St. Xavier's College (Autonomous), Ahmedabad-09

Syllabus of Semester – III of the following departments under Faculty of Science based on Under Graduate Curriculum Framework - 2023 to be implemented from the Academic Year 2025-26.

FACULTY OF SCIENCE

DEPARTMENT OF CHEMISTRY

BSc. (Hons.) Chemistry
Category – IV

Major Course – 1: Organic Chemistry (Theory)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Pre-requisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
CHMC331C-Organic Chemistry-I (Theory)	4	0	0	10 + 2 from a recognized board in any stream	

LEARNING OBJECTIVES (LO): The main objective of the course will be to build the basic foundation for studying chemistry. By the end of the paper, a student should be able to:	
LO-1	To be acquainted with the fundamentals of organic chemistry to describe the structure, synthesis and chemical properties of carbohydrates, especially monosaccharides, disaccharides and basics of amino acid chemistry
LO-2	To understand the Basic Concept of and apply the principles of Electrophilic aromatic Substitution in details and reaction mechanisms

LO-3	To understand and apply basic concept chemistry of some selected heterocycles and beta dicarbonyl compounds
LO-4	To know and apply basics knowledge of resonance, inductive effects etc to evaluate the acid-base properties of organic molecules
Course OUTCOMES (CO)	
On Completion of this course, the student will be able to	
CO-1	Apply the fundamentals of organic chemistry to describe the structure, synthesis and chemical properties of carbohydrates, especially monosaccharides, disaccharides and basics of amino acid chemistry.
CO-2	To understand electrophilic aromatic substitution in details and reaction mechanisms employed to synthesize derivatives of benzene, naphthalene and other polynuclear hydrocarbons
CO-3	To understand the chemistry of some selected heterocycles and beta dicarbonyl compounds
CO-4	Apply the concepts of resonance, inductive effects etc to evaluate the acid-base properties of organic molecules

Unit:1 CARBOHYDRATES AND AMINO ACID (15L)

A Carbohydrates: Introduction, classification of carbohydrates, osazone formation, epimerization, step up and stepdown reactions of monosaccharides, simple structures of glucose and fructose, Fischer's proof of configuration of D-glucose. Haworth Presentation of Glucose, Mutarotation.

Disaccharides: Introduction of disaccharides, Structure of Maltose, Cellobiose, Lactose and Sucrose

B Amino acid: Introduction of amino acid, Classification, and properties of amino acids, Zwitter ion, Isoelectric point, Strecker's and Gabriel phthalimide synthesis of amino acids. Reactions of amino acids, Ninhydrin test.

Unit 2 ELECTROPHILIC AROMATIC SUBSTITUTION AND POLYNUCLEAR HYDROCARBON (15L)

A Introduction, effect of substituent groups, determination of orientation and relative reactivity, classification of substituent groups, electrophilic substitution (ES) reactions. (Nitration, Sulfonation, Halogenation, Friedel Craft alkylation and acylation), Orientation in mono and disubstituted benzene.

B Nomenclature, structure and synthesis of Naphthalene and its derivatives. Reactions (oxidation, reduction and electrophilic substitution reaction (ESR) of naphthalene. Preparation and reactions of anthracene and phenanthrene.

Unit 3 HETEROCYCLIC COMPOUNDS AND B -DICARBONYL COMPOUNDS (15L)

A Introduction, Three and four membered ring with one hetero atom: Preparation of azirine (Neber rearrangement), oxirane (oxidation of alkenes), azitidine (cyclization of γ haloalkylamines), Five membered ring with one hetero atom: Structure and preparation of Pyrrole (Knorr synthesis, Paal Knorr synthesis, Hantzsch synthesis), Furan (synthesis from carbohydrates, Paal-Knorr synthesis) and Thiophene (Paal-Knorr synthesis, Hinsberg method); Electrophilic substitution reactions of pyrrole, furan and thiophene, Six membered ring with one heteroatom: Structure and preparation of pyridine(Hantzsch synthesis, cyclization of acetylene with hydrogen cyanide) and piperidine (from 1,5 diamine hydrochloride salt); – Electrophilic substitution reactions of pyridine.

