SYLLABUS
For Academic Session 2023-24

For B.Sc. Medical/Non-Medical
UNDERGRADUATE PROGRAMME
Choice Based Credit System (CBCS)

FACULTY OF SCIENCES
P. G. DEPARTMENT OF CHEMISTRY
MATA GUJRI COLLEGE
FATEHGARH SAHIB
(An Autonomous College)
Affiliated to Punjabi University Patiala

Dr. Baljit Singh	Dr. Sonal Singhal	Mr. Ravinderjeet Singh	Dr. Kamalpreet Kaur	Mrs. Rachna Bhardwaj
Dr. Poonam Patyar	Ms. Simrat Kaur	Mr. Puneet Bhardwaj	Dr. Kiran	Dr. Kuldeep Kaur
	Ms. Priya Goyal	Ms. Seema Maheshwari	Dr. Manpreet Kaur	

Scheme of the Course

Semester	Core Course (CC)	Ability Enhancement Compulsory Course (AECC)	Skill Enhancement Course (SEC)	Discipline Specific Elective (DSE)
I	**CC-I** Physics **CC-II** Chemistry/Computer Science **CC-III** Mathematics	**AECC-I** Punjabi*/Basic Punjabi** **AECC-II** Environmental and Road Safety Awareness		
II	**CC-IV** Physics **CC-V** Chemistry/Computer Science **CC-VI** Mathematics	**AECC-III** Punjabi*/Basic Punjabi** **AECC-IV** English **AECC-V** Drug Abuse		
III	**CC-VII** Physics **CC-VIII** Chemistry/Computer Science **CC-IX** Mathematics	**AECC-VI** Punjabi*/Basic Punjabi**	**SEC I** (Choose any one) Physics Chemistry Computer Science Mathematics	
IV	**CC-X** Physics **CC-XI** Chemistry/Computer Science **CC-XII** Mathematics	**AECC-VII** Punjabi*/Basic Punjabi**	**SEC II** (Choose any one) Physics Chemistry Computer Science Mathematics	
V		**AECC-VIII** Punjabi*/Basic Punjabi**	**SEC III** (Choose any one) Physics Chemistry Computer Science Mathematics	**DSE –I** Physics **DSE-II** Chemistry/ Computer Science **DSE-III**

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				Mathematics
VI		**AECC-IX** Punjabi*/Basic Punjabi**	**SEC IV** (Choose any one) Physics Chemistry Computer Science Mathematics	**DSE IV** Physics
				DSE-V Chemistry/ Computer Science
				DSE-VI Mathematics

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B.Sc. – II (Non- Medical) SEMESTER-III					
Course	**Course Code**	**Course Name**	**L T P (Credits)**	**No. of Lectures**	**Max. Marks (External + Internal)**
CC-VII	BCC(P)-301	Statistical Mechanics and Optics	4 0 0 (4)	60	100 (75+25)
CC-VII Practical	BCC(P)-301(P)	Physics Lab	0 0 2 (2)	60	50
CC-VIII	BSNM/BSM-302/ BCC(CP)-302	BSNM/BSM-302 Solutions, Phase Equilibrium, Conductance, Electrochemistry and Functional Group Organic Chemistry	4 0 0 (4)	60	100 (75+25)
		BCC(CP)-302 Data Structure			
CC-VIII Practical	BSNM/BSM -302(P)/ BCC(CP)-302(P)	BSNM/BSM-302(P) Solutions, Phase Equilibrium, Conductance, Electrochemistry and Functional Group Organic Chemistry Lab.	0 0 2 (2)	60	50
		BCC(CP)-302(P) Software Lab based on Data Structures			
CC-IX	BCC(M)-303	Real Analysis	5 1 0 (6)	90	100 (75+25)
SEC-I	BSEC(P)-304/ BSEC(C)-304/ BSEC(M)-304/ BSEC(CP)-304	BSEC(P)-304 Physics Workshop Skill	0 0 2 (2)	30	50
		BSEC(C)-304 Green Methods in Chemistry	0 0 2 (2)	30	50
		BSEC(M)-304 Transportation and Game Theory	2 0 0 (2)	30	50 (40+10)
		BSEC(CP)- 304 Web Designing	0 0 2 (2)	30	50
AECC-VI	BAECC-305/ BAECC-305A	Punjabi/Basic Punjabi	5 0 0 (5)	60	100 (75+25)
			Total Credits:25		**Total Marks:550**

