DEPARTMENT OF

HUMANITIES AND SCIENCES

M.Sc. (CHEMISTRY)

ACADEMIC SESSION 2017-2018

YMCA UNIVERSITY OF SCIENCE AND TECHNOLOGY

YMCA UNIVERSITY OF SCIENCE AND TECHNOLOGY

VISION

YMCA University of Science and Technology aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building.

MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creative activities.
- To provide an enviable research environment and state-of-the art technological exposure to its scholars.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities

HUMANITIES AND SCIENCES DEPARTMENT

VISION

A department that can effectively harness its multidisciplinary strengths to create an academically stimulating atmosphere; evolving into a well-integrated system that synergizes the efforts of its competent faculty towards imparting intellectual confidence that aids comprehension and complements the spirit of inquiry.

MISSION

- To create well-rounded individuals ready to comprehend scientific and technical challenges offered in the area of specialization.
- To counsel the students so that the roadmap becomes clearer to them and they have the zest to turn the blueprint of their careers into a material reality.
- To encourage critical thinking and develop their research acumen by aiding the nascent spirit for scientific exploration.
- Help them take economic, social, legal and political considerations when visualizing the role of technology in improving quality of life.
- To infuse intellectual audacity that makes them take bold initiatives to venture into alternative methods and modes to achieve technological breakthroughs.

M.Sc. Chemistry

Chemistry is a fundamental science and has contributed immensely to the improvement of the life of human beings by providing many of human requirements and essentialities. The developments in Chemistry during last few decades are phenomenal. New branches of chemistry are emerging and gaining importance, such as bioorganic chemistry, materials chemistry, computational chemistry, etc. The practice of Chemistry at industrial scale also is undergoing radical changes and is more or more based on deep understanding the chemical phenomena. The emerging Chemical Technologies are highly science based. The aid of computers has not only accelerated growth in the practice of Chemistry, but revolutionized the entire field. A Chemist cannot isolate himself from other disciplines. Thus, after a long span of more and more specialization in graduate and post-graduate syllabi, a symbiotic interdisciplinary approach now seems to be more relevant.

PROGRAM EDUCATIONAL OBJECTIVES

- To impart training in Chemistry at advanced level in a more wholistic way and enthuse the students for the subject;
- To make students confident and capable of accepting any challenge in Chemistry,
- To give a flavour of research in Chemistry and train the students for research career,
- To abreast the students about the current status and new developments in Chemistry,
- To make the students aware of the impact of Chemistry on environment and imbibe the concept of sustainable developments,
- To educate the students with respect to skills and knowledge to practice chemistry in ways that are benign to health and environment,
- To provide flexibility in selecting some of the courses as per the interest and also to provide space for fast learners,
- To make the students aware of resources and make them capable of mining the data.

PROGRAM OUTCOMES

After the successful completion of the course, the student would:

- Have fundamental knowledge of Chemistry.
- Develop global outlook possessing state of the art skills.
- Become capable of taking challenging responsibilities in the field of research in Chemical Sciences.

YMCA UNIVERSITY OF SCIENCE AND TECHNOLOGY, FARIDABAD
DEPARTMENT OF HUMANITIES AND SCIENCES

SCHEME OF M. Sc. CHEMISTRY

SEMESTER I

Subject Code	Title	Teaching Hours per week			Maximum Marks			Credits	Category Code
		L	T	P	Sessional Marks	End-semester Examination	Total Marks		
CH-101A	Inorganic Chemistry (General-I)	4			25	75	100	4	DCC
CH-102A	Organic Chemistry (General-I)	4			25	75	100	4	DCC
CH-103A	Physical Chemistry (General-I)	4			25	75	100	4	DCC
CH-104A-X*	Mathematics for Chemists	3			25	75	100	3	FC
CH-104A- Y*	Chemistry of life processes	3			25	75	100	3	FC
CH-105A	Inorganic Chemistry Lab-I			6	30	70	100	3	DCC
CH-106A	Organic Chemistry Lab-I			6	30	70	100	3	DCC
CH-107A	Physical Chemistry Lab-I			6	30	70	100	3	DCC
XXX	MOOC**								
						Total	**700**	**24**	

DCC – Discipline Core Course; FC – Foundation Course; MOOC – Massive Open Online Course
L – Lecture; T - Tutorial; P - Practical

Candidates with Biology background will appear for CH-104 A-X and Candidates with Mathematical background will appear for CH-104A-Y*

**The students have to pass at least one mandatory MOOC course with 4-6 credits (12-16 weeks) from the list given on the Swayam portal or the list given by the department/ university from 1st semester to 3rd semester as notified by the university.

Instructions to the students regarding MOOC

1. Two types of courses will be circulated: branch specific and general courses from the website https://swayam.gov.in in the month of June and November every year for the forthcoming semester.
2. The department coordinators will be the course coordinators of their respective departments.
3. Every student has to pass a selected MOOC course within the duration ass specified below:

Programme	**Duration**
B. Tech.	Sem. I to Sem. VII
M.Sc./M.Tech./MA/MBA	Sem. I to Sem. III
B.Sc./MCA	Sem. I to Sem. V

The passing of a MOOC course is mandatory for the fullfilment of the award of the degree of concerned programme.

4. A student has to register for the course for which he is interested and eligible which is approved by the department with the help of course coordinator of the concerned department.
5. A student may register in the MOOC course of any programme. However, a UG student will register only in UG MOOC courses and a PG student will register in only PG MOOC courses.
6. The students must read all the instructions for the selected course on the website, get updated with all key dates of the concerned course and must inform his/her progress to their course coordinator.
7. The student has to pass the exam (online or pen-paper mode as the case may be) with at least 40% marks.
8. The students should note that there will be a weightage of Assessment/quiz etc. and final examination appropriately as mentioned in the instructions for a particular course.
9. A student must claim the credits earned in the MOOC course in his/her marksheet in the examination branch by forwarding his/her application through course coordinator and chairperson.

