RANI CHANNAMMA UNIVERSITY BELAGAVI

REVISED CURRICULUM FRAMEWORK FOR UNDER GRADUATE COURSE

STRUCTURE & SYLLABUS OF BACHELOR OF SCIENCE

CHEMISTRY

1ST TO 2ND Semesters

w.e.f.

Academic Year 2024-25 and Onwards

Submitted by

Chairman,
Board of Studies (UG),
Bachelor of Science,
Rani Channamma University, Belagavi.

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RANI CHANNAMMA UNIVERSITY, BELGAVI

VIDYASANAGAMA

Accredited with B+ Grade by NAAC

FACULTY OF SCIENCE : DEPARTMENT OF CHEMISTRY

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Board of Studies in Chemistry

Sl. No.	Name and Address	Designation
01	Prof. Basavaraj Padmashali Department of Chemistry Rani Channamma University Belagavi-591156	Chairman
02	Dr. N.Y. Badannavar, Department of Chemistry S.K. Rathi Science College, Guledgudda,	Member
03	Shri. S.S. Aland Department of Chemistry, S.B.M. College Badami	Member
04	Shri. S.S. Aland Department of Chemistry, S.B.M. College Badami	Co-opt member
05	Prof. C.S. Katageri M.G.V.C College Muddebihal	Co-opt member

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FACULTY OF SCIENCE : DEPARTMENT OF CHEMISTRY

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COURSE STRUCTURE FOR B.Sc. PROGRAMME

Semester	Subjects	Teaching Hours/week	Duration of Exams	Marks			Credits
				IA	Exam	Total	
1	Major1 Theory	04	03	20	80	100	03
	Major1 Practical	04	04	10	40	50	02
	Major2 Theory	04	03	20	80	100	03
	Major2 Practical	04	04	10	40	50	02
	Major3 Theory	04	03	20	80	100	03
	Major3 Practical	04	04	10	40	50	02
	Language1	04	03	20	80	100	04
	Language2	04	03	20	80	100	04
	Compulsory-1	02	02	10	40	50	02
2	Major1 Theory	04	03	20	80	100	03
	Major1 Practical	04	04	10	40	50	02
	Major2 Theory	04	03	20	80	100	03
	Major2 Practical	04	04	10	40	50	02
	Major3 Theory	04	03	20	80	100	03
	Major3 Practical	04	04	10	40	50	02
	Language1	04	03	20	80	100	04
	Language2	04	03	20	80	100	04
	Compulsory-2	02	02	10	40	50	02
Total							**50**

First Semester B.Sc. Chemistry Theory

Paper Title: Chemistry-1T	**Marks: Th-80+IA-20**
Paper Code : SEPBSCHEMT01	**Total hours: 60**
Teaching Hours: 4 Hours/Week	**Credits : 03**

UNIT-I: Atomic Structure	**15 Hours**
Review of Bohr's theory and its limitations, dual behavior of matter and radiation, deBroglie's relation, Heisenberg Uncertainty principle. Introduction to Quantum mechanics: Time independent Schrodinger equation and meaning of various terms in it (no derivation). Significance of ψ and ψ^2. Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Anomalous electronic configurations.	
UNIT-II Chemical Energetics and Ionic Equilibria: I	**15 Hours**
Chemical Energetics: Important principles and definitions of thermochemistry. Concept of standard state andstandard enthalpies of formations, integral and differential enthalpies of solution and dilution.Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Joule-Thomson effect, derivation of Joule Thomson coefficient for an ideal gasand inversion temperature. **Ionic Equilibria-I:** Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect.	
UNIT-III: Fundamentals of Organic Chemistry and Alkenes	**15 Hours**
Fundamentals of Organic Chemistry: Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. **Strength of organic acids and bases:** Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule. **Alkenes:** Methods of preparation of alkenes by (i) dehydration of alcohols (ii) dehydrohalogenation. Saytezaff's elimination (Formation of highly substituted alkene, 2-butene), Hofmann orientation (Formation of least substituted alkene, 1-pentene). Chemical reactions of alkenes- Peroxide effect and its mechanism, hydroboration, oxidation, oxy-mercuration–reduction and mechanism, ozonolysis with respect to2-butene and 2-methyl- 2-butene, oxidation with $KMnO_4$. **Alkynes:** Acidity of Alkynes, reactions of acetylene –metal ammonia reduction, oxidation and polymerization	
UNIT-IV: Chromatography and Stereochemistry	**15 Hours**
Chromatography: *Chromatography:* General principles, types, brief outline of thin layer chromatography, paperchromatography and column chromatography, solvent extraction. *Criteria of purity*: Melting point and boiling point. **Stereochemistry:** Cycloalkanes: Baeyer's strain theory, calculation of angle strain, Sachse Mohr theory of strain less rings. Chair and boat forms of cyclohexane. Axial and equatorial bonds. **Conformational** isomerism: Basic concept of conformational analysis with reference to ethane and butane. **Geometrical isomerism:** definition, E and Z notation for 2-butene and butenedioic acid, rules for assigning notations. Determination of configuration of butenedioic acid by anhydride formation,	

dipole moment measurement, melting point and stability.
Optical isomerism: Chirality, van't Hoff-Lebel hypothesis, optical activity, D and L configurations, R and S notations, sequence and priority rules, enantiomers, distereoisomers, epimers, anomers, racemic and meso (with suitable examples like lactic and tartaric acids.), racemisation, resolution of racemic mixture by chemical method, asymmetric synthesis, Walden inversion.

References

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in InorganicChemistry*, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles ofStructure and Reactivity*, Pearson Education India, 2006.
5. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley &Sons (2014).
6. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning IndiaEdition, 2013.
7. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi(1988).
8. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
9. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
10. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
11. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.

First Semester B.Sc. Chemistry Practicals

Paper Title: Chemistry-1P	**Marks: Th-80+IA-20**
Paper Code : SEPBSCHEMP01	**Total hours: 60**
Teaching Hours: 4 Hours/Week	**Credits : 02**

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO4.
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO4.
4. Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator.
5. Estimation of Cu (II) ions iodometrically using Na2S2O3 (demo only).
6. Determination of the percentage loss in weight of I) Zinc carbonate II) mixture of bariumsulphate and ammonium chloride
7. Estimation of Phenol.
8. Estimation of Aniline.
9. Estimation of Amide.
10. Estimation of Glucose.

Examination

In the practical examination, in a batch at least 15 (Fifteen) students may be made. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:

Accuracy	25 Marks
Calculation and presentation	05 Marks
Journal	05 Marks
Viva Voce	05 Marks
Total	40 Marks

Deduction of marks for accuracy: ±0.2CC -25 marks, ± 0.4CC- 22 marks, ±0.6CC-20 marks, ±0.8CC-15 marks, ±0.9CC-12 marks, above ±0.9-zero marks.(At least two concordant readings to be considered)

References

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook ofPractical Organic Chemistry, Prentice-Hall, 5th edition, 1996.

Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960

Second Semester B.Sc. Chemistry Theory

Paper Title: Chemistry-2T	**Marks: Th-80+IA-20**
Paper Code : SEPBSCHEMT02	**Total hours: 60**
Teaching Hours: 4 Hours/Week	**Credits : 03**

UNIT-I: Chemical Bonding and Molecular Structure -I: Atomic Structure	**15 Hours**
Ionic Bonding: Ionic bonding, lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipolemoment and percentage ionic character. **Covalent bonding:** *VB Approach:* Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.*MO Approach*: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) Comparison of VB and MO approaches.	
UNIT-II: Ionic Equilibria: II and Chemical Equilibrium	**15 Hours**
Ionic Equilibria-II: Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. **Chemical Equilibrium:** Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium (VantHoff reaction isotherm). Distinction between ΔG and ΔG^{o}, Le Chatelier's principle. Relationships between K_p, K_c and K_x for reactions involving ideal gases. Variation of equilibrium constants with temperatures.	
UNIT-III: Fundamentals of Organic Chemistry and Alkenes	**15 Hours**
Spectroscopy: Introduction to conventional methods of elucidation of structure of organic compounds(chemical degradation) and comparison with spectroscopic methods, electromagnetic spectrum. **UV spectroscopy:** Principle, types of transitions, chromophores, concept of auxochromes and their effect on λ_{max}, bathochromic shift, hypsochromic shift, hypochromic and hyperchromic shift. Woodward and Fieser rules and illustration of calculation of λ_{max} taking myrcene and B-phelladrene as examples. Alkyl and Aryl Halides Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. **Alkyl Halides:** Types of Nucleophilic Substitution (S_N1, S_N2 and S_Ni) reactions.Preparation of alkyl halides from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. **Aryl Halides:** Preparation of aryl halides (Chloro, bromo and iodo-benzene) from phenol, Sandmeyer & Gattermann reactions. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$).	
UNIT-IV: Aldehydes and ketones, Carboxylic Acids, Ethers and Epoxides	**15 Hours**
Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde) *Preparation:* from acid chlorides and from nitriles. *Reactions* – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction. **Carboxylic Acids:** Acid strengths of mono, di and tri chloroacetic acids and nitro, chloro and hydroxy substituted benzoic acids, mechanism of esterification and hydrolysis of ester (Aac2 and Bac2).Reactions of carboxylic acids - i) Conversion into acid derivatives(acid chlorides, amides, esters and anhydrides), ii) Curtius rearrangement, iii) Reaction with organometallic compounds and iv) Hell-Volhard-Zelinsky reaction.	

