

BANGALORE UNIVERSITY



Department of Chemistry

**Jnanabharathi Campus
Bengaluru-560 056**

SCHEME AND SYLLABUS FOR UNDER GRADUATE COURSE IN CHEMISTRY (Bachelor of Science)

V and VI SEMESTERS

**Framed as per the State Education Policy
(SEP-2024)**

Effective from the Academic Year 2026-2027

FOREWORD

In accordance with the directive from Bangalore University, the Chemistry syllabus for the B.Sc. degree course (SEP-24) was revised. The Bangalore University provided comprehensive guidelines to ensure the curriculum meets contemporary academic standards with applied component.

At the Department of Chemistry, Bangalore University, a collaborative effort was undertaken with the Chemistry Teachers Forum to form a Core Group comprising faculty from the University Department and affiliated colleges. The objective was to align the syllabus with the UGC Model Curriculum, which emphasizes interdisciplinary skills, integration of general studies with professional courses, and providing both vertical and horizontal mobility while addressing local educational needs. Faculty members specializing in Inorganic, Organic, and Physical Chemistry conducted both separate and joint brainstorming sessions. These sessions were instrumental in developing a comprehensive draft syllabus for V and VI semesters of B.Sc. Chemistry. The Chemistry Teachers' Forum designed this syllabus by ensuring to allow for flexibility in programme, diverse perspectives and educational requirements of the students. Notably, regularly updating the curriculum reflects the commitment to providing high-quality education, fostering a learning environment that promotes critical thinking, innovation, and excellence. Finally, the syllabus revision process not only enhances the academic framework but also ensures that students are equipped with relevant knowledge and skills to meet future challenges and opportunities in the field of Chemistry

I, sincerely, hope that the present syllabus will be a guiding force for the undergraduate students enrolled under Bangalore University Curriculum for years to come.

CHAIRMAN

Department of Chemistry
Jnanabharathi Campus
Bangalore University
Bengaluru-560 056

**Members of the Committee for the Preparation of the Chemistry Syllabus for the
B. Sc., Degree Course (Semester Scheme-SEP)**

INORGANIC CHEMISTRY SECTION	
Dr. Prasanna Kumar S G	M.S. Ramaiah College of Arts, Science & Commerce, Bengaluru
Dr. Sanjeevarayappa C	GFGC, Yelahanka, Bengaluru
Mr. Surendra Reddy	GFGC, Vijayanagara, Bengaluru
Dr. Santhosh Kumar A S	N M K R V College, Bengaluru
ORGANIC CHEMISTRY SECTION	
Dr. Vasudeva Reddy	GFGC, Vijayanagara, Bengaluru
Dr.V. Lakshmid devi	GFGC, Vijayanagara, Bengaluru
Dr. Sumaiya Tabassum	Surana College, Bengaluru
Dr. Shalini K. S	Maharani's Cluster University, Bengaluru
Dr. Meenakshi	Surana College, Peenya Branch, Bengaluru
Dr. Dinesh C	Auregene India Pvt Ltd, Bengaluru
PHYSICAL CHEMISTRY SECTION	
Dr. Nagegowda P	GFGC, Channapatna
Dr. Yogesha N	GFGC, Ramanagara
Dr. Nebula Murukesh	The Oxford College of Science, H S R Layout, Bengaluru

Proceedings of the meeting of the Board of Studies in Chemistry- UG held on 4th April 2026 at 10.30 am in the Department of Chemistry, Bangalore University, Jnana Bharathi, Bengaluru-560 056

The Chairman welcomed the members of the Board to the meeting and placed the agenda before them for discussion.

Agenda: 1. Scrutiny and approval of the Syllabus for 5th and 6th semester of B.Sc., Degree, Chemistry Programme (SEP- 2024 Scheme).

The Chairman informed the members that, as per the directive from the Bangalore University, the Chemistry syllabus for the B.Sc., Chemistry degree for 5th and 6th Semester as per SEP 2024 credit frame works.

The syllabus has prepared with the help of the Chemistry Teachers' Forum by constituting a Core Group from the affiliated Colleges, for the year 2026-2027. In this connection, the Core Group of teachers participated in the meeting held on 13.03.2026 prepared a Draft syllabus. The Board of Studies (UG) approved the Syllabus after some modifications on 04.04.2026, in the presence of a wider group of Teachers offering Chemistry at UG level.

The meeting ended with the vote of thanks by the Chairman.

The following members were present in the BOS meeting held on 04-04-2026.		
MEMBERS OF THE BOS (UG)		
Signature		
1. Dr. Vasudeva Reddy	Member	Not present
2. Dr. Lakshmidevi	Member	U. Lakshmidevi
3. Dr. Nagegowda P	Member	[Signature]
4. Dr. Shalini K S	Member	Shalini K S
5. Dr. Yogesh N	Member	Yogesh N
6. Dr. Dinesh C	Member	Not present
7. Prof. Shivaraj Y	Chairman	[Signature]
8. Dr. Muddukrishna K R	Retired	
9. Mrs. Shubha Shahshikanth	Retired	
Co-opted members:		
1. Dr. Sanjeevarayappa - C	Member	[Signature]
2. Dr. Sumaiya Tabassum	Member	Sumaiya Tabassum
3. Dr. Meenakshi	Member	Meenakshigeenivasan
4. Dr. Nebula Murukesh	Member	Not present
5. Dr. Prasanna Kumar S. G.	Member	S. G. Prasanna Kumar
6. Mr. Surendra Reddy	Member	Not present
7. Dr. Santhosh A S	Member	Not present

Programme outcome:

By the end of the programme the students will:

1. Understand the basic principles of various branches of chemistry.
2. Demonstrate a range of practical skills to conduct and infer experiments independently and in groups.
3. Apply the key concepts and standard methodologies to solve problems related to chemistry.
4. Apply methodologies to the solution of unfamiliar types of problems.
5. Exhibit skills leading to employability in Chemistry and allied industries
6. Comprehend the fundamental aspects of research in Chemistry.
7. Identify chemical formulae and solve numerical problems.
8. Possess the level of proficiency in subject required for post graduation as well as for pursuing research in Chemistry and related interdisciplinary subjects.
9. Introducing Students to modern techniques, various equipments and Chemical softwares.
10. Design solutions stemming from the application of chemistry to local issues.
11. Understand good laboratory practices and safety.
12. Opportunity to the students for getting job in industries besides academic and administrative works.

Program Duration:

The B.Sc. Programme with Chemistry is of three years duration. Each year is called an academic year and is divided into two semesters. Thus, there will be a total of six semesters.

Assessment : Weightage for assessments (in percentage)

Type of Course	Formative Assessment / IA	Summative Assessment Marks /ESE
Theory	20	80
Practical	10	40

The curriculum will be delivered through various methods including chalk and talk, power point presentations, audio, video tools, E-learning/E-content, virtual labs, simulations, field trips/Industry visits, seminars (talks by experts), workshops, projects, models and class discussions. The assessment broadly will comprise of Internal Assessment (Continuous Evaluation) and End Semester Examination (ESE).

