# SYLLABUS

## SESSION: (2018-19)

## COURSE: B.Sc. (Hons.) II Chemistry

## FACULTY OF SCIENCES
## P. G. DEPARTMENT OF CHEMISTRY

# MATA GUJRI COLLEGE

Fatehgarh Sahib

(AN AUTONOMOUS COLLEGE)
Affiliated to Punjabi University, Patiala

# SYLLABUS
# B.Sc. II (Hons.) Chemistry
# Semester III and IV

| Paper Code | Title of Paper | No. of Lectures | L T P (Credits) | Max. Marks (External+Internal) Pass Percentage 40% |
|---|---|---|---|---|
| **SEMESTER III** | | | | |
| BHC301 | Inorganic Chemistry-II | 60 | 4 0 0 (4) | 100 (75+25) |
| BHC301 (P) | Inorganic Chemistry-II Lab | 60 | 0 0 2 (2) | 50 |
| BHC302 | Organic Chemistry-II | 60 | 4 0 0 (4) | 100 (75+25) |
| BHC302 (P) | Organic Chemistry-II Lab | 60 | 0 0 2 (2) | 50 |
| BHC303 | Physical Chemistry-III | 60 | 4 0 0 (4) | 100 (75+25) |
| BHC303 (P) | Physical Chemistry III Lab | 60 | 0 0 2 (2) | 50 |
| BHC 304 A/B/C/D | Physics / Computer /Maths/Zoology* | 60 | 4 0 0 (4)<br>5 1 0 (6) For Maths | 100 (75+25) |
| BHC 304 A/B/D (P) | Physics/ Computer Lab/Zoology | 60 | 0 0 2 (2) | 50 |
| BHC305 A/B (P) | Skill Enhancement Course: 305 A : Green Methods in Chemistry<br>OR<br>305 B : Pesticide Chemistry | 45 | 0 0 2 (2) | 50 |

| Paper Code | Title of Paper | No. of Lectures | L T P (Credits) | Max. Marks (External+Internal) Pass Percentage 40% |
|---|---|---|---|---|
| **SEMESTER IV** | | | | |
| BHC401 | Inorganic Chemistry-III | 60 | 4 0 0 (4) | 100 (75+25) |
| BHC401 (P) | Inorganic Chemistry-III Lab | 60 | 0 0 2 (2) | 50 |
| BHC402 | Organic Chemistry III | 60 | 4 0 0 (4) | 100 (75+25) |
| BHC402 (P) | Organic Chemistry-III Lab | 60 | 0 0 2 (2) | 50 |
| BHC403 | Physical Chemistry-IV | 60 | 4 0 0 (4) | 100 (75+25) |
| BHC403 (P) | Physical Chemistry-IV Lab | 60 | 0 0 2 (2) | 50 |
| BHC 404 A/B/C/D | Physics/ Computer / Maths Zoology* | 60 | 4 0 0 (4)<br>5 1 0(6) For Maths | 100 (75+25) |
| BHC 404 A/B/D (P) | Physics/ Computer/Zoology | 60 | 0 0 2 (2) | 50 |
| BHC 405 A/B (P) | Skill Enhancement Course:<br>405 A: Basic Analytical Chemistry<br>OR<br>405 B: Fuel Chemistry | 45 | 0 0 2 (2) | 50 |

# SEMESTER III
# Core Course V
# BHC-301: INORGANIC CHEMISTRY-II

Maximun Marks: 100
University Examination: 75 Time: 3 Hours
Internal Assessment: 25 Pass Marks: 40%
**(**Credits: 04) Theory: 60 Lectures

## OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons.) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents are revised from time to time as per suggestions of the members of the Board of Studies of the Chemistry. 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.

## 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

**Chemistry of *s* and *p* Block Elements**

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. Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

**Inorganic Polymers:** Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, polysulphates. **30 Hrs.**

## UNIT-II

**Noble Gases**

Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of $XeF_2$, $XeF_4$ and $XeF_6$; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for $XeF_2$). Molecular shapes of noble gas compounds (VSEPR theory).

**General Principles of Metallurgy**

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic Kroll process, Parting process, van Arkel-de Boer process and Mond's process, Zone refining.

**Acids and Bases**

Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids,types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle. **30Hrs.**

**Reference Books:**

1. Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
2. Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. *Concepts & Models of Inorganic Chemistry 3rd Ed.*, John Wiley Sons, N.Y. 1994.
3. Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth- Heinemann. 1997.
4. Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.
5. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.
6. Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry* 4th Ed., Pearson, 2010.
7. Atkin, P. *Shriver & Atkins' Inorganic Chemistry* 5th Ed. Oxford University Press (2010).

# BHC-301 (P): INORGANIC CHEMISTRY-II Lab.

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

**(A) Iodo / Iodimetric Titrations**

(i) Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodometrically).
(ii)Estimation of Potassium permangnate solution using sodium thiosulphate solution (Iodometrically).
(iii) Estimation of available chlorine in bleaching powder iodometrically.

**(B) Inorganic preparations**

(i) Cuprous Chloride, $Cu_2Cl_2$
(ii) Preparation of Manganese(III) phosphate, $MnPO_4.H_2O$
(iii) Preparation of Aluminium potassium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum) or Chrome alum.

**Reference Books:**

Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.

# Core Course VI
# BHC-302: ORGANIC CHEMISTRY-II

Maximum Marks: 100
University Examination: 75 Time: 3 Hours
Internal Assessment: 25 Pass Marks: 40%
(Credits: 04) Theory: 60 Lectures

## OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons.) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents are revised from time to time as per suggestions of the members of the Board of Studies of the Chemistry. 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.

