibers.
- Will have clear understanding of the concept of dyeing.
- Will be familiar with the stages involved in textile processing.
- Will be able to identify and solve problems associated to textile processing.
- Will know the techniques, skills and modern tools mandatory for practicing in textile technology.

REFERENCES
OBJECTIVES

- To introduce the basic concepts of composition, formation and properties of soil.
- To impart knowledge on the composition and application of the natural and artificial fertilizers.
- To understand the effects of pesticides, pest management and sustainable agriculture.
- To familiarize the plant growth regulators and plant hormones.
- To understand the soil biochemistry, composting and biofertilizers.

UNIT I   SOIL CHEMISTRY

UNIT II   FERTILIZERS

UNIT III   PESTICIDES

UNIT IV   PLANT GROWTH REGULATORS

UNIT V   SOIL BIOCHEMISTRY

TOTAL : 45 PERIODS

OUTCOMES

- To conduct soil analysis and to check the acidity of soil based on the absorption and adsorption reactions.
- To apply the knowledge for the optimum use of natural and man-made fertilizers.
- To find the way for sustainable agriculture by minimizing the use of pesticides.
- To understand the different types of plant growth regulators and plant hormones for the growth of the plants.

REFERENCES

OPEN ELECTIVE COURSES (OEC)

MP5491 NUCLEAR ENERGY IN HEALTH CARE AND INDUSTRY

OBJECTIVES
- To provide the student about the action of radiation on living cells and the response.
- To make the student to understand the basic nuclear medicine physics and newer technology systems.
- To enable the students to understand the diagnostic and therapeutic nuclear medicine techniques.
- To provide a broad knowledge in radiation hazard evaluation and control

UNIT I BASICS OF NUCLEAR SCIENCE AND RADIATION EFFECTS
Radioactivity, nuclear reactions and interaction of ionizing radiation with matter, with emphasis on radiation detection, radiation shielding - photoelectric - Compton effect and pair production - biological effects on human health - Action of radiation on living cells - direct and indirect physical damage - cell response to radiation - somatic and genetic radiation effects - Radiation side effects - Acute and chronic effects of low dose effects.

UNIT II DIAGNOSTIC APPLICATIONS OF NUCLEAR ENERGY
Production of X rays and its applications - X-ray radiography - CT scan - contrast studies in X ray imaging - fluoroscopic applications - Mammography - physics of nuclear medicine and nuclear imaging - radio isotopes in diagnosis of nuclear imaging - Tc-99m extraction - radiopharmaceuticals - scanning instruments and techniques.

UNIT III THERAPEUTIC APPLICATION OF NUCLEAR ENERGY
Production of nuclear radiations - alpha, beta and gamma rays - X-rays - External radiation therapy - telecobalt unit and linear accelerators - and internal radiation therapy - Iridium -192 HDR brachtherapy unit - therapeutic nuclear medicine.

UNIT IV INDUSTRIAL APPLICATIONS OF NUCLEAR ENERGY
Industrial applications — Non destructive testing - industrial radiography - tracing, gauging, Radiation sterilization of medical equipments - food preservation and other applications.

UNIT V NUCLEAR RADIATION SAFETY MEASURES
Basic concepts of radiation protection standards - ICRP recommendations - systems of radiological protection - Optimization of protection and individual dos limits - Radiation dose to individuals from natural radioactivity in the environment and man- made sources - Evaluation of external and internal radiation hazards - effect of time, distance and shielding - radioactive waste disposal and transport of radioactive nuclides.

OUTCOMES
After successful completion of the course
- students will be able to handle radioactive source carefully for treatment purpose.
- will develop competence in radioactive waste disposal management
- Will be develop competency to face radiation emergency
- students will develop critical thinking skills in radiation safety and protection.
- will be able to safe guard the radioactive sources used in hospitals.

REFERENCES
OBJECTIVES

- To provide fundamental understanding on smart and intelligent materials.
- To enhance students’ understanding on the structure-property relationship.
- To enable students appreciate novel materials and their usage in current cutting edge technologies.

