

BHAVNAGAR UNIVERSITY

BHAVNAGAR

(NACC Accreditation Grade “B”)

CREDIT AND SEMESTER SYSTEM

SYLLABUS

MASTER OF SCIENCE (M.Sc.)

CHEMISTRY

(In Force From Academic Year: 2010-2011)

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M.Sc.

Credit and semester system syllabus

NAME OF THE SUBJECT: CHEMISTRY

SEMESTER – 1st

SR. NO.	PAPER NO.	NAME OF THE PAPER	TOTAL MARKS EXT.+ INT* = TOTAL	PASSING STANDARD EXT.+ INT* = TOTAL	TOTAL TEACHING HOURS	EXAM HOURS	CREDITS	INTER-DISCIPLINARY
1	C(I)-1	Inorganic Chemistry*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
2	C(O)-2	Organic Chemistry*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
3	C(Ph)-3	Physical Chemistry* (Chemical Thermodynamics)	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
4	C(P)-4	Chemistry Practicals*	100 + 00 = 100	40 + 00 = 40	15 Weeks x 15 Hours = 225	3.5 x 4 = 14	15	N
5	C(G)-100	General Chemistry**	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	Y
6	C(I)-101	Inorganic Chemistry**	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	Y
7	C(O)-102	Organic Chemistry**	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	Y
8	C(Ph)-103	Physical Chemistry**	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	Y

*Core /Compulsory paper; **Elective Choice Paper

* <u>INTERNAL</u>	<u>MARKS</u>
ATTENDANCE	05
ASSIGNMENT	05
SEMINAR	10
TEST	10



M.Sc.

Credit and semester system syllabus

NAME OF THE SUBJECT: CHEMISTRY

SEMESTER – 2nd

SR. NO.	PAPER NO.	NAME OF THE PAPER	TOTAL MARKS EXT.+ INT* = TOTAL	PASSING STANDARD EXT.+ INT* = TOTAL	TOTAL TEACHING HOURS	EXAM HOURS	CREDITS	INTER- DISCIPLINARY
1	C(A)-5	Analytical Chemistry* (Spectroscopy)	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
2	C(OI)-6	Modern Interfaces of Organic & Inorganic Chemistry*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
3	C(Ph)-7	Macromolecular Chemistry*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
4	C(P)-8	Chemistry Practicals-II*	100 + 00 = 100	40 + 00 = 40	15 Weeks x 15 Hours = 225	3.5 x 4 = 14	15	N
5	C(A)-201	Analytical Chemistry** (Spectroscopy)	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	Y
6	C(OI)-202	Organic- Inorganic Chemistry** (Modern Interfaces of Organic & Inorganic Chemistry)	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	Y
7	C(Ph)-203	Physical Chemistry** (Macromolecular Chemistry)	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	Y

*Core /Compulsory paper; **Elective Choice Paper

* <u>INTERNAL</u>	<u>MARKS</u>
ATTENDANCE	05
ASSIGNMENT	05
SEMINAR	10
TEST	10



M.Sc.

Credit and semester system syllabus

NAME OF THE SUBJECT: INORGANIC CHEMISTRY

SEMESTER – 3rd

SR. NO.	PAPER NO.	NAME OF THE PAPER	TOTAL MARKS EXT.+ INT* = TOTAL	PASSING STANDARD EXT.+ INT* = TOTAL	TOTAL TEACHING HOURS	EXAM HOURS	CREDITS	INTER-DISCIPLINARY
1	C(I)-9	Organometallic compounds & Bioinorganic Chemistry*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
2	C(I)-10	Group Theory*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
3	C(I)-11	Selected Topics-I*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
4	C(IP)-12	Inorganic Practicals*	100 + 00 = 100	40 + 00 = 40	15 Weeks x 15 Hours = 225	7 x 2 = 14	15	N
5	C(I)-301	Contemporary Development in Bioinorganic Chemistry & Organometallic compounds**	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	Y

*Core /Compulsory paper; **Elective Choice Paper

<u>* INTERNAL</u>	<u>MARKS</u>
ATTENDANCE	05
ASSIGNMENT	05
SEMINAR	10
TEST	10



M.Sc.

Credit and semester system syllabus

NAME OF THE SUBJECT: ORGANIC CHEMISTRY

SEMESTER – 3rd

SR. NO.	PAPER NO.	NAME OF THE PAPER	TOTAL MARKS EXT.+ INT* = TOTAL	PASSING STANDARD EXT.+ INT* = TOTAL	TOTAL TEACHING HOURS	EXAM HOURS	CREDITS	INTER-DISCIPLINARY
1	C(O)-9	Industrial Chemistry*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
2	C(O)-10	Natural Products-I*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
3	C(O)-11	Selected Topics-I *	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
4	C(OP)-12	Organic Practicals*	100 + 00 = 100	40 + 00 = 40	15 Weeks x 15 Hours = 225	7 x 2 = 14	15	N
5	C(O)-302	Contemporary Development in Organic Industries **	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	Y

*Core /Compulsory paper; **Elective Choice Paper

* <u>INTERNAL</u>	<u>MARKS</u>
ATTENDANCE	05
ASSIGNMENT	05
SEMINAR	10
TEST	10



M.Sc.

Credit and semester system syllabus

NAME OF THE SUBJECT: PHYSICAL CHEMISTRY

SEMESTER – 3rd

SR. NO.	PAPER NO.	NAME OF THE PAPER	TOTAL MARKS EXT.+ INT* = TOTAL	PASSING STANDARD EXT.+ INT* = TOTAL	TOTAL TEACHING HOURS	EXAM HOURS	CREDITS	INTER- DISCIPLINARY
1	C(Ph)-9	Advanced Instrumental Chromatographic Techniques*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
2	C(Ph)-10	Characterization of polymers*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
3	C(Ph)-11	Nuclear and Radio Chemistry*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
4	C(PhP)-12	Physical Practicals*	100 + 00 = 100	40 + 00 = 40	15 Weeks x 15 Hours = 225	7 x 2 = 14	15	N
5	C(Ph)-303	Contemporary Development in Polymer & Nuclear Chemistry**	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	Y

*Core /Compulsory paper; **Elective Choice Paper

* <u>INTERNAL</u>	<u>MARKS</u>
ATTENDANCE	05
ASSIGNMENT	05
SEMINAR	10
TEST	10



M.Sc.

Credit and semester system syllabus

NAME OF THE SUBJECT: ANALYTICAL CHEMISTRY

SEMESTER – 3rd

SR. NO.	PAPER NO.	NAME OF THE PAPER	TOTAL MARKS EXT.+ INT* = TOTAL	PASSING STANDARD EXT.+ INT* = TOTAL	TOTAL TEACHING HOURS	EXAM HOURS	CREDITS	INTER-DISCIPLINARY
1	C(A)-9	Advanced Instrumental Chromatographic Techniques*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
2	C(A)-10	Environmental Analytical Chemistry*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
3	C(A)-11	Applied Analytical Chemistry-I*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
4	C(AP)-12	Analytical Practicals*	100 + 00 = 100	40 + 00 = 40	15 Weeks x 15 Hours = 225	7 x 2 = 14	15	N
5	C(A)-304	Contemporary Development in the Separation of Chemical Compounds**	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	Y

*Core /Compulsory paper; **Elective Choice Paper

* <u>INTERNAL</u>	<u>MARKS</u>
ATTENDANCE	05
ASSIGNMENT	05
SEMINAR	10
TEST	10



M.Sc.

Credit and semester system syllabus

NAME OF THE SUBJECT: INORGANIC CHEMISTRY

SEMESTER – 4th

SR. NO.	PAPER NO.	NAME OF THE PAPER	TOTAL MARKS EXT.+ INT* = TOTAL	PASSING STANDARD EXT.+ INT* = TOTAL	TOTAL TEACHING HOURS	EXAM HOURS	CREDITS	INTER-DISCIPLINARY
1	C(I)-13	Selected Topics-II*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
2	C(I)-14	Coordination Chemistry*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
3	C(I)-15	Recent topics in Inorganic Chemistry *	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
4	C(IP)-16	Inorganic Practicals*	100 + 00 = 100	40 + 00 = 40	15 Weeks x 15 Hours = 225	7 x 2 = 14	15	N
5	C(I)-401	Modern approach in Inorganic Chemistry**	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	Y

*Core /Compulsory paper; **Elective Choice Paper

* <u>INTERNAL</u>	<u>MARKS</u>
ATTENDANCE	05
ASSIGNMENT	05
SEMINAR	10
TEST	10



M.Sc.

Credit and semester system syllabus

NAME OF THE SUBJECT: ORGANIC CHEMISTRY

SEMESTER – 4th

SR. NO.	PAPER NO.	NAME OF THE PAPER	TOTAL MARKS EXT.+ INT* = TOTAL	PASSING STANDARD EXT.+ INT* = TOTAL	TOTAL TEACHING HOURS	EXAM HOURS	CREDITS	INTER- DISCIPLINARY
1	C(O)-13	Drugs*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
2	C(O)-14	Natural Products-II*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
3	C(O)-15	Selected Topics-II *	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
4	C(OP)-16	Organic Practicals*	100 + 00 = 100	40 + 00 = 40	15 Weeks x 15 Hours = 225	7 x 2 = 14	15	N
5	C(O)-402	Modern approach based on Organic Chemistry**	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	Y

*Core /Compulsory paper; **Elective Choice Paper

* <u>INTERNAL</u>	<u>MARKS</u>
ATTENDANCE	05
ASSIGNMENT	05
SEMINAR	10
TEST	10



M.Sc.

Credit and semester system syllabus

NAME OF THE SUBJECT: PHYSICAL CHEMISTRY

SEMESTER – 4th

SR. NO.	PAPER NO.	NAME OF THE PAPER	TOTAL MARKS EXT.+ INT* = TOTAL	PASSING STANDARD EXT.+ INT* = TOTAL	TOTAL TEACHING HOURS	EXAM HOURS	CREDITS	INTER- DISCIPLINARY
1	C(Ph)-13	Advanced Instrumental Electro-Analytical Techniques*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
2	C(Ph)-14	Electrochemistry*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
3	C(Ph)-15	Selected Topics in Physical Chemistry*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
4	C(PhP)-16	Physical Practicals*	100 + 00 = 100	40 + 00 = 40	15 Weeks x 15 Hours = 225	7 x 2 = 14	15	N
5	C(Ph)-403	Modern approach based on Physical Chemistry**	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	Y

*Core /Compulsory paper; **Elective Choice Paper

* <u>INTERNAL</u>	<u>MARKS</u>
ATTENDANCE	05
ASSIGNMENT	05
SEMINAR	10
TEST	10



M.Sc.

Credit and semester system syllabus

NAME OF THE SUBJECT: ANALYTICAL CHEMISTRY

SEMESTER – 4th

SR. NO.	PAPER NO.	NAME OF THE PAPER	TOTAL MARKS EXT.+ INT* = TOTAL	PASSING STANDARD EXT.+ INT* = TOTAL	TOTAL TEACHING HOURS	EXAM HOURS	CREDITS	INTER- DISCIPLINARY
1	C(A)-13	Advanced Instrumental Electro-Analytical Techniques*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
2	C(A)-14	Spectral Methods and Radio-Analytical Techniques*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
3	C(A)-15	Applied Analytical Chemistry-II*	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	N
4	C(AP)-16	Analytical Practicals*	100 + 00 = 100	40 + 00 = 40	15 Weeks x 15 Hours = 225	7 x 2 = 14	15	N
5	C(A)-404	Modern approach based on Electro-Analytical Techniques**	70 + 30 = 100	28 + 12 = 40	15 Weeks x 04 Hours = 60	03	04	Y

*Core /Compulsory paper; **Elective Choice Paper

* <u>INTERNAL</u>	<u>MARKS</u>
ATTENDANCE	05
ASSIGNMENT	05
SEMINAR	10
TEST	10



M.Sc. - Chemistry

Semester:-1

Paper No. I Inorganic Chemistry

Total Marks :

100 Marks

Credits: 04

Marks: Semester End Examination:

70 Marks

Continuous Internal Evaluation:

30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
1	Basic postulates of Quantum Mechanics: <ul style="list-style-type: none">❖ Operators and their algebra❖ Hermitian property of operators❖ Translational, Rotational and Vibrational motion of a particle❖ Applications of Quantum Mechanics to simple systems	12	14 + 6 = 20
2	Particle in a box, Rigid rotator, Harmonic Oscillator: <ul style="list-style-type: none">❖ Application to Hydrogen atom.❖ Solution of R(r), $\theta(\theta)$, $\phi(\phi)$ wave functions❖ Shape of orbital, Angular momentum❖ Commutation relationship, step up and step down operators.	12	14 + 6 = 20
3	Born-Oppenheimer approximation: <ul style="list-style-type: none">❖ LCAO approximation, H₂⁺ ion, the excited states of Hydrogen molecule❖ SCF method, chemical bonding to polyatomic molecules❖ Hybridization❖ HMO to conjugated dienes (cyclic and acyclic)	12	14 + 6 = 20
4	Homogeneous catalysis involving organometallic compounds: <ul style="list-style-type: none">❖ Hydrogenation of alkenes; Hydroformylation reactions❖ Polymerization of alkenes and alkynes❖ Manufacture of Methanol, Acetic Acid and Synthetic Gasoline❖ Compounds with transition metal; single, double, triple bond❖ Alkenes Alkynes and delocalized bonds	12	14 + 6 = 20
5	Theories of Acid & Base, HSAB concept, Buffer solution, p^H, p^{Ka}: <ul style="list-style-type: none">❖ IUPAC nomenclature of simple inorganic complexes	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. Advance Inorganic Chemistry, VIth Edn by F. A. Cotton, G. Wilkinson, C. A. Murillo, M. Bochmann, John Wiley & Sons, New York.
2. Introductory Quantum Chemistry, IVth Edn by A. K. Chandra, Tata McGraw-Hill Publishing Company Ltd., New Delhi
3. Quantum Chemistry IIIrd Edn by R. K. Prasad, New Age International Publishers
4. Inorganic Chemistry: Principles of Structure and Reactivity, IVth Edn by James E. Huheey,
5. Ellen A. Keiter, Okhil K. Medhi, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia
6. Organometallic Chemistry: A Unified Approach by R. C. Mehrotra & A. Singh, New Age International Publishers
7. Principles of Inorganic Chemistry, B. R. Puri, L. R. Sharma and K. C. Kalia, Milestone Publishers & Distributors
8. Introduction to Ligand Fields by B. N. Figgis Inter-science N. Y.
9. Introduction to LFT by C. J. Ballhausen Mc-Graw Hill Publication
10. Structure and Bonding by E. Konig Vol-9 Heidelberg New York



M.Sc. - Chemistry

Semester:-1

Paper No. II Organic Chemistry

Total Marks :

100 Marks

Credits: 04

Marks: Semester End Examination:

70 Marks

Continuous Internal Evaluation:

30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
1	Orbital symmetry and pericyclic reactions: ❖ Concept of orbital symmetry and definition, Hofmann-Woodward rule, Classification, importance and utility ❖ Electrocyclic reactions, cycloaddition reaction, sigmatropic rearrangements, application of FMO method to pericyclic reaction	12	14 + 6 = 20
2	Stereochemistry: ❖ Introduction to conformation and conformational analysis, conformational analysis of mono, di, and poly-substituted derivatives ❖ Conformational analysis of decalin, perhydroanthracene, perhydrophenanthrene, role of spectroscopy in the study of conformational analysis, conformation and reactivity concept	12	14 + 6 = 20
3	(A) Transient intermediates: generation, stability and reactions of the following: ❖ Free radicals, carbanions, carbocations and non-classical carbocations, nitrenes, carbenes (B) Organic photo chemistry: ❖ Principles of photo chemistry, singlet and triplet states, properties and nomenclature of excited states ❖ Physical properties of excited molecules as explained by improved Jablonskii diagram, photo chemistry of carbonyl compounds, photo chemistry of olefins	12	14 + 6 = 20
4	Heterocyclic chemistry: ❖ Nomenclature and classification for 3 to 7 membered heterocyclic systems containing one and two hetero atoms ❖ Preparations and reactions of pyrazoles, imidazoles, thiazole, quinoline and isoquinoline, pyrimidines, pyridazines and pyrazines, chemistry of fused systems with one and two hetero atoms	12	14 + 6 = 20
5	Aromaticity: ❖ Concept of aromaticity, non aromaticity and anti aromaticity, Huckel's rule and its applications to simple and nonbenzenoid aromatic compounds ❖ Cyclopentadiene, azulene, tropolone system, annulenes, hetero annulenes, fullerenes (C ₆₀)	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
2. Attendance: 05 Marks
3. Seminar: 10 Marks
4. Test: 10 Marks