Ethers: Nomenclature of ethers and their methods of preparation, chemical reactions - Reaction with HI, hot and cold taking symmetric and unsymmetrical ethers. Crown ethers: Definition, examples, use of crown ethers as phase transfer catalysts.
Epoxides: Synthesis of 1,2-epoxy ethane and 1,2-epoxycyclopentane, acid catalyzed ring opening of 1,2-epoxycyclopentane in aqueous solution.

References

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley &Sons (2014).
2. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi(1988).
4. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
5. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
6. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
7. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
8. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
9. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning IndiaPvt. Ltd., New Delhi (2009).
10. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
11. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

Secon Semester B.Sc. Chemistry Practicals

Paper Title: Chemistry-2P	**Marks: Th-80+IA-20**
Paper Code : SEPBSCHEMP02	**Total hours: 60**
Teaching Hours: 4 Hours/Week	**Credits : 02**

Organic Spotting

Identification of binary mixture (solid+solid and liquid+liquid) and analysis of the given compound (Separation not needed but can be demonstrated).

Type of mixture to be given

a. Acid+Base: Benzoic acid+p-Nitroaniline / Cinnamic acid+m-Nitroaniline
b. Acid+ Neutral: Benzoic acid+Naphthalene / Phthalic acid+Acetanilde
c. Base+Neutral: o-Nitroaniline+Acetanilide / p-Nitroaniline+Naphthalene
d. Phenol+Neutral: 1-Naphthol+Benzamide / 2-Naphthol+Acetanilide
e. Phenol+Base: 2-Naphthol+p-Nitroaniline / 1-Naphthol+m-Nitroaniline
f. Neutral+Neutral (liquid+liquid): Acetone+Ethyl benzoate / Nitrobenzene+Acetone

Other suitable combinations can also be given.

Analysis of the given compound by

1. Element detection 2. Solubility 3. Functional group 4. Physical constant,

5. Preparation of derivatives and finding melting points.

Examination

In the practical examination, a batch of maximum 15 students may be made. Experiment can be given by selection done by the students based on lots. Viva questions must be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:

1. Identification of the binary mixture	05 marks
2. Preliminary tests and presentation	05 marks,
3. Group test based on solubility	03 marks
4. Distinguishing test and C.T	07 marks (3+4)
5. Preparation of derivative	03 marks
6. Melting point of derivative	02 marks
7. Journal	05marks
8. Viva voce	05marks
Total	**40 marks.**

Reference Books

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbookof Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R.Chand & Co.: New Delhi (2011).

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FACULTY OF SCIENCE : DEPARTMENT OF CHEMISTRY

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PROGRAM /COURSE STRUCTURE AND SYLLABUS

As per the State Education Policy

SEP-2024

Bachelor of Science

Optional Chemistry

Effective from the Academic Year-2024-25 and onwards

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COURSE STRUCTURE FOR B.Sc. PROGRAMME

Semester	Subjects	Teaching Hours/week	Duration of Exams	Marks			Credits
				IA	Exam	Total	
3	Major1 Theory	04	03	20	80	100	03
	Major1 Practical	04	04	10	40	50	02
	Major2 Theory	04	03	20	80	100	03
	Major2 Practical	04	04	10	40	50	02
	Major3 Theory	04	03	20	80	100	03
	Major3 Practical	04	04	10	40	50	02
	Language1	04	03	20	80	100	03
	Language2	04	03	20	80	100	03
	Elective-1	02	02	10	40	50	02
4	Major1 Theory	04	03	20	80	100	03
	Major1 Practical	04	04	10	40	50	02
	Major2 Theory	04	03	20	80	100	03
	Major2 Practical	04	04	10	40	50	02
	Major3 Theory	04	03	20	80	100	03
	Major3 Practical	04	04	10	40	50	02
	Language1	04	03	20	80	100	03
	Language2	04	03	20	80	100	03
	Elective-2	02	02	10	40	50	02
	Skill-1						02
Total							**48**

Third Semester B.Sc. Chemistry Theory

Paper Title: Chemistry-3 T	**Marks: Th-80+IA-20**
Paper Code : SEPBSCHEMT03	**Total hours: 60**
Teaching Hours: 4 Hours/Week	**Credits : 03**

UNIT-I: Chemical Bonding and molecular structure-II	**15 Hours**

Ionic bond II: Structures of ionic solids, Radius ratio rules. **Ionic structures:** Ionic compounds of the type AX (ZnS, NaCl, CsCI), Ionic compounds of the type AX_2 (Calcium fluoride (fluorite) and Rutile structure, Layer structures CdI_2 , Cadmium iodide structure, Limitations of radius ratio concept. 4 hrs

Covalent bond II: Review of Valence shell electron pair repulsion (VSEPR) theory, Effect of lone pairs,electronegativity, isoelectronic principle, Examples using VSEPR theory: BF_3 and BF_4^- ,NH_3 and NH_4^+, H_2O , I_3 and I_3^+, SF_6 and IF_7 . Limitations of VSEPR. 3 hrs

Molecular Orbital theory-II:

Examples of molecular orbital treatment for homonulcear diatomic ions: N_2^+,and O_2^{2-} Heteronuclear diatomic molecules such as CO, NO and NO^+ 3hrs

Metallic Bonding:

General properties of metals: Conductivity, Lustre, Malleability and cohesive force, Crystal structures of metals and Bond lengths. Theories of bonding in metals: Free electron theory, Valence bond theory, Molecular orbital or band theory of solids. Prediction of conducting properties of conductors, insulators and semiconductors, extrinsic and intrinsic semiconductors using M.O. theory.

UNIT-II Quantitative analysis-Instrumental methods	**15 Hours**

Electromagnetic spectrum, absorption of electromagnetic radiation, Beer's law, Beer-Lambert law derivation, deviations from Beer's law, limitations, construction of calibration graph (Plot of absorbance versus concentration), Evaluation Procedures - standard addition, Internal standard addition, validation parameters-detection limits, sensitivity, dynamic/linearity range, 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. 10hrs

Nephelometry and Turbidometry: Introduction, principle, instrumentations of nephelometry and turbidometry; effects of concentration, particle size and wavelength on scattering; choice between nephelometry and turbidometry, applications of nephelometry and turbidimetry (determination of SO_4^{2-} and PO_4^{3-}) 5hrs

UNIT-III: Thermodynamics and Surface chemistry	**15 Hours**

First Law of Thermodynamics:

Nature of Heat and Work, Internal Energy, First Law of Thermodynamics, Enthalpy of a System, Work done in isothermal and adiabatic expansion of an ideal gas, Numerical problems, Joule - Thomson Expansion, Relation between Joule-Thomson coefficient and other thermodynamic parameters

Second law of Thermodynamics:

Concept of entropy, thermodynamic scale of temperature, Statements of the Second Law of Thermodynamics, molecular interpretation of entropy, Calculation of entropy change for reversible and irreversible processes. Free Energy Functions: Gibbs and Helmholtz energy, Variation of S, G, A with T, V and P, Numerical problems, Free energy change and spontaneity,

Gibbs-Helmholtz equation. Third Law of Thermodynamics Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. 10 Hrs

Surface Chemistry:Adsorption

Types of adsorption isotherms. Freundlich adsorption isotherm (only equation), its limitations. Langmuir adsorption isotherm (derivation to be done) and BET equation (derivation not included).

Catalysis

Types of Catalysis and theories with examples (intermediate compound theory and adsorption theory), Michaelis-Menten equation-derivation. Heterogeneous catalysis: surface reactions, unimolecular, bimolecular surface reactions. Autocatalysis with examples. 5 hrs	
UNIT-IV: Alcohols and Phenols	**15 Hours**
Alcohols: Introduction and nomenclature of dihydric and trihydric alcohols, preparation of glycol from ethene, oxidative cleavage of ethylene glycol with lead tetra acetate and per iodic acid, pinacol–pinacolone rearrangement, preparation of glycerol from propene, synthesis and uses of nitroglycerine, composition and uses of dynamite and cordite, distinction between primary, secondary and tertiary alcohols by Lucas reagent. **Phenols:** Classification and nomenclature, acidic character of phenol compared to alcohol and cyclohexenol, mechanism of Fries rearrangement, Claisen rearrangement, Elbs persulphate oxidation and Lederer-Manasse reaction, synthesis and uses of n-hexyl resorcinol and picric acid, structure and uses of dettol.	

References:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).

2. Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).

3. Quantitative Analysis, R.A. Dayand A.L.Underwood, 6th edition, PHI Learning Pvt Ltd. New Delhi (2009).

4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt. Ltd. (2007).

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

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

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

8. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7 th Ed., W. H. Freeman.

9. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002

Third Semester B.Sc. Chemistry Practicals

Paper Title: Chemistry-3P	**Marks: Th-80+IA-20**
Paper Code : SEPBSCHEMP03	**Total hours: 60**
Teaching Hours: 4 Hours/Week	**Credits : 02**

Physical Chemistry Experiments (40 Marks)

1. To study the effect of acid strength on hydrolysis of methyl acetate using HCl and H_2SO_4.
2. To determine the rate constant of second order reaction $KI+K_2S_2O_8$ (a=b) and effect of concentration on rate constant of second order reaction.
3. Adsorption of acetic acid on animal charcoal.
4. Determination of surface tension and parachor of benzene series.
5. Determination of surface tension and parachor of alcohol series.
6. Determination of viscosity of liquids of Ostwald's method.
7. Determination of viscosity of binary liquid mixtures and finding the percentage composition unknown. 8. Determination of molecular weight of urea by Landbergers method.
9. Determination of degree of dissociation of KCl by Landbergers method.
10. Determination of equilibrium constant of distribution of iodine between KI and CCl_4.