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B.Sc. II (Non- Medical) SEMESTER-IV					
Course	**Course Code**	**Course Name**	**L T P (credits)**	**No. of Lectures**	**Max. Marks (External + Internal)**
CC-X	BCC(P)-401	Quantum Mechanics	4 0 0 (4)	60	100 (75+25)
CC-X Practical	BCC(P)-401(P)	Physics Lab	0 0 2 (2)	60	50
CC-XI	BSNM/BSM -402/ BCC(CP)-402	BSNM/BSM-402 Transition Metal & Co-ordination Chemistry, States of matter & Chemical Kinetics	4 0 0 (4)	60	100 (75+25)
		BCC(CP)-402 Database Management Systems			
CC-XI Practical	BSNM/BSM -402(P)/ BCC(CP)-402(P)	BSNM/BSM -402(P) Transition Metal & Co-ordination Chemistry, States of matter & Chemical Kinetics Chemistry Lab.	0 0 2 (2)	60	50
		BCC(CP)-402(P) Software Lab based on DBMS			
CC-XII	BCC(M)-403	Algebra	5 1 0 (6)	90	100 (75+25)
SEC-II	BSEC(P)-404/ BSEC(C)-404 A/B BSEC(M)404 / BSEC(CP)-404	BSEC(P)-404 Applied Optics	0 0 2 (2)	30	50
		BSEC(C)-404 A: Basic Analytical Chemistry OR BSEC(C)-404 B: Minor Research Project in Chemistry	0 0 2 (2)	30	50
		BSEC(M)-404 Number Theory	2 0 0 (2)	30	50 (40+10)
		BSEC(CP)-404 PHP Programming	0 0 2 (2)	30	50
AECC-VII	BAECC-405/ BAECC-405A	Punjabi/Basic Punjabi	5 0 0 (5)	60	100 (75+25)
			Total Credits:25		**Total Marks:550**

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B.Sc. Non-Medical II
SEMESTER-III
PAPER BSNM/BSM-302: SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II
(Common for B.Sc. Medical and Non-Medical)

Maximum Marks: 100 | No. of Lectures: 60
External Examination: 75 | Time: 3 Hrs.
Internal Assessment: 25 | Pass Marks: 35%

Course Objectives

- To provide an insight into the characteristics of different types of solutions and electrochemical phenomena.
- To learn the concept of Phase equilibria and electrochemistry including the measurement of conductance and emf of the cell.
- To study the reactions, synthesis and properties of Carboxylic acid & their derivates, amines and diazonium salts.
- A relationship between structure, reactivity and biological properties of biomolecules is established through the study of these representative biomolecules.

Course Learning Outcomes

On the completion of the course, the students will be able to:

CO1: define the concepts of different types of binary solutions-miscible, partially miscible and immiscible along with their applications.

CO2: construct phase diagrams of one and two component systems.

CO3: test and compare the conductance of various electrolytes.

CO4: predict the reaction mechanism and properties of carboxylic acid & their derivatives, and amines.

CO5: analyze the unknown organic compound containing amino and carboxylate group.

CO6: demonstrate how the structure of biomolecules determines their chemical properties, reactivity and biological uses.

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INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of 3 units: unit I, unit II and unit III. Unit I and II will have 4 questions from respective unit of the syllabus and will carry 12 marks each. Unit III will consist of 9 questions from the whole syllabus and will carry 3 marks each.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt 2 questions from each Unit I & Unit II. Unit III is compulsory. Note: Internal Assessment will be given on the basis of semester test (12), class performance (6), assignment/quiz (7).