Total Marks: 30 Marks

Reference / Text-Books / Additional Reading:

1. Advance Organic Chemistry IIIrd edition by J. March, Wiley Eastern Limited
2. Organic Chemistry Vol. I & II VIth edition by I. L. Finar ELBS Publication
3. Organic Chemistry VIth edition by Morrison & Boyd, Prentice Hall of India
4. Hetero-cyclic Chemistry IIIrd edition by J. A. Joule, K. Mills, G. F. Smith Chapman & Hall
5. Stereochemistry: Conformation and Mechanism IIIrd edition by P. L. Kalsi, New Age International
6. Organic photochemistry by R. O. Kan Mc-Graw Hill publication



M.Sc. - Chemistry

Semester:-1

Paper No. III Physical Chemistry (Chemical Thermodynamics)

Total Marks : 100 Marks

Credits: 04

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
1	Fugacity and Activity: Definition of Fugacity. Graphical Method. Equation of State Method. Approximate Method. Generalized Method. Variation of Fugacity with Temperature and Pressure. Fugacity of Solids and Liquids. Mixture of Ideal Gases. Mixture of Real Gases. Variation of Fugacity of a Gas in a Mixture with Temperature and Pressure. Determinations of Fugacity in Gas Mixtures (The Lewis-Randall Rule). Problems.	12	14 + 6 = 20
2	Free Energy and Chemical Reactions: Chemical Equilibrium. The Equilibrium Constant. Equilibrium in Homogeneous Gaseous Systems. The Ammonia Equilibrium. Homogeneous Reactions in Liquid Solutions and Dilute Solutions. The Reaction Isotherm. Standard Free Energy of Reaction. The Direction of Chemical Change. Variation of Equilibrium Constant with Pressure and Temperature. Integration of Van't Hoff Equation. Variation of Standard Free Energy with Temperature. Determination of Standard Free Energies. Standard Free Energies and Entropy changes. Application of Free Energy and Entropy data. Confirmation of Third Law of Thermodynamics. Free Energy Functions. Calculation of Standard Free Energies. Equilibrium Constant and Partition Functions. Equilibrium Constants of Metathetic Reactions. Problems.	12	14 + 6 = 20
3	The properties of solutions: Properties of Ideal Solutions. The Duhem-Margules Equation. Applications of Raoult's Law to Both Constituents of an Ideal Solution. Vapour Pressure Curves, Composition of Liquid and Vapour in Equilibrium. Influence of Temperature. Derivation from Ideal Behavior. Vapour Pressure Curves for Nonideal Systems. Liquid and Vapour Compositions. Henry's Law. The Freezing Points of Dilute Solutions. Determination of Molecular Weights. The Boiling Points of Solutions. Problems.	12	14 + 6 = 20
4	Activities and Activity Coefficients: ❖ Choice of Standard State. Convenient Standard States. Activity of Solvent from Vapour Pressure. Activity of Solvent from Freezing Points. Activity from E.M.F. Measurements. Osmotic Pressure and Activity. ❖ Solutions of Electrolytes: Mean Activities of Electrolytes. Activities of Electrolytes by the Isopiestic (Isotonic) Method.	12	14 + 6 = 20
5	Partial Molar Properties: ❖ Fundamental Equations of Partial Molar Properties. Thermodynamic Significance. Relation between Apparent Molar Property and Partial Molar Property in the case of Infinite Dilute Solution. Direct Method. Analytical Method. From Apparent Molar Properties, Method of Intercepts. General Methods. Partial Molar Volumes from Density Measurements. Determination of Apparent Molar Volume of Solute. Problems. ❖ Partial Molar Thermal Properties: Relative Partial Molar Heat Contents, Heats of Solution and Dilution. Relative Apparent Molar Heat Contents, Heats of Dilution to Infinite Dilution, Integral Heat of Finite Dilution. Determination of Relative Partial Molar Heat Contents, Activity Coefficients and Relative Partial Molar Heat Contents. Partial Molar Heat Capacities. Apparent Molar Heat Capacities. Problems	12	14 + 6 = 20



Break up of Continuous Internal Evaluation:

1. Assignment:	05 Marks
2. Attendance:	05 Marks
3. Seminar:	10 Marks
4. Test:	<u>10 Marks</u>
Total Marks:	30 Marks

Reference / Text-Books / Additional Reading:

1. Thermodynamics for Chemists. S. Glasstone, East-West Edition, Third Edition.
2. An Introduction to Chemical Thermodynamics. R. P. Rastogi and P. R. Misra Vikash Publishing House Pvt.Ltd.
3. Fundamentals of Chemical Thermodynamics. M. L. Lakhanpal. Tata Mc-Graw Hill Publishing Company Ltd.
4. Thermodynamics. P. C. Rakshit. The New Book Stall, Calcutta



M.Sc. - Chemistry

Semester:-1

Paper No. IV Chemistry Practicals

Total Marks: 100 Marks

Credits: 15

Unit	Detailed Syllabus	Teaching Hours/week	Marks/Weight
1	Inorganic Qualitative Analysis: Mixture containing six radicals in which one is less common metal ion like W, Tl, Ti, Mo, Se, Zr, Th, Ce, V and Li (Minimum 10 mixtures)	15	25
2	Organic preparation: One and two step preparations involving reactions like oxidation, reduction, halogenations, Nitration, Esterification, Friedel-Crafts acylation, acetylation (Minimum 10 preparations)	15	25
3	Physical Chemistry: Reaction dynamics: Zero, first and Second order reactions, Refractometry: Binary mixtures and solids, Thermodynamics: Heat of solution, partial molar volume etc.	15	25
4	Analytical Instrumentation: pH <i>Metry</i> : Mix acid vs. Strong base, weak acid vs. weak base, CO_3^{2-} & HCO_3^- vs. HCl, Dissociation constant of mono basic and dibasic acid Potentiometry: Redox titration, Precipitation (Ag^+ vs. halide), Dissociation constant of mono basic and dibasic acid, Mix acid vs. Strong base Conductometry: Displacement titration, Precipitation, Complex formation and Dissociation constant of mono basic acid	15	25

Reference / Text-Books / Additional Reading:

1. Vogel's Text Book of Practical Organic Chemistry by B. S. Furniss, A. J. Hannford
2. Pearson Education
3. Comprehensive Practical Organic Chemistry by Preparation & Quantitative Analysis
4. V. K. Ahluwalia and Ranu Agarwal University Press Heydrabad
5. Vogel's Text Book of Inorganic quantitative chemical analysis Vth edition by G. H.
6. Jeffery, J. Busseff, J. Mendliam & R. C. Denny
7. Vogel's Qualitative Inorganic Analysis, G. Svehla, Orient Longman Publication.
8. Advance Inorganic Analysis, Subhash-Satish, Pragati-Prakashan.
9. Text book of Quantitative Inorganic Analysis, Vogel's, ELBS.
10. Inorganic Preparation, J. Palmar, Wealy Inter-science publication



M.Sc. - Chemistry

Semester:-1

Elective Paper No. 100 : General Chemistry

Total Marks : 100 Marks

Credits: 04

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Some Basic Concepts of Chemistry and Classification of Elements: Importance of studying Chemistry, physical quantities and their SI units, dimensional analysis, Precision and significant figures, classification of matter, laws of chemical combination, Dalton's Atomic Theory, Mole concept, atomic, molecular and molar masses, Percentage composition and molecular formula, Stoichiometry of chemical reactions. Classification of elements: significance of (i) Mendeleev's periodic law, (ii) Atomic number and periodic law, present form of the periodic table	12	14 + 6 = 20
2	Hydrogen: Unique position in Periodic Table, occurrence, isotopes, Dihydrogen: preparation, properties, reactions and uses. Hydrides: molecular, saline and interstitial. Water: structure and aggregation of water molecules (physical and chemical properties), hard and soft water, water softener. Heavy water, hydrogen peroxide, hydrogen economy, use of liquid hydrogen as a fuel	12	14 + 6 = 20
3	Thermodynamics: Introduction: Importance and limitations, Some important basic terms and concept: System, Surrounding, Boundary, Types of System, Thermodynamics process, Exothermic and Endothermic reactions, State function, Internal energy, Enthalpy, Entropy, Free energy, Heat capacity, Modes of transfer of energy: Heat and Work, Laws of Thermodynamics, Hess's law of constant heat summation and its applications, Bond enthalpy, Energy and alternative sources, Problems	12	14 + 6 = 20
4	Some basic principles of Organic Chemistry: Tetravalency of carbon, hybridization (p and s) bonds, shapes of simple molecules, functional groups: -C-C- (double and triple bond), and functional groups containing halogen, oxygen, nitrogen and sulphur, homologous series, isomerism (structural). General introduction to naming organic compounds-trivial names and IUPAC nomenclature, Illustration with simple examples, Classification of hydrocarbons, alkanes and cycloalkanes (ethane, propane, butane and cyclohexane), Alkenes and alkynes- nomenclature, geometrical isomerism in alkenes, stability of alkenes, general methods of preparation, physical properties, chemical reactions	12	14 + 6 = 20
5	Environmental Chemistry: Environmental pollutants: soil, water and air pollution: chemical reactions in atmosphere, kind of smog, major atmospheric pollutants; acid rain, ozone and its reactions, effects of the depletion of ozone layer, Green house effect and global warming- industrial air pollution, green chemistry as an alternative tool for reducing pollution.	12	14 + 6 = 20



Break up of Continuous Internal Evaluation:

1. Assignment:	05 Marks
2. Attendance:	05 Marks
3. Seminar:	10 Marks
4. Test:	<u>10 Marks</u>
Total Marks:	30 Marks

Reference / Text-Books / Additional Reading:

1. Elements of Physical Chemistry by Peter Atkins and Julio de Paula. IVth Edn, OXFORD University Press.
2. Comprehensive Chemistry by N. K. Verma, S. K. Khanna and B. Kapila, Laxmi Publications (P) Ltd.
3. Thermodynamics for Chemists by Samuel Glasstone, East-West Press Private Ltd.
4. Essential of Physical Chemistry by Bahl and Tuli. S. Chand & Company Ltd.
5. Chemistry for Engineers by B.K. Ambasta. Laxmi Publication (P) Ltd.
6. Engineering Chemistry by Jain and Jain. Dhanpat Rai Publishing Company.
7. Modern's ABC of Chemistry by S. P. Jauhar, Modern Publishers.



M.Sc. - Chemistry

Semester:-1

Elective Paper No. 101 : Inorganic Chemistry

Total Marks : 100 Marks

Credits: 04

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Operator concepts in Quantum Chemistry <ul style="list-style-type: none">❖ Basic postulates of quantum mechanics❖ Operators and their algebra❖ Commutation relationship, step up and step down operators❖ Hermitian property of operators❖ Shape of orbital, Angular momentum	12	14 + 6 = 20
2	Hydrogen and Hydrogen-like Atoms <ul style="list-style-type: none">❖ Solution of $R(r)$, $\theta(\theta)$, $\phi(\phi)$ wave functions❖ Translational motion of a particle: Particle in a one dimensional box, Particle in a three dimensional box❖ Rotational motion of a particle: Particle in a ring, Particle on a sphere, Rotation of diatomic molecules (Rigid rotator)❖ Vibrational motion of a particle: Harmonic Oscillator❖ Variation approximation, Application of HMO to ethylene	12	14 + 6 = 20
3	Theory in Chemical Bonding <ul style="list-style-type: none">❖ Diatomic Molecules: The Born-Oppenheimer Approximation❖ Polyatomic Molecules: Self-Consistent Field (SCF) Method❖ Principles of Hybridization, sp, sp^2 and sp^3 hybridizations❖ LCAO approximation, H_2^+ ion, H_2 molecule	12	14 + 6 = 20
4	Homogeneous catalysis involving organometallic compounds <ul style="list-style-type: none">❖ General Introduction❖ Catalytic processes involving transition metal organometallics such as<ul style="list-style-type: none">i) Hydrogenation of alkenesii) Hydroformylation of alkenes (<i>Oxo</i> process)iii) Polymerization of alkenes and alkynes❖ Manufacture of Methanol, Acetic Acid and Synthetic Gasoline❖ Organometallic compounds with single, double and triple bonds between carbon and transition metals❖ Alkenes and alkynes compounds of transition metals	12	14 + 6 = 20
5	A. Fundamentals of Coordination Chemistry <ul style="list-style-type: none">❖ Introduction, classification of ligands, chelation, Isomerism in coordination compounds B. Modern concepts of acids and bases <ul style="list-style-type: none">❖ Various concepts of acids and bases: Arrhenius, Bronsted Lowery, Lewis. The SHAB principle, applications and their limitations	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks

2. Attendance: 05 Marks

3. Seminar: 10 Marks

4. Test: 10 Marks

Total Marks: 30 Marks



Reference / Text-Books / Additional Reading:

1. Advance Inorganic Chemistry, VIth Edn by F. A. Cotton, G. Wilkinson, C. A. Murillo, M. Bochmann, John Wiley & Sons, New York.
2. Introductory Quantum Chemistry, IVth Edn by A. K. Chandra, Tata McGraw-Hill, Publishing Company Ltd., New Delhi
3. Quantum Chemistry IIIrd Edn by R. K. Prasad, New Age International Publishers
4. Inorganic Chemistry: Principles of Structure and Reactivity, IVth Edn by James E. Huheey, Ellen A. Keiter, Okhil K. Medhi, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia
5. Organometallic Chemistry: A Unified Approach by R. C. Mehrotra & A. Singh, New Age International Publishers
6. Advanced Inorganic Chemistry by Gurdeep Raj, Goel Publishing House, Meerut, India.
7. Principles of Inorganic Chemistry, B. R. Puri, L. R. Sharma and K. C. Kalia, Milestone Publishers & Distributors



M.Sc. - Chemistry

Semester:-1

Elective Paper No. 102 : Organic Chemistry

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Orbital symmetry and pericyclic reactions: ❖ Concept of orbital symmetry and definition, Hofmann-Woodward rule, Classification, importance and utility ❖ Electrocyclic reactions, cycloaddition reaction, sigmatropic rearrangements, application of FMO method to pericyclic reaction	12	14 + 6 = 20
2	Stereochemistry: ❖ Introduction to conformation and conformational analysis, conformational analysis of mono, di, and poly-substituted derivatives ❖ Conformational analysis of decalin, perhydroanthracene, perhydrophenanthrene, role of spectroscopy in the study of conformational analysis, conformation and reactivity concept	12	14 + 6 = 20
3	(A) Transient intermediates: generation, stability and reactions of the following: ❖ Free radicals, carbanions, carbocations and non-classical carbocations, nitrenes, carbenes (B) Organic photo chemistry: ❖ Principles of photo chemistry, singlet and triplet states, properties and nomenclature of excited states ❖ Physical properties of excited molecules as explained by improved Jablonskii diagram, photo chemistry of carbonyl compounds, photo chemistry of olefins	12	14 + 6 = 20
4	Heterocyclic chemistry: ❖ Nomenclature and classification for 3 to 7 membered heterocyclic systems containing one and two hetero atoms ❖ Preparations and reactions of pyrazoles, imidazoles, thiazole, quinoline and isoquinoline, pyrimidines, pyridazines and pyrazines, chemistry of fused systems with one and two hetero atoms	12	14 + 6 = 20
5	Aromaticity: ❖ Concept of aromaticity, non aromaticity and anti aromaticity, Huckel's rule and its applications to simple and nonbenzenoid aromatic compounds ❖ Cyclopentadiene, azulene, tropolone system, annulenes, hetero annulenes, fullerenes (C ₆₀)	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. Advance Organic Chemistry IIIrd edition by J. March, Wiley Eastern Limited
2. Organic Chemistry Vol. I & II VIth edition by I. L. Finar ELBS Publication
3. Organic Chemistry VIth edition by Morrison & Boyd, Prentice Hall of India
4. Hetero-cyclic Chemistry IIIrd edition by J. A. Joule, K. Mills, G. F. Smith Chapman & Hall
5. Stereochemistry: Conformation and Mechanism IIIrd edition by P. L. Kalsi, New Age International
6. Organic photochemistry by R. O. Kan Mc-Graw Hill publication