Examination:
In the practical examination, in a batch at least 15 (Fifteen) students may be made. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:
Accuracy 25 Marks
Calculation and presentation 05 Marks
Journal 05 Marks
Viva Voce 05 Marks
Total 40 Marks
Deduction of marks for accuracy: ±5% -25 marks, ± 10%- 20 marks, ±15% - 15 marks, ±20%-10 marks, ±25% -05 marks, above ±26% -zero marks.

Reference Books:

1. 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.

2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

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

4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press

Fourth Semester B.Sc. Chemistry Theory

Paper Title: Chemistry-4T	**Marks: Th-80+IA-20**
Paper Code : SEPBSCHEMT04	**Total hours: 60**
Teaching Hours: 4 Hours/Week	**Credits : 03**

UNIT-I: Chemistry of d-block and f-block elements, Chelates, Environmental Chemistry	**15 Hours**

Chemistry of d and f block elements: General characteristics of d block elements- Electronic configuration, oxidation states, metallic property, colour, reactivity, reducing property, magnetic, catalytic and complex formation properties. General characteristics of f block elements - Electronic configuration, cause and consequences of lanthanide contraction. General features of actinides- electronic configuration, oxidation state, extraction of uranium from pitchblende.

Chelates: definition, characteristics, factors influencing the stability of metal chelates and importance of chelates.

Environmental Chemistry:

***Air pollution*:** Types of pollutants, sources and control measures- CO, CO_2, SO_x, NO_x, H_2S, hydrocarbons, CFC's and particulates, pesticides, and their adverse effects.

Water pollution: Types of pollutants, sources and adverse effects (sewage, infectious agents, organic chemicals and inorganic mineral, oils and sediments) Parameters of water pollution – Dissolved oxygen (DO), biological oxygen demand (BOD) and chemical oxygen demand (COD), definitions and their determinations. Treatment of sewage and industrial effluents - Preliminary, primary and secondary treatment (Aerated lagoons, trickling filters and activated sludge).

UNIT-II: Chemical Kinetics and Electrochemistry	**15 Hours**

Chemical Kinetics: Temperature dependence of reaction rates; Arrhenius equation, activation energy, Numerical problems on Arrhenius equation in calculating energy of activation and rate constants. Collision theory of reaction rates-Lindemann's mechanism, qualitative treatment of the theory of absolute reaction rates. Experimental determination of kinetics of (i) inversion of cane sugar by polarimetric method (ii) spectrophotometric method for the reaction between potassium persulphate and potassium iodide. 5 Hrs

Electrochemistry–I:

Arrhenius theory of electrolytic dissociation. Merits and Demerits, Conductance, Specific conductance, equivalent and molar conductivity and their variation with dilution. Molar conductivity at infinite dilution. Numerical problems.

Kohlrausch's law of independent migration of ions and its applications, Debye-Hückel-Onsager equation. Ionic mobility and its determinations, transference numbers and their relation to ionic mobility's, determination of transference numbers using Hittorf and Moving Boundary methods.

Applications of conductance measurement: (i) degree of dissociation of weak electrolytes (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts (iv) conductometric titrations (acid base titrations only) and (v) Hydrolysis constants of salts. Numerical problems. 10hrs

UNIT-III: Reaction Intermediates and methods of identification	**15 Hours**

Reaction Intermediates: Generation, Stability and Reactions of,

i) Carbocations: Dienone-phenol; and Pinacol-Pinacolone Rearrangement.

ii) Carbanions: Perkin Reaction, Aldol condensation,

iii) Free Radicals: Sandmeyer Reaction

iv) Carbenes and Nitrenes: Singlet and Triplet states, their relative stability and reactions

v) Arynes: Formation and detection 10hrs

Methods for Identifying Reaction Mechanism: Product analysis, Isolation and identification of intermediates, stereochemical evidences, crossover experiments, isotopic studies, kinetic studies

	5 hrs
UNIT-IV: Spectroscopy and Aromatic Hydrocarbons	**15 Hours**
Infrared spectroscopy: Principle, types of vibrations, identification of following organic compounds by stretching frequencies–Alkanes, alkenes, alkynes, benzene, aldehydes, ketone, alcohol, thiols, acids, esters, amines, problems based on molecular formula and stretching frequency. **Mass Spectroscopy**: Principle, instrumentation, definitions of parent peak and base peak, McLafferty rearrangement with respect to butyraldehyde. **Aromatic Hydrocarbons:** Resonance in benzene, Aromaticity–Huckel's 4n +2 rule with respect to benzene, furan, pyridine and [10]–annulene. Mechanism of electrophilic aromatic substitution–halogenation, nitration, sulphonation and Friedel-Craft's reaction (evidences for two step mechanism and evidences for formation of electrophile).	

References

1. Peter Atkins & Julio De Paula, Physical Chemistry, 9th Ed., Oxford University Press (2010)
2. GWCastellan, PhysicalChemistry, 4th Ed.,Narosa(2004)
3. RGMortimer, PhysicalChemistry3rd Ed., Elsevier: Noida,UP(2009)
4. B R Puri, L R Sharma and M S Pathania, Principal of Physical Chemistry, Vishal Publishing Co.
5. B S Bahl, G D Tuli and ArunBahl, Essentials of Physical chemistry, S Chand & Company Ltd.
6. R L Madan, Chemistry for Degree Students, Semester I, II, III and IV, S Chand and Company Ltd.
7. P L Soni, O P Dharmarha and U N Dash, Textbook of Physical Chemistry, Sultan Chand and Sons.
8. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
9. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004). Page | 23
10. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
11. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
12. Cotton, F.A. & Wilkinson, G. Basic Inorganic Chemistry, Wiley.
13. Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press. 8. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd
14.Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
15. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
16. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
17. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7 th Ed., W. H. Freeman.
18. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002

Fourth Semester B.Sc. Chemistry Practicals

Paper Title: Chemistry-4P	**Marks: Th-80+IA-20**
Paper Code : SEPBSCHEMP04	**Total hours: 60**
Teaching Hours: 4 Hours/Week	**Credits : 02**

Inorganic Chemistry (40 Marks)

Semi-micro Qualitative analysis of two simple inorganic Salts
ANIONS: CO_3^{-2}, S^{-2}, Cl^-, Br^-, I^-, NO_3^-, SO_4^{-2}
CATIONS: Pb^{+2}, Cu^{+2}, Al^{+3}, Fe^{+2}, Fe^{+3}, Mn^{+2}, Co^{+2}, Ni^{+2}, Zn^{+2}, Ca^{+2}, Ba^{+2}, Mg^{+2}, Na^+, K^+ and NH_4^+

Examination:
In the practical examination, in a batch at least 15 (Fifteen) students may be made. Viva questions may be asked on any of the experiments prescribed in the practical syllabus.

Distribution of Marks:
Preliminary tests + Presentation- 6+2 = 8 Marks
Positive radicals 2x6 =12 Marks
Negative radicals 2x4 = 8 Marks
Journal 05 Marks
Viva Voce 05 Marks
Total 40 Marks

Reference Books:
1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
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)

Rani Channamma University Belagavi

BSC III Semester Elective Chemistry

Paper title: Chemistry in Daily Life	**Marks: Th 40 + IA 10**
Paper Code:	**Total hours: 30**
Teaching hours: 3 hours/ Week	**Credits:02**

Syllabus

UNIT-I: 15hrs

Dairy Products: Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Estimation of added water in milk. Beverages: Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, determination of methyl alcohol in alcoholic beverages.

Food additives, adulterants, and contaminants: Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners: Aspartame, saccharin, dulcin, sucralose, and sodium cyclamate. Flavors: Vanillin, alkyl esters (fruit flavors), and monosodium glutamate.

Artificial food colorants: Coal tar dyes and non-permitted colors and metallic salts.

UNIT-II: 15hrs

Vitamins: Classification and Nomenclature. Sources, deficiency diseases, and structures of Vitamin A1, Vitamin B1, Vitamin C, Vitamin D, Vitamin E & Vitamin K1.

Oils and fats: Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like argemone oil and mineral oils. Halphen test.

Soaps and Detergents: Introduction, manufacture of soap by modern process. Cleaning action of soap. Manufacture of Detergents. Distinction between soap and detergents, emulsifiers, stabilizers and builders.

References Books:

1. B. K. Sharma: Introduction to Industrial Chemistry, Goel Publishing, Meerut (1998)
2. Medicinal Chemistry- Ashtoush Kar.
3. Analysis of Foods – H.E. Cox: 13.
4. Chemical Analysis of Foods – H.E. Cox and Pearson.
5. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4thed. New Age International (1998)

Rani Channamma University Belagavi

BSC IV Semester

Elective Chemistry

Paper title: Fuel Chemistry	Marks: Th 40 + IA 10
Paper Code:	Total hours: 30
Teaching hours: 3 hours/ Week	Credits: 02

Syllabus

UNIT-I: Fuel Chemistry: 15hrs

Classification of fuels and their calorific value. Characteristics of good fuel. Comparison between solid, liquid and solid fuels.

Coal: Composition. Classification of coal by rank. Selection of coal. Uses of coal (fuel and non fuel) in various industries. carbonization of coal.

Manufacture, composition and uses of Coal gas, producer gas and water gas..

Metallurgical Coke: Manufacture of metallurgical coke. Requisites of a good metallurgical coke.

Non- conventional sources of energy: Solar energy, tidal energy, biomass and geo-thermal energy.

UNIT-II: Petro Chemicals: 15 hrs

Sources of petrochemicals. Crude oil and its composition. Classification of petroleum based on chemical composition and refinery crude petroleum. Refining of crude oil. Cracking (Thermal and catalytic cracking),

Synthetic petrol: Synthesis by Fisher-Tropsch method and Bergius method.

