# SEMESTER-I

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|---|---|---|---|---|---|---|---|
| **Title of the Course** | **ORGANIC REACTION MECHANISM – I** | | | | | | |
| **Paper No.** | **Core I** | | | | | | |
| **Category** | **Core** | **Year** | I | **Credits** | 4 | **Course Code** | |
| | | **Semester** | I | | | | |
| **Instructional hours per Week** | **Lecture** | **Tutorial** | **Lab Practice** | | | **Total** | |
| | 4 | 1 | - | | | 5 | |
| **Prerequisites** | Basic concepts of organic chemistry | | | | | | |
| **Objectives ofthe course** | To understand the feasibility and the mechanism of various organic reactions.<br>To comprehend the techniques in the determination of reaction mechanisms.<br>To understand the concept of stereochemistry involved in organic compounds.<br>To correlate and appreciate the differences involved in the various typesof organic reaction mechanisms.<br>To design feasible synthetic routes for the preparation of organic compounds. | | | | | | |

**Course Outline**

**UNIT-I: Methods of Determination of Reaction Mechanism:**

Reaction intermediates. The transition state, Reaction coordinate diagrams, Thermodynamic and kinetic requirements of reactions: Hammond postulate. Methods of determining mechanism: non-kinetic methods – product analysis, determination of intermediates-isolation, detection, and trapping. Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism. Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, partial rate factor, substituent and reaction constants.

**UNIT-II:Aromatic and Aliphatic Electrophilic Substitution:**

Aromaticity: Aromaticity in benzenoid, non-benzenoid, heterocycliccompounds and annulenes. Aromatic electrophilic substitution: Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene.

Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling; Sulphur electrophiles: sulphonation; Halogen electrophiles: chlorination and bromination; Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions. Aliphaticelectrophilic substitution Mechanisms: $S_E2$ and $S_Ei$, $S_E1$- Mechanism and evidences.

**UNIT-III**: **Aromatic and Aliphatic Nucleophilic Substitution:**

Aromatic nucleophilic substitution: Mechanisms - $S_NAr$, $S_N1$ and Benzyne mechanisms - Evidences - Reactivity, Effect of structure, leaving group and attacking nucleophile. Reactions: Oxygen and Sulphur-nucleophiles, Bucherer and Rosenmund reactions, von

Richter, Sommelet- Hauser and Smiles rearrangements. $S_N1$, ion pair, $S_N2$ mechanisms and evidences.

Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon. $S_N1$, $S_N2$, $S_Ni$, and $S_E1$ mechanism and evidences.

**UNIT-IV: Stereochemistry-I:**

Introduction to molecular symmetry and chirality – axis, plane, centre, alternating axis of symmetry. Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centres. Optical purity, prochirality, enantiotopic and diastereotopic atoms, groups, faces, axial and planar chirality, chirality due to helical shapes, methods of determining the configuration. Racemic modifications: Racemization by thermal, anion, cation, reversible formation, epimerization, muta rotation. D, L system, R and S nomenclature of simple compounds – allenes, spiranes, biphenyls, cyclooctene, helicene. Asymmetric Synthesis - Crams rule. Stereoselective and stereospecific synthesis.

**UNIT-V: Stereochemistry-II**

Conformation and reactivity of acyclic systems, intramolecular rearrangements, neighbouring group participation, chemical consequence of conformational equilibrium. Stability of five and six-membered rings: mono-, di- and polysubstituted cyclohexanes, conformation and reactivity in cyclohexane systems. Fused and bridged rings: bicyclic, polycyclic, decalins and Brett's rule. Optical rotation and optical rotatory dispersion, conformational asymmetry, ORD curves, octant rule, configuration and conformation.

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| Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved<br>(To be discussed during the Tutorial hours) |
| Skills acquired from this Course | Knowledge, Problem solving, Analytical ability, Professional Competency,Professional Communication and Transferable skills. |
| **Recommended Text** | 1. J. March and M. Smith, Advanced Organic Chemistry, 5th edition,John-Wiley and Sons.2001.<br>2. E. S. Gould, Mechanism and Structure in Organic Chemistry, Holt,Rinehart and Winston Inc., 1959.<br>3. P.S.Kalsi, Stereochemistry of carbon compounds, 8th edition, NewAge International Publishers, 2015.<br>4. P. Y. Bruice, Organic Chemistry, 7th edn, Prentice Hall, 2013.<br>5. J.Clayden, N. Greeves, S. Warren, Organic Compounds, 2nd edition,Oxford University Press, 2014. |

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| **Reference Books** | 1. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5th edition, Kluwer Academic / Plenum Publishers, 2007.<br>2. D. G. Morris, Stereochemistry, RSC Tutorial Chemistry Text 1, 2001.<br>3. N.S. Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, 1987.<br>4. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 2000.<br>5. I. L. Finar, Organic chemistry, Vol-1&2, 6th edition, PearsonEducation Asia, 2004. |
| **Website and e-learning source** | 1. https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic<br>2. https://www.organic-chemistry.org/ |

**Course Learning Outcomes (for Mapping with POs and PSOs)**

Students will be able

**CLO1**: To recall the basic principles of organic chemistry.

**CLO2**: To understand the formation and detection of reaction intermediates of organic reactions.

**CLO3**: To predict the reaction mechanism of organic reactions and stereochemistry of organic compounds.

**CLO4**: To apply the principles of kinetic and non-kinetic methods to determine the mechanism of reactions.

**CLO5**: To design and synthesize new organic compounds by correlating the stereochemistry of organic compounds.

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | S | S | S | S | M | S | S | S | S | M |
| **CO 2** | M | S | S | S | S | M | S | S | S | S |
| **CO 3** | S | S | M | S | S | S | S | M | S | S |
| **CO 4** | M | S | S | S | S | M | S | S | S | S |
| **CO 5** | M | S | M | S | S | M | S | M | S | S |

**Strong – 3,Medium-2, Low-1**

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

| 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 |

**3 – Strong, 2 – Medium, 1 – Low**

| Methods of Evaluation | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |

| Methods of Assessment | |
|---|---|
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions. |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, short summary or overview. |
| **Application (K3)** | Suggest idea/concept with examples, suggest formulae, solve problems, Observe, Explain. |
| **Analyze (K4)** | Problem-solving questions, finish a procedure in many steps, Differentiate between various ideas, Map knowledge. |
| **Evaluate(K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons. |
| **Create (K6)** | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations. |

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom'sTaxonomy Verbs used to describe your course outcome.

- ☐ Remember and Understanding – Lower level
- ☐ Apply and Analyze – Medium Level
- ☐ Evaluate and Create – Strong Level

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|---|---|---|---|---|---|---|---|
| **Title of the Course** | **STRUCTURE AND BONDING IN INORGANIC COMPOUNDS** | | | | | | |
| **Paper No.** | **Core II** | | | | | | |
| **Category** | **Core** | **Year** | I | **Credits** | 4 | **Course Code** | |
| | | **Semester** | I | | | | |
| **Instructional hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | | | **Total** | |
| | 4 | 1 | - | | | 5 | |
| **Prerequisites** | **Basic concepts of Inorganic Chemistry** | | | | | | |
| **Objectives of the course** | To determine the structural properties of main group compounds and clusters.<br>To gain fundamental knowledge on the structural aspects of ionic crystals<br>To familiarize various diffraction and microscopic techniques.<br>To study the effect of point defects and line defects in ionic crystals. '<br>To evaluate the structural aspects of solids. | | | | | | |

**Course Outline**

**UNIT-I: Structure of main group compounds and clusters:**

VB theory – Effect of lone pair and electronegativity of atoms (Bent's rule) on the geometry of the molecules; Structure of silicates - applications of Pauling's rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three-dimensional silicates. Structure of silicones, Structural and bonding features of B-N, S-N and P-N compounds; Poly acids – types, examples and structures; Borane cluster: Structural features of closo, nido, arachano; carboranes, hetero and metalloboranes; Wade's rule to predict the structure of Borane cluster; main group clusters.

**UNIT-II: Solid state chemistry – I:** Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice,Radius ratio, Crystal systems and Bravais lattices, Symmetry operationsin crystals, glide planes and screw axis; point group and space group; Solid state energetics: Lattice energy – Born-Lande equation - Kapustinski equation, Madelung constant.

**UNIT-III:Solid state chemistry – II:** Structural features of the crystal systems: Rock salt, zinc blende & wurtzite, fluorite and anti-fluorite, rutile and anatase, cadmium iodide and nickel arsenide; Spinels -normaland inverse types and perovskite structures. Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and examples.

**UNIT-IV:Techniques in solid state chemistry:** X-ray diffraction technique: Bragg's law, Powder diffraction method – Principle and Instrumentation; Interpretation of XRD data, Phase purity, lattice constants calculation; Systematic absence of reflections; Electron diffraction technique – principle, instrumentation and application. Electron microscopy – difference between optical and electron microscopy, theory, principle, instrumentation, sampling methods and applications of SEM and TEM.

**UNIT-V:Band theory and defects in solids:** Band theory – features and its application of conductors, insulators and semiconductors, Intrinsic and extrinsic semiconductors; Defects in crystals – point defects (Schottky, Frenkel, metal excess and metal deficient) and their effect on the electrical and optical property, laser and phosphors; Linear defects and its effects due to dislocations.

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| Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC othersto be solved<br>(To be discussed during the Tutorial hours) |
| Skills acquired from this course | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |
| **Recommended Text** | 1. A R West, Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd., 2014.<br>2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001.<br>3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012.<br>4. K. F. Purcell and J. C. Kotz, Inorganic Chemistry; W.B. Saunders company: Philadelphia, 1977.<br>5. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry; 4th ed.; Harper and Row: NewYork, 1983. |
| **Reference Books** | 1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994.<br>2. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013.<br>3. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199.<br>4. T. Moeller, Inorganic Chemistry, A Modern Introduction; John Wiley: New York, 1982.<br>5. D. F. Shriver, P. W. Atkins and C.H. Langford; Inorganic Chemistry; 3rd ed.; Oxford University Press: London, 2001. |
| **Website and e-learning source** | https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/ |

**Course Learning Outcomes (for Mapping with POs and PSOs)**

Students will be able

**CO1**: Predict the geometry of main group compounds and clusters.
**CO2**: Explain about the packing of ions in crystals and apply the radius ratio rule to predictthe coordination number of cations.
**CO3**: Understand the various types of ionic crystal systems and analyze their structuralfeatures.
**CO4**: Explain the crystal growth methods.
**CO5**:To understand the principles of diffraction techniques and microscopic techniques.

