M.Sc.

Chemistry	
Program Out Come	-To broaden one's understanding of chemistry domains and to master a certain discipline of chemistry. Ability to communicate clearly and effectively both within and across disciplines. -Developed entrepreneurial skills by utilising an industrial area on the outside of our institution. -Establishment of a research centre with the help of an interdisciplinary university course. -Persuasion of a doctorate in the subject and further research. Development of related short-term courses relating to the requested subject in order to increase knowledge and application -Student training/internships in the public sector, commercial sector, and national laboratories. -Leading interdisciplinary work with specialists from various domains and participating in scientific conversations with respect. -To comprehend and use the best chemical research safety practises.
Programe Specific Outcome	-Develop a scientific mindset and explain scientific information clearly, concisely, and precisely. -Look for jobs in the chemical industry (dyes and pharmaceuticals), national laboratories, and research institutions at all levels. -Use everything you've learned about sustainable and environmentally friendly technologies. -Develop logical thinking skills to solve problems and become more goal-oriented. - Research culture development in Ph.D. programmes at national and international institutes/universities -Take part in competitive examinations held by several public service commissions and other government agencies. -In the context of Atma Nirbhar Bharat, develop and use core knowledge to construct small scale industry. -Start with a pilot plant and work your way up to bulk production. - Improve students' scientific temperament in preparation for the development of a research culture and the execution of policies at the global and local levels. - Clear communication of scientific information in written and orally.

Structure of M. Sc, Syllabus

Semester-I

M. Sc. (Chemistry)

Sr. No.	Course Code	Course Title	L	T/C/S	Credit
1	1803080201010001	Inorganic Chem	4		4
2	1803080201020001	Organic	4		4
3	1803080201030001	Physical	4		4
4	1803080201040001	Instrumental and chemical analysis	4		4
5		Practicals + T/C/S	12	3	6 + 3
			28	3	25

Faculty Code: Science Subject code: Level code:

Name of program: M. Sc. Subject:

ChemistryExternal Examination Time Duration: 03hrs

Name of Exam	Semester	Paper No	Course group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	I	I	Core	04	30	70	100
		II	Core	04	30	70	100
		III	Core	04	30	70	100
		IV	Core	04	30	70	100
			Practical + T/C/S	06 +3	60	140	200
			Total	25	180	420	600

Structure of M. Sc, Syllabus

Semester-II

M. Sc. (Chemistry)

Sr. No.	Course Code	Course Title	L	T/C/S	Credit
1	1903080202010001	Inorganic Chem	4		4
2	1903080202020001	Organic	4		4
3	1903080202030001	Physical	4		4
4	1903080202040001	Instrumental and chemical analysis	4		4
5		Practicals + T/C/S	12	3	6 + 3
			28	3	25

Faculty Code: Science Subject code: Level code:

Name of program: M. Sc. Subject:

ChemistryExternal Examination Time Duration: 03

hrs

Name of Exam	Semester	Paper No	Course group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	II	I	Core	04	30	70	100
		II	Core	04	30	70	100
		III	Core	04	30	70	100
		IV	Core	04	30	70	100
			Practical + T/C/S	06 + 3	60	140	200
			Total	25	180	420	600

Course Outcomes

PAPER-I (Inorganic Chemistry)

SEMESTER-I

UNIT-1: Symmetry and Group Theory In Chemistry and Its applications: 12 Periods

Representation of Groups: Prepration of matrices and vectors matrix notations for geometrical transformations, orthogonality theorem and its consequences, reducible and irreducible representations and their relation, preparation of character table for C_{2v} and C_{3v} point groups, Application of group theory to-Transformation properties of atomic crystals.

UNIT-2 :Quantum Mechanics: 11 Periods

Discussion of solution of schrodinger equation to same model system e.g. the one dimensional harmonic oscillator, two particale rigid rotator. Ordinary angular momentum , generalized angular momentum, Eigen functions of aungular momentum, Eigen values of angular momentum, different types of operators and their uses, addition of angular momentum, spin, Russel-Saunders terms and coupling scheme, term separation energies of the p^n and d^n configuration, magnetic effect:spin orbit coupling and Zeeman effect (splitting).

UNIT-3:Inorganic Reaction Mechanism: 11 Periods

Labile ana inert complexes, factors responsible for lability and inertness of complexes.

Reactivity of metal complexes, ligand replacement reaction: classification of mechanism and energy profile of reaction. Inert and Iabile complexes, interpretation of liability and inertness of transition metal complexes on the basis of reaction rate, VBT and CFT.

Transition state or activated complex, substrate, attacking reagents electrophilic and nucleophilic, Nature of central atom. Kinetic application of CFT.

Kinetics of octahedral substitution, acid hydrolysis, factor affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favor of conjugate mechanism.

UNIT-4:Metal Clusters: 11 Periods

Introduction , Classification, Carbonyl clusters, Low nuclearity carbonyl clusters, High nuclearity carbonyl clusters, Electron conuting scheme for HNCCS, Wade's rules.

Halides type clusters:Dinuclear clusters, Trinuclear clusters, Tetranuclear clusters, Hexanuclear cluster.

Chevrel phases and Zintl Ions, Carboranes, Metalloboranes, Metallocarboranes, Higher boranes (Hexaborane-10, Decaborane-14) , Number and types of bonds present in higher boranes .

Reference book:

1. Quantum Chemistry by Ira N. Levine, Prentice-Hall of India Pvt. Ltd., New Delhi, 1994.

2. Introductory Quantum Chemistry (Third edition) by N. W. Hanna, Benjamin,Menlo Park, Cailf, 1988.

3. Quantum Chemistry and Spectroscopy by M. S. Pathania, Vishal Publications, India, 1981.

4. Chemical applications of group theory by F. A. Cotton (Second edition),Wiley Eastern Limited, 1976 New Delhi.

5. Group theory and its applications by P. K. Bhattacharya, Himalaya Publishing Hours, Mumbai, 1986.

6. Group theory and symmetry by L. R. Hall, McGraw Hill, New York, 1989.

7. 'Kinetic and Mechanism' by A. A. Frost and R. G. Pearson, Wiley, New York, 1953, 1961.

8.Mechanism of Inorganic Reactions by F. Basolo and R. G. Pearson, Second Edition, Wiley Eastern Limited, New Delhi, 1977.

9. Advnced Inorganic Chemistry by F. A. Cotton and R. G. Wilkinson, John Wiley & Sons, N. Y.

10. Principales of Inorganic Chemistry, by Puri. Sharma and Kalia, 33rd Edition, Vishal publishing Co. Jalandhar, Dehli, 2017.

11. Advanced Inorganic Chemistry by S.K.Agarwala and Keemtilal, Pragati Prakashan, Meerut.

12. Advanced Inorganic Chemistry, Volume-II by Gurdeep Raj, Krishna Prakashan Media Ltd., Meerut.

13. Inorganic Chemistry by Gary L. Miessler and Donald A. Tarr, Pearson Education International

M.Sc.Sem. 1 (Inorganic Practicals)

1. Inorganic Qualitative Analysis:

   (Six elements including ONE rare element)

2. Inorganic Preparation:

   i. Hexa-amine nickel (II) chloride

   ii. Mohr's salt (Ferrous Ammonium sulphate)

   iii. Sodium trioxalato ferrate trihydrate

   iv. Sodium cobaltinitrite

   v. Tetra amine cupric silphate

   vi. Reineek's salt (Ammonium tetrathiocyanate diamine Chromate)

Reference Book:

1. A textbook of practical inorganic chemistry – A.I.Vogel

2. Practical Chemistry by Dr.O.P.Pandey,D.N.Bajpai, Dr.S.Giri

3.Advance inorganic analysis by Agarwal, Keemti lal

4. Qualitative Inorganic analysis – Vogel

5.Inorganic practical by Chatwal and Anand

PAPER-I (Inorganic Chemistry)

SEMESTER-II

UNIT-1 ELEMENTS OF MAGNETOCHEMISTRY: 12 Periods

Definitions of magnetic properties, type of magnetic bodies, the source of paramagnetism, diamagnetism and pascal's constant, Example of pascals constant.

Curie and Curie-Weiss law, Magnetic Properties of transition elements.

Determination of magnetic susceptibility:

(a) Gouy method (b) Faraday method (c) Null deflection method.

Application of magnetic susceptibility measurements, Temperature independent paramagnetism (TIP), Orbital contribution to magnetic moment.

UNIT-II: METAL π -COMPLEXES 11 Periods

Metal carbonyls: Introduction, classification of metal carbonyls, structure and bonding, vibrational spectra studies for bonding and structure elucidation. Preparation of metal carbonyls by (1) Direct synthesis and (2) From metal compounds.

preparation Properties and structure of $Ni(CO)_4$, $Fe_2(CO)_9$ and $Co_2(CO)_8$, 18-electron rule and EAN of metal carbonyls.

Metal Nitrosyls: Introduction, coordination compounds of metal nitrosyls, preparation properties of nitrosyl compounds like nitrosyl halides, nitrosyl cyanides, hydroxides and nitrosyl aquo compounds Complex of NO^+ iron, EAN and structures of nitrosyls.

UNIT-III: Inorganic polymers 11Periods

Definition of polymers and their depiction. Characteristic of inorganic polymer.

Characterization of inorganic polymers (physical properties) by molecular weight,

number average and weight average.

Structural features of polymers: (1) Backbone bonding (2) Branching and cross-linking (3) Chemical and stereochemical variability

Classification of inorganic polymer, synthesis, properties, structures uses and application of polyphosphazenes and ploysiloxanes.

UNIT- IV: COORDINATION COMPOUNDS **11 Periods**

Classification of coordination compounds, Werner's theory of coordination,

Electronic interpretation of coordination compounds, Factors effecting the formation of complex ions, Detection of complex ion in solution,

Chelation, Factors influencing the stability of metal chelates, Importance of chelates, Role of metal chelates in living system

Inner complexes and polynuclear complexes, Determination of composition of complex ions.

Reference Book: (For semester –II)

(1) Magneto chemistry by R. L. Carlin.

(2) Elements of Magnetochemistry by A. Syamal and R. L. Dutta, Affileted East-West press, New Delhi,1993.

(3) Introduction to metal pi-complex chemistry by M. Tsusui, M. Ichikwa, K. Mori, Plenum press, New york.

(4) Introductory polymer chemistry by G. S. Mishra, Wiley Eastern Ltd.,1993.

(5) Phosphorous-Nitrogen Compounds, H. R. Allock, Academic, New York,1972.

(6) Advanced in Inorganic Chemistry by S. K. Agarwal, Keemtilal, Pragati prakashan, Meerut.

(7) Coordination Chemistry by Ajaykumar, Aaryush Education publication, Third publication.

(8) Principles of inorganic chemistry by Puri, Sharma and Kalia, Vishal publication Co. Jalandhar, Delhi.

(9) Coordination Chemistry by Gurdeep Chatwal, M. S. Yadav, Himalaya Publishing House.

(10) Inorganic Polymers by Prof. G. R. Chatwal, Himalaya Publishing House.

M.Sc.Sem. II (Inorganic Practical)

1. Analysis of Solder and Type metal (Alloy Analysis)

2. Determine the amount of Ca^{+2} as $CaC_2O_4H_2O$ or as $CaCO_3$ in limestone

3. Estimation of Cu^{+2} as CuSCN.

4. Estimation of Iron in Iron ore.

5. Estimation of available chlorine in bleaching powder.

6. Estimation of Ca^{+2} and Pb^{+2} in Admixture.

7. Determine the amount of Fe^{+3} and Cr^{+3} Present in given Admixture.

8. Determine the percentage purity of the given sample of Manganese salt.

9.Estimation of Aluminium by back titration.

Reference Book:

1. A textbook of practical inorganic chemistry – A.I.Vogel

2. Practical Chemistry by Dr.O.P.Pandey, D.N.Bajpai, Dr.S.Giri

3.Advance inorganic analysis by Agarwal, Keemti lal

4. Qualitative Inorganic analysis – Vogel

5.Inorganic practical by Chatwal and Anand

PAPER-II (Organic Chemistry)

SEMESTER-I

UNIT-I: REACTION MECHANISM & REACTIVE INTERMEDIATES 12 periods

Detailed study of organic reaction intermediates. Generation, structure, stability and reactions of –

Carbocations (Classical and non-classical): Phenonium ion, norbornyl system, common carbocation rearrangements- Demjanov, Pinacole-Pinacolone, Rupe.

