

Semester-II
Core Course-V
Advances in Chemistry

Full Marks -70

Credits-5

Unit-I Nuclear Chemistry

- (a) Shell model, Liquid drop Model, Nuclear Reactions and their Types. Nuclear Reactions Cross-section.
- (b) Application of radio isotopes, tracer techniques, Neutron activation analysis, isotope dilution method.

Unit-II Chemistry of Nanomaterials

Definition, sources, examples, Bottom-up Method of synthesis, Characterizations, and applications

Unit-III Solid state Chemistry

Conductor, Semiconductor, and superconductor; Theory and Application

Unit-IV Industrial Application of Chemistry

Chemistry of Cement, Paper and Pulp, and Petroleum

Unit-V Waste Management

Nuclear waste management,

e-waste management.

Recycling of plastic: (sorting, washing, shredding, identification and classification, extruding.) X-delete.

Books recommended:

- 1- Industrial pollution: ~~by~~ Alka Gupta.
- 2- Solid State Chemistry: ~~by~~ Smart and Moore
3. Nuclear Chemistry : Sharon and Sharon
4. Solid State Chemistry and its application : Anthony R West
5. The chemistry of nanomaterials : CNR Rao, A. Muller & A.K. Cheetham.
6. Nanomaterials and their classification : Zishan Hussain Khan
Chinases -

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Semester-II
Core Course-VI
Inorganic Chemistry II

Full Marks -70

Credits-5

- Unit-I Bonding in coordination Compounds:** Effect of distortion on d- orbital energy level. Jahn- Teller effect, spectro chemical series. Thermo dynamic effect of crystal field Theory. Site selection in Normal and inverse spinel structure. Calculation of hydration energy and lattice energy of complexes. Evidences in support of covalent bonding in Transition metal complexes. M.O. Theory of Mⁿ⁺ with σ and π -bonding ligands using symmetry arguments. Magnetic properties and charge transfer spectra on the basis of M.O. model.
- Unit-II Electronic Spectra of Transition Metal Complexes.**
Spectroscopic ground states, correlation and spin-orbit coupling in free ions for 1st series of transition metals, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1 - d^9 states), calculation of Dq, B and β parameters. Structural evidence from electronic spectrum, Spectrochemical and nephelauxetic series, charge transfer spectra, electronic spectra of molecular addition compounds.
- Unit-III Symmetry in Chemistry.**
Symmetry elements and symmetry operations, definition of groups, subgroup, conjugate and class. Point symmetry group. Requirements of a mathematical group, multiplication table for C_{2v} , C_{3v} .
- Unit-IV Group theory in Chemistry.**
Representation of group by matrices. Working out representation of C_{2v} , C_{3v} point groups. Character of a representation. The great orthogonality theorem (without proof) and its importance in derivation of character table. Construction of character table for C_{2v} and C_{3v} point group.
- Unit-V Metal π -complexes.**
Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation. Preparation, bonding. Structure and important reaction of transition metal nitrosyls.

Dinitrogen, tertiary phosphines as ligands. Metal Carbonyl clusters- Low
Nuclear Carbonyl clusters Total electron count (TEC)

Books Recommended

1. Advanced Inorganic Chemistry- F.A. Cotton and G. Wilkinson.
2. Inorganic Chemistry- Principles of Structure and reactivity - J.E. Huheey
3. Concise Inorganic Chemistry- J.D. Lee
4. Group Theory and its chemical applications- F.A. Cotton
5. Group Theory and its chemical applications- P.K. Bhattacharya

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Semester-II
Core Course-VII
Physical Chemistry II

Full Marks -70

Credits-5

Unit-I Introduction to quantum mechanics.

- (i) Postulates of quantum mechanics, Angular momentum and Linear Operator
- (ii) Hermitian operators, properties of operators.
- (iii) Theorems of operators.

Unit-II Exactly soluble system.

- (i) Linear Harmonic oscillator, Harmonic Vibration Hermite differential equation and its solution through recursion relation polynomial.
- (ii) H-like atoms, separation of r, θ, ϕ equation. Laguerre and associated Laguerre Polynomial. Legendre polynomial equation and their solution.

Unit-III Approximate Method.

Variation method, Secular equation, Slater determinant, Perturbation method, first order perturbation Application to He-atom. Symmetric and antisymmetric wave functions.

Unit-IV Huckel Molecular Orbital Theory.

Huckel theory of conjugated systems, bond order and charge density its calculation. Application to ethylene, butadiene, allyl and benzene

Unit-V Chemical Bonding

LCAO-MO theory, application of LCAO-MO theory to H_2^+ ion and H_2 molecule

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Recommended

Book Suggested:-

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|--|---|
| 1. Quantum chemistry | : I.R. Lavine Prentice Hall |
| 2. Quantum chemistry | : Pillar |
| 3. Quantum chemistry | : R.K. Prasad |
| 4. Quantum chemistry | : Satya Prakash Swati Saluja |
| 5. Solid State Chemistry | : D.K. Chakrabarty, New Age International |
| 6. New Direction Solid State Chemistry | : C.N.R. Rao & J. Gopal |
| 7. Introduction to quantum Chemistry | : A.K. Chandra, Tata |

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Semester-II
Core Course-VIII
Organic Chemistry II

Full Marks -70

Credits-5

Unit-I Addition to Carbon-Carbon Multiple Bonds:

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydroboration Michael reaction. Sharpless asymmetric epoxidation.