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO 7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** |
| **CO 2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 3** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** |
| **CO 4** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 5** | **M** | **S** | **M** | **S** | **S** | **M** | **S** | **M** | **S** | **S** |

**3 – Strong, 2 – Medium, 1 - Low**

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

| 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 |

**3 – Strong, 2 – Medium, 1 - Low**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Title of the Course** | **ORGANIC CHEMISTRY PRACTICAL** | | | | | | |
| **Paper No.** | **Core III** | | | | | | |
| **Category** | **Core** | **Year** | I | **Credits** | 4 | **Course Code** | |
| | | **Semester** | I | | | | |
| **Instructional hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | | | **Total** | |
| | - | 1 | 5 | | | 6 | |
| **Prerequisites** | **Basic concepts of organic chemistry** | | | | | | |
| **Objectives of the course** | To understand the concept of separation, qualitative analysis and preparation of organic compounds.<br>To develop analytical skill in the handling of chemical reagents for separation of binary and ternary organic mixtures.<br>To analyze the separated organic components systematically and derivatize them suitably.<br>To construct suitable experimental setup for the organic preparations involving two stages.<br>To experiment different purification and drying techniques for the compound processing. | | | | | | |

**Course Outline**

**UNIT-I:Separation and analysis:**

Two component mixtures,

Ternary component (Demo)

**UNIT-II:Estimations:**

a) Estimation of Phenol (bromination)
b) Estimation of Aniline (bromination)
c) Estimation of Ethyl methyl ketone (iodimetry)
d) Estimation of Glucose (redox)
e) Estimation of Ascorbic acid (iodimetry)

**UNIT-III: Two stage preparations:**

a) p-Bromoacetanilide from aniline
b) p-Nitroaniline from acetanilide
c) 1,3,5-Tribromobenzene from aniline
d) Acetyl salicyclic acid from methyl salicylate
e) Benzilic acid from benzoin
f) m-Nitroaniline from nitrobenzene
g) m-Nitrobenzoic acid from methyl benzoate
h) Benanilide from benzophenone

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| Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved<br>(To be discussed during the Tutorial hours) |

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|---|---|
| Skills acquired from this course | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |

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|---|---|
| **Recommended Text** | 1. A R West, Solid state Chemistry and its applications, 2nd Edition (Students Edition), John Wiley & Sons Ltd., 2014.<br>2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001.<br>3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012. |
| **Reference Books** | 1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994.<br>2. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013.<br>3. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199. |
| **Website and e-learning source** | https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/ |

**Course Learning Outcomes (for Mapping with POs and PSOs)**
Students will be able:

**CO1**: To recall the basic principles of organic separation, qualitative analysis and preparation.
**CO2**: To explain the method of separation and analysis of separated organic mixtures and convert them as derivatives by suitable preparation method.
**CO3**: To determine the characteristics of separation of organic compounds by variouschemical reactions.
**CO4**: To develop strategies to separate, analyze and prepare organic compounds.
**CO5**:To formulate a method of separation, analysis of organic mixtures and design suitableprocedure for organic preparations.

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | S | S | S | S | M | S | S | S | S | M |
| CO 2 | M | S | S | S | S | M | S | S | S | S |
| CO 3 | S | S | M | S | S | S | S | M | S | S |
| CO 4 | M | S | S | S | S | M | S | S | S | S |
| CO 5 | M | S | M | S | S | M | S | M | S | S |

**3 – Strong, 2 – Medium, 1 - Low**

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

| 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 CourseContribution to Pos** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**3 – Strong, 2 – Medium, 1 - Low**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Title of the Course** | **a). ELECTRO & PHOTOCHEMISTRY** | | | | | | |
| **Paper No.** | **Elective I** | | | | | | |
| **Category** | **Elective** | **Year** | I | **Credits** | 4 | **Course Code** | |
| | | **Semester** | I | | | | |
| **Instructional hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | | | **Total** | |
| | 4 | 1 | - | | | 5 | |
| **Prerequisites** | Basic knowledge of electrochemistry | | | | | | |
| **Objectives of thecourse** | To study the behaviour of electrolytes in solution and compare the structures of electrical double layer of different models.<br>To have knowledge on storage devices and electrochemical reaction mechanism.<br>To understand the Basic concepts of Photochemistry. | | | | | | |

**Course Outline**

**UNIT-I: Ionics**: Concept of ionic strength, Ionic activity, mean ionic activity and mean ionic activity coefficient- Activity coefficient of strong electrolytes, Determination of activity coefficient by Electrochemical method. Concept of ion-solvent and ion-ion interactions. Born Model.

Debye-Huckel limiting law - Derivation - Qualitative and Quantitative verification - Debye-Huckel limiting law at appreciable concentration of electrolytes - modifications and applications.

Debye-Huckel Onsager theory of strong electrolyte - Concept for ionic atmosphere - Debye-Huckel Onsager equation, verification and limitations.

Debye-Huckel Bjerrum model of ion association: Concept of ion-pair formation and triple ion formations. Effect of ion association on conductivity

**UNIT-II:Electrode-electrolyte interface:** Interfacial phenomena -Evidences for electrical double layer, polarizable and non-polarizable interfaces, Electrocapillary phenomena - Lippmann equation electrocapillary curves. Structure of double layer: Helmholtz -Perrin, Guoy Chapman and Stern models of electrical double layer.

Electro-kinetic phenomena: electro-osmosis, electrophoresis, streaming and sedimentation potentials, colloidaland poly electrolytes. Zetapotential and potential at zero charge. Applications and limitations.

**UNIT-III: Electrodics:** Factors affecting Rate of electrochemical reaction; Nernst equation, polarizable and non-polarizable electrodes. Concept of over potential and their types: Chemical and electrochemical phase activation and concentration over potential.

Butler-Volmer equation – for one electron and multi-electron transfer reactions - significance of exchange current density, net current density and transfer coefficient Tafel

equations and Tafel plots.

Mechanism of oxygen and hydrogen evolution reaction – Corrosion and Passivation of Metals. Pourbiax and Evan's diagrams. Fuel Cells: $H_2$-$O_2$ fuel cells, alkaline fuel cell, phosphoric acid fuel cells, high temperature fuel cells.

**UNIT – IV: Photochemistry – I:** Thermal and Photochemical reaction - Decay of electronically excited state; Jablonski Diagram – Radiative and Non radiative transitions.

Luminescence: Fluorescence – mechanism, structural dependence on fluorescence, Types and Quenching of fluorescence. Phosphorescence: Triplet state and phosphorescence emission – Heavy atom effect – comparison of fluorescence and phosphorescence.

Photophysical kinetics of unimolecular process, Quenching: Static, Dynamic and Chemical Quenching. Kinetics of collisional Quenching: Derivation of Stern – Volmer equation and its application. Concentration Quenching – Excimer formation and emission.

Types of photochemical reaction: photo isomerization, photo reduction, photo substitution and photosensitization

**UNIT-V: Photochemistry – II:** Concept of Quantum yield: Primary and secondary process, Reasons for low and high quantum yield, Determination of quantum yield – Chemical Actinometry.

Concept of spontaneous and induced emission, Einstein Transition probability – Relationship between Einstein coefficients.

Lasers: Population Inversion, Characteristics, Mechanism, Examples of laser systems and Applications.

Kinetics of photochemical Reactions: Decomposition of hydrogen iodide, $H_2$-$Cl_2$ reaction, $H_2$-$Br_2$ reaction, photolysis of acetaldehyde and Dimerization of anthracene.

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| Extended Professional Component (is a partof internal component only, Notto be included in the external examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved<br>(To be discussed during the Tutorial hours) |
| Skills acquired from this course | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |
| **Recommended Text** | 1. D. R. Crow, Principles and applications of electrochemistry, 4thedition, Chapman & Hall/CRC, 2014.<br>2. J. Rajaram and J.C. Kuriakose, Kinetics and Mechanism of chemical transformations Macmillan India Ltd., New Delhi, 2011.<br>3. S. Glasstone, Electro chemistry, Affiliated East-West Press, Pvt.,Ltd., New Delhi, 2008.<br>4. B. Viswanathan, S. Sundaram, R. Venkataraman, K. Rengarajan and P.S. Raghavan, Electrochemistry-Principles and applications, S. Viswanathan Printers, Chennai,2007.<br>5. Joseph Wang, Analytical Electrochemistry, 2nd edition, Wiley, 2004. |

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| **Reference Books** | 1. J.O.M. Bockris and A.K.N. Reddy, Modern Electro chemistry, vol.1 and 2B, Springer, Plenum Press, New York, 2008.<br>2. J.O.M. Bockris, A.K.N. Reddy and M.G. Aldeco Morden Electro chemistry, vol. 2A, Springer, Plenum Press, New York, 2008.<br>3. Philip H. Rieger, Electrochemistry, 2nd edition, Springer, New York, 2010.<br>4. L.I. Antropov, Theoretical electrochemistry, Mir Publishers, 1977.<br>5. K.L. Kapoor, A Text book of Physical chemistry, volume-3, Macmillan, 2001. |

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| **Website and e-learning source** | 1. https://www.pdfdrive.com/modern-electrochemistry-e34333229. |

**Course Learning Outcomes (for Mapping with POs and PSOs)**

Students will be able:

**CO1**: To understand the behaviour of electrolytes in solution and compare the structures ofelectrical double layer of different models.

