

Education for Knowledge, Science and Culture”
- Shikshanmaharshi Dr. BapujiSalunkheShri

Swami VivekanandShikshanSanstha's

Vivekanand College, Kolhapur(Autonomous)



Syllabus

For

Bachelor of Science

B.Sc. Part-III Chemistry

(Semester V, VI)

Under Choice Based Credit System

Syllabus with effect from the June, 2020

(Subject to modifications in the future)



Vivekanand College, Kolhapur (Autonomous)

B. Sc. Part III (Chemistry)

Syllabus CBCS Pattern

To be implemented from June-2020

INTRODUCTION

This syllabus is prepared to give the sound knowledge and understanding of chemistry to undergraduate students at last year of the B.Sc. degree course. The goal of the syllabus is to make the study of chemistry as stimulating, interesting and relevant as possible. The syllabus is prepared by keeping in mind the aim to make students capable of studying chemistry in academic and industrial courses and to expose the students, to develop interest in them in various fields of chemistry. The new and updated syllabus is based on disciplinary approach with vigour and depth taking care the syllabus is not heavy at the same time it is comparable to the syllabi of other universities at the same level. The syllabus is prepared after discussions of number of faculty members of the subject and by considering the existing syllabi of B.Sc. Part-I, II & III, new syllabi of XIth & XIIth standards, syllabi of NET and SET exams. U.G.C. model curriculum, syllabi of different entrance examination and syllabi of other Universities. The units of the syllabus are well defined and the scope is given in detail. The periods required for units are given. The lists of reference books are given in detail.

OBJECTIVES

1. To promote understanding of basic facts and concepts in Chemistry while retaining the excitement of Chemistry.
2. To make students capable of studying Chemistry in academic and Industrial courses and to expose the students to different processes used in Industries and their applications.
3. To expose the students to various emerging new areas of Chemistry and apprise them with their prevalent in their future studies and their applications in various spheres of chemical sciences.
4. To develop problem solving skills in students.
5. To develop ability and to acquire the knowledge of terms, facts, concepts, processes, techniques and principles of subjects.
6. To develop ability to apply the knowledge of contents of principles of chemistry.



7. To inquire of new knowledge of chemistry and developments therein.
8. To expose and to develop interest in the fields of chemistry
9. To develop proper aptitude towards the subjects
10. To develop the power of appreciations, the achievements in Chemistry and role in nature and society.
11. To develop skills required in chemistry such as the proper handling of apparatus and chemicals.

List of Laboratory Equipments

- **Apparatus & Equipments**

1. Digital balance with 1 mg accuracy
2. Conductometer
3. Potentiometer
4. pH Meter
5. Polarimeter
6. Colorimeter
7. Thermostat
8. Electric Oven
9. Suction Pump
10. Crucible Heater
11. IR Lamp
12. Magnetic stirrer
13. Büchner funnel
14. Water bath / Thermostat.
15. Platinum electrode
16. Glass electrode
17. Silver, Zinc, Copper electrodes
18. Conductivity cell
19. Distilled water plant.
20. Refractometer
21. Freeze
22. Deep Freeze
23. H₂S Apparatus
24. Muffle Furnace
25. Magnetic Stirrer



- **Glassware & Porcelain ware:**

1. Burette (25/50 ml)
2. Micro burette (10 ml)
3. Pipette (5 ml,10 ml,25ml)
4. Graduated Pipette (1/2/5/10 ml)
5. Conical flask(100 ml, 250 ml)
6. Beakers (100 ml, 250 ml, 500 ml)
7. Volumetric flask (25ml,50 ml,100 ml, 250 ml)
8. Gooch Crucible / Sintered glass Crucible
9. Silica Crucible
10. Watch glass
11. Glass tubing
12. Glass Funnel (3")
13. Gas jar
14. Glass rod
15. Test Tubes (12 x100, 5x5x8)
16. Evaporating dish
17. TLC Unit
18. Measuring cylinder
19. Thile's tubes
20. Fusion Tube
21. Capillary tube
22. Stopper bottle
23. Thermometer (1/10°, 360°)
24. Water condenser
25. Distillation flask (100 ml/ 250 ml)
26. Titration tiles.
27. Asbestos sheet.
28. Desiccators
29. Clay pipe triangle

- **Iron & Wooden ware:**

1. Burners



2. Tripod stand
 3. Iron stand
 4. Wire gauze
 5. Burette stand
 6. Test tube stand
 7. Pair of tongs
 8. Test tube holder
 9. Spatula
 10. Copper foil
- **Chemicals:** All the chemicals required for experiments are mentioned in the syllabus.
 - **Others:**
 1. Filter papers (Kalpi)
 2. Whatman Filter paper No. 1, 40, 41

Lab Safety Precautions / Measures in Chemistry Laboratory:

Part-I: Personal Precautions

1. All personnel must wear safety Goggles at all times.
2. Must wear the Lab. Aprons / Lab jacket and proper shoes.
3. Except in emergency, an over-hurried activity is forbidden.
4. Fume cupboard must be used whenever necessary.
5. Eating, Drinking and Smoking in the laboratories strictly forbidden.

Part-II: Use of safety and Emergency Equipments

1. First aid kits.
2. Sand Bucket.
3. Fire extinguishers (dry chemical and carbon dioxide extinguisher).
4. Chemical storage cabinet with proper ventilation.
5. Material safety data sheets
6. Management of local exhaust system and fume hoods.
7. Sign in register if using instruments.



General Structure

Class	Semester	Course Name	Name of the paper	Credits
B.Sc.-III	V	Chemistry (DSC)	1002E1-Physical & Inorganic Chemistry	4
			1002E2-Organic & Analytical Chemistry	4
			Chemistry Lab-V Practical	2
			Chemistry Lab-VI Practical	2
		Chemistry (SEC-SE)	Basic Analytical Chemistry	2
	VI	Chemistry (DSC)-III	1002F1-Physical & Inorganic Chemistry	4
			1002F2-Organic Spectroscopic techniques & Industrial Chemistry	4
			Chemistry Lab-VII Practical	2
			Chemistry Lab-VIII Practical	2
		Chemistry (SEC)-SF	Project work & Industrial study tour	2
Total Credits				28



Vivekanand College, Kolhapur (Autonomous)
B. Sc. Part-III (Chemistry) CBCS Syllabus with effect from June-2020
Semester-V

Chemistry-DSC-1002E1: Physical and Inorganic Chemistry
Theory: 60 Hrs (75 Lectures) Credits-4

Course Outcomes: After the completion of the course, the student will be able to:

- CO1 Understand the wave mechanics of atomic structure.
- CO2 Know the phenomenon related to the micro particle like electrons.
- CO3 Acquire the fundamentals behinds the spectroscopic techniques like Raman, electronics and vibrational spectroscopy.
- CO4 Adopt the basics of photochemistry, structure, defects in crystals and theory of the reaction rates.
- CO5 Describe the synthesis and applications of the semiconductors and superconductors in electrical and electronic devices.
- CO6 Impart essential knowledge regarding classification, types, mechanism and applications of catalyst in industrial fields.
- CO7 Improve the level of understanding of structure, method of preparation and applications of organometallic compounds in various fields.
- CO8 Gain thorough knowledge of role of various metals and nonmetals in our health.

