JAI HIND COLLEGE
BASANTSING INSTITUTE OF SCIENCE
&
J.T.LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)

"A" Road, Churchgate, Mumbai - 400 020, India.

Affiliated to
University of Mumbai

Program : B.Sc.

Proposed Course for : F.Y. B.Sc. Chemistry

Credit Based Semester and Grading System (CBCS) with effect from the academic year 2019-20

F.Y. B.Sc. Chemistry Syllabus

Academic year 2018-2019

Semester II			
Course Code	**Course Title**	**Credits**	**Lectures /Week**
SCHE201	Concepts of Physical and Inorganic Chemistry - II	2	3
SCHE202	Concepts of Organic and Co-ordination Chemistry-II	2	3
SCHE2PR	Practical Course work in Chemistry - II	2	6

Semester II – Theory

Course: SCHE201	**Concepts of Physical and Inorganic Chemistry - II (Credits: 2 Lectures/Week: 3)** **<u>Course description:</u>** **States of Matter, Ionic Equilibria, Chemical Bonding and Molecular Structure**	
	Objectives: ➢ To understand the theoretical principles of the states of matter, their properties and various applications ➢ To understand the concept of ionic equilibria, pH, theory of ionic products, theory of acids and bases, theory of indicators, solubility product & their practical applications ➢ To understand the importance of the Periodic Table of elements, historical perspective, and role in organization of chemical information ➢ To create and label models of atoms, writing and balancing of chemical equations	
Unit I	**Unit – I: States of matter** **a) Gaseous state** i. Ideal gas behaviour and kinetic theory of gases (only postulates) ii. Distribution of molecular speed (Maxwell Boltzmann's plot) iii. Real gases: Compressibility factor, Boyle's temperature, van der Waal's equation of state iv. Liquefaction of gases (Numerical expected) **b) Liquid state** i. Introduction ii. Liquid-vapour equilibrium (vapour pressure) iii. Surface tension: determination using stalagmometer, effect of temperature on surface tension, parachor and its applications iv. Viscosity : measurement using Ostwald's viscometer , effect of temperature on viscosity v. Refractive index: molar refraction and polarizability, determination using Abbe's refractometer vi. Liquid crystals :Introduction, classification and applications (Numerical expected)	**15L**
Unit II	**Unit – II: Ionic Equilibria** **a) Strong, moderate and weak electrolytes:** i. Ionization constant and ionic product of water ii. pH scale iii. Common ion effect iv. Dissociation constant of mono-, di- and tri-protic acid v. Buffer solution, buffer capacity and buffer action vi. Henderson's equation for acidic and basic buffer vii. Applications of buffer in biochemical processes	**15L**

	b) Hydrolysis of salts i. Hydrolysis constant, degree of hydrolysis **c) Theory of acid-base indicators** Action of phenolphthalein and methyl orange **d) Solubility and solubility product of sparingly soluble salts** i. Applications of principles of solubility product **e) Ionic equilibria involving complex ions** (Numerical expected)	
Unit III	**Unit III: Chemical Bonding and Molecular Structure** **a) Chemical bond** i. Introduction ii. Octet rule **a) Ionic Bonding** i. General characteristics of ionic bonding ii. Polarizing power and polarizability iii. Fajan's rules, ionic character in covalent compounds, iv. Bond moment, dipole moment and percentage ionic character **c) Covalent bonding** i. 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. ii. Concept of resonance and resonating structures in various inorganic and organic compounds	**15L**

References:

<u>Unit 1 & 2</u>

1. Barrow, G.M., *Physical Chemistry*, (6th Edition), Tata McGraw Hill Publishing Co. Ltd. New Delhi
2. Levine, I. N., *Physical Chemistry, (*6th Ed. 2010), Tata McGraw Hill
3. Puri, B. R., Sharma, L.R., Pamania, M.S., *Physical Chemistry*, (45th Ed.), Vishal Publish Co.
4. Glasston& Lewis, *Principles of Physical Chemistry*
5. Atkins P. W., and Paula J. De, *Physical Chemistry*, 10th ed., Oxford University, 12 press (2014)5.
6. Kapoor, K.L. *Textbook of Physical Chemistry*, (2006) McMillan Publishers
7. K. J. Laidler, *Chemical Kinetics* 3rd Ed., Pearson Education