**CO2**: To predict the kinetics of electrode reactions applying Butler-Volmer and Tafel equations

**CO3**: To study different thermodynamic mechanism of corrosion,

**CO4**: To discuss the theories of electrolytes, electrical double layer, electrodics and activitycoefficient of electrolytes

**CO5**:To have knowledge on storage devices and electrochemical reaction mechanism.

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** |
| **CO 2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 3** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** |
| **CO 4** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 5** | **M** | **S** | **M** | **S** | **S** | **M** | **S** | **M** | **S** | **S** |

**3 – Strong, 2 – Medium, 1 - Low**

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

| 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 |

**3 – Strong, 2 – Medium, 1 – Low**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Title of the Course** | **b). PHARMACEUTICAL CHEMISTRY** | | | | | | |
| **Paper No.** | **Elective I** | | | | | | |
| **Category** | **Elective** | **Year** | I | **Credits** | 4 | **Course Code** | |
| | | **Semester** | I | | | | |
| **Instructional hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | | | **Total** | |
| | 4 | 1 | - | | | 5 | |
| **Prerequisites** | **Basic knowledge on drugs and doses** | | | | | | |
| **Objectives of the course** | To understand the advanced concepts of pharmaceutical chemistry. To recall the principle and biological functions of various drugs.<br>To train the students to know the importance as well the consequences of various drugs.<br>To have knowledge on the various analysis and techniques.<br>To familiarize on the drug dosage and its structural activities. | | | | | | |

**Course Outline**

**UNIT-I: Physical properties in Pharmaceuticals:** Physical properties of drug molecule: physical properties. Refractive index-Definition, explanation, formula, importance, determination, specific & molar refraction. Dielectric constant & Induced Polarization-Dielectric constant explanation & determination. Rheology of pharmaceutical systems: Introduction, Definition, Applications, concept of viscosity, Newton's law of flow, Kinematic, Relative, Specific, Reduced & Intrinsic viscosity.

**UNIT-II: Isotopic Dilution analysis:** Principle and applications, Neutron activation analysis: Principle, advantages and limitations, Scintillation counters: Body scanning. Introduction to radio pharmaceuticals. Properties of various types ofradio pharmaceuticals, Radio-pharmaceuticals as diagnostics, astherapeutics, for research and sterilization. Physico Chemical Properties and drug action. Physico chemical properties of drugs (a) Partition coefficient, (b) solubility (c) surface activity, (d) degree of ionization.

**UNIT-III: Drug dosage and product development:** Introduction to drug dosage Forms & Drug Delivery system – Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms. Drug dosage and product development. Introduction to drug dosage Forms & Drug Delivery system – Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drugnomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms.

**UNIT-IV: Development of new drugs:** Introduction, procedure followed in drug design, the research for lead compounds, molecular modification of lead compounds. Structure-Activity Relationship (SAR) Factors effecting bioactivity, resonance, inductive effect, isoterism, bioisosterism, spatial considerations, biological properties of simple functional groups, theories of drug activity, occupancy theory, rate theory, induced-fit theory.

**UNIT-V: Computers in Pharmaceutical Chemistry:** Need of computers for chemistry. Computers for Analytical Chemists Introduction to computers: Organization of computers, CPU, Computer memory, I/O devices, information storage, software components.

Application of computers in chemistry: Quantitative structure activity relationship (QSAR): Development of QSAR, drug receptorinteractions, the additivity of group contributions, physico-chemical parameters, lipophilicity parameters, electronic parameter, ionization constants, steric parameters, chelation parameters, redox potential, indicator-variables.

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| Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved<br>(To be discussed during the Tutorial hours) |
| Skills acquired from this course | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |
| **Recommended Text** | 1. Physical Chemistry- Bahl and Tuli.<br>2. Text Book of Physical Pharmaceutics, IInd edition, VallabhPrakashan-.C.V.S. Subramanyam.<br>3. Medicinal Chemistry (Organic Pharmaceutical Chemistry), G.RChatwal, Himalaya Publishing house.<br>4. Instrumental method of Analysis: Hubert H, Willard,7th edition.<br>5. Textbook of Pharmaceutical Chemistry by,Jayshree Ghosh, S.Chand & company Ltd.Pharmaceutical Chemistry by Dr. S. Lakshmi, Sultanchand & Sons. |
| **Reference Books** | 1. Computers in chemistry, K.V. Raman, Tata Mc.Graw-Hill, 1993.<br>2. Computers for Chemists, S.K Pundir, Anshu bansal, A pragate prakashan., 2 nd edition, New age international (P) limited, New Delhi.<br>3. Physical Pharmacy and Pharmaceutical Sciences by Martins, Patrick J. Sinko, Lippincott. William and Wilkins.<br>4. Cooper and Gunn's Tutorial Pharmacy ,6th edition by S.J. Carter, CBS Publisher Ltd.<br>5. Ansels pharmaceutical Dosage forms and Drug Delivery System byAllen Popvich and Ansel, Indian edition-B.I. Publication Pvt. Ltd. |

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| **Website and e-learning source** | https://www.ncbi.nlm.nih.gov/books/NBK482447/<br>https://training.seer.cancer.gov/treatment/chemotherapy/types.html |

**Course Learning Outcomes (for Mapping with POs and PSOs)**
Students will be able:

**CO1**: To identify the suitable drugs for various diseases.
**CO2**: To apply the principles of various drug action and drug design.
**CO3**: To acquire the knowledge on product development based on SAR.
**CO4**: To apply the knowledge on applications of computers in chemistry.
**CO5**:To synthesize new drugs after understanding the concepts SAR.

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** |
| **CO 2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 3** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** |
| **CO 4** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 5** | **M** | **S** | **M** | **S** | **S** | **M** | **S** | **M** | **S** | **S** |

**3 – Strong, 2 – Medium, 1 - Low**

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

| 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 |

**3 – Strong, 2 – Medium, 1 - Low**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Title of the Course** | **a). MOLECULAR SPECTROSCOPY** | | | | | | |
| **Paper No.** | **Elective II** | | | | | | |
| **Category** | **Elective** | **Year** | I | **Credits** | 4 | **Course Code** | |
| | | **Semester** | I | | | | |
| **Instructional hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | | | **Total** | |
| | 4 | 1 | - | | | 5 | |
| **Prerequisites** | **Basic knowledge of spectroscopy** | | | | | | |

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

**UNIT-I: ELECTRONIC, VIBRATIONAL & ROTATIONAL SPECTROSCOPY**

Principles and Instrumentations – UV, IR.

UV - Franck condon principles - types of electronic transition – selection rules – chromophores and auxochromes – solvent effect - Woodwards Fieser rules - Applications to simple organic and inorganic compounds.

IR – harmonic oscillator – anharmonicity – vibrational frequeiences and factors affecting them – finger print region. Application – metal ligand stretching vibrations.

Microwave(Rotational) – Principles – Spectrum of rigid rotator and non rigid rotator –intensity of spectral lines – Effect of isotopic substitution

**UNIT II: RAMAN & $^{1}$H- NMR SPECTRA**

Raman – polarisability - stokes and antistokes lines – mutual exclusion principle – applications.

NMR-$^{1}$H Principles and instrumentations of NMR

$^{1}$H - Relative populations of energy levels – CW and FT NMR – $^{1}$H NMR – chemical shift – factors influencing chemical shift and coupling constant - spin-spin coupling – Applications to simple organic molecules such as $CH_3CH_2Cl$, $CH_3CHO$ etc. AX, AMX and AB spin system – spin decoupling – nuclear overhauser effect- chemical exchange

**UNIT-III: NMR SPECTRA –$^{13}$C $^{31}$P AND $^{19}$F AND NQR SPECTRA**

$^{13}$C NMR – proton decoupled and off – resonance of $^{13}$C NMR spectra – factors affecting $^{13}$C chemical shift – Applications to simple organic molecules.

NMR of $^{31}$P, $^{19}$F - applications to simple inorganic molecules, NMR shift reagents

NQR – Principles and applications - BrCN, $KI_3$, Sn, Pt and Se compounds

**UNIT-IV: ESR AND PHOTOELECTRON SPECTROSCOPY**

ESR - Introduction – Zeeman equation, g-value, nuclear hyperfine splitting, - Anisotropy – g-value and hyperfine splitting constant. Mcconnel's equation, Zero field splitting, Kramers degeneracy – Applications to simple carbon centered free radicals and transition metal complexes (Cu, Mn, V).

Photoelectron spectroscopy (UV and X-ray) - Koopman's theorem, time structure in PES, chemical shift and correlation with electronic charges – Auger spectroscopy.

**UNIT-V: MASS AND MOSSBAUER SPECTROSCOPY**

Mass Spectroscopy – Principle – measurement techniques – (EI, CI, FD, FAB, SIMS) – molecular ions – isotope ions – fragment ions of odd and even electron types – factors

affecting cleavage patterns – simple and multicentre fragmentation – McLafferty rearrangement - Mass spectra of hydrocarbons, alcohols, phenols, aldehydes and ketones.

Mossbauer spectra – isomer shift – quadrapole interaction – magnetic interaction – Applications to Fe and Sn systems.

