SHIVAJI UNIVERSITY, KOLHAPUR.

Accredited By NAAC with 'A' Grade

Revised Syllabus For

B.Sc Part- III

Chemistry

Syllabus to be implemented from

June, 2020 onwards.

B.Sc. Part III (CBCS) SEMESTER-V
Paper No. DSE-E5, Chemistry Paper No. –IX
(Inorganic Chemistry)
(Theory Credits: 02, 30 hours, 37 lectures)

Expected Learning Outcomes:

Name of the topic	Expected Learning Outcome
1. Acids bases and Non-aqueous solvents	Useful for the study of role of acids and bases in Chemistry. The study of non –aqueous solvents is important to learn all chemical properties of solutes and from the research point of view.
2. Metal ligand bonding in transition metal complexes	Useful to understand geometry, stability and nature of bonding between metal ion and ligand in complexes.
3. Metals, semiconductors and Superconductors	The topic deals with the synthesis and the applications of the semiconductors and Superconductors in electrical and electronic devices.
4. Organometalic compounds	The structure, method of preparation and the applications of organo metallic compound in various fields are explained.
5. Catalysis	The classification, types, mechanism and applications of catalyst in industrial fields is explained.

Unit 1. Acids, Bases and Non aqueous Solvents **[8]**

1.1 Introduction to theories of Acids and Bases-Arrhenius concept, Bronsted-Lowry concept, Lewis Concept, Lux-Flood Concept (definition and examples)

1.2 Hard and Soft Acids and Bases. (HSAB Concept)

1.2.1 Classification of acids and bases as hard, soft and borderline.

1.2.2 Pearson's HSAB concept.

1.2.3 Acid–Base strength and hardness-softness.

1.2.4 Applications and limitations of HSAB principle.

1.3 Chemistry of Non aqueous Solvents.

1.3.1 Introduction, definition and characteristics of solvents.

1.3.2 Classification of solvents.

1.3.3 Physical properties and Acid-Base reactions in Liquid Ammonia (NH_3) and Liquid Sulphur Dioxide (SO_2).

Unit 2. Metal Ligand bonding in Transition Metal Complexes [10]

2.1 Crystal field theory (CFT)

2.1.1 Introduction: Shapes of d-orbitals, Basic assumptions of CFT.

2.1.2 Crystal field splitting of d-orbitals of metal ion in octahedral, tetrahedral, square planar complexes and John-Teller distortion.

2.1.3 Factors affecting the Crystal field splitting.

2.1.4 High spin and low spin octahedral complexes w.r.t. Co (II).

2.1.5 Crystal Field stabilization energy (CFSE), Calculation with respect to octahedral complexes only.

2.1.6 Limitations of CFT.

2.2 Molecular orbital theory (MOT).

2.2.1 Introduction.

2.2.2 MOT of octahedral complexes with sigma bonding such as $[Ti(H_2O)_6]^{3+}$, $[CoF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$.

2.2.3 Merits and demerits of MOT.

Unit 3. Metals, Semiconductors and Superconductors. [9]

3.1 Introduction.

3.2 Properties of metallic solids.

3.3 Theories of bonding in metal.

i. Free electron theory.

ii. Molecular orbital theory (Band theory).

3.4 Classification of solids as conductor, insulators and semiconductors on the basis of band theory.

3.5 Semiconductors- Types - intrinsic and extrinsic and applications of semiconductors.

3.6 Superconductors: Ceramic superconductors - Preparation and structures of mixed oxide $YBa_2Cu_3O_{7-x}$.

3.7 Applications of superconductors.

Unit.4. Organometallic Chemistry. **[4]**

4.1 Definition, Nomenclature of organometallic compounds.

4.2 Synthesis and structural study of alkyl and aryl compounds of Be and Al.

4.3 Mononuclear carbonyls -Nature of bonding in simple mononuclear carbonyls.:[$Ni(CO)_4$], [$Fe(CO)_5$], [$Cr(CO)_6$].

Unit 5. Catalysis **[5]**

5.1 Introduction

5.2 Classification of catalytic reaction- Homogenous and Heterogeneous

5.3 Types of Catalysis.

5.4 Characteristics of catalytic reactions.

5.5 Mechanism of catalysis.

i. Intermediate compound formation theory.

ii. Adsorption theory.

5.6 Industrial applications of catalysis.

Reference Books:

1. Concise Inorganic Chemistry (ELBS, 5th Edition) – J. D. Lee.
2. Inorganic Chemistry (ELBS, 3rd Edition) D. F. Shriver, P. W. Atkins, C. H.Lang Ford, Oxford University Press, 2nd Edition.
3. Basic Inorganic Chemistry : Cotton and Wilkinson.
4. Advanced Inorganic Chemistry (4^{th} Edn.) Cotton and Wilkinson.
5. Concepts and Models of Inorganic Chemistry : Douglas and Mc. Daniel. 3^{rd} Edition. John Wiley publication.
6. Structural principles in inorganic compounds. W. E. Addison.
7. Theoretical principles of Inorganic Chemistry – G. S. Manku.
8. Theoretical Inorganic Chemistry by Day and Selbine.
9. Co-ordination compounds. SFA Kettle.
10. Essentials of Nuclear Chemistry by H. J. Arnikar.
11. Nuclear Chemistry by M. N. Sastri.
12. Organometallic Chemistry by R. C. Mahrotra, A. Sing, Wiley Eastern Ltd.New Delhi.
13. Inorganic Chemistry by A. G. Sharpe, Addision – Wisley Longman – Inc.

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. Inorganic Chemistry 3rd Edn G. L. Miessler and D.A. Tarr, pearson publication.
17. Co-ordination compounds by Baselo and Pearson.
18. UGC Inorganic chemistry by H.C. Khera, Pragati prakashan
19. UGC Advanced Inorganic Chemistry by Agarwal and Keemtilal, Pragati Prakashan

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B.Sc. Part III (CBCS) SEMESTER-V
Paper No. DSE-E6 Chemistry Paper No. X
(Organic Chemistry)
(Theory Credits: 02, 30 hours, 38 lectures)

Expected learning Outcomes:

Name of the topic	Expected Learning Outcome
1. Introduction to Spectroscopy	Understanding of energy associated with electromagnetic radiation and its use in analytical technique.
2.UV-Vis Spectroscopy	Knowledge of chromophore, auxochrome and calculation of λ_{max}.
3. IR Spectroscopy	Knowledge of vibrational transitions, regions of IR spectrum, functional group recognition.
4.NMR Spectroscopy	Understanding of magnetic-non magnetic nuclei, shielding-deshielding, chemical shift, splitting pattern
5. Mass spectroscopy.	Knowledge of molecular ion, fragmentation patte and different types of ions produced.
6. Combined Problems based on UV-Vis, IR, NMR and Mass Spectral data	Student will predict the structure of organic compound with the help of provided spectral data

Unit 1. Introduction to Spectroscopy

1.1 Meaning of spectroscopy. **[03]**

1.2 Nature of electromagnetic radiation: wavelength, frequency, energy, amplitude, wave number and their relationship.

1.3 Different units of measurement of wavelength and frequency.

1.4 Different regions of electromagnetic radiations.

1.5 Interaction of radiation with matter: absorption, emission, fluorescence and scattering.

1.6 Types of spectroscopy and advantages of spectroscopic methods.

1.7 Energy types and energy levels of atoms and molecules.

Unit 2. UV-Vis Spectroscopy

2.1 Introduction. **[05]**

2.2 Beer-Lambert's law, absorption of UV radiation by organic molecules leading to different excitations.

2.3 Terms used in UV Spectroscopy: Chromophore, Auxochrome, Bathochromic shift, hypsochromic shift, hyperchromic and hypochromic effect.

2.4 Modes of electromagnetic transitions.

2.5 Effect of conjugation on position of UV band.

2.6 Calculation of λ_{max} by Woodward and Fischer rules for dienes and enones.

2.7 Colour and visible spectrum.

2.8 Applications of UV Spectroscopy.

Unit 3. IR Spectroscopy **[06]**

3.1 Introduction.

3.2 Principles of IR Spectroscopy.

3.3 Instrumentation, schematic diagram.

3.4 Fundamental modes of vibrations, types and calculation.

3.5 Conditions for absorption of IR radiations.

3.6 Regions of IR spectrum, fundamental group region, finger print region.

3.7 Hook's Law for Calculation of vibrational frequency.

3.8 Factors affecting IR absorption frequency.

3.9 Characteristic of IR absorption of following functional groups a) alkanes, alkenes, alkynes b) alcohol and phenols c) ethers d) carbonyl compounds e) amines f) nitro compounds and g) aromatic compounds.

Unit 4. NMR Spectroscopy [09]

4.1 Introduction.

4.2 Principles of PMR Spectroscopy.

4.3 NMR- Instrumentation, Schematic diagram.

4.4 Magnetic and nonmagnetic nuclei.

4.5 Chemical shift: definition, measurement, calculation, Factors affecting Chemical shift

4.6 Shielding & deshielding.

4.7 Peak Integration.

4.8 Merits of TMS as PMR reference compound.

4.9 Coupling Constant.

4.10 Types of Coupling Constant.

4.11 Spin-spin splitting (n+1 rule).

4.12 Applications.

Unit 5. Mass Spectroscopy. [08]

5.1 Introduction.

5.2 Principles of mass spectroscopy.

5.3 Mass spectrometer - schematic diagram.

5.4 Types of ions produced during fragmentation.

5.5 Nitrogen rul

5.6 Fragmentation patterns of: alkanes, alkenes, aromatic hydrocarbons, alcohols, phenols, amines and carbonyl compounds.