COURSE PATTERN AND SCHEME OF EXAMINATION
B.Sc. Chemistry as per SEP-2024 for V and VI Semester

Title and code of the paper	Teaching hours	Contact hours/Week	Exam. hours	FA/IA Marks	SA Marks	Total Marks	Credits
First Semester							
Chemistry-I BCHT-01	56	4	3	20	80	100	3
Chemistry Practical-I BCHP-01	56	4	3	10	40	50	2
Second Semester							
Chemistry-II BCHT-02	56	4	3	20	80	100	3
Chemistry Practical-II BCHP-02	56	4	3	10	40	50	2
Third Semester							
Chemistry-I BCHT-03	56	4	3	20	80	100	3
Chemistry Practical-III BCHP-03	56	4	3	10	40	50	2
Fourth Semester							
Chemistry-IV BCHT-4	56	4	3	20	80	100	3
Chemistry Practical-IV BCHP-04	56	4	3	10	40	50	2
Fifth Semester							
Chemistry-V Organic Chemistry BCHT-05	56	4	3	20	80	100	3
Chemistry Practical-V Organic Chemistry BCHP-05	56	4	3	10	40	50	2
Chemistry-VI Analytical and Physical Chemistry BCHT-06	56	4	3	20	80	100	3
Chemistry Practical-VI Physical Chemistry BCHP-06	56	4	3	10	40	50	2
Sixth Semester							
Chemistry-VII Inorganic and Biochemistry BCHT-07	56	4	3	20	80	100	3
Chemistry Practical-VII Inorganic and Biochemistry BCHP-07	56	4	3	10	40	50	2
Green Synthesis* BCHDSE-1	56	4	3	20	80	100	3

Industrial Chemistry* BCHDSE-2	56	4	3	20	80	100	3
Job Skills Practicals BCHJSP-01	56	4	3	10	40	50	2

B=B.Sc., CH=Chemistry, T= Theory, P=Practical, E=Elective, JS = Job skills

*** One out of the two to be selected.**

Scheme of Evaluation

Practical Examination:

Sl. no.	Examination particulars	Marks allotted
1	Experimental performance	25
2	Procedure Writing	05
3	Record assessment	05
4	Oral performance (Viva-voce)	05
Total		40

Internal Assessment Marks: Practicals

Sl no.	Particulars	I A Marks
1	Practical Test	06
2	Active participation in practical classes	04
Total Practical IA marks		10

Internal Assessment Marks: Theory

Sl no.	Particulars	I A Marks
1	Attendance	05
2	Internal Tests (Minimum of Two)	10
3	Assignments/Seminars	05
Total Theory IA marks		20

Pedagogy: Teaching-Learning through an intelligent mixture of conventional and modern methods, interactive discussions, organizing various activities, assignments for individual learners as well as for group.

Integrating creativity, critical thinking, communication, and collaboration into Chemistry instruction. We work to develop new approaches to practical teaching in the laboratories and to integrate assessment technologies and tools that work well with our Chemistry concepts.

Fifth Semester
Chemistry-V (Organic Chemistry)

56 hrs

Title of the Course	Organic Chemistry	Course Code	BCHT-05
Total Contact Hours/Semester	56	Teaching hours/week	4 hours
No. of Credits	03	Duration of Examination	03 hours
Formative Assessment marks	20	Summative Assessment Marks	80

COURSE OUTCOMES

After the completion of this course, the students would be able to,

CO-1: Understand stereoisomerism, assigning RS, EZ notation, determination of configuration of geometric isomers conformations of higher cycloalkanes.

CO-2: Understand the principles and strategies involved in the total synthesis of complex natural products.

CO-3: Explain source, extraction, classification, general properties and structural elucidation of some important terpenes and alkaloids.

CO-4: To introduce students to various spectroscopic techniques, including UV-Vis, IR, NMR, and their applications in organic compound analysis.

CO-5: Chemotherapy, classification of drugs and synthesis of some commonly used drugs.

Unit-I

Stereochemistry

9 hrs

Elements of symmetry in chiral and achiral with example molecules, chirality, and stereogenic centre. Fischer projection formulae.

Ex; Glyceraldehyde, Lactic acid, 2-Butanol, Tartaric acid.

Enantiomers: Optical activity; use of +/– and D/L notations. Properties of enantiomers, chiral and achiral molecules with two stereogenic centres. Meso compounds. Cahn-Ingold-Prelog sequence rules: R, S system of nomenclature, with any four examples.

Diastereomers: Threo and Erythro isomers with examples.

Racemisation and resolution. Relative and absolute configuration.

Optical isomerism due to restricted rotation about single bonds- diphenyl systems.

Geometrical isomerism: Determination of configuration of geometrical isomers. *cis* & *trans*, E, Z system of nomenclature. Geometric isomerism in oximes.

Alicyclic compounds: Conformations of four to eight membered cycloalkanes and disubstituted cyclohexanes.

Bicyclic systems: Nomenclature and conformations of decalins and norbornane.

Amines

5 hrs

Classification. Preparation of Hoffmann's synthesis for both alkyl and aryl amines, reductive amination of carbonyl compounds, Gabriel phthalimide. Basic strength of amines in aqueous solution with K_b , & pK_b values: Inductive, resonance, steric and solvation effects. Reaction of amines as nucleophiles – Methylation, quaternary salts, Hoffmann elimination with mechanism. Distinguishing reactions of 1° , 2° and 3° amines.

Diazotization and synthetic applications of diazonium salts. Sandmeyer's reaction. (Conversion to chlorobenzene, bromobenzene and benzonitrile), hydrolysis, reduction (to phenyl hydrazine and

aniline), coupling reactions to give azo dyes (*p*-hydroxyazobenzene and 1-phenylazo-2-naphthol).

Unit-II

Heterocyclic compounds

5 hrs

Introduction, classification, structures, resonance and aromatic character of furan, pyrrole, thiophene and pyridine by MOT. Methods of preparation and reactions of pyrrole, furan, thiophene, pyridine. Mechanism of electrophilic substitution reactions. Nucleophilic substitution reactions of pyridine, Chichibabin reaction. Comparison of basic strength of pyrrole, pyridine and piperidine. Preparation and reactions of indole, quinoline and isoquinoline.

Chemistry of Natural Products

9 hrs

Carbohydrates: **Introduction and classification.**

Monosaccharide's: Aldoses, ketoses with examples, structures of D-aldohexoses. Elucidation of open chain structure of D-glucose. Mechanism of mutarotation, epimers and anomers. Elucidation of ring structure of D-glucose in detail. Fisher and Haworth structures.

Ketoses: Structure of fructose, interconversion of glucose and fructose.

Disaccharides: Glycosidic bond. Haworth and conformational structures of maltose, lactose and sucrose.

Terpenes and terpenoids: Occurrence, classification and isoprene rule. Structural elucidation and synthesis of citral and zingiberene. Structures of limonene, menthol, α -terpineol, camphor, β -carotene, Vitamins-A and their uses.

Alkaloids: Introduction, classification and general characteristics. Structural elucidation and synthesis of nicotine. Structures and uses of ephedrine, caffeine, cocaine, atropine, quinine and morphine. Physiological effects of alkaloids.

Unit-III

Spectroscopy of Organic compounds

9 hrs

UV-Visible spectroscopy: Introduction. Chromophores and auxochromes; blue shift and red shift. Graphical representation of spectra of 1, 3-butadiene, benzene and lycopene. Influence of conjugation on UV absorption-Comparison of UV spectra of acetone and methyl vinyl ketone.

IR spectroscopy: Introduction. Stretching frequencies of -OH (free and H-bonded), alkyl -C-H, $C\equiv C$, $C=C$, C-C, C=O and C-O groups (by taking suitable examples). Graphical representation of IR spectra of benzoic acid and methyl benzoate.

NMR spectroscopy: Basic principles of nuclear magnetic resonance (NMR), nuclear magnetic spin quantum number I, influence of the magnetic field on the spin of nuclei, spin population, saturation using radio frequency. Proton magnetic resonance (PMR). Nuclear shielding and deshielding effects. Equivalent and non-equivalent protons with examples. Chemical shift (δ), uses of TMS as reference. Effect of electro negativity of adjacent atoms on chemical shift values. Spin-spin splitting and spin-spin coupling (qualitative treatment only) (including Pascals triangle).

Applications of NMR spectroscopy including identification of simple organic molecules. *Examples:* Shielding and deshielding effects for (i) methane (ii) CH_3-Cl (iii) CH_2Cl_2 (iv) $CHCl_3$. Spin-spin coupling in (i) Cl_2CHCHO (ii) 1,1,2-trichloroethane (iii) CH_3CH_2Cl (iv) CH_3CH_2OH .