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| Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved<br>(To be discussed during the Tutorial hours) |
| Skills acquired from this course | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |

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|---|---|
| **Recommended Text** | 1. C. N. Banwell and E. M. McCash, *Fundamentals of Molecular Spectroscopy*, 4th Ed., Tata McGraw Hill, New Delhi, 2000.<br>2. R. M. Silverstein and F. X. Webster, *Spectroscopic Identification of Organic Compounds*, 6th Ed., John Wiley & Sons, New York, 2003.<br>3. W. Kemp, *Applications of Spectroscopy*, English Language Book Society, 1987.<br>4. D. H. Williams and I. Fleming, *Spectroscopic Methods in Organic Chemistry*, 4th Ed., Tata McGraw-Hill Publishing Company, New Delhi, 1988.<br>5. R. S. Drago, *Physical Methods in Chemistry*; Saunders: Philadelphia, 1992. |
| **Reference Books** | 1. P.W. Atkins and J. de Paula, *Physical Chemistry*, 7th Ed., Oxford University Press, Oxford, 2002.<br>2. I. N. Levine, *Molecular Spectroscopy*, John Wiley & Sons, New York, 1974.<br>3. A. Rahman, *Nuclear Magnetic Resonance-Basic Principles*, Springer-Verlag, New York,1986.<br>4. K. Nakamoto, *Infrared and Raman Spectra of Inorganic and coordination Compounds*, PartB: 5th ed., John Wiley& Sons Inc., New York, 1997.<br>5. J. A. Weil, J. R. Bolton and J. E. Wertz, *Electron Paramagnetic Resonance*; Wiley Interscience, 1994. |
| **Website and e-learning source** | 1. https://onlinecourses.nptel.ac.in/noc20_cy08/preview<br>2. https://www.digimat.in/nptel/courses/video/104106122/L14.html |

**Course Learning Outcomes (for Mapping with POs and PSOs)**

Students will be able:

**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 $^{31}P$, $^{19}F$NMR and ESR spectroscopic techniques.

**CO5**:To develop the knowledge on principle, instrumentation and structural elucidation ofsimple molecules using Mass Spectrometry, EPR and Mossbauer Spectroscopytechniques.

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** |
| **CO 2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 3** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** |
| **CO 4** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 5** | **M** | **S** | **M** | **S** | **S** | **M** | **S** | **M** | **S** | **S** |

**3 – Strong, 2 – Medium, 1 - Low**

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

| 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 |

**3 – Strong, 2 – Medium, 1 - Low**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Title of the Course** | **b). NANO MATERIALS AND NANO TECHNOLOGY** | | | | | | |
| **Paper No.** | **Elective II** | | | | | | |
| **Category** | **Elective** | **Year** | I | **Credits** | 4 | **Course Code** | |
| | | **Semester** | I | | | | |
| **Instructional hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | | | **Total** | |
| | 4 | 1 | - | | | 5 | |
| **Prerequisites** | **Basic knowledge of crystallography and material science** | | | | | | |
| **Objectives of the course** | To understand the concept of nano materials and nano technology.<br>To understand the various types of nano materials and their properties.<br>To understand the applications of synthetically important nanomaterials.<br>To correlate the characteristics of various nano materials synthesized by new technologies.<br>To design synthetic routes for synthetically used new nano materials. | | | | | | |

**Course Outline**

**UNIT-I:** Introduction of nanomaterials and nanotechnologies, Introduction-role of size, classification-0D, 1D, 2D, 3D. Synthesis Bottom –Up, Top–Down, consolidation of Nano powders. Features of nanostructures, Background of nanostructures. Techniques of synthesis of nanomaterials, Tools of the nanoscience. Applications of nanomaterials and technologies.

**UNIT-II:** Bonding and structure of the nanomaterials, Predicting the Type of Bonding in a Substance crystal structure. Metallic nanoparticles, Surfaces of Materials, Nanoparticle Size and Properties. Synthesis Physical and chemical methods - inert gas condensation, arc discharge, laser ablation, sol-gel, solvo-thermal and hydrothermal- CVD-types,metallo organic, plasma enhanced, and low-pressure CVD. Microwave assisted and electrochemical synthesis.

**UNIT-III:** Mechanical properties of materials, theories relevant to mechanical properties. Techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials Nanoparticles: gold and silver, metal oxides: silica, iron oxide and alumina - synthesis and properties

**UNIT-IV:** Electrical properties, Conductivity and Resistivity,Classification of Materials based on Conductivity, magnetic properties,electronic properties of materials. Classification of magneticphenomena. Semiconductor materials – classification-Ge, Si, GaAs,SiC, GaN, GaP, CdS,PbS. Identification of materials as p and n –type semiconductor-Hall effect - quantum and anomalous, Hall voltage - interpretation of charge carrier density. Applications of semiconductors: p-n junction as transistors and rectifiers, photovoltaic and photogalvanic cell.

**UNIT-V:** Nano thin films, nanocomposites. Application of nanoparticlesin different fields. Core-shell nanoparticles - types, synthesis, and properties. Nanocomposites - metal-, ceramic- and polymer-matrix composites applications. Characterization – SEM, TEM and AFM - principle,instrumentation and applications.

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| Extended Professional Component (is a part of internal component only, Not to be includedin the external examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC othersto be solved<br>(To be discussed during the Tutorial hours) |
| Skills acquired from this course | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |
| **Recommended Text** | 1. S.Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016.<br>2. Arumugam, Materials Science, Anuradha Publications,2007.<br>3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010<br>4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012.<br>5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007. |
| **Reference Books** | 1. S.Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016.<br>2. Arumugam, Materials Science, Anuradha Publications,2007.<br>3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010<br>4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012.<br>5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007. |
| **Website and e-learning source** | 1. http://xrayweb.chem.ou.edu/notes/symmetry.html.<br>2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf. |
| **Course Learning Outcomes (for Mapping with POs and PSOs)**<br>Students will be able:<br>**CO1**: To explain methods of fabricating nanostructures.<br>**CO2**: To relate the unique properties of nanomaterials to reduce dimensionality of thematerial.<br>**CO3**: To describe tools for properties of nanostructures.<br>**CO4**: To discuss applications of nanomaterials.<br>**CO5**:To understand the health and safety related to nanomaterial. | |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** |
| **CO 2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 3** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** |
| **CO 4** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 5** | **M** | **S** | **M** | **S** | **S** | **M** | **S** | **M** | **S** | **S** |

**3 – Strong, 2 – Medium, 1 - Low**

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

| 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 |

**3 – Strong, 2 – Medium, 1 - Low**

## SEMESTER -II

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Title of the Course** | **ORGANIC REACTION MECHANISM-II** | | | | | | |
| **Paper No.** | **Core IV** | | | | | | |
| **Category** | **Core** | **Year** | I | **Credits** | 4 | **Course Code** | |
| | | **Semester** | II | | | | |
| **Instructional hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | | | **Total** | |
| | 4 | 1 | - | | | 5 | |
| **Prerequisites** | **Basic knowledge of organic chemistry** | | | | | | |
| **Objectives of the course** | To understand the concept of aromaticity in benzenoid, non-benzenoid, heterocyclic and annulene compounds.<br>To understand the mechanism involved in various types of organicreactions with evidences.<br>To understand the applications of synthetically important reagents.<br>To correlate the reactivity between aliphatic and aromatic compounds.To design synthetic routes for synthetically used organic reactions. | | | | | | |

**CourseOutline**

**UNIT-I: Elimination and Free Radical Reactions:**
Mechanisms: E2, E1, and E1cB mechanisms. Syn- and anti-eliminations. Orientation of the double bond: Hoffmann and Saytzeff rules. Reactivity: Effect of substrate, attacking bases, leaving group and medium. Stereochemistry of eliminations in acyclic and cyclic systems, pyrolytic elimination. Longlived and short-lived radicals – Production of radicals by thermal and photochemical reactions, Detection and stability of radicals, characteristics of free radical reactions and free radical, reactions of radicals; polymerization, addition, halogenations, aromatic substitutions,rearrangements. Reactivity: Reactivity on aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent.

**UNIT-II: Oxidation and Reduction Reactions:** Mechanisms: Direct electron transfer, hydride transfer, hydrogen transfer, displacement, addition-elimination, oxidative and reductive coupling reactions. Mechanism of oxidation reactions: Dehydrogenation by quinones, selenium dioxides, ferricyanide, mercuric acetate lead tetraacetate, permanganate, manganese dioxide, osmium tetroxide, oxidation of saturated hydrocarbons, alkyl groups, alcohols, halides and amines. DMSO-Oxalyl chloride (Swern oxidation) and Corey-Kim oxidation, dimethyl sulphoxide- dicyclohexyl carbodiimide (DMSO-DCCD). Mechanism of reduction reactions: Wolff- Kishner, Clemmenson, Rosenmund, reduction with Trialkyl and triphenyltin hydrides, Homogeneous hydrogenation, MPV and Bouveault-Blanc reduction.

**UNIT-III: Rearrangements:** Rearrangements to electron deficient carbon: Pinacol-pinacolone and semi-pinacolone rearrangements, Wagner-Meerwein, Demjanov, Dienone-phenol, Baker-Venkataraman, Benzilic acid and Wolff rearrangements. Rearrangements to electron deficient nitrogen: Hofmann, Curtius, Schmidt, Lossen, Beckmann.Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation & Dakin rearrangements. Rearrangements to electron rich atom: Favorskii, Stevens, [1,2]-Wittig and [2,3]-Wittig rearrangements. Fries and Photo Fries rearrangement. Intramolecular rearrangements- claisen, Cope, oxy-cope Benzidine rearrangements.

**UNIT-IV: Addition to Carbon Multiple Bonds:** Mechanisms: (a) Addition to carbon-carbon multiple bonds- Addition reactions involving electrophiles, nucleophiles, free radicals, carbenes and cyclic mechanisms- Orientation and reactivity, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen and Nitrogen; (b) Addition to carbon- hetero atom multiple bonds: Mannich reaction, acids, esters, nitrites, addition of Grignard reagents, Wittig reaction, Prinsreaction. Stereochemical aspects of addition reactions. Addition to Carbon-Hetero atom Multiplebonds: Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Mechanism of condensation reactions involving enolates –Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.

**UNIT-V: Reagents and Modern Synthetic Reactions:** Lithium diisopropylamine (LDA), Azobisisobutyronitrile (AIBN), Sodium cyanoborohydride ($NaBH_3CN$), *meta*-Chloroperbenzoic acid (m-CPBA), Dimethyl aminiopyridine (DMAP), n-$Bu_3SnD$, Triethylamine (TEA),Diazobicyclo[5.4.0]undec-7-ene (DBU), Diisopropylazodicarboxylate (DIAD), Diethylazodicarboxylate (DEAD), *N*-bromosuccinimide (NBS), Trifluoroacetic acid (TFA), Tetramethyl piperiridin-1-oxyl (TEMPO), Phenyltrimethylammonium tribromide (PTAB).Diazomethane and Zn-Cu, Diethyl maleate (DEM)**.**Suzuki coupling, Heck reaction, Negishi reaction, Baylis-Hillman reaction.