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SCHEME OF M. Sc. CHEMISTRY

SEMESTER II

Subject Code	Title	Teaching Hours per week			Maximum Marks			Credits	Category Code
		L	T	P	Internal Assessment	End-semester Examination	Total Marks		
CH-201A	Inorganic Chemistry (General-II)	4			25	75	100	4	DCC
CH-202A	Organic Chemistry (General-II)	4			25	75	100	4	DCC
CH-203A	Physical Chemistry (General-II)	4			25	75	100	4	DCC
CH-204A	Computational Techniques	3			25	75	100	3	FC
CH-205A	Inorganic Chemistry Lab-II			6	30	70	100	3	DCC
CH-206A	Organic Chemistry Lab-II			6	30	70	100	3	DCC
CH-207A	Physical Chemistry Lab-II			6	30	70	100	3	DCC
XXX	Audit Course*	2	0	0	40	60	100	0	AUD
						Total	**700**	**24**	

DCC – Discipline Core Course; FC – Foundation Course ; AUD-Audit Course
L – Lecture; T - Tutorial; P - Practical
*The students have to choose one Audit course from the list provided by the department/university. Only passing of the Audit course is mandatory.

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SCHEME OF M. Sc. CHEMISTRY

SEMESTER III

Subject Code	Title	Teaching Hours per week			Maximum Marks				
		L	T	P	Internal Assessment	End-semester Examination	Total	Credits	Category Code
CH-301A	Spectroscopy-I	4			25	75	100	4	DCC
CH-302A	Spectroscopy-II	4			25	75	100	4	DCC
CH-303A	Analytical Techniques	4			25	75	100	4	DCC
CH-304/314/324A	Inorganic / Organic / Physical Chemistry Lab-Special-I			6	30	70	100	3	DEC
CH-305/315/325A	Inorganic / Organic / Physical Chemistry Lab -Special-II			6	30	70	100	3	DEC
CH-306/316/326A	Inorganic / Organic / Physical Chemistry Lab -Special-III			6	30	70	100	3	DEC
XXX	Open Elective Course*	3			25	75	100	3	OEC
						Total	**700**	**24**	

DCC – Discipline Core Course; DEC – Discipline Elective Course; OEC – Open Elective Course
L – Lecture; T - Tutorial; P - Practical

***** The students have to choose one open elective course related to other branch of Science/ Engg./ other discipline offered by other departments within the same faculty required for enhancing professional performance as provided by the department/ university.

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SCHEME OF M. Sc. CHEMISTRY

SEMESTER IV

Subject Code	Title	Teaching Hours per week			Maximum Marks			Credits	Category Code
		L	T	P	Internal Assessment	End-semester Examination	Total		
CH-401/411/421A	Inorganic / Organic / Physical Chemistry Special-I	4			25	75	100	4	DEC
CH-402/412/422A	Inorganic / Organic / Physical Chemistry Special-II	4			25	75	100	4	DEC
CH-403/413/423A	Inorganic / Organic / Physical Chemistry Special-III	4			25	75	100	4	DEC
CH-404/414/424A	Inorganic / Organic / Physical Chemistry Special-IV	4			25	75	100	4	DEC
CH-431A	Project			16	50	150	200	8	DCC
						Total	**600**	**24**	

DCC – Discipline Core Course; DEC – Discipline Elective Course
L – Lecture; T - Tutorial; P - Practical

YMCA UNIVERSITY OF SCIENCE AND TECHNOLOGY, FARIDABAD
DEPARTMENT OF HUMANITIES AND SCIENCES

The Audit course and Open elective courses offered by PG Department in Environmental Sciences:

Course	Subject	Subject Code
Audit Course	1. Green Chemistry	ACH-204A
Open Elective Course	1. Chemistry for sustainable development	OCH-307A
	2. Applied Chemistry	OCH-308A

The below given Grading Scheme will be followed:

*Percentage	Grade	Grade Points	Category
95-100	O	10	Outstanding
85-95	A+	9	Excellent
75-85	A	8	Very Good
65-75	B+	7	Good
55-65	B	6	Above Average
45-55	C	5	Average
40-45	P	4	Pass
<40	F	0	Fail
.....	Ab	0	Absent

*Lower limit included upper limit excluded.

The multiplication factor for CGPA is 10.

1. Automatic Rounding.
2. Average difference between actual percentage and CGPA percentage ± 2.5%.
3. Worst case difference between actual percentage and CGPA percentage ± 5% if somebody in all the 8 semesters in all the exams (around 75 in numbers) consistently scores at the bottom of the range, say 55 of 55-65 which is a very remote possibility.

M Sc CHEMISTRY, SEMESTER I

CODE: CH-101A

SUBJECT NAME: **Inorganic Chemistry (General-I)**

NO OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

Course Objectives: To learn about the group theory and VSEPR theory, concepts of coordination Chemistry, stability of the complexes and stereochemistry of complexes. To study about structure and bonding in coordination compounds.

UNIT: I

Symmetry and Group Theory in Chemistry

Definitions of group, subgroup, relation between orders of a finite group and its subgroup. Conjugacy relation and classes. Symmetry elements and symmetry operation, Point symmetry group. Schönflies symbols, representations of groups by matrices (representation for the Cn, Cn v, Cn h, Dn h etc. groups to be worked out explicitly). Character of a representation, reducible and irreducible representations, The great orthogonality theorem (without proof) and its importance, Derivation of character tables of C2 v, C3 v and D2 h Character tables and their use. Molecular asymmetry, dissymmetry and optical activity.