5.7 McLaffrety rearrangement.

5.8 Applications.

Unit 6. Combined Problems based on UV, IR, NMR and Mass Spectral data. **[07]**

Reference Books: (Use recent editions)

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 (7^{th} edition) by Willard. Merritt, Dean, Settle.
5. Spectroscopy by G. R. Chatwal and S. K. Anand
6. Spectroscopy by Pavia, lampman, Kriz,Vyvyan
7. Organic Spectroscopy (2^{nd} edition) by JagMohan
8. Organic Spectroscopy (3^{rd} edition) by William Kemp
9. Instrumental Methods of Chemical Analysis by H. Kaur

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B.Sc.-III (CBCS) SEMESTER V
Paper No. DSE- E7 Chemistry Paper No. XI
(Physical Chemistry)
(Theory Credits: 02, 30 hours, 38 lectures)

Expected learning Outcomes:

Name of the Topics	Expected Learning Outcome
1. Elementary quantum mechanics	Learning and understanding quantum Chemistry, Heisenberg's uncertainty principle, concept of energy operators (Hamiltonian), learning of Schrodinger wave equation. Physical interpretation of the ψ and ψ^2. Particle in a one dimensional box
2. Spectroscopy	Knowledge about spectroscopy, Electromagnetic spectrum, Energy level diagram, Study of rotational spectra of diatomic molecules: Rigid rotor model, Microwave oven, vibrational spectra of diatomic molecules, simple Harmonic oscillator model, Raman spectra: Concept of polarizability, pure rotational and pure Vibrational Raman spectra of diatomic molecules, related knowledge will be gained by the students.
3. Photochemistry	Learning and understanding photochemical laws, reactions and various photochemical phenomena.
4. Solution	Learning the various types of solutions, relations vapour pressure, temperature relations.
5. Electromotive force	Learning and understanding the knowledge of emf measurements, types of electrodes, different types of cells, various applications of emf measurements.

Unit 1. Elementary quantum mechanics [08]

1.1 Introduction.

1.2 Drawbacks of classical mechanics, Black body radiation, Photoelectric effect, Compto effect, Duel nature of matter and energy: De Broglie hypothesis.

1.3 The Heisenberg's uncertainty principle.

1.4 Concept of energy operators (Hamiltonian).

1.5 Derivation of Schrodinger wave equation, well behaved function.

1.6 Physical interpretation of the ψ and ψ^2.

1.7 Particle in a one dimensional box.

1.8 Numerical problems.

Unit 2. Spectroscopy [08]

2.1 Introduction.

2.2 Electromagnetic radiation.

2.3 Interaction of radiation with matter, Electromagnetic spectrum, Energy level diagram.

2.4 Rotational spectra of diatomic molecules: Rigid rotor model, moment of inertia, energ levels of rigid rotor, selection rules, Intensity of spectral lines, determination of bon length, isotope effect, Microwave oven

2.5 Vibrational spectra of diatomic molecules: Simple Harmonic oscillator mode Vibrational energies of diatomic molecules, Determination of force constant, overtones

2.6 Raman spectra: Concept of polarizability, pure rotational and pure Vibrational Raman spectra of diatomic molecules, selection rules.

2.7 Comparative study of IR and Raman spectra, rule of mutual exclusion- CO_2 molecule.

2.8 Numerical problems.

Unit 3. Photochemistry [06]

3.1 Introduction, Difference between thermal and photochemical processes.

3.2 Laws of photochemistry: i) Grotthus - Draper law ii) Lambert law iii) Lambert – Beer law (with derivation) iv) Stark-Einstein law.

3.3 Quantum yield. Reasons for high and low quantum yield.

3.4 Factors affecting Quantum yield.

3.5 Photosensitized reactions – Dissociation of H_2, Photosynthesis.

3.6 Photodimerisation of anthracene, decomposition of HI and HBr.

3.7 Jablonski diagram depicting various processes occurring in the excited state: Qualitative description of fluorescence and phosphorescence.

3.8 Chemiluminescence, Electroluminescence and Bioluminescence.

3.9 Numerical problems.

Unit 4. Solutions **[06]**

4.1 Introduction.

4.2 Ideal solutions, Raoult's law, Vapour pressure of ideal and non ideal solutions of miscible liquids.

4.3 Composition of liquid and vapour, vapour pressure and boiling point diagrams of miscible liquids. Distillation of miscible liquid pairs.

Type I : Systems with intermediate total vapour pressure (i.e. System in which b.p. increases regularly – Zeotropic).

Type II : Systems with a maximum in the total vapour pressure (i.e. System with a b.p. minimum – Azeotropic).

Type III : Systems with a minimum in the total vapour pressure (i.e. System with a b.p. Maximum – Azeotropic).

4.4 Solubility of partially miscible liquids.

i. Maximum solution temperature type: Phenol – water system.

ii. Minimum solution temperature type: Triethyl amine – water system.

iii. Maximum and minimum solution temperature type: Nicotine – water system.

Distillation of partially miscible liquid pairs.

4.5 Vapour pressure and distillation of immiscible liquids, steam distillation.

Unit 5. Electromotive force

(Convention: Reduction potentials to be used)

5.1 Introduction

5.2 Thermodynamics of electrode potentials, Nernst equation for electrode an potentials in terms of activities.

5.3 E.M.F. series.

5.4 Types of electrodes: Description in terms of construction, representation, ha reaction and emf equation for

i) Metal – metal ion electrode.

ii) Amalgam electrode.

iii) Metal – insoluble salt electrode.

iv) Gas – electrode.

v) Oxidation – Reduction electrode.

5.5 Reversible and Irreversible cells.

i. Chemical cells without transference.

ii. Concentration cells with and without transference.

iii. Liquid – Liquid junction potential: Origin, elimination and determination.

5.6 Equilibrium constant from cell emf, Determination of the thermodynamic parar such as ΔG, ΔH and ΔS.

5.7 Applications of emf measurements :

i. Determination of pH of solution using Hydrogen electrode.

ii. Solubility and solubility product of sparingly soluble salts (based on concen cells).

5.8 Numerical problems.

Reference Books:

1. Physical Chemistry by G. M. Barrow, International student Edition,Mc Graw Hill.
2. University General Chemistry by C.N.R. Rao, Macmillan.
3. Physical Chemistry by, R. A. Alberty, Wiley Eastern Ltd.
4. The Elements of Physical Chemistry by P. W. Atkins, Oxford.
5. Principles of Physical Chemistry by S. H. Maron, C. H. Prutton, 4thE dition.

6. Nuclear and Radiochemistry by Friedlander, Kennedy and Miller, John Wiley and Sons. Wiley International edition.
7. Essentials of Nuclear Chemistry by H. J. Arnikar, 4th edition. Wiley Eastern.
8. Principles of Physical Chemistry by Puri, Sharma, Pathania,Shobhanlal Naginchand and Company, Jalandar.
9. Instrumental methods of chemical analysis by Chatwal and Anand,5th Edition, Himalaya Publication.
10. Fundamentals of molecular spectroscopy by C. N. Banwell – Tata Mc Graw-Hill.
11. Quantum Chemistry including molecular spectroscopy by B. K. Sen,Tata Mc Graw -Hill.
12. Text Book of Physical Chemistry by S. Glasstone, Macmillan India Ltd.
13. Elements of Physical Chemistry by D. Lewis and S. Glasstone (Macmillan).
14. Principles of Physical Chemistry by Maron and Lando (Amerind).
15. Electrochemistry by S. Glasstone.
16. Physical Chemistry by W. J. Moore.
17. Basic Chemical Thermodynamics by V. V. Rao (Macmillan).
18. Essential of Physical Chemistry, Bahl and Tuli (S. Chand).
19. Text Book of Physical Chemistry, Soni and Dharmarha.
20. Advanced Physical Chemistry Gurdeep Raj GOEL Publishing House, 36th Edition

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B.Sc. Part III (CBCS) SEMESTER-V
Paper No. DSE-E8 Chemistry paper No. XII
(Analytical Chemistry)
(Theory Credits: 02, 30 hours, 38 lectures)

Expected learning Outcomes:

Name of the topic	Expected Learning Outcome
1.Theory of Gravimetric Analysis	Learning and understanding the techniques of gravimetric analysis.
2.Flame Photometry	Knowledge of instrumental analysis of alkali and alkaline earth elements.
3.Colorimetry and Spectrophotometry	Understanding, working and applications of optical methods as an analytical tool.
4.Potentiometric titrations	Understanding theory and applications of potentiometric titrations.
5.Chromatographic techniques and Quality control	Understanding the basics of ion exchange and column adsorption chromatography, Quality control practices in analytical industries / laboratories.

Unit 1. Theory of Gravimetric Analysis **[08]**

1.1 Introduction.

1.2 Gravimetric analysis by precipitation: nucleation, crystal growth, digestion/ageing filtration, drying, ignition, weighing.