Unit I

Physical Chemistry **(30 Lectures)**

Solutions

Ideal and Non-ideal solutions, Thermodynamics of ideal solutions: Free energy change on mixing, Volume change on mixing and enthalpy change on mixing; Ideal solutions and Raoult's law, Deviations from Raoult's law, Non-ideal solutions, Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions, Henry's law, Azeotropes, Partial miscibility of liquids: Critical solution temperature, Effect of impurity on partial miscibility of liquids. **(8 Lectures)**

Phase Equilibrium

Phases, Components and degrees of freedom of a system, Criteria of phase equilibrium, Gibbs phase Rule and its thermodynamic derivation, Clausius–Clapeyron equation and its importance in phase equilibria, Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics (Pb-Ag, Bi-Cd system). **(8 Lectures)**

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Conductance

Conductivity, Equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes, Kohlrausch law of independent migration of ions, Transference number and its experimental determination using Hittorf and Moving boundary methods, Ionic mobility.

Applications of conductance measurements: Determination of degree of ionization of weak electrolyte, Solubility and solubility products of sparingly soluble salts, Ionic product of water, Hydrolysis constant of a salt, Conductometric titrations (only acid-base). **(6 Lectures)**

Electrochemistry

Reversible and irreversible cells, Concept of EMF of a cell, measurement of EMF of a cell, Nernst equation and its importance, Types of electrodes, Standard electrode potential, Electrochemical series, Thermodynamics of a reversible cell, Calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data, Calculation of equilibrium constant from EMF data, Liquid junction potential and salt bridge, pH determination using hydrogen electrode. **(8 Lectures)**

Unit II **(30 Lectures)**

Organic Chemistry

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Carboxylic acids:

Acidity of carboxylic acid, Effect of substituents on the acidity of carboxylic acid; Comparison of acidic character of carboxylic acids and phenols,

Carboxylic acids (aliphatic and aromatic): Methods of preparation by acidic and alkaline hydrolysis of esters and Malonic ester synthesis

Chemical properties of carboxylic acids: Hell-Vohlard-Zelinsky Reaction.

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Carboxylic acid derivatives (Aliphatic) (Upto 5 carbons)
Preparation of derivatives like Acid chlorides, Anhydrides, Esters and amides from acids. Chemical properties of acid derivatives: Comparative study of nucleophilicity of acyl derivatives, Reformatsky Reaction, Perkin condensation. **(6 Lectures)**

Amines (Aliphatic and Aromatic) (Upto 5 carbons)
Structure of amines, Preparation: From alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. Separation of primary, secondary and tertiary amines by Hofmann's method and Hinsberg test, Chemical properties of amines: Carbylamine test, reactions with HNO_2, Schotten-Baumann reaction.
Electrophilic substitution (case aniline): Nitration, Bromination, Sulphonation.
Basicity of amines: Effect of substituents on basicity. **(6 Lectures)**

Amino Acids, Peptides and Proteins
Classification of amino acids, Acid-base behavior of amino acids, Equilibrium existing in acidic or basic solute ions of amino acids, Zwitterion, Isoelectric point and Electrophoresis.
Preparation of Amino acids: Strecker synthesis, Gabriel's phthalimide synthesis.
Reactions of Amino acids: Ester of –COOH group, Acetylation of $–NH_2$ group, Complexation with Cu^{2+} ions, Ninhydrin test.
Peptides: Classification, Geometry of peptide bond, Synthesis of simple peptides (up to dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-phase synthesis.
Proteins: Overview of primary, secondary, tertiary and quaternary structure of proteins, Determination of primary structure of peptides by degradation: Edmann degradation (N-terminal) and (C–terminal) (Hydrazinolysis and Enzymatic method using carboxypeptidase enzyme). **(10 Lectures)**

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Carbohydrates

Classification and general properties: Glucose and Fructose: Chemical properties, Open chain structure, Configuration of Glucose and Fructose, Absolute configuration of Glucose and Fructose, Mutarotation, Ring structures of Glucose and Fructose, Haworth projection formulae and conformations of α- and β-D-(+) Glucopyranose, Pyranose structure, Furanose structure of D-(-)-Fructose, conformations of α- and β-D-(-)-Fructose, Structures of Ribose and Deoxyribose, Structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation. **(8 Lectures)**

Teaching-learning Activities:

- Peer teaching and learning
- Seminar presentation
- Group tutorial
- Assignments
- Use of e-learning resources

