



**GOVINDRAM SEKSARIA SCIENCE COLLEGE
(AUTONOMOUS) BELAGAVI
TILAKWADI, BELAGAVI (KARNATAKA)**

B. Sc. Chemistry Course

STRUCTURE AND SYLLABUS

**as per Revised Curriculum Framework for
Undergraduate Course**

STATE EDUCATION POLICY-2024-25

III & IV Semesters

With Effect from the Academic Year 2024-25

STATE EDUCATION POLICY-2024-25

B.Sc. Program with Optional Subject: Chemistry

**B.Sc., CHEMISTRY First and Second Semester Syllabus
as per SEP
(With effect from the academic year 2024-25 and
onwards)**

Sem	Part	Paper Code	Title of the Paper	Hours/ Week	Marks			Subject Credits
					IA	Exam	Total	
I	DSC	CHEDSCT 1.1	Chemistry -1	4	20	80	100	3
		CHEMDSCP 1.1	Practical I	4	10	40	50	2
		Total: Hours / Credits		8			150	5
II	DSC	CHEDSCT 2.1	Chemistry-2	4	20	80	100	3
		CHEMDSCP 2.1	Practical II	4	10	40	50	2
		Total: Hours / Credits		8			150	5

T: Theory, P: Practical, DSC: Discipline Specific Course. Ele- Elective,

**B.Sc., CHEMISTRY Third and Fourth Semester
Syllabus as per SEP
(With effect from the academic year 2025-26 and
onwards)**

Sem	Part	Paper Code	Title of the Paper	Hours/ Week	Marks			Subject Credits
					IA	Exam	Total	
III	DSC	CHEDSCT 3.1	Chemistry -3	4	20	80	100	3
		CHEDSCP 3.1	Practical III	4	10	40	50	2
	Ele-I	CHESKLEP 3.1	Chemistry in Daily life	3	10	40	50	2
		Total: Hours / Credits		11			200	7
IV	DSC	CHEDSCT 4.1	Chemistry-4	4	20	80	100	3
		CHEDSCP 4.1	Practical IV	4	10	40	50	2
	Ele-II	CHEMLEP 4.1	Polymers and Petrochemicals	3	10	40	50	2
	Skill-I	CHESKLP 4.1	Chemistry of Cosmetics formulation	2	10	40	50	2
		Total: Hours / Credits		15			250	9

T: Theory, P: Practical, DSC: Discipline Specific Course. Ele- Elective,

GOVINDRAM SEKSARIA SCIENCE COLLEGE (AUTONOMOUS) BELAGAVI
THIRD SEMESTER B.Sc. CHEMISTRY THEORY

Paper Title: Chemistry-3	Marks: Theory 80 + I. A. 20
Paper Code: CHEMDSCT 3.1	Total hours: 60
Teaching hours: 4 hours/ Week	Credits:03

UNIT-I. Structure of ionic/covalent molecules/ions and metallic bonding **15 Hrs**

Structures of ionic molecules: Review of ionic structures of solids, Radius ratio rules. Limitations of radius ratio. Ionic compounds of the type AX (ZnS, NaCl, CsCl), Ionic compounds of the type AX₂ (Calcium fluoride (fluorite) and Rutile structure, Layer structures CdI₂, Cadmium iodide structure.

5

hrs

Structures of covalent molecules/ions: Review of Valence shell electron pair repulsion (VSEPR) theory, Effect of lone pairs, electronegativity, isoelectronic principle, Examples using VSEPR theory: BF₃ and BF₄⁻, NH₃ and NH₄⁺, H₂O, I₃ and I₃⁺, SF₆ and IF₇. Limitations of VSEPR. **4 hrs**

Metallic Bonding:

General properties of metals: Conductivity, Lustre, Malleability and cohesive force. 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 MOT **6 Hrs**

UNIT II. Organic reaction intermediates & aromatic electrophilic substitution reaction. 15 Hrs

Reaction Intermediates: Generation, stability and reactions of,

- i) Carbocations: Dienone-phenol. ii) Carbanions: Perkin Reaction & Aldol condensation.
- iii) Free Radicals: Sandmeyer Reaction iv) Carbenes and Nitrenes: Types, Reimer Tiemann reaction & Curtius rearrangement reaction.
- v) Arynes: Formation and detection

Methods for Identifying Reaction Mechanism: Product analysis, Isolation and identification of intermediates **10 Hrs**

Aromatic Hydrocarbons: Resonance in benzene, Mechanism of electrophilic aromatic substitution—halogenation, nitration, sulphonation and Friedel-Craft's reaction (evidences for two step mechanism and evidences for formation of electrophile). **5 Hrs**

UNIT-III. THERMODYNAMICS AND SURFACE CHEMISTRY

15 hrs

Review of Basics of Thermodynamics: State of a system, state variables; Properties-Macroscopic, Extensive and intensive; Thermodynamic Processes – Isothermal, adiabatic, isobaric, isochoric, reversible and irreversible

First Law of Thermodynamics: Nature of Heat and Work, Internal Energy, First Law of Thermodynamics, State functions, Enthalpy of a System, Work done in isothermal and adiabatic expansion of an ideal gas. Problems.