1.3 Optimum conditions for good precipitation.

1.4 Physical nature of precipitate.

1.5 Purity of precipitate: co-precipitation, post-precipitation.

1.6 Organic precipitants and their applications.

Unit 2. Flame Photometry **[06]**

2.1 Introduction.

2.2 General principles of flame photometry.

2.3 Instrumentation: Block diagram, Burners (Premix and Lundergraph burners), mirror, slits, filters, detector (Photomultiplier tube).

2.4 Effect of solvent in flame photometry.

2.5 Experimental procedure of analysis (Standard addition and internal standard).

2.6 Interferences and Factors that influence the intensity of emitted radiation in a flame photometer.

2.7 Applications of flame photometry in real sample analysis.

2.8 Limitations of flame photometry.

Unit 3. Colorimetry and Spectrophotometry **[06]**

3.1 Theory of colorimetry and spectrophotometry.

3.2 Lambert Beer's law, deviation from Beer's law.

3.3 Terms used in colorimetry and spectrophotometry.

3.4 Classification of methods of 'colour' measurement or comparison.

3.5 Photoelectric colorimeter method–Single beam photo-electric colorimeter.

3.6 Spectrophotometer method–Single beam direct reading spectrophotometer.

3.7 Determination of unknown concentration by using concentration-absorbance plot.

3.8 Applications of colorimetry and spectrophotometry.

Unit 4. Potentiometric titrations **[07]**

4.1 Introduction.

4.2 Determination of pH.

4.3 Study of Quinhydrone and Glass electrodes and their use in determination of pH.

4.4 Potentiometric titrations: Classical and analytical methods for locating end points.

4.5 Acids- Bases titration with suitable example.

4.6 Redox titration with suitable example.

4.7 Precipitation titration with suitable example.

4.8 Basic circuit of direct reading potentiometer.

4.9 Advantages of potentiometric titrations.

Unit 5. Chromatographic techniques and Quality control **[10]**

5.1 Introduction, classification.

5.2 **Column chromatography:** Introduction, types, Principle of adsorption colu chromatography, solvent system, stationary phases, Methodology-Column packi applications of sample, development, detection methods, recovery of compone Applications.

5.3 **Ion exchange chromatography:** Introduction, Principle, Types and properties of i exchangers, Methodology-Column packing, application of sample, elutio detection/analysis, Applications.

5.4 **Concepts in Quality control**

i. Introduction and Concept of quality.
ii. Quality control.
iii. Quality assurance.
iv. ISO series.
v. Good laboratory practices.

References

1. Text Book of Quantitative inorganic analysis – A.I.Vogel.
2. Instrumental methods of chemical analysis –Willard, Merit & Dean.
3. Instrumentals methods of chemical analysis – Chatwal & Anand.
4. Vogel's textbook of qualitative inorganic analysis – Bassett, Denny etc.
5. Textbook of qualitative inorganic analysis – Kolthoff and Sandel.
6. Fundamentals of analytical chemistry – Skoog and West.
7. Basic concepts of analytical chemistry – S.M. Khopkar.
8. Text book of qualitative chemical analysis – Vogel.
9. Handbook of quality assurance for the analytical chemistry laboratory – James P.Dux,Van Nostrand Reinhold,New York 1986.
10. Instrumental methods of chemical analysis – H.Kaur.
11. A text book of Quantitative chemical analysis Vogel's by J.Mendham, R. C. Denney.
12. Quantitative Chemical Analysis – Daniel C. Harris.
13. Applying ISO 9000 Quality management system, International trade centre publish genera, Indian edition printed by D. L. Shaha Trust.

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B.Sc. Part III (CBCS) SEMESTER -VI
Paper No. DSE-F5, Chemistry Paper No. –XIII
(Inorganic Chemistry)
(Theory Credits: 02, 30 hours, 38 lectures)

Expected Learning Outcome

Name of the topic	Expected Learning Outcome
1.Coordination Chemistry	The topic focused on the mechanism of the reactions involved in inorganic complexes of transition metals. The students can understand the thermodynamic and kinetic aspects of metal complexes.
2.Nuclear Chemistry	The generation of nuclear power with the help of nuclear reactions is highlighted. Role of radio isotopes in medicinal, industrial and Archaeology fields is explained.
3.Chemistry of f-block Elements	The characteristics, properties and separation of lanthanides and Actinides are discussed. Synthesis and IUPAC Nomenclature of trans uranic elements (TU) explained.
4.Iron and Steel	The techniques involve in ore dressing and extraction of cast iron from its ore are discussed.
5.Bio –inorganic Chemistry	Role of various metals and non metals in our health are discussed.

Unit 1. Coordination Chemistry **[12]**

A. Inorganic Reaction mechanism

1.1 Introduction.

1.2 Classification of Mechanism: Association, dissociation, interchange and the rate determining steps.

1.3 S_N^1 and S_N^2 reactions for inert and labile complexes.

1.4 Mechanism of substitution in cobalt (III) octahedral complexes.

1.5 Trans effect and its theories.

1.6 Applications of trans effect in synthesis of Pt (II) complexes.

B. Thermodynamic and Kinetic aspects of metal complexes.

1.7 Introduction.

1.8 Thermodynamic stability.

1.9 Kinetic Stability.

1.10 Relation between thermodynamic and kinetic stability.

1.11 Stepwise stability constant.

1.12 Factor affecting the stability of complexes.

1.13 Determination of Stability constant by Job variation, Mole ratio and Slope ratio method.

[05]

Unit 2. Nuclear Chemistry

2.1 Nuclear reactions and energetic of nuclear reactions.

2.2 Types of nuclear reactions

i. Artificial transmutation.

ii. Artificial radioactivity.

iii. Nuclear fission and its application in heavy water nuclear reactor.

iv. Nuclear fusion.

2.3 Use of Thorium, Uranium and Plutonium in atomic energy

2.4 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 blood.

iv. Age determination – Dating by C^{14}.

[09

Unit 3. Chemistry of f- Block Elements

A] Lanthanides

3.1 Introduction.

3.2 Occurrence.

3.3 Electronic Configuration.

3.4 Oxidation State.

3.5 Lantahnide contraction.

3.6 Separation of Lanthanides by Ion exchange method.

B] Actinides

3.7 Position in periodic table.

3.8 Electronic configuration.

3.9 General methods of preparation of transuranic elements.

i. Neutron capture – followed by β decay.

ii. Accelerated projectile bombardment.

iii. Heavy ion bombardment.

3.10 IUPAC nomenclature of the super heavy elements with atomic number (Z) greater than 100.

Unit 4. Iron and Steel. **[07]**

4.1 Occurrence and ores of iron.

4.2 Definition of the Terms- Ore , Mineral, Slag, Flux, Gangue , Matrix, Calcinations, Reduction, Roasting, Smelting and Leaching.

4.3 Extraction of iron by Blast furnace.

4.4 Steel: Definition and types.

4.5 Conversion of cast iron into steel by

i. Bessemer process.

ii. L.D. process.

4.6 Heat treatment on steel.

Unit 5. Bio-inorganic Chemistry. **[05]**

5.1 Introduction.

5.2 Essential and trace elements in biological process.

5.3 Metalloporphyrins with special reference to hemoglobin and myoglobin.

5.4 Biological role of alkali and alkaline earth metal ions with special referenc to Na^+, K^+ and Ca^{2+}

Reference Books: (Use recent editions)

1. Concise Inorganic Chemistry (ELBS, 5th Edition) – J. D. Lee.

2. Inorganic Chemistry (ELBS, 3rd Edition) D. F. Shriver, P. W. Atkins, C. H.Lang Ford, Oxford University Press, 2nd Edition.
3. Basic Inorganic Chemistry : Cotton and Wilkinson.
4. Advanced Inorganic Chemistry (4^{th} Edn.) Cotton and Wilkinson.
5. Concepts and Models of Inorganic Chemistry : Douglas and Mc. Daniel. 3^{rd} Edition. Jo Wiley publication.
6. Structural principles in inorganic compounds. W. E. Addison.
7. Theoretical principles of Inorganic Chemistry – G. S. Manku.
8. Theoretical Inorganic Chemistry by Day and Selbine.
9. Co-ordination compounds. SFA Kettle.
10. Essentials of Nuclear Chemistry by H. J. Arnikar.
11. Nuclear Chemistry by M. N. Sastri
12. Organometallic Chemistry by R. C. Mahrotra A. Sing, Wiley Eastern Ltd.New Delhi.
13. Inorganic Chemistry by A. G. Sharpe, Addision – Wisley Longman – Inc.
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 – Ne Delhi.
16. Inorganic Chemistry 3rd edn G. L. Miessler and D.A. Tarr, pearson publication
17. Co-ordination compounds by Baselo and Pearson.
18. UGC Inorganic chemistry by H.C. Khera, Pragati prakashan
19. UGC Advance Inorganic Chemistry by Agarwal and Keemtilal, Pragati Prakashan

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B.Sc. Part III (CBCS) SEMESTER-VI
Paper No. DSE-F6 Chemistry Paper No. XIV
(Organic Chemistry)
(Theory Credits: 02, 30 hours, 38 Lectures)

Expected learning Outcomes:

Name of the topic	Expected Learning Outcome
1. Reagents and Reactions in Organic Synthesis	Knowledge of reagents used in organic transformations and various reactions used in organic synthesis.
2.Retrosynthesis	Knowing basic terms used in retrosynthetic analysis, retrosynthesis of some organic compounds.
3.Electrophilic addition to >C=C< and −C≡C− bond	Student will learn addition reaction across >C=C< bond w.r.t. hydrohalogenation, hydration hydroxylation, ozonolysis and addition of halogen, halogen acid, hydrogen,water, etc. across −C≡C−bond.
4.Natural Products	Knowledge of terpenoids and alkaloids w.r.t. occurrence, isolation, characteristics and classification. Analytical and synthetic evidences of Citral and Nicotine.
5.Pharmaceuticals	Understanding classification of drugs, Qualities of ideal drug. Synthesis and uses of some representative drugs and Drug action of sulpha drugs.