Reference Books:

- Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
- Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengag Learning India Pvt. Ltd.: New Delhi (2009).
- Mahan, B.H. University Chemistry, 3rd Ed. Narosa (1998).
- Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co.: New York (1985).
- Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

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- Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed.,W. H. Freeman.
- Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.
- Kapoor, K.L. (2015), A Textbook of Physical Chemistry,Vol 1, 6th Edition, McGraw Hill Education.
- Kapoor, K.L. (2013), A Textbook of Physical Chemistry,Vol 3, 3rd Edition, McGraw Hill Education.
- B.R.Puri, L.R.Sharma, M.S.Pathania, (2017),Principles of Physical Chemistry, Vishal Page 146 of 167 B.Sc. Hons Chemistry University of Delhi Publishing Co.

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B.Sc. Non-Medical-II
SEMESTER-III

BSNM/BSM -302(P): SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL ORGANIC CHEMISTRY LAB
(Common for B. Sc. Medical and Non-Medical)

Maximum Marks: 50 No. of Lectures: 60
Time allowed: 4hrs

Course Objectives

- To develop skills required for the qualitative analysis of organic compounds.
- Enable the students to determine the various physical properties using simple instrumental methods like conductance and potentiometry**.**

Course Learning Outcomes

On the completion of the course, the students will be able to:

CO1: operate various analytical instruments such as potentiometer and conductometer.

CO2: construct phase diagrams of two component systems.

CO3: determine CST and CSE of two component systems.

CO4: analyze qualitatively the organic compounds containing monofunctional groups.

CO5: perform common laboratory techniques of paper chromatography to separate the mixtures.

CO6: distinguish between reducing and non-reducing sugars by performing chemical tests.

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Unit 1: Physical Chemistry

Phase equilibria

(a) Construction of the phase diagram of a binary system (simple eutectic) using naphthalene and benzoic acid

(b) Determination of the critical solution temperature and composition of the phenol water system and to study the effect of impurities.

(c) Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Conductance

(a) Determination of cell constant

(b) Perform the following conductometric titrations:

i. Strong acid vs. strong base ii. Weak acid vs. strong base

Potentiometry

Perform the following potentiometric titrations:

i. Strong acid vs. strong base ii. Weak acid vs. strong base

Unit II: Organic Chemistry

I) Systematic Qualitative organic analysis of organic compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

II) (a) Separation of spinach and methylene blue/red by paper chromatography
(b) Titration curve of glycine
(c) Action of salivary amylase on starch

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(d) Effect of temperature on the action of salivary amylase on starch.
(e) Differentiation between a reducing and a nonreducing sugar.

Teaching-learning Activities:

- Viva-voce.
- Laboratory-based practical component and experiments.

Reference Books:

- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand

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B.Sc.- II (Non-Medical/Medical)
SEMESTER-III
BSEC(C)-304: GREEN METHODS IN CHEMISTRY
(Common for B.Sc. Medical and Non-Medical)

Maximum Marks: 50 No. of hours- 60
(Credits: 02)

Course Objectives

- The primary goal of this course is to make students aware of how chemical processes can be designed, developed and run in a sustainable way.
- To enable students acquire the competence to think of greener and environmental benign routes of chemical synthesis.

Course Learning Outcomes

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

CO1: recall the twelve principles of green chemistry.
CO2: design safer chemical products and processes that are less toxic than current alternatives.
CO3: compare the conventional methods of synthesis with green methods.
CO4: explain the benefits of using green solvents and biocatalysts to carry out environment friendly synthesis.

Introduction

Definitions of Green Chemistry, Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry. brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy,

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reducing toxicity, green solvents, Green Chemistry and catalysis and alternative sources of energy, green energy and sustainability, Eco Scale, E-Factor.