Section-I: Physical Chemistry(38 Periods)

Unit- 1 Quantum Theory

(10)

Introduction, Dual nature of matter and energy: De Broglie hypothesis, The Heisenberg's uncertainty principle, Concept of energy operators (Hamiltonian), Derivation of Schrodinger wave equation, Physical interpretation of ψ and ψ^2 , Particle in a one-dimensional box, Schrodinger wave equation for hydrogen atom, Concept of quantum numbers.

Unit- 2 Molecular Spectroscopy

(12)

Introduction, Electromagnetic radiations, Electromagnetic spectrum, Energy level diagram.

Rotational spectra of diatomic molecules: Rigid rotor model, Moment of inertia (derivation expected), Energy levels of rigid rotor, selection rules, spectral



intensity, Maxwell-Boltzmann population distribution, Determination of bond length, isotopic effect, interaction of radiation with rotating molecules.

Vibrational spectra of diatomic molecules: Simple Harmonic oscillator model, vibrational energies of diatomic molecules, determination of force constant, overtones. Interaction of radiation with vibrating molecules.

Raman Spectra: concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

Numerical problems.

Unit- 3 Photochemistry

(8)

Introduction - Difference between thermal and photochemical processes.

Laws of photochemistry:

- i) Grothus-Draper law,
- ii) Lambert law,
- iii) Lambert-Beer's law (with derivations),
- iv) Stark-Einstein law.

Quantum yield, reasons for high and low quantum yield, Factors affecting Quantum yield, Photosensitized reactions—dissociation of H_2 , photosynthesis, Photo-dimerization of anthracene, decomposition of HI and HBr, Photophysical and photochemical processes, Jablonaski diagram depicting various processes occurring in the excited state: Qualitative description of fluorescence and phosphorescence, Chemiluminescence, Electroluminescence, Numerical problems.

Unit- 4 Chemical Kinetics

(10)

Introduction, Third order reactions: derivation of rate constant, characteristics and examples of third order reaction. Theories of reaction rate as Collision theory and transition state theory (only quantitative aspect). Simultaneous reactions such as: Opposing reactions: (Derivations of rate equation for first order opposed by first order, expected Numerical problems), side reaction, Consecutive reactions: (Derivation of rate equation).

References:

1. P.W. Atkins, The Elements of Physical Chemistry: 4th ed. Oxford University Press, 2005.
2. G.M. Barrow, Physical Chemistry: 6th Ed, Tata McGraw Hill Publishing Co. Ltd., 2008.



3. G.K. Vemulapalli, Physical Chemistry : Prentice Hall of India Pvt. Ltd., 2009 .
4. G.W. Castellan, Physical Chemistry: 3rd ed., Narosa Publishing House, 2004.
5. S. Glasstone, Text Book of Physical Chemistry, 2nded, Affiliated East-West press Pvt. Ltd., New Delhi.
6. K. J. Laidler and J.H. Meiser, Physical Chemistry: 2nd ed. CBS, First Indian ed.1999.
7. Ira N.Levine, Physical Chemistry: 6th ed., Tata McGraw Hill, Inc., 2011.
8. C.N. Banwell, Fundamentals of Molecular Spectroscopy, 5th ed., Tata McGraw Hill Publishing Co. Ltd, New Delhi,

Section II: Inorganic Chemistry (37 Periods)

Unit-1 Solid State Chemistry (12)

Structures of Solids, Importance of solid state chemistry, Crystals: size and shape of crystals, interfacial angles in crystals, Designation of planes in crystals: Miller indices, Classification of solids on the basis of bonding, Explanation of terms viz. crystal lattice, lattice points, unit cells and lattice constants, Closest packing of rigid spheres (hcp, ccp) packing density in simple cubic, bcc, fcc and hcp lattices (numerical problems expected), Structures of metallic solids, Tetrahedral and octahedral interstitial voids in ccp lattice, tetrahedral holes, Defects in crystal structures; effects of Schottky and Frenkel defects.

Unit-2 Metals, Semiconductors and Superconductors (8)

Introduction, Properties of metallic solids, Theories of bonding in metal: i) Free electron theory ii) Molecular orbital theory (Band theory), Classification of solids as conductor, insulators and semiconductors on the basis of band theory, Semiconductors, Types of semiconductors - intrinsic and extrinsic semiconductors, Applications of semiconductors, Superconductors: Superconductivity, Meissner effect, Ceramic superconductors-Preparation and structures of mixed oxide $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$, Applications of superconductors.

Unit-3 Catalysis (6)

General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogeneous catalysis (catalytic steps and



examples) and their industrial applications, Deactivation or regeneration of catalysts, Phase transfer catalysts, application of zeolites as catalysts.

Unit-4 Organometallic Compounds (6)

Definition nomenclature and Classification of organometallic compounds, EAN rule as applied to carbonyls, Structures of methyl lithium, Zeiss salt and ferrocene, Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals.

Unit-5 Bio-Inorganic Chemistry (5)

Introduction, Essential and trace elements in biological process, Metalloporphyrin's with special reference to haemoglobin and myoglobin, Role of metal ions present in biological systems with special reference to Na^+ , K^+ , Mg^{2+} and Ca^{2+} ions, Na/K pump, Role of Mg^{2+} ions in energy production and chlorophyll, Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones).