Reforming by thermal method.

Petroleum and non-petroleum fuels: Properties and uses of LPG, CNG, LNG, Natural gas. Synthesis, properties and uses of Power alcohol and biogas.

.**References Books:**

1. Stocchi, E. Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK (1990).
2. Jain, P.C. & Jain, M. Engineering Chemistry DhanpatRai Publishing Company, New Delhi.
3. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1998).
4. Industrial Chemistry, B.K.Sharma, 9th Edn. Krishna Prakashan Media (P) Ltd. Meerut (1997-98)

Rani Channamma University Belagavi

BSC IV Semester

Skill-I

Paper title: Skill-I	Marks: Pr 40 + IA 10
Paper Code:	Total hours: 30
Teaching hours: 4 hours/Week	Credits: 02

Section A: Laboratory rules and issues

1. Laboratory safety rules
2. Handling health and Safety issues while carrying out experiments
3. Calibration of burrette, pipette and conical flask

Section B: Experiments (40 Marks)

1. Determination of relative atomic mass of magnesium using molar volume of hydrogen gas
2. Preparation of soap sample in the laboratory
3. Preparation of Chlorine gas and study of physical and chemical properties.
4. Preparation of Sulphur dioxide and study of physical and chemical properties.
5. To determine the pH of the following substances by using a universal indicator solution.
   i) Salt solutions ii) Acids and bases of different dilutions
6. To determine the pH of the following substances by using a pH paper.
   i) Vegetables and fruit juices
7. Separation of the coloured components of the following by paper chromatography and comparison of their Rf values.

a) Black ink or a mixture of red and blue inks b) Juice of a flower or grass

Examination: In the practical examination, a batch of maximum 15 (Fifteen) students may be made. Anyone experiment from Part-B can be given. Viva questions must be asked on any of the experiments prescribed in the practical syllabus.

Section B: Distribution of Marks:

1. Accuracy 25 Marks
2. Calculation and presentation 05 Marks
3. Journal 05 Marks
4. Viva Voce 05 Marks

Total 40 Marks

Deduction of marks for accuracy for Section-B: ±5% -25 marks, ± 10%- 20 marks, ±15% - 15 marks, ±20%-10 marks, ±25% -05 marks, above ±26% -zero marks.

Reference books:

1. J B Yadav, Advanced Physical Chemistry, Krishna Prakashan Media (P) Ltd, Meerut.
2. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co. New Delhi (2011).
3. Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).
4. Organic Chemistry by S. M. Mukherji, S. P. Singh and R. K. Kapoor. (Narosa Publishers)

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RANI CHANNAMMA UNIVERSITY, BELGAVI

VIDYASANAGAMA

Accredited with B+ Grade by NAAC

FACULTY OF SCIENCE & TECHNOLOGY : DEPARTMENT OF CHEMISTRY

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Question Paper pattern

First Semester B.Sc. Degree Examination, December 2024

(SEP Scheme-2024-25: Regular)

Chemistry

Time: 3 Hours Max. Marks: 80

Q. No. I. Answer any TEN of the following 2X10= 20Marks

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

Q. NO. 2. Answer the any 3 following questions 5X3=15 Marks

a)
b)
c)
d)
e)

Q. NO. 3. Answer the any 3 following questions 5X3=15 Marks

a)
b)
c)
d)
e)

Q. NO. 4. Answer the any 3 following questions 5X3=15 Marks

a)
b)
c)
d)
e)

Q. NO. 5. Answer the any 3 following questions 5X3=15 Marks

a)

b)
c)
d)
e)

Instruction to set the question paper.

- Question number 1 has 12 sub questions consisting of 3 questions from each unit. Each question carries two marks. Student has to answer any ten questions.
- Question number 2 are from unit I.
- Question number 3 are from unit II.
- Question number 4 are from unit III
- Question number 5 are from unit IV.

Rani Channamma University, Belagavi

REVISED CURRICULUM FRAMEWORK FOR UNDER GRADUATE COURSE

PROGRAMME / COURSE STRUCTURE AND SYLLABUS OF BACHELOR OF SCIENCE

OPTIONAL CHEMISTRY

V & VI Semesters

As Per The

State Education Policy (SEP) – September - 2024

w.e.f.

Academic Year 2026–27 and Onwards

Submitted by

Chairman
Board of Studies (UG),
Bachelor of Science,
Rani Channamma University, Belagavi

Course Structure for B.Sc. Chemistry Programme (V and VI Semester)

Semester	Paper	Paper Title	Paper Code	Teaching Hours/Week	Total Hours	Credits	Marks
V	Paper – I (Theory)	Chemistry–5T	SEPBSCCHEMT05	4	60	03	Th–80 + IA–20 = 100
	(Practical-05)	Chemistry–5P	SEPBSCCHEMP05	4	60	02	Pr–40 + IA–10 = 50
	Paper – II (Theory)	Chemistry–6T	SEPBSCCHEMT06	4	60	03	Th–80 + IA–20 = 100
	Skill-II	Chemistry–6P	SEPBSCCHEMP06	4	60	02	Pr–40 + IA–10 = 50
VI	Paper – I (Theory)	Chemistry–7T	SEPBSCCHEMT07	4	60	03	Th–80 + IA–20 = 100
	(Practical-06)	Chemistry–7P	SEPBSCCHEMP06	4	60	02	Pr–40 + IA–10 = 50
	Paper – II (Theory)	Chemistry–8T	SEPBSCCHEMT08	4	60	03	Th–80 + IA–20 = 100
	Skill-III	Chemistry–8P	SEPBSCCHEMP08	4	60	02	Pr–40 + IA–10 = 50

Semester-wise Distribution of Teaching Hours, Marks and Credits for B.Sc. Chemistry Programme (V and VI Semester)

Semester	Subjects	Teaching Hours/Week	Duration of Exams (Hours)	IA	Exam	Total Marks	Credits
V	Chemistry–5T	4	3	20	80	100	03
V	Chemistry–5P	4	4	10	40	50	02
V	Chemistry–6T	4	3	20	80	100	03
V	Chemistry Skill II	4	4	10	40	50	02
VI	Chemistry–7T	4	3	20	80	100	03
VI	Chemistry–6P	4	4	10	40	50	02
VI	Chemistry–8T	4	3	20	80	100	03
VI	Chemistry Skill III	4	4	10	40	50	02

Fifth Semester B.Sc. Chemistry Theory (PAPER-I)

Paper Title: Chemistry–5 T (Paper–I)	**Marks: Th–80 + IA–20 =100**
Paper Code: SEPBSCCHEMT05	**Total Hours: 60**
Teaching Hours: 4 Hours/Week	**Credits: 03**

COURSE OBJECTIVES

Students will learn:

1. Advanced concepts of coordination chemistry and stereochemistry of coordination compounds.
2. Principles and applications of gravimetric analysis.
3. Chemistry, synthesis and reactivity of heterocyclic compounds and alkaloids.
4. Principles and applications of green chemistry.
5. Fundamentals and applications of molecular spectroscopy.
6. Structure, properties and applications of polymers and nanomaterials.

COURSE OUTCOMES

After successful completion of the course, students will be able to:

1. Explain bonding, stability and isomerism in coordination compounds.
2. Apply gravimetric principles in quantitative chemical analysis.
3. Describe synthesis, aromaticity and reactions of heterocyclic compounds.
4. Understand environmentally benign synthetic methodologies.
5. Interpret molecular spectra and explain spectroscopic applications.
6. Describe preparation, properties and industrial applications of polymers and nanomaterials.

UNIT – I — 15 Hours

Coordination Chemistry–I — 09 Hours

Werner's coordination theory and experimental verification. Effective Atomic Number (EAN) rule and limitations. IUPAC nomenclature of coordination compounds. Valence Bond Theory (VBT) of coordination compounds with reference to:

- $[Fe(CN)_6]^{3-}$
- $[Fe(CN)_6]^{4-}$
- $[FeF_6]^{3-}$
- $[Zn(NH_3)_4]^{2+}$
- $[Ni(CN)_4]^{2-}$

and limitations of VBT. Inner orbital and outer orbital complexes. Isomerism in coordination compounds: Ionisation, hydrate, linkage, geometrical and optical isomerism with coordination numbers 4 and 6. Stability of coordination compounds and chelate effect.
Applications of coordination compounds in: Analytical chemistry, Medicine and Biological systems.

Theory of Gravimetric Analysis — 06 Hours

Principles of gravimetric analysis. Supersaturation and von Weimarn equation. Conditions for precipitation. Coprecipitation and post precipitation. Digestion of precipitate. Separation of precipitate from mother liquor. Washing, drying and ignition of precipitate. Properties of wash liquids and weighing forms.

UNIT – II **15 Hours**

Heterocyclic Compounds **08 Hours**

Classification, molecular orbital picture and aromatic character of: Furan, Thiophene, Pyrrole, Pyridine.
Synthesis of: Furan and pyrrole from 1,4-diketones and Pyridine by Hantzsch synthesis.
Electrophilic substitution reactions of: Pyrrole and Furan (chlorination and nitration).
Nucleophilic substitution reactions of pyridine. Comparison of basicities of: Pyridine, Piperidine, and Pyrrole. Medicinal importance of heterocyclic compounds.

Alkaloids **03 Hours**

Definition, source, classification and general characteristics of alkaloids. Hofmann exhaustive methylation with pyridine as an example. Isolation, structure and medicinal importance of nicotine.

