SYLLABUS
ACADEMIC SESSION- 2023-24

Generic Elective Papers (GE) (Minor-Chemistry) for other Departments/ Disciplines

B.Sc. (HONOURS) III year
Zoology/Biotechnology/Mathematics

UNDERGRADUATE PROGRAMME
Choice Based Credit System (CBCS)

FACULTY OF SCIENCES
MATA GUJRI COLLEGE FATEHGARH SAHIB
(An Autonomous College)
Affiliated to Punjabi University Patiala

Prof. (Dr.) Baljit Singh
Prof. (Dr.) Sonal Singhal
Mr. Ravinderjeet Singh
Mrs. Rachna Bhardwaj
Dr. Poonam Patiyar
Mr. Puneet Bhardwaj
Mrs. Priya Sharma

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SEMESTER V

BSHCHE GE-5: CHEMISTRY V

Maximum Marks: 100 Time: 3 Hrs
External Examination: 75 Pass marks: 40%
Internal Assessment: 25
(Credits: -04) Theory: 60Lectures

Course Objectives

- To get a deep insight into the various spectroscopic methods used for the characterization of organic compounds.
- Enable the students to elucidate the structure of organic compounds by analyzing thespectral data.
- To understand the general concept of reaction kinetics and mechanism of square planar and octahedral complexes.
- To identify the substance being oxidized and reduced.
- To know the role of metals in biological system.
- To describe the strength of an acid or base in terms of the extent to which its molecules donate or accept protons.

Course Outcomes

After the completion of this course, students will be able to:

CO1 Understand the basic principles of the following spectroscopic techniques: UV/Vis,IR and proton NMR spectroscopy.

CO2 Explain and rationalize the inorganic reaction mechanisms of square planar and octahedral complexes.

CO3 To describe how the strength of either an acid or base is indicated by the magnitude ofits equilibrium constant.

Instructions for the Paper-Setter

The question paper will consist of three units: I, II and III. Unit I and II will have four questions from each unit of the syllabus and will carry 12 marks each. Unit III will consist of 9 questions from the whole syllabus and will be of 3 marks each.

Instructions for the Candidates

Candidates are required to attempt two questions each from units: I and II, unit III is compulsory. Note: Internal assessment will be given on the basis of mid semester tests (12), class performance (6), assignments/quiz (7).

Unit-I

UV-Visible Spectroscopy

Absorption spectra: Ultraviolet (UV) absorption spectroscopy-absorption laws (Beer-Lambert's law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation, concept of chromophore and auxochrome,

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bathochromic, hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones, Woodward-Fiesher rules for calculation of λ_{max} of dienes and enones. Applications of UV spectroscopy.

Infrared (IR) Absorption Spectroscopy

Molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds. Applicationsof IR spectroscopy.

Nuclear Magnetic Resonance (NMR) Spectroscopy

Proton magnetic resonance (PMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, Interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2tribromomethane, ethyl acetate, toluene and acetophenone.

(30 lectures)

Unit-II

Oxidation and Reduction

Oxidation and reduction reactions, oxidation number, redox reactions in terms of oxidation number, standard electrode potential, electrode potential of a cell, electrochemical series, use of redox potential data-analysis of redox cycle, redox stability in water- Frost and Pourbaix diagram.

Reaction Kinetics and Mechanism

Thermodynamic and kinetic stability of complexes, labile and inert complexes, interpretation of lability and inertness of complexes. Kinetics of substitution reactions in square planar complexes, the trans effect, theories and mechanism of trans effect.

Acids and Bases

Classification of acids and bases as hard and soft, Pearson's HSAB concept, acid-base strength and hardness-softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness-softness.

Books recommended:

- W. Kemp, Organic Spectroscopy, UK.
- J. Mohan, Organic Spectroscopy: Principles and Applications, 2001.
- D.L. Pavia, G.M. Lampan and G.S. Kriz, Introduction to Spectroscopy, Hartcourt College Publishers.
- Y.R. Sharma, Organic Spectroscopy, 2015.
- J. D. Lee, Concise Inorganic chemistry, ELBS.
- F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley, VCH, 1999.

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- B. R. Puri, L.R. Sharma and K. C. Kalia, Principle of Inorganic chemistry, Milestone Publishers, Delhi.
- J. E. Huheey, Inorganic Chemistry, Prentice Hall.
- P. Atkins, Physical Chemistry, 1978.
- Elias and B.D. Gupta, Basic Organometallic Chemistry, 2013.

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BSHCHE-GE-5(L): Chemistry V Lab

Max. Marks: 50 | No. of Lectures: 60 Hrs.
Time Allowed: 3 hrs. | Pass Marks: 40%
(Credits- 02)

Course Objectives

To impart a thorough knowledge on absorption spectra of colored compounds using Beer-Lambert's law.

Course Outcomes

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

- Synthesize various organic compounds through multi-step reactions and characterizethese compounds using IR and NMR spectroscopic techniques.
- Understand and operate the UV-Visible spectrophotometer for the study of metal-ligand complexes.

Instructions: Practical examination will be conducted in one single day and marks distribution will be as follows:

Notebook: 5 marks
Viva: 10 marks
Write-up and Performance: 35 marks

1. Preparation of benzpinacol from benzophenone (photoreduction).
2. Preparation of Benzpinacolone from benzpinacol (pinacol-pinacolone rearrangement).
3. Estimation of glycine by Sorenson's formalin method.
4. Study of the titration curve of glycine.
5. Saponification value of an oil or a fat.
6. To study UV-Vis spectra of $KMnO_4$ solution and determine its λ_{max}.
7. Verify Lambert-Beer's law using 5% $CuSO_4$ solution.
8. Preparation of acetylacetonate complexes of Cu^{2+}/Fe^{3+}. Find the λ_{max} of the complex.
9. To draw calibration curve for various concentrations of $FeSO_4$/1-10-phenanthrolinecomplex and hence to find the coefficient of its molar absorptivity.