Industrial Organic Chemistry

5 hrs

Synthetic dyes: Introduction and classification with examples. Colour and constitution. Synthesis of Congo red, malachite green, alizarin and indigo.

Drugs: Chemotherapy, classification of drugs. Synthesis and uses of paracetamol, diclofenac, sulphanilamide and chloramphenicol. Structure and uses of Ranitidine & Penicillin G.

Introduction to Green Chemistry: Principles of Green chemistry and its applications to the synthesis of paracetamol.

Unit-IV

Reaction Intermediates**6 hrs**

Reactions of i) Carbocations-Dienone-phenol and Beckmann rearrangement.

ii) Carbanions-Michael addition, Wittig rearrangement iii) Free Radicals: Sandmeyer Reaction

iv) Carbenes and Nitrenes: Singlet and Triplet states, their relative stability & Wolf rearrangement.

Methods for identifying reaction mechanism**4 hrs**

Product analysis, Isolation and Identification of Intermediates, Stereo chemical Evidences, Effect of Catalyst, crossover Experiments, Isotopic studies, Kinetic Studies.

Tautomerism and Enolates**4 hrs**

Tautomerism in carbonyl compounds – Keto-Enol tautomerism. Acidity of α -hydrogen atoms in aldehydes, ketones and active methylene compounds (example diethyl malonate, ethyl acetoacetate and acetyl acetone). Preparation of (from acetic acid) and synthetic applications of diethyl malonate (preparation of monocarboxylic acids - butanoic acid, dicarboxylic acid - Adipic acid, unsaturated acids - cinnamic acid, ketones - butanone, cyclic compounds - barbituric acid) Preparation of ethyl acetoacetate (from ethyl acetate). Synthetic applications of ethyl acetoacetate (preparation of monocarboxylic acids - butanoic acid, dicarboxylic acid –succinic acid, unsaturated acids - crotonic acid, ketones - butanone).

Course Articulation Matrix: Mapping of course outcome (COs) with programme outcomes

Course outcome (COs)	Programme outcome (POs)									
	1	2	3	4	5	6	7	8	9	10
CO1	3	3	2	3	3	2	2	2	3	3
CO2	3	3	3	2	3	2	3	2	2	3
CO3	2	3	2	3	2	3	3	2	2	3
CO4	2	1	3	3	2	3	2	3	2	2
CO5	1	2	3	2	2	2	3	3	3	1

*1= Low, 2=Medium 3=High

Reference Books

1. Organic Chemistry, Vol. I & II I.L. Finar, ELBS, 1986, 1991, 2005.
2. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice Hall, 1991
3. Advanced Organic Chemistry, O. S. Bahl and A. Bahl, New Delhi, S. Chand & Company Pvt. Ltd., Multicolor edition, 2012.
4. Advanced Organic Chemistry J. March, John Wiley & Sons, 2008.
5. Organic Chemistry, M.K. Jain, Nagin & Co., 1987
6. Organic Spectroscopy, V. R. Dani, Tata Mc Graw Hill, 1998
7. Organic Spectroscopy, W. Kemp, ELBS IV Edition, 1998.
8. Synthetic Drugs, G. R. Chatwaal, Himalaya Publications, 2000.
9. Modern Organic Chemistry, M. K. Jain, S. C. Sharma Vishal Publishing, fourth reprint, 2009.
10. Reaction Mechanism in Organic Chemistry, S.M. Mukherji, and S.P. Singh, Macmillan India Ltd., third edition, 2009.
11. Stereochemistry of Organic Compounds, D. Nasipuri, New-Age International (1999).
12. P. S. Kalsi 'Organic Reactions and their Mechanisms' New Age International Publishers. 2010.

Chemistry Practical-V (Organic Chemistry)

Title of the Course	Organic Chemistry	Course Code	BCHP-05
Total Contact Hours/Semester	56	Teaching hours/week	4 hours
No. of Credits	02	Duration of Examination	03 hours
Formative Assessment marks	10	Summative Assessment Marks	40

Course Outcome

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

- CO-1:** exercise the practicals in the laboratories impart the students the knowledge about various chemical reagents and reactions.
- CO-2:** Develop the techniques involved in the preparation of organic compounds.
- CO-3:** Prepare the small organic molecules by single and two steps.
- CO-4:** To understand isolation and purification of products.
- CO-5:** Acquire the necessary skills and knowledge.

Contents of the Course

1. Preparation of aspirin- acetylation
2. Preparation of m-dinitrobenzene from nitrobenzene- nitration
3. Preparation of dibenzal Acetone- Claisen condensation
4. Preparation of adipic acid from cyclohexanol- oxidation
5. Preparation of phenyl-azo- β -naphthol (an azo dye) from aniline- coupling
6. Paracetamol from aminophenol
7. Preparation of 7-hydroxy-4-methyl coumarin- Pechman reaction
8. Preparation of iodoform from acetone
9. Preparation of iodo nitro benzene from nitroaniline

Two step preparation

10. Preparation of diazo naphthol from nitrobenzene - Reduction of nitrobenzene to aniline and diazotisation
11. Preparation of nitro acetanilide from aniline-Acetylation of aniline to acetanilide and nitration.

Course Articulation Matrix: Mapping of course outcome (COs) with programme outcomes

Course outcome (COs)	Programme outcome (POs)									
	1	2	3	4	5	6	7	8	9	10
CO1	2	2	2	3	3	2	2	3	3	3
CO2	3	2	2	1	3	2	3	2	2	2
CO3	3	3	2	3	1	3	3	2	2	3
CO4	2	1	3	3	2	3	2	3	2	2
CO5	1	2	3	2	3	2	3	3	3	1

*1= Low, 2=Medium 3=High

Reference Books:

1. Vogel's quantitative Organic Analysis, G. Svehla, 7th Ed, Longman (2001).
2. Advanced Practical Chemistry, Jagadamba Singh, Pragathi, Publications (2017).
3. College Practical Chemistry: V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati. University Press-2011.
4. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, V. K. Ahluwalia, R. Aggarwal, and Universities Press (India), (2000).
5. Advanced Practical Organic Chemistry, J. Mohan, and Vol. I and II, Himalaya Publishing House, (1992).
6. Vishnoi, N.K. Advanced Practical Organic Chemistry, 3rd ed., Vikas Publishing House, New Delhi, 2010.
7. Laboratory Manual in Organic Chemistry–R. K. Bansal (New Age, New Delhi) 1990.

**Chemistry-VI
(Analytical and Physical Chemistry) 56 hours**

Title of the Course	Analytical and Physical Chemistry	Course Code	BCHT-06
Total Contact Hours/Semester	56	Teaching hours/week	4 hours
No. of Credits	03	Duration of Examination	03 hours
Formative Assessment marks	20	Summative Assessment Marks	80

Course Outcomes (COs):

By the end of the course, the students will be able to:

CO-1: Understand the principles of electrochemistry to analyse electrochemical systems and demonstrate their applications.

CO-2: Understand the role of ionic equilibria to explain hydrolysis, buffer action, indicator behaviour, and qualitative analysis, and to determine pH.

CO-3: Explain the structure, properties, and applications of newer materials such as conducting polymers, superconductors, fullerenes, carbon nanotubes, and nanomaterials.

CO-4: Develop a good understanding of the electromagnetic spectrum and describe the principles of Vibrational, Raman, Electronic and Electronic spectroscopy.

CO-5: Apply the principles of solvent extraction in separation processes, solve numerical problems, and perform extraction of metals such as iron and copper.

Unit-I

Quantitative Analysis-Instrumental methods

6 hrs

Review of electromagnetic spectrum, absorption of electromagnetic radiation, Definition and units of frequency, wavelength, wave number.

Beer's law, Beer-Lambert law derivation, deviations from Beer's law, limitations, construction of calibration graph (Plot of absorbance versus concentration), Instrumentation, single beam and double beam spectrophotometers, quantitative applications of colorimetry (determination of Fe, Mo, Cu, Ti and PO_4^{3-}) and numerical problems on application of Beer's law.