Unit 1. Reagents and Reactions in Organic Synthesis **[10]**

A] Reagents

Preparation and Applications of following reagents.

1. Lithium aluminium hydride $LiAlH_4$.
2. Raney Nickel.
3. Osmium tetraoxide.

4. Selenium dioxide (SeO_2).
5. Dicyclohexyl Carbodiimide (DCC).
6. Diazomethane.

B] Reactions

Statement, General Reaction, Mechanism and Synthetic applications

1. Diels -Alder reaction.
2. Meerwein –Pondorff-Verley reduction.
3. Hofmann rearrangement.
4. Wittig reaction.
5. Wagner- Meerwein rearrangement.
6. Baeyer Villiger oxidation.
7. Problem based on above reactions.

Unit 2. Retrosynthesis **[06]**

2.1 Introduction.

2.2 Recapitulation of basics of reaction mechanism and reagents.

2.3 Terms used- Target molecule (TM), Disconnection, Synthons, Synthetic equivalen Functional group interconversion (FGI), one group disconnection (w. r. t. suitab examples).

2.4 Retrosynthetic analysis and synthesis of target molecules: Cinnamaldehyd Cyclohexene, para methoxy acetophenone, Methyl-3-phenyl propionate, α,α-dimeth benzyl alcohol, Paracetamol.

Unit 3. Electrophilic addition to >C=C< and −C≡C− bonds [08]

A. Addition to Carbon-Carbon double (>C=C<) bond:

3.1 Introduction.

3.2 Examples of addition reactions.

3.3 Mechanism of electrophilic addition to >C=C< bond, orientation & reactivity,

i. Hydrohalogenation.
ii. Anti-Markovnikoff's addition (peroxide effect).
iii. Rearrangements (support for formation of carbocation).

iv. Addition of halogens.

v. Addition of water.

vi. Addition of hypohalous acids (HO-X).

vii. Hydroxylation (formation of 1,2-diols).

viii. Hydroboration-oxidation (formation of alcohol).

ix. Hydrogenation (formation of alkane).

x. Ozonolysis (formation of aldehydes & ketones).

B. Addition to Carbon-Carbon triple (−C≡C−) bond:

3.4 Introduction.

3.5 Examples of addition reactions.

3.6 Mechanism of electrophilic addition to−C≡C−bond.

i. Addition of halogens.

ii. Addition of halogen acids.

iii. Addition of hydrogen.

iv. Addition of water.

v. Formation of metal acetylides.

Reference books:

1. Organic Reactions and Their Mechanisms P. S. Kalsi 3rd Revised edition.

2. Advanced organic Chemistry by B.S. Bahl & Arun Bhal (Reprint in 1997)

3. Organic Chemistry by Morrison and Boyd 6thedition.

Unit 4. Natural Products **[08]**

A] Terpenoids:

4.1 Introduction, Occurrence, Isolation, General Characteristic, Classification.

4.2 General Methods for structure determinations.

4.3 Isoprene rule.

4.4 Analytical evidences and synthesis of Citral.

B] Alkaloids:

4.5 Introduction, Occurrence, Isolation, Classification, Properties.

4.6 General Methods for structure determination.

4.7 Analytical evidences and synthesis of Nicotine.

Unit 5. Pharmaceuticals [06]

5.1 Introductio.

5.2 Classification.

5.3 Qualities of ideal drug.

5.4 Synthesis and uses of ethambutal, phenobarbitone, isoniazide, benzocaine, Chloramphenicol,paludrine.

5.5 Drug action of sulpha drugs.

Reference books:1

1. Advanced Organic Chemistry : Reactions, Mechanisms and structure by – Jerry Marc
2. Reagents for Organic Synthesis by Louis F. Fieser , Mary Fieser -1967.
3. A Text book of Practical Organic Chemistry including Qualitative Organic Analysis b A. I.Vogel.
4. Mechanism and Structure in Organic Chemistry. April,1963 By Edwin S.Gould.
5. A text book of Organic Chemistry by Arun Bahl, B.S.Bhal Eighteenth Revised edition 2006.
6. A guidebook to mechanism in Organic Chemistry sixth Edition by Peter Syke.
7. Organic Synthesis: The Disconnection Approach by Stuart Warren.
8. Organic Synthesis Through Disconnection Approach by P. S. Kalsi
9. Fundamentals of Organic Synthesis the Retrosynthetic Analysis by Ratan Kumar Kar
10. Organic Reactions and Their Mechanisms P. S. Kalsi 3rd Revised edition.
11. Advanced organic Chemistry by B.S. Bahl & Arun Bhal (Reprint in 1997)
12. Organic Chemistry by Morrison and Boyd 6thedition.
13. Organic Chemistry Vol II Stereochemistry and the Chemistry of Natural Products (5th e by I. L.Finar.
14. Organic Chemistry Natural Products Vol I, by O. P.Agrawal
15. Industrial Chemistry-B.K. Sharma, Goyal publishing house,Mirut
16. Shreeves chemical process industries 5th Edition, G.T. Oustin, McGrawHill
17. Riegel's hand book of Industrial chemistry, 9th Edition, Jems A.Kent
18. Industrial chemistry –R.K. Das, 2nd Edition,1976.

19. Synthetic drugs by M.S.Yadav,Campus book international.

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B.Sc. III (CBCS) SEMESTER-VI
Paper No. DSE-F 7 Chemistry Paper No. XV
(Physical Chemistry)
(Theory Credits: 02, 30 hours, 37 Lectures)

Expected Program Outcomes:

Name of the Topics	Expected Learning Outcome
1. Phase equilibria	Learning and understanding of phase rule, learning of One component, Two component and Three component systems phase diagrams with suitable examples.
2. Thermodynamics	Knowledge about basic concept of Thermodyanamics, free energy, Gibbs-Helmholtz equation and its applications, problem related with it.
3. Solid state chemistry	Learning and understanding Space lattice, lattice sites, Lattice planes, Unit cell. Laws of crystallography, Weiss indices and Miller indices, Cubic lattices and types of cubic lattice, planes or faces of a simple cubic system, Diffraction of X-rays, Derivation of Bragg's equation. Determination of crystal structure by Bragg's method. crystal structure of NaCl and KCl on the basis of Bragg's equation.
4. Chemical kinetics	Learning of kinetics, Simultaneous reactions such as i)opposing reaction ii)side reaction iii)consecutive reactions: iv) chain reaction v) explosive reaction
5. Distribution law	Learning and understanding the knowledge of distribution law, its modifications, applications of distribution laws, process of extraction, determination of solubility, distribution indicators, molecular weights.

Unit 1. Phase Equilibria [07]

1.1 Introduction.

1.2 Gibbs phase rule : Phase rule equation and explanation of terms involved in the equation.

1.3 Phase diagram, true and metastable equilibria.

1.4 One component systems:

i. Water system.

ii. Sulphur system with explanation for polymorphism.

1.5 Two component systems:

i. Eutectic system: (Ag – Pb system); Desilverisation of lead.

ii. Freezing mixture: ($KI - H_2O$ system).

iii. Formation of compound with congruent melting point ($FeCl_3 - H_2O$).

1.6 Three component solid-liquid system:

i. Development of triangular phase diagram: (Acetic acid – Chloroform – system).

Unit 2. Thermodynamics **[09]**

2.1 Introduction.

2.2 Free energy: Gibbs function (G) and Helmholtz function (A), Criteria thermodynamic equilibrium and spontaneity.

2.3 Relation between ΔG and ΔH : Gibbs-Helmholtz equation.

2.4 Phase equilibria : Clapeyron – Clausius equation and its applications.

2.5 Thermodynamic derivation of law of mass action, Van't – Hoff isotherm a isochore.

2.6 Fugacity and activity concepts.

2.7 Partial molar quantities, Partial molar volume, Concept of chemical potential, Gibb Duhem equation.

2.8 Numerical problems.

Unit 3. The Solid State **[09]**

3.1 Introduction: Space lattice, lattice sites, lattice planes, unit cell.

3.2 Laws of crystallography:

i. Law of constancy of interfacial angles

ii. Law of rational indices

iii. Law of crystal symmetry.

