



BAGALKOT UNIVERSITY

Mudhol Road, Jamkhandi-587301 Dist: Bagalkot

PROGRAM /COURSE STRUCTURE AND SYLLABUS

FOR

CHEMISTRY

as per the Choice Based Credit System (CBCS) designed in
accordance with Learning Outcomes-Based Curriculum
Framework (LOCF)

For

Bachelor of Science(CHEMISTRY)

(General Degree)

I and II Semester

w.e.f.

Academic Year 2024-25

Preamble for UG Syllabus of Bagalkot University

Bagalkot University Jamkhandi has been established by the Government of Karnataka and has started functioning from the academic year 2023-24. All the degree colleges other than engineering and medical colleges in the district of Bagalkote, are affiliated to this university as per the Karnataka State Universities Act 2000, as modified by the 26th Act of 2022. The students taking admission to any of the colleges in the district of Bagalkote, from the academic year 2023-24 will be students of Bagalkot University. The Government of Karnataka has instructed all the Universities to revise the under graduate syllabus as per the Government order no. ED 166 UNE 2023 Bengaluru Dated 08-05- 2024 from the academic year 2024-25.

Hence the Bagalkot University has revised the syllabus as suggested by its Board of Studies and approved by Academic Council and Syndicate. The subject code format for all the subjects of the new syllabus is also revised.

The subject code format is described in the following.

Subject Code Format

1	2	3	4	5	6	7	8	9	10
VER	DEGREE	SEM	DISCIPLINE			SUB. TYPE	SL. NO. FOR SUB. TYPE		TH/LAB/F
2	A	1	C	H	E	M	0	1	T
2	B	1	P	O	L	M	0	1	T

[1] The Version information gives the version of the syllabus. It can take values 1,2..9,a,b,...

[2] The UG degree codes to be provided as / The code applicable to all degrees

Sl. No	Degree Code		Degree
1	B.Sc.	A	Bachelor of Science
2	B.A	B	Bachelor of Arts
3	B.Com.	C	Bachelor of Commerce
4	BBA	D	Bachelor of Business Administration
5	BCA	E	Bachelor of Computer Applications
6	BSW	F	Bachelor of Social Work
7.	-----	S	Applicable to all degrees

[3] The Semester Information is provided as

Sl. No	Semester
1	1
2	2
3	3
....	

[4-6]The Discipline Information to be provided as

Sl No	Degree	Discipline Code
1	B.Com.	XXX
2	BCA	XXX
3	BBA	XXX
4	BSW	XXX
5	B.A	'HIS', 'POL', 'GEO', 'KAN', 'HIN' etc. The detailed list is to be provided
6	B.Sc.	'PHY', 'CHE', 'BOT', 'ELE' etc. The detailed List is to be Provided

[7] The Subject Type to be provided as

Sl. No.	TYPE	Description
1	Major	M
2	Language	L
3	Constitutional Moral Values	C
4.	Elective	E
5.	Skill / Practical based learning	S
6.	Mini Project	P
7.	Internship	I
8.	Case study/ Survey using principles of Research methodology	R

[8-9] The Running Serial Number is to be provided for a particular Subject type 01 to 99

[10] This character specifies the category of the subject namely, T=Theory, L-Practical, P-Project Work, F-Field work, Viva-V, I-Internship, Dissertation-D

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	3	-	-	3	3	-	
L2	----	Language 2	20	80	100	3	-	-	3	3	-	
Major	2A1CHEM01T	Chemistry-1T	20	80	100	3	-	-	3	3	Chemistry	
	2A1CHEM01L	Chemistry-1P	10	40	50	-	-	4	2	3	Chemistry	
Major	-----	Major Subject-2	20	80	100	3	-	-	3	3	---	
	-----	Practical	10	40	50	-	-	4	2	3	---	
Major	-----	Major Subject-3	20	80	100	3	-	-	3	3	---	
	-----	Practical	10	40	50	-	-	4	2	3	---	
Common	2S1XXXC01T	Constitutional values	10	40	50	2	-	-	2	2	Constitutional Values:	
	2S1XXXC02T	Environment Studies									Political Science	
			Total Marks			700			Semester Credits		23	