Carbanions: Mechanism of condensation involving enolates - Aldol, Claisen, Mannich, Dieckmann, Michael and Shapiro reactions.

Carbenes: Mechanism of Arndt-Eistert reaction, Reimer-Tiemann reaction and Bamford Steven's rearrangement reaction.

Free Radicals: Allylic halogenation (NBS), coupling of alkenes and arylation of aromatic compounds by diazonium salts. Sandmeyer reactions. Free radical rearrangements, Hunsdiecker reaction.

Reference book:

1. Carbenes, Benzynes and Nitrenes by Gilchrist, T. L. and Rees.
2. Advanced Organic Chemistry-Reactions, Mechanism and Strucuture, Jerry March, John Wiley.
3. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
4. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond (McGraw-Hill Book Co. &Kogekusha Co. Ltd., 1970).
5. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
6. Advanced Organic Chemistry by Carey &Sundberg (3rd edition).
7. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
8. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
9. Organic chemistry 2nd ed. Jonathan clayden, Nick greeves, Stuart Warren.
10. Reaction Mechanism and Reagents in Organic Chemistry by C. R. Chatwal (Himalaya Publishing House, Bombay, 1987).

UNIT-II: PERICYCLIC REACTIONS **11 periods**

Introduction - Definition, Characteristics and Classification

Molecular orbitals and symmetry propertiesofethylene, 1,3- butadiene, 1,3,5- hexatriene and allylsystems.

Electrocyclic Reactions: Woodward-Hoffman Correlation diagram and derivation of selectionrules,Conrotatory and disrotatory motions, FMO and PMO approach for 4n and (4n+2) π electron system and allyl systems.

Cycloaddition Reactions: Antarafacial and suprafacial additions. FMOand PMO approach for 4n and (4n+2) π electron Systems(No correlation diagram),Diels-Alder reaction, stereoselectivity,Effect of substituents.

Sigmatropicrearrangements: Suprafacial and antarafacialshifts involving H & C moieties, retention and inversion of configurations.

The Cope and Claisen rearrangements, Ene reaction, 1, 3- dipolar cydoadditions.

Examples of electrocyclic, cycloaddition and sigmatropic rearrangements.

Reference book:

1. March's Advanced Organic Chemistry Reactions, Mechanisms, And Structure 7th ed. 2013 Michael B. Smith. Wiley.
2. Mechanism AndTheoryIn Organic Chemistry-2007 by Thomas H. Lowry, Kathleen S. Richardson, Forbes.Harper& Row, Publishers. New York, Hagerstown, San Francisco, London.
3. Advanced Organic Chemistry Part A: Structure and Mechanisms by Carey &Sundberg (5th edition),2000, Springer.
4. Pericyclic Reactions, S. M. Mukherji, Macmillan, India.
5. Photochemistry AndPericyclic Reactions 3rd ed. by Jagdamba Singh 2010. New Age International Publishers Ltd. New Delhi.
6. Pericyclic Reactions A mechanistic and problem solving approach Sunil Kumar, Vinod Kumar, S.P.Singh Academic Press 2015

UNIT-III; SUBSTITUTION AND ELIMINATION REACTIONS **11 periods**

A: Aliphatic Nucleophilic Substitution: The SN^1 , SN^2 , SN^i mechanisms. Reactions of Allylic halides, neighbouring group participation by -OH, -NH_2, -COO- , -RS, - halogen, aromatic ring.

B: Aromatic Nucleophilic Substitution: The SN^2 , SN^1 and benzyne mechanisms, Reactivity - effect of substrate structure, leaving group and attaching nucleophile, The Von Richter rearrangement.

C: Elimination reaction: Hoffmann and Zaitsev's rule of elimination, E1, E2 and E1CB Reaction mechanism and orientation.

Reference book:

1. Advanced Organic Chemistry-Reactions, Mechanism and Strucuture, Jerry March, John Wiley.
2. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
3. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond (McGraw-Hill Book Co. &Kogekusha Co. Ltd., 1970).
4. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
5. Advanced Organic Chemistry by Carey &Sundberg (3rd edition).
6. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
7. Physical organic chemistry by Jack Hyne
8. Reaction mechanism by Jagdambasingh.
9. organic chemistry - Reaction mechanism, by P.S. Kalsi, New age international publishers.

UNIT-IV: Stereochemistry **11 periods**

A. Stereo chemical principles; Enantiomeric relationships; Distereomeric relationship; R-S and E-Z nomenclature; Dynamic stereochemistry; Chiral-Prochiral relationships; Stereo selective and Stereo specific reactions; Racemates and racemic modification, Resolution of racemic modification, Optical activity in the absence of chiral carbons biphenyl, allenes, spiranes.

B. Confirmational Analysis: Interconversion of Fischer, Newman and Sawhorse projections. Newer method of asymmetric synthesis (including enzymatic and catalytic nexus), enantio and diastereo selective synthesis.Simple acyclic and cyclic (chair and boat cyclohexanes, Decalins, Perhydrophenanthrene)systems.Effects of conformation on reactivity in acyclic compounds and substituted cyclohexanes.

Reference book:

1. Advanced Organic Chemistry: Part A: Structure and Mechanisms; By Francis A. Carey, Richard J. Sundberg, fifth edition, Published by Springer.
2. Advanced Organic Chemistry: Part B: Reaction and Synthesis; By Francis A. Carey, Richard J. Sundberg, fifth edition, Published by Springer.
3. Stereochemistry of Carbon Compounds; By Ernest L. Eliel, Published by Tata McGraw-Hill Publishing Company Ltd.
4. Basic organic stereochemistry; By Ernest Ludwig Eliel, Samuel H. Wilen, Michael P. Doyle, Published by Wiley-Interscience.
5. Introduction to Stereochemistry; By Kurt Martin Mislow, Dover Publication INC.
6. Stereochemistry of Organic Compounds: Principles and Applications; By D. Nasipuri, New Age International (P) Ltd. Publisher.
7. Stereochemistry Conformation and Mechanism; By P.S. Kalsi, New Age International (P) Ltd. Publisher.
8. Basic Stereochemistry of Organic; By SubrataSen Gupta, First edition, Published by Oxford University Press.

M.Sc. Semester – I (PRACTICALS)

1. Mixture analysis: (Minimum eight mixtures) Ternary mixture to be given. (S+S+S), Semisolids or (L+L+L). Type determination.Separation by physical and chemical methods. (both permitted in case of liquids)
2. Paper Chromatography

Reference book:

1. A text book of practical organic chemistry – A. I. Vogel
2. Practical organic Chemistry – Mann and Saunders
3. A handbook of quantitative and qualitative analysis – H. T. Clarke
4. Comprehensive Practical Organic Chemistry: Qualitative Analysis V K Ahluwalia & S. Dhingra.
5. Comprehensive Practical Organic Chemistry: Preparations and Quantitative Analysis V K Ahluwalia & R. Aggarwal Universities Press.
6. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.

PAPER-II (Organic Chemistry)

SEMESTER-II

UNIT-I: Organic Name Reactions **12 Periods**

General nature, method, mechanism and synthetic applications of the following reactions:

(i) Heck reaction
(ii) Dakin reaction
(iii) Darzen'sglycidic ester synthesis
(iv) Suzuki reaction
(v) Willgerodt reaction
(vi) Buchwald-Hartwig reaction
(vii) H. V. Z. reaction
(viii) Mitsunobu reaction
(ix) Sonagashira reaction
(x) Dickmann reaction.

UNIT-II: AROMATICITY **11 Periods**

A. Aromaticity and Aromatic character; structure and stability of benzene, Frost circle diagram, concept of aromaticity; Resonance and chemical stabilization; criteria to checkaromatic character-IR, NMR, heat of hydrogenation; Huckel's rule; HMO method
B. Antiaromaticity, homoaromaticity, nonaromaticity; aromaticity in benzanoid compounds: naphthalene, pyrene, acepleialdelene.
C. Aromaticity non-benzenoid compounds: azulene, tropolones, charged rings, annulenes, fullerenes, and mesoionic compounds.

UNIT-III: ORGANIC TRANSFORMATION AND REAGENTS **11 Periods**

I. Sharplessepoxidation
II. Umpolung reagent (1,3-dithiane)
III. Dess martin periodinane
IV. DDQ
V. Tri-n-butyltinhydride $(C_4H_9)_3SnH$
VI. Diisobutyl aluminum hybride (DIDAL-H)
VII. Lithium disoprpyl amide (LDA)
VIII. OZONE
IX. Crown ethers
X. Wilkinson's Catalyst

UNIT-IV: **11 Periods**

PHOTO CHEMISTRY

A. Energy of molecules, photochemical energy, electronic excitation, Jablonski diagram, laws of photochemistry, quantum efficiency.

B. Photochemistry of carbonyl compounds- α- cleavage of acyclic, cyclicand α-β unsaturated cleavage of carbonyl compounds, β- cleavage of, inter and intramolecular hydrogen abstraction, addition to carbon- carbon doublr bond, photo reduction of carbonylcompounds.

C. Photo induce rearrangement of enones, dienones and alkenes. Photochemistry of alkenesand aromatic compounds- isomerization, dimerization and addition reactions.

Reference book:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
3. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond (McGraw-Hill Book Co. & Kogekusha Co. Ltd., 1970).
4. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
5. Advanced Organic Chemistry by Carey & Sundberg (3rd edition).
6. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
7. Name Reactions by A. R. Parikh &H.A.Parikh
8. Name reaction: A collection of detailed reaction mechanism by Jie Jack Li
9. Reaction Mechanism and Reagents in Organic Chemistry by C. R. Chatwal (Himalaya Publishing House, Bombay, 1987).
10. Organic Chemistry-Reactions and Mechanism by P S Kalsi
11. Advanced Organic Chemistry : Reactions and Mechanisms byM.S. Singh
12. Organic chemistrybyCram, Hammond, Pine and Handrickson
13. Photochemistry and Pericyclic Reactions by Jagdamba Singh
14. Pericyclic reactions: A text book by S. Sankararaman
15. Excited states in Organic Chemistry by J. D. Coyle and J. A. Barltrop
16. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure by Michael B. Smith
17. Advanced Organic Chemistry: Part B: Reaction and Synthesis byCarey & Francis
18. Organic Chemistry by Jonathan Clayden

M.Sc. - Semester – II (PRACTICALS)

Preparation of organic compounds : (Minimum six)

(i) Nitration : m-dinitrobenzene from Nitrobenzene
(ii) Bromination: p-bromoacetanilide from acetanilide
(iii) Reduction: m-phenylenediamine from m-dinitrobenzene
(iv) Oxidation : p-nitrobenzoic acid from p-nitrotoluene
(v) Diazotization reaction: Orange-I
(vi) Friedl-Craft's reaction: Resacetophenone from Resocinol
(vii) Cannizzaro reaction: Benzoic acid from Benzaldehyde via KOH
(viii) Aldol condensation: Chalcone from Benzaldehyde + Acetophenone (Claisen Schmidt reaction)

Quantitative Estimations: (Minimum three)

a. Estimation of ester + acid
b. Estimation of formaldehyde
c. Estimation of glycine
d. Estimation of amide + acid

References:

1. A text book of practical organic chemistry – A. I. Vogel
2. Practical organic Chemistry – Mann and Saunders
3. A handbook of quantitative and qualitative analysis – H. T. Clarke
4. Comprehensive Practical Organic Chemistry : Qualitative Analysis V K Ahluwalia& S. Dhingra.
5. Comprehensive Practical Organic Chemistry : Preparations and Quantitative Analysis V K Ahluwalia & R. Aggarwal Universities Press.
6. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.

