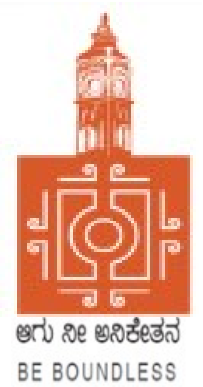

BENGALURU CITY UNIVERSITY

CHOICE BASED CREDIT SYSTEM
(As per SEP)

Syllabus for Chemistry

2025-26

III Semester

Chemistry Paper – III

Instructions per week	Total contact hours	Marks		Duration of Examination	Total Marks	Credits
		Internal Assessment	End Semester Examination			
4 Hours	**52**	**20**	**80**	**3 Hours**	**100**	**03**

UNIT – I

Chemical Kinetics 7 hours

Review of terms - Rate, Order and Molecularity. Second order reactions-definition with examples. Derivation of expression for the rate constant of a second order reaction with a = b and a ≠ b. Half-life period - Definition and derivation for the expression for half-life of a second order reaction with a = b. Mean life period of a reaction -definition, expression for mean life period of a II order reaction (a=b). Problems on rate constant (a=b); half-life period, mean life period and order of reaction.

Determination of order of reaction: differential method, method of half-life period and isolation method.

Theories of reaction rates: Effect of temperature on rate of reaction – temperature coefficient and probability distribution curve with rise in temperature of 10ºC. Arrhenius equation-indication of the terms involved, concept of activation energy, threshold energy definitions with energy profile diagram. Problems on Arrhenius equation in calculating activation energy and rate constants.

Simple collisions theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects, Limitations of collision theory. Steady state approximation statement and Lindemann's hypothesis-postulates. Explanation of the hypothesis using concentration dependence in deciding the order of a reaction.

Experimental determination of kinetics of (i) inversion of cane sugar by Polarimetric method (ii) spectrophotometric method for the reaction between potassium per sulphate and potassium iodide.

Nuclear and Radiochemistry 6 hours

Nucleus – nucleons, nuclear force, nuclear density, stability - explanation using meson theory, n/p ratio, n versus p graph. Mass defect; Binding energy – definition, Explanation of the instability of the nuclei. Problems.

Radioactive decay law, derivation of $N=N_0e^{-\lambda t}$, half-life period of a radioisotope, relationship between half-life and decay constant, numerical problems. Radioactive equilibrium - explanation, introduction of the terms parent and daughter elements. Group displacement law - statement and explanation taking examples; Artificial radioactivity: Rutherford's first artificial transmutation, induced radioactivity; nuclear reactions – differences between chemical and nuclear reactions; reason for the large amount of Q value; symbolic representation of a nuclear reaction, Examples of nuclear reaction induced by γ-radiation, α, n, p and deuteron. Nuclear fission - explanation with an example, chain reaction, Nuclear fusion - explanation with an example, thermonuclear reaction, advantages and disadvantages of fusion over fission, Nuclear reactors - principle, diagram, explanation of the terms like nuclear fuel, control rods, moderators and coolant.

Atomic energy programme in India. Use of radio isotopes in tracer technique - agriculture (phosphorous in agriculture research), medicine (phosphorous to check crack in bones, sodium/iodine to detect clots in blood vessels), food preservation. Carbon dating - formation of radioactive carbon in the atmosphere. Explanation for the determination of age of wood or fossil. Numerical problems on carbon dating.

UNIT – II

Thermodynamics -I 8 hours

Review of terms. Exact and inexact differentials, I law of Thermodynamics – statement.

Mathematical expression with explanation of the terms. Derivation of expressions for work done in isothermal and adiabatic expansion and compression of an ideal gas (IUPAC sign conventions to be used). Numerical problems. Heat capacity of a gas at constant pressure and constant volume, derivation of the relationship between Cp and Cv. Relation between P, V and T in an adiabatic process to be derived. Derivation of Kirchhoff's equation - Numerical problems.

Spontaneous and non-spontaneous processes definitions with suitable examples.

Second law of thermodynamics: Limitations of I law of thermodynamics. Need for II law of thermodynamics, different ways of stating II law with respect to heat and spontaneity. Concept of entropy and its physical significance. Heat engine-Carnot's cycle and derivation of the expression for its efficiency based on entropy concept. Problems based on efficiency equation. II law in terms of efficiency (η). Change in entropy in reversible and irreversible processes (derivations required). Calculation of entropy changes in reversible isothermal and reversible adiabatic processes. Phase transitions in terms of Entropy (Fusion, vaporization, sublimation and polymorphic changes). Numerical Problems on Phase transitions.