UNIT: II

Stereochemistry and Bonding in Main Group compounds: VSEPR theory, dπ –pπ bonds, Bent rule and energetic of hybridization. Huckel theory with reference to ethylene and butadiene. Some simple substitution reactions of covalently bonded molecules of boron, silicon and nitrogen.

UNIT: III

Metal-Ligand Equilibria in solution

Stepwise and overall formation constants and their interactions, trends in stepwise constants, factors affecting stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry. Substitution reactions in octahedral complexes, theories of trans effect with respect to Pt(II) complexes, brief account of electron transfer reactions, inert and labile complexes.

UNIT: IV

Metal-Ligand Bonding

Limitation of crystal field theory, crystal field effects, John Teller distortion, nephelauxetic series, spin-orbital coupling, molecular orbital theory of octahedral, tetrahedral and square planar complexes (with and without π -bonding).

Course Outcomes:

After the successful completion of the course the learner would be able to

i. undestand the bonding concepts involved in Coordination compounds
ii. and can utilize this knowledge for complex formation of research interest.

Referenc Books

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harper & Row.
3. Chemical Applications of Group Theory; F.A. Cotton, Wiley, New York.
4. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
5. The Chemical bond; J.N.Murre l, SFA Kettle and JM. Tedder; Wiley, New York.
6. Modern Aspects of Inorganic Chemistry; H.J. Emeleus and Sharpe.
7. Concepts and Models of Inorganic Chemistry; B. Douglas, D.H. McDanie l and. J.J.Alexander; John Wiley and Sons.
8. Inorganic Chemistry, A Modern Introduction; T Moeller, John Wiley and Sons.

M Sc CHEMISTRY, SEMESTER I

CODE: CH-102A

SUBJECT NAME: **Organic Chemistry (General-I)**

NO OF CREDITS: 4

L	P
4	0

SESSIONAL:	25
THEORY EXAM:	75
TOTAL:	100

Course Objectives:
To understand the bonding, basics of reaction mechanism, reaction intermediates and mechanism of nucleophilic substitution reactions. To learn the concepts of stereochemistry, conformational analysis and their Application in the determination of reaction mechanism.

UNIT: I
Nature of Bonding in Organic molecules: Delocalized chemical bonding –conjugation, cross conjugation, resonance, hyperconjugation, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternante and non-alternante hydrocarbons, Huckel's rule,

Reaction Mechanism: Structure and Reactivity: Types of mechanisms, types of reactions, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Effect of structure on reactivity. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects. Hard and soft acids and bases. Generation, structure, stability and reactivity of carbocations, carbanions, carbenes and nitrenes.

UNIT: II
Aliphatic Nucleophilic Substtitution: The SN2, SN1, mixed SN1 and SN2, SNi, SN1', SN2' SNI' and SET mechanisms. Reactivity- effects of substrate structure, attacking nucleophile, leaving group and reaction medium. Ambident nucleophile, regioselectivity. The neighbouring group mechanisms, neighbouring group participation by n electrons, π and σ bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, common carbocation rearrangements.

UNIT: III
Stereochemistry-I: Symmetry elements, D-L, R-S, E-Z and threo-erythro nomenclature, interconversion of Fischer, Newman, Sawhorse and flying wedge formulae. conformational analysis, enantiomerism and diastereomerism of simple, cyclic (chair and boat configuration) and acyclic systems. Axial and planer chirality, optical somerism in allenes, biphenyls (atropoisomerism), spiranes, hemispiranes. elementary ideas about stereochemistry o f tertiary amines, quaternary salts, sulphur and phosphorous compounds.

UNIT: IV

Stereochemistry – II: Topicity of ligands and faces, their nomenclature and prostereoisomerism, stereogenecity, chirogenicity, pseudoasymmetry and prochiral centre. stereospecific and stereoselective reaction.

Elementary idea of principle categories of asymmetric synthesis, Cram's rule and its modification, Prelog rule and horeaus rule.

Stereochemistry of sugars- C1 and 1C conformations of hexoses, c_2'-endo and c_3'-endo conformation of pentoses, homomorphous sugars, abnormal mutarotation and Δ-2 instability factor. Stereochemistry of decalins,

Chemical correlation of configuration -determination of relative configuration of 2-butanol, isoserine, alanine, malic acid, lactic acid and mandelic acid.

Course Outcomes: After the successful completion of the course the learner would be able to

i. understand the principles involved in an organic reaction
ii. and their relation with stereochemistry of compounds.

Reference Books:

1. Advanced Organic Chemistry Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.
5. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice -Hall.
6. Modern Synthetic Reactions, H. O. House, Benjamin.
7. Principles of Organic Synthesis, R. O. C. Norman and J. M. Coxon, Blackie Academic & Professional.
8. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillan.
9. Organic Chemistry, J. Clayden, N. Greeves, S.Warren, P. Wothers, Oxford Press.

M Sc CHEMISTRY, SEMESTER I

CODE: CH-103A

SUBJECT NAME: **Physical Chemistry (General-I)**

NO OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

Course Objectives:

To study the thermodynamic properties associated with chemical processes and partial molar quantities. To understand theories and basic concepts of Chemical kinetics, ion-ion interacrions and catalysis reactions.

UNIT: I

Thermodynamics: Brief recapitulation of first and second Law of thermodynamics. Entropy changes in reversible and irreversible processes; variation of entropy with temperature , pressure and volume, entropy concept as a measure of unavailable energy and criteria for the spontaneity of reaction; free energy functions and their significance, criteria for spontaneity of a process; partial molar quantities (free energy, volume ,heat concept), Gibb's-Duhem equation.