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| Extended Professional Component (is a part of Internal Component only, Not to be included in the External Examination Question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved<br>(To be discussed during the Tutorial hours) |
| Skills acquired from this Course | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |

| | |
|---|---|
| **Recommended Text** | 1. J. March and M. Smith, *Advanced Organic Chemistry*, 5th ed.,John-Wiley and Sons.2001.<br>2. E. S. Gould, *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart and Winston Inc.,1959.<br>3. P. S. Kalsi, *Stereochemistry of carbon compounds*, 8thedn, New Age International Publishers,2015.<br>4. P. Y.Bruice, *Organic Chemistry*, 7thedn.,Prentice Hall, 2013.<br>5. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee*Organic Chemistry*, 7th edn., Pearson Education,2010. |

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|---|---|
| **Referenc eBooks** | 1. S. H. Pine, *Organic Chemistry*, 5thedn, McGraw Hill International Editionn,1987.<br>2. L. F. Fieser and M. Fieser, *Organic Chemistry*, Asia Publishing House, Bombay,2000.<br>3. E.S. Gould, *Mechanism and Structure in Organic Chemistry*, Holt,Rinehart and Winston Inc.,1959.<br>4. T. L. Gilchrist, *Heterocyclic Chemistry*, Longman Press, 1989.<br>5. J. A. Joule and K. Mills, *Heterocyclic Chemistry*, 4thed., John-Wiley,2010. |
| **Website and e-learning Source** | 1. https://sites.google.com/site/chemistryebookscollection02/home/organ ic-chemistry/organic<br>2. https://www.organic-chemistry.org/ |
| **Course Learning Outcomes (for Mapping with POs and PSOs)**<br><br>Students will be able:<br>**CO1**: To recall the basic principles of aromaticity of organic and heterocyclic compounds.<br>**CO2**: To understand the mechanism of various types of organic reactions.<br>**CO3**: To predict the suitable reagents for the conversion of selective organic compounds.<br>**CO4**: To correlate the principles of substitution, elimination, and addition reactions.<br>**CO5**:To design new routes to synthesis organic compounds. | |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** |
| **CO 2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 3** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** |
| **CO 4** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 5** | **M** | **S** | **M** | **S** | **S** | **M** | **S** | **M** | **S** | **S** |

**3 – Strong, 2 – Medium, 1 - Low**

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

| 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 |

**3 – Strong, 2 – Medium, 1 - Low**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Title of the Course** | **PHYSICAL CHEMISTRY-I** | | | | | | |
| **Paper No.** | **Core V** | | | | | | |
| **Category** | **Core** | **Year** | I | **Credits** | 4 | **Course Code** | |
| | | **Semester** | II | | | | |
| **Instructional hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | | | **Total** | |
| | 4 | 1 | - | | | 5 | |
| **Prerequisites** | **Basic concepts of physical chemistry** | | | | | | |
| **Objectives of the course** | To recall the fundamentals of thermodynamics and the composition ofpartial molar quantities.<br>To understand the classical and statistical approach of the functions<br>To compare the significance of Maxwell-Boltzman, Fermi-Dirac andBose-Einstein<br>To correlate the theories of reaction rates for the evaluation of thermodynamic parameters.<br>To sudy the mechanism and kinetics of reactions. | | | | | | |

**Course Outline**

**UNIT-I: Classical Thermodynamics:** Partial Molar Properties: Concept and Physical significance of Partial Molar Properties,

Determination of Partial Molar Properties – Method of Intercepts.

Chemical Potential: Chemical potential and its physical significance – Gibbs-Duhem equation.

Variation of chemical potential with temperature and pressure. Chemical Potential of a System of Ideal Gases – Applications of Chemical Potential – Henry's Law, Nernst Distribution Law, and Raoult's Law. Fugacity: Concept and Determination of fugacity of real gases by graphical method – Variation of fugacity with temperature and pressure – Lewis Randal rule – Duhem-Margules equation. Activity and Activity Coefficient: Concept and Determination of activity and activity coefficient of non-electrolyte (EMF method) – Choice of Standard State.

**UNIT-II: Statistical thermodynamics I:**

Introduction of Statistical Thermodynamics, Concept of Energy levels and Energy States, Microstates and macrostates – Distribution of Particles (Distinguishable and indistinguishable particles) in Energy Levels. Assemblies, Ensembles and Canonical Particles. Concept of mathematical and thermodynamic probabilities, relationship between entropy and thermodynamic probability. Calculation of Thermodynamic Probability (W) for Distinguishable and indistinguishable particles with and without restriction on occupations. Fundamental Postulates of Statistical Thermodynamics, Stirling's approximation, Classical statistics - Maxwell-Boltzmann (MB) statistics - Derivation Quantum statistics-Bose-Einstein (BE) and Fermi-Dirac (FD) statistics.

Derivation of distribution function – Maxwell-Boltzmann (MB) statistics-Quantum statistics-Bose- Einstein (BE) and Fermi-Dirac (FD) statistics – Comparison of Classical and Quantum statistics.

Partition Functions-Translational, rotational, vibrational and electronic partition function. Calculation of thermodynamic parameters – Pressure (P), Internal Energy (U), Entropy (S), Enthalpy (H), Gibbs function (G), Helmholtz function (A), and Equilibrium constant (K) in terms of partition function..

**UNIT-III: Statistical thermodynamics and Irreversible Thermodynamics:**

Applications of partition function to heat-capacity of ideal monoatomic and diatomic gases. Heat capacity of solids – Assumptions, Derivation and Limitations of Einstein and Debye models –Comparative study of Einstein's and Debye Theories of Heat Capacity of Solids.

Basic concepts of Irreversible Thermodynamics – Forces and fluxes – Phenomenological equations– Heat Transfer: Fourier's Law, Mass Transfer: Fick's Law, Momentum Transfer: Newton's Laws and Flow of Electricity: Ohm's Law.

Onsager Theory – Validity and verification – Principle of microscopic reversibility, Onsager reciprocal relations. Electro kinetic and thermo mechanical effects- Application of irreversible thermodynamics to biological systems.

**UNIT IV: CHEMICAL KINETICS - I**

Theories of reactions-effect of temperature on reaction rates, collision theory of reaction rates, Unimolecular reactions -Lindeman and Christiansen hypothesis- molecular beams, collision cross sections, effectiveness of collisions, Potential energy surfaces.

ARRT: Thermodynamics formulation of CTST – Eyring equation and its modification – Estimation of free energy, enthalpy and entropy of activation and their significance – Problems related to the calculation of $\Delta G^{\neq}$, $\Delta S^{\neq}$, $K_r$.

Reactions in solutions: Effect of solvation on reaction rate, Effect of ionic strength – Salt effect – Jerrum-Bronsted equation – Effect of dielectric constant – Electrostriction – Scatchard equation. Effect of hydro static pressure on reaction rate – Concept of $\Delta V^{\neq}$

Acid – Base Catalysis: Mechanism of acid base catalysis – Protolytic and prototropic mechanism. Catalytic activity and Acid – Base Strength – Bronsted catalysis law.

Enzyme catalysis: Kinetics – Michaelis – Menton equation. Determinations of $K_M$ and its significance.

**UNIT – V: CHEMICAL KINETICS - II**

Complex Reactions: Kinetics of parallel, consecutive, and Reversible reactions – Examples. Chain reactions: General treatment of chain reactions – Linear chain reaction – chain length, Thermal reactions between $H_2$-$Cl_2$ and $H_2$-$Br_2$. Rice–Herzfeld mechanism: Thermal decomposition of Acetaldehyde – Rate expression for half, one and one and half order.

Branched chain Reaction and Explosion: $H_2$ - $O_2$ reaction and lower, upper explosion limits.

Fast Reactions: Flow method - stopped flow method, relaxation methods - temperature and pressure jump methods-electric and magnetic field jump methods, Flash photolysis and pulse radiolysis.

| | |
|---|---|
| Extended Professional Component (is a part of internal component only, Not to be includedin the external examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC othersto be solved<br>(To be discussed during the Tutorial hours) |

| | |
|---|---|
| Skills acquired from this course | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |
| **Recommended Text** | 1. J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry, 2nd edition,S.L.N.Chand and Co., Jalandhar, 1986.<br>2. I.M. Klotz and R.M. Rosenberg, Chemical thermodynamics, 6thedition, W.A.BenjaminPublishers, California, 1972.<br>3. M.C. Gupta, Statistical Thermodynamics, New Age International,Pvt. Ltd., New Delhi,1995.<br>4. K.J. Laidler, Chemical Kinetics, 3rd edition, Pearson, Reprint - 2013.<br>5. J. Rajaram and J.C. Kuriokose, Kinetics and Mechanisms of chemical transformation,Macmillan India Ltd, Reprint - 2011. |
| **Reference Books** | 1. D.A. Mcqurrie And J.D. Simon, Physical Chemistry - A Molecular Approach, Viva Books Pvt. Ltd., New Delhi, 1999.<br>2.R.P. Rastogi and R.R. Misra, Classical Thermodynamics, Vikas Publishing, Pvt. Ltd., New Delhi, 1990.<br>3. S.H. Maron and J.B. Lando, Fundamentals of Physical Chemistry,Macmillan Publishers, New York, 1974<br>4. K.B. Ytsiimiriski, "Kinetic Methods of Analysis", Pergamom Press,1996.<br>5. Gurdeep Raj, Phase rule, Goel Publishing House, 2011. |
| **Website and e-learning source** | 1. https://nptel.ac.in/courses/104/103/104103112/<br>2. https://bit.ly/3tL3GdN |

**Course Learning Outcomes (for Mapping with POs and PSOs)**

Students will be able:

**CO1**: To explain the classical and statistical concepts of thermodynamics.

**CO2**: To compare and correlate the thermodynamic concepts to study the kinetics of chemical reactions.

**CO3**: To discuss the various thermodynamic and kinetic determination.

**CO4**: To evaluate the thermodynamic methods for real gases ad mixtures.

**CO5**:To compare the theories of reactions rates and fast reactions.

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** |
| **CO 2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 3** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** |
| **CO 4** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 5** | **M** | **S** | **M** | **S** | **S** | **M** | **S** | **M** | **S** | **S** |

**3 – Strong, 2 – Medium, 1 - Low**

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

| 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 |

**3 – Strong, 2 – Medium, 1 - Low**

<table>
<tr><td>Title of the Course</td><td colspan="7">INORGANIC CHEMISTRY PRACTICAL</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>1</td><td colspan="3">4</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic principles of Qualitative analysis</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand and enhance the visual observation as an analytical toolfor the quantitative estimation of ions.<br>To recall the principle and theory in preparing standard solutions.<br>To train the students for improving their skill in estimating the amountof ion accurately present in the solution<br>To estimate metal ions, present in the given solution accurately withoutusing instruments.<br>To determinethe amount of ions, present in a binary mixture accurately.</td></tr>
</table>

**Course Outline**

**UNIT I Compulsory**

**UNIT-I: Analysis of mixture of cations:**Analysis of a mixture of four cations containing two common cations and two rare cations.Cations to be tested.