Thermodynamics –II 5 hours

Gibb's free energy: Work function, Chemical potential definitions, and physical significance. Relationship between free energy and work function. Criteria for equilibrium, spontaneous and non-spontaneous processes based on free energy. Gibb's-Helmholtz equation-Derivation. Change of free energy with respect to temperature and pressure. Mention of temperature coefficient, van't Hoff isotherm (derivations included), $\Delta G^{o} = -RT \ln K_p$ – Problems. Derivation of van't Hoff reaction isochore. Clausius-Clapeyron equation - applications (thermodynamic derivation not required).

Qualitative treatment of Nernst heat theorem and III law of thermodynamics-statement only. Elementary concept of residual entropy

UNIT –III

Metallurgy 5 hours

Ellingham's diagrams: principle, salient features, Curves corresponding to formation of CO, CO_2 and oxides of Cr, Al, Mg, Ca, Hg and Ag. Applications with reference to selection of reducing agents using Carbon for ZnO and Al for Cr_2O_3.

Extraction of the following metals: (i) Nickel from pentlandite ore (ii) Thorium from monazite sand (iii) Uranium from pitch blende (iv) Plutonium from nuclear waste.

Powder Metallurgy 2 hours

Advantages of powder metallurgy- and its applications. Methods of production of metal powders: Production of tungsten powder from Wolframite.

Steel 4 hours

Phase diagram of iron-carbon: explanation of the composition of austenite, ferrite, cementite and pearlite phases in the diagram.

Alloy steels: Influence of Si, Mn, Cr, Ni, Ti and W on the properties of steel and their applications. Ferro alloys: production of ferrochrome, ferromanganese and ferrosilicon: diagram, equation and manufacture. Applications of alloy steels.

Carbon steel: classification based on carbon content. Heat treatment of steels: hardening, case hardening, carbiding, nitriding, tempering and annealing - definition with applications of each type.

Non-aqueous solvents 2 hours

Introduction, Classification of Solvents Physical Properties of Solvents and their Role in Chemical Reactions: Acid-Base behaviour in Non-aqueous solvents.

Examples- Liquid Ammonia, Liquid Sulfur Dioxide.

UNIT –IV

Alcohols and Thiols 6 hours

Introduction and classification: monohydric, dihydric and trihydric alcohols with an example each.1^o, 2^o and 3^o alcohols with an example each.

Methods of preparation: (i) from carbonyl compounds –by the reduction of Aldehydes and ketones (by Meerwin-Pondorff-Verley reaction) (ii) from acids and esters (by reduction with $LiAlH_4$) (iii) Hydroboration-oxidation of alkenes and (iv) hydration of alkenes.

Reactions of alcohols: Amphoteric nature of alcohols-reaction with sodium, etherification, oxidation of alcohols with $KMnO_4$. Comparison of the reactivity of 1^o, 2^o and 3^o alcohols-Lucas test and oxidation with $K_2Cr_2O_7$-with equations.

Glycols: Preparation from alkenes using OsO_4, $KMnO_4$ and from epoxides. Oxidation of glycols by periodic acid and lead tetra acetate with mechanisms. Pinacol - Pinacolone re-arrangement.

Glycerol**:** Preparation from propene and from oils/fats. Reactions of glycerol (i) nitration (ii) action of concentrated H_2SO_4 and (iii) oxidation by periodic acid. Uses of glycerol.

Thiols: Nomenclature. Methods of preparation (Ex: methane thiol). Chemical reactions of Methane thiol with (i) sodium (ii) NaOH (iii) formation of thio esters and (iv)oxidation with mild oxidising agent (H_2O_2) and strong oxidizing agent (HNO_3). Uses of dithanes. Introduction of umpolung character (reversal of polarity) in carbonyl compounds taking 1,3-dithane as an example.