UNIT: II

Chemical Kinetics: Collision theory of reaction rates, the steric requirement, Arrhenius equation and activated complex theory (ACT), comparison of collision and activation complex theory, Potential energy surfaces (Only basic Idea) , thermodynamic formulation of activated complex theory, chain reactions (hydrogen-halogen reaction) , unimolecular reactions , Lindemann – Hinshelwood mechanism of unimolecular reactions.

UNIT: III

Electrochemistry: Ion - Ion Interactions: The Debye -Huckel theory of ion- ion interactions: potential and excess charge density as a function of distance from the central ion, Debye Huckel reciprocal length, ionic cloud and its contribution to the total potential, Debye – Huckel limiting law of activity coefficients and its limitations, ion - size effect on potential, ion - size parameter and the theoretical mean - activity coefficient in the case of ionic clouds with finite - sized ions.
Debye - Huckel -Onsager treatment for aqueous solutions and its limitations Debye- Huckel-Onsager theory for non-aqueous solutions,

UNIT: IV

Surface Chemistry and Catalysis: Gibbs adsorption equation, Langmuir adsorption isotherm and its kinetic derivation for non- dissociative and dissociative adsorption, BET adsorption

isotherm, its kinetic derivation and applications. Study of surfaces by SEM & TEM (brief idea). Heterogeneous catalysis, surface heterogeneity, surface catalyzed unimolecular and bimolecular reactions, temporary and permanent catalytic poisons, activation energy for surface reactions. Comparison of homogeneous and heterogeneous reaction rates.

Course Outcomes: After the successful completion of the course the learner would be able to

i. Handle the thermodynamics of a chemical process.
ii. Understand the rate of a reaction and its associated kinetics which help in designing a new reaction.
iii. Solve the peculiar behaviour of ions based on electrochemistry
iv. Explore surface characteristics of compounds.

Reference Books

1. An Introduction to Chemical Thermodynamics, R.P. Rastogi and R.R. Misra, Vikas Pub.
2. Physical Chemistry, P.W. Atkins, Oxford University Press.
3. Thermodynamics for Chemists, S. Glasstone, Affiliated East -West Press.
4. Thermodynamics, I.M. Klotz and R.M. Rosenbers, Benzamin.
5. Chemical Kinetics, K.J. Laidler, McGraw Hill.
6. Kinetics and Mechanism, A. A. Frost and R.G. Pearson, John Wiley and Sons.
7. Electrochemistry, S. Glasstone, Affiliated East -West Press.
8. Physical Chemistry, G.W. Castellan, Narosa.
9. Heterogeneous Catalysis: Fundamentals and Applications, Julian R.H. Ross, Wiley-VCH; 2nd, Revised and Enlarged Edition, edition (October 1, 2007)
10. Concepts of Modern Catalysis and Kinetics, I. Chorkendorff and J. W. Niemantsverdriet

M Sc CHEMISTRY, SEMESTER I

CODE: CH-104A-X

SUBJECT NAME: **Mathematics for Chemists**

NO OF CREDITS: 3

		SESSIONAL:	25
L	P	THEORY EXAM:	75
3	0	TOTAL:	100

Course Objectives: To impart knowledge of basic mathematics, which is necessary for a chemist.

UNIT: I

Vectors: Examples of scalar and vectors, definitions of vectors in two, three spaces, representation and simple properties of vectors, addition and subtraction of vectors, vector addition by the method of triangles , resolution of vectors into rectangular components, addition of vectors by components, multiplication and differentiation of vectors . Scalar product of vectors, vector product

Matrices and Determinants: Definition of matrix, types of matrices, viz. row matrix, column matrix, null matrix, square matrix, diagonal matrix, addition, subtraction and multiplication by a number, matrix multiplication. Transpose and adjoint of matrix, elementary transformation, representation and applications (without development of theory) to solution of linear equations. Definition, properties and evaluation of determinants.

UNIT: II

Logarithm: definition of logarithm, common logarithms, natural logarithms, laws of logarithm, expressing the logarithm of a number, simplifying expressions using laws of logarithm, change of base, calculating antilogs.

Graphical Representation of Equations: Rectangular coordinates, straight lines, slope and intercept of the equation, slope and point equation, two point equation, parallel lines , points of intersection, distance between two points, change of origin. Curve fitting for least squares method.

Differential Calculus: Theory, rules of differentiation, powers, added and subtracted functions, constants, products, quotients, functions of a function, logarithmic differentiation, and parametric functions. Algebraic simplification, differentiation of implicit functions, graphical significance of differentiation, rate of change of slope, successive differentiation.

UNIT: III

Partial Differentiation: The fundamental theorem, geometrical significance of partial differentiation, special cases of fundamental theorem, successive partial differentiation. Integral

transforms (Fourier and Laplace). Reduction formulae. Methods of Lagrangian multipliers, Sterling's approximation, probability and errors.

Integral Calculus: Integral theory, rules of integration between limits, significance of 'e' exponential equations, methods of integration, viz. algebraic simplifications, substitution, integration by parts, integration by partial fractions, coordinate transformation (e.g., cartesian to spherical polar), curve sketching, integral as area

Course Outcomes: After the successful completion of the course the learner would be able to

i. solve numerical problems of chemistry.
ii. explain deivations of theories and principles.
iii. handle concepts of computational chemistry and modelling.

Reference Books

1. Mathematical Preparation for Physical Chemistry, F. Daniels, McGraw Hill.
2. Mathematical Preparation for General Physics, J.B. Marian, R.C. Davidson Saunder Company.
3. Mathematical Methods for Science Students, G. Stephemen, ELBS.
4. Chemical Thermodynamics, R.C. Reid.

M Sc CHEMISTRY, SEMESTER I

CODE: CH-104A-Y

SUBJECT NAME: **Chemistry of Life Processes**

NO OF CREDITS: 3

		SESSIONAL:	25
L	P	THEORY EXAM:	75
3	0	TOTAL:	100

Course Objectives:

To introduce the basic chemistry of life processes amd compounds of life. To understand the chemistry behind genetics.