PRACTICALS

i. Microwave assisted ammonium formate-mediated Knoevenagel reaction. (Solvent free reaction)
ii. Synthesis of organic compounds (Schiff's base, benzimidazole, benzthiazole) in aqueous medium using surfactant. (Water as solvent)
iii. Photoreduction of benzophenone to benzo-pinacol by sunlight. (Photochemical reaction)
iv. Detection of elements in organic compounds with zinc and sodium carbonate rather than hazardous sodium. (Non-hazardous reaction)
v. Synthesis of silver nanoparticles from very dilute solution of silver nitrate and citrous fruit juice/pulp powder/aloe vera juice etc. (Use of Eco-Friendly reagent)
vi. Preparation of acetanilide from aniline with acetic acid and zinc rather than acetic anhydride and pyridine. (Atom economy concept)

Reference Books

- Anastas, P.T. & Warner, J.K. Green Chemistry- Theory and Practical, Oxford University Press (1998).
- Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001).
- Cann, M.C. & Connely, M.E. Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).
- Ryan, M.A. & Tinnesand, M. Introduction to Green Chemistry, American Chemical Society, Washington (2002).
- Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. Green Chemistry Experiments: A monograph I.K. International Publishing House Pvt Ltd. New Delhi, Bangalore.

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- Lancaster, M. Green Chemistry: An introductory text RSC publishing, 2nd Edition.
- Ahluwalia, V. K, and Kidwai, M. New Trends in GREEN CHEMISTRY. ISBN 978-94-015-7102-9 ISBN 978-1-4020-3175-5 DOI 10.1007/978-1-4020-3175-5.

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B.Sc. Non-Medical II
SEMESTER-IV

BSNM/BSM-402: TRANSITION METAL & COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS

(Common for B.Sc. Medical and Non-medical)

Maximum Marks: 100 | No. of Lectures: 60
External Examination: 75 | Time: 3 Hrs.
Internal Assessment: 25 | Pass Marks: 35%

Course Objectives

- To understand the general characteristics of the d and f block elements.
- To give the students a thorough knowledge of the different theories to explain bonding in coordination compounds**.**
- To understand the general characteristics of different states of matter.
- To impart knowledge to the students about the intermolecular forces in gases and liquids and the structure of solids.
- To know the structure and bonding of important coordination compounds**.**
- To understand the magnetic properties of complexes and to know how magnetic moments can be employed for the interpretation of their structure**.**
- To get an overview about the stereochemistry of coordination compounds.
- The student will also learn about the reaction rate, order, activation energy and theories of reaction rates.

Course Learning Outcomes

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

CO1: illustrate the properties, characteristics and complexes and comparison of d and f block elements.

CO2: understand various concepts and factors affecting the strength of acids and bases.

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CO3: derive ideal gas law from kinetic theory of gases and explain why the real gases deviate from ideal behavior.
CO4: describe the properties of liquids especially surface tension and viscosity.
CO5: find symmetry elements, crystal structures of ionic solids
CO6: know the concept of rate of reactions and the factors affecting the rates.

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of 3 units: unit I, unit II and unit III. Unit I and II will have 4 questions from respective unit of the syllabus and will carry 12 marks each. Unit III will consist of 9 questions from the whole syllabus and will carry 3 marks each.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt 2 questions from each Unit I & Unit II. Unit III is compulsory.
Note: Internal Assessment will be given on the basis of semester test (12), class performance (6), assignment/quiz (7).

Unit-I

Chemistry of d-block Elements

Definition of transition elements, Position in the periodic table, General characteristics and properties of transition elements including atomic radii, Melting and boiling points, Ionisation energies, Metallic character, Oxidation states, Magnetic properties, Formation of alloys, Colour, Complex formation, Catalytic properties, Structures and properties of some compounds of Transition elements- TiO_2, $TiCl_4$, chromium (II) acetate, chromate and dichromate ion, $VOCl_3$, $KMnO_4$, Mn_2O_7, $FeCl_3$, $Ni(dmg)_2$, $CuCl_2$.

Electronic Configurations of elements of second and third transition series, General characteristics of second and third transition series and comparison with the first transition

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series: Irregular or anomalous electronic configuration, Atomic and ionic radii, Oxidation states, Stability of complexes, Coordination number, Magnetic properties, Ionisation energies and metal-metal bonding. Comparative study of the elements of second and third transition series**.** **(9 Lectures)**

Lanthanoids

Electronic configurations, Oxidation states, Color, Magnetic properties, Spectra, lanthanoid contraction, Complex formation tendency of lanthanoids, Occurrence of lanthanoids.

