**CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK**

**B.Sc Chemistry**

**Those who have joined from the Academic year 2023-24 onwards**

- Students will possess basic subject knowledge required for higher studies, professional andapplied courses
- Students will acquire basic Practical skills & Technical knowledge along with domain knowledge of different subjects in the science & humanities stream.
- Students will develop scientific aptitude Integrate skills of analysis, critiquing, application andcreativity.
- Students will employ appropriate digital tools and techniques necessary in analysing data andcreative design.
- Students will gain competence to pursue higher learning, research and careers or will be able toopt for entrepreneurship
- Students will interact meaningfully with others displaying leadership and coordination inexecuting projects.
- Students will demonstrate responsibility as citizens committed to national developmentthrough community outreach, wellness of self and a sustainable environment.

**PROGRAMME SPECIFIC OUTCOMES**

**PSO1: Students acquire in-depth knowledge of the fundamental concepts in all disciplines ofchemistry.**

**PSO2: Students can disseminate the basics of chemistry and advanced topics and analyticalskills in organic, inorganic and physical chemistry.**

**PSO3: Students will be able develop creativity in academics and research.**

**PSO4: Students will be able apply digital tools to collect, analyse and interpret data and presentscientific findings.**

**PSO5: gain competence to pursue higher education and career opportunities in chemistry andallied fields.**

**PSO6: exhibit leadership qualities to work individually and within a team in organizingcurricular, co-curricular and extracurricular activities.**

**PSO7: apply the concepts of chemistry to solve problems in the community, entrepreneurial andresearch pursuits.**

**PSO8: exhibit competence in educational, industrial and research pursuits that contributetowards the holistic development of self and community.**

## Credit Distribution for UG Programme in Chemistry

| Sem I | Credit | Sem II | Credit | Sem III | Credit | Sem IV | Credit | Sem V | Credit | Sem VI | Credit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.1. Language | 3 | 2.1. Language | 3 | 3.1. Language | 3 | 4.1. Language | 3 | 5.1 Core Course – \CC IX | 4 | 6.1 Core Course – CC XIII | 4 | |
| 1.2 English | 3 | 2.2 English | 3 | 3.2 English | 3 | 4.2 English | 3 | 5.2 Core Course – CC X | 4 | 6.2 Core Course – CC XIV | 4 | |
| 1.3 Core Course – CC I | 4 | 2.3 Core Course – CC III | 4 | 3.3 Core Course – CC V | 4 | 4.3 Core Course – CC VII Core Industry Module | 4 | 5. 3.Core Course CC -XI | 4 | 6.3 Core Course – CC XV | 4 | |
| 1.4 Core Course – CC II | 4 | 2.4 Core Course – CC IV | 4 | 3.4 Core Course – CC VI | 4 | 4.4 Core Course – CC VIII | 4 | 5. 3.Core Course – / Project with viva-voce CC -XII | 4 | 6.4 Elective -VII Generic/ Discipline Specific | 3 | |
| 1.5 Elective I Generic/ Discipline Specific | 3 | 2.5 Elective II Generic/ Discipline Specific | 3 | 3.5 Elective III Generic/ Discipline Specific | 3 | 4.5 Elective IV Generic/ Discipline Specific | 3 | 5.4 Elective V Generic/ Discipline Specific | 3 | 6.5 Elective VIII Generic/ Discipline Specific | 3 | |
| 1.6 Skill Enhancement Course SEC-1 (NME) | 2 | 2.6 Skill Enhancement Course SEC-2 (NME) | 2 | 3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill) | 1 | 4.6 Skill Enhancement Course SEC-6 | 2 | 5.5 Elective VI Generic/ Discipline Specific | 3 | 6.6 Extension Activity | 1 | |
| | | 2.7 Skill Enhancement Course –SEC-3 | 2 | 3.7 Skill Enhancement Course SEC-5 | 2 | 4.7 Skill Enhancement Course SEC-7 | 2 | 5.6 Value Education | 2 | 6.7 Professional Competency Skill | 2 | |
| 1.7Ability Enhancement Compulsory Course (AECC) Soft Skill-1 | 2 | 2.8 Ability Enhancement Compulsory Course (AECC) Soft Skill-2 | 2 | 3.7 Ability Enhancement Compulsory Course (AECC) Soft Skill-3 | 2 | 4.7 7Ability Enhancement Compulsory Course (AECC) Soft Skill-4 | 2 | 5.5 Summer Internship /Industrial Training | 2 | | | |
| 1.8 Skill Enhancement - (Foundation Course) | 2 | | | 3.8 E.V.S | - | 4.8 E.V.S | 2 | | | | | |
| | **23** | | **23** | | **22** | | **25** | | **26** | | **21** | |
| | **Total Credit Points** | | | | | | | | | | **140** | |

**CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK**

# UG Chemistry

## Semester I

| Part | Courses | Subject | Code | Cr. | Hrs |
|---|---|---|---|---|---|
| I | Lang. – I | பொதுத்தமிழ் - **I** | 230103101 | 3 | 6 |
| II | Lang. - II | General English | 231003101 | 3 | 4 |
| III | CC – 1 | General Chemistry I | 232203101 | 5 | 5 |
| | CC – 2 | Quantitative Inorganic Estimation and Preparation - Lab | 232203102 | 2 | 3 |
| | EC – I [Any One] | Allied Mathematics Paper – I / Animal Diversity | 232003121/ 232303121 | 4 | *6/4 |
| | | | *6hr for Maths / 4hr for Zoology(I & II Semester | | |
| | EC I Lab | Animal Diversity, Genetics, Cell Biology and Biochemistry Lab | - | - | 2 |
| IV | SEC –I(NME) | Food Chemistry | 234603122 | 2 | 2 |
| IV | FC | Basic Principles of Chemistry | 234403122 | 2 | 2 |
| | AECC - 1 | Soft Skill - I | 236003101 | 2 | 2 |
| | Total | | | **23** | **30** |
| **SEMESTER II** | | | | | |
| I | Lang. -I | பொதுத்தமிழ் - **II** | 230103201 | 3 | 6 |
| II | Lang. -II | General English | 231003201 | 3 | 4 |
| III | CC – 3 | General Chemistry – II | 232203201 | 5 | 5 |
| | CC - 4 | Qualitative Organic Analysis & Preparation of Organic Compounds - Lab | 232203202 | 2 | 3 |
| | EC – II Theory | Allie Mathematics Paper – II / Genetics, Cell biology and Bio Chemistry | 232003221/ 232303221 | 2 | 6/4 |
| | | | *4 Cr for Maths/2Cr for Zoology | | |
| | EC – II Lab | Animal Diversity, Genetics, Cell Biology and Biochemistry Lab | 232303222 | 2 | 2 |
| IV | SEC –II (NME) | Dairy Chemistry | 234603222 | 2 | 2 |
| | SEC - III | Cosmetics and Personal Grooming | 234403222 | 2 | 2 |
| | AECC –II | Soft Skill - II | 236003201 | 2 | 2 |
| | | | | **23** | **30** |
| **SEMESTER III** | | | | | |
| I | Lang. -I | பொதுத்தமிழ் - **III** | 230103301 | 3 | 6 |
| II | Lang. -II | General English | 231003301 | 3 | 4 |
| III | CC – 5 | General Chemistry III | 232203301 | 5 | 5 |
| | CC - 6 | Qualitative Inorganic Analysis - Lab | 232203302 | 2 | 3 |
| | EC –3 T | Allied – Physics Paper | 232103321 | 3 | 4 |
| | EC – 3 P | Allied-Physics Practical I | 232103322 | 1 | 2 |
| IV | SEC –IV | Entrepreneurial Skills in Chemistry | 234403322 | 1 | 1 |
| | SEC – V | Pesticide Chemistry | 238203322 | 2 | 2 |
| | AECC – III | Soft Skill -III | 236003301 | 2 | 2 |
| | EVS | Environmental Studies | 234103301 | 1 | 1 |
| | | | | **23** | **30** |

| Part | Courses | | Code | Cr. | Hrs |
|---|---|---|---|---|---|
| **SEMESTER IV** | | | | | |
| I | Lang. – I | பொதுத்தமிழ் - **IV** | 230103101 | 3 | 6 |
| II | Lang. - II | General English | 231003101 | 3 | 4 |
| III | CC – 7 | General Chemistry - IV | 232203401 | 4 | 4 |
| | CC - 8 | Physical Chemistry Practical - I | 232203402 | 3 | 3 |
| | EC – 4 T | Allied – Physics Paper | 232103421 | 3 | 4 |
| | EC – 4 P | Allied – Physics Practical - II | 232103422 | 1 | 2 |
| IV | SEC –VI | Instrumental Methods of Chemical Analysis | 234403422 | 2 | 2 |
| | SEC –VII | Forensic Science | 238203422 | 2 | 2 |
| | AECC- IV | Soft Skill – IV | 236003401 | 2 | 2 |
| | EVS | Environmental Studies | 234103401 | 1 | 1 |
| | Total | | | **24** | **30** |
| **SEMESTER V** | | | | | |
| III | CC – 9 | Organic Chemistry – I | 232203501 | 4 | 5 |
| | CC - 10 | Inorganic Chemistry – I | 232203502 | 4 | 5 |
| | CC - 11 | Physical Chemistry - I | 232203503 | 4 | 5 |
| | Core 12 | Project with Viva voce | 232203504 | 4 | 5 |
| | EC – V | Biochemistry | 232203505 | 4 | 5 |
| | EC – VI | Industrial Chemistry | 232203506 | 3 | 4 |
| IV | | Value Education | 234303501 | 1 | 1 |
| | | Internship/Industrial Training (carried out in II year summer vacation) 30 hrs | 232203507 | 2 | |
| | | | | **25** | **30** |
| **SEMESTER VI** | | | | | |
| III | CC – 13 | Organic Chemistry – II | 232203601 | 4 | 5 |
| | CC – 14 | Inorganic Chemistry – II | 232203602 | 3 | 4 |
| | CC – 15 T | Physical Chemistry – II | 232203603 | 4 | 5 |
| | CC – 15 P | Physical Chemistry Practical – II | 232203604 | 2 | 3 |
| | EC –7 | Fundamentals of Spectroscopy | 232203605 | 3 | 4 |
| | EC - 8 | Nano Science | 232203606 | 2 | 4 |
| IV | Processional competency skill enhancement course | Dye Chemistry | 232203607 | 2 | 4 |
| | | Value Education | 234303601 | 1 | 1 |
| V | | Extension Activity (outside college hrs) | 232203608 | 1 | |
| | | | | **22** | **30** |

| **ALLIED – CHEMISTRY FOR PHYSICS** | | | | | |
|---|---|---|---|---|---|
| **Sem** | **Title of the Paper** | **SUB CODE** | **Hrs.** | **Cr.** | **Generic/Discipline Specific** |
| **III** | Allied Chemistry - I | 232203321 | 4 | 3 | EC 3 - Theory |
| **III** | Chemistry Practical for Physical and Biological Science | 232203322 | 2 | 1 | EC 3 - Practical |
| **IV** | Allied Chemistry - II | 232203421 | 4 | 3 | EC 4 - Theory |
| **IV** | Chemistry Practical for Physical and Biological Chemistry | 232203422 | 2 | 1 | EC 4 - Practical |

| **ALLIED – CHEMISTRY FOR ZOOLOGY** | | | | | |
|---|---|---|---|---|---|
| **Sem** | **Title of the Paper** | **SUB CODE** | **Hrs.** | **Cr.** | **Generic/Discipline Specific** |
| **I** | Chemistry for Biological Science I | 232203121 | 4 | 3 | EC 1 - Theory |
| **I** | Chemistry Practical for Physical and Biological Science | 232203122 | 2 | 1 | EC 1 - Practical |
| **II** | Chemistry for Biological Science – II | 232203221 | 4 | 3 | EC 2 - Theory |
| **II** | Chemistry Practical for Physical and Biological Chemistry | 232203222 | 2 | 1 | EC 2 - Practical |

| **Title of the Course** | | **GENERAL CHEMISTRY III** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Part** | | **III** | | | | | | |
| **Category** | Core 5 | **Year** | II | **Credits** | 5 | **Course Code** | **232203301** | |
| | | **Semester** | III | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 4 | 1 | -- | 5 | 25 | 75 | 100 |

**Learning Objectives**

This course aims to provide a comprehensive knowledge on

- ✍ the physical properties of gases, liquids, solids and X-ray diffraction ofsolids.
- ✍ fundamentals of nuclear chemistry and nuclear waste management.
- ✍ applications of nuclear energy
- ✍ basic chemistry of halo-organic compounds, phenol and other aromaticalcohols.
- ✍ preparation and properties of phenols and alcohols.

| **UNIT** | **Details** | **No. of Periods for the Unit** |
|---|---|---|
| **I** | **Gaseous state**<br>Kinetic molecular model of a gas: postulates and derivation from the kinetic gas equation; The Maxwell –Boltzmann distribution of speed of molecules- average, root mean square and most probable velocity and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Collision frequency; collision diameter; mean free path and viscosity of gases.<br>Real gases: Deviations from ideal gas behaviour, (Andrew's and Amagat's plots); compressibility factor, Z, and its variation with pressure for different gases. equations of states for real gases-van der Waal's equation; Virial equation; Boyle temperature; Numerical problems based on equations of states for real gases, isotherms of real gases – critical phenomena – isotherms of $CO_2$ - continuity of state– Van der waal's equation and the critical state; law of corresponding states-liquefaction of gases; numerical problems involving the core concepts**.** | **15** |
| **II** | **Liquid and Solid State**<br>Properties of Liquids- Surface tension, viscosity and their applications. Crystalline and amorphous – differences - geometry, isotropy and anisotropy, melting point; isomorphism, polymorphism. Crystals –size and shape; laws of crystallography; symmetry elements – plane, centre and axis; Miller indices, unit cells and space lattices; classification of crystal systems; Bravais lattices; X – ray diffraction – Bragg's equation Packing in atomic solids – simple cubic, body centered cubic, face centered and hexagonal close packing; Co-ordination number in typical structures - NaCl, CsCl, ZnS, $TiO_2$; comparison of structure and properties of diamond and graphite;.numerical problems involving core concepts Defects in solids - stoichiometric and nonstoichiometric defects-Liquid crystals – classification and applications. | **15** |

| | | |
|---|---|---|
| **III** | **Nuclear Chemistry:** Natural radioactivity - α, β and γ rays; half-life period; Fajan–Soddy group displacement law; Geiger–Nattal rule; isotopes, isobars, isotones, mirror nuclei, iso diaphers; nuclear isomerism; radioactive decay series; magic numbers; units – Curie, Rutherford, Roentgen; nuclear stability - neutron- proton ratio; binding energy; packing fraction; mass defect. Simple calculations involving mass defect and B.E., decay constant and $t_{1/2}$ and radioactive series.<br>Isotopes – uses – tracers – determination of age of rocks by radiocarbon dating. (Problems to be worked out) Nuclear energy; nuclear fission and fusion – major nuclear reactors in India;radiation hazards, disposal of radioactive waste and safety measures. | **15** |
| **IV** | **Halogen derivative Aliphatic halogen derivatives**<br>Nomenclature and classes of alkyl halides – isomerism, physical properties, Chemical reactions. Nucleophilic substitution reactions – SN1, SN2 and SNimechanisms with stereochemical aspects and effect of solvent.<br>**Di, Tri & Tetra Halogen derivatives:** Nomenclature, classification, preparation, properties and applications.<br>**Aromatic halogen compounds**<br>Nomenclature, preparation, properties and uses Mechanism of nucleophilic aromatic substitution – benzyne intermediate.<br>**Aryl alkyl halides**<br>Nomenclature, benzyl chloride – preparation – preparation properties and uses<br>**Alcohols:** Nomenclature, classification, preparation, properties, use; conversions – ascent and descent of series; test for hydroxyl groups. Oxidation of diols by periodic acid and lead tetra acetate. | **15** |
| **V** | Nomenclature; classification, Preparation from diazonium salts, cumene, Dow's process, Raching process; properties – acidic character and effect of substitution on acidity. Reactions – Fries, claisen rearrangement, Electrophilic substitution reactions, Reimer - Teimen, Kolbe, Schmidt, Gatermann synthesis, Libermann, nitro reaction, phthalein reaction.<br>Resorcinol, quinol, picric acid – preparation, properties and uses.<br>**Aromatic alcohols**<br>Nomenclature, benzyl alcohol – methods of preparation – hydrolysis, reduction of benzaldehyde, Cannizzaro reaction, Grignard synthesis, physical properties, reactions – reaction with sodium, phosphorus pentachloride, thionyl chloride, acetic anhydride, hydrogen iodide, oxidation – substitution on the benzene nucleus, uses.<br>Thiols: Nomenclature, structure, preparation and properties. | **15** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will; |
| **CO1** | explain the kinetic properties of gases by using mathematical concepts. |
| **CO2** | describe the physical properties of liquid and solids; identify various types of crystalswith respect to its packing and apply the XRD method for crystal structure determinations. |
| **CO3** | investigate the radioactivity, nuclear energy and it's production, also the nuclear wastemanagement. |

| | |
|---|---|
| **CO4** | write the nomenclature, physical & chemical properties and basic mechanisms of haloorganic compounds and alcohols. |
| **CO5** | investigate the named organic reactions related to phenol; explain the preparation andproperties of aromatic alcohol including thiol. |

| **Text Books (Latest Editions)** | |
|---|---|
| 1 | B.R. Puri, L.R. Sharma, M.S. Pathania; *Principles of Physical Chemistry*,46th edition, Vishal Publishing, 2020. |
| 2 | B.R. Puri, L.R. Sharma and K.C. Kalia, *Principles of Inorganic Chemistry*,Milestone Publishers and Distributors, New Delhi, thirtieth edition, 2009. |
| 3 | P.L. Soni and Mohan Katyal, *Textbook of Inorganic Chemistry*, SultanChand & amp; Sons, twentieth edition, 2006. |
| 4 | M. K. Jain, S. C. Sharma, *Modern Organic Chemistry*, Vishal Publishing,fourth reprint, 2003. |
| 5 | S.M. Mukherji, and S.P. Singh, *Reaction Mechanism in Organic Chemistry*,Macmillan India Ltd., third edition, 1994. |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
| 1 | T. W. Graham Solomons, *Organic Chemistry*, John Wiley & Sons,fifth edition, 1992. |
| 2 | A. Carey Francis, *Organic Chemistry*, Tata McGraw-Hill Education Pvt.,Ltd.,New Delhi, seventh edition, 2009. |
| 3 | I. L. Finar, *Organic Chemistry*, Wesley Longman Ltd, England, sixth edition, 1996. |
| 4 | P. L. Soni, and H. M.Chawla - *Text Book of Organic Chemistry*, New Delhi,Sultan Chand & Sons, twenty ninth edition, 2007. |
| 5 | J.D. Lee, *Concise Inorganic Chemistry*, Blackwell Science, fifth edition,2005. |
| **Web Resources** | |
| 1 | **MOOC components** https://nptel.ac.in/courses/104104101 Solid state chemistry |
| 2 | https://nptel.ac.in/courses/103106071 Nuclear industries and safety |
| 3 | https://nptel.ac.in/courses/104106119s Introduction to organic chemistry |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S | S | S | M | S | M |
| **CO2** | M | S | S | S | M | S | S | M | M | M |
| **CO3** | S | S | S | M | S | S | S | M | S | M |
| **CO4** | S | S | S | S | S | S | S | M | M | M |
| **CO5** | S | M | S | S | S | S | S | M | M | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | | **QUANTITATIVE INORGANIC ANALYSIS - LAB** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Part** | | **III** | | | | | | |
| **Category** | Core – 6 | **Year** | II | **Credits** | 2 | **Course Code** | **232203302** | |
| | | **Semester** | III | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | - | - | 3 | 3 | 25 | 75 | 100 |

**Learning Objectives**

- To develop the skill on systematic analysis of simple inorganic salts and mixtureof salts.