M.Sc. - Chemistry

Semester:-1

Elective Paper No. 103 : Physical Chemistry

Total Marks : **100 Marks**

Credits: 4

Marks: Semester End Examination: **70 Marks**

Continuous Internal Evaluation: **30 Marks**

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Fugacity and Activity: Definition of Fugacity. Graphical Method. Equation of State Method. Approximate Method. Generalized Method. Variation of Fugacity with Temperature and Pressure. Fugacity of Solids and Liquids. Mixture of Ideal Gases. Mixture of Real Gases. Variation of Fugacity of a Gas in a Mixture with Temperature and Pressure. Determinations of Fugacity in Gas Mixtures (The Lewis-Randall Rule). Problems.	12	14 + 6 = 20
2	Free Energy and Chemical Reactions: Chemical Equilibrium. The Equilibrium Constant. Equilibrium in Homogeneous Gaseous Systems. The Ammonia Equilibrium. Homogeneous Reactions in Liquid Solutions and Dilute Solutions. The Reaction Isotherm. Standard Free Energy of Reaction. The Direction of Chemical Change. Variation of Equilibrium Constant with Pressure and Temperature. Integration of Van't Hoff Equation. Variation of Standard Free Energy with Temperature. Determination of Standard Free Energies. Standard Free Energies and Entropy changes. Application of Free Energy and Entropy data. Confirmation of Third Law of Thermodynamics. Free Energy Functions. Calculation of Standard Free Energies. Equilibrium Constant and Partition Functions. Equilibrium Constants of Metathetic Reactions. Problems.	12	14 + 6 = 20
3	The properties of solutions: Properties of Ideal Solutions. The Duhem-Margules Equation. Applications of Raoult's Law to Both Constituents of an Ideal Solution. Vapour Pressure Curves, Composition of Liquid and Vapour in Equilibrium. Influence of Temperature. Derivation from Ideal Behavior. Vapour Pressure Curves for Nonideal Systems. Liquid and Vapour Compositions. Henry's Law. The Freezing Points of Dilute Solutions. Determination of Molecular Weights. The Boiling Points of Solutions. Problems.	12	14 + 6 = 20
4	Activities and Activity Coefficients: ❖ Choice of Standard State. Convenient Standard States. Activity of Solvent from Vapour Pressure. Activity of Solvent from Freezing Points. Activity from E.M.F. Measurements. Osmotic Pressure and Activity. ❖ Solutions of Electrolytes: Mean Activities of Electrolytes. Activities of Electrolytes by the Isopiestic (Isotonic) Method.	12	14 + 6 = 20
5	Partial Molar Properties: ❖ Fundamental Equations of Partial Molar Properties. Thermodynamic Significance. Relation between Apparent Molar Property and Partial Molar Property in the case of Infinite Dilute Solution. Direct Method. Analytical Method. From Apparent Molar Properties, Method of Intercepts. General Methods. Partial Molar Volumes from Density Measurements. Determination of Apparent Molar Volume of Solute. Problems. ❖ Partial Molar Thermal Properties: Relative Partial Molar Heat Contents, Heats of Solution and Dilution. Relative Apparent Molar Heat Contents, Heats of Dilution to Infinite Dilution, Integral Heat of Finite Dilution. Determination of Relative Partial Molar Heat Contents, Activity Coefficients and Relative Partial Molar Heat Contents. Partial Molar Heat Capacities. Apparent Molar Heat Capacities. Problems	12	14 + 6 = 20



Break up of Continuous Internal Evaluation:

1. Assignment:	05 Marks
2. Attendance:	05 Marks
3. Seminar:	10 Marks
4. Test:	<u>10 Marks</u>
Total Marks:	30 Marks

Reference / Text-Books / Additional Reading:

1. Thermodynamics for Chemists. S. Glasstone, East-West Edition, Third Edition.
2. An Introduction to Chemical Thermodynamics. R. P. Rastogi and P. R. Misra Vikash Publishing House Pvt.Ltd.
3. Fundamentals of Chemical Thermodynamics. M. L. Lakhanpal. Tata Mc-Graw Hill Publishing Company Ltd.
4. Thermodynamics. P. C. Rakshit. The New Book Stall, Calcutta



M.Sc. - Chemistry

Semester:-2

Paper No. V : Analytical Chemistry(Spectroscopy)

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	<p>Principle, instrumentation and applications of Vibrational spectroscopy, Rotational and Electronic spectroscopy (UV-Visible, IR, Raman & Microwave)</p> <p>UV-Visible Principle, Type of transitions in UV, Woodward-Fieser Rules for Dienes and α-β unsaturated Ketones, Brief introduction to Beer-Lambert law, Deviation from Beer's law, Basic components of instrument, schematic diagram of single and double beam spectrophotometer and working of each component.</p> <p>Infra-Red Principle, Type of vibrations in IR, different important group frequencies, criteria for compound to be IR active, some simple examples of organic compounds, Basic components of instrument, schematic diagram of single and double beam spectrophotometer and working of each component.</p> <p>Raman Principle, criteria for compound to be Raman active, Stokes Lines and Anti-stokes line, Basic components of instrument, schematic diagram Raman spectrophotometer and working of each component</p> <p>Microwave Principle, Type of molecules in the microwave spectra with suitable example, energy level diagram for di-atomic molecule and linear molecule.</p>	12	14 + 6 = 20
2	<ul style="list-style-type: none">❖ Principle, instrumentation and applications of Nuclear Magnetic Resonance Spectroscopy (^1H ^{13}C ^{31}P, ^{11}B, FT-NMR)❖ Principle, criteria for compound to be NMR active, Basic components of instrument for PMR, schematic diagram of NMR spectrophotometer and working of each component, Relaxation process, shielding and de-shielding, Chemical shift.	12	14 + 6 = 20
3	<ul style="list-style-type: none">❖ Principle, instrumentation and applications of Electron spin resonance spectroscopy (ESR)❖ Principle, methodology of ESR, Continuous Wave and RF-pulse method of ESR, schematic diagram of ESR spectrophotometer and working of each component.	12	14 + 6 = 20
4	<ul style="list-style-type: none">❖ Principle, instrumentation and applications of Atomic Absorption and Emission spectroscopy (AAS, Flame photometry)❖ Basic components of instrument for AAS & Flame-photometry, schematic diagram of AAS and Flame-photometry, working of each component, criteria for AAS and methodology	12	14 + 6 = 20
5	<ul style="list-style-type: none">❖ Principle, instrumentation and applications of Mass spectroscopy❖ Basic components of instrument for Mass spectrometer, schematic diagram of Mass spectrometer, working of each component, molecular ion peak, base peak and their criteria.	12	14 + 6 = 20



Break up of Continuous Internal Evaluation:

- | | |
|---------------------|-----------------|
| 1. Assignment: | 05 Marks |
| 2. Attendance: | 05 Marks |
| 3. Seminar: | 10 Marks |
| 4. Test: | <u>10 Marks</u> |
| Total Marks: | 30 Marks |

Reference / Text-Books / Additional Reading:

1. Principle of Instrumental Analysis VIth edition by D. A. Skoog F. J Hooller & T. A. Nieman Saunders College Publication
2. Introduction to Instrumental Analysis by R. D. Braun Mc-Graw Hill Book Company
3. Vogel's Text Book of Inorganic quantitative chemical analysis Vth edition by G. H. Jeffory, J. Busseff, J. Mendliam & R. C. Denny
4. Fundamental of Molecular Spectroscopy by C. N Banwell Tata Mc-Grew Hill Publication
5. Application of Nuclear Magnetic Resonance spectroscopy in Organic Chemistry By L. Jackman Pergaman New York
6. Fundamental of Analytical Chemistry by D. A. Skoog, West & Holler
7. Principle of Instrumental Analysis VIth edition by D. A. Skoog and Leary
8. Photo-electron spectroscopy in *Essays in Chemistry* by Bradly, Gillard & Hudson Vol.-5 (Academic Press N. Y)



M.Sc. - Chemistry

Semester:-2

Paper No. VI : Modern Interfaces of Organic & Inorganic Chemistry

Total Marks : 100 Marks

Credits:04

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Selected Name Reactions: ❖ Michael, Mannich, Shapiro, Ene, Barton, Hofman-Loffler Freytag reaction. ❖ Bayer-Villager, Chichibarin, MPV reduction, Oppenauer oxidation	12	14 + 6 = 20
2	Rearrangements: Hofman, Schmidt, Cartius, Beckman, Fries, Benzillic acid, Lossen cope, Claisen, Sommelet, Pinacole-Pinacolone	12	14 + 6 = 20
3	(A) Oxidizing- Reducing agents Al-isopropoxide, PPA, OsO ₄ , LiAlH ₄ , SeO ₂ , NBS, Crown ethers PTC) (B) Studies and applications of Lanthanides Spectral and magnetic properties, use of lanthanide compounds as shift reagents in NMR spectroscopy	12	14 + 6 = 20
4	Approximation Methods ❖ V.B.T. and M.O.T. ❖ Variation Principle and its application ❖ Perturbation method (Time independent) ❖ Application to H-atom	12	14 + 6 = 20
5	Metal-ligand binding, Adjusted CFT, MOT for octahedral and tetrahedral complexes ❖ Limitation of CFT and MOT ❖ Metal- π complexes of Transition metals ❖ Di-nitrogen complexes: their structure, binding and relevance in biology ❖ Di-oxygen complexes: their structure, binding relevance in biology	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks

2. Attendance: 05 Marks

3. Seminar: 10 Marks

4. Test: 10 Marks

Total Marks: 30 Marks

Reference / Text-Books / Additional Reading:

1. Advance Organic Chemistry IIIrd edition by J. March, Wiley Eastern Limited
2. Organic Chemistry Vol. I & II VIth edition by I. L. Finar ELBS Publication
3. Organic Chemistry VIth edition by Morrison & Boyd, Prentice Hall of India
4. Reactions, Rearrangements and Reagents by S. N. Sanyal Bharti, Bhavn & Publishers
5. Physical Methods in Inorganic Chemistry, R. S. Dreger, Saunders College.
6. Advance Inorganic Chemistry, VIth Edn by F. A. Cotton, G. Wilkinson, C. A. Murillo, M. Bochmann, John Wiley & Sons, New York.
7. Introductory Quantum Chemistry by A. K. Chandra IVth Edn Tata McGraw-Hill Publication
8. Structural Inorganic Chemistry – 5th edition, (1984) by A. F. Wells
9. Organometallic Chemistry by P. L. Pauson
10. Atomic Structure and Chemical bonding by Manas Chanda
11. Quantum Chemistry by R. K. Prasad New Age International Publishers
12. Introduction to Ligand Fields by B. N. Figgis Inter-science N. Y.
13. Introduction to LFT by C. J. Ballhausen McGraw-Hill Publication
14. Elements of Magnetochemistry IIInd Edn by R. L. Dutta and A. Syamal, Affiliated East-West Press Pvt. Ltd.
15. Metal Ions in Biochemistry by P. K. Bhattacharya, Narosa Publishing House



M.Sc. - Chemistry

Semester:-2

Paper No. VII : Macromolecular Chemistry

Total Marks : 100 Marks

Credits: 04

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	<ul style="list-style-type: none">❖ Introduction: Basic concept and nomenclature, classification of polymers❖ Free radical polymerization: Methods of initiating free radical polymerization, kinetics of free radical polymerization, Factors determining chain polymerization, Equilibrium of free radical polymerization	12	14 + 6 = 20
2	<ul style="list-style-type: none">❖ Ionic (catalytic) Polymerization:❖ Cationic Polymerization, Methods of initiating cationic polymerization, kinetics and Thermodynamics cationic polymerization❖ Anionic Polymerization, Methods of initiating anionic polymerization, kinetics of anionic polymerization❖ Zeigler-Natta Catalysis, Methods of initiating stereo-regular polymerization	12	14 + 6 = 20
3	<ul style="list-style-type: none">❖ Mechanism of co-polymerization, significance of reactivity ratios, variation of composition with conversion, co-polymerization kinetics❖ Bulk; Solution; Suspension and Emulsion polymerizations❖ Comparison of polymerization processes	12	14 + 6 = 20
4	Principle, theory, instrumentation and applications of TGA, DTG and Thermometric titrations	12	14 + 6 = 20
5	Principle, theory, instrumentation and applications of DTA and DSC	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. Physical Chemistry of Polymers by A. Tager, Mir Publishers, Moscow
2. A First Course in Polymer Chemistry by A. Strepiaheyn V. Dereviskaya & G. Stonimsky, Mir Publishers Moscow
3. Polymer Chemistry-An introduction by M. P. Stevens, Addison Wesley Publishing Co. USA
4. Polymer Science by V. R. Gowariker, N. V. Vishwanathan and J. Shreedhara Willey Eastern Ltd, New Delhi
5. Macromolecular Physical Chemistry by Dr. P. H. Parsania
6. Principle of Instrumental Analysis VIth edition by D. A. Skoog F. J Hooller & T. A. Nieman Saunders College Publication
7. Introduction to Instrumental Analysis by R. D. Braun Mc-Graw Hill Book Company
8. Vogel's Text Book of Inorganic quantitative chemical analysis Vth edition by G. H. Jeffory, J. Busseff, J. Mendliam & R. C. Denny
9. Application of Nuclear Magnetic Resonance spectroscopy in Organic Chemistry By L. Jackman Pergaman New York
10. Fundamental of Analytical Chemistry by D. A. Skoog, West & Holler
11. Principle of Instrumental Analysis VIth edition by D. A. Skoog and Leary



M.Sc. - Chemistry

Semester:-2

Paper No. VIII: Chemistry Practicals-II

Total Marks : **100 Marks**

Credits: 7.5

Marks: Semester End Examination: **70 Marks**

Continuous Internal Evaluation: **30 Marks**

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Inorganic Chemistry Preparation, purification and % purity determination of coordination compounds (05)	15	25
2	Organic Chemistry Identification of Organic compounds containing more than one functional groups (minimum 10)	15	25
3	Physical Chemistry Partition coefficient, Ultrasonic, Molecular weight determination by viscosity, Synthesis of polymer materials	15	25
4	Analytical Instrumentation Spectrophometric determination of: NO_2^- , Equilibrium constant of Fe (III)-thiocyanate complex, Simultaneous determination of Mn^{2+} & Cr^{3+} Chromatographic separation of amino acids by paper chromatography and TLC Total ion concentration by Ion-exchange method Solvent extraction technique: Estimation of Fe(III) by 8-hydroxyquinoline	15	25

Reference / Text-Books / Additional Reading:

1. Vogel's Text Book of Practical Organic Chemistry by B. S. Furniss, A. J. Hannford Pearson Education
2. Comprehensive Practical Organic Chemistry Qualitative Analysis by V. K. Ahluwalia and Sunita Dhingra University Press Heydrabad
3. Vogel's Text Book of Inorganic quantitative chemical analysis Vth edition by G. H. Jeffery, J. Busseff, J. Mendliam & R. C. Denny
4. Vogel's Qualitative Inorganic Analysis, G. Svehla, Orient Longman Publication.
5. Advance Inorganic Analysis, Subhash-Satish, Pragati-Prakashan.
6. Text book of Quantitative Inorganic Analysis, Vogel's, ELBS.
7. Inorganic Preparation, J. Palmar, Wealy Inter-science publication
8. Experiments in Physical Chemistry (Instrumental & Physico-Chemical) by Dr. P. H. Parsania and Dr. Falguni Karia, Neminath Printers Rajkot



M.Sc. - Chemistry

Semester:-2

Elective Paper No. 201 : Analytical Chemistry (Spectroscopy)

