BAGALKOT UNIVERSITY

Mudhol Road, Jamkhandi – 587301 Dist: Bagalkote

PROGRAM /COURSE STRUCTURE AND SYLLABUS
Of
CHEMISTRY

IV Semester

BACHELOR OF SCIENCE (CHEMISTRY)

As Per NEP – 2020 and Adapted from RCU Belagavi
Applicable from the Academic Year 2024-25

SEMESTER-IV											
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA			**L**	**T**	**P**		
L7		Kannada	40	60	100	4	-	-	3	2
		Functional Kannada								
L8		English	40	60	100	4	-	-	3	2
		Hindi								
		Sanskrit								
		Arabic								
		Urdu								
DSC 4	126BSC04CHEDSC07T	Chemistry-4	40	60	100	4	-	-	4	2
	126BSC04CHEDSC08L	Chemistry Lab-4	25	25	50	-	-	4	2	4
DSC 4	Another Department Code	Another Department Course Title	40	60		4	-	-	4	2
			25	25	50	-	-	4	2	4
SEC	126COM03XXXSEC03T	Artificial Intelligence	20	30	50	1	-	2	2	2
VBC 7	126COM04XXXVBC08B	Yoga/ Sports	25	-	25	-	-	2	1	-
VBC 8	126COM03XXXVBC09B	H&W, /NCC/NSS/R&R/CA	25	-	25	-	-	2	1	-
			Total Marks		**600**	**Semester Credits**			**22**	

Semester –IV; CHEMISTRY: DSC-4: Chemistry-IV
COURSE CODE: 126BSC04CHEDSC07T

Number of Theory Credits	Number of lecture hrs/semester	Number of practical Credits	Number of practical hrs/ sem
4	56	**2**	**56**
Content of Theory Course 4			**56Hrs**

Course Objectives: Students learn about

1. Different types of bonding in molecules/compounds/ions
2. The structures of molecules/compounds/ions based on different models/theories
3. Properties of compounds based on bonding and structure
4. The fundamentals of thermodynamics including the laws, the concept of entropy and free energy functions and their applications.
5. The concepts of surface chemistry, catalysis and their applications.
6. The theoretical and experimental aspects of chemical kinetics including basic theories of reaction rates and methods of determining order.
7. Electrochemistry dealing with electrolytes in solution. Conductance measurements and applications. Concept of ionic mobility and their determination.

Course outcomes: After the completion of this course, the student would be able to

1. Predict the nature of the bond formed between different elements
2. Identify the possible type of arrangements of ions in ionic compounds
3. Write Born-Haber cycle for different ionic compounds
4. Relate different energy parameters like, lattice energy, entropy, enthalpy and solvation energy in the dissolution of ionic solids
5. Explain covalent nature in ionic compounds
6. Write the M.O. energy diagrams for simple molecules
7. Differentiate bonding in metals from their compounds
8. Learn important laws of thermodynamics and their applications to various thermodynamic systems
9. Understand adsorption processes and their mechanisms and the function and purpose of a catalyst.
10. Apply adsorption as a versatile method for waste water purification.
11. Understand the concept of rate of a chemical reaction, integrated rate equations, energy of activation and determination of order of a reaction based on experimental data
12. Know different types of electrolytes, usefulness of conductance and ionic mobility measurements
13. Determine the transport numbers

Syllabus:

Unit-I Separation methods **14hrs**

Fundamentals of chromatography: General description, definition, terms and parameters used in chromatography, classification of chromatographic methods, criteria for selection of stationary and mobile phase, nature of adsorbents. Principles of paper, thin layer, column chromatography. Column efficiency, factors affecting the column efficiency, van Deemter's equation and its modern version. **5hrs**

Paper chromatography: Theory and applications

Thin layer chromatography (TLC): Mechanism, $R_f$value, efficiency of TLC plates, development, spray reagents, identification and detection, qualitative applications **2hrs**

Solvent Extraction: Types-batch, continuous, efficiency, selectivity, distribution coefficient, factors affecting the partition, relationship between % extraction and volume fraction, Numerical problems on solvent extraction. Solvent extraction of iron and copper. **4hrs**

Ion exchange Chromatography

Resins, types with examples-cation exchange and anion exchange resins, mechanism of cation and anion exchange process and applications of ion -exchange chromatography (softening of hard water, separation of lanthanides,). **3hrs**

Unit-II Structure and Bonding-II **14hrs**

Structure and Bonding-II

Concept of resonance, resonance energy, hybridisation, types of hybridization, sp, sp^2, sp^3,dsp^2,dsp^3, d^2sp^3, sp^3d^2, with one example each, and energetics of hybridization. Bent's rule, Limitations of Valence Bond Theory. **4hrs**

Molecular Orbital theory-II:

Calculation of bond order, relationship between bond order, bond energy and bond length. Magnetic properties based on MOT. Examples of molecular orbital treatment for homonulcear diatomic molecules: He_2, Li_2, Be_2, B_2, C_2, N_2, N_2^+, and O_2^{2-} **5hrs**

Metallic Bonding:

General properties of metals: Conductivity, Lustre, Malleability and cohesive force, Crystal structures of metals and Bond lengths. Theories of bonding in metals: Free electron theory, Valence bond theory, Molecular orbital or band theory of solids. Prediction of conducting properties of conductors, insulators and semiconductors, extrinsic and intrinsic semiconductors using M.O. theory. **5hrs**