## 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

**Chemistry of Halogenated Hydrocarbons**

***Alkyl halides****:* Methods of preparation, nucleophilic substitution reactions – $S_N1$, $S_N2$ and $S_Ni$ mechanisms with stereochemical aspects and effect of solvent , nucleophilic substitution vs. elimination.

***Aryl halides:*** Preparation, including preparation from diazonium salts. nucleophilic aromatic substitution; $S_NAr$, Benzyne mechanism.

Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Organometallic compounds of Mg and Li – Use in synthesis of organic compounds.

**Alcohols, Phenols, Ethers and Epoxides** ***Alcohols:*** preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of

glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement

***Phenols:*** Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism;

***Ethers and Epoxides:*** Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$. **30 Hrs.**

## UNIT-II

**Carbonyl Compounds**

Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV, PDC and PCC); Addition reactions of unsaturated carbonyl compounds: Michael addition. Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

**Carboxylic Acids and their Derivatives**

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids.

Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic sustitution at acyl group-Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmannbromamide degradation and Curtius rearrangement.

**Sulphur containing compounds**

Preparation and reactions of thiols, thioethers and sulphonic acids. **30 Hrs.**

**Reference Books:**

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt.Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Graham Solomons, T.W. *Organic Chemistry,* John Wiley & Sons, Inc.
4. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.

## BHC-302 (P): ORGANIC CHEMISTRY-II Lab.

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

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.
2. Organic preparations:
   i. Acetylation of one of the following compounds: amines (aniline, *o*-, *m*-, *p*-toluidines and o-, *m*-, *p*-anisidine) and phenols (β-naphthol, vanillin, salicylic acid) by any one method:
      a. Using conventional method.
      b. Using green approach
   ii. Benzolyation of one of the following amines (aniline, *o*-, *m*-, *p*- toluidines and *o*-, *m*-, *p*-anisidine) and one of the following phenols (β-naphthol, resorcinol, pcresol) by Schotten- Baumann reaction.
   iii. Oxidation of ethanol/ isopropanol (Iodoform reaction).
   iv. Nitration of Salicylic acid by green approach (using ceric ammonium nitrate).
   v. Selective reduction of *meta* dinitrobenzene to *m*-nitroaniline.
   vi. Reduction of *p*-nitrobenzaldehyde by sodium borohydride.
   vii. Hydrolysis of esters.
   viii. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.
   ix. *S*-Benzylisothiouronium salt of one each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).
   x. Aldol condensation using either conventional or green method.
   xi. Benzil-Benzilic acid rearrangement.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point and TLC.

**Reference Books**

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

# Core Course VII
# BHC-303: PHYSICAL CHEMISTRY-III

Maximum Marks: 100
University Examination: 75 Time: 3 Hours
Internal Assessment: 25 Pass Marks: 40%
**(**Credits: 04) Theory: 60 Lectures

## OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons.) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents are revised from time to time as per suggestions of the members of the Board of Studies of the Chemistry. 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.

## 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

**Phase Equilibria**

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solidliquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems(water and sulphur)and two component systems involving eutectics , congruent and incongruent melting point (lead-silver, $FeCl_3$-$H_2O$).

Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points, solid solutions. Three component systems, water-chloroform-acetic acid system, triangular plots.

**Binary solutions**

Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications. **30Hrs.**

## UNIT-II

**Chemical Kinetics**

Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.

Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.

**Catalysis**

Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

**Surface chemistry**

Physical adsorption, chemisorption, adsorption isotherms. nature of adsorbed state.

**30Hrs.**

**Reference Books:**

1. Peter Atkins & Julio De Paula, *Physical Chemistry* 10th Ed., Oxford University Press (2014).
2. Castellan, G. W. *Physical Chemistry*, 4th Ed., Narosa (2004).
3. McQuarrie, D. A. & Simon, J. D., *Molecular Thermodynamics*, Viva Books Pvt. Ltd.: New Delhi (2004).
4. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
5. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics.* CRC Press: NY (2011).
6. Zundhal, S.S. *Chemistry concepts and applications* Cengage India (2011).
7. Ball, D. W. *Physical Chemistry* Cengage India (2012).
8. Mortimer, R. G. *Physical Chemistry 3rd Ed.,* Elsevier: NOIDA, UP (2009).
9. Levine, I. N. *Physical Chemistry 6th Ed.,* Tata McGraw-Hill (2011).
10. Metz, C. R. *Physical Chemistry 2nd Ed.,* Tata McGraw-Hill (2009).

# BHC-303 (P): PHYSICAL CHEMISTRY-III Lab.

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

I. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.
II. Phase equilibria: Construction of the phase diagram using cooling curves or ignition tube method: a. simple eutectic and b. congruently melting systems.
III. Distribution of acetic/ benzoic acid between water and cyclohexane.
IV. Study the equilibrium of at least one of the following reactions by the distribution method: (i) $I_2(aq) + I^- \rightarrow I_3^-$
(ii) $Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n$
V. Study the kinetics of the following reactions.
1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
a. Acid hydrolysis of methyl acetate with hydrochloric acid.
b. Saponification of ethyl acetate.
3. Compare the strengths of HCl and $H_2SO_4$ by studying kinetics of hydrolysis of methyl acetate.
VI. Adsorption
1. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

**Reference Books:**

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R.Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

# Generic Elective III
# BHC-304 A: PHYSICS-III

Maximum Marks: 100
University Examination: 75 Time: 3 Hours
Internal Assessment: 25 Pass Marks: 40%
(Credits: 04) Theory: 60 Lectures

## 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

**Entropy:** Statistical Definition of Entropy, Change of Entropy of a System, Additive Nature of Entropy, Law of Increase of Entropy, Reversible and Irreversible Process with Examples, Work Done in a Reversible Process.