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Generic Elective Papers (GE) (Minor-Chemistry)
BSHCHE-GE-6 Chemistry VI

Maximum Marks: 100 Time: 3 Hrs
External Examination: 75 Pass marks: 40%
Internal Assessment: 25
(Credits: -04) Theory: 60Lectures

Course Objectives

- The course is adequated with basic knowledge of nitrogen containing functional groups, heterocyclic & polynuclear compounds.
- To learn about electronic spectra and magnetic properties of transition metal complexes.

Course Outcomes

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

- Learn the technique of synthesis of heterocyclic compounds used in synthesis of various drugs & students will also get basic idea of properties and reactions of heterocyclic compounds.
- Identify the repeat units of particular polymers and specify the isomeric structures which can exist for those repeating units.
- To estimate the number and weight average molecular masses of polymer samples given by the degree of polymerization and mass fraction of chains present.
- Learn the concept of electronic transitions responsible for the imparting colour to transition metal complexes.

Instructions for the Paper-Setter

The question paper will consist of three units: I, II and III. Unit I and II will have four questions from each unit of the syllabus and will carry 12 marks each. Unit III will consist of 9 questions from the whole syllabus and will be of 3 marks each.

Instructions for the Candidates

Candidates are required to attempt two questions each from units: I and II, unit III is compulsory. Note: Internal assessment will be given on the basis of mid semester tests (12), class performance (6), assignments/quiz (7).

UNIT-I

Heterocyclic-I

Introduction: Molecular orbital picture of pyrrole, furan, thiophene, pyridine. Classification, Nomenclature, structure and aromaticity in 5 and 6 membered rings containing heteroatom. Methods of synthesis, reaction and mechanism of electrophilic substitution of: Furan (Paal Knorr synthesis, Fiest-Benary synthesis) Pyrrole (Paal Knorr synthesis, Hantzsch pyrrole synthesis), thiophene (Paal Knorr synthesis, from acetylene), pyridine (Hantzsch synthesis, from pyrrole), comparison of basicity of pyridine, piperidine and pyrrole.

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Heterocyclic-II

Indole (Fischer indole synthesis, Madelung synthesis, Reissert synthesis, Bischler synthesis), Quinoline (Skraup synthesis, Doebner-Miller synthesis), Isoquinoline (Bischer-Napieralski synthesis, Pomeranz-Fritsch synthesis), Basicity, electrophilic and nucleophilic substitution reactions of indole, quinoline and isoquinoline.

(30 lectures)

UNIT-II

Molecular Symmetry

Basics of symmetry, symmetry elements and symmetry operations

Electronic Spectra of Transition Metal Complexes

Types of electronic transitions, selection rules for d-d transitions, relaxation to selection rules,spectroscopic ground states, spectrochemical series, Orgel energy level diagrams for d^1, d^2,d^3, d^7, d^8, d^9 states, discussion of electronic spectrum of $[Ti(H2O)6]^{3+}$ and $[V(H2O)6]^{3+}$complexion, Jahn Teller effect.

Magnetic Properties of Transition Metal Complexes

Types of magnetic behavior, methods of determining magnetic susceptibility, Curie law, Neel's point, spin-only formula, L-S coupling, correlation of μ_S and μ_{eff} values, orbital contribution to magnetic moment, temperature independent paramagnetism, magnetic behavior of first row transition metal compounds. **(30 lectures)**

Reference Books

- R.T Morrison and R.N Boyd, Organic Chemistry darling Kindersley (India) Pvt. Ltd. (Pearson Education).
- J.A. Joule and K. Mills, Heterocyclic Chemistry, 4th Ed.
- T. L. Gilchrist Hetrocyclic Chemistry 3rd Ed.
- S.P. Singh, R.P. Kapoor, S.M. Mukherji, R. Dass, Organic Chemistry, Volume 2.
- J.E. Huheey, Inorganic Chemistry, Prentice Hall, 3rd Ed.
- F.A Cotton and Wilkinson; Inorganic Chemistry.
- B. R. Puri, L.R. Sharma and K. C. Kalia, Principle of Inorganic chemistry, Milestone Publishers, Delhi.

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BSHCHE-GE-6(L) Chemistry VI Lab

Max. Marks: 50 | No. of Lectures: 60 Hrs.
Time Allowed: 3 hrs. | Pass Marks: 40%
(Credits- 02)

Course Objectives

- To impart the knowledge of methods of preparation of coordination complexes.
- The technique of synthesis of heterocyclic compound is important in the synthesis of different drugs. This course gives the quantitative idea about the synthesis of heterocyclic compounds.

Course Outcomes

At the end of this course, the students will be able to

- Learn various synthetic and mechanistic approaches for heterocyclic compounds.
- Learn about the synthesis and coordination chemistry of various transition metal complexes.

Instructions: Practical examination will be conducted in one single day and marksdistribution will be as follows:

Notebook: 5 marks
Viva: 10 marks
Write-up and Performance: 35 marks

Inorganic Preparations:

1. Preparation of tetramminecopper sulphate complex.
2. Preparation of hexaaminecobalt (III)chloride
3. Preparation of Potash Alum
4. Preparation of Potassium tri(oxalato)ferrate (III)
5. Preparation of sodium trioxalotoferrate (III).

Organic Preparations:

1. Preparation of benzimidazole.
2. To prepare Dibenzalacetone by aldol condensation.
3. To prepare Benzilic acid from Benzil using green approach.
4. To prepare semicarbazone of aldehyde or ketone.
5. To prepare pure sample of acetanilide from aniline.

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