References:

1. Concise Inorganic Chemistry by J.D. Lee-5th Edition.
2. Inorganic Chemistry, - D.F. Shiver & P.W. Atkins- C.H. Longford ELBS-2nd Edition.
3. Basic Inorganic Chemistry, - F.A. Cotton and G. Wilkinson, Wiley Eastern Ltd 1992.
4. Concept and Model of Inorganic Chemistry by Douglas-Mc Daniels – 3rd Edition.
5. Co-ordination Compounds by Baselo and Pearson
6. Inorganic Chemistry by J.E. Huheey, 4th Edition, Pearson Education.
7. Theoretical Inorganic Chemistry by Day and Selbin
8. Inorganic Chemistry by A. G. Sharpe - 3rd Edition
9. Principles of Bioinorganic Chemistry by S. J. Lippard and J. M. Berg, 1st Edition.
10. Advanced Inorganic Chemistry (4th Edition) Cotton and Wilkinson
11. Theoretical Inorganic Chemistry by Day and Selbine.
12. Organometallic Chemistry by R. C. Mahrotra A. Sing, Wiley Eastern Ltd. New Delhi.
13. Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vallabh Publication. Pitampur Delhi.
14. Text book of Inorganic Chemistry by K. N. Upadhyaya Vikas Publishing House – New Delhi.



15. Inorganic Solids: An introduction to concepts in solid-state structural chemistry by Adam, D.M. John Wiley & Sons, 1974.
16. Inorganic and Solid State Chemistry by Rodger, G.E. Cengage Learning India Edition, 2002.
17. B. K. Sharma: Engineering Chemistry, Goel Publishing House, Meerut



Vivekanand College, Kolhapur (Autonomous)
B. Sc. Part-III (Chemistry) CBCS Syllabus with effect from June-2020
Semester -V
Chemistry-DSC-1002E2: Organic and Analytical Chemistry
Theory: 60 Hrs (75 Lectures) Credits-4

Course Outcomes: After the completion of the course, the student will be able to:

- CO1** Learn mechanism of different organic name reactions and to become confident to solve the problems based on the reactions.
- CO2** Adopt the utility of reagents in organic synthesis.
- CO3** Understand the fundamentals of terpenoids and alkaloids.
- CO4** Describe the applications of nucleophilic substitution reactions of aromatic compounds.
- CO5** Acquire the knowledge of pharmaceuticals and its use.
- CO6** Discuss the basic concepts of qualitative and quantitative analysis.
- CO7** Develop the skills of potentiometric, titrimetric, gravimetric and colorimetric analysis.
- CO8** Illustrate the separation techniques such as paper and thin layer chromatography.

Section I: Organic Chemistry (38 Lectures)

- Unit-1 Name Reactions (9)**
Beckmann, Benzylic acid, Baeyer Villiger, Diels -Alder reaction, Mannich Reaction, Michael Reaction, Fries, Dienone-Phenol rearrangement, Problems based on reactions.
- Unit-2 Synthetic Reagents (9)**
DDQ, OsO₄, N-bromosuccinamide, Zn-Hg, DCC, LiAlH₄, CAN, Raney Ni, Diazomethane.
- Unit-3 Natural product (5)**
 - A) Terpenoid:** Introduction, Occurrence, Isolation, General Characteristics, Classification, General Methods for structure determinations, Isoprene rule, Analytical evidences and synthesis of Citral.
 - B) Alkaloids:** Introduction, Occurrence, Isolation, Classification, Properties,



General Methods for structure determinations, Analytical evidences and synthesis of Nicotine.

Unit-4 A) Electrophilic and nucleophilic substitution reactions of Aromatic Compounds (7)

Chemical properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Furan, Pyrrole, Thiophene, and Pyridine.

B) Active methylene compounds

Preparation: Claisen ester condensation. Keto-enol tautomerism, Knoevenagel Condensation, Reactions: Synthetic uses of ethylacetoacetate, Malononitrile preparation of nonheteromolecules having upto 6 carbon).

Unit-5: A) Pharmaceuticals

(8)

Introduction, importance, qualities of good drug, Meaning of the terms: analgesic, antipyretic, anaesthetics, antibiotics, anti-inflammatory, tranquilizer, antiallergic and cardiovascular, anti-hypertensive, anti-neoplastic, sedative and hypnotics. Synthesis and uses: Isoniazid, benzocaine, ethambutol, phenobarbitone, chloramphenicol, paludrine.

B) Green Chemistry

Introduction, Principles and Significance of green chemistry, Applications of microwaves and ionic liquids in chemical reactions.

References:

1. Organic Chemistry by Morrison and Boyd 6th Edition.
2. Organic Chemistry, Pearson Education, 7th Edition, Tata McGraw Hill, 2008. by Francis A Carey,
3. A guide to mechanism in Organic Chemistry, 6th Edition, Pearson Education, New Delhi-Peter Sykes.
4. Organic Reaction Mechanism, 4th Edition, Narosa Publications. By V. K. Ahluwalia and R. K. Parashar.
5. Mechanism and Structure in Organic Chemistry. April, 1963 By Edwin S. Gould 6. A text book of Organic Chemistry by Arun Bahl, B. S. Bhal Eighteenth Revised edition 2006.
7. Green Chemistry by V. K. Ahluwalia.
8. Medicinal chemistry A. Kar.
9. Medicinal chemistry Alka Gupta



Section II: Analytical Chemistry (37 Lectures)

Unit-1 Qualitative and Quantitative Aspects of Analysis (6)

General introduction, Sampling techniques of solid, liquid and gases; Types of errors, determinate and indeterminate errors, constant and proportionate errors, Accuracy and precision, measures of dispersion and central tendency: mean, median, average deviation, relative average deviation, standard deviation, variance, coefficient of variation, Numerical problems.

Unit-2 Titrimetric Analysis (8)

General Introduction, types of titrations,

Acid-Base titrations: Neutralization Indicators (Acid-Base Indicators), Theory of indicators w.r.t. Ostwald's colour change interval and Ostwald's Quinoid theory, Construction of titration curves and choice of indicators in the titration of: (i) strong acid and strong base (ii) strong acid and weak base (iii) weak acid and strong base (iv) weak acid and weak base.

Complexometric titrations: General introduction, types of EDTA titrations, metallochromic indicators w.r.t. Eriochrome Black-T.

Redox titrations: General introduction, theory of redox indicators, Use of diphenyl amine and ferroin as redox indicators.