UNIT I: BASICS OF SMART MATERIALS AND STRUCTURES


UNIT II: INTELLIGENT MATERIALS FOR ENERGY GENERATION

Artificial Intelligence in Materials, Ferroelectricity: Introduction - Piezoelectric effect, Piezoelectric materials as sensors, Actuators and bimorphs - Transparent Conducting Materials – Band-gap and electrical conductivity, Conditions for transparency – role of defects on conductivity - Applications: Solar cells, Touch screen, etc.

UNIT III: SHAPE MEMORY MATERIALS FOR ENERGY STORAGE

Introduction to structure types, Structure-property relationships, Shape memory effect (SME), One way and two-way SME, Shape memory alloys (SMAs), Intelligence in the form of SMA, Functional properties of SMAs. Thermal-storage, and aerospace materials. Shape-memory polymers, and their applications.

UNIT IV: MULTIFERROIC MATERIALS FOR NOVEL REFRIGERATION


UNIT V: INTELLIGENT OPTICAL MATERIALS FOR ENVIRONMENT


OUTCOMES

- The student will understand the working principle of smart materials
- The student will get an overview on various types of smart materials and their application areas.
- The student will get ideas to use smart materials in green energy and environment applications.
- The student will get motivated to find novel applications of these multifunctional materials in new technologies.
- The student will get an idea on different synthesis and characterization techniques.

REFERENCES

OBJECTIVES

- To offer a comprehensive approach to reporting of climate change.
- To impart knowledge about political, economic, and ethical questions raised by the need for transformative change of societies in the wake of climate change.
- To reflect over the development of climate change as a nature and a society issue.
- To synthesize knowledge from different areas related to climate change.
- To reflect on the norms and values of journalism in the context of climate change.

UNIT I  HUMAN INFLUENCES

Anthropocene Era (anthropo: man, and cene: new) - Freshwater scarcity - The decline of our oceans, fish, and wildlife - Environmental health - Sustainable energy, agriculture, and food systems – Role and responsibility of journalists – Making climate change relevant as a society issue – Politics and economics of climate change – Environmental ethics – Human health – Species migration.

UNIT II  PUBLIC NARRATIVES

Complex science and uncertainty - Public apathy and politics - Well-funded counter-narratives - Zealous stakeholders - What can (incorrectly) appear due to a lack of news hook for stories - Two centuries of CO₂ emissions.

UNIT III  JOURNALISTIC CHALLENGES

Environmental Journalism as a craft - Roles and differences between journalism and communications – Finding the most accurate, credible and timeliest information on science and issues – Essentials of environmental reporting – Discerning uncompromised expert sources – Using human narratives and descriptive storytelling to relate real-world impact – Tapping the databases, records and other tools commonly used by environmental reporters.

UNIT IV  CLIMATE ISSUES

The lack of diversity in environmental journalism – “Junk science” – Battling climate denial - Covering GMOs – The problem of doomsday climate reporting – Digital security for journalists and researchers etc.

UNIT V  JOURNALISTIC SKILLS

Hands-on journalistic series – Reporting, developing, funding, crafting and publishing environmental stories – Writing diverse stories on environmental history, a wildlife or ocean story, a clam-aquaculture story, a work of nature writing, etc. – A polished, fact-checked, final story with questions answered and edits made from the first draft and at least two added elements such as photos, audio or video clips, graphics, timelines or others to draw people in.

TOTAL: 45 PERIODS

OUTCOMES

- Students will understand the importance of climate issues.
- Students will understand the various aspects of climate change and its effect in society.
- Students will learn to cover the climate change issues.
- Students will understand the need of journalistic skills for covering climate issues.
- Students will learn the various strategies, approaches on covering climate issues in various media.

REFERENCES


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EA5492 DIGITAL PHOTOGRAPHY

OBJECTIVES

- To create opportunities for professional and creative expression through the practice and art of photography.
- To inculcate aesthetic sense involved in creativity.
- To get to know the genres of photography

UNIT I - CAMERA


UNIT II - LENS AND ELEMENTS OF PHOTOGRAPHY

- Different type of Lenses - Basic Shots and Camera Angles, Photographic Composition - View point and Camera angle-Eye Level, Low and High, Balance- Aspects of Balancing, Shapes and Lines, Pattern, Volume, Lighting, Texture, Tone, Contrast- and Colour, Framing, various Perspectives.