Free Radical Reactions

Allylic halogenations (NBS), oxidation of aldehydes to carboxylic acids auto-oxidation, coupling of alkynes, Free radical rearrangement Hunsdiecker reaction.

Unit-II Photochemistry of carbonyl compounds.

Photochemistry of enones, hydrogen abstraction, Rearrangements of α,β unsaturated ketones and cyclohexadienones, photochemistry of p-benzoquinones.

Photochemistry of unsaturated system

Olefins, cis-trans isomerisation, dimerisation hydrogen abstraction and additions. Acetylenes-dimerisation, dienes-photochemistry of 1, 3-butadiene [2+2] additions leading to cage structures, photochemistry of cyclohexadienes, photochemistry of aromatic compounds-excited state of benzene and its 1,2 and 1,3-shifts, Photo-Fries rearrangement, Photo-Fries reaction of anilides, photosubstitution reaction of benzene derivatives, Photolysis of nitride esters and Barton reaction.

Unit-III Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1, 3-butadiene, 1,3,5-hexatriene and allyl system, Classification of pericyclic reactions, Woodward-Hoffmann correlation diagrams, FMO and PMO approach, Electrocyclic reactions-conrotatory and disrotatory motions, $4n$, $4+2$ and allyl systems. Cycloadditions-antrafacial and suprafacial additions, $4n$ and $4n+2$ systems, $2+2$ addition of ketenes, 1,3-dipolar cycloadditions and cheletropic reactions.

Sigmatropic rearrangement

Suprafacial and antarafacial shift of H, sigmatropic shifts involving carbon moieties, retention and inversion of configuration, (3,3) and (5,5) sigmatropic rearrangements detailed treatment of Claisen and Cope-rearrangements. Aza-Cope rearrangements. Introduction to Ene reactions. Simple problems on pericyclic reactions.

Unit-IV Carbohydrate

Conformation of monosaccharides and important derivatives of monosaccharide- glycosides, deoxysugar, aminosugar. Structure determination and chemical synthesis of sucrose, and maltose.

Unit-V Amino acids, peptides and proteins

Chemical and enzymatic hydrolysis of proteins, amino acid sequencing. Secondary structure of protein, force responsible for secondary structure of protein, α -helix, β -sheet. Super secondary structure, tertiary structure of proteins folding.

~~Books also available...~~

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Semester-II
Core Course -IX
Practical (Organic Chemistry)

Full Marks-50

Duration of Exam 6 hrs.

Credits-5

1. Quantitative Analysis

Separation and identification of organic compounds in binary mixtures by chemical tests and preparation of their derivatives. 15Marks

2. Organic Synthesis via two steps preparation

15 Marks

- a. β -Nitroaniline from acetanilide.
- b. β -Bromoaniline from acetanilide
- c. β -Anthranilic acid from phthalic anhydride.
- d. β -Bromoacetanilide from aniline.
- e. β -Nitroacetanilide from aniline.
- f. β -Aminoazo benzene from aniline.

3. Viva Voce

15 Marks

4. Note Book

05 Marks

Books Recommendation:

1. Advanced Practical Chemistry by Jagdamba Singh, L.D.S Yadav and Jaya Singh
2. Systematic Qualitative Organic Analysis by H. Middleton.
3. Handbook of Organic Analysis- Qualitative and Quantitative by H. Clark.
4. Vogel's Textbook of Practical Organic Chemistry by A.R. Tatchell.

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Semester-II
AEC-1

Practical & Applications of Spectroscopy

Total Marks: 70

Duration: 3 hours

Unit-I: Rotational Spectroscopy

Qualitative and quantitative analysis using rotational spectroscopy
Classification of diatomic and polyatomic molecules
Rotational energy levels and transitions
Selection rules for rotational transitions
Molecular structure determination

Unit-II (A): Vibrational Spectroscopy

Normal modes of vibration in diatomic and polyatomic molecules
Vibrational energy levels and transitions
Selection rules for vibrational transitions
Molecular structure determination

Unit-III: Photoacoustic Spectroscopy

Principle and applications of photoacoustic spectroscopy
Measurement of absorption coefficients
Molecular structure determination
Photoacoustic cell design and construction
Applications in environmental monitoring and industrial process control

Unit-IV: Raman Scattering Spectroscopy

Principle and applications of Raman scattering spectroscopy
Measurement of Raman scattering cross-sections
Molecular structure determination
Applications in material science and biological systems

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