**Experiment**

**Semi - Micro Qualitative Analysis**

1. Analysis of simple acid radicals: Carbonate, sulphide, sulphate, thiosulphite, chloride, bromide, iodide, nitrate
2. Analysis of interfering acid radicals: Fluoride, oxalate, borate, phosphate,arsenate, arsenite.
3. Elimination of interfering acid radicals and Identifying the group of basic radicals
4. Analysis of basic radicals (group wise): Lead, copper, bismuth, cadmium, tin, antimony, iron, aluminium, arsenic, zinc,manganese, nickel, cobalt, calcium, strontium, barium, magnesium, ammonium
5. Analysis of a mixture - I to VIII containing two cations and two anions (of which one is interfering type)

**Course Outcomes**

| **Course Outcomes** | On completion of this course, students will; |
|---|---|
| **CO1** | acquire knowledge on the systematic analysis of Mixture of salts. |
| **CO2** | identify the cations and anions in the unknown substance. |
| **CO3** | identify the cations and anions in the soil and water and to test the quality of water. |
| **CO4** | assess the role of common ion effect and solubility product |

**References Books**

V. Venkateswaran, R. Veeraswamy and A. R. Kulandivelu, Basic Principles ofPractical Chemistry, Sultan Chand & Sons, New Delhi, second edition, 1997.

**Web Resources**

https://www.vlab.co.in/broad-area-chemical-sciences

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S | S | S | M | S | M |
| **CO2** | M | S | S | S | M | S | S | M | M | M |
| **CO3** | S | S | S | M | S | S | S | M | S | M |
| **CO4** | S | S | S | S | S | S | S | M | M | M |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 12 | 12 | 12 | 12 | 12 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | | **ENTREPRENEURIAL SKILLS IN CHEMISTRY** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Part** | | **IV** | | | | | | |
| **Category** | SEC – IV | **Year** | II | **Credits** | 1 | **Course Code** | **234403322** | |
| | | **Semester** | III | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 1 | - | -- | 1 | 25 | 75 | 100 |

**Learning Objectives**

The course aims at providing training to

- ✍ develop entrepreneur skills in students
- ✍ to provide hands on experience to prepare and develop products develop start ups

| UNIT | Details | No. of Periods for the Unit |
|---|---|---|
| I | **Food Chemistry**<br>Food adulteration-contamination of food items with clay stones, waterand toxic chemicals -Common adulterants.<br>Food additives, Natural and synthetic anti-oxidants, glazing agents (hazardous effect),food colourants, Preservatives, leavening agents, Baking powder and baking soda, yeast,MSG,vinegar. | **3** |
| II | **Dyes**<br>Classification – Natural, synthetic dyes and their characteristics – basicmethods and principles of dyeing | **3** |
| III | **Hands on Experience I**<br>Detection of adulterants in food items like coffee, tea, pepper, chilli powder, turmeric powder, butter, ghee, milk, honey etc., by simple techniques. Preparation of Jam, squash and Jelly, Gulkand, cottage cheese. | **3** |
| IV | **Hands on Experience I**<br>Preparation of products like candles, soap, detergents, cleaning powder, shampoos, pain balm, tooth paste/powde rand disinfectants in small scale. | **3** |
| V | **Hands on Experience I**<br>Extraction of oils from spices and flowers.<br>Testing of water samples using testing kit.<br>Dyeing – cotton fabrics with natural and synthetic dyes<br>Printing – tie and dye, batik. | **3** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will; |
| **CO1** | identify adulterated food items by doing simple chemical tests. |
| **CO2** | prepare cleaning products and become entrepreneurs |
| **CO3** | educate others about adulteration and motivate them to become entrepreneurs |
| **Text Books (Latest Editions)** | |
| 1 | George S & Muralidharan V, (2007) Fibre to Finished Fabric – A Simple Approach, Publication Division, University of Madras, Chennai. |
| 2 | Appaswamy G P, A Handbook on Printing and Dyeing of Textiles. |

| References Books<br>(Latest editions, and the style as given below must be strictly adhered to) | |
|---|---|
| 1 | Shyam Jha, Rapid detection of food adulterants and contaminants(Theory and Practice), Elsevier, e Book ISBN 9087128004289, 1st Edition,2015 |
| **Web Source** | |
| 1 | https://www.vlab.co.in/broad-area-chemical-sciences |

**Mapping with Programme Outcomes:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S | S | S | M | S | M |
| **CO2** | M | S | S | S | M | S | S | M | M | M |
| **CO3** | S | S | S | M | S | S | S | M | S | M |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| CO /PO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 6 | 6 | 6 | 6 | 6 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO's and CO's**

| **Title of the Course** | | **PESTICIDE CHEMISTRY** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Part** | | **IV** | | | | | | |
| **Category** | SEC V | **Year** | II | **Credits** | 2 | **Course Code** | **238203322** | |
| | | **Semester** | III | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 2 | - | -- | 2 | 25 | 75 | 100 |

**Learning Objectives**

This course aims to providing the students

- ✍ knowledge about the various types of pesticides and their toxicity.
- ✍ to understand the accumulation of pesticides in in the form ofresidues and its analysis.
- ✍ knowledge on choice of alternate and eco-friendly pesticides.

| UNIT | Details | No. of Periods for the Unit |
|---|---|---|
| I | **Introduction**: History of pesticides. Chemistry of Pesticides: Brief introduction to classes of pesticides (Chemical class, targets), structures, chemical names, physical and chemical properties.<br>**Toxicity of pesticides**: Acute and chronic toxicity in mammals, birds, aquatic species etc. Methods of analysis of pesticides.<br>**Insecticides:** Classification and study of following insecticides with respect to structure, chemical name, physical properties, chemical properties, synthesis, degradation, metabolism, formulations, Mode of action, uses, toxicity.<br>Organophosphates and Phosphothionates: Acephate, Chlorpyriphos, Monocrotophos, and parathion-methyl. Organochlorine – Endosulfan, heptachlor; Carbamate: Cartap hydrochloride, Methomyl, Propoxur | **6** |
| II | **Pesticides residues I:** Introduction- application of agrochemicals, dissemination pathways of pesticides, causes of pesticide residues, remedies. Pesticides residues in atmosphere- entry into atmosphere, action of pesticides, effects on environments. | **6** |
| III | **Pesticides residues I:** Pesticides residues in water- entry into water systems, action and effect in aquatic environment. Pesticides residues in soil. Entry into soil, absorption, retention and transport in soil, effects on microorganism, soil condition and fertility, decomposition and degradation by climatic factors and microorganism. | **6** |
| IV | **Pesticide Residues effect and analysis:** Effects of pesticides residue on human life, birds and animals- routes for exposure to pesticides, action of pesticides on living system. Analysis of pesticides residues- sample preparation, extraction of pesticides residues (soil, water and vegetables/fruits) simple methods and schemes of analysis, multi-residue analysis. | **6** |
| V | **Biopesticides:** Pheromones, attractants, repellents – Introduction, types and application (8- Dodecen-1-ol, 10-cis-12-hexadecadienoic, Trimedlure, Cue-lure, methyl eugenol, N,N- Diethyl-m-toluamide, Dimethyl phthalate, Icaridin). Baits- Metaldehyde, Iron (II) phosphate, Indoxacarb, Zinc Phosphide, Bromadiolone. | **6** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will; |
| **CO1** | teach about the pesticides and their toxicity with respect to structure and category. |
| **CO2** | explain the preparation and property of pesticides |
| **CO3** | investigate the pesticide residues, prevention and care |
| **CO4** | demonstrate the extraction and analytical methods of pesticide residues |
| **CO5** | make awareness to the public on bio-pesticides |

| **Text Books (Latest Editions)** | |
|---|---|
| 1 | Handa SK. Principles of pesticide chemistry. Agrobios (India); 2012. |
| 2 | Matolcsy G, Nádasy M, Andriska V. Pesticide chemistry. Elsevier; 1989. |
| 3 | J. Miyamoto and P. C. Kearney Pesticide Chemistry Human Welfare and the Environment vol. IV Pesticide Residue and Formulation Chemistry, Pergamon press,1985. |
| 4 | R. Cremlyn: Pesticides, John Wiley. |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
| 1 | Roy N. K., Chemistry of Pesticides. CBS Publisher & Distributors PLtd; 1st Ed. (2010). |
| 2 | Nollet L.M., Rathore H.S., Handbook of pesticides: methods ofpesticide residues analysis. CRC press; 2016. |
| 3 | Ellerbrock R.H., Pesticide Residues: Significance, Management andAnalysis, 2005 |
| **Web Resources** | |
| | |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S | S | S | M | S | M |
| **CO2** | M | S | S | S | M | S | S | M | M | M |
| **CO3** | S | S | S | M | S | S | S | M | S | M |
| **CO4** | S | S | S | S | S | S | S | M | M | M |
| **CO5** | S | M | S | S | S | S | S | M | M | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | | **GENERAL CHEMISTRY IV** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Part** | | **III** | | | | | | |
| **Category** | Core – 7 | **Year** | II | **Credits** | 4 | **Course Code** | **232203401** | |
| | | **Semester** | IV | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 3 | 1 | -- | 4 | 25 | 75 | 100 |

**Learning Objectives**

This course aims to provide a comprehensive knowledge on

- thermodynamic concepts on chemical processes and appliedaspects.
- thermo chemical calculations
- transition elements with reference to periodic properties and groupstudy of transition metals.
- the organic chemistry of ethers, aldehydes and ketones
- the organic chemistry of carboxylic acids

| **UNIT** | **Details** | **No. of Periods for the Unit** |
|---|---|---|
| **I** | **Thermodynamics I**<br>Terminology – Intensive, extensive variables, state, path functions; isolated, closed and open systems; isothermal, adiabatic, isobaric, isochoric, cyclic, reversible and irreversible processes; First law of thermodynamics – Concept and significance of heat (q), work (w), internal energy (E), enthalpy (H); calculations of q, w, E and H for reversible, irreversible expansion of ideal and real gases under isothermal and adiabatic conditions; relation between heat capacities (Cp & Cv); Joule Thomson effect- inversion temperature.<br>Thermochemistry - heats of reactions, standard states; types of heats of reactions and their applications; effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions; Hess's law and its applications; determination of bond energy; Measurement of heat of reaction – determination of calorific value of food and fuels<br>Zeroth law of thermodynamics-Absolute Temperature scale. | **12** |
| **II** | **Thermodynamics II**<br>Second Law of thermodynamics - Limitations of first law, spontaneity and randomness; Carnot's cycle; Concept of entropy, entropy change for reversible and irreversible processes, entropy of mixing, calculation of entropy changes of an ideal gas and a van der Waals gas with changes in temperature, volume and pressure, entropy and disorder.<br>Free energy and work functions - Need for free energy functions, Gibbs free energy, Helmholtz free energy - their variation with temperature, pressure and volume, criteria for spontaneity; Gibbs-Helmholtz equation – derivations and applications; Maxwell relationships, thermodynamic equations of state; Thermodynamics of mixing of ideal gases, Ellingham Diagram-application.<br>Third law of thermodynamics - Nernst heat theorem; Applications of thirdlaw - evaluation of absolute entropies from heat capacity measurements, exceptions to third law. | **12** |

| | | |
|---|---|---|
| **III** | **General Characteristics of d-block elements**<br>**Transition Elements**- Electronic configuration - General periodic trend variable valency, oxidation states, stability of oxidation states, colour, magnetic properties, catalytic properties and tendency to form complexes. Comparative study of transition elements and non transition elements – comparison of II and III transition series with I transition series. Group study of Titanium, Vanadium, Chromium, Manganese, Iron, Cobalt, Nickeland Zinc groups | **12** |
| **IV** | **Aldehydes and Ketones**<br>Nomenclatue, structure and reactivity of aliphatic and aromatic aldehydes and ketones; general methods of preparation and physical properties. Nucleophilic addition reactions, base catalysed reactions with mechanism- Aldol, Cannizzaro's reaction, Perkin reaction, Benzoin condensation, Haloform reaction, Knoevenagel reaction. Oxidation of aldehydes. Baeyer - Villiger oxidation of ketones. Reduction: Clemmensen reduction, Wolf - Kishner reduction, Meerwein – Pondorf Verley reduction, reduction with $LiAlH_4$ and $NaBH_4$.<br>Addition reactions of unsaturated carbonyl compounds: Michael addition. | **12** |
| **V** | **Carboxylic Acids**: Nomenclature, structure, preparation and reactions of aliphatic and aromatic monocarboxylic acids. Physical properties, acidic nature, effect of substituent on acidic strength. HVZ reaction, Claisen ester condensation, Bouveault Blanc reduction, decarboxylation, Hunsdieckerreaction.Formic acid-reducing property.<br>Reactions of dicarboxylic acids, hydroxy acids and unsaturated acids.<br>**Carboxylic acid Derivatives:** Preparations of aliphatic and aromatic acid chlorides, esters, amides and anhydrides. Nucleophilic substitution reaction at the acyl carbon of acyl halide, anhydride, ester, amide. Schottan- Baumann reaction. Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann bromamide degradation and Curtius rearrangement.<br>**Active methylene compounds:** Keto – enol tautomerism. Preparation andsynthetic applications of diethyl malonate and ethyl acetoacetate<br>**Halogen substituted acids** – nomenclature; preparation by direct halogenation, iodination from unsaturated acids, alkyl malonic acids<br>**Hydroxy acids** – nomenclature; preparation from halo, amino, aldehydic and ketonic acids, ethylene glycol, aldol acetaldehyde; reactions – action of heat on $\alpha$, $\beta$ and $\gamma$hydroxy acids. | **12** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will; |
| **CO1** | explain the terms and processes in thermodynamics; discuss the various laws of thermodynamics and thermo chemical calculations. |
| **CO2** | discuss the second law of thermodynamics and its application to heat engine; discussthird law and its application on heat capacity measurement. |
| **CO3** | investigate the chemistry of transition elements with respect to various periodic properties and group wise discussions. |
| **CO4** | discuss the fundamental organic chemistry of ethers, epoxides and carbonyl compoundsincluding named organic reactions. |
| **CO5** | discuss the chemistry and named reactions related to carboxylic acids and their derivatives; discuss chemistry of active methylene compounds, halogen substituted acidsand hydroxyl acids. |

| | |
|---|---|
| **Text Books (Latest Editions)** | |
| 1 | B.R. Puri and L.R. Sharma, *Principles of Physical Chemistry*, ShobanLal Nagin Chand and Co., thirty three edition, 1992. |
| 2 | K. L. Kapoor, *A Textbook of Physical chemistry*, (volume-2 and 3), Macmillan, India Ltd, thirdedition, 2009. |
| 3 | P.L. Soni and Mohan Katyal, *Textbook of Inorganic Chemistry*, SultanChand & Sons, twentieth edition, 2006. |
| 4 | M. K. Jain, S. C. Sharma, *Modern Organic Chemistry*, VishalPublishing, fourth reprint, 2003. |
| 5 | S.M. Mukherji, and S.P. Singh, *Reaction Mechanism in OrganicChemistry*, Macmillan India Ltd., third edition, 1994. |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
| 1 | Maron, S. H. and Prutton C. P. *Principles of Physical Chemistry*,4$^{th}$ed.; The Macmillan Company: Newyork,1972. |
| 2 | Lee, J. D. *Concise Inorganic Chemistry*, 4th ed.; ELBS WilliamHeinemann: London,1991. |
| 3 | Gurudeep Raj, *Advanced Inorganic Chemistry*, 26$^{th}$ed.; GoelPublishing House: Meerut, 2001. |
| 4 | Atkins, P.W. & Paula, J. *Physical Chemistry*, 10th ed.; OxfordUniversity Press:New York, 2014. |
| 5 | Huheey, J. E. *Inorganic Chemistry: Principles of Structure and Reactivity*, 4$^{th}$ ed; Addison Wesley Publishing Company: India,1993. |
| **Web Resources** | |
| https://nptel.ac.in/courses/112102255 Thermodynamics<br>https://nptel.ac.in/courses/104101136 Advanced transition metal chemistry | |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S | S | S | M | S | M |
| **CO2** | M | S | S | S | M | S | S | M | M | M |
| **CO3** | S | S | S | M | S | S | S | M | S | M |
| **CO4** | S | S | S | S | S | S | S | M | M | M |
| **CO5** | S | M | S | S | S | S | S | M | M | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | | **PHYSICAL CHEMISTRY PRACTICAL - I** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Part** | | **III** | | | | | | |
| **Category** | Core 8 | **Year** | II | **Credits** | 3 | **Course Code** | **232203402** | |
| | | **Semester** | IV | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | - | - | 3 | 3 | 25 | 75 | 100 |

**Learning Objectives**

The course aims at providing an understanding of

- the laboratory experiments in order to understand the conceptsof physical changes in chemistry
- the rates of chemical reactions
- colligative properties and adsorption isotherm

**Experiment**

**Chemical kinetics**

Determination of rate constant of acid catalysed hydrolysis of an ester (methyl acetate).
Determination of order of reaction between iodide and persulphate(initial rate method).
Polarimetry: Determination of rate constant of acid catalysedinversion of cane sugar

**Thermochemistry**

Determination of heat of neutralisation of a strong acid by a strong base.
Determination of heat of hydration of copper sulphate.