UNIT III - COLOUR AND LIGHTING

- Colour Theory, Colour Temperature, Electromagnetic spectrum, Lighting Philosophies – Basic styles of Lighting – Properties of Light – Additive and Subtractive Light – Contrast and Lighting Ratios – Direct and Indirect Light – Three point and Five Point Lighting – Light Sources. Light meters and filters

UNIT IV - PEOPLE AND PORTRAIT PHOTOGRAPHY

- Indoor and outdoor lighting techniques for portraits, the Casual Portrait, Environmental Portraits, Group Portraits, Familiar Subjects, Hands and Other Details.

UNIT V - GENRES OF PHOTOGRAPHY

- Basic shooting and Lighting Techniques and Equipments required for different genres of Photography like Black and White, Landscape, Cityscape, Architecture, Advertising, Table top photography Fashion, Food, Automobile, Sports, Travel, Children, Portrait, wild life, Still Life, Event, Silhouette, Festival and Themes.

TOTAL: 45 PERIODS

OUTCOMES

- Students will be able to utilize the principles of good composition in photography.
- Students will be able to develop an individual style in representing the society through photographs.
- Students will have a thorough understanding of how to create visual variety
- Students will understand the foundation principles of design
- Students will gain understanding in Depth of field
- Students will understand the different genres of photography
REFERENCES
2. BalakrishnaAiyer, Digital Photojournalism, Authors press, 2005

AC5491 GREEN CHEMISTRY

OBJECTIVES
• To introduce the basic concept and principles of green chemistry for environmental management.
• To make the students know about green reagents and its importance to the environment
• To acquaint the student with green solvents and its impacts in green chemistry
• To familiarize the synthesis of materials using green methods
• To impart the knowledge on applications of green synthesis technology

UNIT I PRINCIPLES OF GREEN CHEMISTRY

UNIT II GREEN REAGENTS AND CATALYSTS
Choice of starting materials – reagents (Dimethyl carbonate, polymer supported reagents) – catalysts (microencapsulated Lewis acids, zeolites, basic catalysts polymer supported catalysts, introduction to biocatalysts).

UNIT III GREEN SOLVENTS
Aqueous phase reactions (Claisen rearrangement, Aldol condensation, wurtz reaction, reduction of carbon carbon double bond, oxidation of amines into nitro compounds – Electrochemical synthesis (synthesis of adiponitrile) - Ionic liquids – reactions in acidic ionic liquids- reactions in neutral ionic liquids (hydrogenations, diels-Alder reactions, Heck reactions, O-alkylation and N-alkylation, methylene insertion reactions.

UNIT IV GREEN SYNTHESES
Microwave induced green synthesis (Hoffmann Elimination and Oxidation of alcohols) – Ultra sound assisted green synthesis (Esterification, Saponification and Cannizaro reaction) – Solid state green synthesis (Dehydration of alcohols to alkenes, Grignard reaction)- Solid supported organic synthesis (Synthesis of furans and pyrrole)

UNIT V APPLICATIONS OF GREEN SYNTHESIS

TOTAL: 45 PERIODS
OUTCOMES
• To be familiar with basic concepts of green chemistry and apply to them in various field
• To recognize the catalytic reaction with green reagents and its importance. To identify available green solvents and apply them to various synthesis process
• To recognize the preparations of materials with green process and its application to the environment.
• To gain the knowledge of preparation of various drugs using green synthesis methods
• To be have the skills and technology towards green chemistry and apply in industry.