B Introduction, synthesis of Ethyl acetoacetate (EAA) and Diethylmalonate. Acidic and ketonic hydrolysis of β-dicarbonyl compounds. Synthetic applications of β -dicarbonyl compounds. (i) Crotonic acid from EAA (ii) Valeric Acid from diethyl malonate.

Unit 4 CHEMICAL REACTIVITY AND MOLECULAR STRUCTURE: (ACID- BASE PROPERTIES)(15L)

Acid-Bases, scale of acidity-basicity, Resonance effect, drawing of structures and the condition for resonance, Effect of change of hybridization on acidity and basicity, Inductive and electronic effects, steric effect and hydrogen bonding, Lewis acid and bases, Keto – enol tautomerism. Difference between resonance and tautomerism.

Suggestive readings:

1. "Organic Chemistry" by Robert Thornot Morrison and Robert Neilson Boyd, Prentice Hall of India Pvt Ltd, New Delhi, Sixth Edition, 1992.
2. "Organic Chemistry", by Bhupinder Mehta, Manju Mehta Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. "Organic Chemistry", by James B Hedrickson Donald J. Cram and George S. Hammond, Mc-Graw-Hill Kogakusha, Ltd., Third Edition.
4. "Advance Organic Chemistry", by Arun Bahl, B. S. Bahl, S. Chand & Company Ltd., New Delhi, First Edition, 2003.
5. "Organic Chemistry", by I. L. Finar, Pearson Education Pet Ltd, New Delhi, First Edition, 2002.
6. "Organic Chemistry", by G. Marc Loudon, Oxford University Press, Forth Indian edition, 2010.
7. "Text book of Organic Chemistry" by P.S.Kalsi, MacMillan of India Pvt. Ltd., 1999.
8. "Text book of Organic Chemistry" by P.L. Soni and H.M. Chawala, Sultan Chand & Sons Publication, New Delhi, 26th Edition, 1995.
9. "Heterocyclic chemistry" by Raj K. Bansal, New Age International (P) Ltd Publishers, Fourth Edition, 2008.
10. "Heterocyclic Chemistry in Drug Discovery", Edited by Jie Jack Li (Editor), Wiley Publishers, New Jersey 2013

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FACULTY OF SCIENCE

DEPARTMENT OF CHEMISTRY

BSc. (Hons.) Chemistry
Category – IV

Major Course – 2: Physical Chemistry (Theory)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course			Eligibility Criteria	Pre-requisite(s) of the Course (if any)
	Lecture	Tutorial	Practical / Practice		
CHMC332C Physical Chemistry (Theory)	4	0	0	10 + 2 from a recognized board in any stream	Basic Knowledge of Chemistry

LEARNING OBJECTIVES (LO)	
LO-1	To be acquainted with basics to Calculate the work function and free energy of chemical systems to determine the spontaneity of the reaction and also modify the kinetic rate equation to include temperature
LO-2	To understand the Basic Concept of , electrolytic dissociation ions mobilities and Debye Huckle theory. To determine the outcome of simple acid-base titrations conductometrically and also to understand chemistry related to Phase Rule, Theoretical derivation of phase rule, One component system, Condensed phase rule, Congruent melting point etc.
LO-3	To understand and apply basic concept /laws of Physical Properties and chemical constitution and also to understand chemistry related to Colloids and different types of colloidal.
LO-4	To know and apply basics knowledge of polymer chemistry in terms of its classification, molecular weight determination and role of additives. Also

	to learn different types of artificial nuclear reactions, accelerator and counters in nuclear chemistry
Course OUTCOMES (CO)	
On Completion of this course, the student will be able to	
CO-1	Calculate the work function and free energy of chemical systems to determine the spontaneity of the reaction and also modify the kinetic rate equation to include temperature
CO-2	Employ the fundamentals of Electrolytic Dissociation to determine the transport number, equivalent conductance. To know simple acid-base titrations conductometrically and activity. To understand chemistry related to Phase Rule, Theoretical derivation of phase rule, One component system, Condensed phase rule, Congruent melting point etc
CO-3	To understand various aspects related to Physical Properties and chemical constitution and also to understand chemistry related to Colloids and different types of colloidal.
CO-4	Remember and recognize the basics of polymer chemistry as well as nuclear chemistry