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Electronic and Vibrational spectroscopy ❖ Principle, Type of transitions in UV, Woodward-Fieser Rules for dienes and α - β unsaturated ketones, Brief introduction to Beer-Lambert law, Deviation from Beer's law, Basic components of instrument, schematic diagram of single and double beam spectrophotometer and working of each component. ❖ Principle, Type of vibrations in IR, different important group frequencies, criteria for compound to be IR active, some simple examples of organic compounds, Basic components of instrument, schematic diagram of single and double beam spectrophotometer and working of each component.	12	14 + 6 = 20
2	Rotational and Vibrational spectroscopy ❖ Principle, criteria for compound to be Raman active, Stokes Lines and Anti-stokes line, Basic components of instrument, schematic diagram Raman spectrophotometer and working of each component ❖ Principle, Type of molecules in the microwave spectra with suitable example, energy level diagram for di-atomic molecule and linear molecule	12	14 + 6 = 20
3	Resonance spectroscopy Principle, instrumentation and applications of ^1H NMR spectroscopy criteria for compound to be NMR active, Basic components of instrument for PMR, schematic diagram of NMR spectrophotometer and working of each component, Relaxation process, shielding and de-shielding, Chemical shift.	12	14 + 6 = 20
4	Emission spectroscopy Principle, instrumentation and applications of Atomic Absorption and Emission spectroscopy (AAS, Flame photometry) Basic components of instrument for AAS & Flame-photometry, schematic diagram of AAS and Flame-photometry, working of each component, criteria for AAS and methodology	12	14 + 6 = 20
5	Mass spectroscopy Principle, instrumentation and applications of Mass spectroscopy Basic components of instrument for Mass spectrometer, schematic diagram of Mass spectrometer, working of each component, molecular ion peak, base peak and their criteria	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**



Reference / Text-Books / Additional Reading:

1. Principle of Instrumental Analysis VIth edition by D. A. Skoog F. J Hooller & T. A. Nieman Saunders College Publication
2. Introduction to Instrumental Analysis by R. D. Braun Mc-Graw Hill Book Company
3. Vogel's Text Book of Inorganic quantitative chemical analysis Vth edition by G. H. Jeffory, J. Busseff, J. Mendliam & R. C. Denny
4. Fundamental of Molecular Spectroscopy by C. N Banwell Tata Mc-Grew Hill Publication
5. Application of Nuclear Magnetic Resonance spectroscopy in Organic Chemistry By L. Jackman Pergaman New York
6. Fundamental of Analytical Chemistry by D. A. Skoog, West & Holler
7. Principle of Instrumental Analysis VIth edition by D. A. Skoog and Leary
8. Photo-electron spectroscopy in *Essays in Chemistry* by Bradly, Gillard & Hudson Vol.-5 (Academic Press N. Y)
9. Instrumental methods of chemical analysis by G. R. Chatwal and S. Anand, Himalaya Publishing House



M.Sc. - Chemistry

Semester:-2

Elective Paper No. 202 : Organic - Inorganic Chemistry (Modern Interfaces of Organic & Inorganic Chemistry)

Total Marks : 100 Marks Credits: 4

Marks: Semester End Examination: **70 Marks**

Continuous Internal Evaluation: **30 Marks**

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Selected Name Reactions: ❖ Michael, Mannich, Shapiro, Ene, Barton, Hofman-Loffler Freytag reaction. ❖ Bayer-Villager, Chichibarin, MPV reduction, Oppenauer oxidation	12	14 + 6 = 20
2	Rearrangements: Hofman, Schmidt, Cartius, Beckman, Fries, Benzillic acid, Lossen cope, Claisen, Sommelet, Pinacole-Pinacolone	12	14 + 6 = 20
3	(C) Oxidizing- Reducing agents Al-isopropoxide, PPA, OsO ₄ , LiAlH ₄ , SeO ₂ , NBS, Crown ethers PTC) (B) Studies and applications of Lanthanides Spectral and magnetic properties, use of lanthanide compounds as shift reagents in NMR spectroscopy.	12	14 + 6 = 20
4	Approximation Methods ❖ V.B.T. and M.O.T. ❖ Variation Principle and its application ❖ Perturbation method (Time independent) ❖ Application to H-atom	12	14 + 6 = 20
5	Metal-ligand binding, Adjusted CFT, MOT for octahedral and tetrahedral complexes ❖ Limitation of CFT and MOT ❖ Metal- π complexes of Transition metals ❖ Di-nitrogen complexes: their structure, binding and relevance in biology ❖ Di-oxygen complexes: their structure, binding relevance in biology	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. Advance Organic Chemistry IIIrd edition by J. March, Wiley Eastern Limited
2. Organic Chemistry Vol. I & II VIth edition by I. L. Finar ELBS Publication
3. Organic Chemistry VIth edition by Morrison & Boyd, Prentice Hall of India
4. Reactions, Rearrangements and Reagents by S. N. Sanyal Bharti, Bhavn & Publishers
5. Physical Methods in Inorganic Chemistry, R. S. Dreger, Saunders College.
6. Advance Inorganic Chemistry, VIth Edn by F. A. Cotton, G. Wilkinson, C. A. Murillo, M. Bochmann, John Wiley & Sons, New York.
7. Introductory Quantum Chemistry by A. K. Chandra IVth Edn Tata McGraw-Hill Publication
8. Structural Inorganic Chemistry – 5th edition, (1984) by A. F. Wells
9. Organometallic Chemistry by P. L. Pauson
10. Atomic Structure and Chemical bonding by Manas Chanda
11. Quantum Chemistry by R. K. Prasad New Age International Publishers
12. Introduction to Lignad Fields by B. N. Figgis Inter-science N. Y.
13. Introduction to LFT by C. J. Ballhausen McGraw-Hill Publication
14. Elements of Magnetochemistry IInd Edn by R. L. Dutta and A. Syamal, Affiliated East-West Press Pvt. Ltd.
15. Metal Ions in Biochemistry by P. K. Bhattacharya, Narosa Publishing House



M.Sc. - Chemistry

Semester:-2

Elective Paper No. 203 : Physical Chemistry (Macromolecular Chemistry)

Total Marks : **100 Marks**

Credits: 04

Marks: Semester End Examination: **70 Marks**

Continuous Internal Evaluation: **30 Marks**

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	<ul style="list-style-type: none">❖ Introduction: History of Macromolecular Science, definition, difference between Polymer and Macromolecules, nomenclature and classification of polymers, Polymerization process: addition and condensation polymerization, chemical and physical properties of Polymers.❖ Free radical polymerization: Monomers and repeat units for addition Polymers, free radical initiators, methods of initiating free radical polymerization, kinetics of free radical polymerization, factors affecting free radical polymerization.	12	14 + 6 = 20
2	<ul style="list-style-type: none">❖ Ionic (catalytic) Polymerization❖ Cationic Polymerization, Methods of initiating cationic polymerization, kinetics and Thermodynamics cationic polymerization❖ Anionic Polymerization, Methods of initiating anionic polymerization, kinetics of anionic polymerization❖ Zeigler-Natta Catalysis, Methods of initiating stereo-regular polymerization	12	14 + 6 = 20
3	<ul style="list-style-type: none">❖ Copolymerization, classification of copolymers, copolymer equation, mechanism of co-polymerization, Mayo and Lewis equation, significance of reactivity ratios, reactivity ratio and copolymerization behavior❖ Polymerization techniques: Bulk, Solution, Suspension and Emulsion polymerizations❖ Comparison of polymerization processes	12	14 + 6 = 20
4	<ul style="list-style-type: none">❖ Introduction to thermal methods❖ Brief classification of thermal methods❖ Principle and methodology of TGA with suitable examples❖ Instrument of TGA with brief introduction to each component❖ Thermometric Titrations; A brief overview	12	20
5	<ul style="list-style-type: none">❖ Principle and methodology of DTA with suitable example❖ Instrument of DTA with brief introduction to each component❖ Principle and methodology of DSC with suitable example❖ Heat Flux DSC and Power compensated DSC	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**



Reference / Text-Books / Additional Reading:

1. F.W. Billmeyer, Jr. Textbook of polymer science, Wiley- Interscience, N.Y.
2. Principles of Polymer Science: P. Bahadur & N. V. Sastry, Narosa
3. Polymer science by Govarikar V.R. and others, Wiley Eastern
4. Textbook of Polymer Science, Padma L. Nayak, S. Lenka, Kalyani Publishers
5. A Textbook of Polymers, M. S. Bhatnagar, S. Chand
6. Physical Chemistry of Macromolecules, C. Tanford, John Wiley & Sons
7. Introduction to Instrumental Analysis by R. D. Braun Mc-Graw Hill Book Company
8. Vogel's Text Book of Inorganic quantitative chemical analysis Vth edition by G. H. Jeffory, J. Busseff, J. Mendliam & R. C. Denny
9. Application of Nuclear Magnetic Resonance spectroscopy in Organic Chemistry By L. Jackman Pergaman New York
10. Fundamental of Analytical Chemistry by D. A. Skoog, West & Holler
11. Principle of Instrumental Analysis VIth Edn by D. A. Skoog F. J Hooller & T. A. Nieman Saunders College Publication



M.Sc. Semester:-3

ORGANIC CHEMISTRY

Paper No. IX : Industrial Chemistry

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teachin g Hours	Marks/ Weight
1	Polymers and polymerization: Definition of monomer, polymer, oligomer, HDP, LDP, filler, plastisizers and antioxidants with respect to polymer chemistry, polymeric reactions and their illustrations, addition polymerization and condensation polymerization, definition of true, natural and semi-synthetic fibers, manufacture of Viscose rayon, manufacture of phenol formaldehyde resin, manufacture of Nylon polymers and manufacture of synthetic elastomers.	12	14 + 6 = 20
2	Petroleum and petrochemicals: Theory of origin of petroleum and techniques for the search of petroleum, definition of petrochemicals and their importance in the day to day life, manufacture of important chemicals from C ₂ – cut of petroleum (at least four chemicals), manufacture of important chemicals form C ₃ – cut of petroleum, manufacture of important chemicals from aromatic cut of petroleum.	12	14 + 6 = 20
3	Unit processes and unit operations: Introduction to unit processes and unit operations, unit process of sulphonation, nitration, hydroxylation, hydrogenation, amination, allylation, halogenation and alkylation	12	14 + 6 = 20
4	A. Pesticides: 06 Pesticides: Introduction, classification, inorganic, natural, synthetic organic insecticides, dinitrophenols, organo halogen compounds, organic phosphorous and synthesis of several pesticides. Brief introduction and synthesis of herbicides and fungicides. B. Synthetic perfumes: 06 Brief introduction to perfumes, solvent, fixative, odorous substance, synthesis of esters, alcohols, ketones, aldehydes and diphenyl compounds.	12	14 + 6 = 20
5	A. Sugar, starch and paper industries: 06 Manufacture of sugar with utilization of by-products, starch and starch products, manufacture of pulp and paper. B. Some fundamental aspects of IPR 06 Understanding of intellectual property rights, Overview of the IPR and its tools, World Trade Organization, Patent Cooperation Treaty	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks

2. Attendance: 05 Marks

3. Seminar: 10 Marks

4. Test: 10 Marks

Total Marks: 30 Marks



Reference / Text-Books / Additional Reading:

1. Introduction to industrial Chemistry, Howard L. Whate
2. Industrial Chemistry Including Chemical Engineering by B. K. Sharma, Krishna Prakashan Media (p) Ltd
3. Text book of Polymer Science, F. W. Billmeyer
4. Principles of Polymer Science: P. Bahadur & N. V. Sastry, Narosa
5. Unit Processes in Organic Synthesis, P. H. Groggins
6. Contemporary Polymer Chemistry, H. R. Alcock and F. W. Lambe
7. New Trends in Green Chemistry by V.K. Ahluwalia, M. Kidwai Second Edition, 2004
8. "Green Chemistry" theory and practice, P. T. Anastas and J. C. Warner, New York Oxford university press, 1998
9. Chemical Process Industries by R. N. Shreve
10. Intellectual Property Rights in frontier industries edd. By Robert W. Hann.



M.Sc. Semester:-3

ORGANIC CHEMISTRY

Paper No. X : Natural Products-I

Total Marks : **100 Marks**

Credits: 4

Marks: Semester End Examination: **70 Marks**

Continuous Internal Evaluation: **30 Marks**

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Carbohydrates: Introduction, classification, types of glycosidic linkage, configuration of mono saccharides, ring structure of mono saccharides, disaccharides: lactose and maltose, polysaccharides: starch and cellulose, glycosides: salicin, indican and amygdalin, photosynthesis.	12	14 + 6 = 20
2	Vitamins: General introduction and classification, role of vitamins in biochemical reactions, vitamin A group, vitamin C and vitamin E group (α , β , γ and δ tocopherols), vitamin K group.	12	14 + 6 = 20
3	Alkaloids: Introduction, classification and general methods used for determination of structure of alkaloids, structure and synthesis of atropine, quinine and narcotine. Structure of strychnine and reserpine (analytical evidences only)	12	14 + 6 = 20
4	Amino acids and polypeptides: Introduction and classification of amino acids, a modern approach for the synthesis of polypeptides, general synthesis and different methods of synthesis, amino acids sequence determination in polypeptide, modern synthetic approach for end group analysis, illustration of polypeptide synthesis with amino acids arranged in a particular sequence.	12	14 + 6 = 20
5	Isoprenoids: Introduction and classification of Isoprenoids, isoprene rule and its importance in isoprenoid chemistry and their structure determination, sesquiterpenoids: farnesol and cadinene, constitution of phytol, constitution of abietic acid.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. Organic Chemistry of Natural Products by O.P. Agarwal, Goel Publishing. House, Meerut (1997).
2. Chemistry Of Natural Products by S. V. Bhatt, B. A. Nagasampagi, S. Minakshi, Springer- Berlin Heidelberg (2005).
3. Natural Products Chemistry, Vols. I & II by K. Nakanashi, Academic Press, New York and London (1974).
4. Heterocyclic Chemistry (2nd edition) by T.L. Gilchrist, Longman Scientific & Technical Publications (1992)..
5. Organic Chemistry – I.L.Finar 6th edition (low price), Pearson Education (2003).
6. Organic Chemistry Of Natural Products by Ayodhya Singh & Seema Singh, Campus Publishers (2008).
7. Natural Product Chemistry-Apsimon



M.Sc. Semester:-3

ORGANIC CHEMISTRY

Paper No. XI : Selection Topics - I

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Green Chemistry: Brief introduction, principles, green catalysts-acid catalyst, basic catalyst, oxidation catalysts, polymer supported catalysts, photocatalyst, green synthesis-phase transfer catalyst, green synthesis of polycarbonates, paracetamol, ibuprofen, citral, urethane, adipic acid and styrene	12	14 + 6 = 20
2	Antibiotics: Introduction to antibiotics and manufacture of penicillin, streptomycin and erythromycin, chemistry of penicillins, chloromycetin and streptomycin, cephalosporins, an introduction to tetracyclines, macrolides and polypeptide antibiotics.	12	14 + 6 = 20
3	A. Explosives 06 Introduction, classification and synthesis and importance of different types of explosives like nitro explosives, nitric esters nitramides, nitramines, guanidines and diazo explosives B. Synthetic detergents: 06 Synthetic detergents: classification, mechanism of action, large scale manufacture of detergents like anionic surfactants, cationic detergents, ampholytic surfactants non ionic surface active agents, detergents builders and additives	12	14 + 6 = 20
4	Pollution and pollution control: Introduction and fundamental aspects of various pollutants from air, water and soil, purification and treatment of municipal waste water, industrial effluent in ETP, waste treatment of soil, air pollution and its control.	12	14 + 6 = 20
5	Synthesis of some industrially important food colors and dyes: Dyes:- Classification of Dyes. Synthesis and application of industrially important dyes, Non-textile applications of dyes, Direct Black-EW, Direct Green, Direct Blue-2B, Direct violet-R, Tartarazine, Amaranth, Direct Brown-MR, Auramine O & G, Methylene Blue, Mercurochrome, Phenolphthalein, Methyl orange, Fast sulphone black, Benzidine yellow, Benzidine orange, Indigo solution blue, Brown-RRD, Alizarin, Benzanthone, Dibenzanthone, Caledon-Z Green.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
2. Attendance: 05 Marks
3. Seminar: 10 Marks
4. Test: 10 Marks

Total Marks: 30 Marks

Reference / Text-Books / Additional Reading:

1. Introduction to industrial Chemistry, Howard L. White
2. Industrial Chemistry Including Chemical Engineering by B. K. Sharma, Krishna Prakashan Media (p) Ltd
3. New Trends in Green Chemistry by V.K. Ahluwalia, M. Kidwai Second Edition, 2004
4. "Green Chemistry" theory and practice, P. T. Anastas and J. C. Warner, New York Oxford university press, 1998
5. The Chemistry of Synthetic dyes, Vol. I to VII by Venkataraman, Academic Press, New York.
6. Technology of Textile Processing by V. A. Shehna, Sevak Publications, Bombay.
7. Riegel's hand book for industrial chemistry 3rd edd. By James A. Kent.



