# BAGALKOT UNIVERSITY
# JAMKHANDI

## PROGRAM /COURSE STRUCTURE AND SYLLABUS
## For

## Bachelor of Science with CHEMISTRY
## I and II Semester

**w.e.f.**
**Academic Year 2024-25 and onwards**

## PROGRAM STRUCTURE

Syllabus and Credits Structure under Choice Based Credit System [CBCS] General Degree for the Three Years B.Sc. with Chemistry Undergraduate Programme with effect from 2024-25.

| SEMESTER-I | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Category** | **Course code** | **Title of the Paper** | **Marks** | | | **Teaching hours/ week** | | | **Credits** | **Duration of Exam** (Hrs) | **Teaching Department** |
| | | | **IA** | **SEE** | **Total** | **L** | **T** | **P** | | | |
| L1 | ----- | Language 1 | 20 | 80 | 100 | 4 | - | - | 3 | 3 | - |
| L2 | ----- | Language 2 | 20 | 80 | 100 | 4 | - | - | 3 | 3 | - |
| Major | 2A1CHEM01T | Chemistry-1T | 20 | 80 | 100 | 4 | - | - | 3 | 3 | Chemistry |
| | 2A1CHEM01L | Chemistry-1P Lab | 10 | 40 | 50 | - | - | 4 | 2 | 3 | Chemistry |
| Major | ---------- | Major Subject-2 | 20 | 80 | 100 | 4 | - | - | 3 | 3 | --- |
| | ---------- | Practical | 10 | 40 | 50 | - | - | 4 | 2 | 3 | --- |
| Major | ---------- | Major Subject-3 | 20 | 80 | 100 | 4 | - | - | 3 | 3 | --- |
| | ---------- | Practical | 10 | 40 | 50 | - | - | 4 | 2 | 3 | --- |
| Common | 2S1XXXC01T | Constitutional values | 10 | 40 | 50 | 2 | - | - | 2 | 2 | Constitutional Values: Political Science |
| | 2S1XXXC02T | Environmental Studies | | | | | | | | | Environmental Studies: Chemistry/ /Geography/ Botany |
| **Total Marks** | | | | | **700** | **Semester Credits** | | | **23** | | |

## PROGRAM STRUCTURE

Syllabus and Credits Structure under Choice Based Credit System [CBCS] General Degree for the Three Years B.Sc. with Chemistry Undergraduate Programme with effect from 2024-25

| SEMESTER-II | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Category** | **Course code** | **Title of the Paper** | **Marks** | | | **Teaching hours/ week** | | | **Credits** | **Duration of Exam** (Hrs) | **Teaching Department** |
| | | | **IA** | **SEE** | **Total** | **L** | **T** | **P** | | | |
| L3 | ------ | Language 3 | 20 | 80 | 100 | 4 | - | - | 3 | 3 | - |
| L4 | ------ | Language 4 | 20 | 80 | 100 | 4 | - | - | 3 | 3 | - |
| Major | 2A2CHEM02T | Chemistry-2T | 20 | 80 | 100 | 4 | - | - | 3 | 3 | Chemistry |
| | 2A2CHEM02L | Chemistry-2P Lab | 10 | 40 | 50 | - | - | 4 | 2 | 3 | Chemistry |
| Major | | Major Subject 2 | 20 | 80 | 100 | 4 | - | - | 3 | 3 | --- |
| | | Practical | 10 | 40 | 50 | - | - | 4 | 2 | 3 | --- |
| Major | | Major Subject 3 | 20 | 80 | 100 | 4 | - | - | 3 | 3 | --- |
| | | Practical | 10 | 40 | 50 | - | - | 4 | 2 | 3 | --- |
| Common | 2S1XXXC01T | Constitutional values | 10 | 40 | 50 | 2 | - | - | 2 | 2 | Constitutional Values: Political Science |
| | 2S1XXXC02T | Environmental Studies | | | | | | | | | Environmental Studies: Chemistry/ /Geography/ Botany |
| **Total Marks** | | | | | **700** | **Semester Credits** | | | **23** | | |