Unit-1

(A) Thermodynamics

Work and free energy functions; Variation of Free Energy with Temperature and Pressure, Isothermal change in Free Energy, Gibbs Helmoltz equations-(a) In Terms of Free Energy and Enthalpy, (b) In terms of Internal Energy and Work Function, Numericals based on theory. Nernst theorem and consequences.

(B) Chemical Kinetics

Theories of reaction rates: Collision theory of bimolecular gaseous reactions, limitations of collision theory, Activated Complex theory of bimolecular reactions; Primary and secondary salt effects. Effects of temperature on reaction rates; Derivation of Arrhenius equation, Calculation of Ea Using Arrhenius Equation, numerical problems.

Unit-2

(A) Theory of Electrolytic Dissociation

Migration of ions, Hittorf's theoretical cell and explanation, Determination of transport numbers by moving boundary method; Kohlrausch law and its applications, Debye Huckle theory of strong electrolytes, Conductometric titrations: Principle and advantages; Titration of Strong acid against strong base (HCl vs NaOH); Titration of Weak acid against strong base (CH_3COOH vs NaOH); Titration of Strong acid against weak base (HCl vs NH_4OH); Titration of very weak acid against strong base (H_3BO_3 vs NaOH); Titration of mixture of acids against strong base (HCl + CH_3COOH vs NaOH); differences between conductometric and volumetric titrations. Activity and activity-coefficient; Ionic strength.

(B) Phase Rule

Introduction, terms: number of phases, number of components, degrees of freedom, Theoretical derivation of phase rule; One component system: water system and sulphur system; Condensed phase rule; Silver – lead (Ag-Pb) system; Zn-Cd system, Freezing mixture (salt-H_2O) system, Congruent melting point.

Unit 3

(A) Physical Properties and chemical constitution

Types of properties, molar volume, parachor, application of parachor in deciding structure, viscosity, measurement of viscosity by Ostwalds' method, Refractive index, specific refraction, molar refraction, determination of refractive index, optical activity, specific rotation, measurement of optical activity by polarimeter

(B) Colloids

Colloidal Systems; Preparation of Colloidal Solutions; General Properties of Colloidal Systems; Properties of hydrophobic Colloidal Systems. Purification of colloidal solution.

Unit 4

(A) Polymer Chemistry

Polymer: Definition, Classification of Polymers, Techniques of polymerization, Bio-polymers, Polymer additives, Thermodynamics of polymer solution, Molecular weight determination of polymers: Number average molecular weight, Weight average molecular weight, Viscosity and Osmotic pressure method.

(B) Nuclear Chemistry

Artificial transmutation (nuclear reactions with proton, neutron, deuteron, alpha particle) ,Particle acceleration –linear accelerator, Cyclotron, Geiger-Muller counter, proportional counter, scintillation counter

Suggestive Reading:

1. Physical Chemistry by Puri, Sharma and Pathania 48th edition, Vishal publication, 2021
2. Polymer Science by V R Gowariker 3rd edition, new age internation publishers ,2019
3. Essentials of Nuclear Chemistry by Arnikar,4th edition new age internation publishers 2011
4. Nuclear & Radiation Chemistry by B K Sharma, Krishna publishers 2020
5. Thermodynamics: a core course by Srivastava, Saha and jain , 3rd edition, PHI learning 2021
6. An Introduction To Electrochemistry by S Glasstone, East-West Press (Pvt.) Ltd ,2006
7. Physical Chemistry by Atkins,11th edition, Oxford,2018