Solvent extraction

4 hrs

Separation methods Solvent Extraction: Definition of solvent extraction, Types- batch, continuous, efficiency, selectivity, Nernst distribution law, derivation, distribution coefficient, factors affecting the partition, relationship between % extraction and volume fraction, Numerical problems on solvent extraction. Solvent extraction of iron and copper.

Electroanalytical Methods

4 hrs

Voltammetry at a dropping mercury electrodes (DME)-Types of current obtained at DME.

Ilkovic equation and its applications. Current –potential relation for a cathodic process – half wave potential.

Cyclic Voltammetry-Principles-Experimental set up-Quantitative analysis, determination of diffusion coefficients.

Unit-II

Analytical Chemistry

9 hrs

Acid-base titrimetry

Titration curves for strong acid vs strong base, weak acid vs strong base and weak base vs strong acid titrations. Titration curves, Quantitative applications – selecting and standardizing a titrant, inorganic analysis - alkalinity, acidity.

Complexometric titrimetry

Indicators for EDTA titrations - theory of metal ion indicators, titration methods employing EDTA - direct, back, displacement and indirect determinations, Application-determination of hardness of water.

Redox Titrimetry

Balancing redox equations, calculation of the equilibrium constant of redox reactions, titration curves, Theory of redox indicators, calculation of standard potentials using Nernst equation. Applications. Precipitation titrimetry: Titration curves, titrants and standards, indicators for precipitation titrations involving silver nitrate- Volhard's and Mohr's methods and their differences.

Gravimetric Analysis

Requisites of precipitation, mechanism of precipitation, Factors influencing precipitation, Co-precipitation, post-precipitation, Advantages of organic reagents over inorganic reagents, reagents used in gravimetry (8-hydroxy quinoline (oxine) and dimethyl glyoxime (DMG). Numerical problems on all the above aspects.

Ionic equilibria

5 hrs

Hydrolysis of salts of weak acids and weak bases. Ionic product of water. Relationship between K_h , K_w , K_a and K_b . Degree of hydrolysis and its relationship with K_h . Effect of temperature and dilution on degree of hydrolysis. pH of salt solutions. Problems.

Common-ion effect, buffers, buffer action and buffer capacity with. pH of buffers. Henderson's equation and its derivation. Solubility product and ionic product in precipitation and in qualitative analysis. Analytical and biological applications of buffers. Theories of indicators.

Unit-III

Electrochemistry I

14 hrs

Review of electrolytes and Conductance related terms

Methods of determination of molar conductance. Conductometric titrations (only acid-base type).

Transport numbers: definition – determination by moving boundary method. Causes of abnormal transport numbers observed in certain systems. Ionic mobility. Problems on transport numbers. Conductivity of water.

Kohlrausch's law and its applications: (i) evaluation of Λ_∞ from Λ_+ & Λ_- (ii) evaluation of degree of dissociation of a weak electrolyte (iii) evaluation of Λ_∞ of a weak electrolyte (iv) determination of solubility from conductance of saturated solutions of sparingly soluble salts (AgCl and BaSO_4). Problems based on these.

Theories of strong electrolytes, Limitations of Arrhenius theory, qualitative account of Debye-Huckel theory-asymmetric effect & electrophoretic effect, Debye-Huckel- Onsagar equation for aqueous solutions of 1:1 electrolyte. Verification of DHO equation.

Galavanic cell: conventions of representing galvanic cells-reversible and irreversible cells, derivation of Nernst equation for single electrode potential (free energy concept).

Weston-cadmium cell: Determination of emf of a cell by compensation method. Determination of E° of Zn/Zn^{2+} and Cu/Cu^{2+} electrodes. Liquid junction potentials, elimination of liquid junction potential.

Types of electrodes: Metal and gas ion electrodes (hydrogen & chlorine), metal/metal insoluble salt electrodes ($\text{Ag}-\text{AgCl}$), redox electrodes. Reference electrodes-standard hydrogen electrode, calomel electrode, quinhydrone electrode and glass electrode (construction & working). Determination of pH using these electrodes. Numerical problems.

Concentration cells: (i) emf of concentration cells (ii) determination of solubility of sparingly soluble salts and numerical problems. Redox electrodes, emf of redox electrodes. Potentiometric titration involving only redox systems.

Unit-IV

Chemical Spectroscopy

14 hrs

The interaction of radiation with matter. Regions of electromagnetic spectrum and associated spectroscopic techniques.

Origin of molecular spectra: Born-Oppenheimer approximation.

Rotational spectra of diatomic molecules: Relationship between internuclear distance and moment of inertia. Expression for rotational energy. Numerical problems. Criterion for absorption of radiation-selection rule.

Vibrational spectroscopy: Hooke's law- Expression for the frequency of SHO-force constant and its significance. Expression for vibrational energy levels of SHO. Zero point energy., numerical problems. Degree of freedom of polyatomic molecules– modes of vibration for CO_2 and H_2O molecules.

Raman spectroscopy:

Concept of polarisability. Pure rotation, vibration, qualitative study. Stokes and anti-Stokes lines-selection rules. Advantages of Raman spectroscopy over IR spectroscopy.

Electronic spectroscopy: Potential energy curves for bonding and antibonding molecular orbitals. Electronic transitions –qualitative description of non-bonding orbitals and transitions between them. Selection rules and Franck-Condon principle.

Course Articulation Matrix: Mapping of course outcome (COs) with programme outcomes

Course outcome (COs)	Programme outcome (POs)									
	1	2	3	4	5	6	7	8	9	10
CO1	3	3	3	3	3	2	2	3	3	3
CO2	3	2	2	2	3	2	2	2	2	2
CO3	2	3	3	2	1	3	3	3	2	2
CO4	2	2	2	1	2	3	3	3	2	2
CO5	2	1	3	2	3	2	3	3	3	1

*1= Low, 2=Medium 3=High

Reference Books

1. Physical Chemistry, Peter Atkins & Julio de Paula, Oxford University Press, 11th Edition, 2018.
2. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma & M. S. Pathania, Vishal Publishing Co., 47th Edition, 2023.
3. An Introduction to Electrochemistry, Samuel Glasstone, East-West Press, Reprint Edition, 2002.
4. Electrochemistry, Philip H. Rieger, Springer, 2nd Edition, 1994.
5. Fundamentals of Molecular Spectroscopy, C. N. Banwell & E. M. McCash, Tata McGraw-Hill, 4th Edition (Reprint), 2017.
6. Principles of Instrumental Analysis, D. A. Skoog, F. J. Holler & S. R. Crouch, Cengage Learning, 6th Edition, 2007.
7. Instrumental Methods of Chemical Analysis, G. R. Chatwal & S. K. Anand, Himalaya Publishing House, 5th Edition, 2007.
8. Nanoscience and Nanotechnology, T. Pradeep, Tata McGraw-Hill, 1st Edition, 2007.
9. The Chemistry of Nanomaterials: Synthesis, Properties and Applications, C. N. R. Rao, A. Müller & A. K. Cheetham, Wiley-VCH, 1st Edition, 2004.
10. Vogel's Textbook of Quantitative Chemical Analysis, G. H. Jeffery, J. Bassett, J. Mendham & R. C. Denney, Pearson Education, 6th Edition, 2000.

Chemistry Practical-VI (Physical Chemistry)

Title of the Course	Physical Chemistry	Course Code	BCHP-06
Total Contact Hours/Semester	56	Teaching hours/week	4 hours
No. of Credits	02	Duration of Examination	03 hours
Formative Assessment marks	10	Summative Assessment Marks	40

Course Outcomes (COs):

By the end of the course, the students will be able to:

CO-1: Perform experiments to understand the kinetics and determine rate constants and activation energy for chemical reactions.

CO-2: Apply conductometric methods to determine equivalent conductivity, dissociation constants, and critical micellar concentration, and verify the Debye–Hückel–Onsager Equation.