**Electrochemistry – Conductance measurements**

Determination of cell constant

Determination of molar conductance of strong electrolyte

Determination of dissociation constant of acetic acid

**Colorimetry**

Determination of concentration of copper sulphate solution

**Colligative property**

Determination of molecular weight of an organic compound by Rast method using naphthalene or diphenyl as solvent

**Adsorption**

Construction of Freundlich isotherm for the adsorption of acetic acid on activated charcoal

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will; |
| **CO1** | describe the principles and methodology for the practical work |
| **CO2** | explain the procedure, data and methodology for the practical work. |
| **CO3** | apply the principles of electrochemistry, kinetics for carrying out the practical work. |
| **CO4** | demonstrate laboratory skills for safe handling of the equipment and chemicals |

| References Books<br>(Latest editions, and the style as given below must be strictly adhered to) | |
|---|---|
| 1 | Sindhu, P.S.*Practicals in Physical Chemistry*, Macmillan India :New Delhi, 2005. |
| 2 | Khosla, B. D.Garg,V. C.; Gulati, A.; *Senior Practical PhysicalChemistry*, R.Chand : New Delhi, 2011. |
| 3 | Gupta, Renu, *Practical Physical Chemistry*, 1st Ed.; New AgeInternational: New Delhi, 2017. |
| **Web Resources** | |
| 1 | https://www.vlab.co.in/broad-area-chemical-sciences |

**Mapping with Programme Outcomes:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S | S | S | M | S | M |
| **CO2** | M | S | S | S | M | S | S | M | M | M |
| **CO3** | S | S | S | M | S | S | S | M | S | M |
| **CO4** | S | S | S | S | S | S | S | M | M | M |

**3 – Strong, 2 – Medium , 1 - Low**

**CO-PO Mapping (Course Articulation Matrix)**

| CO /PO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 12 | 12 | 12 | 12 | 12 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO's and CO's**

| **Title of the Course** | **INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS** | | | | | | |
|---|---|---|---|---|---|---|---|
| **PART** | **IV** | | | | | | |
| **Category** | SEC – IV | **Year** | II | **Credits** | 2 | **Course Code** | **234403422** |
| | | **Semester** | IV | | | | |

| **Instructional Hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
|---|---|---|---|---|---|---|---|
| | 2 | - | -- | 2 | 25 | 75 | 100 |

Objectives ofthe course

The course aims at providing an overall view of the

- operation and troubleshooting of chemical instruments
- fundamentals of analytical techniques and itsapplication in the characterization of compounds
- theory of chromatographic separation and
- theory of thermo / electro analytical techniques
- stoichiometry and the related concentration terms

| **UNIT** | **Details** | **No. of Periods for the Unit** |
|---|---|---|
| **I** | **Qualitative and Quantitative Aspects of Analysis**<br>S.I Units, Distinction between Mass and Weight. Moles, Millimoles, Milli equivalence, Molality, Molarity, Normality, Percentage by Weight and Volume, ppm, ppb. Density and Specific Gravity of Liquids. Stoichiometry Calculations<br>Sampling, evaluation of analytical data, Errors – Types of Errors, Accuracy, Precision, Minimization of Errors. Significant Figures. Methods of Expressing Precision: Mean, Median, Average Deviation, Standard Deviation, Coefficient of Variation, Confidence Limits, Q- test, F-test, T-test. The Least Square Method for Deriving Calibration plots. | 6 |
| **II** | **Atomic Absorption Spectroscopy**: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples. | 6 |
| **III** | **UV-Visible and IR Spectroscopy**<br>Origin of spectra, interaction of radiation with matter, fundamental lawsof spetroscopy and selection rules, validity of Beer-Lambert's law.<br><br>**UV-Visible Spectrometry:** Basic principles, instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. **Infrared Spectroscopy:** Basic principles of instrumentation (choice of source, monochromator& detector) for single and double beam instrument; sampling techniques. | 6 |
| **IV** | **Thermal and Electro-analytical Methods of Analysis**<br>TGA and DTA- Principle, Instrumentation, methods of obtaining Thermograms, factors affecting TGA/DTA, Thermal analysis of silver nitrate, calcium oxalate and calcium acetate DSC- Principle, Instrumentation and applications.<br><br>Electroanalytical methods: polarography - principle, instrumentation and applications. Derivative polarography- Cyclic Voltammetry - principle. | 6 |

| | | |
|---|---|---|
| **V** | **Separation and purification techniques**<br>Classification, principle, Factors affecting - Solvent Extraction – Liquid - Liquid Extraction,<br>Chromatography: Column, TLC, Paper, Gas, HPLC and Electrophoresis, Principle, Classification, Choice of Adsorbents, Solvents, Preparation of Column, Elution Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms and Rf value. | 6 |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will; |
| **CO1** | apply error analysis in the calibration and use of analytical instruments, explain theory, instrumentation and application of flame photometry and Atomic Absorption spectrometry |
| **CO2** | explain theory, instrumentation and application of UV visible and Infrared spectroscopy. |
| **CO3** | able to discuss instrumentation, theory and applications of thermal and electrochemicaltechniques |
| **CO4** | explain the use of chromatographic techniques in the separation and identification ofmixtures |
| **CO5** | explain preparation of solutions, stoichiometric calculations |

| **RECOMMENDEDTEXT** | |
|---|---|
| 1 | Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed., The English Language Book Society of Longman. |
| 2 | R. Gopalan, P. S. Subramanian and K. Rengarajan, Elements of Analytical Chemistry, Sultan Chand, New Delhi, 2007 |
| 3 | Skoog, Holler and Crouch, Principles of Instrumental Analysis, Cengage Learning, 6th Indian Reprint (2017). |
| 4 | R. Speyer, Thermal Analysis of Materials, CRC Press, 1993. |
| 5 | R.A. Day and A.L. Underwood, Quantitative Analysis, 6thedn., Prentice Hall of India Private Ltd., New Delhi, 1993 |
| **REFERENCEBOOKS** | |
| 1 | D. A. Skoog, D. M. West and F. J. Holler, Analytical Chemistry: An Introduction, 5thedn., Saunders college publishing, Philadelphia, 1998. |
| 2 | Dash U N, Analytical Chemistry; Theory and Practice, Sultan Chand and sons Educational Publishers, New Delhi, 2011. |
| 3 | Christian, Gary D; Analytical Chemistry, 6th Ed., John Wiley & Sons, New York, 2004. |
| 4 | Mikes, O. &Chalmes, R.A. Laboratory Handbook of Chromatographic & Allied Methods, Elles Harwood Ltd. London |
| 5 | G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney, Vogel's Textbook of Quantitative Chemical Analysis, sixth edition PearsonEducation, 2000 |
| **Web Sources** | |
| 1 | http://www.epa.gov/rpdweb00/docs/marlap/402-b-04-001b-14- final.pdf |
| 2 | http://eric.ed.gov/?id=EJ386287 |
| 3 | http://www.sjsu.edu/faculty/watkins/diamag.htm |
| 4 | http://www.britannica.com/EBchecked/topic/108875/separation- and-purification |
| 5 | http://www.chemistry.co.nz/stoichiometry.htm |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S | S | S | M | S | M |
| **CO2** | M | S | S | S | M | S | S | M | M | M |
| **CO3** | S | S | S | M | S | S | S | M | S | M |
| **CO4** | S | S | S | S | S | S | S | M | M | M |
| **CO5** | S | M | S | S | S | S | S | M | M | S |

**CO-PO Mapping (Course Articulation Matrix)**

| CO /PO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO's and CO's**

| **Title of the Course** | | **FORENSIC SCIENCE** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **PART** | | **IV** | | | | | | |
| **Category** | SEC – VII | **Year** | II | **Credits** | 2 | **Course Code** | **238203422** | |
| | | **Semester** | IV | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 2 | - | -- | 2 | 25 | 75 | 100 |

**Objectives ofthe course**

This course aims at giving an overall view of

- crime detection through analytical instruments
- forgery and its detection
- medical aspects involved

| UNIT | Details | No. of Periods for the Unit |
|---|---|---|
| I | **Poisons**<br>Poisons - types and classification - diagnosis of poisons in the living and the dead -clinical symptoms - postmortem appearances. Heavy metal contamination (Hg, Pb, Cd) of seafoods - use of neutron activation analysis in detecting arsenic in human hair. Treatment in cases of poisoning – use of antidotes for common poisons. | **6** |
| II | **Crime Detection**<br>Accidental explosion during manufacture of matches and fireworks (as in Sivakasi). Human bombs - possible explosives (gelatin sticks and RDX) - metal detector devices andother security measures for VVIP-composition of bullets and detecting powder burns. | **6** |
| III | **Forgery and Counterfeiting**<br>Documents - different types of forged signatures - simulated and traced forgeries -inherent signs of forgery methods - writing deliberately modified - uses of ultraviolet rays -comparison of type written letters – checking silver line water mark in currency notes – alloy analysis using AAS to detect counterfeit coins – detection of gold purity in 22 carat ornaments – detecting gold plated jewels - authenticity of diamond. | **6** |
| IV | **Tracks and Traces**<br>Tracks and traces - small tracks and police dogs - foot prints - costing of foot prints -residue prints, walking pattern or tyre marks – miscellaneous traces and tracks – glass fracture - tool marks - paints - fibres - Analysis of biological substances - blood, semen, saliva, urine and hair - Cranial analysis (head and teeth) DNA Finger printing for tissue identification in dismembered bodies - detecting steroid consumption in athletes and racehorses. | **6** |
| V | **Medical Aspects**<br>Aids - causes and prevention - misuse of scheduled drugs - burns and their treatment by plastic surgery. Metabolite analysis using mass spectrum - Gas chromatography-Arson -natural fires and arson - burning characteristics and chemistry of combustible materials - nature of combustion. Ballistics - classification - internal and terminal ballistics - small arms -laboratory examination of barrel washing and detection of powder residue by chemical tests. | **6** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will; |
| **CO1** | learn about the Poisons - types and classification of poisons in the living and the deadorganisms and also get information about Postmortem. |
| **CO2** | get awareness on Human bombs, possible explosives (gelatin sticks and RDX) and metal defector devices and other security measures for VVIP - composition of bulletsand detecting powder burns |
| **CO3** | detect the forgery documents, different types of forged signatures |
| **CO4** | have an idea about how to tracks and trace using police dogs, foot prints identification and gain the knowledge in analyzing biological substances - blood, semen, saliva, urine and hair - DNA Finger printing for tissue identification in dismembered bodies |
| **CO5** | get the awareness on Aids - causes and prevention and also have an exposure on handling fire explodes. |

| **Recommended Text** | |
|---|---|
| 1 | SA Iqbal, M Liviu, Textbook of forensic chemistry, Discovery publishing house private limited, 2011. |
| 2 | Kelly M. Elkins, Introduction to Forensic Chemistry, CRC Press, Taylor & Francis Group, 2019. |
| 3 | Javed I. Khan, Thomas J. Kennedy, Donnell R. Christian, Jr., Basic principles of Forensic chemistry, Humana Press, first edition, 2012. |
| 4 | Bapuly AK, (2006) Forensic Science – Its application in crime investigation, Paras Medical Publisher, Hyderabad. |
| 5 | Sharma B.R., (2006) Scientific Criminal Investigation, Universal Law Publishing Co. Pvt. Ltd, New Delhi. |
| **ReferenceBooks** | |
| 1 | Richard Saferst in and Criminalistics-An Introduction to Forensic Science (College Version), Sopfestein, Printice hall, eighth edition,2003 |
| 2 | Suzanne Bell, Forensic Chemistry, Pearson, second international edition, 2014. |
| 3 | Jay Siegel, Forensic chemistry: Fundamentals and applications, Wiley-Blackwell, first edition, 2015. |
| 4 | Max M. Houck & Jay A. Segal, (2006) Fundamentals of ForensicScience, Elsevier Academic press. |
| 5 | Henry C. Lee, Timothy Palmbach, Marilyn T. Miller, (2006) HenryLee's Crime Scene Book Elsevier Academic press. |
| **Website source** | |
| **1** | http://www.library.ucsb.edu/ist/03-spring/internet.html |
| **2** | http://www.wonder howto.com/topic/forensic-science/ |

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S | S | S | M | S | M |
| **CO2** | M | S | S | S | M | S | S | M | M | M |
| **CO3** | S | S | S | M | S | S | S | M | S | M |
| **CO4** | S | S | S | S | S | S | S | M | M | M |
| **CO5** | S | M | S | S | S | S | S | M | M | S |

**CO-PO Mapping (Course Articulation Matrix)**

| CO /PO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO's and CO's**

| **Title of the Course** | | **ALLIED CHEMISTRY – I (for Physics Students)** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Part** | | **III** | | | | | | |
| **Category** | EC – 3 Generic Elective | **Year** | II | **Credits** | 3 | **Course Code** | **232203321** | |
| | | **Semester** | III | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 4 | - | -- | 4 | 25 | 75 | 100 |

**Objectives of thecourse**

- basics of atomic orbitals, chemical bonds, hybridization
- concepts of thermodynamics and its applications.
- Concepts of nuclear chemistry
- Importance of chemical industries
- Qualitative and analytical methods.

| **UNIT** | **No. of Periods for the Unit** | **No. of Periods for the Unit** |
|---|---|---|
| **I** | Chemical Bonding: Molecular Orbital Theory - bonding, antibonding, and non-bonding orbitals. Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties.<br>Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones, and Isomers - Differences between chemical reactions and nuclear reactions - group displacement law. Nuclear binding energy - mass defect calculations. Nuclear fission and nuclear fusion - differences - Stellar energy. Applications of radioisotopes - carbon dating, rock dating, and medicinal applications. | **12** |
| **II** | **Industrial Chemistry**<br>Fuels: Fuel gases: Natural gas, water gas, semi-water gas, carbureted water gas, producer gas, CNG, LPG, and oil gas (manufacturing details not required). Silicones: Synthesis, properties, and uses of silicones. Fertilizers: Urea, ammonium sulfate, potassium nitrate, NPK fertilizer, superphosphate, triple superphosphate. | **12** |
| **II** | **Fundamental Concepts in Organic Chemistry**<br>Hybridization: Orbital overlap, hybridization, and geometry of CH4, C2H4, C2H2, and C6H6. Electronic effects: Inductive effect and consequences on Ka and Kb of organic acids and bases, electromeric, mesomeric, hyperconjugation, and steric - examples. Reaction mechanisms: Types of reactions - aromaticity (Huckel's rule) - aromatic electrophilic substitution; nitration, halogenation, Friedel-Craft's alkylation and acylation. Heterocyclic compounds: Preparation, properties of pyrrole and pyridine. | **12** |
| **IV** | **Thermodynamics and Phase Equilibria**<br>Thermodynamics: Types of systems, reversible and irreversible processes, isothermal and adiabatic processes, and spontaneous processes. Statements of the first law and second law of thermodynamics. Carnot's cycle and efficiency of heat engine. Entropy and its significance. Free energy change and its importance (no derivation). Conditions for spontaneity in terms of entropy and Gibbs free energy. Relationship between Gibbs free energy and entropy.<br>Phase Equilibria: Phase rule - definition of terms in it. Applications of phase rule to water system. Two-component system - Reduced phase rule and its application to a simple eutectic system (Pb-Ag). | **12** |

| | | |
|---|---|---|
| **V** | **Analytical Chemistry**<br>Introduction to qualitative and quantitative analysis. Principles of volumetric analysis. Separation and purification techniques - extraction, distillation, and crystallization. Chromatography: principle and application of column, paper, and thin-layer chromatography. | **12** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will; |
| **CO1** | To gain in-depth knowledge about the theories of chemical bonding, nuclear reactions, and its applications. |
| **CO2** | Evaluate the efficiencies and uses of various fuels and fertilizers. |
| **CO3** | Explain the type of hybridization, electronic effect, and mechanism involved in the organic reactions. |
| **CO4** | Apply various thermodynamic principles, systems, and phase rule. |
| **CO5** | Explain various methods to identify an appropriate method for the separation of chemical components. |

| **Text Books** | |
|---|---|
| 1 | V.Veeraiyan,TextbookofAncillaryChemistry;Highmountpublishinghouse,Chennai,first edition,2009. |
| 2 | S.Vaithyanathan,TextbookofAncillaryChemistry;PriyaPublications,Karur,2006 |
| 3 | S.ArunBahl,B.S.Bahl,AdvancedOrganicChemistry;S.ChandandCompany,NewDelhi,twentythirdedition,2012. |
| 4 | P.L.Soni,H.M.Chawla, TextBook of Organic Chemistry; Sultan Chand&sons, NewDelhi, twenty ninth edition,2007. |
| **Reference Books** | |
| 1 | P.L.Soni,MohanKatyal,TextbookofInorganicchemistry;SultanChandandCompany,New Delhi,twentiethedition,2007. |
| 2 | B.R.Puri,L.R.Sharma,M.S.Pathania,TextbookPhysicalChemistry;VishalPublishingCo., NewDelhi,fortyfortyseventhedition,2018. |
| 3 | B.K,Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition,2014. |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |

**3 – Strong, 2 – Medium , 1 - Low**

**CO-PO Mapping (Course Articulation Matrix)**

| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | **CHEMISTRY PRACTICAL FOR PHYSICAL AND BIOLOGICAL SCIENCE (for Zoology Students – I Year / I Semester ; for Physics Students – II Year / III Semester)** |
|---|---|
| **Part** | **III** |

| **Category** | EC – 3 | **Year** | I /II | **Credits** | 1 | **Course Code** | **232203322** |
|---|---|---|---|---|---|---|---|
| | | **Semester** | I/III | | | | |

| **Instructional Hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
|---|---|---|---|---|---|---|---|
| | - | - | 2 | 2 | 25 | 75 | 100 |

| | |
|---|---|
| **Prerequisites** | |
| **Objectives of the course** | This course aims to provide knowledge on the<br>• basics of preparation of solutions.<br>• principles and practical experience of volumetric analysis |
| **Course Outline** | **VOLUMETRIC ANALYSIS**<br>1. Estimation of sodium hydroxide using standard sodium carbonate.<br>2. Estimation of hydrochloric acid using standard oxalic acid.<br>3. Estimation of ferrous sulphate using standard Mohr's salt.<br>4. Estimation of oxalic acid using standard ferrous sulphate.<br>5. Estimation of potassium permanganate using standardsodium hydroxide.<br>6. Estimation of magnesium using EDTA.<br>7. Estimation of ferrous ion using diphenyl amine as indicator. |
| **Reference Books** | V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, Basic Principlesof Practical Chemistry; Sultan Chand & sons, Second edition, 1997. |

**Course Learning Outcomes (for Mapping with POs and PSOs)**
**On completion of the course the students should be able to**
CO 1: gain an understanding of the use of standard flask and volumetric pipettes, burette.
CO 2: design, carry out, record and interpret the results of volumetric titration.
CO 3: apply their skill in the analysis of water/hardness.
CO4: analyze the chemical constituents in allied chemical products

| **CO /PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 12 | 12 | 12 | 12 | 12 |
| **Weighted percentage of Course Contribution to PSOs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO's and CO's**

| **CO /PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 12 | 12 | 12 | 12 | 12 |
| **Weighted percentage of Course Contribution to POs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | | **ALLIED CHEMISTRY – II (For Physics Students)** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Part** | | **III** | | | | | | |
| **Category** | EC – 4 Generic Elective | **Year** | II | **Credits** | 3 | **Course Code** | **232203421** | |
| | | **Semester** | IV | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 4 | - | -- | 4 | 25 | 75 | 100 |

**Objectives of thecourse**

- Co-ordination Chemistry and Water Technology
- Carbohydrates and Aminoacids
- Basics and applications of electrochemistry
- Basics and applications of kinetics and catalysis
- Various photo chemical phenomenon

| UNIT | No. of Periods for the Unit | No. of Periods for the Unit |
|---|---|---|
| I | **Coordination Chemistry and Water Technology**<br>Coordination Chemistry: Definition of terms - IUPAC Nomenclature - Werner's theory - EAN rule - Pauling's theory – Postulates - Applications to [Ni(CO)4], [Ni(CN)4]2-, [Co(CN)6]3- - Chelation - Biological role of Haemoglobin and Chlorophyll (elementary idea) – Applications in qualitative and quantitative analysis.<br>Water Technology: Hardness of water, determination of hardness of water using EDTA method, zeolite method - Purification techniques - BOD, COD. | **12** |
| II | **Carbohydrates and Amino Acids**<br>Carbohydrates: Classification, preparation, and properties of glucose, fructose, and sucrose. Discussion of open-chain ring structures of glucose and fructose. Glucose-fructose interconversion. Properties of starch and cellulose.<br>Amino Acids: Classification - preparation and properties of alanine, preparation of dipeptides using Bergmann method. RNA and DNA (elementary idea only). | **12** |
| III | **Electrochemistry**<br>Galvanic cells - Standard hydrogen electrode - calomel electrode - standard electrode potentials - electrochemical series. Strong and weak electrolytes - ionic product of water - pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method – buffer solutions and its biological applications - electroplating - Nickel and chrome plating – Types of cells - fuel cells - corrosion and its prevention. | **12** |
| IV | **Kinetics and Catalysis**<br>Order and molecularity. Integrated rate expression for I and II (2A → Products) order reactions. Pseudo-first-order reaction, methods of determining the order of a reaction – Half-life period – Catalysis - homogeneous and heterogeneous, catalyst used in Contact and Haber's processes. Concept of energy of activation and Arrhenius equation. | **12** |
| V | **Photochemistry**<br>Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield - Hydrogen-chloride reaction. Phosphorescence, fluorescence, chemiluminescence, and photosensitization and photosynthesis (definition with examples). | **12** |

| Course Outcomes | |
|---|---|
| **Course Outcomes** | On completion of this course, students will; |
| **CO1** | Write the IUPAC name for complex, different theories to explain the bonding in coordination compounds, and water technology. |
| **CO2** | Explain the preparation and property of carbohydrate, amino acids, and nucleic acids. |
| **CO3** | Apply/demonstrate the electrochemistry principles in corrosion, electroplating, and fuel cells. |
| **CO4** | Identify the reaction rate, order for chemical reaction, and explain the purpose of a catalyst. |
| **CO5** | Outline the various types of photochemical processes. |

| Text Books | |
|---|---|
| 1 | V.Veeraiyan,TextbookofAncillaryChemistry;Highmountpublishinghouse,Chennai, firstedition,2009. |
| 2 | S.Vaithyanathan,TextbookofAncillaryChemistry;PriyaPublications,Karur,2006. |
| 3 | ArunBahl,B.S.Bahl,AdvancedOrganicChemistry;S.ChandandCompany,NewDelhi,twe ntythirdedition,2012. |
| 4 | P.L.Soni,H.M.Chawla,TextBookofOrganicChemistry;SultanChand&sons,NewDelhi,twent yninth edition,2007. |
| **Reference Books** | |
| 1 | P.L.Soni,MohanKatyal,TextbookofInorganicchemistry;SultanChandandCompany,New Delhi,twentiethedition,2007. |
| 2 | R.Puri,L. R.Sharma ,M.S.Pathania, Tex tbook Physical Chemistry; VishalPublishing Co., NewDelhi, forty seventh edition,2018 |

**Mapping with Programme Outcomes:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |

**3 – Strong, 2 – Medium , 1 - Low**

**CO-PO Mapping (Course Articulation Matrix)**

| CO /PO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO's and CO's**

| **Title of the Course** | | **CHEMISTRY PRACTICAL FOR PHYSICAL AND BIOLOGICAL SCIENCE (for Zoology Students – I Year / II Semester ; for Physics Students – II Year / IV Semester)** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Part** | | **III** | | | | | | |
| **Category** | EC – 4 (Generic Elective) | **Year** | I/II | **Credits** | 1 | **Course Code** | **232203422** | |
| | | **Semester** | II/IV | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | - | - | 2 | 2 | 25 | 75 | 100 |

| | |
|---|---|
| **Objectives of thecourse** | This course aims to provide knowledge on<br>• identification of organic functional groups<br>• different types of organic compounds with respect to their properties.<br>• determination of elements in organic compounds. |
| | **SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS**<br>The analysis must be carried out as follows: |
| | (a) Functional group tests [phenol, acids (mono & di) aromatic primary amine, amides (mono & di), aldehydeand glucose].<br>(b) Detection of elements (N, S, Halogens).<br>(c) To distinguish between aliphatic and aromaticcompounds.<br>(d) To distinguish – Saturated and unsaturated compounds. |
| **Reference Books** | V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, Basic Principles ofPractical Chemistry; Sultan Chand & sons, Second edition, 1997. |

**Course Learning Outcomes (for Mapping with POs and PSOs)On completion of the course the students should be able to**

CO 1: gain an understanding of the use of standard flask and volumetric pipettes, burette.
CO 2: design, carry out, record and interpret the results of volumetric titration.
CO 3: apply their skill in the analysis of water/hardness.
CO4: analyze the chemical constituents in allied chemical products

| **CO /PSO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 12 | 12 | 12 | 12 | 12 |
| **Weighted percentage of Course Contribution toPSOs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO's and CO's**

| **CO /PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 12 | 12 | 12 | 12 | 12 |
| **Weighted percentage of Course Contribution to POs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PO's and CO's**

| **CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK** | |
|---|---|
| **Programme** | **M.Sc.** |
| **Programme Code** | 22 |
| **Duration** | **2 years for PG** |
| **Programme Outcomes (Pos)** | **PO1: Problem Solving Skill**<br>Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.<br>**PO2: Decision Making Skill**<br>Foster analytical and critical thinking abilities for data-based decision-making.<br>**PO3: Ethical Value**<br>Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.<br>**PO4: Communication Skill**<br>Ability to develop communication, managerial and interpersonal skills.<br>**PO5: Individual and Team Leadership Skill**<br>Capability to lead themselves and the team to achieve organizational goals.<br>**PO6: Employability Skill**<br>Inculcate contemporary business practices to enhance employability skills in the competitive environment.<br>**PO7: Entrepreneurial Skill**<br>Equip with skills and competencies to become an entrepreneur.<br>**PO8: Contribution to Society**<br>Succeed in career endeavors and contribute significantly to society.<br>**PO 9 Multicultural competence**<br>Possess knowledge of the values and beliefs of multiple cultures and<br>a global perspective.<br>**PO 10: Moral and ethical awareness/reasoning**<br>Ability to embrace moral/ethical values in conducting one's life. |
| **Programme Specific Outcomes (PSOs)** | **PSO1 – Placement**<br>To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.<br>**PSO 2 - Entrepreneur**<br>To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.<br>**PSO3 – Research and Development**<br>Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.<br>**PSO4 – Contribution to Business World**<br>To produce employable, ethical and innovative professionals to sustain in the dynamic business world.<br>**PSO 5 – Contribution to the Society** |

| | |
|---|---|
| | To contribute to the development of the society by collaborating with stakeholders for mutual benefit. |

**CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK**

# M.Sc Chemistry

| Part | | Course | Code | Cr. | Hrs |
|---|---|---|---|---|---|
| **SEMESTER I** | | | | | |
| A | CC – 1 | Organic Reaction Mechanism – I | 232204101 | 4 | 5 |
| | CC – 2 | Structure and Bonding in Inorganic Compounds | 232204102 | 4 | 5 |
| | CC – 3 | Organic Chemistry Practical | 232204103 | 4 | 5 |
| | EC –I (Generic/ DS) | Pharmaceutical Chemistry | 232204104 | 3 | 5 |
| | | Nano Materials and Nano Technology | 232204105 | | |
| | Elective - II | Electro Chemistry | 232204106 | 3 | 5 |
| | | Molecular Spectroscopy | 232204107 | | |
| B | SEC I | Preparation of Consumer products Lab | 232204108 | 2 | 3 |
| | AECC - 1 | Chemistry in Consumer Products | 232204109 | 2 | 2 |
| | Total | | | **22** | **30** |
| **SEMESTER II** | | | | | |
| A | CC – 4 | Organic Reaction Mechanism II | 232204201 | 4 | 5 |
| | CC – 5 | Physical Chemistry – I | 232204202 | 4 | 5 |
| | CC – 6 | Inorganic Chemistry Practicals | 232204203 | 4 | 5 |
| | EC – III | Medicinal Chemistry | 232204204 | 3 | 5 |
| | | Green Chemistry | 232204205 | | |
| | EC - IV | Bio Inorganic Chemistry | 232204206 | 3 | 5 |
| | | Material Science | 232204207 | | |
| B | SEC – II | Drugs and Cosmetics | 232204208 | 2 | 3 |
| | AECC - 2 | Food Preservation | 232204209 | 2 | 2 |
| | | | | **22** | **30** |
| **SEMESTER III** | | | | | |
| A | CC – 7 | Organic Synthesis and Photochemistry | 232204301 | 4 | 5 |
| | CC – 8 | Coordination Chemistry – I | 232204302 | 4 | 5 |
| | CC – 9 | Physical Chemistry Practical | 232204303 | 4 | 5 |
| | EC - V | Pharmacognosy and Phytochemistry | 232204304 | 3 | 5 |
| | | Biomolecules and Heterocyclic Compounds | 232204305 | | |
| | Core | Industrial Chemistry | 232204306 | 3 | 4 |
| B | SEC – III | Molecular spectroscopy | 232204307 | 2 | 4 |
| | AECC – 3 | Research Tools and Techniques in Chemistry | 232204308 | 2 | 2 |
| | Internship | **Internship / Industrial Activity** | 232204309 | 2 | - |
| | | | | **24** | **30** |
| **SEMESTER IV** | | | | | |
| A | CC – 10 | Coordination Chemistry - II | 232204401 | 4 | 5 |
| | CC – 11 | Physical Chemistry – II | 232204402 | 4 | 5 |
| | CC - 12 | Analytical Instrumentation Technique Practicals | 232204403 | 4 | 5 |
| | CC – 13 | Project with Viva Voce | 232204404 | 3 | 4 |
| | EC VI | Polymer Chemistry | 232204405 | 3 | 5 |
| | | Cheminformatics | 232204406 | | |
| B | SEC IV | Chemistry of Natural products and Organic spectroscopy | 232204407 | 2 | 4 |
| | AECC – 4 | Interpretation and Identification of Chemical Compounds | 232204408 | 2 | 2 |
| C | EA | Extension Activity | **232204409** | 1 | |

| | | | | | |
|---|---|---|---|---|---|
| | Total | | | **23** | **30** |
| * Internship will be carried out during the summer vacation of the first year and marks will be included in the Third Semester Marks Statement. | | | | | |

| **Title of the Course** | | **ORGANIC SYNTHESIS AND PHOTOCHEMISTRY** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **Category** | Core - 7 | **Year** | II | **Credits** | 4 | **Course Code** | **232204301** | |
| | | **Semester** | III | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 4 | 1 | -- | 5 | 25 | 75 | 100 |

**Learning Objectives**

- ✍ To understand the molecular complexity of carbon skeletons and the presence of functional groups and their relative positions.
- ✍ To study various synthetically important reagents for any successful organic synthesis.
- ✍ To apply disconnection approach and identifying suitable synthons to effect successful organic synthesis.
- ✍ To learn the concepts of pericyclic reaction mechanisms.
- ✍ To gain the knowledge of photochemical organic reactions

| **UNIT** | **Details** | **No. of Periods for the Unit** |
|---|---|---|
| **I** | Planning an Organic Synthesis and Control elements: Preliminary Planning – knowns and unknowns of the synthetic system studied, analysis of the complex and interrelated carbon framework into simple rational precursors, retrosynthetic analysis, alternate synthetic routes, key intermediates that would be formed, available starting materials and resulting yield of alternative methods. Linear Vs convergent synthesis. synthesis based on umpolung concepts of Seeback, regiospecific control elements. Use of protective groups, activating groups and bridging elements. Examples on retrosynthetic approach, calculation of yield, advantages of connvergent synthesis, synthesis of stereochemistry-controlled products. | **15** |
| **II** | **Organic Synthetic Methodology:** Retrosynthetic analysis; Alternate synthetic routes. Synthesis of organic mono and bifunctional compounds via disconnection approach. Key intermediates, available starting materials and resulting yields of alternative methods. Convergent and divergent synthesis, Synthesis based on umpolung concepts of Seebach. Protection of hydroxyl, carboxyl, carbonyl, thiol and amino groups. Illustration of protection and deprotection in synthesis. Control elements: Regiospecific control elements. Use of protective groups, activating groups, and bridging elements. Stereospecific control elements. Functional group alterations and transposition. | **15** |
| **III** | **Pericyclic Reactions:** Woodward Hoffmann rules; The Mobius and Huckel concept, FMO, PMO method and correlation diagrams. Cycloaddition and retrocycloaddition reactions; [2+2], [2+4], [4+4, Cationic, anionic, and 1,3-dipolar cycloadditions. Cheletropic reactions. ; Electrocyclization and ring opening reactions of conjugated dienes and trienes. Sigmatropic rearrangements: (1,3), (1,5), (3,3) and (5,5)-carbon migrations, degenerate rearrangements. Ionic sigmatropic rearrangements. Group transfer reactions. Regioselectivity, stereoselectivity and periselectivity in pericyclic reactions. | **15** |

| | | |
|---|---|---|
| **IV** | **Organic Photochemistry-I:** Photochemical excitation: Experimental techniques; electronic transitions; Jablonskii diagrams; intersystem crossings; energy transfer processes; Stern Volmer equation.<br>Reactions of electronically excited ketones; $\pi \rightarrow \pi^*$ triplets; Norrish type-I and type-II cleavage reactions; photo reductions; Paterno-Buchi reactions; | **15** |
| **V** | **Organic Photochemistry-I:** Photochemistry of $\alpha,\beta$-unsaturated ketones; cis-trans isomerisation. Photon energy transfer reactions, Photo cycloadditions, Photochemistry of aromatic compounds; photochemical rearrangements; photo-stationery state; di-$\pi$-methane rearrangement; Reaction of conjugated cyclohexadienone to 3,4-diphenyl phenols; Barton's reactions. | **15** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will; |
| **CO1** | To recall the basic principles of organic chemistry and to understand the various reactions of organic compounds with reaction mechanisms. |
| **CO2** | To understand the versatility of various special reagents and to correlate their reactivity with various reaction conditions. |
| **CO3** | To implement the synthetic strategies in the preparation of various organic compounds. |
| **CO4** | To predict the suitability of reaction conditions in the preparation of tailor-made organic compounds |
| **CO5** | To design and synthesize novel organic compounds with the methodologies learnt during the course |

**Text Books (Latest Editions)**

1. F. A. Carey and Sundberg, Advanced Organic Chemistry, 5thed, Tata McGraw-Hill, New York, 2003.
2. J. March and M. Smith, Advanced Organic Chemistry, 5th ed., John-Wiley and sons, 2007.
3. R. E. Ireland, Organic synthesis, Prentice Hall India, Goel publishing house, 1990.
4. Clayden, Greeves, Warren, Organic Chemistry, Oxford University Press, Second Edition, 2016.
5. M. B. Smith, Organic Synthesis 3rd edn, McGraw Hill International Edition, 2011.