Phenols 3 hours

Classification. Amphoteric nature-Comparison of acidic strength of phenol with alcohols and mono carboxylic acids. Effect of electron withdrawing group (NO_2) and electron donating group (CH_3) on acidity of phenols at o-, m-, p- positions. Mechanisms of Reimer-Tiemann and Kolbe-Schmidt reactions. Industrial applications of phenols: Conversion of phenol to(i) aspirin (ii) methyl salicylate (iii) salol (iv) salicyl salicylic acid

Ethers and Epoxides 2 hours

Ethers: Methods of preparation - (i) dehydration of alcohols (ii) Williamson's ether synthesis with diethyl ether as an example. Reactions - Ethers as Lewis bases (complexation with metal ions), cleavage and auto-oxidation. Zeisel's method.

Epoxides: Definition**,** Preparation using per acids, Darzen's reaction. Reactions of epoxides with (i) carbon nucleophiles (Ex: CH_3MgI) (ii) nitrogen nucleophiles (Ex: NH_3) (iii) reduction with $LiAlH_4$.

Organo metallic compounds 2 hours

Preparation and synthetic applications of Grignard reagents. Preparation of methyl magnesium iodide. Applications in the synthesis of ethanol, acetic acid, acetaldehyde and acetone from methyl magnesium iodide. Organo lithium compounds - preparation from methyl iodide and synthetic applications- preparation of methane and ethanoic acid. Lithium dialkyl cuprates- preparation from methyl iodide.

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III Semester (SEP) - Question Paper Blue Print
Chemistry Paper – III

Sl. No	Topic	No. of Teaching Hours	Marks per Teaching hour	Part-A		Part-B		Part-C		Total
				No. of questions	Marks	No. of questions	Marks	No. of questions	Marks	
1	Chemical Kinetics	7	16	2	4			1	10	14
2	Nuclear and Radiochemistry	6	13	2	4			1	10	14
3	Thermodynamics-I	7	16	2	4	2	10			14
4	Thermodynamics-II	6	13	1	2			1	10	12
5	Metallurgy	5	11	1	2			1	10	12
6	Powder Metallurgy	6	13	2	4			1	10	14
7	Non-Aqueous solvents	2	5			1	5			5
8	Alcohols, Phenols, Thiols and Ethers	11	24	3	6	2	10	1	10	26
9	Organometallic compounds	2	5			1	5			5
		52	**116**	**13**	**26**	**6**	**30**	**6**	**60**	**116**

Part A			Part B			Part C		
2 Marks Questions			5 Mark questions = (3 + 2) or (4 + 1) Pattern			10 Mark questions = (5 + 5) or (4 +4+2) Pattern		
No. of questions set	**No. of questions to answer**	**Marks per question = 2**	**No. of questions set**	**No. of questions to answer**	**Marks per question = 5**	**No. of questions set**	**No. of questions to answer**	**Marks per question = 10**
13	10	10 x 2 = 20	6	4	4 x 5 = 20	6	4	4 x 10 = 40

Chemistry Practical – III Semester

Sessions per week	Marks		Duration of Examination	Total Marks	Credits
	Internal Assessment	End Semester Examination			
3 Hours	**10**	**40**	**3 Hours**	**50**	**02**

PRACTICAL - 3

List of experiments:

1. a) Re-crystallization and determination of melting point of solids.
   b) Simple distillation and determination of boiling point of liquids.
2. Preparation of m-dinitrobenzene from nitrobenzene.
3. Preparation of dibenzal acetone from benzaldehyde (using acetone and alcoholic NaOH).
4. Preparation of benzoic acid from toluene.
5. Preparation of tribromo aniline from aniline.
6. Preparation of coumarin.
7. Preparation of p-amino benzoic acid from p-nitrobenzoic acid.
8. Preparation of p-bromo aniline from acetanilide.
9. Preparation of p-nitro aniline from acetanilide.
10. Separation of a mixture of two organic compounds by TLC.

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ELECTIVE-I

CHEMISTRY OF COSMETICS AND PHARMACEUTICALS

Sessions per week	Total contact hours	Marks		Duration of Examination	Total Marks	Credits
		Internal assessment	End semester Exam			
2 hrs.	**26 hrs**	**10 marks**	**40 Marks**	**1.30 hrs**	**50**	**02**

UNIT –I

Cosmetics 13 hours

Introduction to Cosmetics, History and evolution of cosmetics, classification of cosmetics (according to physical nature/state, function and use), Site of application-skin, hair, teeth and mouth, eyes) Importance of personal grooming and hygiene, Types of skin (oily, dry, normal, combination, sensitive)