UNIT: I

Introduction to metabolic processes: Catabolism and anabolism, ATP, currency of biological energy, energy rich and energy poor phosphates, role of NADH, NADPH, FADH2, TPP, coenzyme A, lipoic acid and biotin.
Introduction to photosynthesis.

UNIT: II

Lipids: Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Lipoproteins - composition and function, role in atherosclerosis

Lipid metabolism - β-oxidation of fatty acids.

Protiens: Primary, secondary, tertiary and quaternary structures, enzymes, active sites, allosteric sites and mechanism of their action, e.g. Chymotrypsin

UNIT: III

Nucleic Acids and Genetic Code: Structure of nucleotides, nucleosides, DNA (Watson-Crick mode l) RNA structure and conformation, Replication of DNA (semi-conservative, conservative and dispersive replication Maselson-Stahl experiment) , transcription, translation of genetic material, genetic code, universality of the code, codon, anticodon pairing, RNA.

Course Outcomes: After the successful completion of the course the learner would be able to

- Understand the metabolism and energy cycle of living beings.
- Corelate the metabolism of a body and chemical reactions responsible for it.
- Predict biochemistry of any metabolism
- Solve problems of genetic engineering.

Reference Books

1. Principles of Biochemistry, A. L. Lehninger, Worth Publishers.
2. Biochemistry, L.Stryer, W.H.Freeman.
3. Biochemistry, J. David Rawn, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry, E. E.Conn and P. K. Stumpf, John Wiley.

M Sc CHEMISTRY, SEMESTER I

CODE: CH-105A

SUBJECT NAME: Inorganic Chemistry Lab-I

NO OF CREDITS: 3

		SESSIONAL:	30
L	P	FINAL EXAM:	70
0	6	TOTAL:	100

Course Objectives:

To analyse a given mixture of salts qualitatively in laboratory.

Qualitative Analysis:
Less common metal ions- W,Tl,Mo,Se,Ti,Zr,Th,V,U,Ce ,Be.(two metal ions in cationic/anionic forms)

Insolubles- Oxides(Al_2O_3 ,Cr_2O_3,SnO_2 , TiO_2 , SiO_2 WO_3,); Sulphates(Lead Sulphate, Barium Sulphate Strontium Sulphate and Calcium Sulphate); Halides(Calcium fluoride and silver halides)

(2 less common metal ions and 1 insoluble to be given)

Experiment: 45 marks
Lab Record: 15 marks
Viva-voce: 10 marks

Course Outcomes: After the successful completion of the course the learner would be able to

- identify a given mixture of inorganic salts qualitatively by experiments.
- to learn comprehensive laboratory techniques

Reference Books

1. A Text Book of Macro and Semi-micro Quantitative Analysis, A.I.Vogel, Orient Longman.
2. A Vogel's Text Book of Quantitative Inorganic Analysis , J. Bassett, R.C. Denney, G.B. Jaffery and J. Menaham, Longman, London.
3. Synthesis and Characterization of Inorganic Compounds, W.B. Jolly, Prentice Hall, Englewood.
4. Synthesis and Physical Studies of Inorganic Compounds, C.F. Bell, Pergamon Press
5. Inorganic Preparations; W.G. Palmer.

M Sc CHEMISTRY, SEMESTER I

CODE: CH-106A

SUBJECT NAME: **Organic Chemistry Lab-I**

NO OF CREDITS: 3

		SESSIONAL:	30
L	P	FINAL EXAM:	70
0	6	TOTAL:	100

Course Objectives:

To analyse a given mixture of compounds qualitatively in laboratory. To synthesise various organic compounds in laboratory

Experiments

- Qualitative analysis of mono and bifunctional compounds.
- Synthesis of organic compounds involving some of the following reactions: acylation reaction, Oxidation and reductions, Coupling reactions, Diels-Alder reaction, Nucleophilic substitution reaction, Condensation reaction, Diazotization reactions.

Experiment: 45 marks
Lab Record: 15 marks
Viva-voce: 10 marks

Course Outcomes: After the successful completion of the course the learner would be able to

i. analyse a given mixture of compounds qualitatively by experiments
ii. synthesise various organic compounds.
iii. propose different synthetic routes for a compound.

Reference Books

1. A Hand book of Organic Analysis -Qualitative and Quantitative by H.T. Clarke, and revised by B.Haynee, Edward Arnold, London 1975.
2. Vogel's Text Book of Practical Organic Chemistry by B.S. Furhen et. al, Longman-Group Ltd.
3. Systematic Qualitative Organic Analysis by H. Middleton, Edward Arnold (Publishers) Limited, London 1959.
4. Elementary Practical Organic Chemistry by Arthur I. Vogel, Ex CBS Publishers and Distributors.

5. Experiments in Organic Chemistry by Louis, F.Fieser, D.C. Heath and Company Boston, 1955.

M Sc CHEMISTRY, SEMESTER I

CODE: CH-107A

SUBJECT NAME: **Physical Chemistry Lab-I**

NO OF CREDITS: 3

		SESSIONAL:	30
L	P	FINAL EXAM:	70
0	6	TOTAL:	100

Course Objectives:

To determine the strength of given acid / base by conductometric titration. To determine the strength of given acid / base by pH-metric titration. To study the chemical kinetics of some simple reactions. To determine the viscosity of liquidsand variation of viscosity. To determine molar mass of a polymer.