Unit-3 Gravimetric Analysis (7)

General Introduction, Common ion effect and solubility product principles, Conditions for good precipitation, qualities of good precipitate, Factors affecting precipitation like acid, temperature, nature of solvent, Super saturation and precipitate formation, Precipitation from homogeneous solution and examples, Co-precipitation, post-precipitation and remedies for their minimization, Washing of precipitate and ignition of precipitate, Brief idea about method of filtration and drying of precipitate.



nit-4 Potentiometric titrations: General Introduction, Potentiometric titrations- (8)
Classical and analytical methods for locating end points, Types of Potentiometric Titration: Acid-base titration, Redox titration, Precipitation titration, Advantages of potentiometric titrations, Basic circuit of direct reading potentiometer.
Colorimetry: Introduction, Lambert-Beer's law, basic terms used-Transmittance, Optical Density, Opacity, Extinction coefficient, Deviation from Beer's law, Classification of methods of 'colour' measurement or comparison. Photoelectric Colorimeter method- Single beam photo-electric colorimeter, Determination of unknown concentration by using Concentration-Absorbance plot.

Unit-5 Chromatography (8)
General Introduction, Basic principle of chromatography, Classification of Chromatography.

Paper Chromatography: Principle, methodology, types of Papers and treatment, sample loading, choice of solvent, development: ascending, descending, circular; location of spot, determination of R_f value, applications and Advantages and Disadvantages.

Thin layer chromatography: principle, solvent system, stationary phases, preparation of TLC plates, detecting reagents, methodology-sample loading, development, detection of spot, determination of R_f value, preparative TLC, applications and Advantages and Disadvantages. Comparison of TLC and paper chromatography.

References:

1. A. I. Vogel, Textbook of Quantitative Chemical Analysis, 6th ed, Pearson Education, 2002.
2. S. M. Khopkar, Analytical Chemistry Problems and Solutions, New Age International Publishers, 2002.
3. S. M. Khopkar, Basic Concepts of Analytical Chemistry, 3rd ed, New Age International Publishers, 2008.
4. D. A. Skoog, D.M. West, F.J. Holler, Fundamentals of Analytical Chemistry, 8th ed. Philadelphia, Saunders College Publishing, 1996.
5. D. A. Skoog, F.J. Holler, T.A. Nieman, Principles of Instrumental Analysis, 6th ed. Philadelphia, Saunders College Publishing, 1996.



6. G. R. Chatwal and S. K. Anand: Instrumental methods of Chemical Analysis, Himalaya Publishing House.
7. H. H. Willard, L. L. Merritt and J. A. Dean; Instrumental methods of Analysis, 7th ed. CBS Publishers, 1986.
8. Instrumental methods of chemical analysis – H.Kaur
9. Instrumental methods of chemical analysis –Willard, Merit & Dean
10. Text Book of Quantitative inorganic analysis – A.I.Vogel
11. Analytical chemistry – Walton
12. Textbook of qualitative inorganic analysis – Kolthoff and Sandel



Vivekanand College, Kolhapur (Autonomous)
B. Sc. Part-III (Chemistry) CBCS Syllabus with effect from June-2020
Semester -V
Chemistry-SEC-SE-Basic Analytical Chemistry
Periods- 30 Hrs (Credit-2)

A) Theory: (10)

Basics in Practical Chemistry

Introduction, Definition and Explanation of following terms- Solute, Solvent, Solution, Polar solvent, Non-Polar solvent, Saturated solution, Unsaturated solution, Super saturated solution, Normality, Equivalent weight, Molecular weight, Molarity, Acidity of base, Basicity of acid, Percentage solution, ppt, ppm, ppb solutions, Mole Fraction, Weight fraction, Percentage composition by W/W, W/V, V/V, Numerical problems.

B) Hands-on: (Any Four) (15)

- **Preparation of solution of different concentration:** Normal, Molar, Molal, ppm, ppb, ppt, percentage, etc.
- To compare organic compounds by TLC method.
- Identification of adulterants in some common food items like coffee, tea powder, chilli powder, turmeric powder, coriander powder, etc. **(Any one)**
- Determination of dissolved oxygen (DO) of a water sample.
- Determination of pH of soil samples.

C) Demonstrations (Any Two) (05)

- Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.
- Estimation of Nitrogen by Kjeldahl's method
- Analysis of Organic compound by NMR.
- Analysis of Organic compound by UV.
- Analysis of Organic compound by IR.

References:

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.



2. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
3. Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry 6th Ed.*, Saunders College Publishing, Fort Worth (1992).
4. Harris, D. C. *Quantitative Chemical Analysis*, W. H. Freeman.
5. Dean, J. A. *Analytical Chemistry Notebook*, McGraw Hill.
6. Day, R. A. & Underwood, A. L. *Quantitative Analysis*, Prentice Hall of India.
7. Freifelder, D. *Physical Biochemistry 2nd Ed.*, W.H. Freeman and Co., N.Y. USA (1982).
8. Cooper, T.G. *The Tools of Biochemistry*, John Wiley and Sons, N.Y. USA. 16 (1977).
9. Vogel, A. I. *Vogel's Qualitative Inorganic Analysis 7th Ed.*, Prentice Hall.
10. Vogel, A. I. *Vogel's Quantitative Chemical Analysis 6th Ed.*, Prentice Hall.
11. Robinson, J.W. *Undergraduate Instrumental Analysis 5th Ed.*, Marcel Dekker, Inc., New York (1995).



Vivekanand College, Kolhapur (Autonomous)
B. Sc. Part-III (Chemistry) CBCS Syllabus with effect from June-2020
Semester -VI
Chemistry-DSC-1002F1: Physical and Inorganic Chemistry
Theory: 60 Hrs (75 Lectures) Credits-4

Course Outcomes: After the completion of the course, the student will be able to:

- CO1 Understand the theoretical aspect of chemical transformation.
- CO2 Recognize about surface phenomenon and isotherms of surface reactions.
- CO3 Describe the methods of detections of radioactivity of the samples, the working principle of cells and batteries.
- CO4 Explain the chemistry behind the ethanol fermentation by anaerobic bacteria.
- CO5 Get idea about theories, factors and knowledge of prevention from corrosion.
- CO6 Gain the knowledge about ligands, chelates, classification and applications of chelating agents in analytical chemistry.
- CO7 Develop interest in various nuclear reactions and role of radio isotopes in medicinal, industrial and archaeology fields.
- CO8 Study the important aspects of the mechanism of the reactions involved in inorganic complexes of transition metals. Also acquire a basic understanding of nanochemistry, nanotechnology and its fascinating aspects.

