The Kelkar Education Trust's
Vinayak Ganesh Vaze College of Arts, Science & Commerce
AUTONOMOUS
Mithagar Road, Mulund East, Mumbai-400081, India
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Syllabus for F.Y. B. Sc. Programme

Chemistry

Syllabus as per Choice Based Credit System

(June 2020 Onwards)

Submitted by

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Vinayak Ganesh Vaze College of Arts, Science & Commerce

(AUTONOMOUS)

❖ Syllabus as per Choice Based Credit System

1. Name of the Programme	**F. Y. B. Sc. Chemistry : CBCS**	
The F. Y. B. Sc. course in Chemistry is a one Year Full Time Course consisting of two semesters, to be known as Semester I and Semester II. Each semester consists of TWO core courses and practicals.		
2. Course Code	SCH101	SCH201
	SCH102	SCH202
3. Course Title	General Chemistry : Paper - I	
	General Chemistry : Paper - II	
4. Semester wise Course Contents	Copy of the detailed syllabus Enclosed	
5. References and additional references	Enclosed in the Syllabus	
6. No. of Credits per Semester	06	
7. No. of lectures per Unit	15	
8. No. of lectures per week	06	
9. No. of Tutorials per week	--	
10. Scheme of Examination	Semester End Exam: **60 marks** (4 Questions of 15 marks each)	
	Internal Assessment : **40 marks**	
	Class Test : 15 marks	
	Project/ Assignment : 15 marks	
	Class Participation : 10 marks	
11. Special notes, if any	No	
12. Eligibility, if any	As laid down in the College Admission brochure / website	
13. Fee Structure	As per College Fee Structure specifications	
14. Special Ordinances / Resolutions, if any	No	

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Programme Structure and Course Credit Scheme :

Programme : F. Y. B. Sc.	**Semester: I**	**Credits**	**Semester: II**	**Credits**
Course 1 : General Chemistry	**Course Code** SCH301	2.0	**Course Code** SCH401	2.0
Course 2 : General Chemistry	**Course Code** SCH302	2.0	**Course Code** SCH402	2.0
Course 3 : Chemistry Practical	**Course Code** SCHP1	2.0	**Course Code** SCHP2	2.0

❖ Semester-wise Details of Chemistry Course

Semester - I									
Teaching Scheme (Hrs/Week)				**Continuous Internal Assessment (CIA) 40 marks**			**End Semester Examination Marks**		**Total**
Course	**L**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**	**Theory**	**Practical**	
Course 1	03	03	2.0	15	15	10	60	--	100
Course 2	03	03	2.0	15	15	10	60	--	100
Course 3, Pracs.	--	--	2.0	--	--	--	--		100
Total credits of the course = 04 + 02 **= 06**									
Max. Time, End Semester Exam (Theory) : 2 .00 Hrs.									

Semester - II

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks			End Semester Examination Marks		Total
Course	**L**	**P**	**C**	**CIA-1**	**CIA-2**	**CIA-3**	**Theory**	**Practical**	
Course 1	03	03	2.0	15	15	10	60	--	100
Course 2	03	03	2.0	15	15	10	60	--	100
Course 3, Pracs.	--	--	2.0	--	--	--	--	100	100
Total credits of the course = 04 + 02 = **06**									
Max. Time, End Semester Exam (Theory) : 2 .00 Hrs.									

- L - Lectures
- T - Tutorials
- P - Practical
- C - Credits

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Course Objectives

1. To infuse in the learner a spirit of inquiry into the fundamental aspects of the various core areas of Chemistry.
2. To make the learner capable of solving problems in the various units of this course.
3. To impart various skills of handling chemicals, reagents, apparatus, instruments and the care and safety aspects involved in such handling.