## 1st Semester B.Sc. Chemistry Theory

| Year | I | Course Code: : 2A1CHEM01T<br>Paper Title: Chemistry-1T | Credits | 03 |
|---|---|---|---|---|
| Sem. | 1 | | Hours | 52 |

| Internal Assessment Marks: 20 | External Assessment Marks: 80 | Duration of Exam: 03hrs. |
|---|---|---|

| Unit No. | Course content : | Hours |
|---|---|---|
| Unit I | **Atomic Structure**<br>Review of Bohr's theory and its limitations, dual behavior of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to atomic structure - Introduction to Quantum mechanics: Time independent Schrodinger equation and meaning of various terms in it (no derivation). Significance of $\psi$ and $\psi^2$. Significance of quantum numbers, orbital angular momentum and quantum numbers $m_l$and $m_s$. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number ($m_s$).<br>Rules for filling electrons in various orbitals, Electronic configurations of the atoms. | 13 Hours |
| Unit II | **Fundamentals of Organic Chemistry and Alkenes**<br>Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.<br>Alkenes: Methods of preparation of alkenes by (i) dehydration of alcohols (ii) dehydro halogenation. Saytezaff's elimination (Formation of highly substituted alkene, 2-butene), Hofmann orientation (Formation of least substituted alkene, 1-pentene).<br>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 | 13 Hours |
| Unit III | **Gaseous state and Distribution Law**<br>Gaseous state: Molecular velocity: Maxwell's Boltzmann distribution law of molecular velocities (most probable, average and root mean square velocities). Relation between RMS,<br>average and most probable velocity and average kinetic energies | 13 Hours |

| | | |
|---|---|---|
| | (derivation not required), Collision frequency, collision diameter, Collision cross-section, collision number and mean free path Critical phenomena: Andrews isotherms of CO2, critical constants and their determination Relation between critical constants and van der Waals equation (Derivation), continuity of states, law of corresponding states. Numerical problems are to be solved wherever applicable<br><br>Distribution Law: Nernst Distribution Law - Statement and its derivation. Distribution constant, factors affecting distribution constant, validity of Distribution Law, Modification of distribution law when molecules undergo a) Association b) Dissociation. Application of Distribution Law in Solvent extraction. Principles of distribution law in Parkes Process of desilverisation of lead. Numerical Problems. | |
| **Unit IV** | **Analytical chemistry**<br><br>Errors and treatment of analytical data: Limitations of analytical methods – Errors: Determinate and indeterminate errors, absolute error, relative error, minimization of errors.<br>**Titrimetric analysis:** Basic principle of titrimetric analysis. Classification of Titrimetric Analysis.<br>**Acid-base titrimetry**: Theory, Titration curves for all type of acid- base titrations. Quantitative applications – selecting and standardizing a titrant, inorganic analysis - alkalinity, acidity.<br>**Complexometric titrimetry**: Indicators for EDTA titrations - theory of metal ion indicators, titration methods employing EDTA - direct, back, displacement and indirect determinations, Application determination of hardness of water.<br>**Redox titrimetry**: Balancing redox equations, calculation of the equilibrium constant of redox reactions, titration curves, Theory of redox indicators,<br>**Precipitation titrimetry**: Titration curves, titrants and standards, indicators for precipitation titrations involving silver nitrate-Volhard's and Mohr's methods and their differences. | 13 Hours |

**Recommended Learning Resources**


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 Inorganic Chemistry*, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure 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 India Edition, 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.

| Year | I | Course Code: 2A1CHEM01L | Credits | 02 |
|---|---|---|---|---|
| Sem. | 1 | Course Title: Chemistry-1P Lab | Hours | 50 |

| Internal Assessment Marks: 10 | External Assessment Marks: 40 | Duration of Exam: 03hrs. |
|---|---|---|

| Unit No. | Course content | Hours 50 |
|---|---|---|
| | **List of Experiments**<br>1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.<br>2. Estimation of oxalic acid by titrating it with KMnO4.<br>3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO4.<br>4. Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator.<br>5. Estimation of Cu (II) ions iodometrically using Na2S2O3 (demo only).<br>6. Determination of the percentage loss in weight of<br>i) Zinc carbonate<br>ii) bariumsulphate<br>iii) ammonium chloride<br>Mixture of barium sulphate and<br>ammonium chloride | |

| Year | I | Course Code: 2A2CHEM02T<br>Course Title : Chemistry-2T | Credits | 03 |
|---|---|---|---|---|
| Sem. | II | | Hours | 52 |

| Internal Assessment Marks: 20 | External Assessment Marks: 80 | Duration of Exam: 03hrs. |
|---|---|---|