REFERENCES

AC5492 FOOD CHEMISTRY

OBJECTIVES
• To enable the students to acquire knowledge on the macro and micro constituents of the food
• To know the structure and chemical characteristics of constituents of food.
• To demonstrate the knowledge of food chemistry and applying, the principles and concepts of chemistry as they apply to food systems.
• To familiarize the student with the relationship between water and food.
• To explain the rationale for certain food processes and preservation

UNIT I INTRODUCTION TO FOOD AND ITS PROPERTIES
Proteins-Enzymes- Chemistry and structure, kinetics, Maillard reaction. Food carbohydrates: Structural, nutritional and functional aspects. Emulsifiers-role of emulsifiers selection of emulsifier based on hydrophilic and Lipophilic balance (HLB) and its application. Thickeners-definition, chemical structure, gel formation, list of permitted thickeners and food application. Chemical and biochemical changes: changes occur in foods during different processing.

UNIT II PROCESSING AND PRESERVATION
Scope and benefits of industrial food preservation. Preservation of foods by chemicals, antibodies, antioxidants, salt and sugar. Principles of food freezing: freezing point of foods Psychrometric chart, Freeze concentration, freeze drying, IQF. Nanotechnology: Principles and application in foods, Hurdle technology: Types of preservation techniques and their principles, concept of hurdle technology and its application.

UNIT III FLAVOURS AND COLOURING AGENTS
Chemistry of food flavor, definitions, Flavourmatics /flavouring compounds, flavor retention-off flavours and food taints. Colour -Natural and synthetic food colours, their chemical structure, stability, permitted list of colours, usage levels and food application.

UNIT IV WATER RELATIONS IN FOOD
Moisture in food: Structure, properties. Types of water in food and their specific function water activity and stability.

UNIT V FOOD ADDITIVES
Definitions, uses and functions of: Acids, Bases, Buffer system, chelating/sequestering agents, Antioxidants, Anti-caking agents, Firming agents. Flour bleating agents and Bread improvers. Anti-microbial agents/ class I & II.

TOTAL: 45 PERIODS
## Outcomes

- Will know about the factors governing the food quality and chemical constituents.
- Will be able to name and describe the general chemical structures of the major components of foods and selected minor components.
- Will come to know about the techniques involved in food processing and preservation.
- Will be acquainted with food additives and their function in preservation.
- Will be familiarize with the nature of packed food from industrial processes.

## References


### AG5491 Natural Hazards and Management

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## Objectives

- To teach characteristics of natural hazards.
- To teach mitigation methods for natural hazards.
- To provide knowledge on assessment and management of natural hazards.

### Unit I Disaster Phenomenon

Disaster threat - characteristics-parameters – mapping aspects for earthquake, landslides, tsunami, cyclones, flood, drought and epidemics.

### Unit II Mitigation


### Unit III Assessment


### Unit IV Management


### Unit V Case Studies and Advanced Tools

Post disaster review – role of remote sensing and GIS –National and state level case studies on various disasters.

Total: 45 Periods

## Outcomes

On completion of this course, the students expected to be able to:

- Gain knowledge on natural hazards and their characteristics.
- Have better understanding on geological and hydrological hazards.
- Appreciate various mitigation techniques.
- Carryout risk assessment and vulnerability mapping.
- Understand the role of remote sensing and GIS in natural hazard risk reduction.
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AG5492 OCEAN RESOURCES AND EXPLORATION TECHNIQUES L T P C 3 0 0 3

OBJECTIVES
- To understand the Sources of Marine Minerals.
- To understand the various energy resources pertain to marine system
- To understand the importance and economic aspects of marine minerals

UNIT I INTRODUCTION

UNIT II OCEAN RESOURCES

UNIT III ENERGY RESOURCES
Wind Energy - Wave Energy - Tidal Energy - Ocean Current Energy - Ocean thermal energy conversion (OTEC) - osmotic power plant-Petroleum resources and radioactive nuclear mineral deposits

UNIT IV OCEAN RESOURCES EXPLORATION AND EXPLOITATION
Marine sampling - Water Samplers - Bottom Samplers - Instrumentation
UNIT V OCEAN MINERAL MINING

Mining aspects of deep-sea polymetallic sulphides - Manganese Nodules - Methane Hydrates. Sand, Sand Mining & Beach replenishment-Marine maps of Exclusive Economic Zone (EEZ)

TOTAL: 45 PERIODS

OUTCOMES

- Students will understand the various sources of marine minerals.
- Students will able to understand the Mineral deposits derived from land sources.
- Students will learn about the energy resources of marine system.
- Students will learn about various sampling methods and instrumentation.
- Students will able to understand the economic aspects of marine minerals.