**Laws of Thermodynamics and Carnot Cycle:** Brief Review of Terms and Laws of Thermodynamics, Carnot's Cycle, Entropy Changes in Carnot Cycle, Applications of Thermodynamics to Thermoelectric Effect, Change of Entropy along a Reversible Path in a P-V Diagram, Entropy of a Perfect Gas, Heat Death of the Universe.

**Maxwell's equation:** Thermodynamic Functions or Potentials, Derivation of Maxwell's Thermodynamical Relations, Cooling Produced by Adiabatic Stretching, Adiabatic Compression, Change of Internal Energy with Volume, Specific Heat at Constant Pressure and Constant Volume, Expression for Cp-Cv.
Change of State and Deduction of Clausius-Clapeyron Equation, Thermodynamical Treatment of Joule Thomson Effect, Liquification of Helium, Production of very Low Temperature by Adiabatic Demagnetization.
**30 Hrs.**

## UNIT-II

**Introductory Concepts**: Spontaneous and Stimulated Emission, Concept of Population Inversion, The Laser Idea, Properties of Laser Light, Derivation's of Einstein's Relation, Introduction of Three Level and Four Level Laser Schemes, Types of Lasers (Concept only), Application of Lasers( a general outline).

**Lagrangian Formulation**: Conservation Laws of Linear, Angular Momentum and Energy for a Single Particle and System of Particles, Constraints and Generalized Coordinates, Principle of Virtual Work, D'Alembert Principle, Lagrange's Equations of Motion.

**Problems:** Lagrange's Equations of Motion for Systems like Motion of Single Particle in Space, On the Surface of a Sphere, Cone & Cylinder.
**30 Hrs.**

**TEXT BOOKS:**

1. Statistical Physics and Thermodynamics, V.S Bhatia (Sohan Lal nagin Chand, Jalandhar)

2. Statistical Physics and Thermodynamics, A.K Sikri (Pardeep Pub.)

3. Lasers Fundamentals, W.T Silfvast (Foundation Books)

4. Lasers and Non Linear Optics, B.B Laud (New Age Pub.)

5. Classical Mechanics, H. Goldstein, Narosa Publishing House, New Delhi.

**REFERNCE BOOKS:**

1. Statistical Mechanics: An Introductory Text, Bhattacharjee, J.K (Allied Pub. Delhi)

2. Statistical Mechanics, B.B Laud (Macmillan India Ltd.)

3. Lasers, Svelto (Plenum Press)

4. Classical Mechanics, N.C. Rana and P.S. Joag, Tata McGraw-Hill, N. Delhi, 1991

# Generic Elective III
# BHC-304 A (P): PHYSICS-III Lab.

Maximum Marks: 50 Time Allowed: 3 Hours
Pass Percentage: 40% Credits: 02

**List of Experiments:**

1 Adiabatic expansion of a gas
2 Probability distribution using coloured dice and coins.
3 To find height of an inaccessible object using sextant.
4 To determine the refractive index of liquid using spectrometer
5 To determine the Cauchy's constants
6 To study the refractive index of doubly refracting prism
7 To determine the principal points of a lens system
8 To determine refractive index of simple prism.

# Generic Elective III
# BHC-304 B: COMP-3: Data Structure

Maximum Marks: 100
University Examination: 75 Time: 3 Hours
Internal Assessment: 25 Pass Marks: 40%
(Credits: 04) Theory: 60 Lectures

## OBJECTIVE OF THE COURSE

To understanding about writing algorithms and step by step approach in solving problems with the help of fundamental data structures. To understand the abstract data types stack, queue, deque, and list.To understand prefix, infix, and postfix expression formats

## 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

**Data Structure:** Introduction to data structure and algorithm, complexity of an algorithm.

**Algorithm analysis:** Time space tradeoff algorithms and Big O notation, Complexity.

**Arrays:** Introduction, one dimensional and multidimensional arrays, memory representation of arrays,operations on arrays, sparse arrays and sparse matrices and their implementation

**Stacks:** Introduction; Operation on stacks; Implementation of stacks Application of stacks: matching parenthesis, evaluation of arithmetic expressions, conversion from infix to postfix, recursion.

**Queues:** Introduction, operation on queues, circular queue, memory representation of queues, priority queues, application of queues.

**30 Hrs.**

## UNIT-II

**Linked List:** Introduction to operation on linked list, circular linked list, doubly linked list, header linked list,implementation of linked list, application of linked lists.

**Trees:** Introduction to Trees, Binary Tree; Binary Search Tree, Introduction to Heaps
**Graphs:** Introduction Graph: Graph terminology , Memory Representation of Graphs in memory: Operations performed on graphs, Application of graphs.
**Searching and Sorting:** Linear search ,Binary Search. Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Shell Sort, Radix Sort, Quicksort and Heapsort.

**30 Hrs.**

**Text Books:**

1. Seymour Lipschutz, “Data Structures using C", McGraw-Hill, 2002.

**References:**

1. A. Tanenbaum, Y. Langsam and A.J. Augenstein, "Data Structures Using C", Prentice Hall of India, 1990
2. Loomis, “Data and File Structures”,
3. Seymour Lipschutz, “Theory and Problems of Data Structures", McGraw-Hill, 2002.