EXPERIMENTS

1. Conductometry

i. Determine the strength of strong acid by conductometric titration with strong base.
ii. Determine the strength of weak acid by conductometric titration with strong base.
iii. Determine the strength of strong acid and weak acid in a mixture by conductometric titration with strong base.
iv. Study precipitation titration between KCl and $AgNO_3$ conductometrically.
v. Determine the basicity of mono- , di- and tri-basic acids conductometrically.
vi. Determine solubility and solubility product of sparingly soluble salts like $PbSO_4$, $BaSO_4$.

2. pH-metry

i. Determine the strength of strong acid by pH-metric titration with strong base.
ii. Determine the strength of weak acid by pH-metric titration with strong base.
iii. Determine the dissociation constant of acetic acid using pH-meter.

3. Chemical Kinetics

i. Study the hydrolysis of methyl acetate in presence of hydrochloric acid.
ii. Study saponification of ethyl acetate by sodium hydroxide solution taking the initial concentration of ester and base to be different.

4. Viscosity

i. Determine the viscosity of liquids (environment friendly) using Ostwald viscometer.
ii. Study the variation of viscosity with concentration for a glycerol solution using Ostwald viscometer and thereafter determine the concentration of unknown solution of glycerol.
iii. Determination of molar mass of a polymer.

Experiment: **45 marks**
Lab Record: **15 marks**
Viva-voce: **10 marks**

Course Outcomes: After the successful completion of the course the learner would be able to

i. solve problems related to strength of a given acid / base by conductometric and ph-metric titration.
ii. handle chemical kinetics and other related problems of some simple reactions.
iii. determine the viscosity of a given liquid.
iv. find out the molar mass of a given polymer.

Reference Books

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical Chemistry, B.P. Lavitt, Longman.
3. Practical Physical Chemistry, S.R. Pa lit and S.K. De, Science.
4. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
5. Experiments in Physical Chemistry, D.P. Shoemaker
6. Experiments in Physical Chemistry, D.V. Jahagirdhar.
7. Senior Practical Physical Chemistry by B.D. Khosla, V. Garg and A. Gulati.
8. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.

M Sc CHEMISTRY, SEMESTER II

CODE: CH-201A

SUBJECT NAME: **Inorganic Chemistry (General-II)**

NO OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

Course Objectives:
To study about properties of metal complexes especially magnetic properties and spectral behaviour. To learn about structure and bonding in metal compounds.

UNIT: I
Electronic Spectra and Magnetic Properties of Transition Metal Complexes -I
Electronic arrangements of microstates, calculation of the number of microstates in various electronic arrangements, spectroscopic term symbols, vector diagrams to indicates coupling of orbital angular momenta in p^2, p^3, d^2 configurations and spin orbit coupling for p^2 arrangement, spectroscopic terms, spectral terms of d^2 to d^8 metal ions, determining the ground state terms - Hund's rules, derivation of the term symbol for a closed subshell.

UNIT: II
Electronic Spectra and Magnetic Properties of Transition Metal Complexes -II
Interpretation of electronic spectra, Orgel diagrams, Tanabe-Sugano diagrams for transition metal complexes (d^1 –d^9 states), calculations of Dq, B and β parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

Circular Dichroism and Optical Rotatory Dispersion
Polarized light, fundamental symmetry requirements, for optical activity, interaction of polarized light with optically active matter, optical rotation, Cotton effect, configuration of Tris -chelated complexes.

UNIT: III
Metal л-Complexes
Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding, structure and

important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand.

UNIT: IV

Metal Clusters

Higher boranes, carboranes, metalloboranes and metallocarboranes. Metal carbonyl and halide clusters, compounds with metal-meta l multiple bonds.

Course Outcomes: After the successful completion of the course the learner would be able to

i. corelate structure of a metal compound and its magnetic properties.
ii. design a complex with required magnetic properties.
iii. explore more about complexes like boranes, carboranes, metal carbonyles etc and their applications.

Reference Books

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harper & Row.
3. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
4. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
5. Introduction to Ligand fields; B.N. Figgis, Wiley, New York.
6. Modern Aspects of Inorganic Chemistry; H.J. Emeleus and Sharpe.
7. Introduction to Ligand Field Theory; C.J .Ballahyen, McGraw Hill, New York.
8. Organometallic Chemistry; R.C.Mehrotra and A.Singh, New Age International.
9. Concepts and Models of Inorganic Chemistry; B. Douglas, D.H.McDaniel and J.J.Alexander; John Wiley.
10. The Organometallic Chemistry of the Transit ion Metals; R.H. Crabtree, John Wiley.

M Sc CHEMISTRY, SEMESTER II

CODE: CH-202A

SUBJECT NAME: O**rganic Chemistry (General-II)**

NO OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

Course Objectives: To study about various types of aliphatic and aromatic reactions, rearrangements and their synthetic utility.

UNIT: I

Aromatic Electrophilic Substitution: The arenium ion, mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Vilsmeir reaction, Gattermann-Koch reaction.

Aromatic Nucleophilic Substitution: The ArSN1, ArSN2, and Benzyne mechanisms. Generation, structure and reaction of arynes. Reactivity – effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser, and Smiles rearrangements.

UNIT: II

Aliphatic Electrophilic Substitution: Bimolecular mechanisms - SE2 and SEi. The SE1 mechanism, Electrophilic substitution accompained by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

Elimination Reactions: The E2, E1 and E1cB mechanisms. Orientation of the double bond. Reactivity –effects of substrate structures, attacking base, the leaving group and the medium. Stereochemistry of E2 Elimination, Reaction and Eclipsing Effects in E2 Eliminations. Dehydration of Alcohols, Elimination not involving C-H Bonds, Mechanism and orientation in pyrolytic eliminations.

Carbocation Rearrangements: Wagner Meerwin rearrangement, Pinacol-pinacolone rearrangements, Aldehyde-Ketones, Demjanov ring expansion & contraction and Transannular rearrangement.