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MC5491 BASIC CRYSTALLOGRAPHY AND CRYSTAL GROWTH

OBJECTIVES

- To introduce the basics of crystal symmetry and crystal structures.
- To provide students with a background to X-ray generation and detection
- To provide instruction on the steps involved in single crystal structure determination
- To teach the concept of powder X-ray diffraction and its applications
- To teach various crystal growth techniques

UNIT I CRYSTAL SYMMETRY AND STRUCTURES


UNIT II X-RAYS

X-rays - generation of X-rays - sealed tube and rotating anode generators – synchrotron radiation – continuous and characteristic X-rays - X-ray absorption – X-ray monochromators – collimation – Soller slits - X-ray detectors (principles only)
UNIT III SINGLE CRYSTAL STRUCTURE DETERMINATION

UNIT IV POWDER X-RAY DIFFRACTION

UNIT V CRYSTAL GROWTH TECHNIQUES

TOTAL: 45 PERIODS

OUTCOMES
Upon completion of the course the students will
- understand crystal symmetry, crystal planes and simple crystal structures
- gain a knowledge of X-ray generation, absorption, monochromatization and detection
- get a working knowledge of single crystal structure determination
- get some insight into the powder diffraction and its applications
- be able to understand the basics of various crystal growth techniques

REFERENCES

MC5492 NONLINEAR SCIENCE

OBJECTIVES
- The students will be introduced to the basics of nonlinear dynamics and its applications.
- The students will learn about the mathematical models needed to study the concepts of fixed points, oscillations, bifurcations and integrability.
- The students will know about the nonlinear dynamical phenomena in chemical systems.
- The students will understand the importance of nonlinear dynamics in biological systems.
- The students will be introduced to the concepts of nonlinear dynamical analysis in geological systems.

UNIT I NONLINEAR DYNAMICS
UNIT II  MATHEMATICAL MODELS  9
First-order differential equations - separation of variables - slope fields - Euler’s method - equilibria and phase plane - bifurcations - higher-order equations - trace-determinant plane - harmonic oscillators - equilibrium point analysis - non-autonomous systems and chaos - finite dimensional integrable systems - dispersive systems - solitary waves - solitons - analysis of soliton solutions.

UNIT III  CHEMICAL SYSTEMS  9

UNIT IV  BIOLOGICAL SYSTEMS  9

UNIT V  GEOLOGICAL SYSTEMS  9

TOTAL: 45 PERIODS

OUTCOMES
After completing this course, the students should able to
- Understand the basics of nonlinear dynamics and its applications.
- Gain knowledge on the concepts of fixed points, oscillations, bifurcations and integrability.
- Appreciate the importance of nonlinear dynamical phenomena in chemical systems.
- Understand the role of nonlinear dynamics in biological systems.
- Apply nonlinear dynamical analysis for geological systems.

REFERENCES

MT5491  STATISTICAL METHODS  L T P C
3 0 0 3

OBJECTIVES
- To organize and describe the data and hence compute the various descriptive measures
- To give an idea of testing the statistical hypothesis claimed based on a set of data points using standard sampling distributions
- To expose to the basic principles of experimental design and hence carry out the analysis of variance
- To use non parametric methods on data sets which are not from normally distributed population
- To prepare the students to implement the various concepts in statistics using R statistical tool
UNIT I DESCRIPTIVE STATISTICS 9
Frequency distribution - Graphs of frequency distribution - Descriptive Measures - Quartiles and Percentiles - Calculation of sample mean and population mean

UNIT II HYPOTHESIS TESTING 9
Sampling Distributions - Central Limit Theorem - Testing a Statistical Hypothesis - Tests Concerning Means and variances - Independence of Attributes - Goodness of Fit