| Unit No. | Course content | Hours |
|---|---|---|
| Unit I | **Chemical bonding and molecular structure**<br>**Ionic Bonding***:* General characteristics of ionic compounds. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Born-Haber cycle and its applications.<br>**Covalent bonding:** General characteristics of covalent compounds. VB approach, shapes of some inorganic molecules and ions on the basis of hybridization with suitableexamples of linear, trigonal planar, square planar, tetrahedral,trigonal bipyramidal and octahedral arrangements.<br>**Molecular Orbital Theory:** LCAO method, bonding and antibonding MOs and their characteristics for*s-s*,*s- p*and*p-p*combinations of atomicorbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules ($H_2$ and $O_2$ or $N_2$). And heteronucler – diatomic molecules such as CO , NO and NO+ ion. Comparison of VB and MO approaches. | 13 Hours |
| Unit II | **Steriochemistry**<br>**Stereoisomersim**: Definition of stereoisomerism, conformational isomers and configurational isomers (distinction between conformation and configuration). Newman, Sawhorse and Fischer projection formulae and their interconversions.<br>**Geometrical isomerism:** Definition, reason for geometrical isomerism, E and Z notation -CIP rules and examples, determination of configuration of geometric isomers by dipole moment method and anhydride formation method, *syn* and *anti* isomers in compounds containing C=N.<br>**Optical isomerism:** Chirality/asymmetry, enantiomerism, diastereomerism and meso compounds. R and S notations (compounds with two asymmetric centers), D and L configurations and *threo* and *erythro* nomenclature, racemic mixture and racemization,<br>Resolution: Definition, Resolution of racemic mixture by: i) Mechanical separation ii) Formation of diastereomers iii) Biochemical methods. Biological significance of chirality. Problems are to be solved wherever applicable. | 13 Hours |

| | | |
|---|---|---|
| **Unit III** | **Solids and liquid state:**<br>**Solids:** Types of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography -Law of constancy of interfacial angles, Law of rational indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl. Defects in crystals, glasses and liquid crystals. Numerical problems.<br>**Liquid state:**<br>**Surface tension:** surface tension, surface energy, effect of temperature on surface tension, shapes of liquid drops and soap bubbles, capillary action, determination of surface tension by drop number methods using stalagmometer. Effect of temperature on surface tension. Parachor, Additive and constitutive properties: atomic and structural parachor. Elucidation of structure of benzene and benzoquinone.<br>**Viscosity:** Definition, viscosity coefficient, fluidity, molecular viscosity, relative viscosity and absolute viscosity, determination of coefficient of viscosity using Ostwald viscometer.<br>**Refractive index:** Definition, Specific and molar refraction.<br>Determination of refractive index using Abbe's refractometer.<br>Additive and constitutive properties: Numerical problems are to be solved wherever applicable. | 13 Hours |
| **Unit IV** | **Basics of Spectroscopy**<br>Introduction to electromagnetic spectrum, interaction of electromagnetic radiation with matter.<br><br>**Microwave Spectroscopy:** Classification of molecules, rotational spectra of rigid diatomic molecules, criteria for showing the spectra, energy levels of rigid rotator, selection rules (final equations only), determination of bond length and moment of inertia of HCl molecule.<br><br>**Vibrational spectrum:** 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 nonlinear). | 13 Hours |

| Year | I | Course Code: 2A2CHEM02L | Credits | 02 |
|---|---|---|---|---|
| Sem. | II | Course Title: Chemistry -2P Lab | Hours | 50 |

| Internal Assessment Marks: 10 | External Assessment Marks: 40 | Duration of Exam: 03hrs. |
|---|---|---|

| Unit No. | Course content | Hours 50 |
|---|---|---|

**Organic Spotting**

Identification of following organic compounds and preparation of their derivatives:

| S.L | Name of compound | S.L | Name of compound |
|---|---|---|---|
| 1 | Phthalic acid | 9 | Acetone |
| 2 | Benzoic Acid | 10 | Ethyl benzoate |
| 3 | Salicylic Acid | 11 | Benzaldehyde |
| 4 | Aniline | 12 | Acetanilide |
| 5 | *p*-Nitroaniline | 13 | Naphthalene |
| 6 | Phenol | 14 | Urea |
| 7 | 1-Naphthol | 15 | Benzamide |
| 8 | 2-Naphthol | | |

**Identification by** i) Element detection, ii) Solubility iii) Functional group, iv) Physical constant v) Preparation of derivtives and vi) melting points.

**Recommended Learning Resources**


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 IndiaEdition, 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).