Course Content - Semester I

Course Code	Unit	Topics	Credits	L/Week
SCH101	I	Chemical Thermodynamics, Stoichiometry - I	02	01
	II	Atomic Structure Periodic Table and Periodicity		01
	III	Basics of Organic Chemistry		01
SCH102	I	Chemical Kinetics, Liquid State	02	01
	II	Comparative Chemistry of Main group Elements.		01
	III	Stereochemistry - I		01
SCHP1		Chemistry Practical - I	02	06

F. Y. B. Sc. CHEMISTRY : Choice Based Credit System			
Semester I			
PAPER : I			
Course Name: General Chemistry (45 lectures)		**Course Code SCH101**	
Periods per week (1 period 50 minutes)		**03**	
Credits		**02**	
Evaluation System		**Hours**	**Marks**
	Theory Examination	2.0	60
	Theory Internal		40

		No. of lectures
Unit I	**1.1 <u>Chemical Thermodynamics</u>** **1.1.1** Thermodynamic terms: System, surrounding, boundaries, open, closed and isolated system, intensive and extensive properties, state functions and path functions, zeroth law of thermodynamics **1.1.2** First law of thermodynamics: Concept of heat (q), work (w), internal energy (U), statement of first law, enthalpy, relation between heat capacities, sign conventions, calculations of heat (q), work (w), internal energy (U), and enthalpy (H) (Numericals expected) **1.1.3** Thermochemistry: Heats of reactions, standard states, enthalpy of formation of molecules, enthalpy of combustion and it applications, calculation of Bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equation (Numericals expected) **1.2 <u>Stoichiometry - I</u>** **1.2.1** Mole concept and Avogadro's constant. **1.2.2** Expressing concentration of solutions: Normality, molality, molarity, formality, mole fractions, weight ratio, volume ratio, weight to volume ratio, ppm, ppb, millimoles, milliequivalents (Numericals expected)	**10** **05**
Unit II	**2.1 Atomic structure:** **2.1.1** Historical perspectives of the atomic structure: Rutherford's atomic model, Limitations of Rutherford's atomic model, Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Structure of hydrogen atom. (No derivations of the mathematical equations are required. **2.1.2 Hydrogenic atoms:** 1. Simple principles quantum mechanics: 2. Atomic orbitals i) Hydrogenic energy levels. ii) Shells, subshells and orbitals iii) Electron spin iv) Radial shapes of orbitals v) Radial distribution function vi) Angular shapes of orbitals.	**10**

	3. Many Electron Atoms i) Penetration and shielding ii) Effective nuclear charge 4. Aufbau Principle 5. Hund's rule of maximum multiplicity 6. Pauli's exclusion principles. **2.2 Periodic Table and periodicity** **2.2.1** Long form of the periodic table: Classification of elements as main group, transition and inner transition elements; **2.2.2** Periodicity in the following properties: Atomic and ionic size: electron gain enthalpy: ionization enthalpy, effective nuclear charge (Slater's rule); **2.2.3** Electronegativity: Pauling, Mulliken and Alfred Rochow electronegativities (Numerical problems expected)	**05**
Unit III	**Basics of Organic Chemistry** **3.1 Classification and Nomenclature of Organic Compounds:** **3.1.1** Recapitulation of basic rules of IUPAC nomenclature. **3.1.2** Nomenclature of mono and bi-functional aliphatic compounds on the basis of priority order of the following classes of compounds: alkanes, alkenes, alkynes, haloalkanes, alcohols, ethers, aldehydes, ketones, carboxylic acids, carboxylic acid derivatives (acid halides, esters, anhydrides, amides), nitro compounds, nitriles and amines; including their cyclic analogues. **3.2 Bonding and Structure of organic compounds:** **3.2.1** Hybridization: sp^3, sp^2, sp hybridization of carbon and nitrogen; sp^3 and sp^2 hybridizations of oxygen in Organic compounds. **3.2.2** Overlap of atomic orbitals: Overlaps of atomic orbitals to form sigma and pi bonds, shapes of organic molecules. **3.2.3** Influence of hybridization on bond properties **3.3 Fundamentals of organic reaction mechanism:** **3.3.1** Electronic Effects: Inductive, electromeric, resonance and Mesomeric effects; Dipole moment; hydrogen bonding and their applications. **3.3.2** Organic acids and bases and the factors affecting their relative strengths. **3.3.3** Bond fission: Homolytic and Heterolytic fission with suitable examples.; Electrophiles and Nucleophiles; electrophilicity and acidity; Nucleophilicity and basicity; **3.3.4** Intermediates: Carbocations, Carbanions and Free radicals. structure and factors affecting stability	**03** **03** **06**

