SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

Part B

Syllabus Prescribed for Three Year UG Programme (CBCS)

Programme: B.Sc. with Chemistry

Semester 3

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
CHE(3S)T	**Chemistry 3S**	**84**

COs:

By the end of this course, the students will be able to:

1. apply concepts of volumetric and gravimetric analysis
2. use commercial method for extraction of elements and acquaintance of transition series elements
3. compare functional group chemistry through the study of methods of preparation, properties and chemical reactions with underlying mechanism.
4. select correct synthetic approach to prepare derivatives of industrially important molecules
5. solve different numerical problem of varying difficulty associated with thermodynamics, phase equilibrium and colligative properties.
6. apply the concepts from advanced mathematics to solve the derivation of different chemical formulae.

Unit	Content
Unit I	**A) Volumetric Analysis:** (a) Introduction: -Volumetric analysis, titrant, titrate, end point, equivalence point, indicator etc. Requirements of volumetric analysis. Definition of standard solution, primary standard substance. Requirements of primary standard substance. Terms to express concentrations namely- molarity, normality, molality, mole fraction and percentage. (Simple numerical expected). (b) Acid-Base titrations: - Types of acid base titrations. pH variations during acid base titration. Acid base indicators. Modern theory (Quinoniod theory) of acid base indicators. Choice of suitable indicators for different acid base titrations. (c) Redox Titrations: -General principles involved in redox titrations (redox reactions, redox potentials, oxidant, reductant, oxidation number). Brief idea about use of $KMnO_4$, $K_2Cr_2O_7$ as oxidants in acidic medium in redox titrations. Use of I_2 in iodometry and iodimetry. Redox indicators-external and internal indicators. Use of starch as an indicator. Iodometric estimation of Cu (II). **B) Gravimetric Analysis:** Definition. Theoretical principles underlying various steps involved in gravimetric analysis with reference to estimation of barium as barium sulphate. Coprecipitation and post precipitation. (Definition, types and factors affecting). **Periods: 14**
Unit II	**A) P-Block Elements-**Comparative study of 16^{th} and 17^{th} group elements with reference to electronic configuration, ionization energy and oxidation states. Oxidising properties of halogens with reference to oxidation potential. Interhalogen compounds, structure and bondings. Introduction to fluorocarbons. **B) Chemistry of elements of transition series:** Definition of transition elements. General characteristics of transition elements. Comparative study of first transition series elements (3d) with reference to following properties: (i) Electronic configuration (ii) Atomic and ionic size (iii) Ionization energy (iv) Metallic nature (v) Oxidation states (vi) Magnetic properties (vii) Color of salts (viii) Catalytic properties (ix) Complex formation behaviour. Study of 4d and 5d series elements-Electronic configuration. Comparison of 3d series elements with 4d and 5d series elements with respect to size, oxidation states, magnetic properties and color. **Periods: 14**
Unit III	**A) Aldehydes and Ketones:** Introduction, Structure of carbonyl group, acidity of α hydrogen in carbonyl compounds. Preparation of aldehydes and ketones from appropriate alcohol, dihalide, alkyne.

