B.Sc.-III (Chemistry), Syllabus
2019-20, 2020-21 & 2021-22

SEMESTER V

Paper	Title	Max. Marks	Minimum Pass Marks
I	INORGANIC CHEMISTRY	35	12
II	ORGANIC CHEMISTRY	35	12
III	PHYSICAL CHEMISTRY	35	12
I	PRACTICAL CHEMISTRY-I	45	16

SEMESTER VI

Paper	Title	Max. Marks	Minimum Pass Marks
I	INORGANIC CHEMISTRY	35	12
II	ORGANIC CHEMISTRY	35	12
III	PHYSICAL CHEMISTRY	35	12
II	PRACTICAL CHEMISTRY-II	45	16

CHEMISTRY
SEM-V

PAPER I : INORGANIC CHEMISTRY

Max. Marks: 35 — Pass Marks: 35%
Semester Paper=26 — Time: 3 hrs
Internal Assessment=9 — 30 Hrs (2 Hrs/Week)
3 Periods/Week

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 4 marks each. Section C will consist of 5 short answer questions that will cover the entire syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions (Section C all questions being compulsory) selecting two questions from each of A & B Sections.

SECTION-A

I. Metal-ligand Bonding in Transition Metal Complexes. 10 Hrs.

Limitations of valence bond theory, an elementary idea of crystal- field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.

II. Thermodynamic and Kinetic Aspects of Metal Complexes 5 hrs.

A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes.

SECTION -B

III. Magnetic Properties of Transition Metal Complexes 7 Hrs.

Types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, Correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moment, application of magnetic moment data for 3d-metal complexes.

IV. Electronic Spectra of Transition Metal Complexes. 8 Hrs.

Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series. Orgel-energy level diagram for d^1 and d^9 states, discussion of electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complexion.

CHEMISTRY
SEM-V

PAPER I: ORGANIC CHEMISTRY

Max. Marks: 35 Pass Marks: 35%
Semester Paper=26 Time: 3 hrs
Internal Assessment=9 30 Hrs (2 Hrs/Week)
3 Periods/Week

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 4 marks each. Section C will consist of 5 short answer questions that will cover the entire syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions (Section C all questions being compulsory) selecting two questions from each of A & B Sections.

SECTION-A

I. Spectroscopy **8 hrs.**

Nuclear magnetic resonance (NMR) spectroscopy.

Proton magnetic resonance (^{1}H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2 tribromoethane, ethyl acetate, toluene and acetophenone.

II. Electromagnetic spectrum: Absorption Spectra 7hrs.

Ultraviolet (UV) absorption spectroscopy-absorption laws (Beer-Lambert's law, Molar absorptivity, presentation and analysis ofUV Spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones.

SECTION - B

III Infrared (IR) 5 hrs.

Infrared (IR) absorption spectroscopy-molecular vibrations, Hooke's law, Selection rules, intensity and position of IR bands, measurement of lR spectrum, fingerprint region, characteristic absorption of various functional groups and Interpretation of IR spectra of simple organic compounds.

Problems pertaining to the structure elucidation of simple organic compounds using UV, IR, and PMR spectroscopic techniques.

IV. Organometallic Compounds 5 hrs.

Organomagnesium Compounds The Grignard reagents formation, structure and chemical reactions.

Organozinc compounds: formation and chemical reactions.

Organolithium compounds: formation and chemical reactions.

V. Organosulphur Compounds 5 hrs.

Nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, and sulphonamides.

CHEMISTRY
SEM-V

PAPER III: PHYSICAL CHEMISTRY

Max. Marks: 35 Pass Marks: 35%
Semester Paper=26 Time: 3 hrs
Internal Assessment=9 30 Hrs (2 Hrs/Week)
3 Periods/Week

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 4

marks each. Section C will consist of 5 short answer questions that will cover the entire syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions (Section C all questions being compulsory) selecting two questions from each of A & B Sections.