	3.4 Classification of organic reactions based on mechanism: **3.4.1** Polar & Non-polar mechanism; use of curved arrows in depicting Mechanism. **3.4.2** Polar Mechanism: Electrophilic addition; nucleophilic addition; electrophilic substitution; nucleophilic substitution (one example of each type, no Mechanism) **3.4.3** Non polar mechanism: Free radical addition to alkenes; free radical substitution (one example of each type, no Mechanism) **3.4.4** Elimination; Redox; Concerted /Pericyclic (one example of each type, no Mechanism)	**03**

Learning Outcomes:

On studying the syllabi ,the learner will be able to

- Define the terms system, surroundings, open system, closed system, isolated system ,internal energy, enthalpy
- Distinguish between state function and path function
- State the zeroth law and first law of thermodynamics
- Formulate the relationship between internal energy and enthalpy
- Elaborate the concept of thermochemistry and discuss its applications
- Explain the concept of bond enthalpy , bond dissociation enthalpy and resonance energy
- Solve numericals based on Kirchoff's equation, bond enthalpies and heat of reaction.
- Outline the importance of mole concept and Avogadro's constant
- Explain the different units of concentration of the solution and solve numericals based on these units.
- Recall J.J. Thomson's atomic model.
- Describe Rutherford's atomic model and Bohr's atomic model.
- Illustrate all the quantum numbers and outline the shapes of orbitals.
- Explain hydrogenic atoms and system of many electron atoms.
- Recollect Doberniers law of triads and Newlands law of octaves.
- Illustrate Mendeleev's periodic table and Mosley's periodic table.
- Define Ionization potential, Electronegativity and electron affinity.
- Discuss electronegativity on Pauling scale.
- Draw the structures of organic compounds
- Identify the functional groups in organic compounds
- Write the IUPAC name of a given organic compound
- Predict the hybridization of different atoms in given organic compound
- Explain the effect of inductive and resonance effects on the properties of organic compounds
- Distinguish between heterolytic and homolytic fission
- Distinguish between polar and non polar reactions
- Identify intermediates and the factors which stabilise them
- Classify the reactions based on the mechanism

Reference Books :

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press (2014).
2. Ball D.W., Physical Chemistry, Thomson Press, India (2007).
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa (2004).
4. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
5. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson (2013).
6. Peter A. and Paula J. de., Physical Chemistry, 10th Ed., Oxford University Press (2014).
7. McQuarrie D.A. and Simon J.D., Molecular Thermodynamics, Viva Books Pvt. Ltd., New Delhi (2004).
8. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill (2010).
9. Metz C.R., 2000 Solved Problems in Chemistry, Schaum Series (2006).
10. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP (2009).
11. Banwell C.N., Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill (1994).
12. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan(2000).
13. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
14. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970
15. Atkins, P.W. & Paula, J. Physical Chemistry, 10^{th} Ed., Oxford University Press, 2014.
16. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
17. Rodger, G.E. Inorganic and Solid-State Chemistry, Cengage Learning India Edition, 2002.
18. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
19. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd.(Pearson Education).
20. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
21. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London,1994.
22. Kalsi, P.S.StereochemistryConformationandMechanism,NewAgeInternational, 2005.
23. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7^{th} Ed. Cengage Learning India Edition, 2013.

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F. Y. B. Sc. CHEMISTRY : Choice Based Credit System			
Semester I			
PAPER : II			
Course Name: General Chemistry (45 lectures)		**Course Code SCH102**	
Periods per week (1 period 50 minutes)		**03**	
Credits		**02**	
Evaluation System		**Hours**	**Marks**
	Theory Examination	2.0	60
	Theory Internal		40