M.Sc. Semester:-3

ORGANIC CHEMISTRY

Paper No. XII : Organic Practicals

Total Marks : 100 Marks

Credits: 7.5

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	❖ Organic preparations involving two or three steps, (minimum ten)	40	50
2	❖ Paper chromatography and TLC	20	25
3	❖ Viva-voce (Questions related to fundamentals of Organic chemistry and topics related to the syllabus of M.Sc. Organic Chemistry.	-	25

Reference / Text-Books / Additional Reading:

1. Vogel's Textbook of Practical Organic Chemistry, 5th Edition by B. S. Furniss et al.
2. Comprehensive Practical Organic Chemistry, Qualitative Analysis by V. K. Ahluwalia
3. Comprehensive Practical Organic Chemistry, Organic Preparation by V. K. Ahluwalia



M.Sc. Semester:-3

ORGANIC CHEMISTRY

Elective Paper No. 301 : Contemporary Development in Organic Industries

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Polymers and polymerization: Definition of monomer, polymer, oligomer, HDP, LDP, filler, plastisizers and antioxidants with respect to polymer chemistry, polymeric reactions and their illustrations, addition polymerization and condensation polymerization, definition of true, natural and semi-synthetic fibers, manufacture of Viscose rayon, manufacture of phenol formaldehyde resin, manufacture of Nylon polymers and manufacture of synthetic elastomers.	12	14 + 6 = 20
2	Petroleum and petrochemicals: Theory of origin of petroleum and techniques for the search of petroleum, definition of petrochemicals and their importance in the day to day life, manufacture of important chemicals from C ₂ – cut of petroleum (at least four chemicals), manufacture of important chemicals from C ₃ – cut of petroleum, manufacture of important chemicals from aromatic cut of petroleum.	12	14 + 6 = 20
3	Unit processes and unit operations: Introduction to unit processes and unit operations, unit process of sulphonation, nitration, hydroxylation, hydrogenation, amination, allylation, halogenation and alkylation	12	14 + 6 = 20
4	A. Pesticides: 06 Pesticides: Introduction, classification, inorganic, natural, synthetic organic insecticides, dinitrophenols, organo halogen compounds, organic phosphorous and synthesis of several pesticides. Brief introduction and synthesis of herbicides and fungicides. B. Synthetic perfumes: 06 Brief introduction to perfumes, solvent, fixative, odorous substance, synthesis of esters, alcohols, ketones, aldehydes and diphenyl compounds.	12	14 + 6 = 20
5	Green Chemistry Brief introduction, principles, green catalysts-acid catalyst, basic catalyst, oxidation catalysts, polymer supported catalyst, green synthesis-phase transfer catalyst, green synthesis of polycarbonates, paracetamol, ibuprofen, citral, urethane, adipic acid and styrene.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. Introduction to industrial Chemistry, Howard L. Whate
2. Industrial Chemistry Including Chemical Engineering by B. K. Sharma, Krishna Prakashan Media (p) Ltd
3. Text book of Polymer Science, F. W. Billmeyer
4. Principles of Polymer Science: P. Bahadur & N. V. Sastry, Narosa
5. Unit Processes in Organic Synthesis, P. H. Groggins
6. Contemporary Polymer Chemistry, H. R. Alcock and F. W. Lambe
7. New Trends in Green Chemistry by V.K. Ahluwalia, M. Kidwai Second Edition, 2004
8. "Green Chemistry" theory and practice, P. T. Anastas and J. C. Warner, New York Oxford university press, 1998



M.Sc. Semester:-4

ORGANIC CHEMISTRY

Paper No. XIII: Drugs

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	A. Introduction to chemotherapy, detailed account of drugs from the view point of body systems, disease and bacteria B. (I) Antimalarials (II) Trypanocides	12	14 + 6 = 20
2	(i) Analgesics and antipyretics (ii) Hypoglycemics (iii) Quinilone antibacterials (iv) Cardiovascular	12	14 + 6 = 20
3	(i) Antibiotics (ii) Anti-HIV agents (iii) Organo arsenicals and antimonials	12	14 + 6 = 20
4	(i) Antitubercular agents (ii) Antileprotic agents (iii) Coagulants and anticoagulants (iv) Sulpha drugs (v) Local and general anesthetics	12	14 + 6 = 20
5	(i) Neoplastics (ii) Anthelmintics (iii) Antiseptics (iv) Adrenergic and cholinergic drugs (v) Antipsychotics (Tranquilizers)	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. Burger's Medicinal Chemistry and Drug Discovery, Sixth Edition, Ed.M.E.vWolff, John Wiley.
2. Principles of Medicinal Chemistry, William Foye, Fourth Edition, Lippincott, William and Wilkins.
3. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed Robert F. Dorge.
4. Textbook of Medicinal Chemistry by Ashutosh Kar, Asian Age. Publication.
5. Pharmaceutical substances by A. Kleemann & Engle.
6. The Organic Chemistry of drug design and drug action by R. B. Silverman.
7. Advanced organic chemistry Part B by F.A. Carey & R. J. Sundberg.



M.Sc. Semester:-4

ORGANIC CHEMISTRY

Paper No. XIV : Natural Products - II

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Natural pigments: Introduction to natural pigment: pyrrole and polyene pigments, constitution of α , β and γ carotenes and constitution of lycopene, constitution of haemin with synthesis, constitution of chlorophyll.	12	14 + 6 = 20
2	Steroids: Introduction to steroids and Diel's hydrocarbon, definition of sterols, steroids, constitution of cholesterol, constitution of ergosterol, chemistry of vitamin D group, introduction and importance of bile pigments and bile acids.	12	14 + 6 = 20
3	Hormones: Introduction to hormones, chemistry of sex hormones (oestrone, progesterone), chemistry of androgens (androsterone and testosterone), chemistry of adrenaline, thyroxine, chemistry stilboestrol, hexoestrol and ACTH	12	14 + 6 = 20
4	Nucleic acids: Detailed study of structure of nucleosides and nucleotides with their synthesis, hydrolysis of nucleic acids under different conditions, structure of DNA and RNA, Biosynthesis of proteins and genetic continuity.	12	14 + 6 = 20
5	A. Vitamin B group of compounds: 06 Elucidation of the structure and synthesis of vitamins B ₁ , B ₂ , B ₆ , and Biotin. Biochemical importance of these vitamins B. Alkaloids 06 Elucidation of the structure of morphine and cholchicine (analytical evidence only)	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. Organic Chemistry of Natural Products by O.P. Agarwal, Goel Publishing. House, Meerut (1997).
2. Chemistry Of Natural Products by S. V. Bhatt, B. A. Nagasampagi, S. Minakshi, Springer- Berlin Heidelberg (2005).
3. Natural Products Chemistry, Vols. I & II by K. Nakanashi, Academic Press, New York and London (1974).
4. Heterocyclic Chemistry (2nd edition) by T.L. Gilchrist, Longman Scientific & Technical Publications (1992).
5. Organic Chemistry – I.L.Finar 6th edition (low price), Pearson Education (2003).
6. Organic Chemistry of Natural Products by Ayodhya Singh & Seema Singh, Campus Publishers (2008).
7. Natural Product Chemistry by Apsimon



M.Sc. Semester:-4

ORGANIC CHEMISTRY

Paper No. XV : Selected Topics - II

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Preparation and isolation of some clinically used drugs Salicylic acid, aspirin, methylsalicylate, d-propoxyphene hydrochloride, acetanilide, 4 – aminophenol, paracetamol, saccharin, caffeine, camphor, insulin, morphine, codeine and cocaine	12	14 + 6 = 20
2	A. Structure activity relation, an introduction to QSAR. Drug design (primary concept) 06 B. i) Hypnotics and sedatives 06 ii) Antihistamines	12	14 + 6 = 20
3	Enzymes: Nomenclature, classification of enzymes, chemical nature of co-enzymes-I and II, carboxylase, FAD, ATP, AMP, metallo-enzymes, mechanism of enzyme action, specificity of enzymes.	12	14 + 6 = 20
4	A. Introduction to nano-materials, their size and the fundamental science behind nanotechnology 06 B. Introduction to disconnections, concept of synthons, synthetic equivalent, functional group inter conversions, concept and design of synthesis, criteria of good disconnection 06	12	14 + 6 = 20
5	Fundamentals of Patent: Definition and concept of patent system, Procedure for patent system, Procedures for patent applications in India, US and Europe, Patentability in India, US and Europe, Infringement and remedies of patent search.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. The handbook of Nano Technology by John C Miller and Rubben Serrato
2. 3 D QSAR in Drug design, Ligand-Protein interaction and molecular similarity Vol-2 by V C Martin.
3. Patent searching made easy, 5th edition by David Hitchcock
4. Medicinal chemistry by Ashutosh Kar and D. Sriram
5. The organic chemistry of Drug design and drug action by Silverman R., Academic press, 2007
6. Design and drugs, basic principles and application by J H Poupaert
7. The text book of Drug and discovery by Krogsguard-Larsen, Taylor & Frances, 2002.



M.Sc. Semester:-4

ORGANIC CHEMISTRY

Paper No. XVI: Organic Practicals

Total Marks : 100 Marks

Credits: 7.5

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Separation of three component organic mixtures and identification of the given components (solid, semisolid and liquid) (minimum 10)	35	50
2	❖ Estimation of mixtures like acid + ketone, acid + ester, and acid + amide	15	15
3	❖ Estimation of drugs & Estimation of glucose and sucrose	10	10
4	❖ Viva-voce (Questions related to fundamentals of Organic chemistry and topics related to the syllabus of M.Sc. Organic Chemistry.	-	25

Reference / Text-Books / Additional Reading:

1. Vogel's Textbook of Practical Organic Chemistry, 5th Edition by B. S. Furniss et al.
2. Comprehensive Practical Organic Chemistry, Qualitative Analysis by V. K. Ahluwalia
3. Comprehensive Practical Organic Chemistry, Organic Preparation by V. K. Ahluwalia



M.Sc. Semester:-4
ORGANIC CHEMISTRY

Elective Paper No. 402 : Modern Approach basec on Organic Chemistry

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Introduction of drugs and primary concept of QSAR A. Introduction to chemotherapy, detailed account of drugs from the view point of body systems, disease and bacteria B. Structure activity relation, an introduction to QSAR. Drug design (primary concept)	12	14 + 6 = 20
2	Brief introduction, synthesis and uses of commonly available drugs 1. Antimalarials, 2. Analgesics and antipyretics 3. Antitubercular agents 4. Sulpha drugs 5. Antiseptics	12	14 + 6 = 20
3	Pollution and pollution control: Introduction and fundamental aspects of various pollutants from air, water and soil, purification and treatment of municipal waste water, industrial effluent in ETP, waste treatment of soil, air pollution and its control.	12	14 + 6 = 20
4	Vitamins: General introduction and classification, role of vitamins in biochemical reactions, vitamin A group, vitamin C and vitamin E group (α , β , γ and δ tocopherols), vitamin K group.	12	14 + 6 = 20
5	Fundamental aspects of IPR and patents Understanding of intellectual property rights, Overview of the IPR and its tools, World Trade Organization, Patent Cooperation Treaty. Definition and concept of patent system, Procedure for patent system, Procedures for patent applications in India, US and Europe, Patentability in India, US and Europe, Infringement and remedies of patent search.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. Principles of Medicinal chemistry by Foye
2. Medicinal chemistry, 4th addition, by ashutosh kar
3. Medicinal chemistry by willson & Gisvol
4. Medicinal chemistry and drug discovery ,Burger,6Th addition
5. Chemistry of Natural Products by O.P.Agarwal
6. Chemistry of Natural products By S.V. Bhat and Bhimsen A.
7. Stereo Chemistry and chemistry of Natural products by I L Finar, 2008
8. Demystifying Intellectual Property Rights, NR Subbaram



M.Sc. Semester:-3
INORGANIC CHEMISTRY

Paper No. IX : Organometallic Compounds & Bioinorganic Chemistry

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	<ul style="list-style-type: none">❖ Polymeric metal carbonyl clusters.❖ Metal halide clusters❖ Mode of bonding, structure and reactivity of metal carbonyl and metal halide clusters.❖ Metallorganic compounds of molybdenum and tungsten involving metal-metal multiple bonds.❖ Synthesis, structures and their reactivity	12	14 + 6 = 20
2	<ul style="list-style-type: none">❖ Fluxionality of organometallic compounds, Techniques which are used to observe❖ Fluxional behaviour of transition metal organometallic compounds with special reference to compounds of carbonyl and cyclopentadienyl ligands❖ Alkali metal NMR spectroscopy in vivo studies in cellular, tissues and whole organs❖ Compounds involving macrocyclic ligands❖ Paramagnetic lanthanides as contrast enhancing agents in magnetic resonance imaging	12	14 + 6 = 20
3	<ul style="list-style-type: none">❖ f⁰ block organometallics.❖ The compounds and complexes of lanthanide in organic synthesis❖ Organometallic compounds with biological and environmental relevance.❖ Reaction mechanisms of organometallic compounds, synthesis and reactivity❖ Metal alkoxides and metal carboxylates	12	14 + 6 = 20
4	<ul style="list-style-type: none">❖ Complexes of I a and II a group cations in Biological chemistry❖ Metal-macromolecule interactions in Biology❖ Ionophores, Crown ethers, Kryptanols, Antibiotic molecules, Ion transport❖ Ca⁺⁺ channel and calcium channel blockers, Biological membranes	12	14 + 6 = 20
5	<ul style="list-style-type: none">❖ Ferredoxin, iron-sulphur proteins and their relevance❖ Hemoglobin, Myoglobin, Mechanism of binding of dioxygen molecule to Hemoglobin❖ Dinitrogen complexes of transition metals, their structure and reactivity❖ Biological Nitrogen fixation.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks

2. Attendance: 05 Marks

3. Seminar: 10 Marks

4. Test: 10 Marks

Total Marks: 30 Marks



Reference / Text-Books / Additional Reading:

1. Organometallic Chemistry: A Unified Approach by R. C. Mehrotra & A. Singh, New Age International Publishers
2. Fluxional Organometallic and Coordination Compounds, Vol. 4 by Marcel Gielen, Rudolph Willem, Bernd Wrackmeyer, John Wiley & Sons
3. Transition Metal Carbonyl Cluster Chemistry by P. J. Dyson and J. S. McIndoe, Gordon and Breach Science Publishers
4. Inorganic Chemistry: Principles of Structure and Reactivity, IVth Edn by James E. Huheey, Ellen A. Keiter, Okhil K. Medhi, Dorling Kindersley (India) Pvt. Ltd.
5. The Inorganic Chemistry of Biological Processes by M. N. Hughes, John Wiley & Sons.
6. Metal Ions in Biochemistry by P. K. Bhattacharya, Narosa publishing House
7. Principles of Bioinorganic Chemistry: S.J.Lippard and J.M Berg, University Science Books, Mill Valley, California (1994).
8. Fluxional Organometallic and Coordination Compounds, Vol. 4 by Marcel Gielen, Rudolph Willem, Bernd Wrackmeyer, John Wiley & Sons
9. Transition Metal Carbonyl Cluster Chemistry by P. J. Dyson and J. S. McIndoe, Gordon and Breach Science Publishers
10. Principles of Bioinorganic Chemistry: S. J. Lippard and J.M Berg, University Science Books, Mill Valley, California (1994).