3.3 Weiss indices and Miller indices.

3.4 Cubic lattice and types of cubic lattice, planes or faces of a simple cubic system, spacing of lattice planes.

3.5 Diffraction of X-rays, Derivation of Bragg's equation.

3.6 Determination of crystal structure by Bragg's method.

3.7 Determination of crystal structure of NaCl and KCl on the basis of Bragg's equation.

3.8 Numerical problems.

Unit 4. Chemical Kinetics [06]

4.1 Introduction.

4.2 Simultaneous reactions such as

i. Opposing reaction: (Derivation of rate equation for first order opposed by first order expected).

ii. Side reaction.

iii. Consecutive reactions.

iv. Chain reaction.

v. Explosive reaction (Derivation of rate equation and Numerical problems are not expected).

Unit 5. Distribution law [06]

5.1 Introduction, solute, solvent and solution, miscible and immiscible liquids.

5.2 Nernst distribution law and its limitations.

5.3 Modification of distribution law with respect to change in molecular state of solute (association and dissociation of solute in one of the solvent).

5.4 Applications of the distribution law

i. Process of extraction (derivation expected).

ii. Determination of solubility of solute in particular solvent.

iii. distribution indicators.

iv. determination of molecular weight of solute in different solvents.

5.5 Numerical problems.

Reference Books:

1. Physical Chemistry by G. M. Barrow, International student Edition,Mc Graw Hill.
2. University General Chemistry by C.N.R. Rao, Macmillan.
3. Physical Chemistry by, R. A. Alberty, Wiley Eastern Ltd.
4. The Elements of Physical Chemistry by P. W. Atkins, Oxford.
5. Principles of Physical Chemistry by S. H. Maron, C. H. Prutton, 4thE dition.
6. Nuclear and Radiochemistry by Friedlander, Kennedy and Miller, John Wiley and S Wiley International edition.
7. Essentials of Nuclear Chemistry by H. J. Arnikar, 4th edition. Wiley Eastern.
8. Principles of Physical Chemistry by Puri, Sharma, Pathania,Shobhanlal Naginchand and Company, Jalandar.
9. Instrumental methods of chemical analysis by Chatwal and Anand,5th Edition, Himalaya Publication.
10. Fundamentals of molecular spectroscopy by C. N. Banwell – Tata Mc Graw-Hill.
11. Quantum Chemistry including molecular spectroscopy by B. K. Sen,Tata Mc Graw -Hill.
12. Text Book of Physical Chemistry by S. Glasstone, Macmillan India Ltd.
13. Elements of Physical Chemistry by D. Lewis and S. Glasstone (Macmillan).
14. Principles of Physical Chemistry by Maron and Lando (Amerind).
15. Electrochemistry by S. Glasstone.
16. Physical Chemistry by W. J. Moore.
17. Basic Chemical Thermodynamics by V. V. Rao (Macmillan).
18. Essential of Physical Chemistry, Bahl and Tuli (S. Chand).
19. Text Book of Physical Chemistry, Soni and Dharmarha.
20. Advanced Physical Chemistry Gurdeep Raj GOEL Publishing House, 36th Edition

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B. Sc. Part III (CBCS) SEMESTER-VI
Paper No. DSE-F8 Chemistry Paper No. XVI
(Industrial Chemistry)
(Theory Credits: 02, 30 hours, 38 lectures)

Expected learning Outcomes:

Name of the topic	Expected Learning Outcome
1.Sugar Industry	Learning and understanding the whole process of manufacture of sugar and byproducts of sugar industry.
2.Manufacture of industrial heavy chemicals	Learning and understanding of physico-chemical principles of production of ammonia, sulfuric acid, nitric acid and sodium carbonate along with its manufacturing plant.
3.Synthetic polymers	Understanding and learning the classification, synthesis and applications of various polymers.
4.Petroleum industry and eco-friendly fuels	Understanding the petroleum Industry, fuels and need of use of ecofriendly fuels.
5.Nanotechnology	Understanding and learning of nanotechnology including classification, optical properties, synthesis routes, characterization techniques and applications of nano-materials.

Unit 1. Sugar Industry **[07]**

1.1 Introduction.

1.2 Manufacture of cane sugar in India: Extraction of juice, Clarification, Concentration, crystallization, centrifugation and other details of industrial process.

1.3 Byproducts of sugar industry.

1.4 Manufacture of Ethyl Alcohol from Molasses: by Fermentation.

Unit 2. Manufacture of Industrial Heavy Chemicals **[08]**

2.1 Introduction

2.2 Manufacture of Ammonia (NH_3)

i. Physico-chemical principles.

ii. Manufacture by Haber's process.

2.3 Manufacture of Sulphuric acid (H_2SO_4)

i. Physico-chemical principles.

ii. Manufacture by Contact process.

2.4 Manufacture of Nitric acid (HNO_3)

i. Physico-chemical principles.

ii. Manufacture by Ostwald's process (Ammonia oxidation process).

2.5 Manufacture of Sodium carbonate (Na_2CO_3) (Washing soda).

i. Physico-chemical principles.

ii. Manufacture by Solvay process.

Unit 3. Synthetic Polymers [08

3.1 Introduction.

3.2 Classification.

i. Based on origin.

ii. Based on composition-organic, inorganic polymers.

iii. Based on method of preparation.

iv. Based on general physical properties.

v. Based on structure.

3.3 Addition Polymerization: Free radical addition and ionic addition polymerization.

3.4 Zigler Nata polymerization.

3.5 Methods of preparation and applications of some organic polymers: Polyethylene, polystyrene, polyvinyl chloride, Phenol-formaldehyde resin.

3.6 Conducting organic polymers: Synthesis and properties of Polyaniline, polypyrrol.

3.7 Applications of conducting organic polymers.

Unit 4. Petroleum industry and eco-friendly fuels [07]

A] Petroleum industry

Introduction, occurrence, composition of petroleum, resources, processing of petroleum, calorific value of fuel, cracking, octane rating (octane number), cetane

number, flash point, petroleum refineries, applications of petrochemicals, synthetic petroleum, lubricating oils & additives.

B] Fuels

Fuels and eco-friendly fuels: liquid, gaseous fuel (LPG, CNG), fossil fuels, diesel, bio diesel, gasoline, aviation fuels. Use of solar energy for power generation.

Unit 5. Nanotechnology **[08]**

5.1 Introduction of nanotechnology, history, Classification of nanoparticles based on size.

5.2 Optical properties of Nanomaterial's

i. Semiconducting NPs.

ii. Metallic NPs.

5.3 Synthetic Routes of nanomaterials: Top-down and bottom-up approaches.

5.4 Synthesis methods: Sol-gel, precipitation, chemical reduction, chemical vapor deposition, hydrothermal, electrodeposition.

5.5 Characterization of nanomaterials: X-Ray diffractometer, Scanning Electron Microscope, Transmission electron microscope.

5.6 Applications of nanotechnology.

References:

1. Industrial Chemistry-B.K. Sharma
2. Chemical process industries – Shrieve & Brink
3. Industrial chemistry – Kent
4. Industrial chemistry – Rogers
5. Industrial chemistry – R. K. Das
6. Mechanical chemistry – Burger
7. Nanotechnology: Principles and Practices – Sulbha Kulkarni
8. The Petroleum chemicals industry by R. F. Goldstine, e &Fn London
9. Fundamentals of petroleum chemical technology by P Below.
10. Petro Chemicals Volume 1 and 2 ; A Chauvel and Lefevrev ; Gulf Publishing company

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PHYSICAL CHEMISTRY

I. Non instrumental Experiments:

A. Any one of the following

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 N HCl / 0.5 N H_2SO_4.
2. The study of energy of activation of second order reaction i.e. reaction between $K_2S_2O_8$ and KI (Equal concentrations).
3. The study of energy of activation of second order reaction i.e. reaction between $K_2S_2O_8$ 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 $K_2S_2O_8$ 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 $K = \alpha^2.C/1-\alpha$
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 conduct metric 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 thiocynate 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. pH – metry (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.

Reference Books:

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).

Nature of Practical Examination

1) The practical examination will be of **200** marks.

2) The duration of practical examination will be of **three days - six and half hour per day**

3) Questions related to the practical exercise/project report/industrial visit carried out by the student should be asked in viva.

4) Use of scientific calculator is allowed.

5) S.I. units should be used wherever possible.

6) Use of Chart / Hand book / Text book of practical is allowed.

7) A student is expected to submit a journal certified by the Head of the Department.

8) A student not be permitted to appear at the practical examination unless he/she produces a certified journal. If the journal is lost, the student should produce a certificate from the Head of the Department stating that he/she has satisfactory completed the practical work but his / her journal is lost.

9) Use of Digital / Analytical / Chainometric / Single pan balance is allowed.

10) A student should submit one copy of project at the time of examination.

Each examiner should asses the project work for Five marks and sign the same. If any student will not submit project work, he/she will be given Zero mark for the project.

11) The distribution of marks for practical examination will be as follows:

A) Physical Chemistry 60 marks

i) Non-instrumental experiment 25 marks

ii) Instrumental experiment 25 marks

iii) Viva 05 marks

iv) Journal 05 marks

B) Inorganic Chemistry 65 marks

i) Gravimetric analysis 25 marks

ii) Preparation 15 marks

iii) Volumetric estimation 15 marks

iv) Viva 05 marks

v) Journal 05 marks

C) Organic Chemistry 60 marks

i) Mixture separation and identification of compounds 25 marks

ii) Estimation/Preparation 20 marks

iii) Derivative 05 marks

iv) Viva 05 marks

v) Journal 05 marks

D) Project 15 marks

Total:- 200 marks

SHIVAJI UNIVERSITY, KOLHAPUR.