PAPER-III (PHYSICAL CHEMISTRY)

SEMESTER-I

UNIT-I: CHEMICAL KINETICS **12 Periods**

Theories of Unimolecular gas reactions: Lindemann theory, Kinetics of some complex reactions (i)Reversible reactions(only first order opposed by first order) (ii)Consecutive reactions(A→B→C); Steady state treatment or approximation, Enzyme catalysed reactions, Kinetics of general Chain reaction, Kinetics of photochemical reactions(H_2-$Cl_2$and H_2-Br_2) , Kinetics , Mechanism ,determination of activation energy and chain length of some organic decomposition (i) decomposition of ethane (ii) decomposition of acetaldehyde, Effect of Ionic strength on rates of ionic reactions (Primary and secondary salt effect)
Numerical.

UNIT- II: THERMODYNAMICS **11 Periods**

Introduction to Laws of thermodynamics, state and path functions and their applications, thermodynamic description of various types of processes,Maxwell's relations, Partial molar quantities, Calculation of partial molar quantities, determination of partial molar volume and partial molar enthalpy, Ideal and non-ideal liquid mixtures,Thermodynamics functions of mixing of non-ideal solutions (i) free energy of mixing (ii) entropy of mixing (iii) volume of mixing and (iv) enthalpy of mixing ,Excess functions(μ^E ,G^E , S^E ,H^E and V^E) for non ideal solutions and expression for excess thermodynamic functions.
Numerical

UNIT –III STATISTICAL THERMODYNAMICS **11 Periods**

Basics of Statistical thermodynamics(Assembly ,Canonical ensemble, occupation numberstatistical weight factor, probability),Thermodynamic probability,Probability and entropy, Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics. Lagrange's methods of multipliers, Partition function,Thermodynamic properties in term of partition functions(i) Internal energy (ii) Heat Capacity (iii) Third law of thermodynamics(iv) Helmholtz free energy (v) Enthalpy (vi) Gibb's free energy(vii) Chemical potential (viii) Equilibrium constant Molecular partition functions for an ideal gas , Derivation for Translational, Rotationaland Vibrational partition functions
Numerical.

UNIT-IV: POLYMER CHEMISTRY **11 Periods**

Types of polymers, Stereochemistry of polymers, Kinetics of polymerization (Addition and Condensation),Thermodynamics of polymerization, Phase techniques of polymerization (Bulk, solution, suspension and emulsion), Number & Mass average Molecular mass, Polydispersity Index (P.D.I) Molecular mass determination by Viscometry and Osmometry, Thermal transitions in polymer: glass transition temperature and its significance,
Numerical

Reference Book:

1. **Physical Chemistry, Atkins, P.W., W.H. Freeman (2017) 10 thediton**
2. **Thermodynamics for chemist Samuel Glasstone, East-West Press Pvt. Ltd. (2008)**
3. Principles of Physical Chemistry**Puri B.R., Sharma L.R. and Pathania, M.S.,** Vishal Publishing Co. 41th ed. (Kinetics of some complex reactions (i) Reversible reactions(only first order opposed by first order), Consecutive reactions page no. 700-704) Kinetics of general Chain reaction page no. 706-708 Kinetics of photochemical reactions(H_2-Br_2) page no. 351-352Maxwell's relations page no. 565 Number &Mass average Molecular mass,Polydispersity Index(P.D.I) Molecular mass determination by Viscometry and Osmometry page no. 1036 -1042
   Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics. Lagrange's methods of multipliers, page no. 629-635
   Molecular partition function for an ideal gas , Derivation for Translational, Rotational And Vibrational partition functions page no. 636-641

4. **Chemical KineticsLaidlerK.J.TATAMcGRAW-HILL PUBLISHING COMPANY LTD.,** (Theories of unimolecular gas reactions: Lindemann theory Page No. 143-147) Steady state treatment or approximation page no. 327-328 Enzyme catalysed reactions page no. 474-477 Kinetics of photochemical reactions(H_2-Cl_2 and H_2-Br_2) page no. 360-364 ,327-328 ,358-359 Kinetics, Mechanismand determination of activation energy and chain length of some organic decomposition
   (i) decomposition of ethane (ii) decomposition of acetaldehyde page no. 386-390
5. **Principles of Chemical Kinetics, James E. House, Elsevier Publication**

6. **Kinetics and Mechanism of Chemical Transformations,Rajaraman, J. and Kuriacose, J., McMillan (2008).**

7. **Kinetics of chemical reactionsS.K. Jain , Vishal Publications**
   Mechanismand determination of activation energy and chain length of some organic decomposition (i) decomposition of ethane (ii) decomposition of acetaldehyde page no. 141-143 , 144-145Effect of Ionic strength on rates of ionic reactions (Primary and Secondary Salt Effect) page no. 160-162 Kinetics of polymerization (Addition and Condensation) page no. 192-195

8. **A Text Book of Physical chemistry K.L.Kapoor Vol-5 Macillan India Ltd. 2007**
   Effect of Ionic strength on rates of ionic reactions (Primary and Secondary Salt Effect) page no. 164-167
9. **An Introduction to Chemical Thermodynamics R P Rastogi and R R Mishra VIKASH PUBLISHING HOUSE PVT LTD. 6th edition** Introduction to Laws of thermodynamics, state and path functions and their applications, thermodynamic description of various types of processes page no. 1-15 , 42-47 Maxwell's relations page no. 254-258Partial molar quantities(Partial molar volume ,Internal energy, enthalpy, entropy ,Gibb,s free energy and Work function) page no. 318-325
   Thermodynamics functions of mixing of non-ideal solutions (i) free energy of mixing (ii) entropy of mixing (iii) volume of mixing and (iv) enthalpy of mixing page no. 396- 397 Calculation of partial molar quantities determination of partial molar volume and partial molar enthalpy page no. 402-413

Excess functions(μ^E ,G^E , S^E ,H^E and V^E) for non ideal solutions and expression for excess thermodynamic function. Page no. 397-398
(Assembly,Canonicalensemble,occupation number , statistical weight factor, probability page no. 269-273Thermodynamic probability ,Probability and entropy page no. 274-278Partition functionpage no. 284Thermodynamic properties in term of partition functions (i) Internal energy (ii) Heat Capacity (iii) Third law of thermodynamics(iv) Helmholtz free energy (v) Enthalpy (vi) Gibb's free energy(vii) Chemical potential (viii) Equilibrium constant page no.
286- 291

10. **Advanced Physical Chemistry D.N.Bajpai S.CHAND& COMPANY LTD. 2nd edition**
Effect of Ionic strength on rates of ionic reactions (Primary and secondary salt effect) Page no. 508-512Partition function page no. 275-276 Derivation for Translational, Rotationaland Vibrational partition functions page no. 278-282.
11. **Polymer science by V.R.Gowarikar. WILEY EASTERN LTD.**
Types of polymers (12). Stereochemistry of polymers (46). Kinetics of polymerisation (105). Phase techniques (71). Number and mass average molecular mass, PDI (90). Molecular mass determination by viscometry and osmometry (404, 392). Glass transition temperature (150)

SEMESTER -I

GROUP-C PHYSICAL PRACTICAL (Any Six)

1. Determine the dissociation constants of a given dibasic acid pH-metrically.
2. Determine the amount of ferrous sulphate / ferrous ammonium sulphate in given flask potentiometrically using cerric salt solution.
3. Verification of Onsager's equation and determination of equivalent conductance at infinite dilution of strong electrolytes
4. Determine the CMC of a surfactant by conductivity measurements.
5. Calculate the molar absorptivity of each of the given two solutions (A) and (B) and also find out concentration of supplied unknown solution colorimetrically.
6. Investigation the reaction between $K_2S_2O_8$ and KI at two different temperatures and calculate the energy of activation for the reaction.
7. To study the phase diagram of a three component system Water – acetic acid – chloroform.
8. Determination of CMC and area per molecule of a surfactant by surface tension measurement.
9. Determine the molecular weight of a given polymer from viscosity measurement.

Note : For instrumental analysis, solution should be prepared by the candidate.

PAPER-III (PHYSICAL CHEMISTRY)

SEMESTER-II

UNIT-I:THEORIES OF ELECTROLYTIC CONDUCTANCE AND OVER VOLATEGE 11 Periods

Debye-Huckel theory of strong electrolytes, relaxation effect and electrophoretic effect, Debye Falkenhagen effect, Weineffect.Ionic strength and its determination ,Debye-Huckel limiting law. Activity and activity coefficient, determination of activity coefficient by (i) solubility (solubility product principle) (ii) EMF method (cell without transference), Determination of dissociation constant of monobasic acid by conductance method and approximate EMF method, Electrolytic polarization, Dissolution and Decomposition potential, Concentration polarization, Decomposition potential and its determination, over voltage, determination of over voltage,theories of over voltage:combination of atom as slow process (Tafel theory)

Numerical.

UNIT-II: SURFACE CHEMISTRY 11 Periods

Adsorption Multilayer Adsorption, the BET adsorption isotherms, derivation of BET equation, determination of surface area and area of cross section of molecules by BET equation.Derivation of Langmuir equation from BET equation. Explanation of different adsorption isotherms, Change in enthalpy ,entropy and free energy of adsorption, Adsorption at the surface of liquid : Gibbs adsorption isotherms (derivation).Thermodynamic treatment of adsorption,Surface –Active substances, orientations of surfactants on the surface of solution , surface inactive substances, surface pressure,Insoluble surface films on liquid

Numerical

UNIT-III: COLLOIDS: 11 Periods

Types of colloidal systems, preparation of lyophobic colloidal, Properties of Colloidal systems: (i) electrical properties origin of charges on colloidal, electrical double layer, Zeta potential and its determination by electrophoresis, factor affecting zeta potential, explanation on DLVO theory of colloid stability (ii) Electrokinetic properties: Electrophoresis, elecroosmosis.

Surface active agents, critical micellar concentration (CMC), factors affecting the CMC of surfactants, thermodynamics of micellization: mass action and phase separation model, solubilisation, emulsion, types of emulsion, methods for determination of types of emulsion, microemulsion, types of microemulsion, theories of microemulsion.

UNIT IV: MOLECULAR SPECTROSCOPY 12 Periods

Molecular spectra, **Microwave spectroscopy** (Rotational spectroscopy): The Rotation of molecules, Linear molecule, Symmetric tops ,Spherical tops, Asymmetric tops, Rotational spectra of rigid diatomic molecule ,Intensities of spectral lines , Effect of isotopic substitution, Techniques and instrumentation of rotational spectrum,

IR Spectroscopy: Classical frequency of harmonic oscillator,The classical potential energy of harmonic vibration of a diatomic molecule, Quantum expression of potential energy, energy level diagram, Relative population of energy levels ,Mechanism of interaction with radiation, selection rule, determination of force constant, Amplitude of vibration, The anharmonicvibrationor oscillator , Morse potential , Vibrational energy of diatomic molecule following the Morse potential, energy level diagram, vibrational transitions.

Vibrational –Rotational spectra of diatomic molecule(CO molecule) Application of Vibrational rotational spectra

Numerical

Reference Book:

1. Atkins, P.W., Physical Chemistry, W.H. Freeman (2017) 10 thediton
2. Samuel Glsstone, Introduction to Electro chemistry, East-West Press Pvt. Ltd. (2008)
3. Puri, B.R., Sharma, L.R., and Pathania, M.S., Principles of Physical Chemistry, Vishal Publishing Co. (2017-18) 45th ed. Debye-Huckel theory of strong electrolytes, relaxation effect and electrophoretic effect, Debye Falkenhagen effect, Wein effect. Ionic strength and its determination ,Debye-Huckel limiting law page 866-874Insoluble surface films on liquid page no.1025

   Types of colloidal systems, preparation of lyophobic colloidal, Properties of Colloidal systems: (i) electrical properties origin of charges on colloidal, electrical double layer, Zeta potential and its determination by electrophoresis, factor affecting zeta potential, explanation on DLVO theory of colloid stability (ii) Electrokinetic properties: Electrophoresis, elecroosmosis. Page no. 989-1001

4. **Fundamentals of Molecular Spectroscopy C N Banwell TATA McGRAW-HILL15th edition**

   Molecular spectra page no.-1Microwave spectroscopy (Rotational spectroscopy): The Rotation of molecules Linear molecule, Symmetric tops ,Spherical tops Asymmetric tops, Rotational spectra of rigid diatomic molecule ,Intensities of spectral lines , Effect of isotopic substitution page no. 40-53Techniques and instrumentation of rotational spectrum page no. 66 –67Quantum expression of potential energy, energy level diagram, Relative population of energy levels ,Mechanism of interaction with radiation, selection rule, determination of force constant, The anharmonic vibration or oscillator , Morse potential, Vibrational energy of diatomic molecule following the Morsepotential, energy level diagram, vibrational transitions.Vibrational –Rotational spectra of CO molecule Application of Vibrational rotational spectrapage no. 72-88

5. **A Text Book of Physical chemistry K. L. Kapoor Vol-4 Macillan India Ltd. 3rd edition**

   Classical frequency of harmonic oscillator ,The classical potential energy of harmonic vibration of a diatomic molecule, Quantum expression of potential energy, energy level diagram, Relative population of energy levels ,Mechanism of interaction with radiation, selection rule, determination of force constant, Amplitude of vibration, The anharmonic vibration or oscillator , Morse potential , Vibrational energy of diatomic molecule following the Morse potential, energy level diagram, vibrational transitions page no.