**References Books**
**(Latest editions, and the style as given below must be strictly adhered to)**

1. Gill and Wills, Pericyclic Reactions, Chapman Hall, London, 1974.
2. J.A. Joule, G.F. Smith, Heterocyclic Chemistry, Garden City Press, Great Britain, 2004.
3. W. Caruthers, Some Modern Methods of Organic Synthesis 4thedn, Cambridge University Press, Cambridge, 2007.
4. H. O. House. Modern Synthetic reactions, W.A. Benjamin Inc, 1972.
5. Jagdamba Singh and Jaya Singh, Photochemistry and Pericyclic Reactions, New Age International Publishers, New Delhi, 2012.

**Web Resources**

1.https://rushim.ru/books/praktikum/Monson.pdf

**Mapping with Programme Outcomes:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S | M |
| **CO2** | M | S | S | S | S | M | S | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S | S |
| **CO4** | M | S | S | S | S | M | S | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| CO /PO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | | **COORDINATION CHEMISTRY – I** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **Category** | Core – 8 | **Year** | II | **Credits** | 4 | **Course Code** | **232204302** | |
| | | **Semester** | III | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 4 | 1 | -- | 5 | 25 | 75 | 100 |

**Learning Objectives**

- ✍ To gain insights into the modern theories of bonding in coordination compounds.
- ✍ To learn various methods to determine the stability constants of complexes.
- ✍ To understand and construct correlation diagrams and predict the electronic transitions that are taking place in the complexes.
- ✍ To describe various substitution and electron transfer mechanistic pathways of reactions in complexes.
- ✍ To evaluate the reactions of octahedral and square planar complexes.

| **UNIT** | **Details** | **No. of Periods for the Unit** |
|---|---|---|
| **I** | **Modern theories of coordination compounds:** Crystal field theory - splitting of d orbitals in octahedral, tetrahedral and square planar symmetries - measurement of 10Dq - factors affecting 10Dq - spectrochemical series - crystal field stabilisation energy for high spin and low spin complexes- evidences for crystal field splitting - site selections in spinels and antispinels - Jahn Teller distortions and its consequences. Molecular Orbital Theory and energy level diagrams concept of Weak and strong fields, Sigma and pi bonding in octahedral, square planar and tetrahedral complexes. | **15** |
| **II** | **Spectral characteristics of complexes:** Term states for d ions - characteristics of d-d transitions - charge transfer spectra - selection rules for electronic spectra - Orgel correlation diagrams - Sugano-Tanabe energy level diagrams - nephelauxetic series - Racha parameter and calculation of inter-electronic repulsion parameter. | **15** |
| **III** | **Stability and Magnetic property of the complexes:** Stability of complexes: Factors affecting stability of complexes, Thermodynamic aspects of complex formation, Stepwise and overall formation constants, Stability correlations, statistical factors and chelate effect, Determination of stability constant and composition of the complexes: Formation curves and Bjerrum's half method, Potentiometric method, Spectrophotometric method, Ion exchange method, Polorographic method and Continuous variation method (Job's method) Magnetic property of complexes: Spin-orbit coupling, effect of spin-orbit coupling on magnetic moments, quenching of orbital magnetic moments. | **15** |
| **IV** | **Kinetics and mechanisms of substitution reactions of octahedral and square planar complexes:** Inert and Labile complexes; Associative, Dissociative and SNCB mechanistic pathways for substitution reactions; acid and base hydrolysis of octahedral complexes; Classification of metal ions based on the rate of water replacement reaction and their correlation to Crystal Field Activation Energy; Substitution reactions in square planar complexes: Trans effect, theories of trans effect and applications of trans effect in synthesis of square planar compounds; Kurnakov test | **15** |
| **V** | Electron Transfer reactions in octahedral complexes: Outer sphere electron transfer reactions and Marcus-Hush theory; inner sphere electron transfer reactions; nature of the bridging ligand in inner sphere electron transfer reactions. Photo-redox, photo-substitution and photo-isomerisation reactions in complexes and their applications | **15** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, Students will be able |
| **CO1** | Understand and comprehend various theories of coordination compounds. |
| **CO2** | Understand the spectroscopic and magnetic properties of coordination complexes. |
| **CO3** | Explain the stability of complexes and various experimental methods to determine the stability of complexes. |
| **CO4** | Predict the electronic transitions in a complex based on correlation diagrams and UV-visible spectral details. |
| **CO5** | Comprehend the kinetics and mechanism of substitution reactions in octahedral and square planar complexes. |

| **Text Books (Latest Editions)** | |
|---|---|
| 1 | J E Huheey, EA Keiter, RL Keiter and OK Medhi, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson Education Inc., 2006. |
| 2 | G L Meissler and D ATarr, Inorganic Chemistry, 3rd Edition, Pearson Education Inc., 2008 |
| 3 | D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993. |
| 4 | B. N. Figgis, Introduction to Ligand Fields, Wiley Eastern Ltd, 1976. |
| 5 | F. A. Cotton, G. Wilkinson.; C. A. Murillo; M. Bochmann, Advanced Inorganic Chemistry, 6th ed.; Wiley Inter-science: New York, 1988. |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
| 1 | Keith F. Purcell and John C. Kotz, Inorganic Chemistry, Saunders Publications, USA, 1977. |
| 2 | Peter Atkins and Tina Overton, Shriver and Atkins' Inorganic Chemistry, 5th Edition, Oxford University Press, 2010. |
| 3 | Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, P. L. Guas, John Wiley, 2002, 3rd edn. |
| 4 | Concepts and Models of Inorganic Chemistry, B. Douglas, D. McDaniel, J. Alexander, John Wiley, 1994, 3rd edn. |
| 5 | Inorganic Chemistry, D. F. Shriver, P. W. Atkins, W. H. Freeman and Co, London, 2010. |
| **Web Resources** | |
| 01.https://ocw.mit.edu/courses/5-04-principles-of-inorganic-chemistry-ii-fall-2008/pages/syllabus/ | |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S | M |
| **CO2** | M | S | S | S | S | M | S | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S | S |
| **CO4** | M | S | S | S | S | M | S | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Title of the Course** | **PHYSICAL CHEMISTRY PRACTICAL** | | | | | | |
| | | | | | | | |
| **Category** | Core - 9 | **Year** | II | **Credits** | 4 | **Course Code** | **232204303** |
| | | **Semester** | III | | | | |

| **Instructional Hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
|---|---|---|---|---|---|---|---|
| | - | - | 5 | 5 | 25 | 75 | 100 |

**Learning Objectives**

- ✍ To understand the principle of conductivity experiments through conductometric titrations.
- ✍ To evaluate the order of the reaction, temperature coefficient, and activation energy of the reaction by following pseudo first order kinetics.
- ✍ To construct the phase diagram of two component system forming congruent melting solid and find its eutectic temperatures and compositions.
- ✍ To determine the kinetics of adsorption of oxalic acid on charcoal.
- ✍ To develop the potential energy diagram of hydrogen ion, charge density distribution and Maxwell's speed distribution by computational calculation.

**Experiments**

**Conductivity Experiments**

1.Determination of equivalent conductance of a strong electrolyte & the verification of DHO equation.

2. Verification of Ostwald's Dilution Law & Determination of pKa of a weak acid.

3. Verification of Kohlrausch's Law for weak electrolytes.

4. Determination of solubility of a sparingly soluble salt.

5. Acid-base titration (strong acid and weak acid vs NaOH).

6. Precipitation titrations (mixture of halides only).

**Kinetics**

1. Study the kinetics of acid hydrolysis of an ester, determine the temperature coefficient and also the activation energy of the reaction.
2. Study the kinetics of the reaction between acetone and iodine in acidic medium by half-life method and determine the order with respect to iodine and acetone.

**Phase diagram**

Construction of phase diagram for a simple binary system

1. Naphthalene-phenanthrene
2. Benzophenone- diphenyl amine

**Adsorption**

Adsorption of oxalic acid on charcoal & determination of surface area (Freundlich isotherm only).

**Course Outcomes**

| **Course Outcomes** | On completion of this course, students will; |
|---|---|
| **CO1** | To recall the principles associated with various physical chemistry experiments. |
| **CO2** | To scientifically plan and perform all the experiments. |
| **CO3** | To observe and record systematically the readings in all the experiments. |
| **CO4** | To calculate and process the experimentally measured values and compare with graphical data. |
| **CO5** | To interpret the experimental data scientifically to improve students' efficiency for societal developments. |

| | |
|---|---|
| **Text Books (Latest Editions)** | |
| 1. | B. Viswanathan and P.S.Raghavan, Practical Physical Chemistry, Viva Books, New Delhi, 2009. |
| 2. | Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S. Viswanathan Co. Pvt., 1996. |
| 3. | V.D. Athawale and Parul Mathur, Experimental Physical Chemistry, New Age International (P) Ltd., New Delhi, 2008. |
| 4. | E.G. Lewers, Computational Chemistry: Introduction to the Theory and Applications of Molecular and Quantum Mechanics, 2nd Ed., Springer, New York, 2011. |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
| 1 | J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2001. |
| 2 | G.W. Garland, J.W. Nibler, D.P. Shoemaker, Experiments in Physical Chemistry, 8th edition, McGraw Hill, 2009. |
| 3 | J. N. Gurthu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987. |
| 4 | Shailendra K Sinha, Physical Chemistry: A laboratory Manual, Narosa Publishing House Pvt, Ltd., New Delhi, 2014. |
| 5 | F. Jensen, Introduction to Computational Chemistry, 3rd Ed., Wiley-Blackwell. |
| **Web Resources** | |
| 1 | https://web.iitd.ac.in/~nkurur/201516/Isem/cmp511/lab_handout_new.pdf |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S | M |
| **CO2** | M | S | S | S | S | M | S | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S | S |
| **CO4** | M | S | S | S | S | M | S | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | | **PHARMOCOGNOSY AND PHYTOCHEMISTRY** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **Category** | EC – 5.1 | **Year** | II | **Credits** | 3 | **Course Code** | **232204304** | |
| | | **Semester** | III | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 5 | - | -- | 5 | 25 | 75 | 100 |

**Learning Objectives**

- ✍ To develop the knowledge of natural products, biological functions and pharmacological uses.
- ✍ To develop knowledge on primary and secondary metabolites and their sources
- ✍ To understand the concepts of isolation methods and separation of bioactive compounds.
- ✍ To provide the knowledge on selected glycosides and marine drugs.
- ✍ To familiarize the guidelines of WHO and different sampling techniques

| **UNIT** | **Details** | **No. of Periods for the Unit** |
|---|---|---|
| **I** | **Pharmacognosy and Standardization of Herbal drugs:** Introduction, definition, development classification and Source of Drugs: Biological, mineral, marine,and plant tissue cultures. Study of pharmacognostic of a crude drug. Biosynthesis: Shikimic acid pathway and acetate pathway. Systematic analysis of Crude drugs. Standardization of Herbal drugs. WHO guidelines, Sampling of crude drug, Methods of drug evaluation. Determination of foreign matter, moisture Ash value. Phytochemical investigations-General chemical tests. | **15** |
| **II** | **Extraction Techniques:** General methods of extraction, types – maceration, Decoction, percolation, Immersion and soxhlet extraction. Advanced techniques - counter current, steam distillation, supercritical gases, sonication, Micro waves assisted extraction. Factors affecting the choice of extraction process. | **15** |
| **III** | **Drugs containing Terpenoids and volatile oils:** Terpenoids: Classification, Isoprene rule, Isolation and separation techniques, General properties Camphor, Menthol, Eucalyptol. Volatile Oils or Essential Oils: Method of Preparations, Classifications of Volatile oils, Camphor oil, Geranium oil, Citral- Structure uses. Pentacyclic triterpenoids: amyrines; taraxasterol: Structure and pharmacological applications. | **15** |
| **IV** | **Drugs containing alkaloids:** Occurrence, function of alkaloids in plants, pharmaceutical applications. Isolation, Preliminary Qualitative tests and general properties. General methods of structural elucidation. Morphine, Reserpine, papaverine - chemical properties, structure and uses. papaverine - structure, chemical properties and uses. | **15** |
| **V** | **Plant Glycosides and Marine drugs:** Glycosides: Basic ring system, classification, isolation, properties, qualitative analysis. Pharmacological activity of Senna glycosides, Cardiac glycosides-Digoxin, digitoxin, Steroidal saponins glycosides- Diosgenin, hecogenin. Plant pigments: Occurrence and general methods of structure determination, isolation and synthesis of quercetin and cyanidin chloride. Marine drugs -Selected Drug Molecules: Cardiovascular active substances, Cytotoxic compounds, antimicrobial compounds, antibiotic compounds, Anti-inflammatory agents. Marine toxins. | **15** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will be able |
| **CO1** | To recall the sources of natural medicines and analysis of crude drugs. |
| **CO2** | To understand the methods of evaluation based on various parameters. |
| **CO3** | To analyze the isolated drugs |
| **CO4** | To apply various techniques to discover new alternative medicines. |
| **CO5** | To evaluate the isolated drugs for various pharmacological activities |
| **Text Books (Latest Editions)** | |
| 1 | Gurdeep R Chatwal (2016), Organic chemistry of Natural products, Volume I&II, 5th edition, Himalaya publishing House. |
| 2 | S.V.Bhat, B.A. Nagasampagi, M.Sivakumar (2014), Chemistry of Natural Products, Revised edition, Narosa Publishers. |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
| 1 | Jeffrey B. Harborne (2012), Phytochemical methods: A Guide to Modern Techniques of Plant Analysis, 4th edition, Indian reprint, Springer. |
| 2 | Ashutoshkar (2007), Pharmacognosy and Pharmacobiotechnology, 2 nd edition, New age international (P) limited, New Delhi. |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S | M |
| **CO2** | M | S | S | S | S | M | S | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S | S |
| **CO4** | M | S | S | S | S | M | S | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | | **5.2 BIOMOLECULES AND HETEROCYCLIC COMPOUNDS** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **Category** | EC – 5.2 | **Year** | II | **Credits** | 3 | **Course Code** | **232204305** | |
| | | **Semester** | III | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 5 | - | -- | 5 | 25 | 75 | 100 |

**Learning Objectives**

- ✍ To learn the basic concepts and biological importance of biomolecules and natural products.
- ✍ To explain various of functions of carbohydrates, proteins, nucleic acids, steroids and hormones.
- ✍ To understand the functions of alkaloids and terpenoids.
- ✍ To elucidate the structure determination of biomolecules and natural products.
- ✍ To extract and construct the structure of new alkaloids and terpenoids from different methods.

| **UNIT** | **Details** | **No. of Periods for the Unit** |
|---|---|---|
| **I** | **Chemistry and metabolism of carbohydrates:** Definition, classification and biological role of carbohydrates. onosaccharides: Linear and ring structures (Haworth formula) of ribose, glucose, fructose and mannose (structure determination not required), physical and chemical properties of glucose and fructose. Disaccharides: Ring structures (Haworth formula) – occurrence, physical and chemical properties of maltose, lactose and sucrose. Polysaccharides: Starch, glycogen and cellulose – structure and properties, glycolysis of carbohydrates. | **15** |
| **II** | **Steroids and Hormones:** Steroids-Introduction, occurrence, nomenclature, configuration of substituents. Diels' hydrocarbon, stereochemistry, classification, Diels' hydrocarbon, biological importance, colour reactions of sterols, cholesterol-occurrence, tests, physiological activity, biosynthesis of cholesterol from squalene. Hormones-Introduction, classification, functions of sex hormones- androgens and estrogens, adrenocortical hormones-cortisone and cortisol structure and functions of non-steroidal hormones-adrenaline and thyroxin. | **15** |
| **III** | **Proteins:** Separation and purification of proteins – dialysis, gel filtration and electrophoresis. Catabolism of amino acids - transamination, oxidative deamination and decarboxylation. Biosynthesis of proteins. | **15** |
| **IV** | **Nucleic acids:** Role of nucleic acids. Amino acid metabolism and urea cycle. Structure, methods for the synthesis of nucleosides - direct combination, formation of heterocyclic base and nucleoside modification, conversion of nucleoside to nucleotides. Primary and secondary structure of RNA and DNA, Watson-Crick model, solid phase synthesis ofoligonucleotides. | **15** |
| **V** | **Fused Ring Heterocyclic Compounds:** Benzofused five membered rings: Indole, isoindole, benzofuran and benzothiophene, Preparation and properties. Benzofused six membered rings: Quinoline and isoquinoline: Preparation by ring closure reactions, Reactions: Mechanism of electrophilic and nucleophilic substitutions, oxidation and reduction reactions. | **15** |