Accredited By NAAC with 'A' Grade

Revised Syllabus For

B.Sc Part- III

Physics

Syllabus to be implemented from

June, 2020 onwards.

SHIVAJI UNIVERSITY, KOLHAPUR

B.Sc. Part-III Physics CBCS Syllabus with effect from June 2020

B.Sc. Part-III Semester-V

PHYSICS Paper-IX

DSE-E1 Mathematical Physics

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks -50 (Credits: 02)

UNIT-I

1. **Partial Differential Equation** **(8 hours)**

Introduction to differentialequations, Method of separation of variables for solving second order partial differential equations, Form of two dimensional Laplace differential equation in Cartesian coordinates and its solution, Three dimensional partial differential equation in Cartesian coordinates and its solution, The differential equation of progressive wave and its solution.

2. **Frobenious Method and Special Functions** **(10hours)**

Singular points of second order differential equations, Application of singularity to Legendre and Bessel differential equation, Series solution method of solving second order linear differential equation(Frobenious method) and its application to Legendre differential equation.

UNIT-II

1. **Some Special Integrals** **(6 hours)**

Gamma function, Properties of Gamma function, Beta function, Properties of Beta function,Relation between Beta and Gamma functions, Error function (Probability Integral).

2. **Complex Analysis** **(12 hours)**

Revision of complex numbers and their graphical representation: Geometrical representation, Equal complex numbers, Addition, Subtraction, Multiplication and Division of complex number by geometry. Types of complex numbers, square roots of complex numbers, Logarithmic function of complex variables, Euler's formula, De'Moivre's theorem, Cauchy-Riemann conditions.

B.Sc. Part-III Semester-V

PHYSICS Paper-X

DSE-E2 Quantum Mechanics

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks -50 (Credits: 02)

Unit-I

1. Matter Waves **(08 hours)**

Wave particle duality, De-Broglie hypothesis of matter waves, Derivation of wavelength of matter wave, Concept of wave packet, Relation between group velocity - phase velocity and group velocity-particle velocity, Davisson and Germer experiment, Uncertainty principle (statements only): position–momentum and energy- time, Application of uncertainty principle- non existence of free electrons in the nucleus.

2. Schrodinger's Wave Equation **(10 hours)**

Wave function and its physical interpretation, Condition of physically acceptable wave function, Normalized and orthogonal wave function, Schrödinger time dependent and time independent (steady state) wave equations in 1D and 3D, Probability current density(continuity equation), Eigen values and Eigen functions, Expectation values of dynamic variables.

Unit-II

1. Operators in Quantum Mechanics **(08 hours)**

Definition of an operator, Position operator (x), Linear momentum operator (p), Commutation relation in quantum mechanics, Commutation relation between x and p, Kinetic energy operator (T), Hamiltonian operator (H), Parity operator (π), Angular momentum operator (L) – components of angular momentum operator in Cartesian coordinate system, Ladder operators, Eigen values of L_z and L^2 (use equations for L^2 and Lz in spherical polar coordinates).

2. Applications of Schrodinger Equation **(10 hours)**

Particle in a rigid box (infinite potential well) in one dimension and three dimension, Step potential- reflection and transmission coefficients, Potential barrier- tunneling effect (qualitative treatment), One dimensional simple harmonic oscillator (operator method)- energy levels, zero point energy, Schrodinger equation for Hydrogen atom in spherical polar coordinates, Separation of radial and angular parts, Solution of radial part of Schrodinger's equation - Energy Eigen values.

ReferenceBooks

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill.
3. Microelectronic Circuits, M.H. Rashid, 2nd Edn.,2011, Cengage Learning.
4. Modern Electronic Instrumentation & Measurement Tech., Helfrick&Cooper,1990, PHI Learning
5. Digital Principles & Applications, A.P. Malvino, D.P. Leach &Saha, 7th Ed.,2011, Tata McGraw Hill
6. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
7. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.
8. OP-AMP and Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd.
9. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
10. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
11. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
12. A text book of Electronics, SantanuChattopadhay, New Central Book Agency, Kolkata
13. Basic Electronics, 2nd Edition , B. Basavaraj, H. N. Shivashankar, Vikas Publishing house pvt. Ltd. New Delhi.
14. Electronic principles, V. K. Mehta
15. Basic Electronics, Bhargava and Gupta

B.Sc. Part-III Semester-V

PHYSICS Paper-XI

DSE-E3 Classical Mechanics and Classical Electrodynamics

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks -50 (Credits: 02)

UNIT-I **(10 hour)**

1.Lagrangian Formulation

Constraints, Degrees of freedom, Generalized coordinates, Principle of virtual work, D'Alembert's principle, Lagrange's equation from D'Alembert's principle, Applications of Lagrange's equation to a particle in space, Atwood's machine and a bead sliding on uniformly rotating wire under force free condition.

(8 hour)

2.Techniques of Calculus of Variation

Hamilton's principle, Deduction of Hamilton's principle from D'Alembert's principle, Deduction of Lagrange's equation from Hamilton's principle, Applications-shortest distance between two points in a plane,Brachistochrone problem.

UNIT- II **(12 hours)**

1.Special Theory of Relativity

Inertial and non-inertial reference frames, Galilean transformation equations, Michelson-Morley experiment, postulates of special theory of relativity, Lorentz transformation equations, Relativistic addition of velocities, Length contraction, Time dilation, Variation of mass with velocity, Mass-energy relation.

(6 hours)

2. Charged Particles Dynamics

Poisson's and Laplace's equations and their physical significance, Laplace's equation in one dimension and its solutions, Motion of charged particle - in uniform electric field E, magnetic field B, Crossed uniform electric field E and magnetic field B.

Reference Books

1. Modern Physics, R. Murugeshan, 1997, S. Chand and Company Ltd.
2. Atomic Physics, J B Rajam, S Chand and Co.
3. Perspectives of Modern Physics, Arthur Beiser, McGraw Hill International Editions.
4. Concepts of Modern Physics, Arthur Beiser, Ahobhit Mahajan, S. Rai Choudhury, Sixth Edition, Tata McGraw Hill Education Private Ltd.
5. Modern Physics, S. L. Kakani and Shubhra Kulkarni, 2006, Viva books Private Ltd.
6. Modern Physics, D. L. Sehgal, K. L. Chopra and N. K. Sehgal, Reprint 1995, Sultan Chand & sons.
7. Introduction to Modern Physics, F. K. Richtmyer, E. H. Kennard, John N. Cooper, Sixth Edition, Tata McGraw Hill Education Private Ltd
8. A Text book of Quantum Mechanics, P.M. Mathews & K. Venkatesan, 2nd Edn.,2010, Tata McGraw Hill,
9. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
10. Quantum Mechanics Theory and Applications, A. K. Ghatak and S. Lokanathan, Third Edn.1995, Macmillan India Ltd.
11. Quantum Mechanics Theory and applications, AjoyGhatak, S. Lokanathan, 5th Ed,2017, Trinity.
12. Quantum Mechanics, Chatwal and Anand, Reprint 2010, Himalaya Publishing house.
13. Quantum Mechanics, Gupta, Kumar, Sharma, Thirtieth Edn., 2011, Jai Prakash Nath Publications.
14. Advanced Quantum Mechanics, SatyaPrakash, Reprint 2011, KedarNath Ram Nath Meerut.
15. Advanced Quantum Mechanics, B. S. Rajput, Ninth Edn., 2009, Pragati Prakashan.
16. Quantum Mechanics, B. N. Srivastava, Reprint 2011, Pragati Prakashan.
17. Quantum Mechanics, P. J. E. Peebles, 2003, Prentice Hall of India.
18. Quantum Mechanics, S. P. Singh,M. K. Bagade, Kamal Singh, S. Chand & company Ltd, New Delhi

B.Sc. Part III-Semester-V

PHYSICS Paper-XII

DSE-E4 Digital and Analog Circuits and Instrumentation

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks -50 (Credits: 02)

Unit-I

1.Digital Electronics **(08 hours)**

Review of basic logic gates, Derived logic gates (NOR, NAND, XOR and XNOR gates), NAND and NOR gates as universal gates, De Morgan's theorems, R-S flip flop, J-K flip-flop, Half adder, Full adder, 4 bit parallel binary adder.

2.TransistorsAmplifier and Sinusoidal Oscillators **(10 hours)**

Transistor Amplifier: Single stage transistor CE amplifier, D.C. and A.C. equivalent circuits, load line analysis-d.c. load line, a.c. load line and Q point.

Oscillator: Feedback in amplifiers and its types,theory of feedback oscillator, Barkhausen's criterion for sustained oscillations,Oscillatory circuit (tank circuit),essentials of transistor oscillator, sinusoidal oscillators-phase shift oscillator, Colpitts oscillator, Hartley oscillator, Crystal oscillator using transistors.