Section-I: Physical Chemistry (38 Periods)

Unit-1 Thermodynamics (12)

Introduction, Recapitulation of all four laws of thermodynamics, Free energy: Gibbs function (G) and Helmholtz function (A), Criteria for thermodynamic equilibrium and spontaneity, Relation between G and H: Gibbs Helmholtz equation, Phase equilibria: Clapeyron-Clausius equation and its applications, Thermodynamic derivation of law of mass action, van't-Hoff isotherm and isochore, Fugacity and activity concept, Partial molar quantities, partial molar volume, Concept of chemical potential,



Numerical problems.

Unit-2 Adsorption

(08)

Introduction, Adsorption as a surface phenomenon (mechanism), Definition of important basic terms: adsorption, adsorbent, adsorbate, interface etc., Distinction between adsorption and absorption, Characteristics of adsorption, Factors affecting adsorption, Types of adsorption, Distinction between physical adsorption and chemical adsorption, Adsorption isotherms: Freundlich, Langmuir adsorption isotherm, BET equation (derivation not expected), determination of surface area using Langmuir method and BET equations.

Unit-3 Radioactivity and its Detection

(9)

Introduction, Detection and measurement of nuclear reactions by scintillation and Geiger Muller counter methods, Decay constant, half life and average life of radioactive elements, Radioactive equilibrium and range of α -particles, GeigerNuttall relation, determination of radioactive constant (Decay constant), Numerical problems.

Unit-4 Renewable Energy Sources

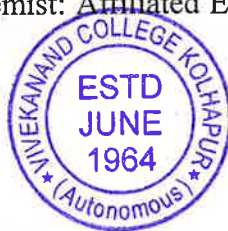
(10)

Introduction, Batteries -Primary, Secondary cells, Lithium Ion Cell Fuel Cells- Types of fuel cells, Hydrogen- Oxygen fuel cell, Hydrocarbon – Oxygen fuel cell, Coal fired fuel cell.

Biomass Energy – Introduction, Origin of biomass, conversion of biomass into energy by alcohol fermentation and anaerobic digestion method.

References:

1. P.W. Atkins, The Elements of Physical Chemistry: 4th ed. Oxford University Press, 2005.
2. G.M. Barrow, Physical Chemistry: 6th Ed, Tata McGraw Hill Publishing Co. Ltd., 2008.
3. G.K. Vemulapalli, Physical Chemistry : Prentice Hall of India Pvt. Ltd., 2009 .
4. G.W. Castellan, Physical Chemistry: 3rd ed., Narosa Publishing House, 2004.
5. S. Glasstone, Text Book of Physical Chemistry, 2nded, Affiliated East-West press Pvt. Ltd., New Delhi.
6. K.J. Laidler and J.H. Meiser, Physical Chemistry: 2nd ed. CBS , First Indian ed.1999.
7. S. Glasstone, Thermodynamics for Chemist: Affiliated East-West Press Pvt. Ltd., New Delhi.



8. Ira N. Levine, Physical Chemistry: 6th ed., Tata McGraw Hill, Inc., 2011.
9. Reisman Arnold, Phase equilibria –Edited by Ernest M. Loebe, New York and London Academic Press.
10. F.D. Ferguson and P.K. Jones, Phase Rule: (Butterworth Publisher).
11. J.N. Murrell and E.A. Boucher, Properties of Liquids and Solution: Wiley, 1982.
12. D.K. Chakravarty, Adsorption and Catalysis, Oxford Publishers.
13. D.J. Shaw, Introduction to Colloid and Interface Science: Butterworth and Co., 1981.
14. D.H. Everett, Basic Principles of Colloid Science: Royal Society of Chemistry, 1988.
15. Thomas J.M. and Thomas W.J. Introduction to Principles of Heterogeneous Catalysis: VCH Publishers, New York, 2008.
16. Friedlander, Kennedy and Joseph W., Nuclear and Radiochemistry –John Wiley & Sons, New York, 1955.
17. Arnikar H.J., Essentials of Nuclear Chemistry: 4th ed, New Age International Ltd., Publishers, New Delhi. 1955.

Section II: Inorganic Chemistry (37 Periods)

Unit-1 Corrosion and Passivity

(8)

Introduction of corrosion, Electrochemical theory of corrosion, Factors affecting on corrosion: i. Position of metals in the electrochemical series on the basis of standard reduction potential ii. Purity of metal iii. Effect of moisture iv. Effect of oxygen (differential aeration principle) v. Hydrogen overvoltage, Methods of protections of metals from corrosion, Passivity: i. Definition ii. Types of passivity iii. Oxide film theory and evidences iv. Applications of passivity.

Unit-2 Chelation

(7)

A brief introduction with respect to ligands, chelating agent, chelation and metal chelates, Structural requirements of chelate formation, Difference between metal chelate and metal complex, Classification of chelating agents (with specific illustration of bidentate chelating agents), Application of chelation with respect to chelating agents - EDTA and DMG.



Unit-3 Nuclear Chemistry

(10)

Nuclear reactions and energetic of nuclear reactions, Types of nuclear reactions: i) Artificial transmutation ii) Artificial radioactivity iii) Nuclear fission and its application in Heavy water nuclear reactor iv) Nuclear fusion, Applications of radio-isotopes as tracers: i) Chemical investigation-Esterification ii) Structural determination-Phosphorus pentachloride iii) Analytical Chemistry-Isotopic dilution method for determination of volume of blood iv) Age determination-Dating by C^{14} .

Unit-4 Inorganic Reaction mechanism

(6)

Introduction, Classification of Mechanism Association, dissociation, interchange and the rate determining steps, SN^1 and SN^2 reaction for inert and labile complexes, Mechanism of substitution in cobalt (III) octahedral complexes, Trans effect and its theories, Applications of trans effect in synthesis of Pt (II) complexes.

Unit-5 Nanomaterials

(6)

Introduction and Importance of nanomaterials, Properties (Comparison between bulk and nanomaterials): i) Optical properties ii) Electrical conductivity and iii) Mechanical properties, Methods of preparation: Top-down, bottom-up fabrication a) Co precipitation method b) Sol-gel method c) Chemical reduction method d) Hydrothermal method, Applications of Nanomaterials.