Chemical composition of talcum powder, cold Cream, Shaving cream, Raw materials required for the preparation of toothpaste and tooth powder, Lip cosmetics (Lipstick, types, chemical composition and side effects), Hair and Nail Care products, Hair care products (shampoos- types, chemical composition and conditioners), Hair Colour - Components required and their side effects, Nail care - Nail polish (chemical composition) and thinners, Hygiene and Safety, Sanitization and sterilization, Allergic reactions and patch testing , Safe product usage and storage

UNIT –II

Pharmaceutical Chemistry 13 hours

Introduction to pharmaceutical chemistry 2 hours

Definition, its role in drug discovery and development, Chemotherapy, definition for drug and prodrug, drug discovery, drug design and drug action, classification of drugs with examples i) drugs used for infectious diseases ii) drugs used for non-infectious diseases

Inorganic Pharmaceuticals: 4 hours

Inorganic pharmaceuticals, Pharmaceutical formulations, preparations and uses of Haematinics: $FeSO_4$, Ferrous fumarate, Ferric ammonium citrate, ferrous ascorbate and carbonyl iron, Gastro-intestinal agents, Antacids- Al $(OH)_3$ gel, Mg $(OH)_2$, $NaHCO_3$, $CaCO_3$, Epsom salt, Potash Alum, Mohr's salt. Adsorbents, Protective's- $AgNO_3$, ionic silver, gold sol, H_2O_2, Boric acid and $KMnO_4$. Dental products- $CaCO_3$, NaF, Denture cleaners, Denture adhesives, silicates in dental products.

Important Medicinal Compounds: 7 hours

Study of the following category of medicinal compounds -Definition and uses of

1. Antipyretics-paracetamol
2. Analgesics-Aspirin
3. Anti-inflammatory Agents-Ibuprofen, Diclofenac
4. Anesthetics- Diethyl ether
5. Sedatives and hypnotics, Tranquilizers-Morphine derivatives and barbiturates
6. Anti-depressants-MDMA
7. Anti-hypertensive drugs- Atenolol.
8. Anti anginal drugs-isosorbide dinitrate, Glyceryl trinitrate
9. Hypoglycemic agents: Metformin
10. Anti-tubercular drugs: DOTS treatment with p - amino salicylic acid, rifampicin and streptomycin.
11. Antiviral drugs- Acyclovir
12. Anti helmentics: Albendazole and mebendazole
13. Antifungal agents: Miconazole, fluconazole
14. Anti leprotic drugs: Dapsone
15. Urinary tract anti-infective agents: Ciprofloxacin, Ofloxacin
16. Antibiotics-Penicillin, Cephalosporin, Tetracycline

Note-Structures of paracetamol, aspirin, ibuprofen, penicilin, p-amino salicylic acid, glyceryl trinitrate, Atenolol and general structure of barbiturate.
Mechanism of action of Aspirin to be discussed.

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References

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6. Pharmaceutical Chemistry by S. Lakshmi
7. Wilson and Gisvold &39; Textbook of Organic Medicinal and Pharmaceutical Chemistry
8. Introduction to Medicinal Chemistry by Graham L. Patrick
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III Semester (SEP) Question Paper Blue Print

Elective-1

Sl. No.	Topic	No. of Teaching Hours	Marks per Teaching hour	Part A		Part B	
				No. of questions	Marks	No. of questions	Marks
1	Cosmetics	13	29	3	6	4	20
2	Pharmaceutical Chemistry	13	30	4	8	5	25

Part A			Part B		
2 Marks Questions			5 Mark questions = (3 + 2) or (4 + 1) or (5) Pattern		
No. of questions set	**No. of questions to answer**	**Marks per question = 2**	**No. of questions set**	**No. of questions to answer**	**Marks per question = 5**
7	5	5 □ 2 = 10	9	6	6 □ 5 = 30

IV Semester
Chemistry Paper – IV

Sessions per week	Total contact hours	Marks		Duration of Examination	Total Marks	Credits
		Internal Assessment	End Semester Examination			
4 Hours	**52**	**20**	**80**	**3 Hours**	**100**	**03**

UNIT – I

Phase equilibria 7 hours

Review of equilibrium in systems and factors affecting equilibrium. Explanation of the terms with examples: phase (P), component (C) and degree of freedom (F). Phase rule - statement, significance and derivation. Applications of phase rule: one component systems -water and Sulphur systems - phase diagram and explanation of the curves, areas, triple point, transition equilibria. Effect of pressure on freezing point of water, melting point of monoclinic Sulphur and transition temperature of rhombic Sulphur. calculation of degree of freedom. Two component systems – types, condensed phase rule, temperature - composition phase diagrams for simple eutectic systems such as water–potassium-iodide and lead-silver systems; explanation of effect of mixing of two solids on melting point of a component, eutectic point, eutectic mixtures, effect of temperature on the solubility of KI. Desilverisation of lead by Pattinson's process. Freezing mixtures - preparation and examples.