460-471Vibrational –Rotational spectra of diatomic molecule Application of Vibrational rotational spectra page no. 480-484
Raman Spectrum in detail page no. 488-500

6 **A Text Book of Physical Chemistry K. L. Kapoor Vol -5 Macillan India Ltd. 3rd edition**

Adsorption Multilayer Adsorption, the BET adsorption isotherms, derivation of BET equation, determination of surface area and area of cross section of molecules by BET equation. Derivation of Langmuir equation from BET equation. Explanation of different adsorption isotherms, Change in enthalpy ,entropy and free energy of adsorption, Adsorption at the surface of liquid : Gibbs adsorption isotherms (derivation).Thermodynamic treatment of adsorption, Surface –Active substances, orientations of surfactants on the surface of solution , surface inactive substances, surface pressure page no. 11-22 , 24-26 , 30-32 ,34-38

7 **Advanced Physical Chemistry D.N.Bajpai, S.CHAND & COMPANY LTD. 2nd edition**

Activity and activity coefficient, determination of activity coefficient by (i) solubility (solubility product principle) (ii) EMF method (cell without transference), page no. 623-626

SEMESTER -II
GROUP – C PHYSICAL PRACTICAL (Any Six)

1. Determine the dissociation constant and strength of borax solution pH-metrically.
2. Determine the velocity constant of the hydrolysis of ethyl acetate with sodium hydroxide at room temperature by conductance measurements.
3. Determine the solubility of silver chloride in water potentiometrically.
4. To determine the concentration of given components in a mixture colorimetrically.
5. Determine the equilibrium constant of the reaction $I^- + I_2 = I_3^-$ by distribution method.
6. Investigation the reaction between H_2O_2 and HI at two different temperatures and calculate the energy of activation for the reaction
7. Determine the formula of a complex between Cu^{+2} and NH_3 by distribution method.
8. Determine CST of Phenol -Water system
9. Determine CST of Phenol –NaCl system

Note : For instrumental analysis, solution should be prepared by the candidate.

PAPER-IV (Instrumental and chemical analysis)

SEMESTER-I

UNIT-I: UV-VisibleSpectrophotometry 12 Periods

Types of electronic transition, auxochrome, chromophore, Bathochromic effect, Hypso chromic effect, Hyper chromic effect, Hypo chromic effect, Factor affecting λ_{max} like resonance, hyper conjugation, hydrogen bonding, steric effect , Woodward's rules for α,β-unsaturatedketones, Diene systems, aromatic system, Effect of solvent on absorption bands, law of absorption with derivation, Elementary idea of double beam automatic recording, Spectrophotometer, Application.

UNIT-II: CHROMATOGRAPHY 11 Periods

Thin-Layer Chromatography: Selection of stationary and mobile phase, Detection techniques –Elementary idea of HPTLC

Gas Chromatography: Selection of mobile phase – Selection of stationary phase in GLC and GSC – Detectors: FID (with modifications), TCD and ECD, Their comparison, Packed column, WCOT,SCOT(advantagesanddisadvantages)–Temperatureprogramming– Derivatisation in GC – Quantitative Analysis.

UNIT-III: CHEMICAL MATHEMATICS 11 Periods

Errors in Chemical analysis, classification of errors, nature and origin of errors, Propagation of error, Accuracy and precision, Average deviation and standard deviation and its physical significance, Normal Distribution curve and its properties. Confidence limit and probability, Statisticaltreatmentforerroranalysis,student't'test,rejectioncriteriaand Q-test, method of least square

UNIT-IV: THERMAL METHODS OF ANALYSIS 11 Periods

(A) THERMOGRAVIMETRY:

Thermogravimetry, Instruments for TGA- thermobalace and furnace, Calibration of temperature scale, Factorsaffecting TGA results instrumental and experimental, Applications.

(B) THERMOMETRIC TITRATION:

Thermometric Titration (TT), Advantages, Instrument, Applications of TT in Neutralization Titration, Precipitation Titration, Complexometry Titration and Redox titration.

PAPER-IV (Instrumental and chemical analysis)

SEMESTER-II

UNIT-I: IR SPECTROPHOTOMETRY 12 Periods

IR Spectroscopy*:* Introduction: Theory, Instrumentation: single beam, double beam spectrophotometers, radiation sources, sample cells, monochromators, detectors, sample handling, Resolution, wave number measurement,Useful terms: IR region, types of vibrations: fundamental and overtones, linear and nonlinear molecule, equation for vibrational frequency, selection rule, coupling interactions, hydrogen bonding information, Fermi resonance. IR spectra: group frequency, group frequency region, finger print region, spectra interpretations (Amino, carboxyls, hydroxyl, ethers groups containing compounds) and structure elucidation. FTIR: principle, instrument design, and function of beam splitter, Advantages of FTIR vs. IR.

UNIT-II: LIQUID CHROMATOGRAPHY 11 Periods

Principle of Liquid – Solid chromatography, Comparison with GC, Column chromatography,Gradient elution, Displacement chromatography, Principle of HPLC, Instrument andsignificance of each component, Pumps, Guard column Criteria in selection of mobilephase, Stationary phases (solid, liquid), Bonded phase supports, Detectors: UVabsorption, RI detectors – Normal phase and Reversed phase. Method of introducing sample.

UNIT-III GREEN CHEMISTRY AND WATER ANALYSIS 11 Periods

(A) Green Chemistry (04 Periods)

Twelve principles, Green solvents and their applications*:* Ionic liquids, types, properties and applications, ILs as solvents, Supercritical fluids, Supercritical CO_2, its properties and applications in dry cleaning and decaffeination of coffee.

(B) Water analysis (07Periods)

Sources of water pollution, Sewage and industrial effluents, Analysis of waterpollutants, Sampling, Preservation, Measurement of parameters such as COD, BOD, DO,TDS,suspended solids, TCC, phenols, fluoride.

UNIT-IV TITRIMETRIC METHODS AND ELEMENTAL ANALYSIS 11 Periods

(A) Solution and Their Concentration: (03 Periods)

Molarity, Molality, Normality, ppm, ppb, ppt, %w/v, %w/w, %v/v, Formality, Primary and Secondary standard, Acid Value, Density and Specific Gravity, Numerical.

(B) Non Aqueous Titration: (04 Periods)

Protic and Aprotic Solvent, Solvent system, Dielectric constant, Titrant, Titration Curve, Determination of Equivalence point, Karl Fisher Titration, Numerical.

(C) Elemental Analysis: (04 Periods)

Step on Analysis, C and H Analysis, N Analysis, Halogen Analysis and Sulpher Analysis, Numerical.

Reference book:

1. Fundamental of molecular spectroscopy, C.N. Banwell, Tata McGraw Hill Pub. Camp.
2. Spectrometric Identification of Organic Compounds (4thedition/5thedition), Silverstein,Bassler&Morril,JohnWiley&Sons.
3. IntroductiontoMolecularSpectroscopy,G.M.Barrow, McGraw – Hill.
4. Modern Spectroscopy, J.M.Hollas, John Wiley.
5. Basic Principles of Spectroscopy, R.Chang, McGraw-Hill.
6. ModernMethodsofChemicalAnalysis(2nded.),Pecsok,Shields,Cairns&McWilliom, JohnWiley&Sons.
7. Instrumental Analysis byR. D. Braun, McGraw-Hill.
8. Mathematics for Chemistry, Doggett and Sucliffe, Longman.
9. Mathematical preparation for Physical Chemistry, F. Daniels, McGrawHill.
10. Introductionto Instrumental Analysis by R. D. Brawn, McGraw-Hill Book.
11. FundamentalsofAnalyticalChemistry:SkoogD.R.andWestD.M.(Holt,Rinehart&Winston, New York).
12. Chemical Analysis in Industry(in Gujarati) by M. N. Desai.
13. Instrumental Methods of Analysis by G. W. Ewing.
14. ModernMethodofChemicalAnalysisbyPecsok,Shield,Cairns,McWilliam,John Wiley and Sons.
15. Quantitative Analysis, 6thEd.,R.A.DayandA.L.Underwood, Prentice– Hall of India, 1993.
16. Instrumental Analysis: G. D. Caristian and J. E. O'Reilly (Allyn& Bacon Inc., NewYork, 2ndedition.
17. Instrumental Methods of Chemical Analysis: G. W. Ewing (McGraw-Hill, NewYork), 5thedition.
18. Instrumental Methods of Analysis: H. R. Willard, L. L. Merrit, J. A. Dean, F. A. Settle (Van Nostrand Reinhold Co., New York), 6thedition.
19. Modern Methods of Chemical Analysis: Pecsok, Shield & Cairns (John Wiley), 2ndedition.
20. Introduction to Instrumental Analysis (1987), R. D. Braun (McGraw-Hill Book Company), New Delhi.
21. Analytical Chemistry: Principles and Techniques: Larry G. Hargis (Prentice-Hall International edition).
22. Introduction to Modern Liquid Chromatography: L. R. Shyder& J. J. Kirkland (John Wiley & Sons, New York).
23. Treatise on Analytical Chemistry: I. M. Kohthoff& P. J. Elving (John Wiley & Sons, New York).
24. Handbook of Analytical Chemistry: L. Meites (McGraw-Hill, New York).
25. Environmental Chemistry: B. R. Sharma, H. Kaur (Goel Publishing House, Meerut).
26. Environmental Chemistry by A.K.de
27. Spectrometric Identification of Organic Compounds; By Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, Eight edition, Published by Wiley

28. Introduction to Spectroscopy; By Donald L. Pavia, Gary M. Lampman, George S. Kriz, James A. Vyvyan,Fourth edition, Published by Brooks cole.
29. Spectroscopic Methods in Organic Chemistry; By D.H Williams, I. Fleming, Sixth edition, Published by Tata Mcgraw Hill Education.
30. Spectroscopy of Organic Compounds; By P S Kalsi, Sixth edition, Ne Age International Publisher.
31. Organic Spectroscopy: Principles and Applications; By Jag Mohan, Second edition, Published by Alpha Science International Ltd.
32. Organic Spectroscopy (NMR, IR, Mass and UV); By Dewan S.K.,First edition, CBS Publisher & Distributors Pvt Ltd.
33. Basic Principles of Spectroscopy; By Raymond Chang, Published by McGraw-Hill Inc.
34. Elementary Organic Spectroscopy; By Y R Sharma, S. Chand & Company Pvt. Ltd.
35. Organic Spectroscopy; By William Kemp, Published by Palgrave Macmillan.

36. Green chemistry by V. K. Ahluwalia, Narosa Pub New Delhi
37. Green Chemistry, Theory and Practice, P. T. Anastas and John C. Warner, Oxford University Press, 2000, New York, USA.
38. Green Chemistry: An Introductory Text, Mike Lancaster, Green Chemistry Network, University of York, RSC, 2002.