Green Chemistry **04 Hours**

Need for green chemistry and eco-efficiency. Green methods and green products. Recycling of wastes. Twelve principles of green chemistry. Atom economy. Microwave-assisted synthesis and solvent-free synthesis. Applications of green chemistry in sustainable development.

UNIT – III **15 Hours**

Introduction to Molecular Spectra **02 Hours**

Electromagnetic radiation and regions of electromagnetic spectrum. Interaction of electromagnetic radiation with matter. Born–Oppenheimer approximation.

Microwave / Rotational Spectroscopy **04 Hours**

Classification of molecules. Rotational spectra of rigid diatomic molecules. Criteria for rotational spectra. Energy levels of rigid rotator. Selection rules (final equations only). Determination of bond length and moment of inertia of HCl molecule. Applications of rotational spectroscopy.

Infrared/Vibrational Spectroscopy **04 hours**

Simple harmonic oscillator, Hooke's law, energy level of simple harmonic oscillator model of diatomic molecule (final equations only), selection rules, zero point energy determination of force constant and qualitative relation between force constant and bond dissociation energies. Vibrational degrees of freedom of molecules (Linear and non linear).

Phase Rule

05 Hours

Terminology and explanation of phase, component and degree of freedom. Gibbs phase rule. One-component systems: Water system and sulphur system. Two-component systems: Bismuth–cadmium system and KI–water system. Eutectic point and freezing mixtures.

UNIT – IV **15 Hours**

Properties of Polymers **08 Hours**

Physical, thermal, flow and mechanical properties of polymers.

Preparation, structure, properties and applications of: Polyolefins, Polystyrene And Styrene Copolymers, Poly(Vinyl Chloride), Poly(Vinyl Acetate), Acrylic Polymers, Fluoropolymers, Polyamides, Phenol-Formaldehyde Resins (Bakelite And Novolac), Polyurethanes, Silicone Polymers, Polycarbonates.

Conducting polymers: Polyacetylene, Polyaniline, Poly(P-Phenylene Sulfide), Polypyrrole, Polythiophene, Biodegradable polymers and applications.

Inorganic Polymers **03 Hours**

Inorganic polymers and types. Comparison with organic polymers.

Silicones and Phosphonitrilic halides: Formation, structure and applications

Nanomaterials **04 Hours**

Overview of nanostructures and nanomaterials: classification. Preparation of: Gold and Silver nanoparticles Self-assembled nanostructures and control of nanoarchitecture. Carbon nanotubes and inorganic nanowires. Bioinorganic nanomaterials and applications.

RECOMMENDED REFERENCE BOOKS

Inorganic Chemistry

1. Puri, B.R., Sharma, L.R. & Kalia, K.C. — *Principles of Inorganic Chemistry*, Vishal Publishing Co.
2. Sathya Prakash, Tuli, G.D., Basu, S.K. & Madan, R.D. — *Advanced Inorganic Chemistry*, S. Chand.
3. Cotton, F.A. & Wilkinson, G. — *Advanced Inorganic Chemistry*, Wiley.
4. Huheey, J.E. — *Inorganic Chemistry*, Pearson Education.

Organic Chemistry

5. Bahl, A. & Bahl, B.S. — *Advanced Organic Chemistry*, S. Chand.
6. Morrison, R.T. & Boyd, R.N. — *Organic Chemistry*, Pearson Education.
7. Finar, I.L. — *Organic Chemistry*, Vol. I & II.
8. Sykes, P. — *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman.

Physical Chemistry & Spectroscopy

9. Puri, B.R., Sharma, L.R. & Pathania, M.S. — *Principles of Physical Chemistry*, Vishal Publishing Co.
10. Bahl, B.S., Tuli, G.D. & Arun Bahl — *Essentials of Physical Chemistry*, S. Chand.
11. Banwell, C.N. & McCash, E.M. — *Fundamentals of Molecular Spectroscopy*, Tata McGraw Hill.
12. Barrow, G.M. — *Physical Chemistry*, Tata McGraw Hill.

Polymer & Nanotechnology

13. Billmeyer, F.W. — *Textbook of Polymer Science*, Wiley.
14. Ahluwalia, V.K. — *Green Chemistry*, Narosa Publishing House.
15. Pradeep, T. — *Nanoscience and Nanotechnology*, McGraw Hill Education India.

Fifth Semester B.Sc. Chemistry Practicals (Practical -05)

Paper Title: Chemistry–5 P	**Marks: Pr–40 + IA–10 = 50**
Paper Code: SEPBSCCHEMP05	**Total Hours: 60**
Teaching Hours: 4 Hours/Week	**Credits: 02**

PART–A : Inorganic Chemistry Practical

1. Preparation of cis- and trans-potassium dioxalatodiaquachromium(III) complex.
2. Preparation of hexamminecobalt(III) chloride and estimation of cobalt.
3. Preparation of potassium tris(oxalato)ferrate(III).
4. Preparation of pentamminechlorocobalt(III) chloride.

PART–B : Physical Chemistry Practical

1. Determination of concentration of HCl by conductometric titration using standard NaOH.
2. Determination of concentration of CH_3COOH by conductometric titration using standard NaOH.
3. Potentiometric titration of weak acid against strong base using quinhydrone electrode and calculation of Ka and pKa values.
4. Determination of percentage composition of unknown mixture of liquids using Abbe's refractometer.
5. Estimation of Fe^{3+} ions colorimetrically.

PART – C: Organic Preparations

1. Preparation of m-dinitrobenzene from nitrobenzene.
2. Preparation of phthalimide from phthalic anhydride and urea.
3. Preparation of p-bromoacetanilide from acetanilide.
4. Preparation of benzoic acid from benzaldehyde.
5. Preparation of aspirin from salicylic acid.

Examination Scheme

In the practical examination, a batch of maximum 15 (fifteen) students may be formed. Any one experiment from Part–A or Part–B or Part-C shall be allotted to the student by lot method. Viva-voce questions shall be based only on the experiments prescribed in the practical syllabus. Proper observations, calculations and results shall be recorded in the laboratory journal.

Part – A : Distribution of Marks

Component	**Marks**
Reaction and mechanism	06 Marks
Calculation of theoretical yield	04Marks
Observed yield and purity	14 Marks
Melting point / Purity	06 Marks
Viva-Voce	05 Marks
Journal	05 Marks
Total	**40Marks**

Deduction of Marks for Observed Yield

Percentage Error in Yield	**Marks Awarded**
Less than 10%	14Marks
11–15%	12 Marks
16–20%	10 Marks
21–25%	08 Marks
Above 25%	00 Marks

Part – B : Distribution of Marks

Component	Marks
Accuracy	16 Marks
Technique and presentation	06 Marks
Calculations and Graph	08Marks
Viva-Voce	05 Marks
Journal	05 Marks
Total	**40 Marks**

Deduction of Marks for Accuracy

Error	Marks Awarded
Less than 10%	16Marks
11–15%	14Marks
16–20%	12Marks
21–25%	10 Marks
Above 25%	00 Marks

Part – C : Distribution of Marks

Component	Marks
Reaction and mechanism	06 Marks
Calculation of theoretical yield	04Marks
Observed yield and purity	14 Marks
Melting point / Purity	06 Marks
Viva-Voce	05 Marks
Journal	05 Marks
Total	**40Marks**

Deduction of Marks for Observed Yield

Percentage Error in Yield	Marks Awarded
Less than 10%	14Marks
11–15%	12 Marks
16–20%	10 Marks
21–25%	08 Marks
Above 25%	00 Marks

RECOMMENDED REFERENCE BOOKS

V Semester Practical

1. Vogel, A.I. — *Textbook of Quantitative Chemical Analysis*, Pearson Education.
2. Svehla, G. — *Vogel's Qualitative Inorganic Analysis*, Pearson Education.
3. Ahluwalia, V.K. — *Practical Physical Chemistry*, Universities Press.
4. Khosla, B.D., Garg, V.C. & Gulati, A. — *Senior Practical Physical Chemistry*, R. Chand & Company.
5. Mendham, J., Denney, R.C., Barnes, J.D. & Thomas, M.J.K. — *Vogel's Quantitative Chemical Analysis*, Pearson Education.
6. Vogel, A.I. — *Practical Organic Chemistry*, Pearson Education.
7. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. — *Vogel's Textbook of Practical Organic Chemistry*, Pearson Education.
8. Ahluwalia, V.K. & Aggarwal, R. — *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*, Universities Press.
9. Mann, F.G. & Saunders, B.C. — *Practical Organic Chemistry*, Pearson Education.
10. Shriner, R.L., Fuson, R.C. & Curtin, D.Y. — *The Systematic Identification of Organic Compounds*, Wiley.

Fifth Semester B.Sc. Chemistry Theory (PAPER-II)

Paper Title: Chemistry–6 T (Paper–II)	**Marks: Th–80 + IA–20 =100**
Paper Code: SEPBSCCHEMT06	**Total Hours: 60**
Teaching Hours: 4 Hours/Week	**Credits: 03**

COURSE OBJECTIVES

Students will learn:

1. Industrial preparation and applications of alloys, abrasives, glass, cement and fuels.
2. Preparation and synthetic applications of important organic reagents.
3. Chemistry and applications of synthetic dyes.
4. Advanced electrochemistry and EMF measurements.
5. Construction and applications of batteries and fuel cells.
6. Applications of IR, UV and Mass spectroscopy in structure elucidation.

COURSE OUTCOMES

After successful completion of the course, students will be able to:

1. Explain industrial manufacture and applications of important materials.
2. Apply organic reagents in synthetic organic chemistry.
3. Describe synthesis and industrial importance of dyes.
4. Explain EMF measurements and electrochemical applications.
5. Describe construction and working of batteries and fuel cells.
6. Interpret IR, UV and Mass spectral data of organic compounds.