UNIT IV ANALYSIS OF VARIANCES 9
One way and two way classification - Completely Randomized Design - Randomized Block Design - Latin Square Design

UNIT V NONPARAMETRIC METHODS 9
Sign Test - Wilcoxon’s Signed Rank Test - Rank Sum Tests - Tests of Randomness - Kolmogrov Smirnov and Anderson Darling Tests

UNIT V CALCULATIONS USING R 9

TOTAL: 45 PERIODS

OUTCOMES
- It equips the student to compute mean, variances, quartiles and percentiles for a large set of data points obtained from a series of measurements
- It imparts the knowledge of various test statistics used in hypothesis testing for mean and variances of large and small samples
- It enables the students to compare several means
- It makes the students use sign test and rank test which can be applied to any raw data without the underlying assumptions that the observations are from normal population.
- It equips the students to implement the various concepts learnt using R tool for statistics

REFERENCES

HS5491 PROFESSIONAL EMAIL COMMUNICATION L T P C
UNIT I Email as a medium of professional communication (1 hour)
- Clear, grammatically correct sentences
- Clear and coherent paragraphs
- Polite and professional expression
- Accurate punctuation

The nature of the e-mail in its present technological state
- The pros and cons of using email for professional communication
UNIT II Standard email conventions and etiquette
   a. Conventions for effective emailing intra and inter workplaces (inclusive of formatting)
   b. Interpersonal etiquette to be used in professional emailing
   c. Cross-cultural dos and don'ts when using email across borders

UNIT III Understanding email messages accurately (2 hours)
   a. Understanding the core message
   b. Understanding the writer's intention and expectation accurately
   c. Interpreting the style and tone of the message
   d. Reading and understanding messages quickly

UNIT IV Writing clear and contextually appropriate responses (12 hours)
   a. Writing appropriate opening and closing sentences
   b. Structuring the email logically and coherently
   c. Positioning the core message for reader attention and action
   d. Writing messages for a range of professional functions such as giving an update, reporting, requesting, clarifying and confirming, giving instructions etc.

UNIT V Using a range of professional styles (10 hours)
   a. Maintaining courtesy and professional poise in all messages
   b. Being direct or indirect as necessary
   c. Being elaborate or brief as necessary
   d. Being assertive and decisive when needed

Learning outcome: At the end of the course, the students should
   • Understand email as a professional communication medium and as it is used in workplaces today.
   • Use standard e-mailing conventions and etiquette used in workplaces internationally.
   • Use appropriate style and tone for communicating a variety of professional messages that are generally communicated via e-mail in work and business communication.
   • Read and interpret e-mail messages accurately and write contextually appropriate responses.
   • Use English accurately while writing emails in generic professional contexts.
   • Use punctuation accurately while writing e-mail messages.

Assessment (with individualised feedback for mid-course tests):
   Mid-course Assessment - 1 hour + 1 hour for feedback after evaluation
   Mid-course Assessment - 2 (1 hour + 1 hour for feedback after evaluation)
   Final Assessment – 2 hours (inclusive of Email English test )

Classroom teaching methodology: Concept familiarisation will be accompanied with practice in generic professional emailing contexts. Practice tests and individualised feedback will be used feedback.

Material for the course will be teacher generated
PROJECT REPORT WRITING

OBJECTIVES
The Course aims to,
- Develop the project writing skills of engineering graduates
- Give engineering and technology students practice in writing a project report
- Enhance their awareness on the importance of report writing in the professional context

UNIT I

UNIT II

UNIT III
Structure of the Project Report: (Part 1) Framing a Title – Content – Acknowledgement – Funding Details - Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework

UNIT IV
Structure of the Project Report: (Part 2) – Literature Review, Research Design, Methods of Data Collection - Tools and Procedures - Data Analysis - Interpretation - Findings –Limitations - Recommendations – Conclusion – Bibliography

UNIT V
Proof reading a report – Avoiding Typographical Errors – Bibliography in required Format – Font – Spacing – Checking Tables and Illustrations – Presenting a Report orally – Techniques