M.Sc. Semester:-3
INORGANIC CHEMISTRY

Paper No. X : Group Theory

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	❖ Molecular symmetry, symmetry groups ❖ Reducible and Irreducible representations ❖ Character tables ❖ Wave functions basis for irreducible representations.	12	14 + 6 = 20
2	❖ SALC ❖ Projection operator ❖ Hybrid orbitals.	12	14 + 6 = 20
3	❖ Symmetry aspects of M.O. theory ❖ Applications of MOT in Carbocyclic system ❖ LCAO-MO, bonding.	12	14 + 6 = 20
4	❖ Method of descending symmetry-construction of correlation diagram ❖ Selection rules, U.V. visible spectra of complexes and group theory.	12	14 + 6 = 20
5	❖ Vibrational spectra and group theory (I.R. & Raman) ❖ Molecular vibrations ❖ Diatomic and polyatomic molecules ❖ Interpretation of IR spectra of some coordination compounds.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks

2. Attendance: 05 Marks

3. Seminar: 10 Marks

4. Test: 10 Marks

Total Marks: 30 Marks

Reference / Text-Books / Additional Reading:

1. Chemical Applications of Group Theory, 3rd Edn., F. A. Cotton, John Wiley & Sons, Inc.
2. Group Theory and its Chemical Applications, P. K. Bhattacharya, Himalaya Publishing House.
3. Symmetry and Spectroscopy of Molecules, K. Veera Reddy, New Age International Publishers.
4. Molecular Symmetry and Group Theory, Robert L. Carter
5. Introduction to Symmetry and Group Theory for Chemists, Arthur M. Lesk



M.Sc. Semester:-3
ORGANIC CHEMISTRY

Paper No. XI : Selected Topics - I

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	<ul style="list-style-type: none">❖ Metal ions as probes and isomorphous substitution of metal ions, Metalloenzymes❖ Metalloporphyrin structures and synthesis, Structure of chlorophyll and photosynthesis.	12	14 + 6 = 20
2	<ul style="list-style-type: none">❖ Ligand field theory and group theory, U.V. visible spectroscopy, electronic structures❖ L-S coupling, spectroscopic states, splitting of levels in different chemical environment❖ Sine rule, construction of energy level diagrams.	12	14 + 6 = 20
3	<ul style="list-style-type: none">❖ M.O. of naphthalene❖ Bonding, three centered bonds❖ M.O. for AB_n molecules.	12	14 + 6 = 20
4	<ul style="list-style-type: none">❖ Theory & principle of Mossbauer spectroscopy❖ Applications of M.S. for understanding the structure of coordination compounds.	12	14 + 6 = 20
5	<ul style="list-style-type: none">❖ NQR spectroscopy, theory and principle❖ Applications of NQR for structural elucidation of metal complexes❖ Photo electron spectroscopy (PES)	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. The Inorganic Chemistry of Biological Processes by M. N. Hughes, John Wiley & Sons.
2. Metal Ions in Biochemistry by P. K. Bhattacharya, Narosa publishing House
3. Principles of Bioinorganic Chemistry: S. J. Lippard and J. M. Berg, University Science Books, Mill Valley, California (1994).
4. Electronic Absorption Spectroscopy and Related Techniques, D. N. Sathyanarayana, Universities Press.
5. Chemical Applications of Group Theory, 3rd Edn., F. A. Cotton, John Wiley & Sons, Inc.
6. Group Theory and its Chemical Applications, P. K. Bhattacharya, Himalaya Publishing House.
7. Instrumental Methods of Chemical Analysis, G. R. Chatwal & S. Anand, Himalaya Publishing House.
8. Publishing House.
9. Spectroscopy, H. Kaur, Pragati Prakashan, Meerut



M.Sc. Semester:-3
ORGANIC CHEMISTRY

Paper No. XII : Inorganic Practicals

Total Marks : 100 Marks

Credits: 7.5

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	❖ Inorganic Qualitative analysis of mixtures containing eight radicals in which two are rare metal ions (minimum 10)	20	30
2	❖ Ore analysis (03 ores)	20	25
3	❖ Paper Chromatography (03 mixtures)	20	20
4	Viva-voce (Questions related to fundamentals of Inorganic chemistry)	-	25

Reference / Text-Books / Additional Reading:

1. Vogel's Qualitative Inorganic Analysis, G. Svehla, Orient Longman Publication.
2. Advanced Practical Inorganic Chemistry, Gurdeep Raj, Goel Publishing House, Meerut
3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, T. K. Chondhekar, Anjali Publication, Aurangabad.
4. Advance Inorganic Analysis, Subhash-Satish, Pragati-Prakashan.
5. Text book of Quantitative Inorganic Analysis, Vogel's, ELBS.
6. Inorganic Preparation, J. Palmar, Wealy Inter-science publication



M.Sc. Semester:-3

INORGANIC CHEMISTRY

Elective Paper No. 301 : Contemporary Development in Bioinorganic Chemistry & Organometallic Compounds

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: **70 Marks**

Continuous Internal Evaluation: **30 Marks**

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	<ul style="list-style-type: none">❖ Organometallic compounds: Introduction, Theory of metal-carbon bond❖ Organolithium compounds: Preparative methods, Halogen-metal exchange reactions, Metallation of onium halides, Detection of organolithium compounds, Applications.❖ Organoboranes: Introduction, Synthesis of organoboranes via organometallics, Hydroboration, Hydroboration of diens, cyclic olefins and acetylene.	12	14 + 6 = 20
2	<ul style="list-style-type: none">❖ Fluxional organometallic compounds: General and Historical❖ Fluxional behavior of transition metal organometallic compounds with special reference to compounds of carbonyl and cyclopentadienyl ligands❖ Alkali metal NMR spectroscopy in vivo studies in cellular, tissues and whole organs❖ Compounds involving macrocyclic ligands❖ Paramagnetic lanthanides as contrast enhancing agents in magnetic resonance imaging	12	14 + 6 = 20
3	<ul style="list-style-type: none">❖ Polymeric metal carbonyl clusters.❖ Metal halide clusters❖ Mode of bonding, structure and reactivity of metal carbonyl and metal halide clusters.❖ Metalorganic compounds of molybdenum and tungsten involving metal-metal multiple bonds.❖ Synthesis, structures and their reactivity	12	14 + 6 = 20
4	<ul style="list-style-type: none">❖ Complexes of IA and IIA group cations in Bioinorganic Chemistry❖ Ionophores, Crown ethers, Antibiotic molecules, Membrane transport❖ Biological membranes❖ Ferredoxin, iron-sulfur proteins and their relevance❖ Effect of deficiency and excess of essential metal ions in biological systems	12	14 + 6 = 20
5	<ul style="list-style-type: none">❖ Metal ions as probes and isomorphous substitution of metal ions, Metalloenzymes❖ Hemoglobin and Myoglobin, Mechanism of oxygen molecule carrier by hemoglobin❖ Structure of chlorophyll and photosynthesis❖ Dinitrogen complexes of transition metals, their structure and reactivity❖ Biological Nitrogen fixation.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks

2. Attendance: 05 Marks

3. Seminar: 10 Marks

4. Test: 10 Marks

Total Marks: 30 Marks



Reference / Text-Books / Additional Reading:

1. Organometallic Chemistry: A Unified Approach by R. C. Mehrotra & A. Singh, New Age International Publishers
2. Fluxional Organometallic and Coordination Compounds, Vol. 4 by Marcel Gielen, Rudolph Willem, Bernd Wrackmeyer, John Wiley & Sons
3. Transition Metal Carbonyl Cluster Chemistry by P. J. Dyson and J. S. McIndoe, Gordon and Breach Science Publishers
4. Inorganic Chemistry: Principles of Structure and Reactivity, IVth Edn by James E. Huheey, Ellen A. Keiter, Okhil K. Medhi, Dorling Kindersley (India) Pvt. Ltd.
5. The Inorganic Chemistry of Biological Processes by M. N. Hughes, John Wiley & Sons.
6. Metal Ions in Biochemistry by P. K. Bhattacharya, Narosa Publishing House
7. Principles of Bioinorganic Chemistry: S. J. Lippard and J. M. Berg, University Science Books, Mill Valley, California (1994).



M.Sc. Semester:-4
INORGANIC CHEMISTRY

Paper No. XIII : Selected Topics - II

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	(iv) Solid state chemistry: (v) Point defects, Schottky and Frankel defects, colour centers line defects, edge and screw dislocation, Burgers vectors (vi) Drude – Lorenz theory, electrical conductivity, Band theory of solids, Brillouin zones, Motion of electron in a band, distinction between conductors, semi-conductors and insulators (vii) Semi-conductors (viii) Super conductors	12	14 + 6 = 20
2	Boron-Hydrogen, Boron-Nitrogen compounds and equations of balance Boron-Carbon cage structure	12	14 + 6 = 20
3	1. Inorganic Polymers 2. Silicone polymers 3. Poly phosphazenes	12	14 + 6 = 20
4	1. Theory of ESR 2. ESR applications for the structure determination of metal complexes 3. Applications of ESR for understanding metal complexes relevant to biology	12	14 + 6 = 20
5	1. Theory of NMR spectroscopy 2. Contact and pseudo contact shifts 3. Applications of NMR spectroscopy for understanding fluxional organometallic molecules	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks

2. Attendance: 05 Marks

3. Seminar: 10 Marks

4. Test: 10 Marks

Total Marks: 30 Marks

Reference / Text-Books / Additional Reading:

1. Elements of Magneto Chemistry, 2nd Edn., R. L. Datta and A. Syamal, Affiliated East-West Press Pvt. Ltd., New Delhi
2. Introduction to Magneto Chemistry by A. Earnshaw, Academic Press, Elsevier
3. Concepts in Magneto Chemistry by Morris Sylvain, IVY Publishing House, New Delhi.
4. Mechanism of Inorganic Reactions by F. Basolo and R. G. Pearson, Wiley Eastern (1967).
5. Concepts and Models of Inorganic Chemistry (3rd edn.) by B. Douglas, D. McDaniel and J. Alexander, John Wiley & Sons (1994).
6. Inorganic Polymers by James E. Mark, H. R. Allcock and Robert West, Prentice Hall of India Pvt. Ltd., New Delhi, 1992.
7. Text-book of Polymer Science, 2nd edition, by F. W. Jr. Billmeyer Jr., Wiley-Interscience, New York, 1971.



8. Inorganic and Organometallic Polymers by M. Zelding, K. J. Wynne and H. R. Allcock, ACS Symposium Series, American Chemical Society, Washington, DC, Vol. 360 (1988).
9. Inorganic Polymers by G. R. Chatwal
10. Phosphorous-Nitrogen Compounds, H. R. Allcock, Academic, New York, 1972.
11. Principle of the Solid state by H. V. Keer
12. Solid State Chemistry by N. B. Hannuy
13. Solid State Chemistry by L. Smart and Elaine Moore
14. Solid State Chemistry, D.K. Chakrabarty, New Age International
15. Organometallic Chemistry: A Unified Approach by R. C. Mehrotra & A. Singh, New Age International Publishers
16. Spectroscopy, H. Kaur, Pragati Prakashan, Meerut
17. Fluxional Organometallic and Coordination Compounds, Vol. 4 by Marcel Gielen, Rudolph Willem, Bernd Wrackmeyer, John Wiley & Sons



M.Sc. Semester:-4

INORGANIC CHEMISTRY

Paper No. XIV : Coordination Chemistry

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	<ul style="list-style-type: none">❖ Effect of Voct on d^1 system. The solution of various \emptyset integral❖ The solution of various θ integrals and Solution of R part❖ Prepare a secular determinant for d^1 and solution of the wave function	12	14 + 6 = 20
2	<ul style="list-style-type: none">❖ Effect of Voct on d^2 system❖ Use of ladder operator to obtain the wave function for d^2 system❖ Prepare a secular determinant for d^2❖ To determine the wave function for d^2 system Ligand field theory (M.O. theory)	12	14 + 6 = 20
3	<ul style="list-style-type: none">❖ Introduction and origin of magnetic character in inorganic substances❖ Origin of paramagnetism, Van Vleck equation❖ Effect of L-S coupling on A, E, T terms and TIP❖ Anamolous Magnetic properties	12	14 + 6 = 20
4	<ul style="list-style-type: none">❖ Complex Equilibrium: I❖ Experimental determination of composition and stability by spectroscopic methods, method of continuous variations, pH metric Irving Rossotti method❖ Methods for computing stability constants by half integral, correction term, graphical and Numerical methods	12	14 + 6 = 20
5	<ul style="list-style-type: none">❖ Complex Equilibrium: II❖ Computation of stability constants from equilibrium data❖ Basic principles mathematical functions and their interrelationship❖ Factors affecting stability constants, nature of central metal ion, nature of ligand	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. Chemistry of the Metal Chelate Compounds by A. E. Martell and M. Calvin, Prentice-Hall, Inc., New York
2. The Determination of Stability Constants by F. J. C. Rossotti and H. Rossotti, McGraw-Hill, New York, 1961.
3. Elements of Magneto Chemistry, 2nd Edn., R. L. Datta and A. Syamal, Affiliated East-West Press Pvt. Ltd., New Delhi
4. Physical methods in Inorganic Chemistry, R. S. Drago
5. Coordination Compounds, F. A. Kettle, ELBS and Nelson
6. Basic Principles of Ligand Field Theory, H. L. Schlafer and G. Liemann
7. Introduction of Ligand Field Theory, A. K. Chandra
8. Introduction to Magneto Chemistry by A. Earnshaw, Academic Press, Elsevier
9. Concepts in Magneto Chemistry by Morris Sylvain, IVY Publishing House, New Delhi.



M.Sc. Semester:-4

INORGANIC CHEMISTRY

Paper No. XV : Recent Topics in Inorganic Chemistry

Total Marks : **100 Marks**

Credits: 4

Marks: Semester End Examination: **70 Marks**

Continuous Internal Evaluation: **30 Marks**

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	<ul style="list-style-type: none">❖ Derivation of crystal fields for octahedral, cubic and square planar arrangements.❖ Transformation of these potentials from Cartesian to Polar coordinates❖ L-S coupling and Microstates	12	14 + 6 = 20
2	<ul style="list-style-type: none">❖ Reaction mechanism of Transition Metal complexes:❖ Kinetics of octahedral substitution, acid hydrolysis, base hydrolysis❖ Substitution reactions in square planar complexes, Trans effect. Mechanism of substitution reactions in square planar complexes❖ Redox reactions❖ Electron transfer reactions and mechanism of one electron transfer reaction.❖ Outer and Inner sphere complexes	12	14 + 6 = 20
3	<ul style="list-style-type: none">❖ Methods of preparation, reactions, bonding and shapes of Fullerenes❖ Metal Amide complexes	12	14 + 6 = 20
4	<ul style="list-style-type: none">❖ Co-ordination polymers❖ Metal acetyl acetonate polymers.❖ Zeolites	12	14 + 6 = 20
5	<ul style="list-style-type: none">❖ Catalysis in industrial applications, Phase Transfer catalyst, concept of green chemistry❖ Use of computer in chemistry and industry	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. Physical methods in Inorganic Chemistry, R. S. Drago
2. Coordination Compounds, F. A. Kettle, ELBS and Nelson
3. Basic Principles of Ligand Field Theory, H. L. Schlafer and G. Liemann
4. Introduction of Ligand Field Theory, A. K. Chandra
5. Elements of Magneto Chemistry, 2nd Edn., R. L. Datta and A. Syamal, Affiliated East-West Press Pvt. Ltd., New Delhi
6. Mechanism of Inorganic Reactions by F. Basolo and R. G. Pearson, Wiley Eastern (1967).
7. Inorganic Chemistry: Principles of Structure and Reactivity, IVth Edn by James E. Huheey, Ellen A. Keiter, Okhil K. Medhi, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia
8. Inorganic Polymers by James E. Mark, H. R. Allcock and Robert West, Prentice Hall of India Pvt. Ltd., New Delhi, 1992.
9. Text-book of Polymer Science, 2nd edition, by F. W. Jr. Billmeyer Jr., Wiley-Interscience, New York, 1971.
10. Developments in Fullerene Science, Tibor Braun, Springer
11. Science of Fullerenes and Carbon Nanotubes: Their Properties and Applications, [M. S. Dresselhaus](#), [G. Dresselhaus](#), [G. Dresselhaus](#), [P. C. Eklund](#), [Peter C. Eklund](#), Elsevier Science & Technology Books.
12. New Trends in Green Chemistry by V.K. Ahluwalia, M. Kidwai Second Edition, 2004
13. Catalysis and Its Industrial Applications, [Edgar Jobling](#), General Books.