SECTION-A

I. Elementary Quantum Mechanics 15 Hrs.

Black-body radiations, Planck's radiation law, photoelectric effect, heat capacity of solids.

Sinusoidal wave equation Hamiltonian operator, Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box.

Schrodinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions.

SECTION-B

II. Spectroscopy **15 hrs.**

Introduction:

Electromagnetic radiation, regions of spectrum, basic features of different spectrometers, statement of Born-Oppenheimer approximation, degrees of freedom.

Rotational Spectrum:

Diatomic molecules. Energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, determination of bond length, qualitative description of non-rigid rotor, isotope effect.

Vibrational Spectrum:

Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.

B.Sc. III, Semester V

PRACTICALS

Max. Marks : 45 Time: 4 Hrs.

6 Periods/Week

INSTRUCTIONS FOR EXAMINERS AND CANDIDATES

Candidate are required to prepare inorganic complex and synthesise organic

compound. The candidate will perform experiments. Distribution of marks will be as under:

1. Viva-Voce = 10
2. Note Books = 5
3. Inorganic Complex = 15 (5 for initial write up)
4. Organic Synthesis = 15 (5 for initial write up)

Total 45

Synthesis and Analysis

(a) Preparation of sodium trioxalatoferrate(III), Na_3 $[Fe(C_2O_4)_3]$ and determination of its composition by permagnometry.

(b) Preparation of Ni-DMG complex, $[Ni (DMG)_2]^{2+}$

(c) Preparation of copper tetra-ammine complex. $[Cu (NH_3)_4] S0_4$.

(d) Preparation of cis-and trans-bis(oxalato)diaquachromate(III) ion.

Synthesis or Organic Compounds

(a) Iodoform from ethanol and acetone

(b) Aromatic electrophlic substitution of benzene

1. p-nitroacetanilide
2. 2,4,6-tribromophenol
   Diazotization/Coupling
3. Preparation of methyl orange and methyl red
4. Preparation of benzoic acid from toluene
5. Reduction

Preparation of m-nitroaniline from m-dinitrobenzene

CHEMISTRY
SEM-VI

PAPER I: INORGANIC CHEMISTRY

Max. Marks: 35 Pass Marks: 35%
Semester Paper=26 Time: 3 hrs
Internal Assessment-9 30 Hrs (2 Hrs/Week)
3 Periods/Week

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 4 marks each. Section C will consist of 5 short answer questions that will cover the entire

syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions (Section C all questions being compulsory) selecting two questions from each of A & B Sections.

SECTION-A

I. Hard and Soft acids and Bases (HSAB) 5 Hrs.

Classification of acids and bases as a hard and soft, Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.

II. Bioinorganic Chemistry 10 Hrs.

Essential and trace elements in biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{+2}, Nitrogen fixation.

SECTION-B

III. Silicones and Phosphazenes 5 Hrs.

Silicones and Phosphazenes as examples of inorganic polymers,nature of bonding in triphosphazenes.

IV. Organometallic Chemistry 10 Hrs.

Definition, Nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls of' Li, Al, Hg, Sn and Ti, a brief account of metal-ethylene complexes and homogeneous hydrogenation, mononuclear carbonyls and the nature of bonding in metal carbonyls.

CHEMISTRY

SEM-VI

PAPER II: ORGANIC CHEMISTRY

Max. Marks: 35 Pass Marks: 35%
Semester Paper=26 Time: 3 hrs
Internal Assessment-9 30 Hrs (2 Hrs/Week)
3 Periods/Week

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 4

marks each. Section C will consist of 5 short answer questions that will cover the entire syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions (Section C all questions being compulsory) selecting two questions from each of A & B Sections.

SECTION-A

I. Heterocyclic Compounds **7 hrs.**

Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on mechanism of electrophlic substitution. Mechanism of nucleophlic substitution reaction in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed five and six membered heterocycles.Preparation and reactions of indole, quinoline and isoquinoline wi th special reference to Fischer indole synthesis, Skraup synthesis and Bischler- Napieralski synthesis. Mechanism of electrophlic substitution reactions of indole, quinoline and isoquinoline.