CO-3: Carry out titrimetric analyses using conductometric and potentiometric techniques for quantitative analyses.

CO-4: Verify the Lambert-Beer's law through colorimetric experiments.

CO-5: To determine composition of solutions miscibility temperature method.

Contents of the course

1. Determination of velocity constant for acid catalysed hydrolysis of methyl acetate and determination of energy of activation.
2. Determination of velocity constant for the saponification of ethyl acetate ($a = b$).
3. The study of kinetics of potassium persulphate and potassium iodide colorimetrically.
4. Determination of equivalent conductivity of 0.1 N sodium chloride and verification of DHO equation.
5. Determination of dissociation constant of monochloroacetic acid by conductivity method.
6. Conductometric titration of hydrochloric acid with sodium hydroxide.
7. Potentiometric titration of potassium dichromate with ferrous ammonium sulphate.
8. Determination of Critical Micellar Concentration (CMC) by conductivity method.
9. Determination of percentage of sodium chloride by miscibility temperature method.
10. Estimation of Cu^{2+} colorimetrically and verification of Beer-Lambert's law.

Semester-VI
Chemistry-VII (Inorganic and Biochemistry)

56 hours

Title of the Course	Inorganic and Biochemistry	Course Code	BCHT-07
Total Contact Hours/Semester	56	Teaching hours/week	4 hours
No. of Credits	03	Duration of Examination	03 hours
Formative Assessment marks	20	Summative Assessment Marks	80

Course Outcomes

By the end of the course, the students will be able to:

- CO-1:** Understand the concept of nomenclature of coordination compounds, geometries (e.g., octahedral, tetrahedral, square planar), and the factors that influence the geometry of coordination complexes by taking various examples.
- CO-2:** Familiar with bioinorganic chemistry and organometallic chemistry.
- CO-3:** Requisite background knowledge in the field of materials science.
- CO-4:** Know about the structure, chemistry and functions of biomolecules like carbohydrates, lipids, nucleic acids and proteins.
- CO-5:** The basic characteristics of enzyme and its classification, mechanism enzyme action, enzyme kinetics, enzyme inhibition and co-enzymes.

Unit-I

Coordination and Organometallic compounds

14 hrs

Coordination compounds, ligands and their classification (mono, bi, tri, tetra, penta and hexa dentate ligands), ambidentate and chelate ligands, coordination number, nomenclature of coordination compounds in detail. Theories of structure and bonding (Explanation for the formation of complexes by Werner's Theory in detail and its limitations). EAN rule, Valence bond theory- postulates, low spin and high spin complexes with examples, limitations of VBT. Crystal field theory (octahedral, tetrahedral and square planar complexes). Crystal field splitting and crystal field stabilization energies, limitations of CFT. Magnetic properties of $[\text{CoF}_6]^{3-}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Fe}(\text{CN})_6]^{4-}$, $[\text{Fe}(\text{CN})_6]^{3-}$. Spectral properties of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$, $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$, $[\text{CoCl}_4]^{2-}$. Isomerism-Structural: ionization, linkage, hydrate and coordination isomerism with examples. Stereoisomerism-geometrical and optical isomerism with examples.

Organometallic compounds – ligands, classification (hapticity). Synthesis and structure of $\text{K}[\text{PtCl}_3(\eta^2\text{-C}_2\text{H}_4)]$ and $[\text{Fe}(\eta^5\text{-C}_5\text{H}_5)_2]$,

Metal carbonyls – $\text{Cr}(\text{CO})_6$, $\text{Co}_2(\text{CO})_8$, $\text{Mn}_2(\text{CO})_{10}$; eighteen electron rule and its deviations with examples.

Applications of coordination/organometallic compounds: *cis-platin* in cancer therapy, Na_2Ca EDTA in the treatment of heavy metals (Pb, Hg) poisoning, Monsanto acetic acid process.

Unit-II

Chemistry of Newer materials

10 hrs

Conducting polymers: Introduction, definition and examples-polyaniline, polyacetylene. Mechanism of conduction Oxidative I_2 & reductive mechanism (Na) with one example. Qualitative treatment of doping, Properties: elasticity with high electrical conductivities, Engineering and biological applications.

Super conductors: Introduction, definition, type-1, type-2 and its differences 1 Preparation of high temperature super conductor- $\text{Y}_1\text{Ba}_2\text{Cu}_3\text{O}_{x\pm\frac{1}{2}}$, BCS theory (qualitative treatment only) and general applications of high temperature super conductors.

Fullerenes: Introduction, definition, preparation and isolation of C_{60} . Structure and Chemical reactions (redox reactions, electrophilic aromatic substitution and bromination) of C_{60} . Commercial uses of C_{60} . Carbon nanotubes-Introduction, definition, examples and structure.

Nanomaterials: Introduction, definition and electronic structure. Different methods of production: Sol gel synthesis, inert gas condensation, mechanical alloying (ball milling), plasma synthesis, electrodeposition, and general applications.

Bioinorganic Chemistry

4 hrs

Essential and trace elements importance in biological systems with reference to Na^+ , K^+ , Ca^{2+} , Fe^{2+} , P, Cu, V and Ni. Metallo-porphyrins with special reference to haemoglobin, myoglobin and chlorophyll. Role of cobalamin (vitamin- B_{12} coenzyme) in living systems.

Unit-III

INTRODUCTION TO BIOCHEMISTRY

2 hrs

Contributions of Lavoisier, Wohler, Emil Fischer, Louis Pasteur, Embden, Meyerhof, Parnas, Hans Krebs, Michaelis and Menton, Watson and Crick, Chargaff, H.G. Khorana, Knoop, Pauling, Hopkins and Miescher. Elemental and biochemical composition of living organisms. Role of water in biochemical systems (mention the properties of water which makes water a solvent of life). Importance of water in biological system with special reference to the maintenance of the native structure of biological molecules. Types of bonding in biological molecules. Biological relevance of P^{H} and P^{Ka} of functional groups in biopolymers, proteins and nucleic acids, Buffers.

CARBOHYDRATES

4 hrs

Structure and biological importance of derivatives of monosaccharides.

Sugar acids—structure and biological importance of D-gluconic acid, D-glucuronic acid and D-glucaric acid.

Amino sugars: β -D-glucosamine, galactosamine and their N-acetylated forms: N-acetylmuramic acid (NAMA); N-acetylneuraminic acid (NANA)

Sugar phosphates—structure and biological importance of Glucose-6-P, Fructose-6-P, Fructose- 1,6-di-P, β -D-ribose-5-P and β -D-deoxyribose-5-P.

Structure and biological importance of oligosaccharides – isomaltose, cellobiose, trehalose.

Polysaccharides - source, comparative account of partial structure and biological function of starch, glycogen, cellulose & chitin.

PROTEINS

5 hrs

α -amino acids: Introduction, structure, classification on the basis of polarity of R-groups, essential and non-essential amino acids, ionic properties and reactions of amino acids with alcohol, nitrous acid and Ninhydrin.

Levels of organizations of Protein: Primary structure, Secondary structure (α -helix, triple helix eg., Collagen and β -pleated sheet), tertiary structure and forces stabilizing it, quaternary structure.

Denaturation and renaturation: Thermal renaturation-Anfinsen's experiment with ribonuclease.

Classification of proteins based on structure, composition and biological function (enzymes, hormones, transport agents, antibodies, structural materials with examples).

Nucleic acids

3 hrs

Types–Components of nucleic acids, bases, nucleosides and nucleotides with structures. Partial structure of polynucleotide.

Structure of DNA (Watson-Crick model) and RNA. Biological roles of DNA and RNAs. Protein-nucleic acid interaction- chromatin and viral nuclear capsid.