		No. of lectures
Unit I	**1.1 Chemical Kinetics** **1.1.1** Rate of reaction, rate constant, measurement of reaction rates, order and molecularity of reaction, integrated rate equation of first and second order reactions (with equal initial concentration of reactants) (Numericals expected). **1.1.2** Determination of order of reaction by (a) Integration method (b) Graphical method (c) Ostwald's isolation method (d) Half time method (Numericals expected) **1.2 Liquid State** **1.2.1 Surface tension:** Introduction, methods of determination of surface tension by drop number method (Numericals expected). **1.2.2 Viscosity:** Introduction, coefficient of viscosity, relative viscosity, specific viscosity, reduced viscosity, determination of viscosity by Ostwald viscometer (Numericals expected). **1.2.3 Refractive index:** Introduction, molar refraction and polarizability, determination of refractive index by Abbe's refractometer (Numericals expected). **1.2.4 Liquid crystals:** Introduction, classification and structure of thermotropic phases (Nematic, smectic and cholesteric phases), applications of liquid crystals. Concept of optical activity and specific rotation	**08** **07**
Unit II	**2.1 Comparative Chemistry of Main Group Elements.** **2.1.1** Metallic and nonmetallic nature, oxidation states, electro negativity, anomalous behaviour of second period elements, allotropy, catenation diagonal relationship. **2.1.2** Comparative study of carbides, nitrides, oxides and hydrides of Group I and II elements. Some important compounds, $NaHCO_3$. Na_2CO_3, NaCl, NaOH, CaO, CaCO **2.2.** Study of Oxides and Oxy acids Of C, N ,S With Respect To Environmental aspects.	**15**

Unit III	**Stereochemistry I** **3.1** Different types of isomerism: position ,chain; functional group; stereoisomer; optical isomers; geometrical isomers. **3.2 Fischer Projection**, Newman and Sawhorse Projection formulae and their interconversions. **3.3 Optical Isomerism**: Asymmetric carbon; Optical Activity, Specific Rotation, Chirality /Asymmetry, stereogenic centre ; Enantiomers, Molecules with two similar and dissimilar chiral-centres, Distereoisomers, meso structures, racemic mixture and resolution (methods of resolution not expected). Relative and absolute configuration: D/L and R/S designations. **3.4 Geometrical isomerism** in alkene and cycloalkanes: cis–trans and syn-anti isomerism E/Z notations with C.I.P rules. **3.5** Conformation analysis of alkanes (ethane, propane and n-butane); Relative stability with energy diagrams.	**15**

Learning Outcomes:

At the end of this module, the learner should be able to

- Distinguish between order and molecularity of the reaction
- Derive first and second order integrated rate equation
- Evaluate surface tension and viscosity of given liquids by the methods given
- Classify liquid systems and write their uses.
- Correlate chemical properties of elements with their periodic properties.
- Discuss environmental implication, health hazards due to oxides of carbon, nitrogen and sulphur and the control measures.
- Recognize and draw constitutional isomers, stereoisomers, including enantiomers and diasteromers, racemic mixture and meso compounds
- Define stereosiomers and classify isomers
- Interconvert molecules from Fischer to Sawhorse to Newman projection
- Determine configurations of simple chiral molecules
- Distinguish between conformations and configuration
- Draw the different conformations of ethane, propane and butane and compare their stability

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Reference Books :

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press(2014).
2. Ball D.W., Physical Chemistry, Thomson Press, India(2007).
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa(2004).
4. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP(2009).
5. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson(2013).
6. Peter A. and Paula J. de., Physical Chemistry, 10th Ed., Oxford University Press (2014).
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8. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill(2010).
9. Metz C.R., 2000 Solved Problems in Chemistry, Schaum Series(2006).
10. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP(2009).
11. Banwell C.N., Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill (1994).
12. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan (2000).
13. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
14. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970
15. Atkins, P.W. & Paula, J. Physical Chemistry, 10^{th} Ed., Oxford University Press, 2014.
16. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
17. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.
18. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
19. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
20. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (PearsonEducation).
21. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London,1994.
22. Kalsi, P. S. Stereochemistry Conformation and Mechanism, NewAgeInternational, 2005.
23. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7^{th} Ed. Cengage Learning India Edition, 2013.

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PRACTICALS

SEMESTER : I

Paper- I &II

COURSE CODE: SCHP1 **CREDITS: 02**

Orientation of students to Laboratory Safety Practices

Unit I: Physical Chemistry

1. To prepare 0.1 N succinic acid and standardize the NaOH of two different concentrations.
2. To determine the rate constant for the hydrolysis of ester using HCl as catalyst.
3. To determine enthalpy of dissolution of salt (like KNO_3)

Unit II: Inorganic Chemistry

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1. **Commercial analysis of (any two)**
   a) Mineral acid
   b) Organic acid
   c) Salt of weak acid and strong base.