Second law of Thermodynamics: Limitations of first law of thermodynamics, cyclic process, Carnot cycle, Heat engine, Carnot theorem, Concept of entropy, Statements of the Second Law of Thermodynamics, entropy change for reversible and irreversible processes. Free Energy Functions: Gibbs and Helmholtz energy (to be derived) - Condition for spontaneity of a reaction, Variation of free energy with temperature and pressure, Gibbs-Helmholtz equation (to be derived).

Third Law of Thermodynamics: Statement of third law.

11 Hrs

Surface Chemistry: Adsorption

Types of adsorption isotherms - Freundlich adsorption isotherm (only equation), its limitations. Langmuir adsorption isotherm (to be derived) and BET equation (only equation).

Catalysis Types of Catalysis, Michaelis-Menten equation (to be derived).

4 Hrs

Unit-IV. Quantitative analysis-Instrumental methods

15 Hrs

Spectrophotometry

Beer-Lambert law derivation, deviations from Beer's law, limitations, numerical problems on application of Beer's law. Construction of calibration graph (Plot of absorbance vs concentration 7 Absorbance Vs Wavelength), Calibration methods. 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, Cu, and PO_4^{3-})

10

Hrs

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-})

5 hrs

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. Day and 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 7th Ed., W. H. Freeman.
9. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002

THIRD SEMESTER B.Sc. (CHEMISTRY) PRACTICALS-3

Paper title: Chemistry-3P	Marks: Practical 40 + IA 10
Paper Code: CHEMDSCP 3.1	Total hours: 60
Teaching hours: 4 hours/ Week	Credits:02

Physical Chemistry (40 Marks)

Kinetics

1. Study of the effect of acid strength on hydrolysis of methyl acetate using HCl and H₂SO₄.
2. Determination of velocity constant of second order reaction between KI and K₂S₂O₈ and study the effect of concentration on velocity constant.

Viscosity

3. Determination of Co-efficient of Viscosity of liquid A and B.
4. Determination of Co-efficient of Viscosity of given liquids A, B, C of which C is a mixture of A and B. Further determine the percentage composition of liquid mixture c.

Surface Tension

5. Determination of surface tension of the liquids A, B, C by drop number method. Further determine the contribution to parachor by CH₂ group.

Adsorption

6. Study of Adsorption of acetic acid by activated charcoal and verification of Freundlich adsorption isotherm.

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:

1. Accuracy : 18 Marks (3 x 6)
2. Calculation and Graph : 09 Marks (5+4)
(If no graph then 9 marks for calculation)
3. Technique and presentation : 03 Marks
4. Journal and attendance : 05 Marks
5. Viva Voce : 05 Marks

Total 40 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)

GOVINDRAM SEKSARIA SCIENCE COLLEGE (AUTONOMOUS) BELAGAVI
BSC III Semester Open Elective Chemistry (OEC-1)

Paper title: Chemistry in Daily Life	Marks: Theory 40 + I. A. 10
Paper Code: CHEOEC 3.1	Total hours: 30
Teaching hours: 2 hours/ Week	Credits:02

UNIT-I: 15hrs

Dairy Products: Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Nutraceuticals, Beverages: Detection 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, and 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, Bioavailability of food dyes

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: Introduction, sources of oils and fats in India. 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, saponification, manufacture of soap by modern process. Cleaning action of soap. Manufacture of Detergents. Distinction between soap and detergents, emulsifiers, stabilizers and builders, Biodegradability and environmental impact.

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, 4th ed. New Age International (1998)

GOVINDRAM SEKSARIA SCIENCE COLLEGE (AUTONOMOUS) BELAGAVI

B. Sc. FOURTH SEMESTER CHEMISTRY THEORY

Paper Title: Chemistry 4	Marks: Theory 80 + I. A. 20
Paper Code: CHEMDSCT 04	Total hours: 60
Teaching hours: 4 hours/ Week	Credits:03

UNIT- I: Chemistry of d-block and f-block elements, chelates, environmental chemistry

15 Hrs

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. Comparison between 3d and 4d series 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.

08 Hrs

Environmental Chemistry:

Air pollution: Types of pollutants, sources and control measures- CO, CO₂, SO_x, NO_x, H₂S, 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).

Soil pollution

7 Hrs

UNIT-II Alcohols and Phenols

15 Hrs

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.

8 Hrs

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.

4 Hrs

UNIT-III: ELECTROCHEMISTRY AND CHEMICAL KINETICS

15 Hrs

Electrochemistry-I: Introduction: Factors affecting conductance. Conductance-Specific conductance, equivalent and molar conductance. Variation of molar conductance with dilution. Molar conductance at infinite dilution. Numerical problems.