Unit-II

1. Cathode Ray Oscilloscope **(8 hours)**

Introduction to CRO, Block diagram of CRO, Principle, Construction and working of CRT, Applications of CRO: measurement of A.C. and D. C. voltages, periodic time, frequency and phase difference, Lissajous figures.

2. Operational Amplifier and Timer **(10 hours)**

Operational Amplifier: Differential amplifier and its type, Op-Amp, Block diagram of an Op- Amp. Op-Ampparameters, Characteristics of an ideal and practical Op-Amp (IC 741), Applications of Op-Amps: Inverting amplifier and Non-inverting amplifier, Adder, Subtractor, Differentiator, Integrator.

Timer IC: Block diagram of IC555, IC 555 Pin configuration, Applications of IC 555 as astable and monostablemultivibrator.

Reference Books

1. Classical Mechanics, Goldstein Herbert, NarosaPubli./ Pearson Edu. 2018
2. Classical Mechanics, Gupta, Kumar and Sharma, Pragati Praka.2012
3. Introduction to Classical Mechanics, Nikhil Ranjan Roy, S Chand Publ. 2016
4. Introduction to Classical Mechanics,Takwale R.G., Puranik P. S.,Tata McGraw 1979
5. Classical Mechanics,Panat P.V., NarosaPubli. 2016
6. Atomic physics, J B Rajam S Chand
7. Concepts of Modern Physics, ArthurBeiser, McGraw Hill
8. Introduction to Special Relativity, Robert Resnick, Wiley India
9. Classical Electrodynamics, PuriS.P., Tata McGraw/Alpha Science 2011
10. Classical Electrodynamics, Jackson J. D., Wiley India , 2007
11. Electromagnetics, Laud B.B., New Age Interna. 2011

B.Sc. Part-III Semester-VI

PHYSICS Paper-XIII

DSE-F1 Nuclear and Particle Physics

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks -50 (Credits: 02)

Unit-I

1. General Properties of Nuclei and Nuclear Model **(10 hours)**

Constituents of nucleus and their intrinsic properties, Quantitative facts about size, mass, chargedensity (matter energy), binding energy, average binding energy and its variation with mass number,Liquid drop model approach, Semi empirical mass formula, Magic numbers.

2. Particle Accelerators **(8 hours)**

Need of accelerators,Cyclotron- construction, working, theory and its limitations,Principle of phase stable orbit, Synchrocyclotron - construction and working, Synchrotrons- electron synchrotron and proton synchrotron, Betatron - principle, construction and workingcondition, expression of energy gain.

Unit-II

1. Nuclear Detectors **(10 hours)**

Ionization chamber, Geiger Muller counter- construction, working and theory, dead time and recoverytime, quenching mechanism, Construction of photo-multiplier tube (PMT), Scintillation detector-principle, construction and working, Wilson cloud chamber, Semiconductor detector, Cerenkovradiations, Cerenkov detector.

2. Particle Physics **(8 hours)**

Particle interactions, Classification of elementary particles, Symmetries and conservation laws-energy,momentum, angular momentum and parity, Baryon number, Lepton number, Concept of quark model.

ReferenceBooks

1. Introductory nuclear Physics, Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of nuclear physics, Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
3. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004)
4. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
5. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
6. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP-Institute of Physics Publishing, 2004).
7. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
8. Theoretical Nuclear Physics, J.M. Blatt &V.F.Weisskopf (Dover Pub.Inc., 1991)
9. Nuclear Physics by John Lilley,The Manchester Physics Series – Willy
10. Nuclear Physics by S. B. Patel, New age international (p) lit. Publishers New Delhi.
11. Modern Physics by R. Murugeshan, S. Chand & company Ltd, Ram Nagar New Delhi
12. Nuclear Physics by D. C. Tayal, Himalaya Publishing house
13. Concept of modern physics by ArthirBeiser, Tata McGraw- Hill publishing company ltd. New Delhi
14. Atomic and nuclear structure by D. K. JHA, Discovery publishing house New Delhi
15. Nuclear energy by D. K. JHA Discovery publishing house New Delhi)
16. Nuclear physics by S. N. Ghoshal , S. Chand & company Ltd, Ram Nagar New Delhi

B.Sc. Part-III Semester-VI

PHYSICS Paper-XIV

DSE-F2 Solid State Physics

Theory: 36 Hours (45 lectures of 48 min)

Marks-50 (Credits: 02)

Unit-I

1. Crystal Structure **(10 hours)**

Solids: amorphous, polycrystalline and crystalline materials; lattice, basis, unit cell- primitive, non-primitive unit cell, symmetry operations, symmetry elements of cube, Bravais lattice in two and three dimensions, Miller indices, Miller indices andinter-planer spacing, Simple crystal structures: SC, BCC, FCC and HCP(Co-ordination number, atomic radius, atoms per unit cell and packing fraction)

2. X-Ray Diffraction **(08 hours)**

Reciprocal lattice and its properties, Brillouin zone, Diffraction of X-rays by crystals, Ewald construction, Bragg's law in reciprocal lattice, Experimental methods in X-ray diffraction (Laue method,rotating crystal method,powder photograph method),Analysis of cubic crystal by powder method.

Unit-II

1. Magnetic Properties of Matter **(10 hours)**

Classical Langevin theory of diamagnetic and paramagnetic materials, Quantum mechanical treatment of paramagnetism, Curie's law, Weiss theory of ferromagnetism and ferromagnetic domains, Explanation of B-H curve, Hysteresis and energy loss.

2. Elementary Band Theory of Solids **(8 hours)**

Concept of density of states, Bloch theorem (statement only), Kroning–Penny model, Origin of energy gap, Velocity of electrons according to band theory, Effective mass of an electron, Distinction between metals, semiconductors and insulators, Hall Effect - Hall voltage and Hall Coefficient.

Reference Books

1. Introduction to Solid State Physics, Charles Kittle, 8th Ed.,2004,Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006,Prenice-Hall of India
3. Introduction to Solid, Leonid V.Azaroff,2004,Tata Mc-Graw Hill
4. Solid State Physics, Neil W. Aschroft and N. David Mermin, 1976, Cengage Learning
5. Solid State Physics,Rita John,2014,Mc-Graw Hill
6. Solid State Physics, Adrianus J. Dekker, Macmillan Publishers India Ltd.
7. Solid State Physics, M.A.Wahab,3rd Ed.,2018,Narosa Publishing House Pvt. Ltd.
8. Solid State Physics, S.O.Pillai,5th Ed., New Age International(P) Ltd., Publishers.
9. Fundamentals of Solid State Physics, Saxena-Gupta-Saxena, (PragatiPrakashan Meerut)
10. Solid State Physics, R. L. Singhal
11. Solid State Physics, C.M. Kachhava (Tata McGraw Hill Publication)
12. Elements of X-ray diffraction, B.D.Cullity and S.Stock
13. Solid state electronic devices, B.G.Streetman& S.K.Banerjee,5thEd.[PHI Learning Delhi.

B.Sc. Part-III Semester-VI

PHYSICS Paper-XV

DSE-F3 Atomic and Molecular Physics and Astrophysics

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks -50 (Credits: 02)

UNIT-I

1. Atomic Spectra **(09 hours)**

Observed hydrogen fine structure, Spectral notations and optical spectral series for doublet structure, Spectrum of sodium and its doublet fine structure, Selection and intensity rules for fine structure doublets, Normal order of fine structure doublets, Electron spin-orbit interaction,Normal and anomalous Zeeman effect and their explanation from vector atom model, Lande's g factor.

2. Molecular Spectra **(09 hours)**

Molecular bond, Electron sharing, H_2^+ molecular ion, The hydrogen molecule, Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibrational spectra, Vibration – rotation spectra, Electronic spectra of diatomic molecules.

UNIT-II

1 Raman Spectra **(4 hours)**

Raman Effect,Characteristic properties of Raman lines, Classical and quantum theory of Raman Effect,Difference between Raman spectra and infrared spectra.

2. Structure of Universe: **(08 hours)**

Big-Bang theory, Steady state theory, Oscillating theory,Hubble law, Cosmological tests, Milky Way galaxy, Origin of solar system - Condensation theory; arguments for and against the theory.

3. Stellar Evolution **(06 hours)**

The H–R Diagram,Evolution of main sequence stars - Red giants and White dwarfs, Evolution of more massive stars- Supernova, Neutron star, Black hole,Surface of the Sun, Sunspots, Sunspot cycle.

Reference books

1. Atomic and Nuclear Physics – H. Semat and T. E. Albright.
2. Introduction to Atomic Spectra – H. E. White.
3. Concepts of Modern Physics – Arthur Beiser.
4. Perspectives of Modern Physics – Arthur Beiser.
5. Spectroscopy (Atomic and Molecular) – Gurdeep Chatwal, Sham Anand.
6. Astronomy – Fundamentals and Frontiers – Robert Jastrow and M. H.Thompson
7. Astronomy – Frank Bash.
8. Foundation of Astronomy, Michael A. Seeds,10^{th} edition, Thomson Learning, Inc., USA, 2008.