M.Sc. Semester:-4

INORGANIC CHEMISTRY

Paper No. XVI: Inorganic Practicals

Total Marks : 100 Marks

Credits: 7.5

Unit	Detailed Syllabus	Teaching Hours	Marks / Weight
1	❖ Alloy analysis (03 alloys)	20	25
2	❖ Ion-exchange chromatography (02 mixtures)	20	20
3	❖ Composition and Stability constant determination by spectrophotometry and pH metry	20	30
4	Viva-voce (Questions related to fundamentals of Inorganic chemistry)	-	25

Reference / Text-Books / Additional Reading:

1. Vogel's Qualitative Inorganic Analysis, G. Svehla, Orient Longman Publication.
2. Advanced Practical Inorganic Chemistry, Gurdeep Raj, Goel Publishing House, Meerut
3. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, T. K. Chondhekar, Anjali Publication, Aurangabad.
4. Advance Inorganic Analysis, Subhash-Satish, Pragati-Prakashan.
5. Text book of Quantitative Inorganic Analysis, Vogel's, ELBS.
6. Inorganic Preparation, J. Palmar, Wealy Inter-science publication



M.Sc. Semester:-4

INORGANIC CHEMISTRY

Elective Paper No. 401 : Modern Approach in Inorganic Chemistry

Total Marks : **100 Marks**

Credits: 4

Marks: Semester End Examination: **70 Marks**

Continuous Internal Evaluation: **30 Marks**

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Chemical Equilibria <ul style="list-style-type: none">❖ Computation of stability constants from equilibrium data❖ Basic principles mathematical functions and their interrelationship❖ Experimental determination of composition and stability by spectroscopic methods, method of continuous variations, pH metric Irving Rossotti method❖ Factors affecting stability constants, nature of central metal ion, nature of ligand	12	14 + 6 = 20
2	Magnetochemistry <ul style="list-style-type: none">❖ Introduction: Definitions of magnetic properties, types of magnetic behaviors❖ Origin of paramagnetism, Diamagnetism and Pascal's constants❖ Multielectron systems❖ Properties of paramagnetic bodies: Magnetic moments for different multiplet widths❖ Simplification of Van Vleck equation❖ Effect of L-S coupling on A, E, T terms and TIP	12	14 + 6 = 20
3	Inorganic Polymers <ul style="list-style-type: none">❖ Introduction: Definition of polymers and their depiction, Types of characteristic of inorganic polymers❖ Characterization of inorganic polymers by their molecular weights, number average, weight average❖ Experimental techniques determination of molecules weight of polymers by Chemical and Light scattering method❖ Uses of molecular weights❖ Mechanical properties such as elasticity, viscosity, viscoelasticity❖ Synthesis, properties, structures and uses of following polymers:<ol style="list-style-type: none">1) Polyphosphazenes2) Polysiloxanes	12	14 + 6 = 20
4	Solid State Chemistry <ul style="list-style-type: none">❖ Introduction❖ Point defects, Schottky and Frankel defects, colour centers line defects, edge and screw dislocation, Burgers vectors❖ Drude – Lorenz theory, electrical conductivity, Band theory of solids, Brillouin zones, Motion of electron in a band, distinction between conductors, semi-conductors and insulators❖ Semi-conductors❖ Super conductors	12	14 + 6 = 20
5	ESR spectroscopy <ul style="list-style-type: none">❖ Introduction❖ Techniques of ESR spectroscopy❖ Interaction between nuclear spin and electron spin: Hyperfine splitting❖ Lande's splitting factor (g)❖ Zero field splitting and Kramer's degeneracy❖ Applications of ESR for the structure determination of metal complexes.	12	14 + 6 = 20



Break up of Continuous Internal Evaluation:

1. Assignment:	05 Marks
2. Attendance:	05 Marks
3. Seminar:	10 Marks
4. Test:	<u>10 Marks</u>
Total Marks:	30 Marks

Reference / Text-Books / Additional Reading:

1. Chemistry of the Metal Chelate Compounds by A. E. Martell and M. Calvin, Prentice-Hall, Inc., New York
2. The Determination of Stability Constants by F. J. C. Rossotti and H. Rossotti, McGraw-Hill, New York, 1961.
3. Elements of Magneto Chemistry, 2nd Edn., R. L. Datta and A. Syamal, Affiliated East-West Press Pvt. Ltd., New Delhi
4. Introduction to Magneto Chemistry by A. Earnshaw, Academic Press, Elsevier
5. Concepts in Magneto Chemistry by Morris Sylvain, IVY Publishing House, New Delhi.
6. Mechanism of Inorganic Reactions by F. Basolo and R. G. Pearson, Wiley Eastern (1967).
7. Concepts and Models of Inorganic Chemistry (3rd edn.) by B. Douglas, D. McDaniel and J. Alexander, John Wiley & Sons (1994).
8. Inorganic Polymers by James E. Mark, H. R. Allcock and Robert West, Prentice Hall of India Pvt. Ltd., New Delhi, 1992.
9. Text-book of Polymer Science, 2nd edition, by F. W. Jr. Billmeyer Jr., Wiley-Interscience, New York, 1971.
10. Inorganic and Organometallic Polymers by M. Zelding, K. J. Wynne and H. R. Allcock, ACS Symposium Series, American Chemical Society, Washington, DC, Vol. 360 (1988).
11. Inorganic Polymers by G. R. Chatwal.
12. Phosphorous-Nitrogen Compounds, H. R. Allcock, Academic, New York, 1972.
13. Principle of the Solid state by H. V. Keer
14. Solid State Chemistry by N. B. Hannuy
15. Solid State Chemistry by L. Smart and Elaine Moore
16. Solid State Chemistry, D.K. Chakrabarty, New Age International
17. Solid State Chemistry and its applications, A. R. West, Plenum



M.Sc. Semester:-3

PHYSICAL CHEMISTRY

Paper No. IX : Advanced Instrumental Chromatographic Techniques

Total Marks : **100 Marks**

Credits: 4

Marks: Semester End Examination: **70 Marks**

Continuous Internal Evaluation: **30 Marks**

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Gas Chromatography ❖ Theory of Gas Chromatography ❖ GC instrumentation ❖ Use of different columns in G C ❖ Applications of G C	12	14 + 6 = 20
2	Liquid Chromatography-I ❖ Theory of Liquid Chromatography ❖ High Performance Liquid Chromatographic Technique ❖ Use of different columns in H P L C ❖ Applications of H P L C	12	14 + 6 = 20
3	Liquid Chromatography-II ❖ Electrophoresis ❖ Ultra Centrifugation ❖ Solvent Extraction	12	14 + 6 = 20
4	Advance techniques of Chromatography ❖ GC-MS-(Instrumentation) ❖ LC-MS-(Instrumentation) ❖ Ion Chromatography ❖ Head Space technique in chromatography	12	14 + 6 = 20
5	Miscellaneous Techniques ❖ Detectors in GC (Mass, FID, TCD, ECD, N-P detector) ❖ Detectors in HPLC (Mass, UV-Visible, Conductivity, Electrochemical detector) ❖ HP-TLC ❖ Capillary-GC and other advancement in technique ❖ Gel Permeation Chromatography: Introduction, principle of GPC, Instrumentation and Applications	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. Principle of Instrumental Analysis VIth edition by D. A. Skoog F. J Hooller & T. A. Nieman Saunders College Publication
2. Introduction to Instrumental Analysis by R. D. Braun Mc-Graw Hill Book Company
3. Fundamental of Analytical Chemistry by D. A. Skoog, West & Holler
4. Principle of Instrumental Analysis VIth edition by D. A. Skoog & Leary
5. Instrumental Method of Chemical Analysis by B. K. Sharma



M.Sc. Semester:-3

PHYSICAL CHEMISTRY

Paper No. X : Characterization of Polymers

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	<ul style="list-style-type: none">❖ Introduction, Molecular Weight averages, Molecular weight and Degree of polymerization, Polydispersity and Molecular weight distribution in polymers, Significance of polymer molecular weight, Purification and Fractionation of polymers.❖ End group analysis: Introduction, Examples of polymers for analysis.❖ Cryoscopy; Ebulliometry❖ Vapour Pressure Osmometry: Introduction, Principle, Apparatus and Experimental method, Evaluation of molecular weight	12	14 + 6 = 20
2	<ul style="list-style-type: none">❖ Membrane Osmometry: Introduction, Principle, Derivation of Van't Hoff equation relating osmotic pressure and molecular weight, Apparatus and Experimental methods, Evaluation of molecular weight and thermodynamic parameters.❖ Viscometry: Introduction, Definitions, measurement of viscosity, viscosity and molecular weight, evaluation of molecular dimensions.❖ Acoustic property: Introduction, Instrumentation, Applications.	12	14 + 6 = 20
3	<ul style="list-style-type: none">❖ Light scattering: Introduction, Debye equation for scattering of light by polymer molecules, Light Scattering Photometer, Dissymmetry and Zimm methods for evaluation of molecular dimensions and molecular weight.	12	14 + 6 = 20
4	<ul style="list-style-type: none">❖ Super molecular structure of polymers: Physical methods of investigation of molecular structure of polymers: Optical and electron microscopy, X-ray, electron and neutron diffraction techniques. Morphology of crystalline polymers: Lamellar single crystals, fibrillar and globular crystals; Spherulites.	12	14 + 6 = 20
5	<ul style="list-style-type: none">❖ Phase transition in polymers (using various analytical methods): State of matter and phase state. First and second order phase transitions. Crystallization and glass transition. Factors affecting crystallizability and glass transition temperature. Effect of molecular weight and plasticizers on T_g. Glass transitions of copolymers. The relation between T_g and T_m. and importance of T_g. Mechanism and kinetics of polymer crystallization. Thermodynamics of melting and crystallization. Melting temperatures of polymers. Free volume and packing density of polymers. Problems.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. Polymer Science, V. R. Gowariker, N. V. Vishwanathan and J. Shreedhar, Wiley Eastern Ltd., New Delhi.
2. Macromolecular Physical Chemistry, P. H. Parsania, Saurashtra University, 2006.
3. Acoustic Methods of Investigating Polymers, I. Perepechko, Mir Publishers, Moscow.
4. Physical Chemistry of Polymers, A Tager, Mir Publishers, Moscow.
5. Text-book of Polymer Science, F. W. Billmeyer, Wiley Interscience.
6. Physical Chemistry of Macromolecules, D. D. Deshpande, IIT, Bombay.



M.Sc. Semester:-3

PHYSICAL CHEMISTRY

Paper No. XI : Nuclear and Radio Chemistry

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	<ul style="list-style-type: none">❖ Brief introduction of radioactivity, mass defect, binding energy, mean binding energy of stable nuclei. Disintegration theory: Nuclear stability and group displacement law. Synthesis of radioisotopes: ^{14}C, ^3H, ^{35}S, ^{36}Cl, ^{82}Br, ^{131}I, ^{32}P. Contribution of the discovery of artificial radioactivity in the field of heavy element chemistry.❖ Detection and measurement of radioactivity: Ionization chamber, Geiger- Muller, proportional, scintillation counters, Wilson cloud chamber, Health physics instrumentation: Film badges, Pocket ion chambers, portable counters and survey meters, Accelerators: Van de Graff and cyclotron.	12	14 + 6 = 20
2	<ul style="list-style-type: none">❖ Nuclear fission, Nuclear fusion and Nuclear reactor: Characteristics of nuclear reactors and their applications. Nuclear reactors in India. The four factor formula: The reproduction factor, reactor power, life and critical size of reactor, and breeder.	12	14 + 6 = 20
3	<ul style="list-style-type: none">❖ Isotope effects and isotopic exchange reactions: Isotope effect: Definition, physical and chemical isotope effects. Generalities of isotope effects. Isotopic exchange: basic concept, characteristics of isotopic exchange, mechanism of isotopic exchange, kinetics of homogenous and heterogeneous isotopic exchange reactions, self-diffusion, and surface measurements.	12	14 + 6 = 20
4	<ul style="list-style-type: none">❖ Primary radiation: Chemical Process, Direct interaction of radiation with matter, ionization, excitation, neutron impact. Basic reactions involving active species produced in the primary act, and Radiation dosimetry.	12	14 + 6 = 20
5	<ul style="list-style-type: none">❖ Tracer: selection of radioisotopes as tracer, Application of radioisotopes as tracers- analytical, physico- chemical, medical, agriculture and industrial applications. Neutron activation analysis. Radiometric titrations and isotope dilution techniques. Radiopharmaceutical, radio immunoassay and radiation sterilization.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. Nuclear Chemistry and its applications – By. Haissionsky – Addison Wesley
2. Nuclear and Radio Chemistry – By. G. Friedlander, J. W. Kennedy, E. S. Macias and J. M. Miller – A Wiley – Interscience Publication, John Wiley and Sons – III rd Edition.
3. Radio Chemistry – By An. N. Nesmeyanov, Mir Publishers.
4. Artificial Radioactivity – By. K. Narayana Rao and H. J. Arnikaar – Tata McGraw Hill Publishing Company Ltd. New Delhi



M.Sc. Semester:-3

PHYSICAL CHEMISTRY

Paper No. XII : Physical Practicals

Total Marks : 100 Marks

Credits: 7.5

Method	Detailed Syllabus	Teaching Hours	Marks/Weight
A	<ul style="list-style-type: none">❖ Determination of Cl & Br, Cd & Zn and Ni & Zn by ion-exchange methods❖ Identification of Mixture of two components, three components and four components of amino acids using paper and TLC methods❖ Identification of mixture on inorganic cations by Paper & TLC❖ Molecular weight determination by viscosity❖ Synthesis of polymer materials	60	75
B	Viva-voce (Questions related to fundamentals of Inorganic chemistry)	-	25

Reference / Text-Books / Additional Reading:

1. Advanced Practical Physical Chemistry bt J. B. Yadav, Goel Publishing house, Krishna Prakashan Media (P) Ltd.
2. Experimental Physical Chemistry by V. D. Athawale & Parul Mathur, New Age International Publishers.
3. Practicals in Physical Chemistry: A Modern Approach by P. S. Sandhu, MACMILLAN.
4. Advanced Viva Voca in Physical Chemistry Experiments by Subhash-Satish & Dr. Kudesia, Pragati Prakashan, Meerut.
5. Experiments in Polymer Science by D. G. Hundiwale, V. D. Athawale, U. R. Kapadi & V. V. Gite, New Age International Publishers.
6. A Laboratory Manual of Polymers by S. M. Ashraf, Sharif Ahmad & Ufana Riaz, I. K. International



M.Sc. Semester:-3

PHYSICAL CHEMISTRY

Elective Paper No. 303 : Contemporary Development in Polymer & Nuclear Chemistry

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	Fundamentals of molecular weight and molecular- weight distribution Introduction, degree of polymerization, concept of molecular mass, polydispersity, number average and weight average, viscosity average molecular weight and their statistical equations, significance of polymer molecular weight.	12	14 + 6 = 20
2	Measurements of Molecular weight and size of Polymers Molecular weight determination of Polymer: end group analysis, colligative property measurement; light scattering method (Zimm plot), Gel permeation chromatography: theory of separation, instrumentation and technique, Fractionation of polymers by solubility, viscometric method, ultracentrifugation, and polyelectrolytes.	12	14 + 6 = 20
3	Structure and properties of Polymers Morphology of polymer single crystals, structure of polymers crystallized from melt and solution, Polymer structure and physical properties: The crystalline melting point, glass transition temperature, factors influencing the glass transition temperature, study of glass transition temperature related with molecular weight, Polymers and X-ray diffraction, degree of crystallinity, Crystallites, Spherulites, Polymer single crystals, effect of Crystallinity on polymers property.	12	14 + 6 = 20
4	Nuclear Chemistry: Introduction Brief introduction of radioactivity, mass defect, binding energy, mean binding energy of stable nuclei. Disintegration theory: Nuclear stability and group displacement law. Synthesis of radioisotopes: ^{14}C , ^3H , ^{35}S , ^{36}Cl , ^{82}Br , ^{131}I , ^{32}P , Contribution of the discovery of artificial radioactivity in the field of heavy element chemistry. Detection and measurement of radioactivity: Ionization chamber, Geiger- Muller, proportional, scintillation counters, Wilson cloud chamber, Health physics instrumentation: Film badges, Pocket ion chambers, portable counters and survey meters, Accelerators: Van de Graff and cyclotron.	12	14 + 6 = 20
5	Nuclear Chemistry: Tracer Tracer: selection of radioisotopes as tracer, Application of radioisotopes as tracers- analytical, physico- chemical, medical, agriculture and industrial applications, Neutron activation analysis, Radiometric titrations and isotope dilution techniques, Radiopharmaceutical, radio immunoassay and radiation sterilization.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**