First Semester B.Sc. (Chemistry) Scheme

L1 & L2: Language

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	3	-	-	3	3	-
L4	-----	Language 4	20	80	100	3	-	-	3	3	-
Major	2A2CHEM02T	Chemistry-2T	20	80	100	3	-	-	3	3	Chemistry
	2A2CHEM02L	Chemistry-2P	10	40	50	-	-	4	2	3	Chemistry
Major		Major Subject 2	20	80	100	3	-	-	3	3	---
		Practical	10	40	50	-	-	4	2	3	---
Major		Major Subject 3	20	80	100	3	-	-	3	3	---
		Practical	10	40	50	-	-	4	2	3	---
Common	2S1XXXC01T	Constitutional values	10	40	50	2	-	-	2	2	Constitutional Values: Political Science
	2S1XXXC02T	Environment Studies									Environmental Studies: Chemistry/ /Geography/ Botany
Total Marks					700	Semester Credits			23		

First Semester B.Sc. (Chemistry) Scheme

L1 & L2: Language

1st Semester B.Sc. Chemistry Theory

Paper Title: Chemistry-1T	Marks: 80 + IA 20
Paper Code : 2A1CHEM01T	Total hours: 40
Teaching Hours: 3 Hours/Week	Credits : 03

UNIT-I: Atomic Structure

10 h

Review of Bohr's theory and its limitations, dual behaviour 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 ψ and ψ^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).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

UNIT-II: Fundamentals of Organic Chemistry and Alkenes

10 h

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) dehydro halogenation. Saytzeff'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 to 2-butene and 2-methyl- 2-butene, oxidation with KMnO_4 .

Alkynes: Acidity of Alkynes, reactions of acetylene –metal ammonia reduction, oxidation and polymerization

UNIT-III: Gaseous state and Distribution Law

10 h

Gaseous state: Review of kinetic theory of gases, van der Waals equation of state Boyle temperature. Molecular velocity: Maxwell's Boltzmann distribution law of molecular velocities (most probable, average and root mean square velocities). Relation between RMS, average and most probable velocity and average kinetic energies (derivation not required), law of equi-partition of energy. Collision frequency, collision diameter, Collision cross-section, collision number and mean free path and coefficient of viscosity, calculation of σ and η , variation of viscosity with temperature and pressure. Critical phenomena: Andrews isotherms of CO_2 , 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.

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. Derivation for simple and multiple extraction. Principles of distribution law in Parkes Process of desilverisation of lead. Numerical Problems.

Unit – 1V Analytical chemistry

10 h

Definitions of analysis, determination, measurement, techniques and methods. Classification of analytical techniques. Choice of an analytical method - accuracy, precision, sensitivity, selectivity, method validation. Figures of merit of analytical methods and limit of detection (LOD), Limit of quantification (LOQ), linear dynamic range (working range).

Errors and treatment of analytical data: Limitations of analytical methods – Errors: Determinate and indeterminate errors, absolute error, relative error, minimization of errors. Statistical treatment of finite samples -mean, median, range, standard deviation and variance. External standard calibration - regression equation (least squares method), correlation coefficient (R^2). Numerical problems

Titrimetric analysis: Basic principle of titrimetric analysis. Classification, Preparation and dilution of reagents/solutions. Normality, Molarity and Mole fraction. Use of $N_1V_1 = N_2V_2$ formula, Preparation of ppm level solutions from source materials (salts), conversion factors.

Acid-base titrimetry: Theory, Titration curves for all type of acid- base titrations. Quantitative applications – selecting and standardizing a titrant, inorganic analysis - alkalinity, acidity.

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

Redox titrimetry: Balancing redox equations, calculation of the equilibrium constant of redox reactions, titration curves, Theory of redox indicators, calculation of standard potentials using Nernst equation. Applications.

Precipitation titrimetry: Titration curves, titrants and standards, indicators for precipitation titrations involving silver nitrate- Volhard's and Mohr's methods and their differences.

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 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. & Snyder, 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.

1st Semester B.Sc. Chemistry Practicals

Paper Title: Chemistry-1P	Marks: 40 + IA 10
Paper Code : 2A1CHEM01L	Total hours: 60
Teaching Hours: 4 Hours/Week	Credits : 02

List of Experiments

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO_4 .
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4 .
4. Estimation of Fe (II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $\text{Na}_2\text{S}_2\text{O}_3$ (demo only).
6. Determination of the percentage loss in weight of
 - i) Zinc carbonate
 - ii) bariumsulphate
 - iii) ammonium chloride
 - iv) Mixture of barium sulphate and ammonium chloride

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: $\pm 0.2\text{CC}$ -25 marks, $\pm 0.4\text{CC}$ - 22 marks, $\pm 0.6\text{CC}$ -20 marks, $\pm 0.8\text{CC}$ -15 marks, $\pm 0.9\text{CC}$ -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.