Solid state 6 hours

Review of crystalline and amorphous solids, anisotropy, types of crystalline solids, space lattice and unit cell.

Laws of crystallography – law of rational indices, law of constancy of interfacial angles, law of constancy of symmetry elements. Symmetry elements in crystals: plane of symmetry- rectangular and diagonal planes. Axis of symmetry: two-fold, three-fold and four-fold axes. Centre of symmetry; illustration using a simple cubic crystal. Crystal systems –introduction of crystal parameters –a, b, c and α, β, γ; classification into seven systems (an example each, no diagrams required); Bravais lattices-explanation using cubic system (diagrams of primitive, face centered and body centered cubes with an example each). Weiss and Miller indices – calculation and use of h k l symbols; sketching of 100, 110, 111 planes in a cubic crystal; calculation of inter planar spacing in a simple cubic crystal, problems.

X-ray diffraction of crystals - derivation of Bragg's equation and problems.

Liquid crystals: explanation of the liquid crystalline state; types –smectic, nematic and cholesteric; examples and applications.

Superconducting solids: explanation of the phenomenon of superconductivity using mercury as an example; Tc high temperature superconductors – example and applications.

UNIT – II

Ionic equilibria 5 hours

Hydrolysis of salts of weak acids and weak bases. Ionic product of water. Deriving the Relationship between Kh, Kw, Ka and Kb. Degree of hydrolysis and its relationship with Kh. Effect of temperature and dilution on degree of hydrolysis of salt of weak acid and weak base. pH expression for the salt of weak acid - bases. Numerical problems on the calculation of Kh and pH of salts of weak acid and weak bases only.

Common ion effect: statement and example (ammonium hydroxide - ammonium chloride and acetic acid - sodium acetate). Buffers: Types and examples. Buffer action and buffer capacity. pH of buffers- Henderson's equation and its derivation for acidic buffer. Problems in calculating the pH of buffers. Solubility product and ionic product definitions and their applications in the precipitation of II and IV group basic radicals in the qualitative analysis of simple salt mixtures. Analytical and biological applications of buffers.

Theories of indicators (Mentioning the different theories). Acid-base theory by taking phenolphthalein as an example.

Electrochemistry-I 8 hours

Review of electrolytes and Conductance related terms. Definition of molar conductance, determination of molar conductance of an electrolyte ($NaNO_3$ or KCl) using Whetstone's bridge. Conductometric titrations: Definition and advantages over other conventional titrations. Principles involved in conductometric titrations with graph for strong acid strong base, strong acid-weak base, weak acid-strong base and weak acid-weak base titrations.

Ionic mobility, absolute ionic mobility and transport number- definitions. Relationship between transport number and ionic mobility of an ion (no derivation). Determination of transport number of an ion (H^+ ion in HCl) by moving boundary method. Abnormal transport numbers- definition with an example like Cd^{2+} in CdI_2. Causes for abnormal transport numbers observed in certain systems. Numerical problems on (i) transport number calculation by moving boundary method (ii) relationship between transport number and ionic mobility (iii) molar conductance and specific conductance.

Kohlrausch's law**:** Statement and its applications (i) Evaluation of $\lambda\infty$ from $\lambda+$ and $\lambda-$ for CH_3COOH and NH_4OH (ii) evaluation of degree of dissociation of a weak electrolyte - monochloro acetic acid (iii) evaluation of $\lambda\infty$ a weak electrolyte (iv) determination of solubility from conductance of saturated solutions of sparingly soluble salts (AgCl and $BaSO_4$). Numerical problems based on these. Limitations of Arrhenius theory. Qualitative account of Debye-Huckel theory -postulates, asymmetric effect (with diagram) and electrophoretic effect. Debye-Huckel-Onsager equation for aqueous solutions of 1:1 electrolytes. Verification of DHO equation.