UNIT – I **15 Hours**

Industrial Chemistry – I **09 Hours**

Alloys: Significance and types of alloys such as ferrous and non-ferrous alloys, preparation of alloys by fusion and electrodeposition methods, properties and applications of alloys.
Abrasives: Classification of abrasives, Mohs scale of hardness, manufacture and applications of carborundum, alundum and tungsten carbide.
Glass: Physical and chemical properties of glass, raw materials used in glass manufacture, manufacture of glass using tank furnace, annealing of glass, types, composition and applications of glasses.

Industrial Chemistry – II **06 Hours**

Cement: Raw materials and composition of Portland cement, manufacture by rotary kiln method, mechanism of setting and hardening of cement.
Fuels: Characteristics and calorific values of fuels, advantages of gaseous fuels, manufacture of water gas and biogas, introduction to renewable and green fuels, industrial and environmental importance of fuels.

UNIT – II **15 Hours**

Reagents and Reactions **09 Hours**

Preparation, reactions and synthetic applications of DCC in amide formation, LiAlH4 in the reduction of aldehydes, carboxylic acids and esters, DDQ in benzylic oxidation and aromatization, lead tetraacetate in oxidation of vicinal diols, NBS in allylic bromination, OsO_4 in hydroxylation of alkenes and PCC (Pyridinium chlorochromate) in oxidation of primary alcohols. Green alternatives to oxidizing and reducing reagents.

Dyes **06 Hours**

Classification and requirements of dyes, colour and constitution theories of dyes. Synthesis, properties and applications of Congo red, Indigo, Alizarin, Malachite green, Crystal violet, Fluorescein and Eosin. Applications of dyes in industry and medicine. Environmental impact of synthetic dyes.

UNIT – III **15 Hours**

Electrochemistry – EMF **10 Hours**

Reversible and irreversible cells, EMF of a cell and its measurement by potentiometer, Weston standard cell, reference electrodes such as calomel electrode and silver-silver chloride electrode, sign conventions for EMF, Nernst equation and applications, salt bridge and liquid junction potential. Determination of pH using hydrogen electrode, quinhydrone electrode and glass electrode. Electrode concentration cell without transference, Electrolyte concentration cells with and without transference. Applications of EMF measurements in determination of solubility and solubility product of sparingly soluble salts and potentiometric acid-base and redox titrations. Numerical problems.

Batteries and Fuel Cells **05 Hours**

Primary and secondary batteries. Construction and applications of lead-acid battery, lithium battery, lithium-polymer battery and nickel-cadmium battery. Hydrogen-oxygen fuel cell and hydrocarbon-oxygen fuel cell and their applications. Introduction to green energy storage systems.

UNIT – IV **15 Hours**

Infrared Spectroscopy **05 Hours**

Fingerprint region, factors affecting IR frequencies, conjugation effects on IR absorption, hydrogen bonding and its effect on IR spectra, Fermi resonance, applications of IR spectroscopy in structure elucidation and interpretation of simple IR spectra.

UV and Visible Spectroscopy **05 Hours**

Woodward–Fieser rules for calculation of λmax of conjugated dienes such as alicyclic, homoannular and heteroannular dienes. Applications of UV spectroscopy, effects of conjugation on λmax, interpretation of simple UV spectra and numerical problems involving λmax calculations.

Mass Spectrometry **05 Hours**

Principle and instrumentation, determination of m/z ratio, determination of molecular mass and isotopic abundance, molecular ion peak and base peak, McLafferty rearrangement with respect to 2-hexanone, hexanoic acid and methyl hexanoate. Applications of mass spectrometry in structure elucidation.

RECOMMENDED REFERENCE BOOKS

Industrial Chemistry

1. Sharma, B.K. — *Industrial Chemistry*, Goel Publishing House.
2. Jain, P.C. & Jain, M. — *Engineering Chemistry*, Dhanpat Rai Publishing Co.
3. Shreve, R.N. — *Chemical Process Industries*, McGraw Hill.
4. Dryden, C.E. — *Outlines of Chemical Technology*, East-West Press.

Organic Chemistry

5. Bahl, A. & Bahl, B.S. — *Advanced Organic Chemistry*, S. Chand.
6. Morrison, R.T. & Boyd, R.N. — *Organic Chemistry*, Pearson Education.
7. Finar, I.L. — *Organic Chemistry*, Vol. I & II.
8. Sykes, P. — *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman.

Physical Chemistry & Electrochemistry

9. Puri, B.R., Sharma, L.R. & Pathania, M.S. — *Principles of Physical Chemistry*, Vishal Publishing Co.
10. Bahl, B.S., Tuli, G.D. & Arun Bahl — *Essentials of Physical Chemistry*, S. Chand.
11. Glasstone, S. — *An Introduction to Electrochemistry*, East-West Press.
12. Barrow, G.M. — *Physical Chemistry*, Tata McGraw Hill.

Spectroscopy

13. Banwell, C.N. & McCash, E.M. — *Fundamentals of Molecular Spectroscopy*, Tata McGraw Hill.
14. Silverstein, Bassler & Morrill — *Spectrometric Identification of Organic Compounds*, Wiley.
15. Pavia, Lampman, Kriz & Vyvyan — *Introduction to Spectroscopy*, Cengage Learning.

Fifth Semester B.Sc. Chemistry Skill-II Practical

Paper Title: Chemistry–6 P	**Marks: Pr–40 + IA–10 = 50**
Paper Code: SEPBSCCHEMP06	**Total Hours: 60**
Teaching Hours: 4 Hours/Week	**Credits: 02**

Conduct any TEN from the following experiments

1. Determination of saponification value of oil.
2. Determination of iodine value of oil.
3. Determination of acid value of oil.
4. Estimation of glucose by Fehling's method.
5. Estimation of keto group by hydroxylamine hydrochloride method.
6. Determination of specific rotation of glucose by polarimeter.
7. Determination of mutarotation of cane sugar by polarimeter.
8. Determination of pH of buffer solution using quinhydrone electrode and comparison with glass electrode.
9. Conductometric titration of strong acid and salt mixture against NaOH.
10. Preparation of methyl orange.
11. Estimation of Iron in rust sample using potentiometer
12. Determination of pK_a value of vinegar solution using pH meter

Examination Scheme

In the practical examination, a batch of maximum 15 (fifteen) students may be formed. Any one experiment shall be allotted to the student by lot method. Viva-voce questions shall be based only on the experiments prescribed in the practical syllabus. Proper observations, calculations and results shall be recorded in the laboratory journal.

Distribution of Marks

Component	**Marks**
Accuracy	16 Marks
Technique and presentation	06 Marks
Calculations and Graph	08Marks
Viva-Voce	05 Marks
Journal	05 Marks
Total	**40 Marks**

Deduction of Marks for Accuracy

Error	**Marks Awarded**
Less than 10%	16Marks
11–15%	14Marks
16–20%	12Marks
21–25%	10 Marks
Above 25%	00 Marks

RECOMMENDED REFERENCE BOOKS

V Semester Skill II

1. Vogel, A.I. — *Practical Organic Chemistry*, Pearson Education.
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. — *Vogel's Textbook of Practical Organic Chemistry*, Pearson Education.
3. Ahluwalia, V.K. & Aggarwal, R. — *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*, Universities Press.
4. Mann, F.G. & Saunders, B.C. — *Practical Organic Chemistry*, Pearson Education.
5. Shriner, R.L., Fuson, R.C. & Curtin, D.Y. — *The Systematic Identification of Organic Compounds*, Wiley.

Sixth Semester B.Sc. Chemistry Theory (PAPER-I)

Paper Title: Chemistry–7 T (Paper–I)	**Marks: Th–80 + IA–20 =100**
Paper Code: SEPBSCCHEMT07	**Total Hours: 60**
Teaching Hours: 4 Hours/Week	**Credits: 03**

COURSE OBJECTIVES

Students will learn:

1. Crystal Field Theory (CFT) with reference to octahedral, distorted octahedral (Jahn–Teller distortion), tetrahedral and square planar complexes.
2. Thermodynamic and kinetic stability of metal complexes.
3. Structure, stereochemistry and properties of biomolecules such as carbohydrates, vitamins, amino acids, peptides and proteins.
4. Electronic spectra, photochemical processes and photophysical phenomena.
5. Properties of liquid-liquid systems, Raoult's law and azeotropes.
6. Basic principles, instrumentation and applications of ^1H NMR spectroscopy.
7. Different concepts of acids and bases including HSAB principle.
8. Manufacture, classification and cleansing action of soaps and detergents.

COURSE OUTCOMES

After successful completion of the course, students will be able to:

1. Calculate crystal field stabilization energy and explain magnetic and spectral properties of coordination compounds.
2. Explain thermodynamic and kinetic stability of metal complexes.
3. Describe structure, stereochemistry and reactions of important biomolecules.
4. Explain laws of photochemistry and photophysical processes.
5. Differentiate miscible, immiscible and partially miscible liquid systems and explain azeotropic behaviour.
6. Interpret PMR spectra of simple organic compounds.
7. Distinguish various acid-base concepts and explain HSAB principle.
8. Explain manufacture, cleansing action and environmental impact of soaps and detergents.

UNIT – I **15 Hours**

Coordination Chemistry – II **12 Hours**

Crystal Field Theory (CFT) with reference to octahedral, distorted octahedral (Jahn–Teller distortion), tetrahedral and square planar complexes. Calculation of crystal field stabilization energy (CFSE), factors affecting 10 Dq, consequences of crystal field splitting on ionic radii and hydration energies of M2+ ions, explanation of colour and magnetic properties of coordination compounds, high-spin and low-spin complexes, limitations of Crystal Field Theory and determination of magnetic moment by Gouy's method.