M.Sc. Semester-III (ORGANIC CHEMISTRY)

Sr. No.	Course Title	L	T/C/S	Credit
1	Natural Products and Bio-molecules	4	1	4
2	Selected Topics In Organic Chemistry-I	4	1	4
3	Organic Chemistry in Industry	4	1	4
4	Medicinal Chemistry-I OR Dye and Intermediates-I	4	1	4
5	Practicals	12		8
		28	4	24

External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No	Course group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	III	I	Core	04	30	70	100
		II	Core	04	30	70	100
		III	Core	04	30	70	100
		IV	Core	04	30	70	100
			Practical	08	60	140	200
			Total	24	180	420	600

M.Sc. Semester-III (ORGANIC CHEMISTRY)
PAPER-I (Natural Products and Bio-molecules)

UNIT-I NATURAL PIGMENTS & ALKALOIDS (12 Periods)

(A) Natural Pigments & Porphyrins Derivatives

Porphyrins: General structures, Synthesis and Spectral properties. Synthesis of cryptopyrrole, Phytopyrrole, Opsopyrrole and Haemopyrrole and their carboxylic acid derivatives.

Structural elucidation of Haemoglobin and Chlorophyll (Analytical evidences only)

(B) Alkaloids

Classification of alkaloids; Structural elucidation of Morphine, Reserpine and Colchicine (Analytical evidences only)

UNIT-II STEROIDS & SEX HORMONES (11Periods)

(A) Steroids

Introduction to Sterols: Structure determination of cholesterol and ergosterol (no synthesis), Bile acids: Introduction, Structural elucidation and Synthesis of Cholanic acids(α and β both).

(B) Sex Hormones

Classification of hormones: Structure and synthesis of Androgens, Oestrogens and Gestrogens. Name and structures of Adrenocortical hormones, Partial synthesis of cortisone.

UNIT-III VITAMINS & TERPENOIDS (11 Periods)

(A) Vitamins

Structure determination, Synthesis and biochemical functions of Vitamin A, Vitamins B1 andB2, Vitamin H

(B) Terpenoids

Classification, nomenclature and isolation

Structure determination and synthesis of Farnesol, Zingiberene, Cadinene, Gibrelic acid and Abietic acid.

UNIT-IV Nucleic Acids & Enzymes (11 Periods)

(A)Nucleic Acids

Purine and pyrimidine bases of nucleic acids, base pairing via H-bonding, Chemical and enzymatic hydrolysis of nucleic acids, Structure of nucleosides and nucleotides, DNA, RNA(Basics structures only), DNA replication, Transcription, Translation, Protein Biosynthesis.

(B) Enzymes

Classification, nomenclature and inhibition, factors affecting catalytic activity andspecificity in action, regulation of enzyme activity

Reference Books Recommended:

1. Organic Chemistry, Vol. I & II (Sixth edition), I. L. Finar.
2. S.W. Pelletier, Chemistry of the Alkaloids, Van Nostrand Reinhold Co., New York (1970).
3. K.W. Bentley, The Alkaloids, Vol. I., Interscience Publishers, New York (1957).
4. Chemistry of Organic Natural Products, Vol. I & II, O. P. Agrawal.
5. Organic Chemistry of Natural Products, Vol. I & II, Chatwal.
6. Organic Chemistry (5/e) by Morrison & Boyd.
7. Chemistry of Vitamins – S. F. Dyke.
8. Natural Products Chemistry, Vol. I & II, K. Nakanishi.
9. The Molecules of Nature, J. B. Hendrickson.
10. Selected Organic Synthesis: Ian Fleming.
11. Chemistry of Natural Products, N. R. Krishnaswamy.
12. The Chemistry of Natural Products, K. W. Bentley. Vol. I – V.
13. J.W. Apsimon, Total Synthesis of Natural Products, Vol. 1-6, Wiley-InterscicencePublications, New York (Vol. 1, 1973).
14. Principles of biochemistry –Donald J.Voet, Judish G.Voet, charlotte w. pratt (John willey and sons)
15. Lehninger principles of biochemistry- David L.Nelson and Michael M.wx (Palgrave Macmillan / w.h. freeman company new york)
16. Biochemistry – U.Satyanarayana Baro and allied P.Ltd., kolkata

M.Sc. Semester-III (ORGANIC CHEMISTRY)
PAPER-II (Selected Topics in Organic Chemistry-I)

UNIT-I NMR SPECTROSCOPY (12 Periods)

Theory and principles of NMR spectroscopy, Theory of Fourier Transform

(i) 1H NMR Spectroscopy

Proton resonance condition, Aspects of PMR spectra – number of signals, chemical shift, factors influencing chemical shift, deshielding, chemical shift values and correlation for protons bonded to carbons (aliphatic, olefinic, aldehydic, aromatic) and other nuclei (alcohols, phenols, enols, acids, amides and mercaptans), effect of deuteration, spin- spincoupling, (n+1) rule, factors effecting coupling constant "J"

(ii) 13C NMR spectroscopy

Types of 13C NMR Spectra: proton coupled and decoupled 13C spectra, chemical shift, calculations of chemical shifts of aliphatic, olefinic, alkyne, aromatic, hetero aromatic and carbonyl carbons, factors affecting chemical shifts

(iii) 2D NMR Techniques

Preliminary idea of 2D NMR ,

UNIT-II ENVIRONMENTAL CHEMISTRY (11Periods)

(i) Water Pollution: Basic Concepts of Eutrophication, Water Quality, Water contaminants, Heavy minerals, Organic contaminants, PCBs and other Halogens materials, PAH, Pesticides, Waterborne Pathogens, Aquatic toxicology, Water Purification Methods, Sewagetreatment.

(ii) Air Pollution: Air pollution sources and emissions- Particulates, Aerosols, Photochemical smog, Determination of SOx, NOx, COx and hydrocarbons, Air pollutioncontrol technologies of particulate and gaseous pollutants

(iii) Effluent treatment: Industrial pollution of sugar, distillery, drug, pulp & paper andtheir analysis. Effluent treatment plants of above industries.

UNIT-III HETEROCYCLIC CHEMISTRY-I (11 Periods)

(A) Nomenclature of Heterocycles:

Hantzsch-Widman nomenclature systems for monocyclic and fused heterocycles andbridged heterocycles

(B) Five and six membered heterocycles with two hetero atoms:

Synthesis, reactivity, aromatic character and importance of following heterocyclic rings: Oxazole, Thiazole, Pyrazole, Imidazole, Pyridazine, Pyrimidine, Pyrazine

(C) Condensed five membered heterocycles:

Synthesis, reactivity, aromatic character and importance of following heterocyclic Rings: Benzoxazole, Benzthiazole, Benzopyrazole, Benzimidazole.

UNIT-IV REAGENTS FOR ORGANIC SYNTHESIS (11Periods)

Introduction, Preparation and Industrial Applications of the following,

(1)N-Bromosuccinimide (NBS)

(2)Grubbs 1st and 2nd generation catalyst

(3)N,N-dicyclohexylcarbodiimide (DCC)

(4)Lead tetra-acetate (LTA)

(5)Baker's yeast

(6)n- butyl lithium

(7) K3Fe(CN)6 and DMSO

(8) Grignard Reagent

(9)Diazomethane

(10)Polyphosphoric acid

Reference Books Recommended:

1. R.M. Silverstein and F.X. Webster, Spectroscopic Identification of Organic Compounds, 6th Edition (2003) John Wiley, New York.
2. D.H. Williams and I.F. Fleming, Spectroscopic Methods in Organic Chemistry, 4th Edition(1988), Tata-McGraw Hill, New Delhi.
3. P.Y Bruice, Organic Chemistry, 2nd Edition (1998) Prentice – Hall, New Delhi.
4. Nuclear Magnetic Resonance – Basic Principles- Atta-Ur-Rehman, Springer- Verlag (1986).
5. One and Two dimensional NMR Spectroscopy – Atta-Ur-Rehman, Elsevier (1989).
6. Organic structure Analysis- Phillip Crews, Rodriguez, Jaspars, Oxford University Press (1998).
7. G.W. Vanloon, S.J. Duffer, Environmental Chemistry - A Global Perspective, Oxford University Press (2000).
8. F.W. Fifield and W.P.J. Hairens, Environmental Analytical Chemistry, 2nd Edition (2000), Black Well Science Ltd.
9. Colin Baird, Environmental Chemistry, W.H. Freeman and Company, New York (1995).
10. A.K. De, Environmental Chemistry, 4th Edition (2000), New Age International Private Ltd., New Delhi.
11. Peter O. Warner, Analysis of Air Pollutants, 1st Edition (1996), John Wiley, New York.

12. S.M. Khopkar, Environmental Pollution Analysis, 1st Edition (1993), Wiley Estern Ltd., New Delhi.
13. S.K. Banerji, Environmental Chemistry, 1st Edition (1993), Prentice-Hall of India, New Delhi.
14. An introduction to the chemistry of heterocyclic compounds-R M Acheso
15. Heterocyclic Chemistry- J A Joule and Smith
16. Heterocyclic Chemistry-II- R R Gupta, M Kumar, V Gupta, Springer (India) pvt
17. Heterocyclic Chemistry, 4th Edition by J. A. Joule & K. Mills, Published by Chapman & Hall (1995)
18. Principles of modern heterocyclic chemistry, Edited by Leo A. Paquette, Published by Pearson Benjamin Cummings (1968)
19. Heterocyclic Chemistry, 3rd Edition by Thomas L. Gilchrist, Published by Prentice Hall (1997)
20. The Structure & Reactions of Heterocyclic Compounds, Edited by Michael Henry Palmer, Published by Edward Arnold (1967)
21. Heterocyclic chemistry by V. K. Ahluwalia, Narosa publishing house.
22. Organic synthesis using transition metals-Roderick Bates (Wiley).
23. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press).
24. Advanced organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007).
25. Guidebook to organic synthesis-R K Meckie, D M Smith and R A Atken.

M.Sc. Semester-III (ORGANIC CHEMISTRY)

PAPER-III (Organic Chemistry in Industry)

UNIT-I ORGANIC CHEMISTRY IN INDUSTRY (12 Periods)

Introduction, Process Chemistry versus Research Chemistry

Pharmaceutical Industry: Drug Discovery, Drug development, Preclinical and clinical testing, Medicine, Future Problems and Opportunities

Agrochemical Industry: Classification, Biodegradable and Persistent Pesticides, Toxicity, Chemical Classification of Pesticides-Herbicides and Insecticides

UNIT-II BASIC CONCEPTS OF DYE AND DYE INTERMEDIATES (11Periods)

Introduction of Dyes and Pigments, Absorption of visible light, colour of wavelength absorbed, complementary colour. Relation between color and chemical Constitution, Witt's theory, Armstrong's theory, Nietzki's theory, Valence bond theory, Molecular orbital theory, Fastness Properties, Exhaustion and fixation properties. Natural Dyes, Nomenclature of Dye Intermediates, Colour Index

Classification of Dyes: Based on structure, based on mode of application to fibres, Non– Textile uses of dyes: Dyes in medicine, leather, paper, colour photography and electrophotography, food, cosmetics, displays and laser dyes.

UNIT-III BASIC CONCEPT OF DRUGS (11Periods)

Introduction, Classifications: On the basis of their chemical structure and therapeutic action, Nomenclature: Proprietary and Non-proprietary name, Nomenclature of new drugs by WHO, Names of drugs: Generic and brand names

Theories of drug action: Occupancy theory, Rate theory and induced fit theory Biologicaldefence, chemical defences, Furguson principle

Absorption of drugs: Routes of administration, factors that affect on absorption

Physico chemical properties: Solubility, Partition coefficients, Ionization constant, Electronic effect, Steric effect, Stereochemical consideration

UNIT-IV UNIT PROCESSES (11Periods)

(i) Nitration: Nitrating agents. Mechanism of aromatic nitration. Industrial chemicals derived from Benzene, Naphthalene, Anthracene using Nitration.

(ii) Sulphonation and Sulfation: Sulphonating and Sulfating agents. Mechanism of aromatic Sulphonation. Industrial chemicals derived from Benzene, Naphthalene, Anthracene using Sulphonation.

(iii) Amination: Aminating agents, Amination by reduction, Amination by Ammonolysis. Industrial chemicals derived from Benzene using Amination.