Kohlrausch's law of independent migration of ions and its applications. Ionic mobility, transference numbers - determination of transference numbers using Hittorf method

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 titration (acid base titrations only) and (v) Hydrolysis constants of salts. Numerical problems.

11 hrs

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, biomolecular reactions.

4 Hrs

Unit-IV: IR Spectroscopy and Chromatography

(15 Hrs)

Infrared spectroscopy: Principle, types of vibrations, instrumentation, finger print region, sources of IR, identification of following by stretching frequencies—Alkanes, alkenes, alkynes, benzene, aldehydes, ketone, alcohol, thiols, acids, esters, amines, problems based on molecular formula and stretching frequency. FTIR: Water and ethanol. **5 Hrs**

Chromatography: Introduction, Principle, Types of chromatographic methods (Adsorption and partition chromatography), stationary and mobile phase, Paper chromatography, types of paper chromatography, Migration parameters and factors affecting it. Column chromatography, thin layer chromatography, Introduction to affinity chromatography. Applications of each. **10 Hrs**

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).
- Petrucchi, 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).

B. Sc. FOURTH SEMESTER CHEMISTRY PRACTICAL

Paper Title: Chemistry-4P	Marks: Theory 40 + I.A. 10
Paper Code: CHEMDSCP 4.1	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:

- | | |
|-------------------------------------|--------------------|
| 1. Preliminary tests + Presentation | : 8 + 2 = 10 Marks |
| 2. Positive radicals | : 2 x 6 = 12 Marks |
| 3. Negative radicals | : 2 x 4 = 8 Marks |
| 4. Journal | : 05 Marks |
| 5. 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)

GOVINDRAM SEKSARIA SCIENCE COLLEGE (AUTONOMOUS) BELAGAVI
BSC IV Semester Open Elective Chemistry (OEC-2)

Paper title: Polymers and petrochemicals Chemistry	Marks: Theory 40 + I. A. 10
Paper Code: CHEOEC-2 4.1	Total hours: 30
Teaching hours: 2 hours/ Week	Credits:02

Polymers:

UNIT-I: Introduction, Classification and polymerization **7 hrs**

Definition – Monomers and polymers, Classification of polymers: 1. Natural and synthestic 2. Thermoplastics and thermosetting polymers 3. Organic and inorganic polymers 4. Elastomers and fibers Polymerization techniques: 1. Addition polymerization 2. Condensation polymerization 3. Free radical polymerization Degree of polymerization

UNIT II: Preparation, properties and applications **8 hrs**

Physical and chemical properties of polymers. Mechanical strength, elasticity and thermal stability Factors affecting properties – chain structure, cross-linking, molecular weight

Glass transition temperature – meaning, factors affecting glass transition temperature, importance of glass transition temperature.

Preparation, properties and applications of some important polymers:

1. Polyethylene 2. Polyesters 3. Polyvinyl chloride 4. Polyvinyl alcohol 5. Polystyrene 6. Polyurethanes 7. Nylon 8. Bakelite

Petro Chemicals

UNIT-III: Classification, properties and applications of petrochemicals **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), Environmental and safety aspects of petrochemicals. Synthetic petrol.

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. Gowarikar VR, Viswanathan NV, Jayadev Sreedhar, Polymer Science, New Age International Publications.
2. Billmeyer, Text Book of Polymer Science, Wiley India
3. Stocchi, E. Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK (1990).
4. Jain, P.C. & Jain, M. Engineering Chemistry Dhanpat Rai Publishing Company, New Delhi.
5. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1998).
6. Industrial Chemistry, B.K.Sharma, 9th Edn. Krishna Prakashan Media (P) Ltd. Meerut (1997-98)

OVINDRAM SEKSARIA SCIENCE COLLEGE (AUTONOMOUS) BELAGAVI
BSC IV Semester Skill Enhancement Course (SEC-1)

Paper title: Chemistry of Cosmetics formulation	Marks: Practica 40 + I. A. 10
Paper Code: CHESKLP 4.1	Total hours: 60
Teaching hours: 4 hours/ Week	Credits:02

Chemistry of Cosmetics formulation**Practicals**

1. Preparation of Talcum Powder
2. Preparation of Herbal Shampoo using Amla and Shikakai
3. Preparation of Lip Balm using Beeswax and Natural Colors
4. Formulation of Basic Hand Sanitizer
5. Formulation of Moisturizing Cream
6. Preparation of Natural Hair Oil
7. Synthesis of Ester Fragrances (e.g., isoamyl acetate)
8. Determination of Saponification Value of Oil
9. Extraction of Essential Oil by Steam Distillation (e.g., eucalyptus or lemongrass)
10. Preparation of Herbal Shampoo using Amla