Metal–Ligand Equilibria **03 Hours**

Thermodynamic and kinetic stability of metal complexes, stepwise and overall stability constants and their relationship. Factors affecting stability of metal complexes.

UNIT – II **15 Hours**

Carbohydrates **05 Hours**

Haworth and conformational formulae of glucose and fructose, mutarotation and its mechanism, osazone formation, Kiliani synthesis, Ruff degradation, epimers and epimerisation with respect to monosaccharides, interconversion of glucose and fructose.

Vitamins **04 Hours**

Classification and biological importance of vitamins A, B_6, B_{12}, C, D and E. Synthesis of vitamin C from D (+) glucose and synthesis of vitamin A by van Dorp method.

Amino Acids, Peptides and Proteins **06 Hours**

Classification, structure and stereochemistry (D and L) of amino acids, acid-base behaviour, isoelectric point and electrophoresis. Peptides: nomenclature, structure and synthesis of dipeptides by Bergmann method. Proteins: classification and levels of protein structure (primary, secondary and tertiary structures), protein denaturation and renaturation.

UNIT – III **15 Hours**

Electronic Spectra **02 Hours**

Potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules, electronic transitions and Franck–Condon principle.

Physical Properties and Molecular Structure **03 Hours**

Applications of dipole moment in molecular structure determination. Measurement of dipole moment by temperature variation method.

Photochemistry **05 Hours**

Absorbance, transmittance, Beer–Lambert law and limitations, calculation of molar extinction coefficient. Laws of photochemistry: Grothus–Draper law and Stark–Einstein law of photochemical equivalence. Quantum yield, reasons for high and low quantum yields with examples. Photosensitization with examples. Photophysical processes: fluorescence, phosphorescence, chemiluminescence and bioluminescence with examples.

Solutions **05 Hours**

Liquid-liquid mixtures: miscible, immiscible and partially miscible systems. Raoult's law and deviations from Raoult's law. Duhem–Margules equation (no derivation) and applications. Azeotropes: minimum and maximum boiling azeotropes. Partially miscible liquids, conjugate solutions and critical solution temperature (CST). Types of partially miscible systems: phenol–water, triethylamine–water and nicotine–water systems.

UNIT – IV **15 Hours**

1H NMR Spectroscopy **07 Hours**

Basic principles of NMR spectroscopy, instrumentation and working of NMR spectrometer, tetramethylsilane (TMS) as reference standard, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting, coupling constant, n+1 rule and integration of signals. Interpretation of PMR spectra of ethanol, ethyl bromide, 2-chloroethanol, acetaldehyde, ethyl acetate, propanamide, acetophenone and acetanilide.

Acids and Bases **04 Hours**

Arrhenius, Brønsted–Lowry, Lux–Flood, solvent system and Lewis concepts of acids and bases. Hard and Soft Acids and Bases (HSAB), classification of acids and bases as hard and soft and Pearson's HSAB principle and applications.

Soaps and Detergents **04 Hours**

Soaps: manufacture by modern process and cleansing action of soaps. Detergents: anionic, cationic and nonionic detergents with suitable examples. Differences between soaps and detergents, role of emulsifiers, stabilizers and builders. Environmental impact and biodegradability of detergents.

RECOMMENDED REFERENCE BOOKS

Inorganic Chemistry

1. Puri, B.R., Sharma, L.R. & Kalia, K.C. — *Principles of Inorganic Chemistry*, Vishal Publishing Co.
2. Sathya Prakash, Tuli, G.D., Basu, S.K. & Madan, R.D. — *Advanced Inorganic Chemistry*, S. Chand.
3. Cotton, F.A. & Wilkinson, G. — *Advanced Inorganic Chemistry*, Wiley.
4. Huheey, J.E. — *Inorganic Chemistry*, Pearson Education.

Organic Chemistry & Biomolecules

5. Bahl, A. & Bahl, B.S. — *Advanced Organic Chemistry*, S. Chand.
6. Morrison, R.T. & Boyd, R.N. — *Organic Chemistry*, Pearson Education.
7. Finar, I.L. — *Organic Chemistry*, Vol. I & II.
8. Lehninger, A.L. — *Principles of Biochemistry*, Worth Publishers.

Physical Chemistry

9. Puri, B.R., Sharma, L.R. & Pathania, M.S. — *Principles of Physical Chemistry*, Vishal Publishing Co.
10. Bahl, B.S., Tuli, G.D. & Arun Bahl — *Essentials of Physical Chemistry*, S. Chand.
11. Glasstone, S. — *Textbook of Physical Chemistry*, Macmillan.
12. Barrow, G.M. — *Physical Chemistry*, Tata McGraw Hill.

Spectroscopy

13. Banwell, C.N. & McCash, E.M. — *Fundamentals of Molecular Spectroscopy*, Tata McGraw Hill.
14. Silverstein, Bassler & Morrill — *Spectrometric Identification of Organic Compounds*, Wiley.
15. Pavia, Lampman, Kriz & Vyvyan — *Introduction to Spectroscopy*, Cengage Learning.

Sixth Semester B.Sc. Chemistry Practicals

Paper Title: Chemistry–7 P	**Marks: Pr–40 + IA–10 = 50**
Paper Code: SEPBSCCHEMP07	**Total Hours: 60**
Teaching Hours: 4 Hours/Week	**Credits: 02**

PART – A: Gravimetric Analysis

1. Estimation of barium as barium sulphate.
2. Estimation of aluminium as aluminium oxide.
3. Estimation of iron as ferric oxide.
4. Estimation of lead as lead sulphate.

PART – B: Physical Chemistry Practical

1. Conductometric titration of weak and strong acid mixture against NaOH.
2. Potentiometric titration of weak and strong acid mixture against NaOH.
3. Potentiometric titration of $KMnO_4$ against FAS.
4. Verification of Beer–Lambert law by colorimetric method and determination of molar extinction coefficient of Cu^{2+}.

PART – C: Organic Chemistry Practical

1. Preparation of 2,4-dinitrophenylhydrazine from chloronitrobenzene.
2. Preparation of anthranilic acid from phthalic acid.
3. Preparation of benzanilide from benzoic acid.
4. Preparation of benzilic acid from benzoin.

Examination Scheme

In the practical examination, a batch of maximum 15 (fifteen) students may be formed. Any one experiment from Part–A or Part–B or Part - C shall be allotted to the student by lot method. Viva-voce questions shall be based only on the experiments prescribed in the practical syllabus. Proper observations, calculations, graphs and results shall be recorded in the laboratory journal.

Part – A : Distribution of Marks

Component	**Marks**
Accuracy	16 Marks (8+ 8)
Technique and presentation	06 Marks
Reactions and calculations	08Marks
Viva-Voce	05 Marks
Journal	05 Marks
Total	**40 Marks**

Deduction of Marks for Accuracy

Error	**Marks Awarded**
±0.4 mL	08 Marks
±0.6 mL	06 Marks
±0.8 mL	04 Marks
±1.0 mL	02 Marks
Above ±1.0 mL	00 Marks

Part – B : Distribution of Marks

Component	Marks
Accuracy	16 Marks (8+ 8)
Technique and presentation	06 Marks
Reactions and calculations	08Marks
Viva-Voce	05 Marks
Journal	05 Marks
Total	**40 Marks**

Deduction of Marks for Accuracy

Error	Marks Awarded
±0.4 mL	08 Marks
±0.6 mL	06 Marks
±0.8 mL	04 Marks
±1.0 mL	02 Marks
Above ±1.0 mL	00 Marks

Part – C : Distribution of Marks

Component	Marks
Reaction and mechanism	06 Marks
Calculation of theoretical yield	04Marks
Observed yield and purity	14 Marks
Melting point / Purity	06 Marks
Viva-Voce	05 Marks
Journal	05 Marks
Total	**40Marks**

Deduction of Marks for Observed Yield

Percentage Error in Yield	Marks Awarded
Less than 10%	14Marks
11–15%	12 Marks
16–20%	10 Marks
21–25%	08 Marks
Above 25%	00 Marks

RECOMMENDED REFERENCE BOOKS

VI Semester Practical

Inorganic and Physical Chemistry Practical

1. Vogel, A.I. — *Textbook of Quantitative Chemical Analysis*, Pearson Education.
2. Svehla, G. — *Vogel's Qualitative Inorganic Analysis*, Pearson Education.
3. Khosla, B.D., Garg, V.C. & Gulati, A. — *Senior Practical Physical Chemistry*, R. Chand & Company.
4. Ahluwalia, V.K. — *Practical Physical Chemistry*, Universities Press.

5. Mendham, J., Denney, R.C., Barnes, J.D. & Thomas, M.J.K. — *Vogel's Quantitative Chemical Analysis*, Pearson Education.
6. Vogel, A.I. — *Practical Organic Chemistry*, Pearson Education.
7. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. — *Vogel's Textbook of Practical Organic Chemistry*, Pearson Education.
8. Ahluwalia, V.K. & Aggarwal, R. — *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*, Universities Press.
9. Pavia, Lampman, Kriz & Engel — *Introduction to Organic Laboratory Techniques*, Cengage Learning.
10. Silverstein, Bassler & Morrill — *Spectrometric Identification of Organic Compounds*, Wiley.