2. Titration using double indicator:
   Analysis of solution of Na_2CO_3 and $NaHCO_3$

3. Gravimetric analysis
   a) To determine the percent purity of sample of $BaSO_4$ containing NH_4Cl
   b) To determine the percent purity of ZnO containing $ZnCO_3$.

Unit III: Organic Chemistry

1. Purification of any two organic compounds by recrystallization selecting suitable solvent. **(Provide 1 g.)**
   Learners are expected to report
   a) Solvent for recrystallization.
   b) Mass and the melting points of purified compound.

   (Learners should calibrate thermometer before determining melting point.)

2. Chromatography (Anyone)
   a) Separation of a mixture of two sugars by ascending paper chromatography
   b) Separation of a mixture of o- and p-nitrophenols by using thin layer chromatography (TLC)

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Reference Books :

Unit I: Physical Chemistry

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi(2011).
2. Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3. Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rdEd. W.H. Freeman and Co., New York (2003).
4. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001).

Unit II: Inorganic Chemistry

1. Mendham, J., A. I. Vogel's *Quantitative Chemical Analysis* 6^{th}*Ed.*, Pearson, 2009.

Unit III: Organic Chemistry

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education(2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5^{th} Ed., Pearson(2012)
3. 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

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F. Y. B. Sc. CHEMISTRY : Choice Based Credit System (CBCS)

SEMESTER : II

Course content - Semester II

Course Code	Unit	Topics	Credits	L/Week
SCH201	I	• Gaseous State • Chemical Equilibria and Thermodynamic Parameters	02	01
	II	• Concept of Qualitative Analysis: • Acid Base Theories:		01
	III	• Alkanes, Alkenes, Alkynes		01
SCH202	I	• Ionic Equilibria • Molecular Spectroscopy	02	01
	II	• Chemical Bond and Reactivity. • Oxidation- Reduction Chemistry.		01
	III	• Polymers • Aromatic Hydrocarbons		01
SCHP2		Chemistry Practical II	02	06

F. Y. B. Sc. CHEMISTRY : Choice Based Credit System				
Semester II				
PAPER : I				
Course Name: General Chemistry (45 lectures)			**Course Code SCH201**	
Periods per week (1 period 50 minutes)			**03**	
Credits			**02**	
Evaluation System			**Hours**	**Marks**
		Theory Examination	2.0	60
		Theory Internal		40

		No. of lectures
Unit I	**1.1 <u>Gaseous State</u>** **1.1.1** Ideal gas laws, kinetic theory of gases, Maxwell-Boltzmann's distribution of velocities (qualitative discussion), ideal gases, real gases, compressibility factor, Boyle's temperature (Numerical expected). **1.1.2** Deviation from ideal gas laws, reasons for deviation from ideal gas laws, Van der Waals equation of state, Joule-Thomson effect: qualitative discussion. inversion temperature. (Numerical expected). **1.1.3** Critical Phenomenon, critical constants of a gas in terms of van der Waal's constants**.** **1.2 Chemical Equilibria and Thermodynamic Parameters** **1.2.1** Reversible and irreversible reactions, law of mass action, dynamic equilibria, equilibrium constant, (Kc and Kp), relationship between Kc and Kp, **1.2.2** Le Chatelier's principle, factors affecting chemical equilibrium (Numerical expected) **1.2.3** Statement of second law of thermodynamics, concepts of entropy and free energy, spontaneity and physical significance of free energy, thermodynamic derivation of equilibrium constant (Numerical expected**)**	**08** **07**
Unit II	**2. 1 <u>Concept of Qualitative Analysis</u>** **2.1.1** Testing of Gaseous evaluates, Role of papers impregnated with reagents in qualitative analysis (with reference to papers impregnated with starch iodide, potassium dichromate, lead acetate, dimethylglyoxime and oxine reagents). **2.1.2** Precipitation equilibria, effects of common ions, uncommon ions, oxidation states, buffer action, solubility product, complexing agents on precipitation of ionic compounds.(Balanced chemical equations and numerical problems expected).	**08**