Actinoids

Electronic Configurations, Ionic radii and actinoid contraction, Color, Magnetic properties, Chemistry of separation of Neptunium Plutonium and Americium from Uranium, Later or Heavier actinide Elements, Comparison of lanthanoids and actinoids. (**8 Lectures)**

Coordination Chemistry

Valence Bond Theory (VBT): Werner's coordination theory, EAN Rule, Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6), IUPAC system of nomenclature. Structural and stereoisomerism in complexes with coordination numbers 4 and 6, Drawbacks of VBT, Applications of coordination compounds.

(8 Lectures)

Acids and Bases

Arrhenius concept, Bronsted-Lowry concept, Lux-Flood concept, Solvent- System concept and Lewis concepts of acids and bases. Relative strength of acids and bases, Effect of substituents and solvents on the strength of acids and bases, Classification of acids and bases as hard and soft, Pearson's HSAB concept with application. **(5 Lectures)**

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Unit II

Kinetic Theory of Gases

Postulates of Kinetic theory of Gases and derivation of the kinetic gas equation, Deviation of real gases from ideal behavior, Compressibility factor, Causes of deviation, Van der Waals equation of state for real gases, Boyle temperature (derivation not required), Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance, Temperature dependence of these distributions, Most probable, Average and Root mean square velocities (no derivation), Collision cross section, Collision number, Collision frequency, Collision diameter and Mean free path of molecules. **(8 Lectures)**

Liquids

Physical properties of liquids: Vapour pressure, Surface tension and Coefficient of viscosity; determination of vapour pressure by Static methods (Barometric method and Isoteniscope method), Measurement of surface tension by Stalagmometer method (Drop weight and Drop Number method) and measurement of viscosity by Ostwald's viscometer, Effect of addition of various solutes and temperature on surface tension and viscosity, explanation of cleansing action of detergents, Qualitative discussion of structure of water. **(6 Lectures)**

Solids

Types of solids, Symmetry elements, unit cells, Crystal systems, Bravais lattice types and identification of lattice planes, Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices, Miller indices, X–Ray diffraction by crystals, Bragg's law, Structures of NaCl, KCl and CsCl (qualitative treatment only). **(8 Lectures)**

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Chemical Kinetics

The concept of reaction rates, Effect of temperature, Pressure, Catalyst and other factors on reaction rates, Order and molecularity of a reaction, Derivation of integrated rate equations for zero, first and second order reactions, Half–life of a reaction, General methods for determination of order of a reaction, Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. **(8 Lectures)**

Teaching-learning Activities:

- Student directed learning: small groups of students are given individual assignments and they will present their assignment as Power Point Presentation.
- Lecture supported by group tutorial work.
- Technology enabled learning.
- Peer teaching and learning.

Reference Books:

- Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
- Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
- Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
- Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
- Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York s(1985).
- Cotton, F.A. & Wilkinson, G. Basic Inorganic Chemistry, Wiley.
- Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
- Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
- Rodgers, G.E. Inorganic & Solid-State Chemistry, Cengage Learning India Ltd., 2008.

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B.Sc. Medical/Non-Medical- II
SEMESTER-IV
BSNM/BSM-402(P): TRANSITION METAL & COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS
(Common for B.Sc. Medical and Non-Medical)

Maximum Marks: 50 No. of Lectures: 60

Time allowed: 4 hrs.

Course Objectives

- To impart the students a thorough knowledge of systematic qualitative analysis of mixtures containing two acid and two basic radicals with interfering radical by semi-micro methods.
- To develop experimental skills in viscosity, surface tension and inorganic estimations.

Course Learning Outcomes

On the completion of the course, the students will be able to

CO1: identify acidic and basic radicals in the given unknown sample.

CO2: estimate the total hardness (temporary and permanent) of water in a given sample.

CO3: Interpret the results obtained by the stalagmometer and Ostwald's viscometer.

CO4: determine the surface tension and viscosity of an unknown sample.

CO5: measure the kinetics of a chemical reaction.