Unit-IV

LIPIDS

5 hrs

Introduction, Classification: Fatty acids–definition, classification as saturated and unsaturated with examples and structure (lauric, myristic, palmitic, stearic, oleic, linoleic, linolenic and arachidonic acids). Essential fatty acids – definition with examples

Triglycerides–Structure of simple and mixed glycerides, properties of triglycerides- acid and alkali hydrolysis, saponification number and its significance, iodine number and its significance, rancidity (oxidative and hydrolytic), biological importance of triglycerides.

Phosphoglycerides – general structure of 3-Sn–phosphatidic acid, lipid bilayer (as in cell membrane), micelles, liposomes and its applications, structure and biological importance of lecithin, cephalin, phosphatidylserine, phosphatidylinositol.

Cholesterol – definition, types (HDL, LDL and VLDL)

Sphingolipids–structure and biological significance of ceramide.

ENZYMES

3 hrs

Introduction, Holo enzyme (apo enzyme and co enzyme).Active site, specificity.

Classification of enzymes (EC code number not required).

Enzyme substrate interaction- Fischer and Koshland models.

Enzyme kinetics–factors affecting rate of enzymatic reactions – enzyme concentration, substrate concentration, pH and temperature (mention M. M. equation).

Allosteric enzymes–definition and example

Enzyme inhibitions-Competitive, noncompetitive and uncompetitive inhibition with one example for each.

Biological oxidation

2 hrs

Bioenergetics- Introduction-stages of energy transformation. Exergonic and endergonic reactions. Energy coupling in biological reactions

HORMONES

2 hrs

Definition. Classification - a) amino acid derivatives (epinephrine and thyroxine) b) peptide (oxytocin and vasopressin) and polypeptide hormones (insulin and glucagon) c) Steroid hormones (progesterone, testosterone) with functions. Role of insulin and glucagon in glucose homeostasis.

VITAMINS

2 hrs

Definition Classification of vitamins. Fat soluble vitamins and water-soluble vitamins with examples. Sources, deficiency symptoms,. Structure of vitamin- C and Vitamins E.

Course Articulation Matrix: Mapping of course outcome (Cos) with programme outcomes

Course outcome (COs)	Programme outcome (POs)									
	1	2	3	4	5	6	7	8	9	10
CO1	2	3	3	3	3	2	2	2	3	3
CO2	3	3	2	2	3	2	3	3	2	2
CO3	3	2	3	2	2	1	3	2	2	2
CO4	3	2	1	3	2	3	3	3	3	2
CO5	2	1	3	2	3	2	3	3	3	1

*1= Low, 2=Medium 3=High

Recommended Books

1. Advanced Inorganic Chemistry, 6th Edition F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann-John Wiley & Sons, 1999.
2. Concise Inorganic Chemistry, 5th Edition J. D. Lee, Blackwell Science, 2001.
3. Inorganic Chemistry, 4th Edition J. E. Huhee, E. A. Keiter and R. I. Keiter, Pearson Education Asia, 2000.
4. Inorganic Chemistry, ELBS 2nd Edition D. F. Shriver, P. W. Atkins and C. H. Langford, Oxford Univ. Press 2002.
5. Principles of Inorganic Chemistry B. R. Puri and L. R. Sharma, Jauhar S. P-S. N. Chand & Co., 1998
6. University Chemistry, 4th Edition, B. H. Mahan & R. J. Myers, Addison Wesley, 1989.
7. Concise Text Book of Biochemistry T. N. Pattabhiraman, All India Publishers, 2000.
8. Biochemistry A. L. Lehninger et. al., CBS, 2000.
9. A Text Book of Biochemistry A. V. S. S. Rama Rao, UBSPD, 1998.
10. Fundamentals of Biochemistry J. L. Jain, S. Chand & Co., 1983.

Chemistry Practical-VII
(Inorganic and Biochemistry)

Title of the Course	Inorganic and Biochemistry	Course Code	BCHP-07
Total Contact Hours/Semester	56	Teaching hours/week	4 hours
No. of Credits	02	Duration of Examination	03 hours
Formative Assessment marks	10	Summative Assessment Marks	40

Course Outcomes

By the end of the course, the students will be able to:

- CO-1 : Estimate the inorganic matrix by volumetric method.
 CO-2 : Determine the transition metals from gravimetric method.
 CO-3 : Estimation of amino acids by colorimetric method.
 CO-4 : Assessment of biomolecules and reduced sugars by titrimetric method.
 CO-5 : estimate the amount of analytes by biological methods.

Contents of the Course

1. Estimation of percentage of iron in haematite using bariumdiphenylamine sulphonate as an internal indicator.
2. Estimation of calcium in lime stone.
3. Estimation of zinc using EDTA.
4. Gravimetric estimation of nickel as nickel dimethyl glyoximate.
5. Estimation of nickel using EDTA and standard zinc sulphate.
6. Estimation of reducing sugars by Hegdorn-Jensen method.
7. Estimation of creatinine by Jaffe's method.
8. Estimation of inorganic phosphate by Fiske-Subbarow method.
9. Estimation of total reducing sugars by DNS (dinitrosalicylic acid) method.
10. Estimation of α -amino acids using ninhydrin by colorimetric method.

Course Articulation Matrix: Mapping of course outcome (Cos) with programme outcomes

Course outcome (COs)	Programme outcome (POs)									
	1	2	3	4	5	6	7	8	9	10
CO1	2	3	3	3	3	2	2	2	3	3
CO2	3	3	2	2	3	2	3	3	2	2
CO3	3	2	3	2	2	1	3	2	2	2
CO4	3	2	1	3	2	3	3	3	3	2
CO5	2	1	3	2	3	2	3	3	3	1

*1= Low, 2=Medium 3=High

Recommended Books :

1. Vogel's Textbook of Qualitative Chemical Analysis, J. Bassett, G. H. Jeffery and J. Mendham, ELBS (1986).

2. Vogel's textbook of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
3. Inorganic Semimicro Qualitative Analysis, V. V. Ramanujam; The National Pub. Co. (1974).
4. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).

VI SEMESTER

GREEN SYNTHESIS (BCHDSE-1)

52 hours

Title of the Course	GREEN SYNTHESIS	Course Code	BCHDSE-1
Total Contact Hours/Semester	56	Teaching hours/week	4 hours
No. of Credits	03	Duration of Examination	03 hours
Formative Assessment marks	20	Summative Assessment Marks	80

Course outcome:

Upon successful completion of the course, the student will be able to,

CO-1: Explain the field of green chemistry.

CO-2: Acquire knowledge of the 12 principles of green chemistry.

CO-3: Develop an understanding of cleaner production and green synthesis methods

CO-4: Acquire the Knowledge of ionic liquids in organic synthesis. microwave theory and Brief significance of biocatalysis and Photocatalysis

CO-5: Appreciate the Principle of Photochemical degradation and Multi-component Reactions.

Unit-I

Introduction to Green Chemistry. What is Green Chemistry?

Principles of Green Chemistry and Designing a Chemical synthesis. Twelve principles of Green Chemistry with their explanations and examples; Designing a Green Synthesis using these principles; Prevention of Waste/byproducts; maximum incorporation of the materials used in the process into the final products (Atom Economy). **7 hrs**

Use of ultrasound and Microwaves in Organic Synthesis

Use of ultrasound: Introduction, instrumentation, the phenomenon of cavitation. Sonochemical esterification, substitution, addition, alkylation, oxidation, reduction and coupling reactions.

Use of Microwaves: Introduction, concept, reaction vessel/medium, specific effects, atom efficiency (% atom utilization), advantages and limitations. N-alkylation and alkylation of active methylene compounds, condensation of active methylene compounds with aldehydes and amines. Diels-Alder reaction. Deprotection of esters and silyl ethers. Oxidation of alcohols and sulphides. **7 hrs**

Unit-II

Ionic-liquids: Introduction, structure, synthesis and applications of some important ionic liquids in organic synthesis. Ex: CH_3COOH , H_2O , H_2SO_4 , NH_3

Polymer supported reagents in organic synthesis

Introduction- properties of polymer support, advantages of polymer supported reagents and choice of polymers.