	2.2 Acid Base Theories **2.2.1** Arrhenius, Lowry – Bronsted, Lewis, Solvent- Solute concept of acids and bases, Hard and soft acid and bases. Application of HSAB. **2.2.2** Application of acid base chemistry in: Understanding organic reactions like Friedel Craft's (acylation / alkylation) reactions. **2.2.3** Volumetric analysis with special reference to calculation of titration curve involving strong acid and strong base.	**07**
Unit III	**3.1 Chemistry of alkanes** **3.1.1** Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, **3.1.2** Free radical Halogenation (mechanism expected) including relative reactivity and selectivity. **3.2 Chemistry of alkenes** Formation of alkenes by elimination reactions **3.2.2** Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. **3.2.3** Reactions of alkenes: Mechanism of Polar and Non polar addition, allylic and benzylic bromination using N-Bromo succinimide (no mechanism) **3.2.4** Mechanism of oxymercuration - demercuration, hydroboration-oxidation **3.2.5** Ozonolysis, reduction; hydroxylation **3.2.6 Dienes:** classification as isolated, conjugated and cumulenes; 1, 2 and 1, 4- addition reactions in conjugated dienes (with mechanism) and, Diels-Alder reaction (No mechanism). **3.3 Chemistry of Alkynes** **3.3.1** Formation of alkynes **3.3.2** Reactions of alkynes: Acidity, Electrophilic addition reactions. Hydration of alkynes, Alkylation of terminal alkynes.	**03** **09** **03**

Learning Outcomes:

At the end of this module, the learner should be able to

- Explain reasons for deviation of gases from ideal behaviour
- Derive Van der Waal's equation of state
- Relate K_p with Kc
- Interpret concepts of entropy, free energy and spontaneity
- Explain second law of thermodynamics in terms of entropy
- Elaborate Le Chatelier's principle and its application
- Predict the spontaneity of a process in terms of Gibbs free energy
- Discuss the critical phenomenon and relate the critical constants with van der waal's constants.
- Solve numerical based on concept of chemical equilibrium
- Identify various types of qualitative analysis

- Apply reagent paper for the identification of ions.
- Describe ionic product and solubility product.
- Calculate the solubility product and ionic product.
- Identify common ion and uncommon ion effect.
- Explain the Arrhenius, Lowry Bronsted and Lewis concept of acids and bases.
- Define HSAB concept.
- Identify Hard, Border line, Soft acids and bases.
- Apply HSAB concept to explain stability of compounds.
- Summarize the different methods for the synthesis of alkanes, alkenes, dienes and alkynes
- Predict the product of organic reactions involving alkanes, alkenes and alkynes as substrates.
- Design synthesis of simple saturated and unsaturated hydrocarbons
- Write mechanisms for simple organic reactions of hydrocarbons.

Reference Books :

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press(2014).
2. Ball D.W., Physical Chemistry, Thomson Press, India(2007).
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa(2004).
4. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP(2009).
5. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson(2013).
6. Peter A. and Paula J. de., Physical Chemistry, 10th Ed., Oxford University Press (2014).
7. McQuarrie D.A. and Simon J.D., Molecular Thermodynamics, Viva Books Pvt. Ltd.,New Delhi(2004).
8. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill(2010).
9. Metz C.R., 2000 Solved Problems in Chemistry, Schaum Series(2006).
10. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP(2009).
11. Banwell C.N.,Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill (1994).
12. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan (2000).
13. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
14. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
15. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.
16. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.
17. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
18. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt Ltd. (Pearson Education).
19. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt Ltd. (PearsonEducation).
20. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London,1994.
21. Kalsi, P. S. Stereochemistry Conformation and Mechanism, NewAgeInternational, 2005.
22. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.