II. Synthesis of Polymers **3 hrs.**

Ziegler-Natta polymerziation and vinyl polymers. Condensation or step growth polymerziation. Urea formaldhehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers.

III. Organic Synthesis Via Enolatcs

Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate: the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Alkylation and acylation of enamines.

SECTION - B

IV. Carbohydrates **7 hrs.**

Classification and nomenclature, Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses.

Configuration of monosaccharides. Erythro and threodiastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers, and esters. Determination of ring size of monosaccharides. Cyclic structure of D (+)-glucose. Mechanism of mutarotation.

Structures of ribose and deoxyribose.

An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharide starch and cellulose without involving structure determination.

V. Amino Acids, Pcptidcs, Proteins and Nucleic Acids **8 hrs.**

Classification, structure and stereochemistry of amino acids. Acid base behaviour,

isoelectric point and electrophoresis. Preparation and reactions of α-amino acids.

Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical levels of protein structure. Protein denaturation/renaturation.

Nucleic acids: Introduction, Constituents of nucleic acids Ribonucleosides and ribonucleotides. The double helical structure of DNA.

CHEMISTRY
SEM-VI

PAPER III: PHYSICAL CHEMISTRY

Max. Marks: 35 — Pass Marks: 35%
Semester Paper=26 — Time: 3 hrs
Internal Assessment-9 — 30 Hrs (2 Hrs/Week)
3 Periods/Week

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective section of the syllabus and will carry 4 marks each. Section C will consist of 5 short answer questions that will cover the entire syllabus and will be of 2 marks each. Use of scientific non-programmable calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions (Section C all questions being compulsory) selecting two questions from each of A & B Sections.

SECTION-A

I. Raman Spectrum : 15 hrs.

Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.

II. Electronic Spectrum :

Concept of potential energy curves for bonding and antibondingmolecular orbitals, qualitative description of selection rules and Franck-Condon principle. Qualitative description of σ, π and n M.O. their energy levels and their respective transitions.

IV. Solid State 15 hrs.

Definition of space lattice and unit cell.

Laws of crystallography-(i) Law of constancy of interfacial angles. (ii) Law of rationality of indices (iii) Law of symmetry elements in crystals.

X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure ofNaCI, KCI and CsCI (Laue's method and powder method).

SECTION-B

III. Photochemistry

Interaction of radiation with matter, difference between thermal and photochemical process. Laws of photochemistry: Grothus-Drapperlaw, Stark-Einstein law, Jablonski diagram depiciting various processes occurring in the excited state, qualitative description of fluorescence, non- radiative processes (internal conversion, intersystem crossing), quantumyield, photosensitized reactions- energy transfer processes (simple examples). Basic concepts of Laser and Maser. Photochemistry of vision and colour.

B.Sc. III, Semester VI
Practical Chemistry

Max. Marks : 45 Time: 4 hrs

6 Periods/Week

INSTRUCTIONS FOR EXAMINERS AND CANDIDATES

Candidate are required to prepare perform column Chromatography experiment and the physical experiments. The candidate will perform experiments from physical, chemistry. Distribution of marks will be as under:

1. Viva-Voce = 10
2. Note Books = 5
3. Column Chromatography = 5
4. Models = 5
5. Physical Experiments = 20* (5 for initial write up both experiments)

   * (Full credit may be given for error upto 10% and one mark may be deducted for additional 5% error.)

Laboratory Techniques

1. Column Chromatography
2. Separation of fluorescein and methylene blue.
3. Separation of leaf pigments from spinach leaves.
4. Physical Experiments

(a) To determine the strength of the given acid conductometrically using standard alkali solution.

(b) To determine the solubility and solubility product of a given sparingly soluble electrolyte conductometrically.

(c) To study the saponification of ethyl acetate conductometrically.
(d) To determine the ionisation constant of a weak acid conductometrically.
(e) To determine the strength of the given acid solution pH- metrically by using standard alkali solution.
(f) To determine the molar refraction of methanol, ethanol and propanol.
(g) To study the distribution of benzoic acid between benzene and water, and ether and water.
(h) Knowledge of Stereochemical Study of Organic Compounds.