Reference / Text-Books / Additional Reading:

1. F.W. Billmeyer, Jr. Textbook of polymer science, Wiley- Interscience, N.Y.
2. Introduction to polymer chemistry, R. Seymour, Wiley –Interscience
3. Principles of polymer chemistry by P.J. Flory.
4. Principles of Polymer Science: P. Bahadur & N. V. Sastry, Narosa
5. Macromolecular Physical Chemistry, P. H. Parsania, Saurashtra University, 2006
6. Polymer science by Govarikar V.R. and others, Wiley Eastern
7. Textbook of Polymer Science, Padma L. Nayak, S. Lenka, Kalyani Publishers
8. A Textbook of Polymers, M. S. Bhatnagar, S. Chand
9. Physical Chemistry of Macromolecules, C. Tanford, John Wiley & Sons
10. Introduction to Polymer, R. J. Young, Chapman & Hall
11. Nuclear and Radio Chemistry – By. G. Friedlander, J. W. Kennedy, E. S. Macias and J. M. Miller – A Wiley – Interscience Publication, John Wiley and Sons – IIIrd Edition.
12. Radio Chemistry – By An. N. Nesmeyanov, Mir Publishers.
13. Artificial Radioactivity – By. K. Narayana Rao and H. J. Arnikar – Tata McGraw Hill Publishing Company Ltd. New Delhi



M.Sc. Semester:-4

PHYSICAL CHEMISTRY

Paper No. XIII: Advanced Instrumental Electro-Analytical Techniques

Total Marks : **100 Marks**

Credits: 4

Marks: Semester End Examination: **70 Marks**

Continuous Internal Evaluation: **30 Marks**

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	<p>Basic components of Electronics and Computer in Analysis</p> <ul style="list-style-type: none"> ❖ Introduction to general electronic components ❖ Definitions and circuit diagrams of various electronic components like resistance, capacitance, transducers, thermocouples etc. ❖ Introduction to general concepts of computer ❖ Importance of computer in analytical chemistry ❖ Data analysis using regression analysis, least fit square method etc. 	12	14 + 6 = 20
2	<p>Modern Electro-analytical Techniques-I (Techniques based on Control potential)</p> <ul style="list-style-type: none"> ❖ Sampled (Tast/Strobe) D. C. Polarography Introduction, Principle, Methodology, Nature of polarogram, Circuit diagram, Construction of DME, Advantages and Limitation of DME, Polarographic maxima, Use of surfactant, Waive Height Method, Standard Addition Method, Applications. ❖ Amperometry Introduction to Amperometry, Amperometric titration at DME, Amperometric titration with two microelectrodes 	12	14 + 6 = 20
3	<p>Modern Electro-analytical Techniques-II (Techniques based on Control potential)</p> <ul style="list-style-type: none"> ❖ Derivative Polarography Introduction, Principle of the method, Methodology, Circuit diagram, Nature of curve, Advantages and Limitations ❖ Differential Polarography Introduction, Principle of the method, Methodology, Circuit diagram, Nature of curve, Advantages and Limitations ❖ Oscillographic Polarography Introduction, Principle of the method, Methodology, Circuit diagram, Signal excitation and stimulation, Nature of curve, Single sweep method, multiple sweep method, Oscilloscope as a Read out device Advantages and Limitations 	12	14 + 6 = 20
4	<p>Modern Electro-analytical Techniques-III (Techniques based on Control potential)</p> <ul style="list-style-type: none"> ❖ Rapid Scan Methods like Cyclic-voltammetry, Linear scan Voltammetry Introduction of Rapid Scan methods, Nature of curve, Criteria for Reversible, Quasi-reversible and Irreversible nature, Kinetic current, Catalytic current, Adsorption current, Circuit diagram, Signal Excitation and stimulation, Advantages and Limitations, Application of the methods ❖ Pulse Polarography: Differential Pulse and Square Wave Polarography Introduction to pulse polarography, Signal Excitation and stimulation, Nature of Curve, Methodology of technique, Applications of the method, Advantages and Limitations ❖ Stripping Methods Cathodic Stripping Voltammetry Anodic Stripping Voltammetry Differential pulse stripping voltammetry 	12	14 + 6 = 20



5	Modern Electro-analytical Techniques (Techniques based on Control current) General Introduction of chrono techniques, Coulomb's law, Methodology ❖ Coulometric Technique Coulometric titration, Coulometric technique with controlled current and control potential, Chrono-coulometry ❖ Chrono-amperometry Introduction, Principle, Theory and Methodology of the technique, Nature of curve, signal excitation and stimulation ❖ Chrono-potentiometry Introduction, Principle, Theory and Methodology of the technique, Nature of curve, signal excitation and stimulation	12	14 + 6 = 20
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Break up of Continuous Internal Evaluation:

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|---------------------|-----------------|
| 1. Assignment: | 05 Marks |
| 2. Attendance: | 05 Marks |
| 3. Seminar: | 10 Marks |
| 4. Test: | <u>10 Marks</u> |
| Total Marks: | 30 Marks |

Reference / Text-Books / Additional Reading:

1. Principle of Instrumental Analysis VIth edition by D. A. Skoog F. J Hooller & T. A. Nieman Saunders College Publication
2. Introduction to Instrumental Analysis by R. D. Braun Mc-Graw Hill Book Company
3. Fundamental of Analytical Chemistry by D. A. Skoog, West & Holler
4. Principle of Instrumental Analysis VIth edition by D. A. Skoog & Leary
5. Basic Concept of Analytical Chemistry by S. M. Khopker
6. Instrumental Method of Chemical Analysis by B. K. Sharma



M.Sc. Semester:-4

PHYSICAL CHEMISTRY

Paper No. XIV : Electrochemistry

Total Marks : 100 Marks

Credits: 4

Marks: Semester End Examination: 70 Marks

Continuous Internal Evaluation: 30 Marks

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	❖ Fundamentals of electrochemistry: Classification of conductors. The mechanism of electrolysis. Electrolytic dissociation theory. Evidences for the ionic theory. Influence of the solvent on dissociation. Faraday's laws of electrolysis.	12	14 + 6 = 20
2	❖ The Theory of electrolytic conductance: The degree of dissociation and inter ionic attraction. The ionic atmosphere and relaxation time. Mechanism of electrolytic conductance. Validity of Debye - Huckel - Onsager equation. Determination of degree of dissociation. ❖ The Migration of ions: Transference numbers and ionic velocities. The Hittorf method and the moving boundary method. Transference numbers in mixtures. Abnormal transference numbers. Examples.	12	14 + 6 = 20
3	❖ Acids and bases: Definitions, types of solvents, dissociation of constants of acids and bases. Determination of dissociation constants. Acidity function, effect of solvent and temperature on dissociation constant and ionic product of water. Examples.	12	14 + 6 = 20
4	❖ Amphoteric electrolytes: Dipolar ions and evidences for their existence. Dissociation of amino acids, isoelectric points and neutralization curves of ampholytes.	12	14 + 6 = 20
5	❖ Polarization and over voltage: Electrolytic polarization. Dissolution and deposition potentials. Determination of anode and cathode potentials and concentration polarization. Decomposition voltages of aqueous solutions. Metal deposition over voltage. Mechanism of anodic and cathodic phenomena. Ionic diffusion as the slow process. Thickness of diffusion layer. Influence of temperature and agitation on diffusion layer. Ionic discharge is the slow process. Establishment of equilibrium on the electrode is the slow process. Hydrogen over voltage. Influence of current density, pH and temperature on over voltage. Theories of over voltage. Oxygen over voltage. Electrolysis of water. Examples.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
 2. Attendance: 05 Marks
 3. Seminar: 10 Marks
 4. Test: 10 Marks
- Total Marks: 30 Marks**

Reference / Text-Books / Additional Reading:

1. An Introduction of Electrochemistry, S. Glasstone. Affiliated East West Press, New Delhi.
2. Electrochemistry, B. K. Sharma. Goel Publishing House.
3. Modern Electrochemistry Vol.2 JO'M Bockri's and A. K. N. Reddy, Plenum Press, New York.
4. The Principles of Electrochemistry, Duncan A. Mac Innes Dover Publication Inc. New York.



M.Sc. Semester:-4

PHYSICAL CHEMISTRY

Paper No. XV : Selected Topics in Physical Chemistry

Total Marks : **100 Marks**

Credits: 4

Marks: Semester End Examination: **70 Marks**

Continuous Internal Evaluation: **30 Marks**

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	❖ Chain reactions and Chemical Kinetics: Introduction of Chain reactions, Important features of chain reactions, Mechanism of chain reactions, Kinetic of chain reactions, Detection and Estimation of Atoms and Radicals in chain Reactions, Decomposition of ozone, dinitropentoxide, acetaldehyde & butane, Reaction between hydrogen-bromine and hydrogen-chlorine and hydrogen- oxygen (autoxidation), The reaction mechanisms of chain branching, Explosion limits, Effect of temperature on reaction rates. Derivation of Arrhenius equation, Determination of A and E, Activation energy and chemical reactions, Problems.	12	14 + 6 = 20
2 & 3	❖ Statistical Thermodynamics: Introduction, Aspects of statistics, ideal crystal as an isolated assembly, ideal gas as an isolated assembly, Molecular partition functions, Entropy and other state functions of an ideal gas in terms of the molecular partial function.	24	28 + 12 = 40
4	❖ Step Polymerization: Introduction, Polycondensation, Polyaddition, Ring opening-polymerization, Non catalysed polycondensation, Acid catalysed polycondensation molecular weight distributions, Ratio of weight-average molecular weight & number-average molecular weight, Extent of Reaction and Degree of polymerization, Stoichiometry of Reactants and Degree of polymerization, Mono functional Reactants and Degree of polymerization, Copolycondensation.	12	14 + 6 = 20
5	❖ E.M.F. & The Thermodynamics of Ions: Introduction, Reversible cell & Reversible Electrodes, Reactions in Reversible cells, Change of Heat Content in Cell Reaction, General Expression for EMF of Reversible Cells, Single Electrode potentials, Sign of Electrode Potential, Standard Potentials from Equilibrium Constants & Free Energy Data, Standard Electrode Potentials and their Applications: The dissociation (Ionization) Constant of Water as well as of Weak acid, Standard Entropies of Ions.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks
2. Attendance: 05 Marks
3. Seminar: 10 Marks
4. Test: 10 Marks

Total Marks: 30 Marks

Reference / Text-Books / Additional Reading:

1. Chemical Kinetics by Gurdeep-Harish.
2. Molecular Statistics for students of Chemistry, L. A. Woodward, Clarendon Press, Oxford
3. Elements of Statistical Thermodynamics, L. K. Nash, Addison – Wesley Publishing Co. London.
4. Introduction to Statistical Mechanics, G. S. Rushbrooke, Oxford University Press, Amen House, London.
5. Macromolecular Physical Chemistry, P. H. Parsania, Saurashtra University, 2006.
6. Polymer Science, V. R. Gowariker, N. V. Vishwanathan and J. Shreedhar, Wiley Eastern Ltd., New Delhi.
7. Thermodynamics for Chemists by Samuel Glasstone.
8. Statistical Thermodynamics, M. C. Gupta, Wiley Eastern Ltd., ND.



M.Sc. Semester:-4
PHYSICAL CHEMISTRY

Paper No. XVI : Physical Practicals

Total Marks : **100 Marks**

Credits: 7.5

Method	Detailed Syllabus	Teaching Hours	Marks/Weight
A	<ul style="list-style-type: none">❖ Determination of Half wave potential of Cd, Mn, Zn & Pb❖ Estimation of amount of metal ions using Wave Height and Standard Addition❖ Qualitative analysis of Mixture of two metal ions❖ Phase Rule❖ Practical based on Electro chemistry❖ Partition coefficient	60	75
B	Viva-voce (Questions related to fundamentals of Inorganic chemistry)	-	25

Reference / Text-Books / Additional Reading:

1. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publishing house, Krishna Prakashan Media (P) Ltd.
2. Experimental Physical Chemistry by V. D. Athawale & Parul Mathur, New Age International Publishers.
3. Practicals in Physical Chemistry: A Modern Approach by P. S. Sandhu, MACMILLAN.
4. Advanced Viva Voce in Physical Chemistry Experiments by Subhash-Satish & Dr. Kudesia, Pragati Prakashan, Meerut.
5. Experiments in Polymer Science by D. G. Hundiware, V. D. Athawale, U. R. Kapadi & V. V. Gite, New Age International Publishers.
6. A Laboratory Manual of Polymers by S. M. Ashraf, Sharif Ahmad & Ufana Riaz, I. K. International



M.Sc. Semester:-4

PHYSICAL CHEMISTRY

Elective Paper No. 403 : Modern Approach based on Physical Chemistry

Total Marks : **100 Marks**

Credits: 4

Marks: Semester End Examination: **70 Marks**

Continuous Internal Evaluation: **30 Marks**

Unit	Detailed Syllabus	Teaching Hours	Marks/Weight
1	❖ Electrochemistry: Fundamentals Classification of conductors, mechanism of electrolysis, electrolytic dissociation theory, evidences for the ionic theory, influence of the solvent on dissociation, Faraday's laws of electrolysis.	12	14 + 6 = 20
2	❖ Electrochemistry: Theory of electrolytic conductance and migration of the ions The degree of dissociation and inter ionic attraction, ionic atmosphere and relaxation time, mechanism of electrolytic conductance, validity of Debye- Huckel -Onsager equation, determination of degree of dissociation, Transference numbers and ionic velocities, Hittorf method and the moving boundary method, transference numbers in mixtures, Abnormal transference numbers.	12	14 + 6 = 20
3	❖ Electrochemistry: Polarization and over voltage Electrolytic polarization, dissolution and deposition potentials, determination of anode and cathode potentials and concentration polarization, decomposition voltages of aqueous solutions, Over voltage, mechanism of anodic and cathodic phenomena, Ionic diffusion as the slow process, thickness of diffusion layer, influence of temperature and agitation on diffusion layer, dropping mercury cathode, Half-Wave potential, Hydrogen over voltage, influence of current density, pH and temperature on over voltage, theories of over voltage, Oxygen over voltage, electrolysis of water, Examples.	12	14 + 6 = 20
4	❖ Chain reactions and Chemical Kinetics Introduction of chain reactions, important features of chain reactions, mechanism of chain reactions, kinetic of chain reactions, detection and estimation of atoms and radicals in chain reactions, decomposition of ozone, dinitropentoxide, acetaldehyde & butane, reaction between hydrogen-bromine and hydrogen-chlorine and hydrogen- oxygen (autoxidation), the reaction mechanisms of chain branching, explosion limits, effect of temperature on reaction rates, derivation of Arrhenius equation, determination of A and E, activation energy and chemical reactions, Problems	12	14 + 6 = 20
5	❖ E.M.F. & Thermodynamics of Ions Introduction, reversible cell & reversible electrodes, reactions in reversible cells, change of heat content in cell reaction, general expression for EMF of reversible cells, single electrode potentials, sign of electrode potential, standard potentials from equilibrium constants & free energy data, standard electrode potentials and their applications: The dissociation (Ionization) constant of water as well as of weak acid, standard entropies of ions.	12	14 + 6 = 20

Break up of Continuous Internal Evaluation:

1. Assignment: 05 Marks

2. Attendance: 05 Marks

3. Seminar: 10 Marks

4. Test: 10 Marks

Total Marks: 30 Marks



Reference / Text-Books / Additional Reading:

1. An Introduction of Electrochemistry, S. Glasstone. Affiliated East West Press, New Delhi.
2. Electrochemistry, B. K. Sharma. Goel Publishing House.
3. Modern Electrochemistry Vol.2 JO'M Bockri's and A. K. N. Reddy, Plenum Press, New York.
4. The Principles of Electrochemistry, Duncan A. Mac Innes Dover Publication Inc. New York.
5. Chemical Kinetics by Gurdeep-Harish
6. Thermodynamics for Chemists by Samuel Glasstone.
7. Statistical Thermodynamics, M. C. Gupta, Wiley Eastern Ltd., ND.