## Generic Elective III Lab

## BHC-304 B (P): Software Lab based on Data Structure

Maximum Marks: 50 Time Allowed: 3 Hours
Pass Percentage: 40% Credits: 02

## Objective

i) To develop skills to design and analyze simple linear and non linear ***data structure***
ii) To Strengthen the ability to identify and apply the suitable ***data structure*** for the given real world problem
iii) To understanding about writing algorithms and step by step approach in solving problems with the help of fundamental data structures

The setting and evaluation will be done by a board of examiners consisting of Head External Examiner and the teacher(s) involved with the teaching of this paper.
The practical paper will consist of four exercises and the candidates will be required to attempt any three exercises.
The breakup of marks for the University Examination will be as under:
Viva-voce:10
Exercises:20
Lab. Record:20

1. Implementation of Array
2. Implementation of Stacks, Queue
3. implementation of Linked list
4. Implementation of Single, Double and circular Linked List
5. Implement Sorting techniques.
6. Implement Searching Techniques
7. Implementation of Recursive function.
8. Creation and traversal of Binary Search Tree.

## Generic Elective III
## BHC 304 C MATH: DIFFERENTIAL EQUATIONS

Max. Marks: 100 Time Allowed: 3 hours
External Examination: 75 Teaching Hours: 60
Internal Assessment: 25 Minimum Pass Marks: 40%
(Credits: Lectures 05, Tutorial 01)

## INSTRUCTIONS FOR PAPER-SETTER

The question paper will consists of three Units I, II, III. Each of UNIT I & II will have four questions from the respective syllabus. Each will consist of twelve marks. Unit III will have one compulsory question having nine parts of short-answer type covering the entire syllabus uniformly. Each will consist of three marks.

## INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all; selecting two questions from each Units I & II. Unit III is compulsory. All questions carry equal marks.

### UNIT-I

Formation and Solution of Partial Differential Equations of the First Order, Lagrange's Equations. Charpit's Method. Partial Differential Equations of Second and Higher order. Classification of Linear Partial Differential Equations of Second Order. Homogeneous and Non- Homogeneous Equations with constant coefficients. Partial Differential Equations reducible to equations with constant coefficients. Monge's Methods.

### UNIT-II

Laplace Transforms, Inverse Laplace Transforms, Properties of Laplace Transform, Existence Theorem for Laplace Transforms. Linearity of the transformation. Shifting Theorems, Convolution Theorem. Solution of Integral Equations and systems of Partial Differential Equations using the Laplace Transformation.

Heat, wave and Laplace Equation : Heat diffusion equation, solution of the wave equation. D' Almebert's solution of the wave equation, solution of laplace equation.

**Suggested Readings:**

1. Erwin Kreyszig, Advanced Engineering Mathem atics, John Wiley & Sons Inc. New York, 1999.
2. D.A. Murry, Introductory course on Differential Equations, Orient Longman (India), 1967.
3. I.N. Sneddon, Elements of Partial Differential Equations, Dover Publications Inc.
4. M.D. Raisinghania , Advanced Differential Equations, S. Chand & Company Pvt. Ltd. , 1988.
5. Schaum Series, Partial Differential Equations.

# Generic Elective III
# BHC 304 D: FUNDAMENTALS OF MOLECULAR BIOLOGY

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

## OBJECTIVES OF THE COURSE

To acquaint the students with the basic concepts of Molecular biology: structure of nucleic acids , replication , Transcription, Translation, Gene regulation and Repair mechanisms to make them enable to understand more advanced and applied courses in life sciences.

## INSTRUCTIONS FOR THE PAPER-SETTER

Examiner will set two sections A and B of four questions each from respective sections of the syllabus of 12 marks each and Section C of compulsory question of 27 marks (9 short answer type questions) covering the entire syllabus.

## INSTRUCTIONS FOR THE CANDIDATES

The candidate will attempt two questions each from Section A and B and Section C will be compulsory.

NOTE: Internal assessment will be given on basis of mid semester tests (12), class performance (6), assignment/quiz/seminar (7)

## SECTION A

**Unit 1: Nucleic Acids (4)**

Salient features of DNA and RNA, Watson and Crick model of DNA

**Unit 2: DNA Replication (12)**

DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, bidirectional and semi-discontinuous replication, RNA priming, Replication of circular and linear *ds*-DNA, replication of telomeres

**Unit 3: Transcription (10)**

RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors

**Unit 4: Translation (12)**

Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation

## SECTION B

**Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA (6)**

Structure of globin mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA

**Unit 6: Gene Regulation (10)**

Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from *lac* operon and *trp* operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing, Genetic imprinting

**Unit 7: DNA Repair Mechanisms (4)**

Pyrimidine dimerization and mismatch repair

**Unit 8: Regulatory RNAs (4)**

Ribo-switches, RNA interference, miRNA, siRNA

# Generic Elective III Lab
# BHC-304 D (P): MOLECULAR BIOLOGY Lab.

Max. Marks: 50 No. of Lectures: 60 Hrs.
Time Allowed: 4 hrs. Pass Marks: 40%
(Credits: 02)

1. Isolation of DNA
2. Quantiative Estimation of DNA using spectrophotometer
3. Separation of DNA by Electrophoresis and visualisation through Gel Documentation
4. Demonstration of DNA replication using PCR
5. Study and interpretation of electron micrographs/ photograph showing
    a) DNA replication
    b) Transcription
    c) Split genes
6. Extraction of RNA
7. Designing of a primer ( through Hypothetical Data )
8. Numerical Problems on Genetic Code
9. Visit to Molecular research Lab

**Suggested Books:**


1. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell.* VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: *Molecular Biology of the Cell*, IV Edition.
3. Cooper G. M. and Robert E. Hausman R. E. *The Cell: A Molecular Approach***,** V Edition, ASM Press and Sinauer Associates.
4. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
5. Karp, G. (2010) *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.
6. Lewin B. (2008). *Gene XI*, Jones and Bartlett
7. McLennan A., Bates A., Turner, P. and White M. (2015). *Molecular Biology* IV Edition. GS, Taylor and Francis Group, New York and London.


