

DEPARTMENT OF CHEMISTRY
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY,
HISAR

Proposed Scheme and Syllabus for Additional Subjects for Eligibility as Trained Graduate Teacher (TGT) for the students of Dual degree B.Sc. (Hons) -M.Sc. Programme in Physics/ Mathematics (w.e.f. Session 2025-26).

SEMESTER-III								
Type of Course	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours/week	Internal Marks	External Marks	Total Marks	Duration of exam (Hrs)
Core Course	BCL-306AD	Chemistry-III (Periodic Properties & States of Matter)	4	4	30	70	100	3
Core Course	BCP-304AD	Chemistry Lab-III	2	4	30	70	100	4
Total	-----		6	8	60	140	200	-----

SEMESTER-IV								
Type of Course	Course Code	Nomenclature of Paper/Course	Credits	Contact Hours/week	Internal Marks	External Marks	Total Marks	Duration of exam (Hrs)
Core Course	BCL-406AD	Chemistry-IV (Basics of Organic Chemistry & Analytical Techniques)	4	4	30	70	100	3
Core Course	BCP-404AD	Chemistry Lab-IV	2	4	30	70	100	4
Total	-----		6	8	60	140	200	-----

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CHEMISTRY-III
(Periodic Properties & States of Matter)

Paper code: BCL-306AD

60 Hrs (4Hrs/week)

Credits: 4

Time for Major Examination: 3Hrs

Marks for Major Test (External): 70

Marks for Internal Exam: 30

Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus that will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I

Periodicity of Elements

15 Hrs

s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s and p-block.

- (a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
- (b) Atomic radii (van der Waals)
- (c) Ionic and crystal radii.
- (d) Covalent radii (octahedral and tetrahedral)
- (e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.
- (f) Electron gain enthalpy, trends of electron gain enthalpy.
- (g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffe's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

UNIT-II

Chemistry of s and p Block Elements

15 Hrs

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements.

Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate.

UNIT-III

Gaseous state

15 Hrs

Kinetic molecular model of a gas: derivation of the kinetic gas equation; collision frequency and diameter; mean free path and viscosity of gases, temperature and pressure dependence, relation between mean free path and coefficient of viscosity.

Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

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CHEMISTRY LAB-III

Paper code: BCP-304AD

60 Hrs (4Hrs/week)

Credits: 2

Time for Major Examination: 4Hrs

Marks for Major Test (External): 70

Marks for Internal Exam: 30**Total Marks: 100**

(A) Inorganic preparations

- (i) Cuprous Chloride $[\text{Cu}_2\text{Cl}_2]$
(ii) Aluminium potassium sulphate (Potash alum) $[\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}]$

(B) Acid-Base Titrations

- (i) Estimation of carbonate and hydroxide present together in mixture.
- (ii) Estimation of carbonate and bicarbonate present together in a mixture.
- (iii) Estimation of free alkali present in different soaps/detergents.

(C) Phase equilibria

- (i) Construction of the phase diagram using cooling curves or ignition tube method:
- simple eutectic and
 - congruently melting systems.

- (ii) Distribution of acetic/ benzoic acid between water and cyclohexane.**

(D). pHmetry

- (i) Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.

- (ii) Preparation of buffer solutions of different pH

- Sodium acetate-acetic acid
- Ammonium chloride-ammonium hydroxide

- (iii) pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.

BOOKS SUGGESTED:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
2. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
3. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
4. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).
5. Yadav J. B. Advanced Practical Physical Chemistry.

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CHEMISTRY-IV
(Basics of Organic Chemistry & Analytical Techniques)

Paper code: BCL-406AD

60 Hrs (4Hrs/week)

Credits: 4

Time for Major Examination: 3Hrs

Marks for Major Test (External): 70

Marks for Internal Exam: 30

Total Marks: 100

Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus that will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.

UNIT-I

Basics of Organic Chemistry

9 Hrs

Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties of Organic Compounds.

Dipole moment; Organic acids and bases; their relative strength, Curly arrow rules, formal charges; Nucleophilicity and basicity.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Aromatic Hydrocarbons

6 Hrs

Aromaticity: Huckel's rule, aromatic character of arenes, Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

UNIT-II

Chemistry of Aliphatic Hydrocarbons

5 Hrs

Carbon-Carbon sigma bonds

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

Carbon-Carbon pi bonds

10 Hrs

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction;

Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

UNIT-III

Spectroscopy

15 Hrs

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument.

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Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

Thermal methods of analysis

7 Hrs

Electroanalytical methods

8 Hrs

Books Suggested:

1. Morrison, R. N., Boyd, R. N. & Bhattacharjee S. K. Organic Chemistry, 7th ed. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
4. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
5. Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
6. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
7. Harris, D.C. Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016.
8. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009.
9. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.
10. Mikes, O. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
11. Ditts, R. V. Analytical Chemistry: Methods of separation, van Nostrand, 1974.

ts, R. V. Analytical Chemistry; Methods of separation, van Nostrand, 1974.

CHEMISTRY LAB-IV

Paper code: BCP-404AD

60 Hrs (4Hrs/week)

Credits: 2

Time for Major Examination: 4Hrs

Marks for Major Test (External): 70

Marks for Internal Exam: 30

Total Marks: 100

1. Chromatography

- Separation of a mixture of two amino acids by ascending and horizontal paper chromatography.
- Separation of a mixture of two sugars by ascending paper chromatography.
- Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC).

2. **Functional group tests** for alcohols, phenols, carbonyl, carboxylic acid nitro, amine and amide groups.

3. Organic Preparations

- Dibenzalacetone
- m*-dinitrobenzene.

BOOKS SUGGESTED:

- Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
- Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry, 5th Ed. Pearson (2012)
- Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

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