Sixth Semester B.Sc. Chemistry Theory (PAPER-II)

Paper Title: Chemistry–8 T (Paper–II)	**Marks: Th–80 + IA–20 =100**
Paper Code: SEPBSCCHEMT08	**Total Hours: 60**
Teaching Hours: 4 Hours/Week	**Credits: 03**

COURSE OBJECTIVES

Students will learn:

1. Fundamentals of nuclear chemistry and applications of radioisotopes.
2. Biological importance of metal ions and bioinorganic compounds.
3. Properties and reactions of non-aqueous solvents.
4. Principles of retrosynthetic analysis and important organic rearrangements.
5. Structure, classification and synthesis of terpenoids.
6. Basic concepts of quantum chemistry and advanced chemical kinetics.
7. Properties and applications of colloids and micellar systems.
8. Classification, synthesis and medicinal applications of important drugs.
9. Applications of organic reagents in inorganic analysis.
10. Structure and bonding of organometallic compounds.

COURSE OUTCOMES

After successful completion of the course, students will be able to:

1. Explain nuclear reactions and applications of radioisotopes.
2. Describe biological functions of essential metal ions.
3. Explain properties and reactions of non-aqueous solvents.
4. Apply retrosynthetic principles in organic synthesis.
5. Describe mechanisms of important organic rearrangements.
6. Explain quantum mechanical concepts and complex reaction kinetics.
7. Describe properties and applications of colloids and micelles.
8. Explain synthesis and medicinal importance of important drugs.
9. Understand analytical applications of organic reagents.
10. Explain structure, bonding and stability of organometallic compounds.

UNIT – I **15 Hours**

Nuclear Chemistry **08 Hours**

Nuclear instability, radioactive decay, half-life period, radioactive series, nuclear binding energy, nuclear fission and fusion, principle and components of nuclear reactors, breeder reactor and pressurized water reactor (PWR). Nuclear reactions: (α, n), (n, p) and (p, n) reactions. Applications of radioisotopes in tracer techniques, medicine and carbon dating.

Bioinorganic Chemistry **04 Hours**

Essential and trace elements in biological processes. Metalloporphyrins with reference to haemoglobin and chlorophyll (structure and functions). Biological role of sodium, potassium, magnesium, calcium, iron and zinc.

Non-Aqueous Solvents **03 Hours**

Properties of non-aqueous solvents. Liquid ammonia and liquid sulphur dioxide as solvents and their typical reactions.

UNIT – II **15 Hours**

Retrosynthesis **05 Hours**

Introduction to retrosynthetic analysis, synthons, synthetic equivalents, functional group interconversions, one-group and simple two-group disconnections with examples. Retrosynthesis of benzocaine and 4-methoxyacetophenone.

Rearrangements **06 Hours**

Wagner–Meerwein rearrangement, Fries rearrangement, Beckmann rearrangement, Wittig reaction, Baeyer–Villiger oxidation and Benzidine rearrangement with mechanisms and applications.

Terpenoids **04 Hours**

Introduction and classification of terpenoids, Ingold's isoprene rule, constitution and synthesis of citral, synthesis of α- and β-ionones and synthesis of α-terpineol.

UNIT – III **15 Hours**

Quantum Chemistry **06 Hours**

Black body radiation, Planck's quantum theory, photoelectric effect, Einstein's photoelectric equation, Compton effect, wave nature of electron, wave-particle duality, de Broglie equation and applications, experimental verification of wave nature of electron by Davisson–Germer experiment.

Chemical Kinetics **06 Hours**

Derivation of rate equations for unimolecular reactions based on Lindemann hypothesis and bimolecular reactions. Limitations of collision theory, comparison of collision theory and transition state theory, steric factor. Complex reactions involving opposing, consecutive and parallel reactions.

Micelles and Colloids **03 Hours**

Emulsions, microemulsions and their stability, electrokinetic properties of microemulsions, association colloids and micelles, critical micelle concentration (CMC) and applications of surfactants.

UNIT – IV **15 Hours**

Chemotherapy and Drugs **07 Hours**

Introduction and requirements of an ideal synthetic drug, classification and medicinal applications of drugs. Synthesis and uses of antipyrine, novocaine and chlorpheniramine maleate. Introduction to antimalarials and antibiotics with reference to paludrine and tetracycline. Para-pharmaceutical reagents: Benedict's reagent and Barfoed's reagent.

Organic Reagents in Inorganic Analysis **03 Hours**

Sensitivity, selectivity and specificity of organic reagents. Advantages of organic reagents over inorganic reagents. Analytical applications of dimethylglyoxime and 8-hydroxyquinoline (oxine).

Organometallic Compounds **05 Hours**

Introduction and classification of organotransition metal compounds. Eighteen-electron rule with reference to $[Fe(CO)_5]$, $[Ni(CO)_4]$, $[Mn(CO)_5]^+$ and ferrocene. Structure and bonding in metal olefin complexes with reference to Zeise's salt.

RECOMMENDED REFERENCE BOOKS

Inorganic Chemistry

1. Puri, B.R., Sharma, L.R. & Kalia, K.C. — *Principles of Inorganic Chemistry*, Vishal Publishing Co.
2. Sathya Prakash, Tuli, G.D., Basu, S.K. & Madan, R.D. — *Advanced Inorganic Chemistry*, S. Chand.
3. Cotton, F.A. & Wilkinson, G. — *Advanced Inorganic Chemistry*, Wiley.
4. Huheey, J.E. — *Inorganic Chemistry*, Pearson Education.

Organic Chemistry

5. Bahl, A. & Bahl, B.S. — *Advanced Organic Chemistry*, S. Chand.
6. Morrison, R.T. & Boyd, R.N. — *Organic Chemistry*, Pearson Education.
7. Finar, I.L. — *Organic Chemistry*, Vol. I & II.
8. Clayden, J., Greeves, N. & Warren, S. — *Organic Chemistry*, Oxford University Press.

Physical Chemistry

9. Puri, B.R., Sharma, L.R. & Pathania, M.S. — *Principles of Physical Chemistry*, Vishal Publishing Co.
10. Bahl, B.S., Tuli, G.D. & Arun Bahl — *Essentials of Physical Chemistry*, S. Chand.
11. Glasstone, S. — *Textbook of Physical Chemistry*, Macmillan.
12. Atkins, P.W. — *Physical Chemistry*, Oxford University Press.

Medicinal and Organometallic Chemistry

13. Chatwal, G.R. — *Medicinal Chemistry*, Himalaya Publishing House.
14. Singh, H. & Kapoor, V.K. — *Medicinal and Pharmaceutical Chemistry*, Vallabh Publications.
15. Mehrotra, R.C. & Singh, A. — *Organometallic Chemistry*, New Age International.

Sixth Semester B.Sc. Chemistry Skill-III Practical

Paper Title: Chemistry–8 P	**Marks: Pr–40 + IA–10 = 50**
Paper Code: SEPBSCCHEMP08	**Total Hours: 60**
Teaching Hours: 4 Hours/Week	**Credits: 02**

Conduct any TEN from the following experiments

1. Volumetric estimation of calcium and magnesium in dolomite solution.
2. Volumetric estimation of copper in German silver.
3. Volumetric estimation of iron in Cu–Fe alloy solution.
4. Volumetric estimation of zinc in Cu–Zn alloy solution.
5. Conductometric titration of weak acid and salt mixture against NaOH.
6. Determination of critical micelle concentration (CMC) conductometrically.
8. Titrimetric estimation of amino acids.
9. Synthesis of acridone.
10. Synthesis of hydantoin.
11. Estimation of phenol by bromometric method.
12. Determination of strength of an acid in Pb-acid battery
13. Preparation of Urea formaldehyde or Phenol Formaldehyde Resin (Polymers).
14. Determination of COD value for the given Industrial waste water by using FAS.
15. Synthesis of Nanomaterials e.g., (Fe-Oxide)

Examination Scheme

In the practical examination, a batch of maximum 15 (fifteen) students may be formed. Any one experiment shall be allotted to the student by lot method. Viva-voce questions shall be based only on the experiments prescribed in the practical syllabus. Proper observations, calculations and results shall be recorded in the laboratory journal.

Distribution of Marks

Volumetric Analysis

Component	**Marks**
Accuracy	12 Marks
Technique and presentation	03 Marks
Reactions and calculations	05 Marks
Viva-Voce	05 Marks
Total	**25 Marks**

Deduction of Marks for Accuracy

Error	**Marks Awarded**
±0.4 mL	12 Marks
±0.6 mL	10 Marks
±0.8 mL	08 Marks
±1.0 mL	06 Marks
Above ±1.0 mL	00 Marks

Physical Chemistry experiments

Distribution of Marks

Component	**Marks**

Component	Marks
Accuracy	12 Marks
Technique and presentation	03 Marks
Reactions and calculations	05 Marks
Viva-Voce	05 Marks
Total	**25 Marks**

Deduction of Marks for Accuracy

Error	Marks Awarded
±0.4 mL	12 Marks
±0.6 mL	10 Marks
±0.8 mL	08 Marks
±1.0 mL	06 Marks
Above ±1.0 mL	00 Marks

RECOMMENDED REFERENCE BOOKS

VI Semester Skill III

1. Vogel, A.I. — *Practical Organic Chemistry*, Pearson Education.
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. — *Vogel's Textbook of Practical Organic Chemistry*, Pearson Education.
3. Ahluwalia, V.K. & Aggarwal, R. — *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*, Universities Press.
4. Mann, F.G. & Saunders, B.C. — *Practical Organic Chemistry*, Pearson Education.
5. Shriner, R.L., Fuson, R.C. & Curtin, D.Y. — *The Systematic Identification of Organic Compounds*, Wiley.