Applications: Substrate covalently bound to the support: Synthesis of oligosaccharides, Dieckmann cyclisation. Preparation of polymer bound aldehyde and application in aldol and Wittig reactions. Synthesis of polystyryl boronic acid and use in diol protection reaction.

Reagent linked to a polymeric material: Preparation of sulfonazide polymer and application in diazotransfer reaction. Synthesis of polymer bound per acid and its applications.

Polymer supported catalytic reactions: Preparation of polymer supported AlCl_3 and application in etherification and acetal formation reactions. **8 hrs**

Green Solvents in Organic Synthesis

Green Solvents, Characteristics Supercritical fluids (SCFs), Super Critical Water (SCW), Supercritical Carbon Dioxide (SC- CO_2); Pyrolysis of t-butylbenzene,

Pinacol-pinacolone rearrangement, Beckmann rearrangement, Diels-Alder reactions, Reduction of aromatic nitro compounds. Reaction in Supercritical Carbon Dioxide; Kolbe – Schmitt reaction, Friedel–Crafts reaction. **6 hrs**

Unit-III

Catalysis and Green Chemistry

Catalyst and Catalysis; Homogeneous catalysis, Heterogeneous catalysis, Catalysis in Green chemistry, Biocatalysts, Reactions using biocatalyst, Biocatalytic conversion of penicillin to 6-aminopenicillanic acid.

Photochemical Degradation: An Eco-friendly Approach of Waste Treatment

Photochemical Principles, Heterogeneous Photo-catalysis, Homogeneous Photo-degradation, photo oxidation, Direct Photo-degradation, Gas phase Detoxification, Equipments and applications. Titanium dioxide (TiO_2) as a green photocatalyst for destroying organic pollutants, Some important photocatalytic applications of TiO_2 - Photocatalytic disinfection or sterilization. **7 hrs**

Phase transfer catalysis and Crown ethers

Phase transfer catalysis: Introduction, definition, mechanism of phase transfer catalysis. Types of phase transfer catalysts and reactions and their Advantages.

Preparation of catalysts and their application in substitution, elimination, addition, alkylation, oxidation and reduction reactions.

Crown ethers: Introduction, nomenclature, features, nature of donor site. General synthesis of Crown ethers.

Synthetic applications: Alkylation, generation of carbenes, aromatic substitution and displacement reactions. Generation and application of superoxide anions. Cation deactivation reactions. **7 hrs**

Unit-IV

Multi-component Reactions

Studies on the mechanistic aspects and use of the following reactions in organic synthesis:

Passerini-Ugi; Hantzsch; Biginelli; Doebner-Miller; Ritter; Jacobson; Betti; Robinson-Schopf; Barbier; Baylis-Hillman; Ivanov and Suzuki coupling reaction. **14 hrs**

Course Articulation Matrix: Mapping of course outcome (Cos) with programme outcomes

Course outcome (COs)	Programme outcome (POs)									
	1	2	3	4	5	6	7	8	9	10
CO1	2	3	3	3	3	2	2	2	3	3
CO2	3	3	2	2	3	2	3	3	2	2
CO3	3	2	3	2	2	1	3	2	2	2
CO4	3	2	1	3	2	3	3	3	3	2
CO5	2	1	3	2	3	2	3	3	3	1

*1= Low, 2=Medium 3=High

Suggested Books

1. Stereochemistry of carbon compounds, E. L. Eliel, S. H. Wilen and L. N. Mander, John Wiley & Sons, 1994.
2. Organic synthesis: Special techniques, V. K. Ahluwalia and R. Aggarwal, Narosa, New Delhi, 2003.
3. Green Chemistry, environment friendly alternatives, R. Sanghi and M M Srivastava, Narosa, New Delhi, 2003
4. Green Chemistry-an introduction text, Royal Society of Chemistry, UK, 2002.
5. Macrocyclic Polyether Chemistry, G. W. Gokel, S. M. Korzeniowski, Vol 1 to 3, Wiley, NY, 1978, 1981, 1987.
6. Phase Transfer Catalysis in Organic Synthesis, W. B. Weber, G. W. Gokel, Springer, Berlin, 1977.
7. Phase Transfer Catalysis, E. V. Dehmlov, S. S. Dehmlov, 2nd Edn., Verlagchemie, Wienheim, 1983.
8. Anastas, P.T., Warner, J.C. (2014), Green Chemistry, Theory and Practice, Oxford University Press.
9. Lancaster, M. (2016), Green Chemistry: An Introductory Text, 3rd Edition, RSC Publishing.
10. Alhuwalia, V.K., Kidwai, M.R. (2005), New Trends in Green chemistry, Anamalaya Publishers.
11. Sidhwani, I.T, Sharma, R.K. (2020), An Introductory Text on Green Chemistry, Wiley India Pvt Ltd.

Industrial Chemistry (BCHDSE-2)

Title of the Course	Industrial Chemistry	Course Code	BCHDSE-2
Total Contact Hours/Semester	56	Teaching hours/week	4 hours
No. of Credits	03	Duration of Examination	03 hours
Formative Assessment marks	20	Summative Assessment Marks	80

Course Outcomes (COs):

Upon successful completion of the course, the student will be able to,

- CO-1:** Explain the properties, classification, preparation, and industrial applications of refractories, abrasives, glass, cement, paints, pigments, and silicones.
- CO-2:** Describe the types, characteristics, production, and applications of fuels, explosives, lubricants, and petroleum products, including petrochemicals and refining processes.
- CO-3:** Understand the principles of radiation chemistry and polymer science, including conducting polymers and their industrial and technological applications.
- CO-4:** Analyze advanced materials such as superconductors, batteries, fullerenes, carbon nanotubes, and nanomaterials, including their preparation methods and applications.
- CO-5:** Evaluate corrosion processes, factors affecting corrosion, and methods of prevention, along with electroplating and corrosion inhibition techniques.

Unit-I

14 hrs

Refractories: Definition, examples, Properties- determination of PCE values, classification.

Abrasives: Definition, examples, classification, application, hardness, Moh's scale, manufacture and importance of carborundum and tungsten carbide.

Glass: Properties, types, manufacture of soda glass. Composition and applications of borosilicate, metallic glass, optical glasses and polycarbonate glasses, safety glass, fire and bullet proof glasses.

Cement: Raw materials & its importance grades, manufacture of Portland cement (by wet process), setting of cement.

Paints and Varnishes: Constituents of oil and emulsion paints and their role, constituents of varnishes.

Inorganic pigments: General information and economic importance. White pigments: Titanium dioxide and zinc oxide pigments. Colour pigments: Iron oxide, chromium oxide, mixed metal oxide pigments and ceramic colorants, corrosion protection pigments, lustre pigments and luminescent pigments.

Silicones: Definition, nomenclature, preparation (linear, cross-linked and cyclic). Factors affecting the nature of silicone polymers, properties (chemical and thermal stabilities, chemical properties) uses of silicon polymers, silicon fluids/oils-uses, silicon elastomers - rubbers, silicon resins (preparation and uses).

Unit-II

14 hrs

Fuels: Definition, classification with examples, characteristics, calorific value, determination of calorific value of a solid or liquid fuel (bomb calorimetric method). Applications of gaseous fuels. Comparison between solid, liquid and gaseous fuels. Compressed natural gas (CNG), water gas, producer gas and LPG - their production, composition, and applications.

Explosives: Definition, classification with examples and characteristics. Preparation and uses of TNT dynamite, cordite and RDX.

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting). Solid and semi-solid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

Petroleum and Petrochemical Industry: Composition of crude petroleum availability or occurrence, Refining and different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and nonpetroleum 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 and Toluene.