Unit 3

1. Lee, J.D. *Concise Inorganic Chemistry*, (1991), ELBS
2. Douglas, B.E. and McDaniel, D.H., (1970), *Concepts & Models of Inorganic Chemistry*
3. Prakash,S., Tuli, G.D., Basu, S.K., Madan, R.D., *Advanced Inorganic Chemistry*, Volume I
4. Day, M.C. and Selbin, J., (1962), *Theoretical Inorganic Chemistry*, ACS Publications
5. James E. Huheey, *Inorganic Chemistry*, (1983), Harper & Row Publishers, Asia
6. Shriver, D.F., P.W. Atkins, C. H. Langford, 3rd edition, *Inorganic Chemistry*, Oxford University Press
7. Bahl, Tuli and Anand, *Advanced Inorganic Chemistry*, Volume I and II
8. Manas Chanda, *Atomic structure and chemical bond: Including Molecular spectroscopy*, (1972), McGraw-Hill Inc, US

Course: SCHE202	**Concepts of Organic and Coordination Chemistry-II (Credits: 2 Lectures/Week: 3)** **<u>Course description:</u>** **Reactive Intermediates, Aromaticity, Orientation effect in electrophilic aromatic substitution, Basic concepts of Coordination Chemistry and compounds of transition metal elements**	
	Objectives: ➢ To list different reactive intermediates and compare their relative stabilities ➢ To define the parameters required for aromaticity ➢ To correlate the orienting influence of a group in electrophilic aromatic substitution with electron density ➢ To list the methods of preparation and reactions of unsaturated aliphatic hydrocarbons and oxygenated derivatives of aliphatic and aromatic systems ➢ To discuss the chemistry of formation of transition metal compounds; an introduction to coordination chemistry and to understand the salient features of coordination compounds **Learning outcomes** ➢ To recollect the names of reactive intermediates ➢ To analyse the stability of a given reactive intermediate ➢ To identify an aromatic compound by applying the required parameters ➢ To predict the products of electrophilic aromatic substitution based on orienting influence of a group ➢ To recount the methods of preparation and reactions of alkanes and its oxygenated derivatives	
Unit I	**Unit – I: ReactiveIntermediates & reactivity of aromatic compounds** **1. General Organic Chemistry – II** **a) Reactive Intermediates: structure shape & relative stability** i. Carbocations ii. Carbanions iii. Free radicals iv. Carbenes **b) Reactivity of organic molecules** i. Nucleophilicity& basicity ii. Electrophilicity& Acidity **c) Reactions involving Intermediates** i. <u>Carbocations</u>- Acid catalysed hydration of alkenes, Friedel-Crafts alkylation reaction ii. <u>Carbanions</u>- homologation of terminal alkynes; iii. <u>Free radical</u>- Halogenation of alkane, selectivity rules (Mechanism expected) **2. Chemistry of Aromatic Compounds- I** **a) Aromaticity**	**15L**

	i. Conditions of aromaticity ii. Huckel's Rule iii. Aromaticity of arenes & arenium ions **b) Electrophilic Aromatic Substitution** i. ESR- nitration, sulphonation, halogenation (w.r.t. reagents & reaction conditions) ii. Activating, deactivating groups iii. Orientation effect (mono & disubstituted) based on electron density	
Unit II	**Unit – II: Unsaturated aliphatic hydrocarbons & compounds containing oxygen- I** **1. Chemistry of unsaturated aliphatic hydrocarbons** **a) Alkenes** i. Preparation- dehydration of alcohols & dehydrohalogenation of alkyl halides (Saytzeff rule) **ii.** Reactions: addition of $KMnO_4$ and Br_2 (test for unsaturation); addition of HX (Markownikoff's& anti-Markownikoff's addition), hydration, ozonolysis. **b) Alkynes** i. Preparation- Dehydrohalogenation of vicinal dihalides, reaction of metal acetylides with primary alkyl halides, acetylene from CaC_2 (applications in fruit ripening) ii. Reactions: hydration, addition of bromine & alkaline $KMnO_4$, ozonolysis & oxidation. **2. Chemistry of alcohols & ethers** **a) Alcohols** i. Preparation- Industrial preparation (fermentation), using Grignard reagent, using hydride reducing agents ii. Reactions- with sodium, HX (Lucas test), esterification, oxidation **b) Ethers** i. Preparation- Williamson's synthesis ii. Reactions- cleavage of ethers with HI iii. Uses- ethers as solvents (THF, diethyl ether) in organic synthesis	**15L**
Unit III	**Unit III: Comparative chemistry of p-block & transition elements; Co-ordination chemistry** **1. Comparative chemistry of p-block elements** i. Trends in periodic properties ii. Inert pair effect iii. Catenation iv. Allotropy v. Uses and applications	**15L**