Group-I : W, Tl and Pb.
Group-II : Se, Te, Mo, Cu, Bi and Cd.
Group-III : Tl, Ce, Zr, V, Cr, Fe & Ti
Group-IV : Zn, Ni, Co and Mn.
Group-V : Ca, Ba and Sr.
Group-VI : Li and Mg.

**UNIT II and III Choose any three**

**UNIT-II: Preparation of metal complexes:** Preparation of inorganiccomplexes:

a. Preparation of tristhioureacopper(I)sulphate
b. Preparation of potassium trioxalate chromate(III)
c. Preparation of tetramminecopper(II) sulphate
d. Preparation of Reineck's salt
e. Preparation of hexathioureacopper(I) chloridedihydrate
f. Preparation of *cis*-Potassium tri oxalate diaquachromate(III)
g. Preparation of sodium trioxalatoferrate(III)
h. Preparation of hexathiourealead(II) nitrate
i.

**UNIT-III: Complexometric Titration:**

1. Estimation of zinc, nickel, magnesium, and calcium.
2. Estimation of mixture of metal ions-pH control, masking and de-masking agents.
3. Determination of calcium and lead in a mixture (pH control).
4. Determination of manganese in the presence of iron.
5. Determination of nickel in the presence of iron.

| | |
|---|---|
| Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved<br>(To be discussed during the Tutorial hours) |

| | |
|---|---|
| Skills acquired from this course | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |

| | |
|---|---|
| **Recommended Text** | 1. A. JeyaRajendran, Microanalytical Techniques in Chemistry: Inorganic Qualitative Analysis, United global publishers, 2021.<br>2. V. V. Ramanujam, *Inorganic Semimicro Qualitative Analysis*; 3rded.,The National Publishing Company, Chennai, 1974.<br>3. *Vogel's Text book of Inorganic Qualitative Analysis,* 4thed., ELBS,London. |
| **Reference Books** | 1. G. Pass, and H. Sutcliffe, *Practical Inorganic Chemistry*; Chapman Hall, 1965.<br>2. W. G. Palmer, Experimental *Inorganic Chemistry*; CambridgeUniversity Press, 1954. |

**Course Learning Outcomes (for Mapping with POs and PSOs)**

Students will be able:

**CO1**: To identify the anions and cations present in a mixture of salts.

**CO2**: To apply the principles of semi micro qualitative analysis to categorize acid radicals and basic radicals.

**CO3**: To acquire the qualitative analytical skills by selecting suitable confirmatory tests andspot tests.

**CO4**: To choose the appropriate chemical reagents for the detection of anions and cations.

**CO5**:To synthesize coordination compounds in good quality.

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** |
| **CO 2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 3** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** |
| **CO 4** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 5** | **M** | **S** | **M** | **S** | **S** | **M** | **S** | **M** | **S** | **S** |

**3 – Strong, 2 – Medium, 1 - Low**

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

| 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 |

**3 – Strong, 2 – Medium, 1 - Low**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Title of the Course** | **a). GREEN CHEMISTRY** | | | | | | |
| **Paper No.** | **Elective III** | | | | | | |
| **Category** | **Elective** | **Year** | I | **Credits** | 4 | **Course Code** | |
| | | **Semester** | II | | | | |
| **Instructional hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | | | **Total** | |
| | 4 | 1 | - | | | 5 | |
| **Prerequisites** | **Basic knowledge of general chemistry** | | | | | | |

| | |
|---|---|
| **Objectives of the course** | To discuss the principles of green chemistry.<br>To propose green solutions for chemical energy storage and conversion. Propose green solutions for industrial production of Petroleum andPetrochemicals.<br>Propose solutions for pollution prevention in Industrial chemical and fuel<br>production,Automotive industry and Shipping industries.<br>Propose green solutions for industrial production of Surfactants, Organic and inorganic chemicals. |

**Course Outline**

**UNIT-I:** Introduction- Need for Green Chemistry. Goals of Green Chemistry.Limitations/ of Green Chemistry. Chemical accidents, terminologies, International green chemistry organizations and Twelve principles of Green Chemistry with examples.

**UNIT-II:** Choice of starting materials, reagents, catalysts and solvents in detail, Green chemistry in day today life. Designing green synthesis- green reagents: dimethyl carbonate.Green solvents: Water,Ionic liquids- criteria, general methods of preparation, effect on organic reaction.Supercritical carbon dioxide- properties, advantages, drawbacks and a few examples of organic reactions in Super Critical
$CO_2$. Green synthesis- Adipic acid and catechol.

**UNIT-III:** Environmental pollution, Green Catalysis-Acid catalysts, Oxidation catalysts, Basic catalysts, Polymer supported catalysts-Poly styrene aluminum chloride, polymeric super acid catalysts, Poly
supported photosensitizers.

**UNIT-IV:** Phase transfer catalysis in green synthesis-oxidation using hydrogen peroxide, crown ethers-esterification, saponification, anhydride formation, Elimination reaction, Displacement reaction.
Applications in organic synthesis.

**UNIT-V:** Micro wave induced green synthesis-Introduction, Instrumentation, Principle and applications. Sonochemistry – Instrumentation, Cavitation theory - Ultra sound assisted green synthesis and Applications.

| | |
|---|---|
| Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved<br>(To be discussed during the Tutorial hours) |
| Skills acquired from this course | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |

| | |
|---|---|
| **Recommended Text** | 1. Ahluwalia, V.K. and Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers, 2005.<br>2. W. L. McCabe, J.C. Smith and P. Harriott, Unit Operations of Chemical Engineering, 7th edition, McGraw-Hill,NewDelhi,2005.<br>3. J. M. Swan and D. St. C. Black, Organometallics in Organic Synthesis, Chapman Hall,1974.<br>4. V. K. Ahluwalia and R. Aggarwal, Organic Synthesis: Special Techniques, Narosa Publishing House, New Delhi,2001.<br>5. A. K. De, Environmental Chemistry, New Age Publications, 2017. |
| **Reference Books** | 1. Anastas, P.T. and Warner, J.K. Oxford Green Chemistry -Theory and Practical, University Press, 1998<br>2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker, 2001<br>3. Cann, M.C. and Connely, M.E. Real-World Cases in Green Chemistry, American Chemical Society, Washington, 2000<br>4. Ryan, M.A. and Tinnesand, M., Introduction to Green Chemistry, American Chemical Society Washington, 2002.<br>5. Chandrakanta Bandyopadhyay, An Insight into Green Chemistry,Books and Allied (P) Ltd, 2019. |
| **Website and e-learning source** | 2. https://www.organic-chemistry.org/<br>3. https://www.studyorgo.com/summary.php |

**Course Learning Outcomes (for Mapping with POs and PSOs)**

Students will be able:

**CO1**: To recall the basic chemical techniques used in conventional industrial preparations and in green innovations.

**CO2**: To understand the various techniques used in chemical industries and in laboratory.

**CO3**: To compare the advantages of organic reactions assisted by renewable energy sources and non-renewable energy sources.

**CO4**: To apply the principles of PTC, ionic liquid, microwave and ultrasonic assisted organicsynthesis.

**CO5**: To design and synthesize new organic compounds by green methods.

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** |
| **CO 2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 3** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** |
| **CO 4** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 5** | **M** | **S** | **M** | **S** | **S** | **M** | **S** | **M** | **S** | **S** |

**3 – Strong, 2 – Medium, 1 - Low**

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

| 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 |

**3 – Strong, 2 – Medium, 1 - Low**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Title of the Course** | **b). MEDICINAL CHEMISTRY** | | | | | | |
| **Paper No.** | **Elective III** | | | | | | |
| **Category** | **Elective** | **Year** | I | **Credits** | 4 | **Course Code** | |
| | | **Semester** | II | | | | |
| **Instructional hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | | | **Total** | |
| | 4 | 1 | - | | | 5 | |
| **Prerequisites** | **Basic knowledge of medicinal chemistry** | | | | | | |

| | |
|---|---|
| **Objectives of the course** | To study the chemistry behind the development of pharmaceutical materials.<br>To gain knowledge on mechanism and action of drugs.<br>To understand the need of antibiotics and usage of drugs.<br>To familiarize with the mode of action of diabetic agents and treatment ofdiabetes.<br>To identify and apply the action of various antibiotics. |

**CourseOutline**

**UNIT-I: Introduction to receptors:** Introduction, targets, Agonist, antagonist, partial agonist.Receptors, Receptor types, Theories of Drug – receptor interaction, Drug synergism, Drug resistance, physicochemicalfactors influencing drug action.