**Guidelines for the conduction of practical examination**

1. Interpret the given Electron Micrograph A and B 3x2=6
2. To perform the given experiments I and II from the syllabus. Write the principle, procedure and demonstrate it to the examiner. 10x2=20
3. To design the primer from given hypothetical data 04
4. To solve the numerical problem based on Genetic code 04
5. Project 06
6. Viva 05
7. Practical note book 05

## Skill Enhancement Course
## BHC-305 A (P): GREEN METHODS IN CHEMISTRY

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

**Introduction:** Definitions of Green Chemistry. Brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity, green solvents, Green Chemistry and catalysis and alternative sources of energy, Green energy and sustainability ,Eco Scale,E-Factor.

The following Real world Cases in Green Chemistry should be discussed:
1.Surfactants for carbon dioxide – Replacing smog producing and ozone depleting solvents with $CO_2$ for precision cleaning and dry cleaning of garments. Designing of environmentally safe marine antifoulant.
2. Rightfit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments.
3. An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.

**Reference Books:**

1. Anastas, P.T. & Warner, J.K. Green Chemistry- Theory and Practical, Oxford University Press (1998).
2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001).
3. Cann, M.C. & Connely, M.E. Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).
4. Ryan, M.A. & Tinnesand, M. Introduction to Green Chemistry, American Chemical Society, Washington (2002).
5. Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. Green Chemistry Experiments: A monograph I.K. International Publishing House Pvt Ltd. New Delhi, Bangalore.
6. Lancaster, M. Green Chemistry: An introductory text RSC publishing, 2nd Edition.
7. Sidhwani, I.T., Saini, G., Chowdhury, S., Garg, D., Malovika, Garg, N. Wealth from waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from waste further generated "A Social Awareness Project", Delhi University Journal of Undergraduate Research and Innovation, 1(1): 2015.

## Skill Enhancement Course
## BHC-305 B (P): PESTICIDE CHEMISTRY

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

**General introduction to pesticides** (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones ( Chloranil), Anilides (Alachlor and Butachlor).

# Semester IV

## Core Course VII

## BHC-401 : INORGANIC CHEMISTRY-III

Maximum Marks: 100
University Examination: 75 Time: 3 Hours
Internal Assessment: 25 Pass Marks: 40%
(Credits: 04) Theory: 60 Lectures

## OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons.) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents are revised from time to time as per suggestions of the members of the Board of Studies of the Chemistry. 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.

## INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three units: I, II and III. Unit I and II will have four question 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

**Coordination Chemistry**

Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of 10 Dq ($\Delta_o$), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq ($\Delta_o$, $\Delta_t$). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory. IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes. **30Hrs.**

## UNIT-II

**Transition Elements**

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & Frost diagrams). Difference between the first, second and third transition series.Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy)

**Lanthanoids and Actinoids**

Electronic configuration, oxidation states, colour, spectral and magnetic properties,lanthanide contraction, separation of lanthanides (ion-exchange method only).

**Bioinorganic Chemistry**

Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals.Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine. Iron and its application in bio-systems, Haemoglobin; Storage and transfer of iron. **30Hrs.**

**Reference Books:**

1. Purcell, K.F & Kotz, J.C. *Inorganic Chemistry* W.B. Saunders Co, 1977.
2. Huheey, J.E., *Inorganic Chemistry*, Prentice Hall, 1993.
3. Lippard, S.J. & Berg, J.M. *Principles of Bioinorganic Chemistry* Panima Publishing Company 1994.
4. Cotton, F.A. & Wilkinson, G, *Advanced Inorganic Chemistry* Wiley-VCH, 1999
5. Basolo, F, and Pearson, R.C. *Mechanisms of Inorganic Chemistry*, John Wiley & Sons, NY, 1967.
6. Greenwood, N.N. & Earnshaw A. *Chemistry of the Elements*, Butterworth-Heinemann, 1997.

# BHC-401 (P): INORGANIC CHEMISTRY-III Lab

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

**Gravimetric Analysis**

i. Estimation of nickel (II) using Dimethylglyoxime (DMG).
ii. Estimation of copper as CuSCN
iii. Estimation of iron as $Fe_2O_3$ by precipitating iron as $Fe(OH)_3$.
iv. Estimation of Al (III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminium oxinate).

**Inorganic Preparations:**

i. Tetraamminecopper (II) sulphate, $[Cu(NH_3)_4]SO_4.H_2O$
ii. *Cis* and *trans* $K[Cr(C_2O_4)_2.(H_2O)_2]$ Potassium dioxalatodiaquachromate (III)
iii. Tetraamminecarbonatocobalt (III) ion
iv. Potassium tris(oxalate)ferrate(III)

**Chromatography of metal ions**

Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:
i. Ni (II) and Co (II)
ii. Fe (III) and Al (III)

**Reference Book:**

Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.

# Core Course VIII
# BHC-402: ORGANIC CHEMISTRY-III

Maximum Marks: 100
University Examination: 75 Time: 3 Hours
Internal Assessment: 25 Pass Marks: 40%
**(Credits: Theory-04, Practicals-02)** **Theory: 60 Lectures**

## OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons.) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents are revised from time to time as per suggestions of the members of the Board of Studies of the Chemistry. 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.

## 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

**Nitrogen Containing Functional Groups**

Preparation and important reactions of nitro and compounds, nitriles and isonitrile Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Diazonium Salts: Preparation and their synthetic applications.