**Course Outcomes**

| **Course Outcomes** | On completion of this course, students will be able |
|---|---|
| **CO1** | To understand the basic concepts of biomolecules and natural products. |

| | |
|---|---|
| **CO2** | To integrate and assess the different methods of preparation of structurally different biomolecules and natural products. |
| **CO3** | To illustrate the applications of biomolecules and their functions in the metabolism of living organisms. |
| **CO4** | To analyse and rationalise the structure and synthesis of heterocyclic compounds. |
| **CO5** | To develop the structure of biologically important heterocyclic compounds by different methods. |

| | |
|---|---|
| **Text Books (Latest Editions)** | |
| 1 | T. K Lindhorst, Essentials of Carbohydrate Chemistry and Biochemistry, Wiley VCH, North America,2007. |
| 2 | I. L. Finar, Organic Chemistry Vol-2, 5th edition, Pearson Education Asia, 1975. |
| 3 | V. K. Ahluwalia and M. Goyal, Textbook of Heterocyclic compounds, Narosa Publishing, New Delhi,2000. |
| 4 | M. K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publishing Co., Jalandhar, Delhi, 2014. |
| 5 | V. K. Ahluwalia, Steroids and Hormones, Ane books pub., New Delhi,2009. |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
| 1 | I. L. Finar, Organic Chemistry Vol-1, 6thedition, Pearson Education Asia,2004. |
| 2 | Pelletier, Chemistry of Alkaloids, Van Nostrand Reinhold Co, 2000. |
| 3 | Shoppe, Chemistry of the steroids, Butterworthes,1994. |
| 4 | I. A. Khan, and A. Khanum. Role of Biotechnology in medicinal & aromatic plants, Vol 1 and Vol 10, Ukkaz Publications, Hyderabad,2004. |
| 5 | M. P. Singh. and H. Panda, Medicinal Herbs with their formulations, Daya Publishing House, Delhi,2005. |
| **Web Resources** | |
| https://www.organic-chemistry.org/<br>https://www.studyorgo.com/summary.php<br>https://www.clutchprep.com/organic-chemistry | |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S | M |
| **CO2** | M | S | S | S | S | M | S | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S | S |
| **CO4** | M | S | S | S | S | M | S | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | | **INDUSTRIAL CHEMISTRY** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **Category** | Core Industry Module | **Year** | II | **Credits** | 3 | **Course Code** | **232204306** | |
| | | **Semester** | III | | | | | |

| **Instructional Hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
|---|---|---|---|---|---|---|---|
| | 4 | -- | -- | 4 | 25 | 75 | 100 |

**Learning Objectives**

- ✍ To gain the knowledge in solid, liquid and gaseous fuel as a resource for energy production and chemical production.
- ✍ To develop innovative methods to produce soft water for industrial use and potable water at cheaper cost.
- ✍ To learn how to prepare industrial products such as sugar, fermented and explosive products in the chemical laboratory.
- ✍ To know the information about cement, chemical constituent and composition, polymers and their uses in various engineering operations.
- ✍ To learn about the industrial materials,especially fertilizer materials for agricultural production.

| **UNIT** | **Details** | **No. of Periods for the Unit** |
|---|---|---|
| **I** | **Industrial fuels**<br>Classification of fuels: solid, liquid and gas. Calorific value of fuels and its determination. Solid fuels: Coal- types – properties and uses – lignite, sub-bituminous coal, bituminous coal and anthracite, Coking and non-coking coal. Liquid fuels: Refining of crude petroleum and uses of fractions, Hydrodesulphurisation. Gaseous fuels -Natural gas and gobar gas-production, composition and uses, Gobar electric cell. | **12** |
| **II** | **Water treatment**<br>Introduction Sources of water: Hardness of water-temporary hardness, permanent hardness. Disadvantages of hard water in domestic, industry and steam generation (boilers). Estimation of hardness by EDTA method. Water softening methods: Lime – soda process, Zeolite process, Ion-exchange, Demineralisation - deionisation process. Removal of microorganism – Chlorination, Reverse osmosis, Desalination. | **12** |
| **III** | **Industries**<br>Sugar Industry: Manufacture of sugar from molasses and beetroot – sugar industries in India. Fermentation: Manufacture of spirits and wines. Match industries: Manufacture – chemistry of lighting and pyrotechnics. Explosives: Definition – Classification – Characteristics of explosives – Nitro cellulose, T.N.T. Picric acid, Gun Powder, Cordite and Dynamite. | **12** |
| **IV** | **Polymerization:**<br>Polymerization: Types of Polymerization–Addition and Condensation Polymerizations. Plastics –Thermosetting and Thermoplastics–composition and uses of the following: Polyethylene, PVC, Teflon, Bakelite, Polyester, Rubber–Natural and synthetic Rubber. Cement: Chemical Constituents and Composition of Cement–Setting and Hardening. Corrosion: Types of corrosion (dry, wet). | **12** |

| | | |
|---|---|---|
| **V** | **Fertilizers**<br>Fertilizers: Plant nutrients–macro & micronutrients–Need for fertilizers–Fertilizers type–Essential requirements–Classification of fertilizers–simple and mixed fertilizers–Sources–Natural and Artificial fertilizers–Nitrogenous fertilizers–Ammonium nitrate, Ammonium sulphate, Urea (Method of preparation and uses). Phosphate fertilizers–Super phosphate and triple super phosphate–Method of preparation & uses. Potash fertilizers: KNO3 : method of preparation and uses. Mixed fertilizers–preparation & uses. NPK ratio and its importance. | **12** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will be able |
| **CO1** | To gain the knowledge about various types fuels (solid, liquid and gaseous) like coal, petrol, natural gas etc., their properties, refinement and uses. |
| **CO2** | To gain the knowledge about hardness of water estimation and removal by EDTA and softening methods used in industry. |
| **CO3** | To know about sugar, manufacture of sprits, composition and properties of different types of explosives. |
| **CO4** | To acquire knowledge of polymers, cement and corrosion in chemical industry. |
| **CO5** | To know about the manufacturing, properties and application of Nitrogen, phosphorous and potash fertilizer. |

**Text Books (Latest Editions)**

1. B.K.Sharma, Krishnaprakasam (2014), Industrial Chemistry Including Chemical Engineering, Media,Meerut
2. A. Heaton, An Introduction to Industrial Chemistry, Springer, 2019.
3. B.N.Charabarthy – ―Industrial Chemistry‖, 1st Ed., Oxford and IBh Publishing. NewDelhi.
4. D. A. Spera, Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering,ASMEPress.
5. Norris shreve, r. And joseph a. Brink, jr. Chemical process industries, 4th ed.; Mc graw – hill Kogakusha, ltd:1977.

**References Books**
**(Latest editions, and the style as given below must be strictly adhered to)**


1. B.K. Sharma, Industrial Chemistry, 15th edition, Goel Publishing House, 2006.
2. P.C. Jain & Monica Jain, Engineering Chemistry, Dhanpat, Rai Publications, 2009. 3. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Inorganic Chemistry, Vishal Publishing Co., 2017.
3. A. Heaton, An Introduction to Industrial Chemistry, Chapman & Hall Pub. Co., 1996.
4. P.L. Soni, A Text Book of Inorganic Chemistry, Sultan Chand, 2013.
5. S. Mohan, V. Arjunan and Sujin P. Jose, Principles of Materials Science, MJP Publishers, Chennai, 2018.


**Web Resources**

1. https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004132159500424ranvijay_engg_Fuels.pdf
2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCY1213.pdf
3. https://edurev.in/t/98513/Introduction-to-Sugar--Fermentation-Industry-and-M
4. https://unacademy.com/content/wp content/ uploads/ sites/2/ 2022/10/33.-Polymer-Notes.pdf
5. https://www.agricorn.in/2023/03/bsc-ag-chemical-fertilizers.html

**Mapping with Programme Outcomes:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S | M |
| **CO2** | M | S | S | S | S | M | S | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S | S |
| **CO4** | M | S | S | S | S | M | S | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| CO /PO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | | **MOLECULAR SPECTROSCOPY** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Professional Communication Skill** | | | | | | |
| **Category** | SEC - III | **Year** | II | **Credits** | 2 | **Course Code** | **232204307** | |
| | | **Semester** | III | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 4 | -- | -- | 4 | 25 | 75 | 100 |

**Learning Objectives**

- ✍ To understand the influence of rotation and vibrations on the spectra of the polyatomic molecules.
- ✍ To study the principle of Raman spectroscopy, ESR spectroscopy, EPR spectroscopy and fragmentation patterns in Mass spectroscopy.
- ✍ To highlight the significance of Franck-Condon principle to interpret the selection rule, intensity and types of electronic transitions.
- ✍ To interpret the first and second order NMR spectra in terms of splitting and coupling patterns using correlation techniques such as COSY, HETCOR, NOESY.
- ✍ To carry out the structural elucidation of molecules using different spectral techniques.

| **UNIT** | **Details** | **No. of Periods for the Unit** |
|---|---|---|
| **I** | **Rotational and Raman Spectroscopy:** Rotational spectra of diatomic and polyatomic molecules. Intensities of rotational spectral lines, effect of isotopic substitution. Non-rigid rotators. Classical theory of the Raman effect, polarizability as a tensor, polarizability ellipsoids, quantum theory of the Raman effect, Pure rotational Raman spectra of linear and asymmetric top molecules, Stokes and anti-Stokes lines. Vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion, rotational fine structure-O and S branches, Polarization of Raman scattered photons. | **12** |
| **II** | **Vibrational Spectroscopy:** Vibrations of molecules, harmonic and anharmonic oscillators- vibrational energy expression, energy level diagram, vibrational wave functions and their symmetry, selection rules, expression for the energies of spectral lines, computation of intensities, hot bands, effect of isotopic substitution. Diatomic vibrating rotor, vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born-Oppenheimer approximation. Vibrations of polyatomic molecules – symmetry properties, overtone and combination frequencies. Influence of rotation on vibrational spectra of polyatomic molecule, P, Q, R branches, parallel and perpendicular vibrations of linear and symmetric top molecules. | **12** |
| **III** | **Electronic spectroscopy:** Electronic Spectroscopy: Electronic spectroscopy of diatomic molecules, Frank-Condon principle, dissociation and predissociation spectra. $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions and their selection rules. Photoelectron Spectroscopy: Basic principles, photoelectron spectra of simple molecules, Xray photoelectron spectroscopy (XPS). Lasers: Laser action, population inversion, properties of laser radiation, examples of simple laser systems. | **12** |

| | | |
|---|---|---|
| **IV** | **NMR and ESR spectroscopy:** Chemical shift, Factors influencing chemical shifts: electronegativity and electrostatic effects; Mechanism of shielding and deshielding. Spin systems: First order and second order coupling of AB systems, Simplification of complex spectra. Spin-spin interactions: Homonuclear coupling interactions - AX, AX2, AB types. Vicinal, germinal and long-range coupling-spin decoupling. Nuclear Overhauser effect (NOE), Factors influencing coupling constants and Relative intensities. 13CNMR and structural correlations, Satellites. Brief introduction to 2D NMR – COSY, NOESY. Introduction to 31P, 19F NMR. ESR spectroscopy Characteristic features of ESR spectra, line shapes and line widths; ESR spectrometer. The g value and the hyperfine coupling parameter (A), origin of hyperfine interaction. Interpretation of ESR spectra and structure elucidation of organic radicals using ESR spectroscopy; Spin orbit coupling and significance of g- tensors, zero/non-zero field splitting, Kramer's degeneracy, application to transition metal complexes (having one to five unpaired electrons) including biological molecules and inorganic free radicals. ESR spectra of magnetically dilute samples. | **12** |
| **V** | **Mass Spectrometry, EPR and Mossbauer Spectroscopy:** Ionization techniques- Electron ionization (EI), chemical ionization (CI), desorption ionization (FAB/MALDI), electrospray ionization (ESI), isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution. Effect of isotopes on the appearance of mass spectrum. EPR spectra of anisotropic systems - anisotropy in g- value, causes of anisotropy, anisotropy in hyperfine coupling, hyperfine splitting caused by quadrupole nuclei. Zero-field splitting (ZFS) and Kramer's degeneracy. Applications of EPR to organic and inorganic systems. Structural elucidation of organic compounds by combined spectral techniques. Principle of Mossbauer spectroscopy: Doppler shift, recoil energy. Isomer shift, quadrupole splitting, magnetic interactions. Applications: Mossbauer spectra of high and low-spin Fe and Sn compounds. | **12** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will; |
| **CO1** | To understand the importance of rotational and Raman spectroscopy. |
| **CO2** | To apply the vibrational spectroscopic techniques to diatomic and polyatomic molecules. |
| **CO3** | To evaluate different electronic spectra of simple molecules using electronic spectroscopy. |
| **CO4** | To outline the NMR, $^{13}$C NMR, 2D NMR – COSY, NOESY, Introduction to $^{31}$P, $^{19}$FNMR and ESR spectroscopic techniques. |
| **CO5** | To develop the knowledge on principle, instrumentation and structural elucidation of simple molecules using Mass Spectrometry, EPR and Mossbauer Spectroscopy techniques. |

**Text Books (Latest Editions)**

1. C. N. Banwell and E. M. McCash, *Fundamentals of Molecular Spectroscopy*, 4th Ed., Tata McGraw Hill, New Delhi, 2000.
2. R. M. Silverstein and F. X. Webster, *Spectroscopic Identification of Organic Compounds*, 6th Ed., John Wiley & Sons, New York, 2003.

3. W. Kemp, *Applications of Spectroscopy*, English Language Book Society, 1987.

4. D. H. Williams and I. Fleming, *Spectroscopic Methods in Organic Chemistry*, 4th Ed., Tata McGraw-Hill Publishing Company, New Delhi, 1988.
5. R. S. Drago, *Physical Methods in Chemistry*; Saunders: Philadelphia, 1992.

**References Books**

**(Latest editions, and the style as given below must be strictly adhered to)**

1. P.W. Atkins and J. de Paula, *Physical Chemistry*, 7th Ed., Oxford University Press, Oxford, 2002.
2. I. N. Levine, *Molecular Spectroscopy*, John Wiley & Sons, New York, 1974.
3. A. Rahman, *Nuclear Magnetic Resonance-Basic Principles*, Springer-Verlag, New York,1986.
4. K. Nakamoto, *Infrared and Raman Spectra of Inorganic and coordination Compounds*, PartB: 5th ed., John Wiley& Sons Inc., New York, 1997.
5. J. A. Weil, J. R. Bolton and J. E. Wertz, *Electron Paramagnetic Resonance*; Wiley Interscience, 1994.

**Web Resources**

1. https://onlinecourses.nptel.ac.in/noc20_cy08/preview
2. https://www.digimat.in/nptel/courses/video/104106122/L14.html

**Mapping with Programme Outcomes:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S | M |
| **CO2** | M | S | S | S | S | M | S | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S | S |
| **CO4** | M | S | S | S | S | M | S | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| CO /PO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | | **RESEARCH TOOLS AND TECHNIQUES IN CHEMISTRY** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **Category** | AECC - 3 | **Year** | II | **Credits** | 2 | **Course Code** | **232204308** | |
| | | **Semester** | III | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 2 | -- | -- | 2 | 25 | 75 | 100 |

**Learning Objectives**

- ✍ To understand the basic concepts in research methodology in chemical science.
- ✍ To develop the knowledge of report writing and framing Research proposals.
- ✍ To gain the knowledge of about collecting and processing various data types.
- ✍ To understand the concept of separation and purification techniques in chemical compounds.
- ✍ To discuss different types of characterization techniques and their uses.

| **UNIT** | **Details** | |
|---|---|---|
| **I** | **Research Basics**: Basics of scientific research, research process and steps involved, Hypothesis, Research proposals and aspects, literature survey, sources of information, review. Ethical issues and intellectual property rights | **6** |
| **II** | **Scientific Report Writing and Publication Process**: Writing of research report and synopsis (steps involved), paper writing (steps involved), review writing, report preparation, publication process, selection of journals, citation index, impact factor, h-index | **6** |
| **III** | **Data Collection and Processing Data types and collection:** qualitative and quantitative, data processing, data analysis. Sampling: types, steps involved in sampling, sample size, advantages and limitations. | **6** |
| **IV** | **Analytical tool and Techniques:**<br>Separation and purification techniques: Crystallization, distillation techniques (simple distillation, steam distillation, fractional distillation). Solvent extraction.<br>Chromatography: Principles and applications of Thin layer chromatography, Column chromatography, Gas chromatography. | **6** |
| **V** | **Material characterization and Analysis:**<br>Basic principles and applications of SEM, TEM, AFM and HPLC. | **6** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will be able; |
| **CO1** | To understand and comprehend the basics in research methodology and applying them in research/ project work. |
| **CO2** | To gain the knowledge of scientific research writing and publication process. |
| **CO3** | To develop your knowledge and skills to lead, coordinate, and support data collection, processing and sample analysis. |
| **CO4** | To acquire knowledge on the qualitative analysis of separation of binary mixture of chemical compounds and purification techniques. |
| **CO5** | To know the basic principles and applications of different physicochemical techniques. |

| **Text Books (Latest Editions)** |
|---|
| 1. Kumar, R., Research Methodology - A Step-By-Step Guide for Beginners, Pearson Education, Delhi (2006). |
| 2. Montgomery, D. C., Design & Analysis of Experiments, 5th Ed., Wiley India (2007). |
| 3. Kothari, C. K., Research Methodology-Methods and Techniques, 2nd Ed., New Age International, New Delhi. |
| 4. Skoog D. A.,and West D.M., Principles of Instrumental Analysis, East West Press, New Delhi. |
| 5. Willard H., Merit and Dean J. A., Instrumental Methods of Analysis, East west press, New Delhi. |
| **Reference Books** |
| 1. Gurdeep Chatwal, S.K. Anand, Instrumental methods of Chemical analysis, Nirmalaya publication 2013. |
| 2. Drago, R. S., Physical Methods for Chemists, Saunders Company (1999). |
| 3. Aruldas, G., Molecular Structure and Spectroscopy, 2nd Ed., Prentice Hall India (2001). |
| 4. Igwenagu C. Fundamentals of research methodology and data collection. LAP Lambert Academic Publishing; 2016. |
| 5. Kothari CR. Research methodology: Methods and techniques. New Age International; 2004. |
| **Web Resources** |
| https://ccsuniversity.ac.in/bridgelibrary/pdf/MPhil%20Stats%20Research%20Methodology-Part1.pdf |
| https://mrcet.com/downloads/digital_notes/CSE/Mtech/I%20Year/RESEARCH%20METHODLOGY.pdf |
| http://shvaiko.ru/wp-content/uploads/2010/02/Analytical-Techniques-Julia-C.-Drees-Alan-H.-B.-Wu.pdf |
| https://secwww.jhuapl.edu/techdigest/content/techdigest/pdf/V06-N03/06-03-Charles.pdf |

**Mapping with Programme Outcomes:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S | M |
| **CO2** | M | S | S | S | S | M | S | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S | S |
| **CO4** | M | S | S | S | S | M | S | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| CO /PO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Core Subject INTERNSHIP / INDUSTRIAL ACTIVITY Code: 232204309**

**SEMESTER III**

**Credit 2**

***Preamble:***

- ***To give Exposure to real world experience.***

The Students will undergo minimum 7 days of summer internship/industrial activity training in subject related organization after their second semester for PG and Fourth semester for UG examinations (Summer Vacation).