UNIT: III

Addition to Carbon-Carbon Multiple Bonds: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio – and chemo-selectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation.

Free Radicals: General aspects of generation, structure, stability and reactivity of free radicals, types of free radical reactions , halogenation including allylic halogenation (NBS), autooxidation, decomposition of azo compounds and peroxides, coupling of alkynes, homolytic aromatic substitution, Sandmeyer reaction and Hunsdiecker react ion.

UNIT: IV

Addition to Carbon-Hetero Multiple Bonds: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolates – Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters, Reformatsky reaction, Dieckman reaction, Cannizzaro reaction, Robinson-Mannich reaction

Course Outcomes: After the successful completion of the course the learner would be able to

i. solve problems related to reaction mechanism.
ii. propose mechanism for any reaction in rersearch.
iii. propose synthetic routes for a compound of interest.

Reference Books

1. Advanced Organic Chemistry Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.
5. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice -Hall.
6. Modern Organic Reactions, H. O. House, Benjamin.
7. Principles of Organic Synthesis, R. O. C. Norman and J. M. Coxon, Blackie Academic & Professional.
8. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillan.
9. Organic Chemistry, J. Clayden, N. Greeves, S.Warren, P. Wothers, Oxford Press.

M Sc CHEMISTRY, SEMESTER II

CODE: CH-203A

SUBJECT NAME: **Physical Chemistry (General-II)**

NO OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

Course Objectives:
To study about the various aspects and details of quantum mechanics. To understand the chemistry and kinetics of chain reactions.

UNIT: I
Quantum Mechanics-I: The postulates of quantum mechanics, Linear and Hermitian operators. Commutation of operators and Uncertainty Principle. Schrodinger equation, eigen function and eigen values, free particle, Schrodinger equation for a particle in a box, the degeneracy, particle in a box with a finite barrier, Schrodinger equation for linear harmonic oscillator and its solution, zero point energy, Tunneling Problem: Tunneling through a rectangular barrier.

UNIT: II
Quantum Mechanics-II: Energy levels and wave-functions of Rigid rotator. Hydrogen a tom: Complete solution (separation of variables in spherical polar coordinates and its solution). Radial distributions. Angular momentum and its directional quantization, Angular momentum operators, commutation relation, shape of atomic orbitals upto d - level and their discuss ion.

UNIT: III
Chain reactions: Photochemical and thermolytic reactions. General treatment of chain reactions (ortho -para hydrogen conversion and hydrogen - halogen reactions), apparent activation energy of chain reactions, chain length, Branching chain reactions leading to explosions; explosion limits, H_2 - O_2 reaction. Kinetics of (one intermediate) enzymatic reaction: Michaelis - Menton treatment, evaluation of Michaelis's constant for enzyme - substrate binding by Lineweaver - Burk plot, by Dixon and by Eadie- Hofstae methods. Competitive and non-competitive inhibition.

UNIT: IV
Ion Transport in solutions: Ionic movement under the influence of an electric field , mobility of ions, ionic drift velocity and its relation with current density, Einstein relation between the absolute mobility and diffusion coefficient, the Stokes- Einstein relation , the Nernst -Einstein equation, Waldens rule, the Rate- Process approach to ionic migration , the Rate process equation for equivalent conductivity, total driving force for ionic transport, Nernst - Planck Flux equation, ionic drift and diffusion potential , the Onsager phenomenological equations. The basic equation for the diffusion, Planck- Henderson equation for the diffusion potential.

Course Outcomes: After the successful completion of the course the learner would be able to

i. solve problems related to quantum mechanics.
ii. explain enzyme catalysis and kinetics of complex chain reactions.
iii. handle problems of ionic mobility in solutions.

Reference Books

1. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
2. Quantum Chemistry, I.M. Levine, Prentice Ha ll.
3. Physical Chemistry, Peter Atkins, Julio de Paula, Oxford University Press.
4. Quantum Chemistry, B. K. Sen, Kalyani Publishers
5. Quantum Chemistry, R. Prasad, New Age International.
6. Chemical Kinetics, K.J. Laidler, McGraw Hill.

M Sc CHEMISTRY, SEMESTER II

CODE: CH-204A

SUBJECT NAME: **Computational Techniques**

NO OF CREDITS: 3

		SESSIONAL:	25
L	P	THEORY EXAM:	75
3	0	TOTAL:	100

Course Objectives:
To study the basic computational technique. To learn about basic statistics required for data handling in chemistry.

UNIT: I
Introduction to C:
Operators and Expressions: operators, Arithmetic Operators, relational and logical operators
Flow of control: introduction, compound statement, selective execution, repetitive execution, Nested loops, the GOTO statement
Arrays: introduction, one dimensional arrays, strings, multi dimensional arrays
Structures: Introduction, Nested structures, Enumerated data types, unions

UNIT: II
Pointers: introduction, pointer variables, pointer and arrays
Functions: Function prototypes, parameter passing in functions, returning values from functions, recursion
File handling in C, command line arguments.

UNIT: III
Basic Statistics: Mean, Median, Mode, Variance, Standard deviation, Moments, Properties and effect of change of origin and scale.
Probability: rules of probability, conditional probability, independent events, Bays theorem, Random variable, Discrete and continuous random variable

Course Outcomes: After the successful completion of the course the learner would be able to
i. perform computational analysis in chemistry.
ii. perform modelling work in chemistry.
iii. solve problems related to data handling in chemistry

Reference Books

1. C problem solving and programming, Kenneth, A., Prentice Hall.
2. Theory and problems of Programming in C, Gottfried, B., Schaum Series.
3. The Programming Language, Kerninghan & Ritchie, PHI.
4. Fundamentals of Data Structures, E. Horowitz and S. Sahani, Galgotia Book source Pvt. Ltd, 2003

M Sc CHEMISTRY, SEMESTER II

CODE: CH-205A

SUBJECT NAME: Inorganic Chemistry Lab-II

NO OF CREDITS: 3

		SESSIONAL:	30
L	P	FINAL EXAM:	70
0	6	TOTAL:	100

Course Objectives:
To analyse a given salt quantitatively in laboratory. To prepare various inorganic complexes in laboratory

EXPERIMENTS

Quantitative Analysis
Separation of the metal ions and determination of any one of them using volumetric/gravimetric methods.
Cu-Ni, Cu-Zn, Cu-Al, Ca-Ba, Fe -Mg, Fe-Ni etc.