OUTCOMES
At the end of the course students will be able to,
- Write reports successfully
- Analyze issues threadbare and arrive at findings based on the analysis
- Write reports for different purposes

REFERENCE BOOKS

BASIC PRESENTATION SKILLS

OBJECTIVES
The course aims to,
- Develop public speaking skills among students of engineering and technology
- Enhance the presentation skills of students
- Heighten the awareness related to the fundamentals of presentations
UNIT I
Presentation skills – Characteristics of an effective Oral Presentation – Audience - Context, Content, Speaker Status - Purpose – Modus Operandi – Extempore

UNIT II
Emphasis on syllable stress, pronunciation, intonation, pauses, pace - Preparation for a presentation – Avoiding plagiarism –Ample use of Referencing skills – Efficient ways of Collecting and Collating data (due emphasis on important information)

UNIT III

UNIT IV

UNIT V
Presentation skills – Guidelines – Group Presentation - Creative approaches to presenting – Technical presentation - Speaking under time constraint – variations in pitch, tone & intonation - Credibility in presentation (Use of authentic data/information) Podium panache – Effective Delivery

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

TOTAL: 45 PERIODS

REFERENCE BOOKS

AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING L T P C
2 0 0 0

OBJECTIVES
• Teach how to improve writing skills and level of readability
• Tell about what to write in each section
• Summarize the skills needed when writing a Title
• Infer the skills needed when writing the Conclusion
• Ensure the quality of paper at very first-time submission
UNIT I    INTRODUCTION TO RESEARCH PAPER WRITING
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II    PRESENTATION SKILLS

UNIT III    TITLE WRITING SKILLS
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV    RESULT WRITING SKILLS
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V    VERIFICATION SKILLS
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

OUTCOMES
CO1 –Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

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AX5092    DISASTER MANAGEMENT
L T P C
2 0 0 0

OBJECTIVES
- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches
UNIT I INTRODUCTION
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS

UNIT III DISASTER PRONE AREAS IN INDIA
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

OUTCOMES
CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

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OBJECTIVES

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I  ALPHABETS  6
Alphabets in Sanskrit

UNIT II  TENSES AND SENTENCES  6
Past/Present/Future Tense - Simple Sentences

UNIT III  ORDER AND ROOTS  6
Order - Introduction of roots

UNIT IV  SANSKRIT LITERATURE  6
Technical information about Sanskrit Literature

UNIT V  TECHNICAL CONCEPTS OF ENGINEERING  6
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES

- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

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REFERENCES

1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
UNIT I

UNIT II

UNIT III

UNIT IV

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

SUGGESTED READING

AX5095 CONSTITUTION OF INDIA L T P C
2 0 0 0

OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:
UNIT IV  ORGANS OF GOVERNANCE:
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V  LOCAL ADMINISTRATION:

UNIT VI  ELECTION COMMISSION:
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:
• Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
• Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
• Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
• Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING
1. The Constitution of India, 1950(Bare Act), Government Publication.

AX5096  PEDAGOGY STUDIES

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OBJECTIVES
Students will be able to:
• Review existing evidence on there view topic to inform programme design and policy
• Making under taken by the DfID, other agencies and researchers.
• Identify critical evidence gaps to guide the development.

UNIT I  INTRODUCTION AND METHODOLOGY:
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II  THEMATIC OVERVIEW
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.
UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers’ attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to understand:
• What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
• What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
• How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING

AX5097 STRESS MANAGEMENT BY YOGA L T P C
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OBJECTIVES
• To achieve overall health of body and mind
• To overcome stress

UNIT I
Definitions of Eight parts of yoga.(Ashtanga)

UNIT II
Yam and Niyam - Do’s and Don’t’s in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.
UNIT III
Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

OUTCOMES
Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING
1. “Yogic Asanas for Group Tarining-Part-I”: Janardan Swami Yoga bhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

OBJECTIVES
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont’s) - Verses- 71,73,75,78 (do’s)

UNIT II
Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

OUTCOMES
Students will be able to
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and man kind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING
1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari’s Three Satakam, Niti-sringar-vairagya, New Delhi,2010