B.Sc. Part-III Semester-VI

PHYSICS Paper-XVI

DSE-F4 Energy Studies and Materials Science

Theory: 36 Hours (45 lectures)

Marks 50 (Credits: 02)

UNIT-I

1. Energy and Wind Energy **(8 hrs)**

Energy, Forms of energy, Man and environment, Energy chains, Classification of energy resources, Energy demands, Age of renewable and alternatives,Wind energy, Wind energy chains, Wind energy quantum, Planning of wind farm, Wind power density, Efficiency factor of wind turbine (P-H graph), Power of wind turbine for a given incoming wind velocity, Types of a wind turbine generator unit, Horizontal axis propeller type wind turbine generator unit.

2. Solar Energy **(8 hrs)**

Solar energy, Solar energy spectrum (UV,Visible and IR), Utilization of solar energy-thermal route, photovoltaic route, Essential subsystems in solar energy plant, Solar constant, Clarity index, Solar insolation, Solar energy from satellite station through microwave to earth station, Solar photovoltaic systems, Merits and limitations of solar PV systems, Prospects of solar PV systems, Power of a solar cell and solar PV panel.

3. Biomass Energy **(2 hrs)**

Origin of biomass, Biomass energy resources (biomass from cultivated crops, biomass from waste organic matter), Biomass conversion process (biochemical conversion-anaerobic digestion and fermentation)

UNIT-II

1. Superconductivity **(6 hrs)**

Idea of superconductivity, Critical temperature, Critical magnetic field, Meissner effect, Type-I and Type-II superconductors, London equation and penetration depth, Isotope effect, Application (magnetic levitation)

2. Nanotechnology **(12 hrs)**

Introduction tonanoscience and nanotechnology, Length scales relevant to nanoscience, Nanostructures: 1D, 2D and 3Dnanostructures, Size effects in nanosystems, Quantum

confinement, Synthesis of nanostructured materials(Top down and bottom up approach), Photolithography, Ball milling,Nucleation and growth, Applications of nanotechnology (Spintronics, Molecular electronics, Nanobiotechnology)

ReferenceBooks

1. Energy Technology – Non-conventional, Renewable and Conventional – S. Rao and Dr. Parulekar.
2. Non-conventional Energy sources - G. D. Rai (4th edition), Khanna Publishers, Delhi.
3. Solar Energy - S.P. Sukhatme (second edition), Tata Mc.Graw Hill Ltd, New Delhi.
4. Solar Energy Utilization - G. D. Rai (5th edition), Khanna Publishers, Delhi.
5. Non-conventional Energy Sources – G. D. Rai (Khanna Publishers).
6. Elements of Material Science and Engineering - I.H.Vanvlach (4th Edition)
7. Material Science and Engineering - V. Raghva
8. Material science and metallurgy for Engg.-Kodigire V. D. Everest publication house, Pune
9. Material Science and Engg. - 5th Edition- V. Raghavan PHI Learning Pvt. Ltd. Delhi
10. Nanotechnology: Principles and Practices,Sulbha K Kulkarni (2nd Edition), Capital Publishing Co. New Delhi.
11. Science at the Nanoscale: An Introductory Textbook, Chin Wee Shong, ChongHaur Sow, Andrew T. S. Wee (Pan Stanford Publishing Pte. Ltd.)
12. Introduction to Nanoscience, S.M. Lindsay (Oxford University press)

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B.Sc.Part III Physics Laboratory Experiments

Total Marks: 200 Credits: 08

- **Group-I**

1. Resonance pendulum
2. S.T. of soap solution
3. Surface tension of mercury by Fergusson modified method
4. Y and η using Flat Spiral Spring
5. Y by Koenig's method
6. Y by Cornu's spiral
7. C program to arrange the given set of numbers in ascending/descending order
8. C program to findlargest/smallest number from a given set of numbers
9. Scilab Expt. 1 (problem from Quantum Mechanics)
10. Scilab Expt. 2 (problem from Quantum Mechanics)

- **Group-II**

1. Cardinal points by turn table method
2. Cardinal points by Newton's method
3. Refractive index of glass by Brewster's law
4. Diffraction at a Single Slit
5. Diffraction at cylindrical obstacle
6. Lloyd's single mirror
7. Double refracting prism
8. Diameter of Lycopodium powder
9. Spherical aberration
10. Absorption spectrum of a liquid ($KMnO_4$ solution)

- **Group-III**

1. Self Inductance by Owen's Bridge
2. Measurement of B_H , B_V and θ using Earth Inductor /Hysteresis by magnetometer method
3. Mutual inductance using Ballistic galvanometer.
4. Resistance of B.G. by half deflection method
5. e/m of Electron By Thomson's Method/Calibration of wire by Carey Foster bridge
6. Calibration of wire by Griffith's method

7. Absolute capacity of condenser
8. I-V characteristics of Solar Cell
9. Band gap energy of semiconductor using p-n junction diode
10. Determination of Plank's constant by using LED

- **Group–IV**

1. To verify the truth tables of NAND, NOR, Ex-OR and Ex-NOR gates by usingbasic gates with IC-74 series.
2. To verify the De-Morgan's theorems by using IC-74 series.
3. To design a single stage CE amplifier of given gain using voltage divider bias.
4. To built and test Colpitts oscillator using BJT.
5. To builtand test phase shift oscillator using BJT.
6. To determine A.C. and D.C. sensitivity of the C.R.O. andto measure unknown frequency.
7. To design and test an astablemultivibrator using IC-555 Timer.
8. To design and testmonostablemultivibratorusing IC-555 Timer.
9. To studyOp-amp as an inverting amplifier.
10. To study Op-amp as Schmitt trigger.

Skill Testing Experiments

- **Group-V-A**

1. Study of divergence of LASER beam
2. Measurement of wavelength of LASER using plane diffraction grating
3. Schuster's method and optical leveling of spectrometer
4. Obtaining Biprism fringes without lateral shift
5. Measurement of distance between two coherent sources in Biprism experiment
6. Polar graph using photocell/photovoltaic cell
7. Study of quantum tunneling effect using tunnel diode
8. Testing of electronic components
9. C program – Edit,save and execute given C program
10. C program – Edit,save and execute given C program

- **Group – V-B**
    1. Radius of Capillary bore using mercury thread
    2. Determination of lattices constant using given XRD powder pattern
    3. Estimation of errors
    4. Measurement of phase shift of RC network using CRO
    5. Study of Half and Full adder
    6. Simplification of digital circuit using Boolean laws (paper-work).
    7. Measurement of resistance of galvanometer (Kelvin's method)
    8. Electrical wiring of bulb, switch and plug.
    9. Tracing of given electronic circuit/ build the given circuit using breadboard
    10. Assembling of given electronic circuit(soldering method)

- **Group VI: Assessment of Annual Work of a Student**
    1. Certified Laboratory Journal.
    2. Study Tour Report.
    3. Seminar Report (2 Seminars) / Project work.

- **Reference Books for practical**

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition,2011, Kitab Mahal, New Delhi.
4. B.Sc. Practical Physics, C.L.Arora, S.Chand & Company Pvt.Ltd., New Delhi
5. B.Sc. Practical Physics, Harman Singh,Hemane, 2012 Edition.

- **Revised Scheme of Practical Examination for B. Sc. Part – III**

1. Practical examination will be conducted annually.
2. Practical examination will be conducted for three days per batch.
3. The examination will be conducted in two sessions per day and each session will be of three hours duration.

4. Every candidate should perform one experiment each from Groups I to IV and one experiment each from Group V-A and Group V-B (total 6 experiments).
5. Study tour anywhere in India is compulsory.
6. At least eighty percent practical should be completed by the student.
7. The marks distribution for practical is as below.

Practical groups	**Marks**
Group I	30
Group II	30
Group III	30
Group IV	30
Group VA-15, Group VB-15	30
Group VI I)Certified laboratory journal (certified Journal- 10 marks, neatness-5 marks, punctuality- 5 marks) II) Study Tour Report III) Seminar Report / Project Report	 20 10 20
Total Marks	**200**

Nature of Question Paper

Theory: Time -2 hours, Marks-50

Question 1: Select the correct alternative (Compulsory 10 questions) 10 marks

(Four alternatives for each question)

Question 2: (Attempt any Two out of three) 20 marks

(Long answer type)

Question 3: (Attempt any four out of six) 20 marks

(Short answer type)

- **Note:** Equal weightage should be given to each unit.

Reference Books

1. Advanced calculus, Robert C. Wrede, Murray Spiegel.
2. Differential Equations with Modeling Applications, Dennis G.Zill.
3. Partial Differential Equations,Gupta Malik and Mittal.
4. Differential Equations,Gupta Malik and Mittal.
5. Differential Equations,RamachandraRao,H. R. Anuradha.
6. Partial Differential Equations, N. P. Bali.
7. Differential Equations, N. Ch. S. N. Iyenger.
8. Mathematical Physics, B. S. Rajput.
9. Mathematical Methods for Physicists, Arfken, Weber, 2005, Elsevier.
10. Mathematical Methods for Scientists and Engineers, McQuarrie, 2003, Viva Books.
11. Mathematical Physics, H. K. Das, Rama Varma.
12. Essential Mathematical methods, K. F. Riley, M. P. Habson, 2011,Cambridge.
13. Mathematics for Physicists, Susan M.Lea, 2004, Thomson Books/Cole.