	Preparation of benzaldehyde from benzene (Gatterman-Koch synthesis/reaction) and toluene. Preparation of acetophenone from benzene and ethyl benzene. **Chemical Reactions:** Reaction with HCN, ROH, $NaHSO_3$, NH_2^- groups derivatives. Iodoform test, Reactions of aldehydes & /or ketones: Aldol condensations Reformatsky, Mannich, Perkin, Cannizaro's, Benzoin reaction with mechanism, Knoevenagel, Stobbe, Wittig reaction only. Clemmensen, Wolff-Kishner, MPV and $LiAlH_4$ reductions. **B) Carboxylic acids:** Structure and reactivity of carboxylic groups. Acidity of carboxylic acids, effects of substituents on acids strength. **Oxalic acid**: Preparation from ethylene glycol and cyanogen. Reactions: Reaction with ethyl alcohol, ammonia, glycerol and action of heat. **Lactic acid**: Preparation from acetaldehyde and pyruvic acid. Reactions: Reaction with ethanol, PCl_5, action of heat, oxidation and reduction. **Benzoic acid:** Preparation from toluene, benzyl alcohol, phenyl cyanide and benzamide. Reactions: Reaction with ethanol, PCl_5 and ammonia. **Salicylic acid**: Preparation by Reimer-Tiemann reaction. Reactions: Reaction with CH_3COCl, CH_3OH and C_6H_5OH. Hell- Vohlard -Zelinsky Reaction. **Periods: 14**
Unit IV	**Stereochemistry:** **A) Optical isomerism:** Isomerism, Types of isomerism, Stereoisomerism, Optical isomerism, assymetric carbon atom, Element of symmetry, chirality (up to two carbon atoms), enantiomers, diastereoisomers, meso compounds, configuration, relative and absolute configurations, DL and RS nomenclature (for up to 2 chiral carbon atoms), racemisation and resolution (by chemical method). optical isomerism in allenes and biphenyls. **B) Geometrical isomerism:** Cis-trans & E-Z nomenclature (for up to two C=C systems) with examples and applications. **C) Conformational isomerism:** Conformational isomers, Newman & Sawhorse projection formulae, conformations of ethane, n-butane and cyclohexane, their energy level diagrams. conformation of cyclic systems mono-substituted cyclohexanes. **Periods: 14**
Unit V	**A) Colligative Properties of Dilute Solutions:** Definition and examples of colligative properties. Importance and applications of colligative properties. Elevation of boiling point. Thermodynamic derivation of the relationship between elevation of boiling point and the molar mass of non-volatile solute. Cottrell's method for the determination of elevation of boiling point and hence the molar mass of solute. Depression of freezing point. Thermodynamic derivation of the relationship between depression of freezing point and the molar mass of non-volatile solute. Rast's method for the determination of molar mass of solute. Abnormal behaviour of solution. Van't Hoff's factor 'i'. Determination of degrees of association and degree of dissociation from Van't Hoff's factor. Numerical. **B) Phase rule:** Statement of Phase rule. Explanation of Phase, number of components and degrees of freedom. Application of phase rule to water and sulphur systems. Numerical. **Periods: 14**
Unit VI	**A) Thermodynamics:** First law of Thermodynamics and its limitations, Need of Second law. Carnot's heat engine, derivation of expression for the work done and efficiency of Carnot's engine. Statements of Second law of thermodynamics. Concept of Entropy, Physical significance of Entropy, Derivation of expression for the Entropy change for an ideal gas in terms of pressure, temperature and volume. Entropy change for an ideal gas for isothermal, isoberic and isochoric processes, Entropy of fusion, sublimation, vapourization, transition and its calculations. Entropy change for reversible and irreversible processes. Entropy change as a criteria for spontaneity. Numerical. **(B) Phase Equilibrium:** Raoult's Law and it's limitations. Ideal and non-ideal solution. Classification of binary solutions of completely miscible liquids (I, II and III) on the basis of Raoult's Law. Phase diagrams of Phenol-Water, Triethylamine-Water and Nicotine-Water system. Nernst distribution law and its applications to association and dissociation of solute in one of the immiscible solvents. Process of extraction. Derivation of the formula for the amounts of the solute left unextracted after nth extraction. Numerical. **Periods: 14**
***SEM:** A) Appropriate use of chemicals and glassware for determination of concentration, Applications of p-block and transition series elements	

B) Preparation of charts for organic reactions of aldehydes, ketones, and carboxylic acids, Model creation and drawings for different stereoisomers. C) Numerical associated with colligative properties and thermodynamics, Applications of laws of thermodynamics and phase equilibrium,	
COs: By the end of this module, the students will be able to: 1. Create models associated with stereochemistry 2. Use aldehydes, ketones and carboxylic acids as starting material for different commercially important molecules 3. Solve numerical problem associated with thermodynamics and colligative properties.	
**Activities:	Model creation, poster, chart preparation, memory maps, class tests, assignments, project, survey, group discussion, industrial visit, or any other innovative pedagogical method. Any two activities be conducted from above. Class tests are compulsory. Equal weightage for each activity.

Course Material/Learning Resources

Text books:

1. Text book of Inorganic Chemistry by K.N. Upadhyaya, Vikas Publishing House, Delhi.
2. A Text Book of Chemistry for third Semester of B.Sc. by AUCTA Association and DnyanPath Publication

Reference Books:

