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**Syllabus 2023-24**  
**Panjab University**

# **BSc**

# **(CHEMISTRY)**

# **FOURTH SEMESTER**

SCO 80-81, Sec.15D, Chandigarh  
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**CHEMISTRY****SEMESTER-IV**

<i>Paper</i>	<i>Course</i>	<i>Teaching Hrs.</i>		<i>Max. Marks</i>
XIII	Inorganic Chemistry-B	30	3 periods per week	22+3 internal assessment
XIV	Organic Chemistry-B	30	3 periods per week	22+3 internal assessment
XV	Physical Chemistry-B	30	3 periods per week	22+3 internal assessment
XVI	Laboratory Practicals		6 periods per week	22+3 internal assessment
Total			60 periods/week	100

Paper-XIII: INORGANIC CHEMISTRY-B

Time : 3Hrs

**Max. Marks : 22+3****60 Hrs. (2 Hrs/Week)****3 Periods/Week****OBJECTIVE OF THE COURSE**

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (GENERAL) (Semester system) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

**UNIT-I****(8 Hrs.)****Chemistry of Lanthanide Elements:**

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.

**Chemistry of Actinides:**

General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides.

**UNIT-II****(7 Hrs.)****Acids and Bases:**

Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases.

**UNIT-III****(8 Hrs.)****Oxidation and Reduction:**

Use of redox potential data – analysis of redox cycle, redox stability in water – Frost, Latimer and Pourbaix diagrams. Principles involved in the extraction of the elements.

**UNIT-IV****(7 Hrs.)****Non-aqueous Solvents:**

Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH<sub>3</sub> and liquid SO<sub>2</sub>.

**Instructions for paper setters and candidates:**

- i. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.*
- ii. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.*
- iii. Compulsory question carries six marks and remaining all questions carry four marks each.*

**Books Suggested**

1. Cotton, F.A., Wilkinson, G., Gaus, P.L., Basic Inorganic Chemistry; 3<sup>rd</sup> edition, Pubs: John Wiley Sons. 1995.
2. Lee, J.D., Concise Inorganic Chemistry; 4<sup>th</sup> edition, Pubs: Chapman Hall Ltd., 1991.
3. Shriver, D.E., Alkins, P.W., Langford, C.H., Inorganic Chemistry; 4<sup>th</sup> edition, Oxford Publisher: Oxford University Press, 2006.
4. Douglas, B. McDamiel, D., Alexander, J., Concepts and Models of Inorganic Chemistry; 3<sup>rd</sup> edition, Pubs: John Wiley and Sons Inc., 1994.
5. Porterfield, W.W., Wesley, A., Inorganic Chemistry; Pubs: Addison-Wesley Publishing Company, 1984.
6. Miessler, G.L., Larr, D.A., Inorganic Chemistry; 3<sup>rd</sup> edition, Pubs: Pearson Education Inc., 2004.
7. Jolly, W.L., Modern Inorganic Chemistry; 2<sup>nd</sup> edition, Pubs: McGraw-Hill Publishing Company Limited, 1991.
8. Purcell, K.F., Kotz, J.C., Inorganic Chemistry; Pubs: W.B. Saunders Company, 1977.
9. Puri, B.R., Sharma, L.R., Kalia, K.C., Principles of Inorganic Chemistry; 30<sup>th</sup> edition, Pubs: Milestones Publisher, 2006-07.

**Paper-XIV: ORGANIC CHEMISTRY-B**

**Time : 3 Hrs**  
**Max. Marks : 22+3**  
**60 Hrs. (2 Hrs/Week)**  
**3 Periods/Week**

**OBJECTIVE OF THE COURSE**

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (GENERAL) (Semester system) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

**UNIT-I (8 Hrs.)****Carboxylic Acid Derivatives:**

Structure and nomenclature of acid chlorides, esters, amides and acid anhydrides. Relative stability & reactivity of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution.

Preparation of carboxylic acid derivatives, chemical reactions. Mechanisms of esterification and hydrolysis (acidic and basic).