**UNIT-II: Antibiotics:** Introduction, Targets of antibiotics action, classification of antibiotics, enzyme-based mechanism of action, SAR of penicllins and tetracyclins, clinical application of penicillins, cephalosporin.Current trends in antibiotic therapy.

**UNIT-III: Antihypertensive agents and diuretics:** Classification ofcardiovascular agents, introduction to hypertension, etiology, types, classification of antihypertensive agents, classification and mechanism of action of diuretics, Furosemide, Hydrochlorothiazide, Amiloride.

**UNIT-IV:Analgesics, Antipyretics and Anti-inflammatory Drugs:** Introduction, Mechanism of inflammation, classification and mechanism of action and paracetamol, Ibuprofen, Diclofenac, naproxen, indomethacin, phenylbutazone and meperidine. Medicinal Chemistry of Antidiabetic Agents Introduction, Types of diabetics, Drugs used for the treatment, chemicalclassification, Mechanism of action, Treatment of diabetic mellitus. Chemistry of insulin, sulfonyl urea.

**UNIT-V:Traditional Indian Medicine system:** Introduction to Ayurveda, Siddha, Unani, Homeopathy & Sowa- Rigpa Systems and Traditional Formulations - Important Medicinal Plants mentioned in ancient – Nochi, Adathoda, Tulasi, Vallarai, Sirukurunjan, Amla, Shatavari, Moringa, Punarnava - Agro-techniques of Few Aromatic Plants - AYUSH Products, food, nutraceuticals, cosmetics and agrochemicals, - Case Study :Value added products of Neem, Aloe, Licorice, Ashwagandha.

| | |
|---|---|
| Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved<br>(To be discussed during the Tutorial hours) |

| | |
|---|---|
| Skills acquired from this course | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |
| **Recommended Text** | 1. Wilson and Gisvold's textbook of organic medicinal and pharmaceuticalchemistry,<br>2. Wilson, Charles Owens: Beale, John Marlowe; Block, John H, LipincottWilliam, 12th edition, 2011.<br>3. Graham L. Patrick, An Introduction to Medicinal Chemistry, 5th edition, Oxford University Press, 2013. Jayashree Ghosh, A text book of Pharmaceutical Chemistry, S.Chandand Co.Lt d,1999,1999 edn.<br>4. O.LeRoy,Natural and synthetic organic medicinal compounds, Ealemi,1976.5.S. Ashutosh Kar,Medicinal Chemistry, Wiley Eastern Limited, NewDelhi,1993,New edn.<br>6. H. Panda.The Complete Technology Book on Herbal Beauty Products with Formulations and Processes. NIIR Project Consultancy Services. 2005<br>7. Khadabadi SS, Deore SL, Baviskar BA. Experimental Phytopharmacognosy.Nirali Prakashan, Pune. 1st Edition, 2019.<br>8. Deore SL, Khadabadi SS, BaviskarBA.Pharmacognosy and Phytochemistry-A Comprehensive Approach. PharmMed Press, Hyderabad. 2nd Edition, 2018 |
| **Referenc eBooks** | 1. Foye's Princles of Medicinal Chemistry, Lipincott Williams, Seventh Edition, 2012<br>2. Burger's Medicinal Chemistry, Drug Discovery and Development, Donald J. Abraham, David P. Rotella, Alfred Burger, Academic press, 2010.<br>3. WilsonandGisvold'sTextbookofOrganicMedicinalandPharmaceuticalChe mistry,John M.BealeJrandJohnM. Block, Wolters Kluwer, 2011,12th edn.<br>4. P.Parimoo,ATextbookofMedicalChemistry,NewDelhi:CBSPublishers.199 5.<br>5. S.Ramakrishnan, K.G.PrasannanandR.Rajan,TextbookofMedicalBiochemistry,Hydera ba<br>d: OrientLongman.3rd edition,2001. |
| **Website and e-learning source** | 1. https://www.ncbi.nlm.nih.gov/books/NBK482447/<br>2. https://training.seer.cancer.gov/treatment/chemotherapy/types.html<br>3. https://www.classcentral.com/course/swayam-medicinal-chemistry-12908 |
| **Course Learning Outcomes (for Mapping with POs and PSOs)**<br>Students will be able:<br>**CO1**: Predict a drugs properties based on its structure.<br>**CO2**: Describe the factors that affect its absorption, distribution, metabolism, and excretion, and hence the considerations to be made in drug design. | |

**CO3**: Explain the relationship between drug's chemical structure and its therapeutic properties.
**CO4**: Designed to give the knowledge of different theories of drug actions at molecularlevel.
**CO5**:To identify different targets for the development of new drugs for the treatment ofinfectious and GIT.

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** |
| **CO 2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 3** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** |
| **CO 4** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 5** | **M** | **S** | **M** | **S** | **S** | **M** | **S** | **M** | **S** | **S** |

**3 – Strong, 2 – Medium, 1 - Low**

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

| 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 |

**3 – Strong, 2 – Medium, 1 - Low**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Title of the Course** | **a). BIO-INORGANIC CHEMISTRY** | | | | | | |
| **Paper No.** | **Elective IV** | | | | | | |
| **Category** | **Elective** | **Year** | I | **Credits** | 4 | **Course Code** | |
| | | **Semester** | II | | | | |
| **Instructional hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | | | **Total** | |
| | 4 | 1 | - | | | 5 | |
| **Prerequisites** | **Basic knowledge of chemistry** | | | | | | |
| **Objectivesof the course** | To understand the role of trace elements.<br>To understand the biological significance of iron, sulpur.To study the toxicity of metals in medicines.<br>To have knowledge on diagnostic agents.<br>To discuss on various metalloenzymes properties. | | | | | | |

**Course Outline**

**UNIT-I: Essential trace elements:** Selective transport and storage of metal ions: Ferritin, Transferrin and sidorphores; Sodium and potassium transport, Calcium signalling proteins.Metalloenzymes: Zinc enzymes– carboxypeptidase and carbonic anhydrase. Ironenzymes–catalase, peroxidase. Copperenzymes – superoxide dismutase, Plastocyanin, Ceruloplasmin, Tyrosinase. Coenzymes - Vitamin-B12 coenzymes.

**UNIT-II: Transport Proteins:** Oxygen carriers-Hemoglobin and myoglobin - Structure and oxygenationBohr Effect. Binding of CO,NO, CN– to Myoglobin and Hemoglobin.Biological redox system: Cytochromes-Classification, cytochrome a, b and c. Cytochrome P-450.Non-heme oxygen carriers-Hemerythrin and hemocyanin. Iron-sulphur proteins- Rubredoxin and Ferredoxin- Structure and classification.

**UNIT-III: Nitrogen fixation**-Introduction, types of nitrogen fixing microorganisms. Nitrogenase enzyme - Metal clusters in nitrogenase- redox property - Dinitrogen complexestransition metal complexes of dinitrogen - nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia. Photosynthesis:photosystem-I and photosystem-II-chlorophylls structure and function.

J**NIT-IV: Metals in medicine:** Metal Toxicity of Hg, Cd, Zn, Pb, As, Sb.TherapeuticCompounds:Vanadium-Based Diabetes Drugs; Platinum-Containing Anticancer Agents.Chelation therapy; Cancer treatment. Diagnostic Agents: Technetium Imaging Agents; Gadolinium MRI Imaging Agents. temperature and critical magnetic Field.

**UNIT-V: Biomolecules**: Amino acids and Proteins: Amino acids and Protein structure, peptides and their synthesis – (tripeptide using the amino acids glycine, alanine, lysine, cysteine, glutamic acid and arginine) – Analysis of N– terminal and C – terminals in a polypeptide. Sanger method, Edman degradation and Enzymatic analysis. Merrified synthesis – Primary, secondary and tertiary structure of proteins.

| | |
|---|---|
| Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved<br>(To be discussed during the Tutorial hours) |
| Skills acquired from this course | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |

| | |
|---|---|
| **Recommended Text** | 1. Williams,D.R. –Introdution to Bioinorganic chemistry.<br>2. F.M. Fiabre and D.R. Williams– The Principles of Bioinorganic Chemistry,RoyolSoceity of Chemistry, Monograph for Teachers-31<br>3. K.F. Purcell and Kotz., Inorganic chemistry, WB Saunders Co.,USA.<br>4. G.N. Mugherjea and Arabinda Das, Elements of BioinorganicChemistry - 1993.<br>5. R. Gopalan, V. Ramalingam, *Concise Coordination Chemistry*, S. Chand, **2001**. |
| **Reference Books** | 1. M.Satake and Y.Mido, Bioinorganic Chemistry-DiscoveryPublishing House, New Delhi (1996)<br>2. M.N. Hughes, 1982, The Inorganic Chemistry of Biological processes, II Edition, Wiley London.<br>3. R. W. Hay, Bio Inorganic Chemistry, Ellis Horwood, 1987.<br>4. R. M. Roat-Malone, Bio Inorganic Chemistry, John Wiley, 2002.<br>5. T. M. Loehr, Iron carriers and Iron proteins, VCH, 1989. |
| **Website and e-learning source** | 1. https://www.pdfdrive.com/instant-notes-in-inorganic-chemistry- the-instant-notes-chemistry-series-d162097454.html<br>2. https://www.pdfdrive.com/shriver-and-atkins-inorganic-chemistry- 5th-edition-d161563417.html |

**Course Learning Outcomes (for Mapping with POs and PSOs)**

Students will be able:
**CO1**: The students will be able to analyses trace elements.
**CO2**: Students will be able to explain the biological redox systems.
**CO3**: Students will gain skill in analyzing the toxicity in metals.
**CO4**: Students will have experience in diagnosis.
**CO5**:Learn about the nitrogen fixation and photosynthetic mechanism.