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia- S. Naginchand & Co., Delhi.
2. Inorganic Chemistry by A.K. De, Wiley East Ltd.
3. Selected Topics in Inorganic Chemistry by Malik, Tuli and Madan, S. Chand & Co.
4. Concise Inorganic Chemistry by J.D. Lee, ELBS.
5. Inorganic Chemistry by J.E. Huheey- and Kettle, Harper & Row.
6. Advanced Inorganic Chemistry, Vol-I, Satya Prakash, Madan, Tuli, Basu.
7. Organic Chemistry Vol. I, II and III by Mukharjee, Singh and Kapoor- Wiley Eastern.
8. Organic Chemistry by S.K. Ghosh.
9. Reaction Mechanism in Organic Chemistry by S.M. Mukharjee and S.P. Singh.
10. Stereochemistry and mechanism through solved problems by P.S. Kalsi.
11. Organic Chemistry by TWG Solomons, 8th edition, John Wiley
12. Organic chemistry by R. K. Bansal
13. Physical Chemistry: Walter, J. Moore, 5th edn., New Delhi.
14. Physical Chemistry: G.M. Barrow, McGraw Hill, Indian Edn.
15. Principles of Physical Chemistry: Maron and Prutton.
16. Principles of Physical Chemistry: Puri, Sharma, and Pathania.
17. Physical Chemistry: P.W. Atkins, 6th Edn.
18. Physical Chemistry: Levine
19. Practical Organic Chemistry by F.G. Mann, B.C. Saunders, Orient Longman.
20. Comparative Practical Organic Chemistry (Qualitative Analysis) by V.K. Ahluwalia and Sunita Dhingra, Orient Longman.

21. Comprehensive Practical Organic Chemistry (Preparation and Qualitative Analysis) by V.K. Ahluwalia and Renu Agrawal, Orient Longman.

22. Practical Physical Chemistry: Palit and De.

23. Practical Physical Chemistry: Yadao.

24. Practical Physical Chemistry: Khosla.

25. Advanced Practical Inorganic Chemistry by Gurdeep Raj, Goel Pulishing House, Meerut.

Weblink to Equivalent MOOC on SWAYAM if relevant:

Weblink to Equivalent Virtual Lab if relevant:

Any pertinent media (recorded lectures, YouTube, etc.) if relevant:

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Syllabus Prescribed for three Year UG/PG Programme

Programme: B.Sc. with Chemistry

Semester 3

Code of the Course/Subject	**Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity)	**(No. of Periods/Week)**
CHE(3S)PR	**Chemistry 3S**	**Total 26 per Semester**

COs: At the end of Lab/Practical course, students will be able to -
1. estimate different metals using a variety of methods.
2. skilfully prepare solution of different concentrations.
3. determine molecular weight of an organic molecule.
4. determine thermodynamic parameters associated with a physical phenomenon and state.
5. use methods of determination of partition coefficient.

*** List of Practical/Laboratory Experiments/Activities etc.**

Exercise-1 Inorganic	
1	Estimation of Ba^{2+} as $BaSO_4$.
2	Estimation of Fe^{3+} as Fe_2O_3 using china and silica crucible.
3	Estimation of Ni^{2+} as Ni-DMG using sintered glass crucible.
4	Estimation of copper (II) in commercial copper sulphate sample by iodometric titration.
5	To determine the percentage of calcium carbonate in precipitated chalk.
6	To determine volumetrically the amounts of sodium carbonate and sodium hydroxide present together in the given solution
7	Preparation of standard solution of an acid (oxalic acid) & a base (sodium bicarbonate) by weighing and calculation of concentrations in terms of strength, normality, molarity, molality, formality, % by weight, % by volume , ppm, ppb and mole fraction.
8	Preparation of standard solution of hydrochloric acid by dilution and calculation of concentrations in terms of strength, normality, molarity, molality, formality, % by weight, % by volume , ppm, ppb and mole fraction.

	Exercise II: Physical Chemistry Experiments
9	Determination of molecular weight of solute by Rast's method
10	To determine activation energy of a reaction between $K_2S_2O_8$ and KI.
11	Determination of thermodynamic values ($\Delta S°$, $\Delta H°$, and $\Delta G°$) from the dissociation of a weak acid.
12	To determine transition temperature of $MnCl_2.4H_2O$.
13	To study critical solution temperature (CST) of phenol water system.
14	To determine the partition coefficient of CH_3COOH between H_2O and CCl_4
15	To determine the partition coefficient of Benzoic acid between H_2O and toluene.

Note:

Distribution of Marks for Practical Examination

Time : 04 hours (One Day Examination)

Total Practical Marks 50, Duration of Exam 04 Hours	
Internal Practical Exam (25 Marks)	**External Practical Exam* (25 Marks)**
Attendance, Students Performance, Activity, Practical Record Book / Laboratory Manual/Journal Report : 20 Internal Viva/Assignment/Quiz/Test : 05	Experiment 1 Performance / Demonstration : 10 Experiment 2 Performance / Demonstration : 10 External Viva (by External and Internal Examiner: 05
Total : 25	**Total : 25**

*Note: One practical from respective exercise