UNIT –III

Coordination and Organo metallic compounds. 13 hours

Coordination compounds- difference between double salts and complex salts with examples. Ligands -definition and their classification (mono, bi, tri, tetra, penta and hexadentate ligands and ambidentate ligands), examples for each class. Coordination number- definition with examples. 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- statement with illustrations. 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- definition and illustrations with examples. Limitations of CFT. Magnetic properties of $[CoF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$, $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$. Spectral properties of $[Ti(H_2O)_6]^{3+}$, $[Co(H_2O)_6]^{3+}$, $[CoCl_4]^{2-}$.

Isomerism in complexes: Structural isomerism - ionization, linkage, hydrate and coordination isomerism with examples. Stereoisomerism- geometrical and optical isomerism of coordination compounds with coordination number 4 and 6 with examples.

Organo metallic compounds - ligands, classification (hapticity). Synthesis and structure of $K[PtCl_3(\eta^2\text{-}C_2H_4)]$ and $[Fe\ (\eta^5\text{ - }C_5H_5)_2]$.

Metal carbonyls: Structures of $Cr\ (CO)_6$, $Co_2(CO)_8$, $Mn_2(CO)_{10}$; eighteen electron rule and its deviations with examples. Applications of coordination/ organo metallic compounds: cis-platin in cancer therapy, Na_2Ca EDTA in the treatment of heavy metal (Pb, Hg) poisoning, Wilkinson's Catalyst in alkene hydrogenation, Monsanto acetic acid process.

UNIT –IV

Aldehydes and Ketones. 6 hours

Nomenclature. Preparation of Aldehydes (i) from acid chlorides (Rosenmund reaction)-general reaction and from acetyl chloride. (ii) Gattermann- Koch aldehyde synthesis –benzaldehyde from benzene. Preparation of Ketones: from (i) nitriles (preparation of butanone), (ii) carboxylic acids with alkyl lithium, (iii) acid chlorides with metal alkyls- general reaction with one example each.

General mechanism of condensation with ammonia and its derivatives (NH_2-R; R = $-NH_2$, $-OH$ and $-NH-CO-NH_2$).

Mechanisms of aldol condensation, Perkin condensation, Knoevenagel condensation, benzoin condensation and acetal formation.

Reduction: Reduction by $LiAlH_4$ and $NaBH_4$.. Clemmensen and Wolff-Kishner reductions. Mannich reaction- example

Carboxylic acids and their derivatives. 5 hours

Nomenclature of mono, di, tri carboxylic acids. Preparation by acid hydrolysis of nitriles with mechanism. Acidic strength (pKa values). Effect of substituents on the strength of aliphatic and aromatic carboxylic acids - (comparison of acidic strength of formic and acetic acids; acetic acid and monochloro, di chloro, tri chloro acetic acids; benzoic and p-nitro benzoic acid; benzoic acid and para-aminobenzoic acid). Reactions: Formation of esters, acid chlorides, amides and anhydrides explanation with an example for each. Hell-Volhard's-Zelinski reaction, decarboxylation and reduction (using $LiAlH_4$).

Di and tri carboxylic acids**:** Action of heat on di carboxylic acids (oxalic acid, malonic acid, succinic acid, glutaric acid and adipic acid). Reactions of tartaric acid and citric acid – (i) action of heat and (ii) reduction with HI. Reactions of acid chlorides (example: acetyl chloride) - hydrolysis, reaction with alcohol, ammonia and lithium dialkyl cuprates. Reactions of acid anhydrides - hydrolysis, reaction with alcohol, ammonia. Reactions of amides - hydrolysis, reduction, Hoffmann rearrangement. Reactions of esters - alkaline hydrolysis, ammonolysis and alcoholysis. Mechanism of ester hydrolysis - acid and base catalysed (acyl O-cleavage: $B_{AC}2$, $A_{AC}2$; alkyl O-cleavage: $A_{AL}1$ mechanisms).

Tautomerism and Enolates. 2 hours

Tautomerism in carbonyl compounds – keto-enol tautomerism. Acidity of α-hydrogen atoms in aldehydes, ketones and active methylene compounds (example: diethyl malonate and ethyl acetoacetate).

Preparation of diethyl malonate from acetic acid and synthetic applications of diethyl malonate (preparation of mono carboxylic acids - butanoic acid, di carboxylic acid - adipic acid, unsaturated acids -cinnamic acid, ketones - butanone).

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).