**Polynuclear Hydrocarbons**

Reactions of naphthalene phenanthrene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons. **30Hrs.**

## UNIT-II

**Heterocyclic Compounds**

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction. Derivatives of furan: Furfural and furoic acid.

**Alkaloids**

Natural occurrence, General structural features, Isolation and their physiological action Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Quinine, Morphine and Reserpine.

**Terpenes**

Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral, Neral and α-terpineol. **30Hrs.**

**Reference Books:**

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

3. Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

4. Acheson, R.M. *Introduction to the Chemistry of Heterocyclic compounds,* John Welly & Sons (1976).

5. Graham Solomons, T.W. *Organic Chemistry,* John Wiley & Sons, Inc.

6. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.

7. Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.

8. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry,* Oxford University Press.

9. Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, Prajati Parakashan (2010)

## BHC-402 (P) : ORGANIC CHEMISTRY-III Lab

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

1. Detection of extra elements.
2. Functional group test for nitro, amine and amide groups.
3. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds)

**Reference Books**

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012)
3. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,* University Press (2000).
4. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis,* University Press (2000).

## Core Course IX

# BHC-403: PHYSICAL CHEMISTRY-IV

Maximum Marks: 100
University Examination: 75 Time: 3 Hours
Internal Assessment: 25 Pass Marks: 40%
**(Credits: Theory-04, Practicals-02)** **Theory: 60 Lectures**

## OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to B.Sc. (Hons.) (3 Year course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents are revised from time to time as per suggestions of the members of the Board of Studies of the Chemistry. 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.

## 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

### Conductance

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Walden's rules. Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

### Electrical & Magnetic Properties of Atoms and Molecules

Basic ideas of electrostatics, Electrostatics of dielectric media, Clausius-Mosotti equation, Lorenz-Laurentz equation, Dipole moment and molecular polarizabilities and their

measurements. Diamagnetism, paramagnetism, magnetic susceptibility and its measurement, molecular interpretation. **30Hrs.**

## UNIT-II

**Electrochemistry**

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and $SbO/Sb_2O_3$ electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation). **30Hrs.**

**Reference Books:**

1. Atkins, P.W & Paula, J.D. *Physical Chemistry*, 10th Ed., Oxford University Press (2014).
2. Castellan, G. W. *Physical Chemistry 4th Ed.,* Narosa (2004).
3. Mortimer, R. G. *Physical Chemistry 3rd Ed.,* Elsevier: NOIDA, UP (2009).
4. Barrow, G. M., *Physical Chemistry 5th Ed.,* Tata McGraw Hill: New Delhi (2006).
5. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
6. Rogers, D. W. *Concise Physical Chemistry* Wiley (2010).
7. Silbey, R. J.; Alberty, R. A. & Bawendi, M. G. *Physical Chemistry 4th Ed.,* John Wiley & Sons, Inc. (2005).

# BHC-403 (P) : PHYSICAL CHEMISTRY-IV Lab

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

**Conductometry**

I. Determination of cell constant

II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.

III. Perform the following conductometric titrations:

i. Strong acid vs. strong base
ii. Weak acid vs. strong base
iii. Mixture of strong acid and weak acid vs. strong base
iv. Strong acid vs. weak base

**Potentiometry**

I. Perform the following potentiometric titrations:

i. Strong acid vs. strong base
ii. Weak acid vs. strong base
iii. Dibasic acid vs. strong base
iv. Potassium dichromate vs. Mohr's salt

**Reference Books:**

1 .Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).

2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.;* McGraw-Hill: New York (2003).

3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).

# Generic Elective IV
# BHC-404 A: PHYSICS-IV

Maximum Marks: 100
University Examination: 75 Time: 3 Hours
Internal Assessment: 25 Pass Marks: 40%

## 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

**Co-ordinate Systems and Motion of a Particle**: Cartesian, Plane Polar and spherical Polar Co-ordinates System, Area, Volume, Velocity and Acceleration in these Systems, Solid Angle and its Significance.

**Two Body Centre Force Problem:** Basic Forces in Nature, Centre of Mass, Equivalent One Body Problem, Central Force, General Features of Central Force Motion.

**Frames of Reference:** Inertial Frames of Reference, Galilean Transformation and Galilean Invariance, Non-Inertial Frames, Variation of Acceleration due to Gravity with Latitude.

**Collisions and Scattering:** Laboratory and Centre of Mass System, Elastic Collision in Lab and Centre of Mass System, Velocities, Angles and Energies, Differential and Total Scattering Cross Section of Elastic Scattering.

## UNIT-II

**Basic Ideas:** Basic Ideas of Vector Algebra and Calculus of Vectors, Gradient, Divergence, Curl and their Physical Significance, Laplacian in Rectangular Co-ordinate, Stoke's Theorem and Gauss's Divergence Theorem, Green's Theorem.

**Electric Field and Gauss's Law:** Coulomb's Law for Point Charges and Continuous Distribution of Charges, Electric Field due to Uniformly Charged Infinite Wire, Ring and

Circular Disc, Electric Field due to Infinite Charged Sheet, Electric Flux, Gauss's Law and its Application, Gauss Law in Differential Form.

**Electric Potential and Application:** Work and Potential Difference, Potential Difference as a Line Integral of Electric Field, Electric Potential due to a Point Charge, a group of Point Charges, Electric Potential due to a long Uniformly Charged Wire, Charged Disc, Electric Field as Gradient of Scalar Potential, Poisson and Laplace's Equation, Concept of Electrical Images.

**Electric Current:** Current and Current Density, Equation of Continuity, Microscopic Form of Ohm's Law and Conductivity, Failure of Ohm's Law.