References:

1. Concise Inorganic Chemistry by J.D. Lee – 5th Edition.
2. Inorganic Chemistry, - D.F. Shiver & P.W. Atkins- C. H. Longford ELBS – 2nd Edition.
3. Basic Inorganic Chemistry, - F.A. Cotton and G. Wilkinson, Wiley Eastern Ltd 1992.
4. Concept and Model of Inorganic Chemistry by Douglas – Mc Daniels - 3rd Edition.
5. Co-ordination Compounds by Baselo and Pearson
6. Inorganic Chemistry by J.E. Huheey, 4th Edition, Pearson Education.
7. Theoretical Inorganic Chemistry by Day and Selbin.
8. Inorganic Chemistry by A. G. Sharpe - 3rd Edition
9. Principles of Bioinorganic Chemistry by S. J. Lippard and J. M. Berg, 1st Ed
10. Advanced Inorganic Chemistry (4th Edn.) Cotton and Wilkinson
11. Essentials of Nuclear Chemistry by H. J. Arnikar.
12. Nuclear Chemistry by M. N. Sastri.
13. Organometallic Chemistry by R. C. Mahotra, A. Sing, Wiley Eastern Ltd. New Delhi.



14. Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vallabh Publication. Pitampur Delhi.
15. Text book of Inorganic Chemistry by K. N. Upadhyaya Vikas Publishing House – New Delhi.
16. Nanotechnology: Principles and Practices-Sulbha Kulkarni
17. Introduction to Nanotechnology by Poole, C.P. & Owens, F.J. John Wiley & Sons, 2003.



Vivekanand College, Kolhapur (Autonomous)
B. Sc. Part-III (Chemistry) CBCS Syllabus with effect from June-2020
Semester -VI
Chemistry-DSC-1002F2: Organic Spectroscopic Techniques &
Industrial Chemistry
Theory: 60 Hrs (75 Lectures) Credits-4

Course Outcomes: After the completion of the course, the student will be able to:

- CO1:** Understand the basic concepts of spectroscopy.
- CO2:** Acquire the knowledge of various spectroscopic techniques such as UV, IR, NMR and Mass Spectroscopy.
- CO3:** Interpret molecular structures by using spectroscopic techniques.
- CO4:** Understand the basics of industrial chemistry.
- CO5:** Learn the manufacturing processes of heavy chemicals.
- CO6:** Adopt the knowledge of sugar and jaggery industry.
- CO7:** Learn and understand fermentation processes involved in manufacturing of alcohol.
- CO8:** Illustrate the overall information regarding manufacture of fertilizers.

Section-I: Organic Spectroscopic technique (38 Periods)

Unit-1 Introduction to Spectroscopy (3)

Meaning of spectroscopy, Nature of electromagnetic radiation -wave length, frequency, energy, amplitude, wave number, and their relationship, different units of measurement of wavelength frequency, different regions of electromagnetic radiations, Interaction of radiation with matter-absorption, emission, fluorescence and scattering, Types of spectroscopy and advantages of spectroscopic methods. Energy types and energy levels of atoms and molecules.

Unit-2 Ultra-Violet (UV) Spectroscopy (5)

Introduction, Beer-Lamberts law, absorption of U.V. radiation by organic molecule leading to different excitation, Terms used in U.V. Spectroscopy- Chromophore, Auxochrome, Bathochromic shift, hypsochromic shift, hyperchromic and hypochromic effect, Modes of electromagnetic transitions. Effect of conjugation on position of U.V. band, Calculation of λ -max by



Woodward and Fisher rules for dienes and enones systems, Colour and visible spectrum, Applications of U.V. Spectroscopy.

Unit-3 Infra-Red (IR) Spectroscopy

(8)

Introduction, Principle of IR Spectroscopy, IR Instrumentation, schematic diagram, Fundamental modes of vibrations, Condition for absorption of IR radiations, Regions of I.R. Spectrum, fundamental group region, finger print region, Hooks Law for Calculation of vibrational frequency, IR Sampling, Factors affecting on IR absorption frequency, Characteristic of I.R. absorption of following functional groups Alkanes, alkenes, alkynes, Alcohol and phenols, Ethers, Carbonyl compounds, Amines, Nitro com, Aromatic Compounds.

Unit - 4 Nuclear Magnetic Resonance (NMR) Spectroscopy

(9)

Introduction, Principles of PMR Spectroscopy, NMR- Instrumentation, Schematic diagram, Magnetic and nonmagnetic nuclei, Chemical shift- definition, measurement, calculation, Factors affecting Chemical shift, Shielding, & deshielding, Peak Integration, Merits of TMS as PMR reference compounds, Coupling Constant, Types of Coupling Constant, Spin-spin splitting (n+1 rule), Applications

Unit-5 Mass spectroscopy

(8)

Introduction, Principle of mass spectroscopy, Mass spectrometer - schematic diagram, Types of ions produced in mass spectrum, Fragmentation patterns of alkanes, alkenes, aromatic hydrocarbons, alcohols, phenols, amines and carbonyl compounds, McLafferty rearrangement, Applications.

Unit-6

Combined Problems based on UV, IR, NMR and Mass Spectral data.

(5)

Reference:

1. Absorption Spectroscopy of Organic Molecules by V. M. Parikh.
2. Spectroscopy of Organic compounds by P. S. Kalsi.
3. Elementary Organic Absorption Spectroscopy by Y. R. Sharma.
4. Instrumental Methods of Analysis (7th edition) by Willard, Merritt, Dean, Settle.
5. Spectroscopy by G. R. Chatwal and S. K. Anand
6. Spectroscopy by Pavia, Lampman, Kriz



7. Organic Spectroscopy (2nd edition) by Jag Mohan
8. Organic Spectroscopy (3rd edition) by William Kemp
9. Instrumental Methods of Chemical Analysis by H. Kaur.

Section-II: Industrial Chemistry(37 Periods)

Unit-1 Introduction to Industrial Chemistry

(7)

General introduction, Indian Scenario of chemical industries, types of chemical industry, basic requirements of chemical industries, chemical production and raw materials; unit processes and unit operations and its types; modes of manufacturing-batch, semi-batch and continuous process; Introduction to various departments in industry: Quality control, Quality assurance, process development, Research and Development, Analytical development, Environmental health and safety, Industrial legislations-copy right act, patent act, trademarks; MSDS of hazardous chemicals.

Unit-2 Manufacturing of Heavy Chemicals

(6)

General introduction and Indian Scenario of Heavy chemicals, Manufacture of NH_3 by modified Haber-Bosch process, Physico-chemical principles and uses of NH_3 . Manufacture of H_2SO_4 by contact process, Physicochemical principles, and uses of H_2SO_4 . Manufacture of HNO_3 by Ostwald's process, Physicochemical principles involved and uses of HNO_3 .