The student will be allotted a faculty for guiding the internship/industrial activity. After the completion of the internship/industrial activity, he/she has to document the work, and submit the report along with the Certificate from the concern organization (2 copies – one to the Controller's Office, one to the Department Library)

The External viva voce examination will be conducted on or before last working day of the Third semester for PG and Fifth semester for UG.

**Evaluation of internship/industrial activity**

| | Internal | External | Total |
|---|---|---|---|
| Internship Report | 15 | 50 | 65 |
| Viva | 10 | 25 | 35 |
| Total | 25 | 75 | 100 |

| **Title of the Course** | | **COORDINATION CHEMISTRY – II** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **Category** | Core - 10 | **Year** | II | **Credits** | 4 | **Course Code** | **232204401** | |
| | | **Semester** | IV | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 5 | - | -- | 5 | 25 | 75 | 100 |

**Learning Objectives**

- ✍ To recognize the fundamental concepts and structural aspects of organometallic compounds.
- ✍ To learn reactions of organometallic compounds and their catalytic behaviour.
- ✍ To identify or predict the structure of coordination compounds using spectroscopic tools.
- ✍ To understand the structure and bonding in coordination complexes.
- ✍ To evaluate the spectral characteristics of selected complexes.

| UNIT | Details | No. of Periods for the Unit |
|---|---|---|
| I | **Chemistry of organometallic compounds:** Classification of organometallic compounds based on M-C bond – 18 and 16 electron rule; Bonding in metal – olefin complexes (example: Ziese's salt), metal-acetylene and metal-allyl complexes; Metal-cyclopentadienyl complexes – Examples and MO approach to bonding in metallocenes; fluxional isomerism. Metal – carbonyl complexes: MO diagram of CO; Structure and bonding − bonding modes, MO approach of M-CO bonding, π-acceptor nature of carbonyl group, synergistic effect (stabilization of lower oxidation states of metals); Carbonyl clusters: Low nuclearity and high nuclearity carbonyl clusters – Structures based on polyhedral skeleton electron pair theory or Wade's rule. | **15** |
| II | **Reactions and catalysis of organometallic compounds:** Reactions of organometallic compounds: Oxidative addition, reductive elimination (α and β eliminations), migratory insertion reaction and metathesis reaction. Organo-metallic catalysis: Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (oxo process), oxidation of olefin (Wacker process), olefin isomerisation, water gas shift reaction, cyclo-oligomerisation of acetylenes using Reppe's catalysts, Monsonto process. | **15** |
| III | **Inorganic spectroscopy -I:** IR spectroscopy: Effect of coordination on the stretching frequency-sulphato, carbonato, sulphito, aqua, nitro, thiocyanato, cyano, thiourea, DMSO complexes; IR spectroscopy of carbonyl compounds. NMR spectroscopy- Introduction, applications of 1H, 15N, 19F, 31P-NMR spectroscopy in structural identification of inorganic complexes, fluxional molecules, quadrupolar nuclei- effect in NMR spectroscopy. | **15** |
| IV | **Inorganic spectroscopy-II:** Introductory terminologies: g and A parameters-definition, explanation and factors affecting g and A; Applications of ESR to coordination compounds with one and more than one unpaired electrons – hyperfine and secondary hyperfine splitting and Kramer's doublets; ESR spectra of V(II), Mn(II), Fe(II), Co(II), Ni(II), Cu(II) complexes, bis(salicylaldimine)copper(II) and $[(NH_3)_5Co\text{-}O_2\text{-}Co(NH_3)_5]^{5+}$. Mossbauer spectroscopy – Mossbauer effect, Recoil energy, Mossbauer active nuclei, Doppler shift, Isomer shift, quadrupole splitting and magnetic interactions. Applications of Mössbauer spectra to Fe and Sn compounds. | **15** |

| | | |
|---|---|---|
| **V** | **Photo Electron Spectroscopy:** Theory, Types, origin of fine structures - shapes of vibrational fine structures – adiabatic and vertical transitions, PES of homonuclear diatomic molecules ( $N_2$, $O_2$) and heteronuclear diatomic molecules (CO, HCl) and polyatomic molecules ($H_2O$, $CO_2$, $CH_4$, $NH_3$) – evaluation of vibrational constants of the above molecules. Koopman's theorem- applications and limitations. Optical Rotatory Dispersion – Principle of CD and ORD; Δ and λ isomers in complexes, Assignment of absolute configuration using CD and ORD techniques. | **15** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will be able; |
| **CO1** | Understand and apply 18 and 16 electron rule for organometallic compounds |
| **CO2** | Understand the structure and bonding in olefin, allyl, cyclopentadienyl and carbonyl containing organometallic compounds |
| **CO3** | Understand the reactions of organometallic compounds and apply them in |
| **CO4** | understanding the catalytic cycles |
| **CO5** | Identify / predict the structure of coordination complexes using spectroscopic tools such as IR, NMR, ESR, Mossbauer and optical rotatory dispersion studies to interpret the structure of molecules by various spectral techniques. |
| **Text Books (Latest Editions)** | |
| 1 | J E Huheey, EA Keiter, RL Keiter and OK Medhi, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson Education Inc., 2006 |
| 2 | G L Meissler and D ATarr, Inorganic Chemistry, 3rd Edition, Pearson Education Inc., 2008 |
| 3 | D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993. |
| 4 | B D Gupta and A K Elias, Basic Organometallic Chemistry: Concepts, Syntheses and Applications, University Press, 2013. |
| 5 | F. A. Cotton, G. Wilkinson.; C. A. Murillo; M. Bochmann, Advanced Inorganic Chemistry, 6th ed.; Wiley Inter-science: New York, 1988. |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
| 1 | Crabtree, Robert H. The Organometallic Chemistry of the Transition Metals. 3rd ed. New York, NY: John Wiley, 2000. |
| 2 | P Gütlich, E Bill, A X Trautwein, Mossbauer Spectroscopy and Transition Metal Chemistry: Fundamentals and Applications, 1st edition, Springer-Verlag Berlin Heidelberg, 2011. |
| 3 | Concepts and Models of Inorganic Chemistry,B. Douglas, D. McDaniel, J. Alexander, John Wiley, 1994, 3rd edn. |
| 4 | K. F. Purcell, J. C. Kotz, Inorganic Chemistry; Saunders: Philadelphia, 1976. |
| 5 | R. S. Drago, PhysicaI Methods in Chemistry; Saunders: Philadelphia, 1977. |
| **Web Resources** | |
| 1. https://archive.nptel.ac.in/courses/104/101/104101100/ | |

**Mapping with Programme Outcomes:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S | M |
| **CO2** | M | S | S | S | S | M | S | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S | S |
| **CO4** | M | S | S | S | S | M | S | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| CO /PO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | | **PHYSICAL CHEMISTRY-II** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **Category** | Core - 11 | **Year** | II | **Credits** | 4 | **Course Code** | **232204402** | |
| | | **Semester** | IV | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 4 | 1 | -- | 5 | 25 | 75 | 100 |

**Learning Objectives**

- ✍ To understand the essential characteristics of wave functions and need for the quantum mechanics.
- ✍ To know the importance of quantum mechanical models of particle in a box, rigid rotor and harmonic oscillator.
- ✍ To apply the quantum mechanics to hydrogen and polyelectronic systems
- ✍ To familiarize the symmetry in molecules and predict the point groups.
- ✍ To predict the vibrational modes, hybridization using he concepts of group theory.

| **UNIT** | **Details** | **No. of Periods for the Unit** |
|---|---|---|
| **I** | **Introduction of Quantum Mechanics**: Wave particle duality, Uncertainty principle, Particle wave and Schrodinger wave equation, wave function, properties of wave function. Properties of wave function, Normalized, Orthogonal, orthonormal, Eigen values, Eigen functions, Hermitian properties of operators. Introduction to quantum mechanics-black body radiation, photoelectric effect, hydrogen spectrum. Need for quantum mechanics, Postulates of Quantum Mechanics, Schrodinger wave equation, Time independent and time dependent | **15** |
| **II** | **Quantum models:** Particle in a box-1D, two dimensional and three-dimensional, degeneracy, application to linear conjugated molecular system, free particles, ring systems. Harmonic Oscillator-wave equation and solution, anharmonicity, force constant and its significance. Rigid Rotor-wave equation and solution, calculation of rotational constants and bond length of diatomic molecules. | **15** |
| **III** | **Applications to Hydrogen and Poly electron atoms:** Hydrogen atom and hydrogen like ions, Hamiltonian-wave equation and solutions, radial and angular functions, representation of radial distribution functions. Approximation methods –variation methods: trial wave function, variation integral and application to particle in 1D box. Perturbation method - first order applications. Hatrefock self-consistent field method, Hohenberg-Kohn theorem and Kohn-Sham equation, Helium atom-electron spin, paulis exclusion principle and Slater determination. | **15** |
| **IV** | **Group theory:** Groups, sub groups, symmetry elements, operations, classification-axial and non-axial. Dihedral point groups- $C_n$, $C_{nh}$, $D_n$, $D_{nh}$, $D_{nd}$, Td and Oh. Matrix representation and classes of symmetry operations, reducible irreducible and direct product representation. The Great orthogonality theorem – irreducible representation and reduction formula, construction of character table for $C_{2v}$, $C_{2h}$, $C_{3v}$ and $D_{2h}$ point groups. | **15** |
| **V** | **Applications of quantum and group theory:** Hydrogen Molecule-Molecular orbital theory and Heitler London (VB) treatment, Energy level diagram, Hydrogen molecule ion; Use of linear variation function and LCAO methods. Electronic conjugated system: Huckel method to Ethylene butadiene, cyclopropenyl, cyclo butadiene and Benzene. Applications of group theory to molecular vibrations, electronic spectra of ethylene. | **15** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will be able |
| **CO1** | To discuss the characteristics of wave functions and symmetry functions. |
| **CO2** | To classify the symmetry operation and wave equations. |
| **CO3** | To apply the concept of quantum mechanics and group theory to predict the electronic structure. |
| **CO4** | To specify the appropriate irreducible representations for theoretical applications. |
| **CO5** | To develop skills in evaluating the energies of molecular spectra. |

| **Text Books (Latest Editions)** | |
|---|---|
| 1 | R.K. Prasad, Quantum Chemistry, New Age International Publishers, New Delhi, 2010, 4th revised edition. |
| 2 | F. A. Cotton, Chemical Applications of Group Theory, John Wiley & Sons, 2003, 2nd edition. |
| 3 | A. Vincent, Molecular Symmetry and Group Theory. A Programmed Introduction to Chemical Applications, John and Willy & Sons Ltd., 2013, 2nd Edition. |
| 4 | T. Engel & Philip Reid, Quantum Chemistry and Spectroscopy, Pearson, New Delhi, 2018, 4th edition. |
| 5 | G. K. Vemulapalli, Physical Chemistry, Prentice Hall of India Pvt. Ltd. 2001. 6. D.A. McQuarrie, Quantum Chemistry, Viva Books PW. Ltd, 2013, 2nd edition. |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
| 1 | N. Levine, Quantum Chemistry, Allyn& Bacon Inc, 1983, 4th edition. |
| 2 | D.A. McQuarrie and J. D. Simon, Physical Chemistry, A Molecular Approach, Viva Books Pvt. Ltd, New Delhi, 2012. |
| 3 | R. P. Rastogi & V. K. Srivastava, An Introduction to Quantum Mechanics of Chemical Systems, Oxford & IBH Publishing Co., New Delhi, 1999. |
| 4 | R.L. Flurry. Jr, Symmetry Group Theory and Chemical applications, Prentice Hall. Inc, 1980 |
| 5 | J. M. Hollas, Symmetry in Molecules, Chapman and Hall, London, 2011, Reprint. |
| **Web Resources** | |
| 1. https://nptel.ac.in/courses/104101124<br>2. https://ipc.iisc.ac.in/~kls/teaching.html | |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S | M |
| **CO2** | M | S | S | S | S | M | S | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S | S |
| **CO4** | M | S | S | S | S | M | S | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |

| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
|---|---|---|---|---|---|

| **Title of the Course** | **ANALYTICAL INSTRUMENTATION TECHNIQUES PRACTICALS** |
|---|---|
| | |

| **Category** | Core - 12 | **Year** | II | **Credits** | 4 | **Course Code** | **232204403** |
|---|---|---|---|---|---|---|---|
| | | **Semester** | IV | | | | |

| **Instructional Hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
|---|---|---|---|---|---|---|---|
| | - | - | 5 | 5 | 25 | 75 | 100 |

**Learning Objectives**

- ✍ To design chromatographic methods for identification of species.
- ✍ To analyze different constituents through instrumental methods of analysis.
- ✍ To evaluate different contaminants in materials using turbidimetry and conductivity measurements.
- ✍ To design experiments for analysis of inorganic and organic materials.
- ✍ To analyze constituents in materials using emission and absorption techniques.

**Experiment**

1. Determination of the equivalent conductance of a weak acid at different concentrations and verifying Ostwald dilution law. Calculation of the dissociation constant of the acid.
2. Determination of the equivalent conductance of a strong electrolyte at different concentrations and examining the validity of the Onsager's theory as limiting law at high dilutions.
3. Conductometric titration of a mixture of HCl and $CH_3COOH$ Vs NaOH.
4. Conductometric titration of $NH_4Cl$ Vs NaOH.
5. Conductometric titration of $CH_3COONa$ Vs HCl.
6. Potentiometric titration of a mixture of HCl and $CH_3COOH$ Vs NaOH
7. Determination of $pK_a$ of weak acid by EMF method.
8. Potentiometric titration of FAS Vs $K_2Cr_2O_7$
9. Potentiometric titration of KI Vs $KMnO_4$.
10. Potentiometric titration of a mixture of Chloride and Iodide Vs $AgNO_3$.
11. Determination of the pH of buffer solution by EMF method using Quinhydrone and Calomel electrode.

Study of the inversion of cane sugar in the presence of acid by Polarimetric method.