**TEXT BOOKS:**

1. Mechanics. Berkeley Physics Course by C.Kittle, W.D.Knight and M.A Rudeman

2. Mechanics. H.S Hans & S.P Puri, T.M.H Pub.

3 .Fundamentals of Electricity and Magnetism by Author F. Kipp

4. Introduction to classical Electrodynamics by David J Griffth.

# Generic Elective IV Lab
# BHC-404 A (P) PHYSICS IV LAB

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

**List of Experiments:**

1. To study the rotation of plane of polarization with a polarimeter.
2. To determine the wavelength of sodium light by Newton's ring method.
3. To determine the principal point of a lens system.
4. To find the angle of elevation of a tall building.
5. To determine the wavelength of a spectral lines of mercury using diffraction grating.
6. To determine the ionization potential of mercury.
7. To determine the dispersive power of a given plane diffraction grating.

## Generic Elective IV

## BHC-404 B: COMP-4: DATABASE MANAGEMENT SYSTEMS

Maximum Marks: 100
University Examination: 75 Time: 3 Hours
Internal Assessment: 25 Pass Marks: 40%

## OBJECTIVE OF THE COURSE

To understand the different issues involved in the design and implementation of a database system. To study the physical and logical database designs, database modeling, relational, hierarchical, and network models. To understand and use data manipulation language to query, update, and manage a database the given real world problem.

## 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

**Database Management System :** Definition, Characteristic advantages over traditional file processing system, Uses of database, DBA and its responsibilities Database schema, instance. DBMS architecture, data independence, mapping between different levels.

**Database language :** DDL, DML, DCL.

**Data Models:** hierarchical, network, relational.

**Keys** : Super, candidate, primary, unique, foreign.

**constraints**: types of constraints, Integrity constraints,

## UNIT -II

**Entity relationship model :** concepts, mapping cardinalities, entity relationship diagram, weak sets, strong entity sets, aggregation, generalization, converting ER diagram to tables.

**Relational Algebra :** Basic operations, additional operations.

**Database design :** Functional dependency, decomposition, Normalization, multivalued dependency. Database design process, database protection, database integrity,

**Transaction management and Concurrency control:** Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks),Time stamping methods, optimistic methods, database recovery management.

**Text Book:**

1. Siberscharts, Korth and Sudarshan, "Database Concepts", Mcgraw Hill Publication.

**References**:

1. Ivan Bayross, “Oracle 7 The complete reference”, BPB Publications.
2. C..J. Date, "An Introduction to Database Systems", 3rd Ed., Narosa Publishers, (Reprint).
3. Jeffrey D. Ulliman, "Principles of Database Systems", 2nd Ed., Galgotia Publications.
4. D. Kroenke, "Database Processing", Galgotia Publications.

# Generic Elective IV Lab
# BHC-404 B (P): COMP-4: Software Lab based on DBMS

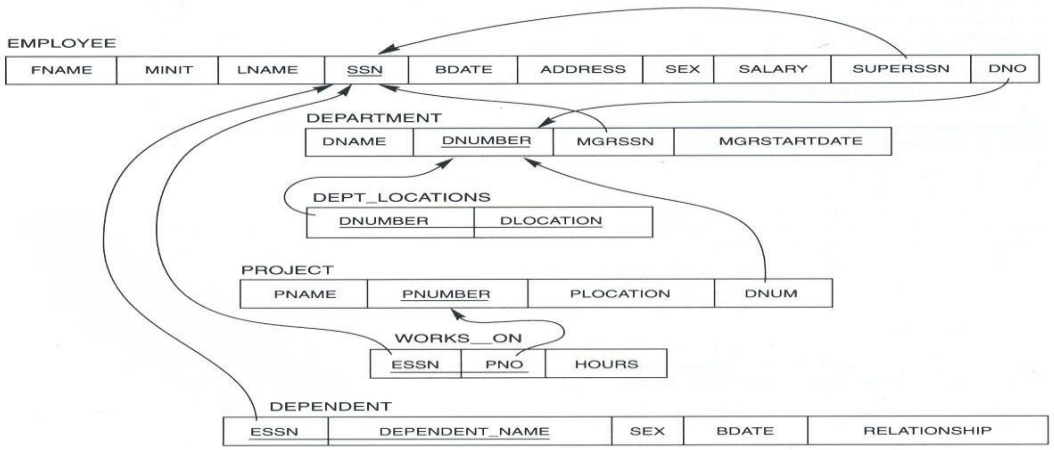
Max. Marks: 50 No. of Lectures: 60 Hrs.
Time Allowed: 3 hrs. Pass Marks: 40%
(Credits: 02)

The setting and evaluation will be done by a board of examiners consisting of Head External Examiner and the teacher(s) involved with the teaching of this paper.
The practical paper will consist of four exercises and the candidates will be required to attempt any three exercises.
The breakup of marks for the University Examination will be as under:
Viva-voce:10 Exercises:20 Lab. Record:20

**MySQL:** Introduction, using DDL Commands,DML Commands, DCL commands

**Implement Any schema and apply various queries**

**Example:**



# Generic Elective IV
# BHC-404 C Maths: APPLIED STATISTICS

Lectures Maximum Marks: 100
University Examination: 75 Time: 3 Hours
Internal Assessment: 25 Pass Marks: 40%
(Credits: Theory-05, Tutorial-01) Theory: 60 Lectures

## INSTRUCTIONS FOR THE PAPER SETTERS /CANDIDATES

The Question paper will consist of three Units I, II and III. Units I and II will have four questions from respective sections of the syllabus. Each will have 12 marks. The students are required to attempt two questions from each Unit. Unit III will be compulsory have only one question which will consist of at-least nine short answer type parts covering the whole syllabus. This question carries 27 marks.
Use of scientific non-programmable calculator is allowed.