Unit-3 Manufacturing of Sugar and Jaggery

(8)

Sugar: Introduction, importance of sugar industry, Manufacture of cane sugar: raw material, Extraction, Clarification and Concentration of cane juice, Crystallization of sucrose, Centrifugation, Refining of cane sugar, Utilization of by-products of sugar industries.

Jaggery: Composition of Jaggery, forms of jaggery, Production process of jaggery, analysis of Jaggery-Moisture content, pH, reducing and non-reducing sugar, colour, total viable bacterial count, yeast count, Mold count.



Unit-4 Fermentation Industry

(8)

Introduction, importance, Basic requirement of fermentation process, Factors favouring fermentation, fermentation operations. Manufacture of Industrial alcohol (Ethyl alcohol) from a) Molasses b) Food grains, c) manufacture of alcohol from fruits (wine). Grades of alcohols: Silence spirit, rectified spirit, absolute alcohol, proof spirit, denatured spirit, duty and duty free alcohol. Importance of power alcohol as fuel.

Unit-5 Fertilizers

(8)

General introduction, Classification of fertilizers, Necessity and requirements of good fertilizers, Manufacture of the following fertilizers: Urea, calcium ammonium nitrate, ammonium phosphates, polyphosphate, triple superphosphate, compound and mixed fertilizers. Introduction to biofertilizers.

References:

1. Industrial Chemistry-B.K. Sharma, Goyal publishing house, Mirut
2. Shreeve's Chemical Process Industries 5th Edition- G.T. Oustin, McGraw Hill
3. Riegel's hand book of Industrial Chemistry, 9th Edition- Jems A. Kent
4. Industrial chemistry-R.K. Das, 2nd Edition, 1976.
5. Hazards in the Chemical Laboratory, 2nd Edition- G. D. Muir, The Chemical Society, London
6. Industrial chemistry-Kent
7. Industrial chemistry-Rogers



B. Sc. III

Syllabus for Practical Chemistry DSC-1002E and DSC-1002F

Physical Chemistry Practical's

I. Non instrumental Experiments:

i) Partition Law

To determine the partition coefficient of CH_3COOH between H_2O and CCl_4 .

ii) Viscosity

To determine the viscosity average molecular weight of a polymer.

iii) Adsorption

To investigate the adsorption of oxalic acid by activated charcoal and test the validity of Freundlich & Langmuir isotherms.

iv) Solubility.

To study the effect of addition of electrolyte (NaCl or KCl) on the solubility of Benzoic acid at room temperature.

B. Chemical Kinetics. (Any four)

1. The study of energy of activation of first order reaction i.e. hydrolysis of methyl acetate in presence of $0.5 \text{ N HCl} / 0.5 \text{ N H}_2\text{SO}_4$.
2. The study of energy of activation of second order reaction i.e. reaction between $\text{K}_2\text{S}_2\text{O}_8$ and KI (Equal concentrations).
3. The study of energy of activation of second order reaction i.e. reaction between $\text{K}_2\text{S}_2\text{O}_8$ and KI (Unequal concentrations).
4. To study the hydrolysis of methyl acetate by using its two concentrations in presence of 0.5 N HCl and hence find velocity constant of the reaction.
5. To study the effect of addition of electrolyte (KCl) on the reaction between $\text{K}_2\text{S}_2\text{O}_8$ and KI (Equal concentrations).

C. Partial molar volume.

1. To determine the partial molar volume of ethyl alcohol in a mixture of ethyl alcohol and water (Any seven mixtures be given).

II. Instrumental experiments

A. Potentiometry (Any four)

1. Titration of strong acid with strong alkali.



N.B. i) 8 to 10 ml of 1N acid solution to be given by examiner in 100 ml volumetric flask & student should dilute it to 100 ml and 10ml of this solution is taken for titration.

ii) Experiment is carried out by taking pilot run from 1 to 10 ml and then final run taking 0.2 ml reading in the range of end point.

2. Preparation of buffer solution and determination of their pH (Any five buffer solutions), Theoretical calculation of pH values by using Henderson's equation.
3. Determination of standard electrode potential of Zn/Zn^{++} , Cu/Cu^{++} , Ag/Ag^+ (Any two).
4. Estimate the amount of Cl^- , Br^- and I^- in given unknown halide mixture by titrating it against standard $AgNO_3$ solution.
5. Titration of ferrous ammonium sulphate using $K_2Cr_2O_7$ solution and to calculate redox potential of Fe^{++} , Fe^{+++} system.

B. Conductometry (Any three).

N.B. i) 8 to 10 ml of 1N acid solution to be given by examiner in 100 ml volumetric flask & student should dilute it to 100 ml and 10ml of this solution is taken for titration.

1. Titration of a mixture of weak acid and strong acid with strong alkali
2. To study the effect of substituent on dissociation constant of weak acid with respect to acetic acid and monochloroacetic acid (cell constant to be given).

N.B. Calculate K by using formula $K = \frac{\alpha^2 C}{1 - \alpha}$

3. To determine the velocity constant of hydrolysis of ethyl acetate by NaOH solution by conduct metric method.
4. To determine the normality of citric acid in lemon by titrating it against standard 0.2 N NaOH solution by conductometric method.
5. To determine λ_∞ of strong electrolyte (NaCl or KCl) and to verify Onsager equation.

C. Refractometry (Any One)

1. To determine the percentage composition of unknown mixture by (i) graphical method and (ii) by composition law (Densities of pure liquids A & B be given).
2. To determine the molar refractivity of methyl acetate, ethyl acetate, n-hexane and carbon tetrachloride and calculate the refraction equivalents of C, H and Cl atoms.



D. Colorimetry (Any Two).

1. To verify Lambert – Beer's law using CuSO_4 solution.
2. To estimate of Fe^{+++} ions by thiocyanate method.
3. To estimate Fe^{+++} ions using salicylic acid by colorimetric titration.
4. To determine the order of reaction for the oxidation of alcohol by potassium dichromate and potassium permanganate in acidic medium colorimetrically.

E. pHmetry (Any One).

1. To determine the dissociation constant of monobasic acid (Acetic acid).
2. To determine the dissociation constant of dibasic acid (Malonic acid).
3. To determine hydrolysis constant of aniline hydrochloride.