Unit III Reaction Intermediates and methods of identification **14hrs**

Reaction Intermediates: Generation, Stability and Reactions of,

i) Carbocations: Dienone-phenol; and Pinacol-Pinacolone Rearrangement.
ii) Carbanions: Perkin Reaction, Aldol condensation,
iii) Free Radicals: Sandmeyer Reaction
iv) Carbenes and Nitrenes: Singlet and Triplet states, their relative stability and reactions
v) Arynes: Formation and detection **9hrs**

Methods for Identifying Reaction Mechanism:
Product analysis, Isolation and identification of intermediates, stereochemical evidences, crossover experiments, isotopic studies, kinetic studies **5 hrs**

UNIT-IV: Kinetics and Electrochemistry **14hrs**
Chemical Kinetics-II

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

5 Hrs

Electrochemistry–I

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

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

Applications of conductance measurement: (i) degree of dissociation of weak electrolytes (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts (iv) conductometric titrations (acid base titrations only) and (v) Hydrolysis constants of salts. Numerical problems. **9hrs**

Reference Books

1. Peter Atkins & Julio De Paula, Physical Chemistry, 9th Ed., Oxford University Press(2010)
2. GWCastellan,PhysicalChemistry,4thEd.,Narosa(2004)
3. RGMortimer,PhysicalChemistry3rdEd.,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. A S Negi and S C Anand, A textbook of Physical Chemistry, New Age International Publishers.
7. BN Bajpai, Advanced Physical chemistry, S Chand and Company ltd.
8. R L Madan, Chemistry for Degree Students, Semester I, II, III and IV, S Chand and Company Ltd.
9. P L Soni, O P Dharmarha and U N Dash, Textbook of Physical Chemistry, Sultan Chand and Sons.

PRACTICALS

Credit Points: 2 Teaching Hours: 4Hrs Evaluation: CIA: 25marks
Semester End Examination: 25 marks COURSE CODE: 126BSC04CHEDSC08L

Course objective: To attain practical knowledge about:

1. Analytical skills in detecting the constituents present in unknown samples by systematically carrying out the qualitative analysis.
2. The methods of determining rates of chemical reactions.
3. Designing electrochemical cells and making measurements related to it.
4. Determination of physical characteristics of electrolytes using conductivity measurements in solution.
5. Adsorption phenomenon, mechanism and basic models to explain adsorption.
6. Simple techniques like conductometry to obtain physicochemical parameters of electrolytes.

Course outcomes: At the end of the course student would be able to

1. Understand the chemical reactions involved in the detection of cations and anions.
2. Explain basic principles involved in classification of ions into groups in semi-micro qualitative analysis of salt mixture
3. Carry out the separation of cations into groups and understand the concept of common ion effect.
4. Understand the choice of group reagents used in the analysis.
5. Analyse a simple inorganic salt mixture containing two anions and cations
6. Use instruments like conductivity meter to obtain various physicochemical parameters.
7. Apply the theory about chemical kinetics and determine the velocity constants of various reactions.
8. Learn about the reaction mechanisms.
9. Interpret the behaviour of interfaces, the phenomena of physisorption and chemisorptions and their applications in chemical and industrial processes.
10. Learn to fit experimental data with theoretical models and interpret the data

Part A- Inorganic Chemistry Practicals

Qualitative semi-microanalysis of mixtures containing 2 anions and 2 cations.
Emphasis should be given to the understanding of different reactions. The following cations and anions are suggested.

Cations: $NH4^{+}$,Pb^{2+},Bi^{3+},Cu^{2+},Al^{3+},Fe^{3+},Co^{2+},Cr^{3+},Ni^{2+},Zn^{2+},Mn^{2+},Ba^{2+},Ca^{2+}, Sr^{2+},

Mg^{2+},Na^{+}, K^{+}.

Anions: $CO3^{2-}$,Cl^{-},Br^{-},I^{-},$NO3^{-}$,,$SO4^{2-}$, S^{-2}(Sulphide)

Spot tests and flame tests to be carried out wherever possible.

Part B- Physical Chemistry Practicals

1. Determination of the enthalpy of neutralization of a strong acid with strong base.
2. Determination of velocity constant for acid catalysed hydrolysis of methylacetate.
3. Determination of equivalent conductivity of strong electrolyte and verification of DHO equation.
4. Determination of dissociation constant of weak acid by conductivity method.
5. Conductometric titration of strong acid and strong base.
6. Conductometric titration of weak acid and strong base. **Examination**

In the practical examination, a batch of maximum 15 (Fifteen) students may be made. Anyone experiment from Part-A or B 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. Part A: Distribution of Marks:**

Preliminary tests and presentation - 04 marks,

Anions (group test + C.T +ionic reactions) (1+1+1)×2=6 marks,

Cations (group test + C.T+ ionic reactions) (1+3+1)×2=10 marks,

Viva-Voce-5 marks, **Total=25 marks**.

Part B: Distribution of marks

1. Accuracy: 12 Marks
2. Technique and presentation: 03 Marks
3. Graphs and Calculations: 05 Marks
4. Viva: 05 Marks

Total 25 Marks

Deduction of marks for accuracy: Error up to 5% - 12 marks, 6 - 10% 09 marks, 11- 15% 6 marks, 16 or above 3 marks.

References

1. Vogel's Qualitative analysis, Revised by G. Svehla, Pearson education, 2002
2. J B Yadav, Advanced Physical Chemistry, Krishna Prakashan Media (P) Ltd, Meerut.
3. Khosla, B. D.; Garg, V. C. &Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co. New Delhi (2011).
4. Garland, C.W. Nibler,J.W.& Shoemaker, D.P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill:NewYork(2003).
5. Halpern, A.M. &McBane, G.C. Experimental Physical Chemistry 3rd Ed.; W.H.Freeman&Co.NewYork(2003).

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