F. Y. B. Sc. CHEMISTRY : Choice Based Credit System				
Semester II				
PAPER : II				
Course Name: General Chemistry (45 lectures)			**Course Code SCH202**	
Periods per week (1 period 50 minutes)			**03**	
Credits			**02**	
Evaluation System			**Hours**	**Marks**
		Theory Examination	2.0	60
		Theory Internal		40

		No. of lectures
Unit I	**1.1 Ionic Equilibria** **1.1.1** Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization **1.1.2** Ionization constant and ionic product of water, ionization of weak acids and bases, pH scale, common ion effect, dissociation constants of mono-di-and triprotic acid (exact treatment for monoprotic acid) **1.1.3** Buffers: Introduction, types of buffers, derivation of Henderson equation for acidic and basic buffers, buffer action, buffer capacity (Numerical expected)	**07**
	1.2 Molecular Spectroscopy **1.2.1** Electromagnetic radiation, electromagnetic spectrum, Planck's equation, interaction of electromagnetic radiation with matter: **1.2.2** Absorption, emission, scattering, fluorescence, electronic, vibrational and rotational transitions, **Beer-Lambert's law** (Numerical expected).	**04**
	1.3 Solid State Chemistry **1.3.1** Types of solids, crystal lattice, lattice points, unit cell, space lattice and lattice plane. **1.3.2** Laws of crystallography: Law of constancy of interfacial angle, law of symmetry and law of rational indices (Numerical expected).	**04**
Unit II	**2.0 Chemical Bond and Reactivity** **2.1.1** Types of Chemical bond. Comparison between Ionic and Covalent bond. **2.1.2** Fajan's rule, **2.1.3** Lewis electron dot structure **2.1.4** Sidgwick - Powell Theory, **2.1.5** VSEPR theory for AB_n with and without Lone pairs of electrons, Limitations of VSEPR theory **2.1.6** Isoelectronic principle	**07**

	2.2 Oxidation- Reduction Chemistry **2.2.1** Reduction potentials, **2.2.2** Balancing redox equations **2.2.3** Latimer and Frost diagram, **2.2.4** Application of redox chemistry: **2.2.5** Extraction of elements (example: isolation of copper by auto reduction) **2.2.6** Redox reagents in volumetric analysis: Iodine, $KMnO_4$, Titration Curves Fe (II) against Ce (IV), Fe (II) against $KMnO_4$	**08**
Unit III	**3.1 Polymers** **3.1.1** Introduction: Definition of monomers, polymers, homopolymers, copolymers, graft polymer; block polymer; thermoplastic and thermosetting resins, natural and synthetic polymers. **3.1.2** Additionpolymers; a) polyethylene (b) polypropylene (c) PVC (d) polystyrene (e) polyacrylonitrile (f) polyvinyl Alcohol (g) Teflon. **3.1.3** Condensation polymerization : (a) Polyesters (b) polyamides (c) polyurethanes (d) phenol formaldehyde resin (e) epoxy resin (f) polycarbonates and their uses. **3.1.4** Stereochemistry of polymers: Tacticity of polymers **3.1.5** Biodegradable polymers and their uses **3.1.6** Additives to polymers: Plasticizers, stabilizers and fillers. (The students are expected to identify monomers in a given polymer and draw the structure of a polymer from a given set of monomers). **3.2 Aromatic Hydrocarbons** **3.2.1** Aromaticity :Huckel's rule of aromaticity ; benzenoid and non benzenoid aromatic compounds ; heterocyclic compounds with suitable examples **3.2.2** Antiaromatic and non aromatic compounds with suitable examples **3.2.3** General mechanism of electrophilic aromatic substitution: halogenation, nitration, sulfonation and Friedel Craft alkylation /acylation with their mechanism. **3.2.4** Activating / deactivating effects and orienting effects in substituted benzenes **Note:** Synthesis of simple substituted aromatic compounds based on orienting and activating/deactivating effects is expected)	**06** **09**

Learning Outcomes:

At the end of this module, the learner should be able to

- Distinguish between strong and weak electrolytes, recognize pH scale
- Differentiate between types of buffer
- Derive Henderson equation for acidic and basic buffers
- Distinguish between electronic vibrational and rotational transition
- Illustrate unit cell, space lattice and elements of symmetry
- Construct Latimer and Frost diagram and determine the relative stabilities of the various oxidation states.
- Discuss the various factors which govern the structure of the molecules.
- Define monomers, polymers, copolymers, resins and classify polymers as random, graft or block co polymers.
- Distinguish between addition and condensation polymers and identify the starting monomer for a given polymer'
- Draw the structure of the polymer derived from a given monomer
- Define tacticity of polymers
- Identify benzenoid ,non-benzenoid aromatic, anti-aromatic and non-aromatic compounds
- Explain electrophilic aromatic substitution reactions and their mechanism
- Predict the reactivity and outcome of electrophilic aromatic substitution reactions in substituted benzene
- Design synthesis of multifunctional aryl compounds based on the orienting effects of substituents.