**UNIT-II (8 Hrs.)****Ethers , Epoxides Fats, Oils and Detergents:**

Nomenclature of ether and methods of their formation, physical properties. Chemical reaction-cleavage and autoxidation, Ziesel's method.

Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.

Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value. Soaps, synthetic detergents; alkyl and aryl sulphonates.

**UNIT-III (7 Hrs.)****Organic Compounds of Nitrogen:**

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid.

Structure and nomenclature of amines, physical properties. Stereochemistry of amines, Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysis. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann bromamide reaction.

**UNIT-IV****Heterocyclic Compounds:****(7 Hrs.)**

Introduction: Molecular Orbital picture and aromatic character of pyrrole, furan, thiophene, pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed-five and six-membered heterocycles. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fischer indole synthesis. Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

**Instructions for paper setters and candidates:**

- i. Examiner will set total of **NINE** questions comprising **TWO** questions from each unit and **ONE** compulsory question of short answer type covering whole syllabi.*
- ii. The students are required to attempt **FIVE** questions in all, **ONE** question from each unit and the Compulsory question.*
- iii. Compulsory question carries six marks and remaining all questions carry four marks each.*

**Books suggested**

1. Morrison, R.T., Boyd, R.N., Organic Chemistry; 6<sup>th</sup> edition, Pubs: Prentice-Hall, 1992.
2. Wade Jr., L.G., Singh, M.S., Organic Chemistry; 6<sup>th</sup> edition, Pubs: Pearson Education, 2008.
3. Mukherji, S.M., Singh, S.P., Kapoor, R.P., Organic Chemistry; Pubs: Wiley Eastern Limited, 1985, Vol. I, II, III.
4. Solomons, T.W., Fryhle, C.B., Organic Chemistry; 9<sup>th</sup> edition, Pubs: Wiley India, 2007.
5. Carey, F.A., Organic Chemistry; 4<sup>th</sup> edition, Pubs: McGraw-Hill, 2000.
6. Streitwieser, A., Clayton, Jr., Heathcock, H., Introduction to Organic Chemistry; 3<sup>rd</sup> edition, Pubs: Macmillan Publishing Company, 1989.

**Paper-XV: PHYSICAL CHEMISTRY-B****Time : 3 Hrs****Max. Marks : 22+3****60 Hrs. (2 Hrs/Week)****3 Periods/Week****OBJECTIVE OF THE COURSE**

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (GENERAL) (Semester system) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

**UNIT-I****(8 Hrs.)****Phase equilibrium:**

Statement and meaning of the terms – phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system—water, CO<sub>2</sub> and S systems.

Phase equilibria of two component system –solid –liquid equilibria, simple eutectic – Bi-Cd system, desilverisation of lead.

Solid solutions—compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCl-H<sub>2</sub>O) system. Freezing mixtures, acetone-dry ice.

Partially Miscible Liquids –Phenol-water, trimethylamine – water, nicotine –water systems.

Nernst distribution law-thermodynamic derivation, applications.

**UNIT-II****(7 Hrs.)****Electrochemistry –I:**

Electrical transport –Conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution.

Migration of ions and Kohlrausch Law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf method and moving boundary method.

**UNIT-III****(8 Hrs.)****Electrochemistry-II:**

Types of reversible electrodes – gas metal – ion, metal –insoluble salt – anion and redox electrodes. Electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode – reference electrodes – standard electrode potential, sign conventions, electrochemical series and its significance.

## UNIT-IV

(7 Hrs.)

Electrolytic and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells.

E.M.F. of a cell and its measurements. Computation of cell E.M.F. Calculation of thermodynamic quantities of cell reactions ( $\Delta G$ ,  $\Delta H$  and  $K$ ), Polarization, over potential and hydrogen overvoltage.

Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations.