(iv) Alkylation: Alkylating agents. Industrial important alkyl compounds derived by various routs

(v) Halogenation: Halogenating agents. Industrial important halogenated compounds derived by various routs

Reference Books Recommended

1. Organic Chemistry: A Mechanism Approach; Penny Chaloner, CRC Press, Tailor and Francis; Florida.
2. Pharmaceutical Process development: Current Chemical and Engineering Challenges, J. Blacker and M. T. Williams, RSC Cambridge, UK.
3. Fine Chemicals: The Industry and Its Business, P. Pollak, 2nd Edition, Wiley.
4. The chemistry of synthetic Dyes, Vol. I to VII by Venkataraman, Academic Press, New York.
5. Chemistry of Synthetic Dyes & Pigments by Lubs.
6. Dyes and their intermediates by E. N. Abrahart.
7. Handbook of synthetic dyes and pigments, Vol. I & II by K. M. Shah.
8. Industrial Dyes by Klans Hunger, Germany by Wiley-VCH.
9. Development in the Chemistry and technology of Organic Dyes by J.Griffiths, Blackwell Sci. Pub., Oxford, London.
10. Principles of colour Technology by Fred W. Billmeyer and Max Saltzman, John Wiley & Sons.
11. Medicinal Chemistry by G. R. Chatwal.
12. A textbook of Pharmaceutical Chemistry by Jayshree Ghosh.
13. Chemical Process Industries by R. N. Shreve.
14. Riegel's Hand-Book of Industrial Chemistry, Ed. by James A. Kent.
15. Industrial Chemicals by Faith, Keyes, Clark.

M.Sc. Semester-III (ORGANIC CHEMISTRY)

PAPER-IV (Medicinal Chemistry-I)

UNIT-I DRUG DESIGN, PHARMACOKINETICS AND PHARMACODYNAMICS (12 Periods)

Drugs and Drug Design Introduction, drug targets, procedure for drug design, pro- drug,concepts of lead compounds, lead modification, structure activity relationship (SAR), LD50, ED50, therapeutic index, Concepts of drug receptors, Elementary treatment of drug receptor interactions.

Introduction to Phramcokinetic and Pharmacodynamic, Drug administration, Drug absorption, drug distribution, drug Metabolism (general pathway of drug metabolism: Phase-I and Phase-II), elementary treatment of enzyme stimulation, biotransformation, Drug excretion.

UNIT-II PSYCHOACTIVE DRUGS (11Periods)

(i) General anaesthetics:

General classification and Structural variations

(ii) Local Anaesthetics:

General classification and SAR

(iii) Sedatives and Hypnotics:

General classification, Structural variations and mode of action

Synthesis and therapeutic uses of only the following:

Thiopental (Pentothal), Amobarbital (Amytal), Diazepam, Chlorazepam, alprazolam, glutethimide, Nikethamide, Benzocaine, Procaine, Lidocaine (xylocaine), Dibucaine (Nupercaine), Phenacaine (Holocaine).

UNIT-III Antipyretic Analgesics and NSAIDs Agents (11 Periods) General classification of Antipyretic Analgesics, Narcotic Analgesics and Non-SteroidalAnti-Inflammatory Drugs

Structural variations in Morphine, Morphan and 4-Phenylpiperidine Analogues. Opioid Receptors (Name only), Limitations of Opoids,

Synthesis and therapeutic uses of only the following:

Meperidine (Pethidine), Ibuprofen, Meclofenamate sodium, Oxyphenbutazone, Diclofenac Sodium, Mefanamic acid,

UNIT-IV DIURETICS, ANTI-DIABETIC AGENTS AND CARDIOVASCULAR DRUGS (11 Periods)

(A) Diuretics:

General classification. Structural variation and SAR of Thiazide Diuretics Synthesis and therapeutic uses of only the following:

Chlorothiazide, Furosemide, Ethacrynic acid, Triamterene

(B) Insulin and Oral Hypoglycemic Agents (Anti-diabetic agents or drugs affecting sugar metabolism):

General classification,
Synthesis and therapeutic uses of only the following:
Glipizide, Glybomuride Troglitazone, Chlorporpamide, Glibenclamide

(C) Cardiovascular Drugs:
General introduction of Antiarrythmic agents and Antihypertensive drugs Structure variation in ß-adrenergic blockers and Dihydropyridines, Structure – activity Relationship of ACE Inhibitors
Synthesis and therapeutic uses of only the following: Verapamil, Methyldopa, Atenolol, Lisinopril, Losartan

Reference Books Recommended

1. Burger's Medicinal Chemistry and Drug Discovery (5/e), 1997, Vol. 1, 2, 3, 4,5, Edited by ManFred E. Wolff (John Wiley & Sons, inc., New York).
2. Principles of Medicinal Chemistry, Vol. I & II (5/e), by S. S. Kadam, K. R. Mahadik, K. G. Bothra (Nirali Prakashan).
3. Principles of Medicinal Chemistry by William O. Foye (ed.), Lea and Febiyer, Philadelphia.
4. Wilson and Gisvold's Text-book of Organic Medicinal and Pharmaceutical Chemistry (5/e, 1982) by Robert F. Doerge (J. B. Lippincott Company, Philadelphia/Toppan Co. Ltd., Tokyo).
5. Essential of Medicinal Chemistry (2/e) by Andrejus Korolkovas (A Wiley Interscience Publication, 1988, John Wiley & Sons, Canada).
6. Medicinal Chemistry by Ashutoshkar (Wiley Eastern Ltd., 1993).
7. The Pharmaceutical Basis of Therapeutics by Goodman and Gilman (The Macmillan Co.).
8. The Organic Chemistry of Drug Synthesis, Vol. I, II & III (1980), Ed. By D. Lednicer and L. A. Mitscher (John Wiley and Sons, New York).
9. Topics in Medicinal Chemistry, Vol. I & II by Rabinowitz and Myerson (Editor) (Interscience, 1968).
10. Adhunik Sanshleshit Aushodhonu Rasayanvighyan, Dr. Anamik Shah, University Granth Nirman Board, Ahmedabad.
11. Medicinal Chemistry, D. Sriram and P. Yogeeswari, 1st edi., Pearson Education, 2007.
12. Handbook of pharmaceutical chemicals by Dr. A. R. Shenoy and Dr. V. R. Shenoy MultitechPublishing Co., 15-Yogesh, Hingwala Lane, Ghatkopar (East) Mumbai.
13. Fundamentals of Medicinal Chemistry by G Thomas.

M.Sc. Semester-III (ORGANIC CHEMISTRY)

PAPER-IV (DYES AND INTERMEDIATES-I)

UNIT-I AZO DYES (12 Periods)

General Introduction: Diazotization, mechanism and different methods of diazotization and laws of coupling, General introduction, classification and synthesis of Monoazo dyes, Bisazo dyes and Azoic dyes.

Synthesis of the following:

Disperse Red 13, Acid Blue 92, Mordant Black 3, Acid Black 1, Acid Blue 113, Direct Blue 15, Direct Violet 1, Direct Red 28, Naphthol AS-BR, Fast Orange GGD.

UNIT-II (11 Periods)

(A) Fluorescent Whitening Agents

Introduction, Theory of fluorescence,Classification of FWA and synthesis of importantmember of each class and their uses.

(B) Types of Fibres and Basic Operations in Dyeing Process

Types of fibres: Natural, semisynthetic and synthetic, Dyeing and

Interactions: Ionic Interactions, Hydrogen bond, Van der Waal's Interactions and Covalent Interactions.

Basic Operations in Dyeing Process: Preparation of the fibres, Preparation of the dyebath, application of the dyebath and finishings, Various methods of dyeing: Direct dyeing, Vat dyeing, Mordant dyeing, Disperse dyeing and Formation of dye on the fibre, Dyeing of wool with the acid dyes, Dyeing with the reactive dyes, Fastness properties: Colour fastness, Light fastness, Sublimation fastness and Burnt gas fumes fastness.

UNIT-III (11Periods)

(A)Classification of Dyes according to application and chemical constitution.

(B)Evaluation of dyes

(C)Dyes for Non-Textile Application

Leather dyes, Paper dyes, Hair dyes, Food dyes, Ink dyes, Photographic dyes, Indicatordyes, Laser dyes, Liquid crystal dyes, Solar cell, biological uses of dyes.

Synthesis of the following:

Eriochrome Black T, Sunset Yellow FCF, Acridine Yellow G, Safranine B, Prontosil, Methylene Blue, Nile Blue 2B, Tartrazine

UNIT-IV **(11 Periods)**

(A) Pigments

Different classes of organic and inorganic pigments and their applications with examples.

(B) Heterocyclic Dyes

Pyrazolone dyes, cyanine dyes, dyes containing azine, oxazine and thiazine ring systems,Thiazole Dyes

Synthesis of only the following:

Basic Yellow 11, Basic Orange 21, Safranine B, Rosinduline GG, Sirius Supra Blue FFRL, Brilliant Alizarin Blue 3R, Sirius Supra Yellow RT, Acid Yellow 19, Copper Phthalocyanine, Sirius Supra Light Green FFGL.

Reference Books Recommended

1. The chemistry of synthetic Dyes, Vol. I to VII by Venkataraman, Academic Press, New York.
2. Chemistry of Synthetic Dyes & Pigments by Lubs.
3. Dyes and their intermediates by E. N. Abrahart.
4. Handbook of synthetic dyes and pigments, Vol. I & II by K. M. Shah.
5. Industrial Dyes by Klans Hunger, Germany by Wiley-VCH.
6. Development in the Chemistry and technology of Organic Dyes by J.Griffiths, Blackwell Sci. Pub., Oxford, London.
7. Principles of colour Technology by Fred W. Billmeyer and Max Saltzman, John Wiley & Sons.
8. Advance in colour chemistry, series vol.-3, Modern colourants: Synthesis and structure, edited by A.T.Peters and H.S. Freeman, Blackie Academic & Professional(1995).
9. Colour chemistry: Synthesis, properties and applications of organic dyes and pigments, Heinrich Zollinger VCH, Germajy(1987).
10. Organic Chemnistry in Colour V., P.F.Gordan, P. Gregory, Spinger-Verlag(1983).
11. Textile Auxiliaries, J.W. Batty
12. The production and applications fluorescent brightening agents, Milos Zahradnik, John Wiley & Sons (1982).
13. Chemistry of Dyes and Principles of dyeing-V.A. Shenai
14. Synthetic dyes- G.R. Chatwal
15. Critical reports on Applied chemistry, Vol-7, Developments in chemistry and Technologyof organic dyes, Edited by : J. Griffths, Blackwell

M.Sc. Semester-III (ORGANIC CHEMISTRY)

M.Sc. - Semester – III
Organic Chemistry
(PRACTICALS)

1	Green Synthesis	4- Credit
2	Preparation (From Given Name reactions)	
3	Estimation	4- Credit
4	Viva-Voce	

1 Green Synthesis (Any four)

1.Preparation of acetanilide from aniline and acetic acid using Zn dust.2.Base catalyzed aldol condensation using LiOH.H2O as a Catalyst.
3.Bromination of *trans*-stilbene using sodium bromide and sodium bromated.
4.[4+2] cycloaddition reaction in aqueous medium at room temperature.
5.Benzil Benzilic acid rearrangement under solvent free condition

2 Preparation of industrially important compounds by following Name reactions (Any four)

1. Sandmayer reaction
   (p-chloro toluene from p-toluidine)
2. Fischer indole synthesis
   (1,2,3,4-tetrahydrocarbazole from cyclohexanone and phenylhydrazine)3
.Riemer-Tiemann reaction (Salicyladehyde from phenol)
4. Skraup synthesis (Quinoline from aniline)
5. Gebriel phthalimide synthesis
   (Anthranilic acid from phthalic anhydride and phthalimide)
6. 2-hydroxy 1-naphthaldehyde from □ □ naphthol