Reference Books :

1. Atkins P.W. and Paula J.de, Atkin's Physical Chemistry, 10th Ed., Oxford University 12 Press(2014).
2. Ball D.W., Physical Chemistry, Thomson Press, India(2007).
3. Castellan G.W., Physical Chemistry, 4th Ed., Narosa(2004).
4. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP(2009).
5. Engel T. and Reid P., Physical Chemistry, 3rd Ed., Pearson(2013).
6. Peter A. and Paula J. de., Physical Chemistry, 10th Ed., Oxford University Press (2014).
7. McQuarrie D.A. and Simon J.D., Molecular Thermodynamics, Viva Books Pvt. Ltd.,New Delhi(2004).
8. Levine I.N., Physical Chemistry, 6th Ed., Tata Mc Graw Hill(2010).
9. Metz C.R., 2000 Solved Problems in Chemistry, Schaum Series(2006).
10. Mortimer R.G., Physical Chemistry, 3rd Ed., Elsevier: NOIDA, UP(2009).
11. Banwell C.N.,Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw Hill (1994).
12. K.L. Kapoor, A Textbook of Physical Chemistry, Macmillan (2000).
13. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
14. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
15. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.

16. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.
17. Morrison, R. T. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt Ltd. (Pearson Education).2012
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22. Mc Murry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.

PRACTICALS

SEMESTER : II

Paper- I &II

COURSE CODE: SCHP2 **CREDITS: 02**

Unit I: Physical Chemistry

1. To determine the rate constant for the saponification reaction between ethyl acetate and NaOH
2. To determine dissociation constant of weak acid (Ka)using Henderson's equation and the method of incomplete titration pHmetrically.
3. To verify Beer-Lambert's law, using $KMnO_4$ solution by colorimetric method.
4. To standardize commercial sample of HCl using borax and to write material safety data of the chemicals involved.

Unit II: Inorganic Chemistry

1. **Qualitative analysis: (at least 4 mixtures to be analyzed)**
   Semi-micro inorganic qualitative analysis of a sample containing two cations and two anions.
   Cations (from amongst):
   Pb^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Cu^{2+}, Cd^{2+}, Fe^{2+}, Ni^{2+}, Mn^{2+}, Mg^{2+}, Al^{3+}, Cr^{3+}, K^{+}, NH^{4+}
   Anions (From amongst):
   CO_3^{2-}, S^{2-}, SO^{2-}, $^3NO_2^-$, NO_3^-, Cl^-, Br^-, I^-, SO_4^{2-}, PO_4^{3-}
   (Scheme of analysis should avoid use of sulphide ion in any form for precipitation / separation of cations.)

2. **Redox Titration:**
   To estimate iron in the given Ferrous Ammonium sulphate solution by titrating against standard $KMnO_4$ solution**.**

Unit III: Organic Chemistry

Characterization of organic compound containing C, H, (O), N, S, X elements. (minimum 6 compounds)

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Reference Books :

Unit I: Physical Chemistry

1. Khosla B.D., Garg V.C. and Gulati A., Senior Practical Physical Chemistry, R. Chand and Co., New Delhi(2011).
2. Garland C. W., Nibler J.W. and Shoemaker D.P., Experiments in Physical Chemistry, 8th Ed., McGraw-Hill, New York (2003).
3. Halpern A.M. and McBane G.C., Experimental Physical Chemistry, 3rdEd. W. H. Freeman and Co., New York (2003).
4. Athawale V.D. and Mathur P., Experimental Physical Chemistry, New Age International, New Delhi (2001).

Unit II: Inorganic Chemistry

5. Mendham, J., A. I. Vogel's *Quantitative Chemical Analysis 6thEd.*, Pearson, 2009.

Unit III: Organic Chemistry

6. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education(2009)
7. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson(2012)
8. 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