2nd Semester B.Sc. Chemistry Theory

Paper Title: Chemistry-2T	Marks: 80 + IA 20
Paper Code : 2A2CHEM02T	Total hours: 40
Teaching Hours: 3 Hours/Week	Credits : 03

UNIT-I: Chemical bonding and molecular structure

10 h

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-Landé equation and calculation of lattice energy. Born-Haber cycle and its applications.

Polarizing power and polarizability: Fajan's rules, ionic character in covalent compounds and percentage of ionic character.

Covalent bonding: General characteristics of covalent compounds. 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. Concept of resonance and resonating structures of NO_3^- , CO_3^{2-} and SO_4^{2-} .

Molecular Orbital Theory: 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 (H_2 and O_2 or N_2) and heteronuclear diatomic molecules such as CO, NO and NO^+ . Comparison of VB and MO approaches.

Unit-II: Confirmation analysis and Stereochemistry

10 h

Concept of Confirmation analysis with reference to Ethane & n-Butane with staggered & eclipsed conformations & energy profile diagrams.

Stereoisomerism: Definition of stereoisomerism, conformational isomers and configurational isomers (distinction between conformation and configuration). Newman, Sawhorse and Fischer projection formulae and their interconversions.

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.

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,

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.

Unit-III: Solids State

10 h

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. Miller indices. X-Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl.

Forms of solids: Unit cell and space lattice, anisotropy of crystals, size and shape of crystals, Laws of Crystallography: Law of constancy of interfacial angles, Law of rational indices, Law of symmetry (Symmetry elements), Crystal systems, Bravais lattice types and identification of lattice planes. Miller indices and its

calculation, X-Ray diffraction by crystals: Bragg's law and derivation of Bragg's equation, Single crystal and powder diffraction methods. Defects in crystals, glasses and liquid crystals. Numerical problems.

Unit-IV: Basics of Spectroscopy

10 h

Introduction to electromagnetic spectrum, interaction of electromagnetic radiation with matter.

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.

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).

References

1. Graham Solomon, T.W., Fryhle, C.B. & Snyder, 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 India Pvt. 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).

2nd Semester B.Sc. Chemistry Practicals

Paper Title: Chemistry-2P	Marks: 40 + IA 10
Paper Code : 2A2CHEM02L	Total hours: 60
Teaching Hours: 4 Hours/Week	Credits : 02

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	<i>p</i> -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 derivatives and vi) 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. Preliminary tests and presentation	05 marks,
2. Group test based on solubility	05 marks
3. Distinguishing test and C.T	10 marks
4. Preparation of derivative	05 marks
5. Melting point of derivative	05 marks
6. Journal	05marks
7. 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., *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 Question Paper pattern

ASSESSMENT METHODS

Formative Assessment for Theory

Evaluation Scheme for Internal Assessment: Continuous Internal Assessment (CIA)

Assessment Criteria 20 marks		
1st Internal Assessment Test for 20 marks of 1 hour duration after 8 weeks and later marks should be reduced to 5	CIA : C1	5 Marks
2nd Internal Assessment Test for 40 marks 2 hours duration after 15 weeks and marks should be reduced to 10	CIA : C2	10 Marks
Assignment/ Activity	CIA : C3	05 Marks
Total		20 Marks

Summative Assessment for Theory:

SEMESTER END EXAM : SEE	C4	80 Marks
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Formative Assessment for Practical:

Assessment Criteria 10 marks		
Internal Test including basic understanding of the concept, Viva Voce, Journal. Test should be conducted for 50 marks and later it should be reduced for 10 marks	CIA : C1	10 Marks

Summative Assessment for Practical:

SEMESTER END EXAM : SEE	C2	40 Marks
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Instructions to set the question paper and question paper pattern :

Instruction to set the question paper.

1. 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.
2. Question number 2 to 7 are from unit I to IV.
Each question carries five marks. Student has to answer any four questions
3. Question number 8 to 12 are from unit I to IV.
Each question carries ten marks. Student has to answer any four questions

Question Paper pattern
First Semester B.Sc.
Degree Examination
(SEP)

Chemistry

Time: 3 hours

Max. Marks: 80

Part- A		
1.		Answer any <u>TEN</u> questions 10 x 2 = 20
	a)	
	b)	
	c)	
	d)	
	e)	
	f)	
	g)	
	h)	
	i)	
	j)	
	k)	
	l)	
		Part-B
		Answer any <u>Four</u> questions 4 x 5 = 20
	2	
	3	
	4	
	5	
	6	
	7	
		Part-C
		Answer any <u>FOUR</u> questions 4 X 10 = 40
	8	
	9	
	10	
	11	
	12	