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** |
| **CO 2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 3** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** |
| **CO 4** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 5** | **M** | **S** | **M** | **S** | **S** | **M** | **S** | **M** | **S** | **S** |

**3 – Strong, 2 – Medium, 1 - Low**

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

| **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 |

**3 – Strong, 2 – Medium, 1 - Low**

| **Title of the Course** | **b). MATERIAL SCIENCE AND NUCLEAR CHEMISTRY** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Paper No.** | **Elective IV** | | | | | | |
| **Category** | **Elective** | **Year** | I | **Credits** | 4 | **Course Code** | |
| | | **Semester** | II | | | | |
| **Instructional hours per week** | **Lecture** | **Tutorial** | **Lab Practice** | | | **Total** | |
| | 4 | 1 | - | | | 5 | |
| **Prerequisites** | **Basic knowledge of solid-state chemistry** | | | | | | |

| | |
|---|---|
| **Objectives of thecourse** | To understand the crystal structure, growth methods and X-ray scattering.<br>To explain the optical, dielectric and diffusion properties of crystals.<br>To recognize the basis of semiconductors, superconductivity materials and magnets.<br>To study the synthesis, classification and applications of nanomaterials.<br>To learn about the importance of materials used for renewable energy conversion. |

**Course Outline**

**UNIT-I: Crystallography:** symmetry - unit cell and Miller indices - crystal systems - Bravais lattices - point groups and space groups - X- ray diffraction-Laue equations-Bragg's law-reciprocal lattice and its application to geometrical crystallography. Crystal structure–powderand single crystal applications. Electron charge density maps, neutron diffraction-method and applications.

**UNIT-II: Crystal growth methods: N**ucleation–equilibrium stability and metastable state. Single crystal –Low and high temperature, solution growth– Gel and sol-gel. Crystal growthmethods-nucleation– equilibrium stability and metastablestate.Singlecrystal– Lowandhightemperature, solution growth– Gel and sol-gel. Melt growth Bridgeman-Stockbarger,Czochralskimethods.Fluxtechnique,physicalandchemical vapourtransport. Lorentz and polarization factor-primary andsecondary extinctions.

**UNIT-III: Materials for Renewable Energy Conversion:** Solar Cells:Organic, bilayer, bulk heterojunction, polymer, perovskite based. Solar energy conversion: lamellar solids and thin films, dye-sensitized photo voltaic cells, coordination compounds anchored onto semiconductorsurfaces - Ru(II) and Os(II) polypyridyl complexes. Photochemical activation and splitting of water, CO2 and N2. Manganese based photo systems for water-splitting. Complexes of Rh, Ru, Pd and Pt - photochemical generation of hydrogen from alcohol.

**UNIT-IV: Nuclear Chemistry I:** Nuclear properties – Nuclear spin and Moments, origin of nuclear forces, Quark Theory for sub-atomic particles (basic). Salient features of the Shell and Liquid Drop Modelof the nucleus. Modes of radioactive decay: Orbital electron capture; nuclear isomerism, internal conversion Isomeric Transition, detection and determination of activity by cloud chamber, Nuclear emulsion, Bubble chamber, Geiger Muller, Scintillation and Cherenkov counters. Compound Nucleus theory, high energy nuclear reactions, nuclear fission and fusion reactions as energy sources: direct reactions.

**UNIT-V: Nuclear Chemistry II:** Nuclear Reaction types, reaction, cross section, Q-value, threshold energy,Stellar energy: synthesis of elements, Hydrogen burning, Carbon burning. Photonuclear andThermo nuclear reactions. Szilard Chalmers reaction. The e, s, r, p and x processes.Nuclear reactors- fast breeder reactors, particle accelerators, cyclotron and synchrotron. Radio analytical methods:Isotope dilution analysis, Radiometric titrations, Radio immuno assay, Neutron activation analysis.

| | |
|---|---|
| Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper) | Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved<br>(To be discussed during the Tutorial hours) |
| Skills acquired from this course | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |
| **Recommended Text** | 1. S. Mohan and V. Arjunan, Principles of Materials Science, MJPPublishers, 2016.<br>2. Arumugam, Materials Science, Anuradha Publications, 2007.<br>3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010<br>4. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.<br>5. Essentials of nuclear chemistry by H.J. Arnikar, Eastern Wiley(1990)<br>6. Nuclear chemistry by Friedlander and Kennedy, John Wiley and Sons(1987) |
| **Reference Books** | 1. Suggested Readings 1. M.G. Arora, Solid State Chemistry, Anmol Publications, New Delhi, 2001.<br>2. R.K. Puri and V.K. Babbar, Solid State Physics, S Chand and Company Ltd, 2001.<br>3.. C. Kittel, Solid State Physics, John-Wiley and sons, NY, 1966.<br>4. H.P. Meyers, Introductory Solid State Physics, Viva Books Private Limited, 1998.<br>5. A.R. West, Solid State Chemistry and Applications, John-Wiley andsons, 1987.<br>6. Nuclear radiation detection by Price. Nuclear radiation detectors by S.S. Kapoor and Ramamoorthy, Wiley Eastern (1986). |
| **Website and e-learning source** | 1. http://xrayweb.chem.ou.edu/notes/symmetry.html.<br>2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf.<br>3. https://bit.ly/3QyVg2R |

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

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** |
| **CO 2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 3** | **S** | **S** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** |
| **CO 4** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO 5** | **M** | **S** | **M** | **S** | **S** | **M** | **S** | **M** | **S** | **S** |

**3 – Strong, 2 – Medium, 1 - Low**

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

| 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 |

**3 – Strong, 2 – Medium, 1 – Low**

# SKILL ENHANCEMENT- I
# COSMETIC CHEMISTRY

**COURSE OBJECTIVES:**

- To gain basic knowledge about cosmetics products.
- To get basic knowledge on soaps.
- To get idea about detergents.
- To get idea about cleansers.
- To gain knowledge about surfactants.

**COURSE OUTCOME:**

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

| CO number | CO statement |
|---|---|
| **CO1** | The basic knowledge of Cosmetics and Preparation of Cosmetics products with desired pH. |
| **CO2** | Basics about health care hygienic products and about the General Preparation and formulations of Soaps. |
| **CO3** | General Preparation and formulations of Detergents and other hygienic products with desired pH identification. |
| **CO4** | To attain the basic ideas to prepare important home care cleaners. |
| **CO5** | To inculcate the knowledge about preparation of different types of wash liquid. |

**UNIT-1: Cosmetics and Preparation of Cosmetics products**

Cosmetics: Composition and formulation of cream: Crack cream, Anti-aging cream, Moisturising cream, perfume, Talcum powder, deodorants, shampoos, eye liner and nail polish.

**UNIT-2: Soaps and soap powder**

Soaps – Classification- different methods of soap preparation- soap powder- liquid soap –Mechanism of Cleaning Action of soap- Advantages and disadvantages of soap- pH identification.

**UNIT-3: Preparation and properties of Detergents**

Detergents Introduction- Classification- Detergents –Advantages and disadvantages ofDetergents– Mechanism of Cleaning Action of detergents- Advantages and disadvantagesof detergents - pH identification.

**UNIT-4: Preparation and formulations Cleaners**

General method of Preparation and formulations of the following: Composition and formulations of toilet cleaner, cleaning powder, hand wash and floor cleaner. Preparationof cleaners-Introduction-Surface cleaner-glass cleaner-tiles and marble cleaner toiletcleaner-different methods of preparation - advantages.

**UNIT 5-: Preparation of surfactants**

Introduction- Surfactants – Classification with an example – Builders – General methodof Preparation and formulations of the following cosmetic products: sanitizers, Hand wash, Toothpaste, Lip Balm.

**References**


1. Jan Berry "The big book of home made products for your skin, health and home,page street publishing, 2020.
2. Dr. Kamala Pathak,"Cosmetic science, concepts and principles, Nirali Prakashan,2020.
3. Ernest W. Flick , Cosmetic and Toiletry Formulations, Noyes Publications, 1992.

# SKILL ENHANCEMENT- I

## RESEARCH TOOLS AND TECHNIQUES

**COURSE OBJECTIVES:**

To study about the importance of research and understanding of the techniques.

To study the evaluation of analytical datas and to understanding of various analytical methods of analysis

**COURSE OUTCOME:**

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

| CO number | CO statement |
|---|---|
| **CO1** | Acquire good knowledge about the nature and importance of research |
| **CO2** | To gain knowledge about search engines used in research |
| **CO3** | Apply the statistical treatment of various tests |
| **CO4** | To inculcate the knowledge about basics of computer |
| **CO5** | To enrich the skill about chemistry related softwares |

**Unit 1: 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.

**Unit 2: Search Engines**

ASAP Alerts, CA Alerts, SciFinder, Chem Port, Science Direct, Web of Science, Scopus, STN International.

**Unit 3: Statistical Treatment of Analytical Data**

Statistical treatment of finite samples – the students 't' test and F test – Criteria for rejection of an observation – Q test – significant figures and computation rules – data plotting – Correlation diagram – least square analysis – correlation and regression analysis – correlation coefficient – bar diagram.

**Unit 4: Computer Applications**

Introduction to basic hardwares and softwares (MS Word, Power Point, Excel, Origin), bits, bytes, words, CPU, memory, operating systems (DOS, WINDOWS, UNIX). Scientific computer uses, algorithms and flow-charts, programming (with FORTRAN).

**Unit 5: Computer Related Software**

Introduction to chemistry related software (Gaussian, Gaussview, ChemDraw) and databases (SciFinder, Scopus, Cambridge Structural Database (CSD)).

**Reference**

1. Kumar, R., Research Methodology - A Step-By-Step Guide for Beginners, Pearson Education, Delhi (2006).

2. Montgomery, D. C., Design & Analysis of Experiments, 5 th Ed., Wiley India (2007).

3. Kothari, C. K., Research Methodology-Methods and Techniques, 2 nd Ed., New Age International, New Delhi.

4. T.S.Wilkinson and P.L Bhandarkar, Methodology And Tecniques Of Social Research, Bombay; Himalaya publishing company, 2001

5. Dynamics of Chromatography- Part I; J.C. Gidding; Dekker, New York.