## UNIT-I

Introduction to statistics: Basic definitions and applications, sampling.

Data collection and presentation: Types of data, collection of primary and secondary data. Methods of data presentation: Diagrammatical and graphical representation.

Measures of central tendency: Mean, median, mode.

Measures of variability: Standard deviation, standard error, range, quartile deviation, mean deviation and coefficient of variation.

Introduction to probability theory and distributions: concept of theory and distribution without derivation, binomial, Poisson and normal (only definitions and problems)

## UNIT-II

Correlation and regression: Positive and negative correlation, Karl- Pearsons co-efficient of correlation, Linear regression and regression equation

Tests of significance: Small sample test (Chi-square test, t- test, F- test), large sample test (Z test)

Analysis of variance-I: Analysis of variance with one way and two way classified data.

**Books Recommended:**

1. S. C. Gupta & V. K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand & Sons Educational Publication, New Delhi.
2. S. C. Gupta & V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons Educational Publication, New Delhi.
3. Goon, A. M. ,Gupta, M. K. & Dasgupta, B. Fundamentals of Statistics, Vol-II, World Press sixth Edition. (Revised and Enlarged), 1986.

# Generic Elective IV
# BHC-404 D: CELL BIOLOGY

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

## INSTRUCTIONS FOR THE PAPER SETTER

Examiner will set two sections A and B of four questions each from respective sections of the syllabus of 12 marks each and Section C of compulsory question of 27 marks (9 short answer type questions) covering the entire syllabus.

## INSTRUCTIONS FOR THE CANDIDATES

The candidate will attempt two questions each from Section A and B and Section C will be compulsory.

NOTE: Internal assessment will be given on basis of mid semester tests (12), class performance (6), assignment/quiz/seminar (7)

## SECTION A

**Unit 1: Overview of Cells**

Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions .

**Unit 2: Plasma Membrane**

Various models of plasma membrane structure Transport across membranes: Active and Passive transport, Facilitated transport Cell junctions: Tight junctions, Desmosomes, Gap junctions.

**Unit 3: Endomembrane System**

Structure and Functions: Endoplasmic Reticulum, Golgi apparatus, Lysosomes.

**Unit 4: Mitochondria and Peroxisomes**

Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis Peroxisomes.

## SECTION B

**Unit 5: Cytoskeleton**

Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

**Unit 6: Nucleus**

Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)

**Unit 7: Cell Division**

Mitosis, Meiosis, Cell cycle and its regulation

**Unit 8: Cell Signaling**

GPCR and Role of second messenger (cAMP)

# Generic Elective IV Lab
# BHC-404 D (P): CELL BIOLOGY PRACTICAL

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

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis.
3. Preparation of permanent slide to show the presence of Barr body in cheek cells.
4. To study the electron micrographs of cell organelles.
5. To study the working and principle of electron microscope.

**Suggested Readings:**


- Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.


**Guidelines for conduction of Practical Examination**

Maximum Marks: 50 Time Allowed : 3hrs

1. To prepare the temporary squash of the given tissue for the given stage of division and to draw it's well labeled figure. 08
2. Identify the slides A, B , C and D and write two identification points for each. 4x2=8
3. To identify and write note and well labeled figure on the given electron micrographs D, E and F. 5x3=12
4. To prepare the slide for presence of Barr body. 6
5. Project 6
6. Note Book 5
7. Viva 5

## Skill Enhancement Course
## BHC-405 A (P): BASIC ANALYTICAL CHEMISTRY

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

**Introduction:** Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

**Analysis of soil:** Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators. a. Determination of pH of soil samples. b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

**Analysis of water:** Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

a. Determination of pH, acidity and alkalinity of a water sample. b. Determination of dissolved oxygen (DO) of a water sample.

**Analysis of food products:** Nutritional value of foods, idea about food processing and food **preservations** and adulteration.

a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc. b. Analysis of preservatives and colouring matter.

**Chromatography:** Definition, general introduction on principles of chromatography, paper chromatography, TLC etc. a. Paper chromatographic separation of mixture of metal ion ($Fe^{3+}$ and $Al^{3+}$). b. To compare paint samples by TLC method. Ion-exchange: Column, ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure i: f use of column is not feasible).

**Analysis of cosmetics:** Major and minor constituents and their function .

a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.

b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

Suggested Applications (Any one):

a. To study the use of phenolphthalein in trap cases. b. To analyze arson accelerants. c. To carry out analysis of gasoline.

Suggested Instrumental demonstrations:

a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.

b. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.

c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drink.

**Reference Books:**

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
2. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.
3. Skoog, D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6th Ed., Saunders College Publishing, Fort Worth (1992).
4. Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman.  Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
5. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India.
6. Freifelder, D. Physical Biochemistry 2nd Ed., W.H. Freeman and Co., N.Y. USA (1982).
7. Cooper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y. USA. 16 (1977).
8. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall.  Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Prentice Hall.
9. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).

## Skill Enhancement Course
## BHC405 B (P): FUEL CHEMISTRY

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

**Review of energy sources (renewable and non-renewable).** Classification of fuels and their calorific value.

**Coal:** Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal.Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

**Petroleum and Petrochemical Industry:** Composition of crude petroleum, Refining and different types of petroleum products and their applications.

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

**Lubricants:** Classification of lubricants, lubricating oils (conducting and nonconducting) Solid and semisolid lubricants, synthetic lubricants.

Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

**Reference Books:**

1. Stocchi, E. Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK (1990).
2. Jain, P.C. & Jain, M. Engineering Chemistry Dhanpat Rai & Sons, Delhi.
3. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996)