2. Chemistry of Transition Elements (3d series)

i. General group trends with special reference to electronic configuration
ii. Variable valency & Colour
iii. Magnetic and Catalytic property
iv. Ability to form complexes and Stability of various oxidation states (Latimer diagrams) for Mn, Fe &Cu

3. Coordination Chemistry

a) Introduction & nomenclature

i. Basic terms
ii. Nomenclature of Coordination compounds
iii. Types of ligands
iv. Evidence for the formation of coordination compounds
v. Isomerism (Structural and stereo isomerism)

b) Werner theory and EAN rule

References:

Unit 1 & 2

1. Morrison, R. T.; Boyd, R. N. (2012). *Organic Chemistry*. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. (2012). *Organic Chemistry (Volume 1)*. Dorling Kindersley (India) Pvt. Ltd. (PearsonEducation).
3. Solomons, T.W.G. (2009).*Organic Chemistry*. John Wiley & Sons, Inc.
4. Ahluwalia, V.K.; Parashar, R.K. (2006) *Organic Reaction Mechanisms*.Narosa Publishing House.
5. Mukherji; Singh; Kapoor. (2002) *Reaction Mechanisms in Organic Chemistry*, McMillan

Unit 3

1. Banerjea, D., 1993, *Coordination chemistry*, Tata McGraw Hill, New Delhi
2. Shriver, D. F and Atkins, P. W. , 1999, *Inorganic chemistry*, 3rd Ed., Oxford University Press
3. W. L. Jolly, 1993, *Modern inorganic chemistry*, McGraw Hill Book Co.
4. Douglas, B. E. and McDaniel, H. , *Concepts and models in inorganic chemistry*, 1994,3rd Ed., John Wiley & Sons, Inc., New York
5. Huheey, J.E., 1993,*Inorganic Chemistry*, Prentice Hall
6. Lee, J.D., 1993, *Concise Inorganic Chemistry*, ELBS
7. Shriver & Atkins,(1994) *Inorganic Chemistry*, Third Edition, Oxford Press.

Semester II – Practical

Course: SCHE2PR	**Practical Course work in Chemistry-II (Credits: 2 Practicals/Week: 2)** **Course description:** **Viscosity, Surface tension, Ionic Equilibria, Indicators, Gravimetric Analysis, Preparation of Inorganic Complexes, Basics of Identification of Organic Compounds, One-Step Synthesis, Chromatography**

Learning Objectives:

- To develop the skill of observation, understanding and analysis of data
- To apply the concept of indicators in determining the pH and strengths of solutions
- To perform the quantitative preparation of coordination complexes with different types of ligands
- To apply the concept of gravimetric analysis in determining the percentage purity of a sample
- To perform preliminary investigations including solubility profile and element detection of mono-functional organic compounds
- To develop the skills for one-step synthesis of organic compounds

PRACTICAL – I

A. Viscosity

To determine the viscosity of aqueous solutions at room temperature using Ostwald's Viscometer:

i. Ethylene Glycol
ii. Glycerine

B. Surface tension

To determine the surface tension of a given liquid using stalagmometer

C. Ionic Equilibria

i. To determine the pH of various concentrations of sodium acetate and acetic acid buffer solutions

ii. Estimation of the amount of sodium carbonate and sodium hydrogen carbonate present in a mixture

PRACTICAL – II

A. Gravimetric analysis

a) To determine the percentage purity of a sample of barium sulphate, containing ammonium chloride as impurity.

b) To estimate the amount of sodium carbonate & bicarbonate in a mixture gravimetrically.

B. Preparation of inorganic complexes (any two)

a) Tetraamine copper (II) sulphate
b) Bis(dimethylglyoximato)nickel (II)
c) Potassium trioxalato ferrate(II)

PRACTICAL – III

A. Basics of Identification of Organic compounds-II

- **a)** To determine the solubility profile and elements (N, S, X) present in a given organic compound.
- **b)** Determination of functional group & physical constant.

B. One-step synthesis

- **a)** Comparative analysis of the procedure of nitration reaction on different substrates:
  - i. Nitration of nitrobenzene
  - ii. Nitration of acetanilide
- **b)** Recrystallization of product formed (not quantitative) Confirmation of purity by melting point

Evaluation Scheme

A. Evaluation scheme for Theory courses

I. Continuous Assessment (C.A.) - 40 Marks

(i) C.A.-I : Test – 20 Marks of 40 mins. duration

(ii) C.A.-II : Worksheets (Best 3 of 5) for 20 marks

II. Semester End Examination (SEE)- 60 Marks

B. Evaluation scheme for Practical courses

I. Internal Assessment - 40 Marks: Journal/Viva/Experiment Scheme

II. Semester End Examination (SEE)- 60 Marks