3 Organic Estimations (Any Six)

1.Determination of Sulphonamides with Silver Nitrate solution by Volumetrically.
2.Determination of aromatic primary amines by either diazotization or indirect diazotization.
3.Estimation of Benzyl Penicillin.
4.Determination of coupling value (C.V.) of Dye intermediates.
5.Non-aqueous titration of Sodium Benzoate.
6.Estimation of Isonazid.
7.Enzyme inhibition
8. -NO_2 and-OH group

Reference Books Recommended

1. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Ren Aggarwal
2. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry Task Force Committee, DST
3. Quantitative analysis by Arther I.Vogel
4. Quantitative analysis by V.K.Ahluwalia
5. Quantitative analysis by Mann and sanders

M.Sc. Semester-IV (ORGANIC CHEMISTRY)

Sr. No.	Course Title	L	T/C/S	Credit
1	Advance Organic Chemistry	4	1	4
2	Selected Topics In Organic Chemistry-II	4	1	4
3	Advance Organic Synthesis	4	1	4
4	Medicinal Chemistry-II OR Dye and Intermediates-II	4	1	4
5	Practicals	12		8
		28	4	24

External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No	Course group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	IV	I	Core	04	30	70	100
		II	Core	04	30	70	100
		III	Core	04	30	70	100
		IV	Core	04	30	70	100
			Practical	08	60	140	200
			Total	24	180	420	600

M.Sc. Semester-IV (ORGANIC CHEMISTRY)

PAPER-I (Advance Organic Chemistry)

UNIT-I NAME REACTIONS (12 Periods)

General nature, method, mechanism and synthetic applications of the following reactions;(1)Ugi reaction
(2) Noyori reaction
(3) Wittig reaction
(4) Peterson olefination reaction
(5)Mannich reaction
(6)Stille reaction (7)Ene
recation (8)Staudinger
reaction
(9)Corey-Fuchs reaction
(10)Ritter reaction
(11)Mcmurry reaction
(12)Michael addition

UNIT-II OXIDATION (11 Periods)

Introduction, Oxidation with Cr(VI), Mn(VII), Mn(IV), OsO_4, Periodic acid. Peroxy acid. Oxidation of hydrocarbons-alkenes, aromatic rings, saturated C-H group (activated and unactivated), aldehyde and ketones

UNIT-III REDUCTION (11 Periods)

Introduction, different reductive processes, hydrocarbons-alkenes, alkynes and aromatic rings, Carbonyl compounds- aldehydes, ketones, ($LiAlH_4$, $NaBH_4$ only for aldehyde and ketone) acids and their derivatives, epoxides, nitro, nitroso, azo and oxime groups, Birch reduction, Shapiro reduction.

UNIT-IV MOLECULAR REARRANGEMENTS (11Periods)

(A) Rearrangement involving migration to electron deficient carbon:
- (i) Expansion and contraction of rings/Demajnov rearrangement
- (ii) Benzil-benzilic acid rearrangement

(B) Rearrangement involving migration to electron rich carbon:
- (i) Favorskii rearrangement
- (ii) Sommelet-Hauser rearrangement
- (iii) Neber rearrangement

(C) Rearrangement involving migration to electron deficient nitrogen:

(i) Schmidt rearrangement

(ii) Curtius rearrangement

(D) Aromatic rearrangements:

(i) Migration around the aromatic nucleus: Jacobsen rearrangement

(ii) Migration of group from the side chain to the nucleus: Orton rearrangement, Hoffmann-Martius rearrangement, Rearrangement of N-nitrosoanilines (Fischer-Hepp rearrangement).

(E) Rearrangement involving migration from oxygen to ring:

(i) Fries rearrangement

(ii) Claisen rearrangement

Reference Books Recommended:

1. Organic synthesis using transition metals-Roderick Bates (Wiley)
2. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press)
3. Some modern methods of organic synthesis – W. Carruthers (Cambridge)
4. Organic synthesis – Michael B. Smith
5. Advanced organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007)
6. Guidebook to organic synthesis-R K Meckie, D M Smith and R A Atken
7. Organic synthesis- Robert E Ireland
8. Strategic Applications of named reactions in organic synthesis-Laszlo Kurti and Barbara Czako
9. Organic Synthesis, Jagdamba Singh & L.D.S. Yadav, 6th edition, Pragati Prakashan (2010).
10. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976)
11. Advance Organic Chemistry, Reaction Mechanism and Structure by Jerry March, 4th ed. John Wiley & Sons, 1992

M.Sc. Semester-IV (ORGANIC CHEMISTRY)

PAPER-II (Selected Topics in Organic Chemistry-II)

UNIT-I MASS SPECTROMETRY (12 periods)

Theory and principles of mass spectroscopy; Instrumentation; low and high resolution mass spectra; Ionization techniques – Electron Impact (EI) ionization, Chemical Ionization (CI), Field Desorption (FD), Fast Atom Bombardment (FAB), Electronspray Ionization (ESI); Determination of molecular weight and molecular formula, nitrogen rule, detection of molecular ion peak, metastable ion peak; Fragmentations – rules governing the fragmentations, McLafferty rearrangement; Interpretation of mass spectra of different class of compounds – saturated and unsaturated hydrocarbons, aromatic hydrocarbons, alcohols, ethers, ketones, aldehydes, carboxylic acids, amines, amides, compounds containing halogens; To write possible fragmentation for given compound; To identify structure from mass spectral data; To identify structure from combined spectral data.

Structure elucidation by suing UV, IR, NMR and Mass Spectroscopic techniques

UNIT-II STRUCTURE-REACTIVITY PRINCIPLES (11 Periods)

Types of mechanisms, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammonds postulate, Curtian-Hammet principle, potential energy diagrams, transition state and intermediates, methods of determining mechanisms-
isotope effect.

Effect of structure on reactivity- resonance and field effect, steric effect, quantitative treatment. The Hammet equation and linear free energy relationships, substituent and reaction constants, positive and negative deviation from Hammet equation, Taft equation,
Solvent effect

UNIT-III HETEROCYCLIC CHEMISTRY-II (11Periods)

(A)Five and six membered heterocycles with more than two hetero atoms: Synthesis, reactivity, aromatic character and importance of following heterocycles:1,2,3- triazole, 1,2,4-triazole, 1,2,4-oxadiazole, 1,3,4-oxadiazole, 1,2,5-oxadiazole (B)Condensed six membered heterocycles:
Synthesis, reactivity, aromatic character and importance of following heterocyclic Rings: Quinoline, Isoquinoline, Cinnoline, Quinoxaline, Phthalazine, Naphthyridine, Phenoxazine

UNIT-IV SYNTHETIC AND BIO-POLYMERS (11 Periods)

Bio-polymers: General introduction, types, properties and uses of polysaccharides – starch and cellulose

Synthetic polymers: General introduction, method of preparation, properties and uses of Polyester, poly-tetrafluoroethylene, polyamino acids, polycyanoacrylates,

polyurethanes, silicone rubbers, polyphosphazenes, divinylether - maleic anhydride cyclopolymer (DIVEMA) polymeric antioxidants,

Reference Books Recommended:

1. Spectroscopic Identification of Organic Compounds, R. M. Silverstein and F. X. Webster, 6th edition (John Wiley & Sons)
2. Introduction to Spectroscopy, D. L. Pavia, G. M. Lampman and G. S. Kriz, 3rdedition (Thomson Brooks/Cole)
3. Spectroscopic Methods in Organic Chemistry, D. H. Williams and I. Fleming, 4thedition (Mcgraw – Hill Book Company)
4. Organic Spectroscopy, William Kemp, 3rd edition (Palgrave)
5. Organic Spectroscopy – Principles and Applications, Jag Mohan, 2nd edition (Narosa Publishing House)
6. Spectroscopy of Organic Compounds, P. S. Kalsi, 5th edition (New Age International Publishers)
7. Elementary Organic Spectroscopy: Principles and Chemical applications (revised edition), Y. R. Sharma (S. Chand Publishing)
8. Organic Chemistry by Francis A. Carey (McGraw-Hill Book Co., 1987).
9 .Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell Uni.Press.
10. Principles of Organic Synthesis, R.O.C. Norman and J. M. Coxon, Blackie Academic and Professional.
11 .Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillan.
12. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers
13. An introduction to the chemistry of heterocyclic compounds-R M Acheso
14. Heterocyclic Chemistry- J A Joule and Smith
15. Heterocyclic Chemistry-II- R R Gupta, M Kumar, V Gupta, Springer (India) pvt
16. Heterocyclic Chemistry, 4th Edition by J. A. Joule & K. Mills, Published by Chapman & Hall (1995)
17. Principles of modern heterocyclic chemistry, Edited by Leo A. Paquette, Published by Pearson Benjamin Cummings (1968)
18. Heterocyclic Chemistry, 3rd Edition by Thomas L. Gilchrist, Published by Prentice Hall (1997)
19. The Structure & Reactions of Heterocyclic Compounds, Edited by Michael Henry Palmer, Published by Edward Arnold (1967)
20. Heterocyclic chemistry by V. K. Ahluwalia, Narosa publishing house.
21. Harry R. Allcock, Frederick W. Lampe and James E. Mark, Contemporary Polymer Chemistry, 3rd edition, Pearson Prentice Hall, 2005.
22. Organic Polymer Chemistry by K. J. Saunders.

M.Sc. Semester-IV (ORGANIC CHEMISTRY)

PAPER-III (Advance Organic Synthesis)

UNIT-I PROTECTING GROUPS (12 Periods)

Need of protecting groups – Protection of alcohols, Carbonyl, Carboxylic acid and amino groups, Synthetic equivalent groups and examples on transformations

UNIT-II DISCONNECTION APPROACH (11 Periods)

Introduction to disconnection, Concept of synthon, Synthetic equivalent, Functional group interconversion

(i) One group disconnection:

Disconnection and synthesis of alcohols, olefins, simple ketones, acids and itsderivatives

(ii) Two groups disconnection:

Disconnections in 1,3-dioxygenated skeletons, preparation of β-hydroxy carbonyl compounds, α,β-unsaturated carbonyl compounds, 1,3-dicarbonyls, 1,5- dicarbonyls and use of Mannich reaction

(iii) Pericyclic reactions:

Disconnections based on Diels-Alder reaction and electrocyclic reaction: Its use in organic synthesis

UNIT-III RING SYNTHESIS (11 Periods)

Introduction to ring synthesis

(i) Synthesis of saturated heterocycles: Synthesis of 3 and 4 membered rings

(ii)heterocycles in organic synthesis:

Synthesis of alkanes and cycloalkanes from thiophene, Synthesis of alkenes and cycloalkenes from pyridines,

Synthesis of Aromatic compounds from pyrilium salts, pyridazine, thiophenes and furan

UNIT-IV ORGANOMETALLIC COMPOUNDS AND THEIR APPLICATIONS (11 Periods)

(i) Carbon-metal bonds in organometallic compounds, Synthesis and applications of Organolithium, Organozinc and Lithium diorganocuprate.

(ii) Basic concept of organoboranes, Preparation of organoboranes, Stereochemistry of hydroboration, Mechanism of hydroboration – oxidation, Synthetic applications.

Reference Books Recommended:

1. Organic synthesis using transition metals-Roderick Bates (Wiley).
2. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press).
3. Some modern methods of organic synthesis – W. Carruthers (Cambridge)
4. Organic synthesis – Michael B. Smith.
5. Advanced organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007).

6. Guidebook to organic synthesis-R K Meckie, D M Smith and R A Atken.
7. Organic synthesis- Robert E Ireland.
8. Strategic Applications of named reactions in organic synthesis-Laszlo Kurti and Barbara Czako.
9. Organic Synthesis, Jagdamba Singh & L.D.S. Yadav, 6th edition, Pragati Prakashan (2010).
10. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
11. Advance Organic Chemistry, Reaction Mechanism and Structure by Jerry March, 4th ed. John Wiley & Sons, 1992.
12. Designing Organic Synthesis – A Programmed Introduction to the Synthon Approach, Stuart Warren, John Wiley & Sons (1994).
13. Organic Synthesis: The disconnection approach, Stuart Warren, John Wiley & Sons (1994).
14. Selected Organic Synthesis, Ian Fleming, John Wiley & Sons (1977).
15. Principles of Organic Chemistry by R.O.C. Norman (Chapman and Hall, 1986).
16. Organometallic Chemistry by P. L. Pauson (Edward Arnold, 1968).
17. Principles of Organometallic Chemistry by Coats, Green, Powell & Wade (Chapman and Hall, 1977).