Unit-III

Radiation Chemistry: Definition, primary and secondary stages in radiochemical process, G - value, LET of radiation, radiation chemistry comparison with photochemistry. Units of radiation - rad, gray, Roentgen. Chemical dosimeters- Frick-dosimeter, Ceric sulphate dosimeter. Theories of radiolysis - Lind's and EHT theories. Radiolysis of water and acetic acid. **6 hrs**

Polymers: Introduction, monomer, repeating units, types (linear, branched and network) with examples, degree of polymerization, Molar masses of polymers -number average and mass average, determination of molar mass by viscosity and osmotic pressure method. Applications of polymers as plastics in electronic, automobile components, medical fields, and aerospace materials. Problems of plastic waste management.

Conducting polymers: Introduction, definition and examples-polyaniline, polyacetylene. Mechanism of conduction oxidative and reductive mechanism. Qualitative treatment of doping, Properties: elasticity with high electrical conductivities, Engineering and biological applications. **8 hrs**

Unit-IV

Super conductors: Introduction, definition, type1, type 2 differences. Preparation of high temperature super conductor- $\text{YBa}_2\text{Cu}_3\text{O}_{x\pm\delta}$, BCS theory (qualitative treatment only) and general applications of high temperature super conductors.

Batteries: Classification, characteristics, primary, secondary batteries with examples and E° values. Working of the following batteries- Lead acid and Lithium batteries. **7 hrs**

Fullerenes: Introduction, definition, preparation and isolation of C_{60} . Structure and Chemical reactions (redox reactions, electrophilic aromatic substitution and bromination) of C_{60} . Commercial uses of C_{60} .

Carbon nanotubes-Introduction, definition, examples and structure. Nanomaterials: Introduction, definition and electronic structure. Different methods of production: Sol gel synthesis, inert gas

condensation, mechanical alloying (ball milling), plasma synthesis, electrodeposition, and general applications. **7 hrs**

Course Articulation Matrix: Mapping of course outcome (Cos) with programme outcomes

Course outcome (COs)	Programme outcome (POs)									
	1	2	3	4	5	6	7	8	9	10
CO1	3	2	3	3	2	2	2	3	3	3
CO2	3	3	2	3	3	2	3	3	3	2
CO3	2	3	3	2	2	1	3	2	3	2
CO4	2	1	2	2	2	3	3	2	3	2
CO5	2	2	1	2	3	2	3	3	3	1

*1= Low, 2=Medium 3=High

Suggested Books

1. Advanced Inorganic Chemistry, 6th Edition F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann-John Wiley & Sons, 1999.
2. Concise Inorganic Chemistry, 5th Edition J. D. Lee, Blackwell Science, 2001.
3. Inorganic Chemistry, 4th Edition J. E. Huhee, E. A. Keiter and R. I. Keiter, Pearson Education Asia, 2000.
4. Environmental Chemistry A. K. De, Wiley Eastern Ltd., 1999.
5. Nuclear and Radiation Chemistry Sharma B. K, Goel Publishing House, 1987.
6. Principles of Inorganic Chemistry, B. R. Puri and L. R. Sharma, Jauhar S. P-S. N. Chand & Co., 1998
7. University Chemistry, 4th Edition (ISE) B. H. Mahan & R. J. Myers, Addison Wesley, 1989.
8. Essential Trends in Inorganic Chemistry C. M. P. Mingos, Oxford Univ Press, 1998
9. Fundamental Concepts of applied Chemistry, Jayashree Ghosh, S Chand Publications, 1994.
10. Industrial Chemistry, B. K. Sharma, Goel Publishing House, 1995.

B. Sc., - VI Semester Chemistry Job Skill Practicals

Title of the Course	Industrial Chemistry	Course Code	BCHJSP-01
Total Contact Hours/Semester	56	Teaching hours/week	4 hours
No. of Credits	02	Duration of Examination	03 hours
Formative Assessment marks	10	Summative Assessment Marks	40

Course Outcomes (COs):

Upon successful completion of the course, the student will be able to,

CO1: Demonstrate safe handling, storage, and disposal of chemicals, and respond effectively to laboratory emergencies.

CO2: Prepare buffer solutions, measure pH using a pH meter, and perform water quality assessment such as free chloride and COD determination.

CO3: Prepare chemical products such as soaps and hand sanitizers, and estimate biochemical parameters like cholesterol using colorimetric methods.

CO4: Perform isolation and separation techniques including extraction of natural products (casein, lycopene) and chromatographic methods (TLC, paper, and column chromatography).

CO5: Gain exposure through industrial/research laboratory visits.

Contents of the Course

1. Handling of chemicals (solids/liquids/gases) – Storage of chemicals/solvents – Chemical spills and emergencies – Chemical wastes and disposal methods – Laboratory protocols: Chemical Hygiene Plan (CHP).
2. Preparation of buffers and determination of their pH values using pH meter.
3. Food Adulteration tests for i) Milk ii) Edible oil
4. Determination of free chloride in a sample of water
5. Estimation of Chemical Oxygen Demand of the given water sample.
6. Preparation of soaps and Hand sanitizers
7. Estimation of cholesterol by colorimetric method.
8. Isolation of casein from milk
9. Isolation of lycopene from tomato
10. Separation of amino acids by TLC and paper chromatography.
11. Column chromatographic separation of a mixture of two organic compounds.
12. Determination of acid value in oils and fats.
13. Exposure visits to Industry/research Laboratory.

Course Articulation Matrix: Mapping of course outcome (Cos) with programme outcomes

Course outcome (COs)	Programme outcome (POs)									
	1	2	3	4	5	6	7	8	9	10
CO1	2	3	3	3	1	2	2	3	3	3
CO2	3	2	2	3	2	2	3	3	3	2
CO3	3	3	3	2	3	1	3	2	3	2
CO4	3	1	2	2	2	3	3	2	3	2
CO5	2	2	1	2	3	2	3	3	3	1

*1= Low, 2=Medium 3=High

Suggested Books

1. Vogel's Textbook of Quantitative Chemical Analysis, G. H. Jeffery, J. Bassett, J. Mendham & R. C. Denney, Pearson Education, 6th Edition, 2000.
2. Fundamentals of Analytical Chemistry, Douglas A. Skoog, Donald M. West, F. James Holler & Stanley R. Crouch, Cengage Learning, 9th Edition, 2014.
3. Quantitative Chemical Analysis, Daniel C. Harris, W. H. Freeman & Company, 9th Edition, 2016.
4. Official Methods of Analysis of AOAC International, 22nd Edition, 2023.
5. Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, American Public Health Association, 24th Edition, 2022.
6. Experimental Organic Chemistry: A Small-Scale Approach, Donald L. Pavia, Gary M. Lampman, George S. Kriz & Randall G. Engel, Cengage Learning, 3rd Edition, 2014.

THEORY QUESTION PAPER PATTERN
B.Sc. Degree Examination
(SEP Scheme-2024-25)
CHEMISTRY

Time: 03 Hours

Max. Marks: 80

Instructions: Answer Q. no. 1 and any 6 of the following

1. Answer any TEN of the following 10X2 = 20 Marks

- a)
- b)
- c)
- d)
- e)
- f)
- g)
- h)
- i)
- j)
- k)
- l)

2. Q. no. 2 from Unit-I 10 Marks

- a)
- b)
- c)

3. Q. no. 3 from Unit-II 10 Marks

- a)
- b)
- c)

4. Q. no. 4 from Unit-III 10 Marks

- a)
- b)
- c)

5. Q. no. 5 from Unit-IV 10 Marks

- a)
- b)
- c)

6. Q. no. 6 from Unit-I and II 10 Marks

- a)
- b)
- c)

7. Q. no. 7 from Unit-II and III 10 Marks

- a)
- b)
- c)

8. Q. no. 8 from Unit-III and IV 10 Marks

- a)
- b)
- c)

9. Q. no. 9 from Unit-I and IV 10 Marks

- a)
- b)
- c)

Pattern for Question Nos. 2 to 8

- $a+b+c$ (4+3+3) = 10 Marks OR $a+b$ (5+5) = 10 Marks,

- Equal weightage to be given for each Units.