Rand S configuration of optical isomers.
E, Z configuration of geometrical isomers.
Conformational analysis of cyclohexanes and substituted cyclohexanes.

BOOKS SUGGESTED (THEORY COURSES)

1. *Basic Inorganic Chemistry,* F.A. Cotton, G Willdson and P.L. Gaus, Wiley.
2. *Concise Inorganic Chemistry,* J.D. Leee, ELBS.
3. *Concept of models of Inorganic Chemistry,* B. Douglas, D. McDaniel, and J. Alexander, Jolin Wiley.
4. *Inorganic Chemistry,* D. E. Shriver, P. W. Atkins and C.H. Langford, Oxford.
5. *Inorganic Chemistry,* W. W. Porterfield Addison-Welsey.
6. *Inorganic Chemistry,* A. G Sharpe, ELBS
7. *Inorganic Chemistry,* G. L. Miessler and D. A. Tarr, Prentice Hall.
8. *Inorganic Chemistry,* Morrison and Boyd, Prentice-Hall.
9. *Inorganic Chemistry,* L.G Wade Jr. Prentice-Hall.
10. *Fundamentals of Organic Chemistry,* Solomons, John Wiley.
11. *Organic Chemistry,* Vol. I, II & III, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).

73639680. *Organic Chemistry,* F.A Carey, McGraw-Hill, Inc.

73639720. *Introduction to Organic Chemistry,* Streitwieser, Healthcock and Kosover and Kosover, Macmillan.

73639721. *Physical Chemistry,* G.M. Barrow, International Student edition, McGraw Hill.

15. *University General Chemistry,* C.N.R. Rao. Macmillan.
16. *Physical Chemistry,* R.A Alberty, Wiley Eastern Ltd.
17. *The Elements of Physical Chemistry,* P. W. Atkins, Oxford.
18. *Physical Chemistry Through Problems,* S.K. Dogra and S. Dogra, Willey Eastern

Ltd.
19. Fundamentals of Photochemistry, Rohtga and Mukherji.

BOOKS SUGGESTED (LABORATORY COURSES)

1. *Vogel's Qualitative Inorganic Analysis,* revised, Svehla, Orienl P Longman.
2. *Vogel's Text book of Quantitative Inorganic Analysis* (revised), J.Bassett, R. C. Denney, G.H. Jeffery and J. Mendham, ELBS.
3. *Standard Methods of Chemical Analysis,* W. W. Scott, The Technical Press.
4. *Experimental Inorganic Chemistry,* W. G. Palmer, Cambridge.
5. *Handbook of Preparative Inorganic Chemistry,* Vol. I & II, Brauer, Academic Press.
6. *Inorganic Synthesis,* Mc-Graw Hill.
7. *Experimental Organic Chemistry,* Vol. I & II, P. R. Singh, D.S. Gupta, and Bajpai, Tata Mc-Graw Hill.
8. *Laboratory Manual In Organic Chemistry,* R. K. Bansal, Wiley Eastern.
9. *Vogel's Textbook of Practical Organic Chemistry,* B. S. Furniss, Al Hannaford, V. frogers, P.W.G. Smith and AR. Tatchell, ELBS
10. *Experiments in General Chemistry,* C.N.R. Rao and U.C. Agarwal, East-West Press.
11. *Experiments in Physical Chemistry,* R.C. Das, and B. Behra, Tata Mc-graw Hill.
12. *Advanced Practical Physical Chemistry,* J.B. Yadav, Goel Publishing House.
13. Advanced Exp. Chemistry, Vol. I-Physical, J.N. Gurutu and R. Kapoor, S. Chand & Co.
14. Selected Exp. in Physical Chemistry, N.G. Mukherjee, J.N. Ghose & Sons.
15. Exp. in Physical Chemistry, J.C. Ghosh, Bharti Bhavan.