M.Sc. Semester-IV (ORGANIC CHEMISTRY)
PAPER-IV (Medicinal Chemistry-II)

UNIT-I ANTIBIOTICS (11 Periods)

General introduction and classification of antibiotics
Broad spectrum antibiotics, Macrolide antibiotics, Amino glycoside antibiotics and Non-classifiable antibiotics

(i) β-lactam antibiotics:

Penicillins (Structural variations and SAR), Cephalosporins (Structural variations)

(ii) Non-lactam antibiotics:

Tetracyclin (Structural variations and SAR)
Structures and medicinal importance/ clinical uses/ pharmacological applications of the following:
Bacitracin, Vancomycin, Erythromycin, Lincomycin, Chloramphenicol, Nalidixic acid, Norfloxacin, Ciprofloxacin
Synthesis and therapeutic uses of only the following:
Methicillin, Ampicillin, Cephalexin, Chloramphenicol, Ciprofloxacin

UNIT-II ANTIALLERGIC AND LOCAL ANTI INFECTIVE DRUGS (12 Periods)

(A) Antihistamines and related Antiallergic Drugs:

General introduction and mode of action, Structure variation in Aminoalkylethers, Ethylenediamines and Piperazine derivatives.
Synthesis and therapeutic uses of only the following:
Diphenhydramine (Benadryl), Antazoline, Chlorpheniramine, Primethazine

(B) Anti – mycobacterial agents:

General Introduction of Tuberculosis & Leprosy-disease, Treatment, Mode of action, adverse effect of Anti TB agents & Anti–leprotic agents
Synthesis and therapeutic uses of only the following: Ethionamide, Ethambutol, DDS (Dapsone), Pyrazinamide.

(C) Sulfonamides:

General classification, mode of action and SAR Synthesis and therapeutic uses of onlythe following:
Sulfamethoxine (Sufadoxine), Sulfamethoxy-Pyrazine (Sulfalene), Succinyl sulfathiazole (Sulfasuxidine)

UNIT-III Antimalerials and Antineoplastic agents (11 Periods)

(A) Antimalarials:

Introduction, Types, Life cycle of plasmodium, drug resistance, General classification, SAR of 4- and 8-aminoquinolines and Structure variation in Sesquiterpene Lactones, mode of action

Synthesis and therapeutic uses of only the following:
Mefloquine, Chloroquine, Primaquine, Pyrimethamine (Daraprim), Quinacrine

(B) Antineoplastic Agents (Cancer Chemotherapy):

Introduction to cancer, types, Causes & Treatment of cancer, Metastasis, Drug Resistance, Targets of anticancer agents, adverse effects of cancer therapy (in brief) General classification of antineoplastic agents, Cell Cycle-Specific (CCS) and Non Cell Cycle-Specific (CCS) Agents, Mode of action,

Synthesis and therapeutic uses of only the following:
Mechlorethamine, Cyclophosphamide, Melphalan, 6-Mercaptopyrine,Trimetrexate, Cytarabine

UNIT-IV Anti-Viral and Anti-HIV agents (11Periods)

(A) Antiviral agents:

Introduction, Types & classes of viruses, Classification of antiviral agents, mechanism of action, Antiviral Compounds for DNA Viruses & Selected RNA Virus Infections other than HIV (Influenza A and B Viruses, Hepatitis C Virus)

(B) Anti-HIV Drugs:

Introduction, HIV Infection and its Pathological Effects, HIV Structure and life cycle, Targets for Drug Design of Anti-HIV Agents, HIV drugs in clinical use, Development of Drug Resistance, the need for new Anti-HIV Drugs, Introduction of AIDS

Synthesis and therapeutic uses of only the following: Amantadine, Acyclovir,Zidovudine, Indinavir, Ritonavir

Reference Books Recommended

1. Burger's Medicinal Chemistry and Drug Discovery (5/e), 1997, Vol. 1, 2, 3, 4,5, Edited by ManFred E. Wolff (John Wiley & Sons, inc., New York).
2. Principles of Medicinal Chemistry, Vol. I & II (5/e), by S. S. Kadam, K. R. Mahadik, K. G.Bothra (Nirali Prakashan).
3. Principles of Medicinal Chemistry by William O. Foye (ed.), Lea and Febiyer, Philadelphia.
4. Wilson and Gisvold's Text-book of Organic Medicinal and Pharmaceutical Chemistry (5/e, 1982) by Robert F. Doerge (J. B. Lippincott Company, Philadelphia/Toppan Co. Ltd., Tokyo).

5. Essential of Medicinal Chemistry (2/e) by Andrejus Korolkovas (A Wiley Interscience Publication, 1988, John Wiley & Sons, Canada).
6. Medicinal Chemistry by Ashutoshkar (Wiley Eastern Ltd., 1993).
7. The Pharmaceutical Basis of Therapeutics by Goodman and Gilman (The Macmillan Co.).
8. The Organic Chemistry of Drug Synthesis, Vol. I, II & III (1980), Ed. By D. Lednicer and L. A. Mitscher (John Wiley and Sons, New York).
9. Topics in Medicinal Chemistry, Vol. I & II by Rabinowitz and Myerson (Editor) (Interscience, 1968).
10. Adhunik Sanshleshit Aushodhonu Rasayanvighyan, Dr. Anamik Shah, University Granth Nirman Board, Ahmedabad.
11. Medicinal Chemistry, D. Sriram and P. Yogeeswari, 1st edi., Pearson Education, 2007.
12. Handbook of pharmaceutical chemicals by Dr. A. R. Shenoy and Dr. V. R. Shenoy MultitechPublishing Co., 15-Yogesh, Hingwala Lane, Ghatkopar (East) Mumbai.
13. Fundamentals of Medicinal Chemistry by G Thomas.

M.Sc. Semester-III (ORGANIC CHEMISTRY)

PAPER-IV (DYES AND INTERMEDIATES)

UNIT-I ANTHRAQUINONE DYES (12 Periods)

Vat Dyes and Solubilized Vat dyes, Acid dyes, Mordant dyes and dyes for cellulose acetate.
Synthesis of only the following:
Indanthrene Orange 7RK, Indanthrene Yellow FFRK, Indanthrene Khakhi 2G, Indanthrene Orange FFRK, Indanthrene Yellow 4GK, Indanthrene Scarlet B, Caledon Jade Green XBN, Anthracene Blue SWX, Indanthrene Brilliant Orange GR, Celliton Fast Blue FFG.

UNIT-II (11 Periods)

General nature, classification, structural variation, synthesis and application of fibres of the following classes of dyes:
(i)Reactive dyes
(ii)Triphenylmethane dyes (TPM)
(iii)Acid dyes
Synthesis of only the following:
Procion Brilliant Blue MR, Procion Brilliant Red H-3B, Remazol Brilliant Blue R, Malachite Green, Crystal Violet, Acid Yellow 73, Acid Red 1, Acid Black 24

UNIT-III (11 Periods)

General nature, classification, structural variation, synthesis and application of fibres of the following classes of dyes:
(i) Disperse dyes
(ii) Indigoid and Thio-indigoid dyes
(iii)Cationic dyes
Synthesis of the following:
Disperse Yellow 16, Disperse Blue 14, Celliton Fast Yellow 7G, Ciba Blue 2B, Indanthrene Brilliant Pink R, Bismarck Brown, Chrysoidine Y, Methylene Blue, Acridine Yellow G, Disperse Orange 29

UNIT-IV (11 Periods)

General nature, classification, structural variation, synthesis and application of fibres of the following classes of dyes:
(A) Sulphur dyes
(B) Ecology and toxicity of dyes with reference to textile dyes, food colours, benzidine etc.
(C) Medicinal dyes and biological stainingagents
(D) High tech application of dyes: Liquid crystal display (LCD), Laser dyes, Photochromic dyes, Thermochromic dyes, dye sensitizer solar cells.

Reference Books Recommended

1. The chemistry of synthetic Dyes, Vol. I to VII by Venkataraman, Academic Press, New York.
2. Chemistry of Synthetic Dyes & Pigments by Lubs.
3. Dyes and their intermediates by E. N. Abrahart.
4. Handbook of synthetic dyes and pigments, Vol. I & II by K. M. Shah.
5. Industrial Dyes by Klans Hunger, Germany by Wiley-VCH.
6. Development in the Chemistry and technology of Organic Dyes by J.Griffiths, Blackwell Sci. Pub., Oxford, London.
7. Principles of colour Technology by Fred W. Billmeyer and Max Saltzman, John Wiley & Sons.
8. Advance in colour chemistry, series vol.-3, Modern colourants: Synthesis and structure, edited by A.T.Peters and H.S. Freeman, Blackie Academic & Professional(1995).
9. Colour chemistry: Synthesis, properties and applications of organic dyes and pigments, Heinrich Zollinger VCH, Germajy(1987).
10. Organic Chemnistry in Colour V., P.F.Gordan, P. Gregory, Spinger-Verlag(1983).
11. Textile Auxiliaries, J.W. Batty
12. The production and applications fluorescent brightening agents, Milos Zahradnik, John Wiley & Sons (1982).
13. Chemistry of Dyes and Principles of dyeing-V.A. Shenai
14. Synthetic dyes- G.R. Chatwal
15. Critical reports on Applied chemistry, Vol-7, Developments in chemistry and Technology of organic dyes, Edited by : J. Griffths, Blackwell

M.Sc. Semester-IV (ORGANIC CHEMISTRY)

M.Sc. - Semester – IV
Organic Chemistry
(PRACTICALS)

1	Spectral Exercise	4- Credit
2	Preparation or organic compounds	
3	Green Synthesis	4- Credit
4	Viva-Voce	

1Spectral Exercise (Minimum 10 from syllabus)

Structure interpretation of organic compounds from spectra (UV, IR, NMR and Mass)

2 Preparation of industrially important compounds (Minimum 8)

1. Sulfanilamide from via p-acetamido benzene sulphonyl chloride and acetamido benzene-sulfonamide.
2. Acridone from anthranilic acid via o-chloro benzoic acid and N-phenylanthranilic acid
3. Benzocaine from p-nitro toluene via p-nitro benzoic acid and p-amino benzoic acid.
4. Eosin from phthalic acid via phthalic anhydride and fluorescein.
5. Benzanilide from benzene via Benzophenone and Benzophenonoxime.
6. p-Nitro chloro benzene from acetanilide via p-nitro acetanilide and p-nitroaniline.
7. p-Chloro bromo benzene from acetanilide via p-bromo acetanilide and p-bromoaniline.
8. Anthrone from phthalic anhydride via o-benzoyl benzoic acid and anthraquinone.
9. 4-Methyl-7-hydroxy-8-acetyl coumarin from resorcinol via 4-methyl-7-hydroxycoumarin and 4-methyl-7-acetyl coumarin.
10. Preparation of Congo red dye from naphthionic acid via hydrozobenzene.
11. Preparation of o & p-hydroxyacetophenone from Aniline via phenol and phenylacetate.

3Green Synthesis (Any Four)

1. Green approach for preparation of benzopinacolone from bezopinacol using iodine catalyst
2. Preparation of 1, 1-bis-2-naphthol under grinding at room temperature
3. Three component coupling reaction by green approach. (Synthesis of dihydropyrimidinone)
4. Green approach to Transesterification reaction (Synthesis of biodiesel)
5. Ecofriendly nitration of phenols and its derivatives using Calcium nitrate

Reference Books Recommended:

1. Vogel's Textbook of practical organic chemistry, 5th edition, B. S. Furniss, A. J. , P. W. G. Smith, A. R. Tatchell (Pearson Education).
2. Comprehensive practical organic chemistry: Preparation and Quantitative analysis, V. K. Ahluwalia, Renu Agarwal (Universities Press).
3. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry Task Force Committee, DST
4. L. D. Field, S. Sternhell, J. R. Kalman - Organic Structures from Spectra-Wiley(2013)