Unit I
Inorganic Chemistry

Semi-micro qualitative analysis (using H_2S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following: Cations: NH_4^+, Cu^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+
Anions: CO_3^{2-} , S^{2-}, SO_4^{2-}, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, HCO^-_3, $C_2O_4^{2-}$

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(Spot tests should be carried out wherever feasible)

1. Estimate the amount of nickel present in a given solution as bis(dimethylglyoximato)nickel (II) or aluminium as oximate in a given solution gravimetrically.

2. Estimation of Zn^{2+} by complexometric titrations using EDTA.

3. Estimation of total hardness of a given sample of water by complexometric titration.

Unit II

Physical Chemistry

(I) Surface tension measurement (use of organic solvents excluded).

a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

(II) Viscosity measurement (use of organic solvents excluded).

a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.

(III) Chemical Kinetics (Integrated rate method):

a) Saponification of ethyl acetate.

Teaching learning activities:

- Viva-voce
- Laboratory-based practical components and experiments.

Reference Books

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.

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2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

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B.Sc. Medical/Non-Medical-II
SEMESTER-IV
BSEC(C)-404 A: BASIC ANALYTICAL CHEMISTRY
(Common for B.Sc. Medical and Non-medical)

Maximum Marks: 50 No. of hours- 60

(Credits: 02)

Course Objectives

- The major goal of this course is to familiarize students with basic concepts of analytical chemistry including fundamental terms such as precision, accuracy, and sources of error in experimental settings.
- The course is also aimed at nurturing students with practical knowledge about analytical chemistry, with focus on soil and water pollution, food analysis, chromatography, and personal care products.

Course Learning Outcomes

On the completion of the course, the student will be able to:

CO1: explain the concept of sampling in analytical applications, the importance of accuracy, precision, and source of error in analytical measurements.

CO2: perform common laboratory techniques of paper chromatography and thin layer chromatography to separate the components of mixtures.

CO3: perform classical analytical experiments, and make observations and assessments of important factors that could affect the analytical result.

CO4: determine the pH of water and soil samples.

CO5: make up methodical reports from chemical experiments and present the results in a transparent manner.

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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.
Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.
Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration.
Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.
Analysis of cosmetics: Major and minor constituents and their function.

PRACTICALS:
1. Analysis of soil:
a. Determination of pH of soil samples.
b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.
2. Analysis of water:
a. Determination of pH, acidity and alkalinity of a water sample.
3. Analysis of food products:
a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.
4. Chromatography:
a. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}).

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5. Analysis of cosmetics:

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

6. Suggested Instrumental demonstrations (any two):

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 drinks.

Teaching-learning Activities:

- Viva-Voce
- Laboratory-based practical component and experiments
- Practicum and project-based learning

Reference Books

- 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.
- Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.
- Skoog, D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6th Ed., Saunders College Publishing, Fort Worth (1992).
- Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman. Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
- Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India.
- Freifelder, D. Physical Biochemistry 2nd Ed., W.H. Freeman and Co., N.Y. USA (1982).
- Cooper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y. USA. 16 (1977).

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- Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall. Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Prentice Hall.
- Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995)

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B.Sc. Non-Medical II
SEMESTER-IV
BSEC(C)-404 B: Minor Research Project in Chemistry
(Common for B.Sc. Medical and Non-medical)

Max. Marks: 50 (Credits: 02)

No. of Hours: 60 Hrs.
Pass Marks: 40%

COURSE OBJECTIVES

- The minor research course will address problems of societal and industrial interest.
- Students get exposed to a blend of theoretical as well as practical knowledge.
- Students will get expertise in understanding, formulating and solving problems.

COURSE LEARNING OUTCOMES

On completion of this course, student will be able to:
CO1: search the related literature.
CO2: develop skills of formulating their own method and ability to use instruments for analysis.
CO3: develop report writing skills.

Students can work on any of the research project of their interest with the consent of teacher in-charge and availability of Chemicals.

Project Report: 30 marks (Students have to submit project report comprising introduction, Experiment, Result and discussion, Conclusion)

Viva voce: 20 marks

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Teaching-learning Activities

- Laboratory-based practical component and experiments
- Peer teaching and learning
- use of e-learning resources

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