1. Estimation of Fe, Cu and Ni by colorimetric method.
2. Estimation of Na and K by flame photometric method.
3. Determination of spectrophotometrically the mole ratio of the ferrithiocyanate complex and equilibrium constant for the complex formation.
4. Determination of the amount (mol/L) of ferricyanide present in the given solution using cyclic voltammetry.
5. Determination of the diffusion coefficient of ferricyanide using cyclic voltammetry.
6. Determination of the standard redox potential of ferri-ferrocyanide redox couple using cyclic voltammetry.
7. Estimation of the amount of sulphate present in the given solution using Nephelometric turbidimeter.
8. Estimation of the amount of nitrate present in the given solution using spectrophotometric method.
9. Heavy metal analysis in textiles and textile dyes by AAS
10. Determination of caffeine in soft drinks by HPLC
11. Analysis of water quality through COD, DO, BOD measurements.
12. Assay of Riboflavin and Iron in tablet formulations by spectrophotometry
13. Estimation of chromium in steel sample by spectrophotometry
14. Determination of Stern-Volmer constant of Iodine quenching by fluorimetry
15. Determination of ascorbic acid in real samples using Differential Pulse Voltammetry and

| |
|---|
| comparing with specifications<br>16. Separation of (a) mixture of Azo dyes by TLC (b) mixture of metal ions by Paper chromatography<br>17. Estimation of chlorophyll in leaves and phosphate in waste water by colorimetry.<br>18. Estimation of Fe(II) by 1,10 phenonthroline using spectrophotometry |
| |

| **Course Outcomes** | On completion of this course, students will; |
|---|---|
| **CO1** | To recall the principles associated with various inorganic organic and physical chemistry experiments |
| **CO2** | To scientifically plan and perform all the experiments |
| **CO3** | To observe and record systematically the readings in all the experiments |
| **CO4** | To calculate and process the experimentally measured values and compare with graphical data. |
| **CO5** | To interpret the experimental data scientifically to improve students efficiency for societal developments. |

| **Text Books (Latest Editions)** | |
|---|---|
| 1 | Vogel's Text book of Practical Organic Chemistry, 5th Ed, ELBS/Longman, England, 2003 |
| 2 | G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denney, *Vogel's Textbook of Quantitative Chemical Analysis*; 6th ed., ELBS, 1989. |
| 3 | J. D. Woollins, *Inorganic Experiments*; VCH: Weinheim, 1995 |
| 4 | B. Viswanathan and P.S.Raghavan, Practical Physical Chemistry, Viva Books, New Delhi, 2009. |
| 5 | Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S.Viswanathan Co. Pvt., 1996. |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
| 1 | N. S. Gnanapragasam and G. Ramamurthy, Organic Chemistry – Labmanual, S. Viswanathan Co. Pvt. Ltd, 2009. |
| 2 | J. N. Gurtu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 2011. |
| 3 | J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2001. |
| 4 | G.W. Garland, J.W. Nibler, D.P. Shoemaker, Experiments in Physical Chemistry, 8th edition, McGraw Hill, 2009. |
| 5 | J. N. Gurthu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987. |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S | M |
| **CO2** | M | S | S | S | S | M | S | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S | S |
| **CO4** | M | S | S | S | S | M | S | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Core** **PROJECT WITH VIVA VOCE** **Code: 212204404**

**SEMESTER IV** **5 Hrs / Credits 3**

Post Graduate students of Chemistry will do projects under the guidance of staff members of chemistry during IV semester. The projects will be on chemistry and chemistry related fields. The project diary signed by the project guide and HOD must be submitted in the month of April. The Viva on Project will be conducted jointly by the guide, external examiner and the HOD.

| | Internal | External |
|---|---|---|
| Project | 15 | 50 |
| Viva | 10 | 25 |

| **Title of the Course** | | **POLYMER CHEMISTRY** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **Category** | EC – 6.1 | **Year** | II | **Credits** | 4 | **Course Code** | **232204405** | |
| | | **Semester** | III | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 4 | - | -- | 4 | 25 | 75 | 100 |

**Learning Objectives**

- ✍ To learn the basic concepts and bonding in polymers.
- ✍ To explain various types of polymerization reactions and kinetics.
- ✍ To understand the importance of industrial polymers and their synthetic uses.
- ✍ To determine the molecular weight of polymers.
- ✍ To predict the degradation of polymers and conductivities.

| **UNIT** | **Details** | **No. of Periods for the Unit** |
|---|---|---|
| **I** | **Characterization, Molecular weight and its Determination:** Primary and secondary bond forces in polymers; cohesive energy, molecular structure, chemical tests, thermal methods, Tg, molecular distribution, stability. Determination of Molecular mass of polymers: Number Average molecular mass ($M_n$) and Weight average molecular mass ($M_w$) of polymers. Molecular weight determination of high polymers by physical and methods. | **12** |
| **II** | **Mechanism and kinetics of Polymerization:** Chain growth polymerization: Cationic, anionic, free radical polymerization, Stereo regular polymers: Ziegler Natta polymerization. Reaction kinetics. Step growth polymerization, Degree of polymerization. | **12** |
| **III** | **Techniques of Polymerization and Polymer Degradation:** Bulk, Solution, Emulsion, Suspension, solid, interfacial and gas phase polymerization. Types of Polymer Degradation, Thermal degradation, mechanical degradation, photodegradation, Photo stabilizers, Solid and gas phase polymerization. | **12** |
| **IV** | **Industrial Polymers:** Preparation of fibre forming polymers, elastomeric material. Thermoplastics: Polyethylene, Polypropylene, polystyrene, Polyacrylonitrile, Poly Vinyl Chloride, Poly tetrafluoro ethylene, nylon and polyester. Thermosetting Plastics: Phenol formaldehyde and expoxide resin. Elastomers: Natural rubber and synthetic rubber - Buna - N, Buna-S and neoprene. Conducting Polymers: Elementary ideas; examples: poly sulphur nitriles, poly phenylene, poly pyrrole and poly acetylene. Polymethylmethacrylate, polyimides, polyamides, polyurethanes, polyureas, polyethylene and polypropylene glycols. | **12** |
| **V** | **Polymer Processing:** Compounding: Polymer Additives: Fillers, Plasticizers, antioxidants, thermal stabilizers, fire retardants and colourants. Processing Techniques: Calendaring, die casting, compression moulding, injection moulding, blow moulding and reinforcing. Film casting, Thermofoaming, Foaming. Catalysis and catalysts – Polymerization catalysis, catalyst support, clay compounds, basic catalyst, auto-exhaust catalysis, vanadium, heterogeneous catalysis and active centres. | **12** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will be able |
| **CO1** | To understand the bonding in polymers. |
| **CO2** | To scientifically plan and perform the various polymerization reactions. |
| **CO3** | To observe and record the processing of polymers. |
| **CO4** | To calculate the molecular weight by physical and chemical methods. |
| **CO5** | To interpret the experimental data scientifically to improve the quality of synthetic polymers. |
| **Text Books (Latest Editions)** | |
| 1 | V.R. Gowariker, *Polymer Science*, Wiley Eastern, 1995. |
| 2 | G.S. Misra, *Introductory Polymer Chemistry*, New Age International (Pvt) Limited, 1996. |
| 3 | M.S. Bhatnagar, A Text Book of Polymers, vol-I & II, S.Chand & Company, New Delhi, 2004. |
| **References Books (Latest editions, and the style as given below must be strictly adhered to)** | |
| 1 | F. N. Billmeyer, *Textbook of Polymer Science*, Wiley Interscience, 1971. |
| 2 | A. Kumar and S. K. Gupta, *Fundamentals and Polymer Science and Engineering*, Tata McGraw-Hill, 1978. |

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S | M |
| **CO2** | M | S | S | S | S | M | S | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S | S |
| **CO4** | M | S | S | S | S | M | S | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| **CO /PO** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | | **CHEMINFORMATICS** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **Category** | EC – 6.2 | **Year** | II | **Credits** | 4 | **Course Code** | **232204406** | |
| | | **Semester** | III | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 4 | - | -- | 4 | 25 | 75 | 100 |

**Learning Objectives**

- ***To improve the knowledge of chemical structure representation and Chemoinformatics tools for drug discovery***
- ***This subject will help to understand the basic concept of chemoinformatics***

| **UNIT** | **Details** | **No. of Periods for the Unit** |
|---|---|---|
| **I** | Computer Representation of Molecules in Databases: Molecular models – Chem draw – Connection table – Linear notation – Canonical representation – Substructure – Sub graph isomerism based finger print. | **12** |
| **II** | Chemical Information – An Introduction: History of Scientific Information – Periodic table – Homologous series – Concepts in Chemistry – Internet test servers – Molecular formats and MIME. | **12** |
| **III** | Computer Sources of Chemical Information: Communication – WWW – URLS – Chemistry on website – Chemical literature – Secondary literature. | **12** |
| **IV** | Chemical Information Searches: Searching skills – Strategies – Advantages and disadvantages – CAS – Keyword search – Chemical abstract – Flow of chemical information and computer searching. | **12** |
| **V** | Application of Cheminformatics: Chemical databases – 2D substructure searching – 3D database searching – Generation and retrieval – Use of QSAR and combinatorial library in drug design. | **12** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will be able |
| **CO1** | To understand the Molecular models |
| **CO2** | To scientifically plan and perform the various analysis of Chemical Information |
| **CO3** | To understand the Chemical literature. |
| **CO4** | To identify the chemical information and computer searching. |
| **CO5** | To interpret the experimental data scientifically to improve the quality of drug design. |

**Text Books (Latest Editions)**

Handbook of Chemoinformatics, volume 1, by John Gastiger, Thomas Engel, WILEYVCH pub 2003.

**References Books**
**(Latest editions, and the style as given below must be strictly adhered to)**


1. Andrew R.Leach, Molecular Modelling, Principles and Applications, 2nd Edition, Dorset Press, Dorchester, Dorset, 2001.
2. An Introduction to Chemoinformatics, by Andrew R. Leach & Valerie j. Gillet, Springer.
3. Instant Notes in Medicinal Chemistry, by G. Patrick, BIOS Scientific pub.

**Mapping with Programme Outcomes:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | M | S | S | S | S | M |
| **CO2** | M | S | S | S | S | M | S | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S | S |
| **CO4** | M | S | S | S | S | M | S | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S | S |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| CO /PO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | | **CHEMISTRY OF NATURAL PRODUCTS** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **B** | | | | | | |
| **Category** | SEC 4 | **Year** | II | **Credits** | 2 | **Course Code** | **232204407** | |
| | | **Semester** | IV | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | 4 | -- | -- | 4 | 25 | 75 | 100 |

**Learning Objectives**

- ✍ To learn the basic concepts and biological importance of biomolecules and natural products.
- ✍ To elucidate the structure determination of biomolecules and natural products.
- ✍ Explain the fundamentals of UV-Vis and IR spectroscopy.
- ✍ Make use of the basic principles underlying NMR and mass spectroscopy and its application in structural elucidation.

| **UNIT** | **Details** | **No. of Periods for the Unit** |
|---|---|---|
| **I** | A**lkaloids and Terpenoids:**<br>**a)** A**lkaloids:**Introduction, occurrence, classification, isolation and functions ofalkaloids. Classification, general methods of structurallelucidation. Chemical methods of structure determination of Quinine and Morphine.<br>**Terpenoids:**Introduction, occurrence, Isoprene rule,classification. General methods of determiningstructure. Structure determination of Camphor, Abietic acid, Cadinene and Zingiberine. | **12** |
| **II** | **Anthocyanines, flavones, Purines and Steroids:**<br>a) **Anthocyanines andflavones:** Introduction toanthocyanines. Structure and synthesis ofanthocyanines, Cyanidine chloride: structure and determination. Flavones: Structure and determination of Quercetin.<br>**b) PurinesandSteroids:** Introduction, Cccurrence and isolation of purines. Classification and spectral properties of steroids. Structure and synthesis of Uric acid and Caffeine. Steroids: Diels' hydrocarbon, biological importance, colour reactions of sterols, cholesterol-occurrence, tests, physiological activity, biosynthesis of cholesterol from squalene. | **12** |
| **III** | **Spectroscopy:**<br>a) **UV Spectroscopy** – introduction – electronic transition – Wood Ward rules – calculation of Xmax of Conjugated Dienes, αβ – Unsaturated Carbonyl Compounds and aromatic compounds – study of in cis – trans isomers – Tautomers –axial and equatorial α haloketones – charge transfer complexes..<br>**b) IR Spectroscopy** – finger print region Molecular Vibrations – Fermi resonance to over tones Vibrational Frequency – Factors Influencing Group Frequencies – study of hydrogen bonding. | **12** |
| **IV** | **Mass Spectroscopy:**<br>Mass Spectroscopy: Principle, Type of ions, Base Peak, Parent ion, Metastable ion and Isotopic ions Nitrogen rule, Fragmentation, General Rules, Pattern of Fragmentation for Various classes of Compounds, McLafferety Rearrangement – Retro Diels – Alder Reaction. | **12** |

| | | |
|---|---|---|
| **V** | **NMR Spectroscopy:**<br>a) $^{1}H$ – NMR Origin of NMR Spectra, Chemical Shift. Spin – Spin Coupling, Coupling Constant, First Order and Second Order Spin – Spin Splitting, Influence of Stereochemical Factors on Chemical Shift of Protons, Simplification of Complex Spectra, Spin Decoupling – Double Resonance, Shift Reagents, CIDNP.<br>b) $^{13}C$ – NMR Spectroscopy, Basic Principle of FT Technique, Assignment of the Signals – broad band decoupling Off, Resonance Decoupling<br>**c)** 2D NMR techniques– COSY, HETCOR, NOESY, INADEQUATE. Structural Problems based on all the above Techniques. | **12** |

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will be able; |
| **CO1** | To understand the biological importance of chemistry of natural products. |
| **CO2** | To scientifically plan and perform the isolation and characterization of synthesized natural products. |
| **CO3** | To explain the fundamental concepts of UV-Vis and IR spectroscopy and analyze their application in simple molecules |
| **CO4** | To understand the basic concept of mass spectroscopy. |
| **CO5** | To explain the theories of NMR spectroscopy of organic molecule. |

| **Text Books (Latest Editions)** |
|---|
| 1. G. K. Chatwal, Organic Chemistry on Natural Products, Vol. 1, Himalaya Publishing House, Mumbai, 2009.<br>2. G. K. Chatwal, Organic Chemistry on Natural Products, Vol. 2, Himalaya Publishing House, Mumbai,2009.<br>3. Dyer J.R., Application of Absorption Spectroscopy, 2nd Edition, Prentice–Hall, Hampshire, 1965.<br>4. Howe I., Williams D.H. and Bowen R.D., Mass Spectrometry, Principles and Applications McGraw Hill, 2nd Edition, New Delhi, 1981.<br>5. Kemp, Organic Spectroscopy, ELBS, 3rd Edition, Hampshire, UK, 1987. |
| **References Books**<br>**(Latest editions, and the style as given below must be strictly adhered to)** |
| 1. L. Finar, Organic Chemistry Vol-2, 5thedition,PearsonEducation Asia, 1975. |
| 2. L. Finar, Organic Chemistry Vol-1, 6thedition, Pearson Education Asia,2004. |
| 3. Silverstein B.M., Bassler G.C., and Morrill T.C., Spectrometric Identification of Organic Compounds. Wiley, 5thEditionn., New York, 1963. |
| 4. Morrison R.T., and Boyd R.N., Organic Chemistry, Prentice–Hall, 6th Edition, New Delhi, 1995. |
| **Web Resources** |
| 1. https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic |

**Mapping with Programme Outcomes:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 |
|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **S** | **M** | **S** |
| **CO2** | **S** | **S** | **S** | **M** | **S** |
| **CO3** | **S** | **S** | **M** | **M** | **S** |
| **CO4** | **S** | **M** | **M** | **M** | **S** |
| **CO5** | **S** | **M** | **M** | **M** | **S** |

**3 – Strong, 2 – Medium , 1 - Low**

**Mapping with Programme Specific Outcomes:**

| CO /PO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

| **Title of the Course** | | **INTERPRETATION AND IDENTIFICATION OF CHEMICAL COMPOUNDS** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **Category** | AECC 4 | **Year** | II | **Credits** | 2 | **Course Code** | **232204408** | |
| | | **Semester** | IV | | | | | |
| **Instructional Hours per week** | | **Lecture** | **Tutorial** | **Lab Practice** | **Total** | **CIA** | **External** | **Total** |
| | | - | -- | 2 | 2 | 25 | 75 | 100 |
| **Prerequisites** | | **Basic knowledge of chemistry** | | | | | | |

**Learning Objectives**

- ✍ To analyze constituents in the material using emission and absorption techniques.

**Experiment**

**Interpretation and identification of the given spectra of various chemical compounds arrived at the following instruments**

**1.UV-Visible**
**2. IR**
**3.Raman**
**4. Mass**
**5.ESR**
**6. NMR**

| **Course Outcomes** | |
|---|---|
| **Course Outcomes** | On completion of this course, students will be able; |
| **CO1** | To interpret the experimental data scientifically to improve the students efficiency for social developments. |

**Text Books (Latest Editions)**


1. Robert silverstein & Francis webster , spectrometric identification of organic compounds, 6th ed, john wiley & sons, 2006.
2. Hamming M, editor. Interpretation of mass spectra of organic compounds. Elsevier; 2012 Dec 2.
3. Jacobsen NE. NMR data interpretation explained: understanding 1D and 2D NMR spectra of organic compounds and natural products. John Wiley & Sons; 2016 Oct 31.
4. Mabbs FE, Collison D. Electron paramagnetic resonance of d transition metal compounds. Elsevier; 2013 Oct 22.
5. Larkin P. Infrared and Raman spectroscopy: principles and spectral interpretation. Elsevier; 2017 Nov 13.


**Web Resources**

1. https://www.wiley.com/en-us/Interpretation+of+Organic+Spectra-p-9780470825167
2. https://search.worldcat.org/title/Interpreting-spectra-of-organic-molecules/oclc/19639258

**Mapping with Programme Outcomes:**

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO10** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | S | S | S | M | S | S | S | S | M |
| **CO2** | M | S | S | S | S | M | S | S | S | S |
| **CO3** | S | S | M | S | S | S | S | M | S | S |
| **CO4** | M | S | S | S | S | M | S | S | S | S |
| **CO5** | M | S | M | S | S | M | S | M | S | S |

**3 – Strong, 2 – Medium , 1 – Low**

## EXTENSION ACTIVITY

**Course Code: 232204409**

**Credit: 1**

The Students should undergo any of the following activities during the period of the program (Two Years) outside the college or in any other institutions. This Extension Activity will be evaluated through the certificate (minimum one) submitted by the students. As per the norms, students must carry out any one of the activity for obtaining the PG Degree. The concern Head of the Department will evaluate the students and submit the report to the Controller of Examinations at the end of the IV semester.

**List of Extension Activity:**

a) Conducting rally, awareness program etc.

b) Seed ball, tree plantation, cleaning work etc.

c) Blood donation, medical camp, organ donation etc.

d) Assisting school children, tribals, and illiterate in learning.

e) Giving assistance to orphanages and old age homes and patients.

f) Awareness program on financial literacy, gender equality, women education etc.

Any other activities which are relevant to develop nearby localities.