**Instructions for paper setters and candidates:**

- i. Examiner will set total of **NINE** questions comprising **TWO** questions from each unit and **ONE** compulsory question of short answer type covering whole syllabi.
- ii. The students are required to attempt **FIVE** questions in all, **ONE** question from each unit and the Compulsory question.
- iii. Compulsory question carries six marks and remaining all questions carry four marks each..

**Books suggested**

1. Atkins, P., Paula, J.de, Atkins Physical Chemistry; 8<sup>th</sup> edition, Pubs: Oxford University Press, 2008.
2. Puri, B.R., Sharma, L.R., Pathania, M.S., Principles of Physical Chemistry; 43<sup>rd</sup> edition, Pubs: Vishal Publishing Co., 2008.
3. Barrow, G.M., Physical Chemistry; 6<sup>th</sup> edition, Pubs: McGraw Hill Companies Inc, 1996.
4. Rao, C.N.R., University General Chemistry; Pubs: Macmillan of India, 1985.
5. Berry, R.S., Rice, S.A., Ross, J., Physical Chemistry; 2<sup>nd</sup> edition, Pubs: Oxford University Press, 2000.
6. Albert, R.A., Silbey, R.J., Physical Chemistry; 1<sup>st</sup> edition, Pubs: John Wiley & Sons Inc., 1992.
7. Dogra, S.K., Dogra, S., Physical Chemistry Through Problems, Pubs: Wiley Eastern Limited, 1991.
8. Levine, I.N., Physical Chemistry; 5<sup>th</sup> edition, Pubs: Tata McGraw Hill Publishing Co. Ltd, 2002.
9. Moore, W. J., Basic Physical Chemistry; Pubs: Prentice Hall of India Pvt. Ltd, 1983.
10. Metz, C.R., Theory and problems of Physical Chemistry; Schaum's outline series, 2<sup>nd</sup> edition, Pubs: McGraw-Hall Book Company, 1989.

**Paper-XVI LABORATORY PRACTICALS****Max. Marks: 22+3  
6 Periods/week****Organic Chemistry**

Laboratory Techniques:

- a) Determination of  $R_f$  values and identification of organic compounds. Separation of isometric mixture of Ortho and paranitroaniline using hexane and ethyl acetate (8.5 : 1.5) by thin layer chromatography.
- b) Extraction of caffeine from tea leaves.

Qualitative Analysis:

Detection of elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide), in simple organic compounds.

**General Instruction to the Examiners:**

Note: Practical examination will be of four hours duration &amp; shall consist of the following questions:

- |  |            |
|--|------------|
| Q.No. I. Organic Chemistry: (analysis of organic compound)         | : 09 marks |
| Q.No II. TLC experiment, Extraction of caffeine)                   | : 06 marks |
| Q.No. III. Viva-Voce   | : 04 marks |
| Ask four questions (2 marks each) related to chemistry practicals. |            |
| Q.No. IV. Note Book  | : 03 marks |

**Books Suggested (Laboratory Courses)**

1. Furniss, B.S., Hannaford, A.J., Rogers, V., Smith, P.W.G., Tatchell, A.R., Vogel's Text Book of Practical Organic Chemistry; 4<sup>th</sup> edition, Pubs: Longman group, 1978.
2. Bansal, R.K., Laboratory Manual of Organic Chemistry; 3<sup>rd</sup> edition, Pubs : Wiley Eastern Limited, New Delhi, 1994.
3. Furniss, B.S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R., Vogel's Textbook of Practical Organic Chemistry; 5<sup>th</sup> edition, Pubs: Dorling Kindersley (India) Pvt. Ltd. Delhi., 2006.
4. Khosla, B.D., Garg, V.C., Gulati, A., Senior Practical Physical Chemistry; 11<sup>th</sup> edition, Pubs: R.Chand& Co., New Delhi, 2002.
5. Das, R.C., Behra, B., Experimental Physical Chemistry; Pubs: Tata McGraw Hill Publishing Co. Ltd., 1983.
6. Levitt, B.P., Findlays Practical Physical Chemistry; 8<sup>th</sup> edition, Pubs: Longman Group Ltd., London & New York, 1978.

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