References:

1. Findlay's Practical Physical Chemistry (Longman)
2. Advanced Practical Physical Chemistry by J. B. Yadav, Goel publishing house.
3. Practical Physical Chemistry by B. D. Khosla, V. C. Garg (R. Chand and Co.)
4. Systematic experimental Physical Chemistry by Rajbhoj, Chandekar (Anjali Publicaiton) Aurangabad.
5. Practical Physical Chemistry: Nandkumari, Kothari and Lavande.
6. Practical Physical Chemistry by Gurtu (S. Chand).
7. Text Book of Qualitative Inorganic Analysis by A. I. Vogel (ELBS Longman).

Inorganic Chemistry Practical's

Gravimetric Estimation: (G). N. B.: Any two experiments from G1 to G3 and any one experiment from G4 & G5.

1. G1: Gravimetric estimation of iron as ferric oxide from the given solution containing ferrous ammonium sulphate, copper sulphate and free sulphuric acid.
2. G2: Gravimetric estimation of aluminium as aluminium oxide from the given solution containing potash alum, coppersulphate and free sulphuric acid.
3. G3: Gravimetric estimation of barium as barium sulphate from the given solution containing barium chloride, ferric chloride and free hydrochloric acid.
4. G4: Gravimetric estimation of manganese as ammonium manganese phosphate from the given solution containing manganese sulphate, copper sulphate and free sulphuric acid.



5. G5: Gravimetric estimation of nickel as bis (dimethylglyoximate) nickel (II) from the given solution containing nickel sulphate, ferrous ammonium sulphate and free Sulphuric acid.

Inorganic Preparations (P) (Any six):

- P1. Preparation of sodium cuprous thiosulphate
- P2. Preparation of potassium trioxalato aluminate (III).
- P3. Preparation of tris (ethylene diamine) nickel (II) thiosulphate.
- P4. Preparation of tetra aminecopper(II) sulphate.
- P5. Preparation of ammonium diamminetetra-thiocyanatochromate (III) P6.
- P6. Preparation of tris(thiourea) cuprous sulphate.
- P7. Synthesis of CuO nanoparticles.
- P8. Preparation of pigment (Zinc Oxide).
- P9. Preparation of Urea formaldehyde resin.
- P10. Preparation of Phenol formaldehyde resin.

Titrimetric Estimations:

A) Percentage Purity (Any two):

- V1. Determination of percentage purity of tetrammine copper (II) sulphate.
- V2. Determination of percentage purity of ferrous ammonium sulphate.
- V3. Determination of percentage purity of potassium trioxalato aluminate.

B) Analysis of Commercial Sample. (Any five):

- V4. Determination of percentage of magnesium in the given sample of talcum powder.
- V5. Determination of amount of aluminum in the given solution of potash alum.
- V6. Determination of titrable acidity in the given sample of milk or lassi.
- V7. Determination of Fe in cement.
- V8. Determination of chlorine in bleaching powder.
- V9. Determination of Free acidity in ammonium sulphate fertilizer.
- V10. Determination of percentage of CaCO_3 in chalk.
- V11. Determination of COD.

C) Ion exchange method (Any two):

- V11. Determination of amount of sodium present in the given solution of common



salt using cation exchange resin (By Acid Base titration)

V12. Determination of amount of magnesium in the given solution containing (Mg^{2+} and Zn^{2+}) using anion exchange resin and standard solution of EDTA.

V13. Determination of amount of zinc in the given solution containing (Mg^{2+} and Zn^{2+}) using anion exchange resin and standard solution of EDTA.

Organic Chemistry Practical's

1. Separation and identification of Binary Organic Mixtures:

2. Organic Estimations (Any four):

- 1) Estimation of Sucrose. /Glucose
- 2) Estimation of Nitro group
- 3) Estimation of acid and ester present in given mixture of acid and ester.
- 4) Estimation of Sulphur in thiourea (Messanger's method.)
- 5) Estimation of glycine (amino acid).
- 6) Saponification value of Oil.
- 7) Determination of number of $-OCH_3$ group.
- 8) Determination of Purity of Phenol.

3. Organic Preparations (Any four):

Preparation of,

- 1) Dihydropyrimidone.
- 2) Dibenzalpropanone.
- 3) Benzilic acid.
- 4) m- Nitroaniline from m- Dinitrobenzene.
- 5) Hippuric acid from glycine.
- 6) Ethylbenzene from acetophenone.
- 7) Adipic acid from cyclohexene.

4. Preparation of Derivatives(Any five):

- 1) Picrate derivative of β - Naphthol and anthracene.
- 2) Urea oxalate derivative of Urea.
- 3) Iodoform derivative of Acetone.



- 4) 2:4 DNP derivative of Acetaldehyde.
- 5) m-Dinitrobenzene from Nitrobenzene.
- 6) Phenylhydrazone derivative of Aldehyde and Ketone.
- 7) Preparation of oxime derivative of Benzophenone.



Nature of Theory and Practical Examinations

N. B. The question paper should cover the entire syllabus. Marks allotted to questions should be in proportion to the lectures allotted to respective units.

Nature of Discipline Specific Elective (DSE) Question Paper

Total Marks: 80 Theory + 20

Internal Marks: (Section-I: 40+10, Section-II: 40+10)

Que. No.	Particulars	Marks	Marks of options
Section-I			
1	Multiple choice questions (One mark for each question)	08	00
2	Long answer type questions (2 out of 3)	16	08
3	Short answer type questions (4 out of 6)	16	08
Section-II			
4	Multiple choice questions (One mark for each question)	08	00
5	Long answer type questions (2 out of 3)	16	08
6	Short answer type questions (4 out of 6)	16	08
Total		80	32

- The duration of each theory paper for examination will be of 3 hours
- Internal examination (Oral/Seminar/test/ assignment) will be conducted for 10 marks for each paper.

Nature of Skill Enhancement Course (SEC) Question Paper

The nature of SEC exam for

Sem-V will be multiple choice questions for 50 marks

Sem-VI project work and industrial study tour for 50 marks.

Nature of Practical Examination

Practical examination will be of 200 marks. The distribution of marks will be as follows:

1. Physical Section: 65 marks
2. Inorganic Section: 70 marks
3. Organic Section: 65 marks

Total: 200 marks

The duration of practical examination will be of three days- six and half hours per day.



Adipatil
Head
Dept. of Chemistry
Vivekanand College, Kolhapur