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16. Finar I.L., Organic Chemistry – Volume 1., Pearson Publishing Co., 2013
17. Finar I.L., Organic Chemistry – Volume 2., Pearson Publishing Co., 2013
18. March J. And Smith M.B., Advanced Organic Chemistry, 6 th Edition., Wiley Publishing Co. 2009.

IV Semester (SEP) - Question Paper Blue Print

Chemistry Paper - IV

Sl.No	Topic	No. of Teaching Hours	Marks per Teaching hour	Part-A		Part-B		Part-C		Total
				No. of questions	Marks	No. of questions	Marks	No. of questions	Marks	
1	Phase Equilibria	7	16	2	4			1	10	14
2	Solid State	6	13	4	8	1	5			13
3	Electrochemistry	8	18	1	2	1	5	1	10	17
4	Ionic Equilibria	5	11	1	2			1	10	12
5	Coordination Chemistry	13	29	3	6	2	10	1	10	26
6	Aldehydes and Ketones	4	9					1	10	10
7	Carboxylic Acids and Amines	9	19	2	4	2	10	1	10	24
		52	**116**	**13**	**26**	**6**	**30**	**6**	**60**	**116**

Part A			**Part B**			**Part C**		
2 Marks Questions			**5 Mark questions = (3 + 2) or (4 + 1) Pattern**			**10 Mark questions = (5 + 5) or (4 +4+2) Pattern**		
No. of questions set	**No. of questions to answer**	**Marks per question = 2**	**No. of questions set**	**No. of questions to answer**	**Marks per question = 5**	**No. of questions set**	**No. of questions to answer**	**Marks per question = 10**
13	10	10 x 2 = 20	6	4	4 x 5 = 20	6	4	4 x 10 = 40

Chemistry Practical – IV Semester

Instructions per week	Marks		Duration of Examination	Total Marks	Credits
	Internal Assessment	End Semester Examination			
3 Hours	**10**	**40**	**3 Hours**	**50**	**02**

List of experiments:

- Semi-micro qualitative analysis of inorganic salt mixtures.

  (Following ions to be analyzed in the given salt mixtures)

  CO_3^{2-}, HCO_3^-, S^{2-}, SO_3^{2-}, $S_2O_3^{2-}$, NO_2^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, PO_4^{3-}, SO_4^{2-}.

  NH_4^+, Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, Na^+, K^+.
- Estimation of COD in given sample of effluent.
- Separation of Fe^{2+} and Mg^{2+} from a mixture by ion exchange method.
- Separation of methylene blue and fluorescein by column chromatography.
- Separation of Na^+ and K^+ ions by paper chromatographic technique.

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ELECTIVE -II

GREEN CHEMISTRY AND ITS APPLICATIONS IN AGRICULTURE, INDUSTRY AND HEALTH.

Sessions per week	Total contact hours	Marks		Duration of Examination	Total Marks	Credits
		Internal assessment	End semester Exam			
2 hrs.	**26 hrs**	**10 marks**	**40 Marks**	**1.30 hrs**	**50**	**02**

Green Chemistry: 8 hours

Introduction:

Introduction to Green Chemistry: Definition and scope of green chemistry, Importance and need for sustainable chemistry, historical background and evolution.

Principles of Green Chemistry

12 Principles of green chemistry with their explanations and examples, Relationship between green chemistry and environmental protection, Green Chemical Synthesis using green catalysts and biocatalysts. Renewable feed stocks and atom economy, green Solvents. Concept of waste minimization, recycling and biodegradability, Hazardous waste treatment. Applications of green Chemistry in pharmaceuticals, agriculture and polymer industries.

Green Synthesis of the following compounds: Adipic acid, citral, ibuprofen, Acetanilide and paracetamol.

Fertilizers: 4 hours

Different types of fertilizers, manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate of lime and mixed fertilizers, potassium chloride, potassium sulphate.

Dyes: 7 hours

Introduction to dyes: Definition and classification of dyes, difference between dyes and pigments, chromophores and auxochromes, theory of Color and Constitution (Witt's theory, Modern theories) Relationship between molecular structure and colour

Classification of Dyes Based on application: Mordant, Vat, Disperse, Reactive dyes, etc.

Uses of Methyl orange and Phenolphthalein. Synthesis of Congo red, Malachite green, Alizarin, Indigo. Role of mordant's in dyeing process, environmental aspects, Impact of dyes on the environment waste management in dye industries, Biodegradable dyes.

Water technology: 5 hours

Importance of water in domestic, industrial and agricultural sectors, Sources of water: surface water, groundwater, rainwater. Physical, chemical, and biological characteristics of water. Water quality parameters and standards, Water Pollution and Control, Effects of water pollution on environment and health, Waste water characteristics (BOD, COD), Water Treatment Methods.

Basic treatment processes: sedimentation, coagulation, filtration, disinfection

Disinfection techniques: chlorination, ozonation, UV treatment, water softening methods: ion exchange,

lime-soda process, Domestic and industrial water treatment systems

Rainwater harvesting and groundwater recharge, Membrane technologies: reverse osmosis, ultrafiltration, Desalination technique Water conservation, recycling, and reuse. Role of biotechnology in water purification, Water quality testing (PH, TDS hardness, turbidity, etc.) Project/report on local water bodies or water management system.

Food additives and adulterants: 2 hours

Definition and examples. Food preservatives-salt, sugar, sodium benzoate, phenyl benzoate; sweetening agents-saccharin, altame.

Adulterants in milk, sugar, honey, mustard, turmeric

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Reference Books

1. Green Chemistry in 21st Century CRC Press, October 2024
2. The Green Chemistry Revolution: The Way to a Sustainable Future M.S. Ali Publisher: March 2025
3. The Chemistry of Synthetic Dyes- by K. Venkataraman (Volumes I–VIII)
4. Industrial Dyes: Chemistry, Properties, Applications edited by Klaus Hunger
5. Color Chemistry by Heinrich Zollinger
6. Water Technology: An Introduction for Environmental Scientists and Engineers By N.F. Gray

7. Water and Waste water Technology By Mark J. Hammer and Mark J. Hammer
8. Waste water Engineering: Treatment and Resource Recovery By Metcalf & Eddy, George Tchobanoglous
9. Handbook of Food Additives by Thomas E. Furia
10. Food Additives (Second Edition) edited by A. Larry Branen,P. Michael Davidson, Seppo Salminen, and John H. Thorngate
11. Food Adulteration and Food Fraud by Jonathan Rees
12. Food Adulteration and Consumers by Dr. N. D. Parikh
13. Food Quality Assurance: Principles and Practices by Inteaz All

B Sc IV Semester (SEP) Question Paper Blue Print

Elective-2

Sl. No.	Topic	No. of Teaching Hours	Marks per Teaching hour, 59/26= 2.27	Part A		Part B	
				No. of questions	Marks	No. of questions	Marks
1	Green Chemistry	10	23	4	8	3	15
2	Fertilizers	6	12	1	2	2	10
3	Dyes	5	12	0	0	2	10
4	Water Technology	5	12	0	0	2	10
5	Food additives and adulterants	2	4	2	4	0	0

Part-A		Part B			
2 Marks Questions		5 Mark questions = (3 + 2) or (4 + 1) Pattern			
No. of questions set	No. of questions to answer	Marks per question = 2	No. of questions set	No. of questions to answer	Marks per question = 5
7	5	5 x 2 = 10	9	6	6 x 5 = 30

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ELECTIVE -II

COMPULSORY PRACTICALS

Sessions per week	Marks		Duration of Examination	Total Marks	Credits
	Internal Assessment	End Semester Examination			
3 Hours	**10**	**40**	**3 Hours**	**50**	**02**

List of experiments

1. Qualitative test for Carbohydrates
2. Qualitative test for proteins and lipids
3. Food Adulteration tests. i. Milk ii. Edible oil
4. Preparation of soaps and shampoo.
5. Preparation of Hand Wash and Hand sanitisers
6. Preparation of perfumes.
7. Extraction of essential oils.
8. Preparation of salol (phenyl salicylate)
9. Green synthesis of Aspirin and Acetanilide.
10. Preparation of talcum powder

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III and IV Semester (SEP) Elective question paper pattern.

2025-26 Onwards

Max marks: 40. **Duration: 1.30 Hrs.**

QP consists of **two** parts, Answer **both** the parts.

Part-A

Answer any **FIVE** of the following questions, each carries **TWO** marks. **5×2= 10**

1.
2.
3.
4.
5.
6.
7.

Part-B

Answer any **SIX** questions each carries **FIVE** marks**.** **6×5=30**

8.
9.
10.
11.
12.
13.
14.
15.
16.

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