Preparations:
Preparation of selected inorganic compounds and their spectroscopic studies.
1. $Hg[Co(SCN)_4]$
2. $Ni(dmg)_2$
3. $[Cu(NH_3)_4]SO_4 H_2O$
4. Prussian Blue and Turnbull's Blue.
5. $Na[Cr(NH_3)_2(SCN)_4]$
6. $Mn(acac)_3$
7. $[Ni(NH_3)_6]Cl2$
8. $VO(acac)_2$

Experiment: 45 marks
Lab Record: 15 marks
Viva-voce: 10 marks

Course Outcomes: After the successful completion of the course the learner would be able to
i. analyse a given salt quntitatively

ii. synthesise an inorganic complex on his own
iii. design and synthesize a complex of interest

Reference Books

1. A Text Book of Macro and Semi-micro Quantitative Analysis, A.I.Vogel, Orient Longman.
2. A Vogel's Text Book of Quantitative Inorganic Analysis , J. Bassett, R.C. Denney, G.B. Jaffery and J. Menaham, Longman, London.
3. Synthesis and Characterization of Inorganic Compounds, W.B. Jolly, Prentice Hall, Englewood.
4. Synthesis and Physical Studies of Inorganic Compounds, C.F. Bell, Pergamon Press
5. Inorganic Preparations; W.G. Palmer.

M Sc CHEMISTRY, SEMESTER II

CODE: CH-206A

SUBJECT NAME: **Organic Chemistry Lab-II**

NO OF CREDITS: 3

		SESSIONAL:	30
L	P	FINAL EXAM:	70
0	6	TOTAL:	100

Course Objectives:

To analyse a given mixture of salts qualitatively in laboratory. To purify various organic compounds using different techniques in laboratory. This course aims to study about UV and IR spectra of simple compounds.

Experiments

1. Qualitative analysis of mixture of organic compounds
2. Purification of organic compounds involving fractional crystallization, fractional distillation, steam distillation, sublimation and extraction.
3. UV and IR spectra of simple compounds (for functional group identification)

Experiment: 45 marks
Lab Record: 15 marks
Viva-voce: 10 marks

Course Outcomes: After the successful completion of the course the learner would be able to

i. Analyse a given mixture of salts qualitatively and give composition of mixture.
ii. Purify various organic compounds from a mixture using different techniques.
iii. Interpret UV and IR spectra of simple organic compounds.

Reference Books

1. A Hand book of Organic Analysis -Qualitative and Quantitative by H.T. Clarke, and revised by B.Haynee, Edward Arnold, London 1975.
2. Vogel's Text Book of Practical Organic Chemistry by B.S. Furhen et. al, Longman-Group Ltd.
3. Systematic Qualitative Organic Analysis by H. Middleton, Edward Arnold (Publishers) Limited, London 1959.
4. Elementary Practical Organic Chemistry by Arthur I. Vogel, Ex CBS Publishers and Distributors.
5. Experiments in Organic Chemistry by Louis, F.Fieser, D.C. Heath and Company Boston, 1955.

M Sc CHEMISTRY, SEMESTER II

CODE: CH-207A

SUBJECT NAME: **Physical Chemistry Lab-II**

NO OF CREDITS: 3

		SESSIONAL:	30
L	P	FINAL EXAM:	70
0	6	TOTAL:	100

Course Objectives:

To determine the refractive index, refaractivity and molar refractivity of some organic liquids. To study about angle of optical rotation, specific & molecular rotation and the kinetics of inversion of cane sugar. To study about standard electrode potential, determination of the strength of a given solution. To determine distribution coefficient of a substance between two liquids.

1. Refractometry

i. Determine the refractive index of simple organic liquids (environment friendly)
ii. Determine the refractivity and molar refractivity of some organic liquids so as to determine the molar refractivities for CH_2, C, H and Cl.
iii. Study the variation of refractive index with concentration for KCl solution and thereafter determine the unknown concentration of given KCl solution.

2. Polarimetry

i. Study the variation of angle of optical rotation with the concentration of any optically active substance (sucrose or glucose) and determine the unknown concentration of given solution.
ii. Determine the specific and molecular rotation of sucrose or glucose at number of concentrations.
iii. Study the kinetics of inversion of cane sugar (sucrose) in presence of an acid.

3. Potentiometry

i. Determine the standard electrode potential of Cu and Zn.
ii. Determine the strength of a given solution of ferrous ammonium sulphate by potentiometric titration with $K_2Cr_2O_7$ solution.
iii. Study the precipitation titration between KCl and $AgNO_3$ potentiometrically.
iv. Determine the strength of iodide, bromide and chloride in a mixture by potentiometric titration with silver nitrate.

4. Distribution Law

i. Determine distribution coefficient of ammonia between chloroform and water.
ii. Determine the formula of the complex formed between copper (II) ion and ammonia using distribution method.

Experiment: 45 marks
Lab Record: 15 marks
Viva-voce: 10 marks

Course Outcomes: After the successful completion of the course the learner would be able to

i. find out the refractive index, refaractivity and molar refractivity of organic liquids.
ii. find out angle of optical rotation, specific & molecular rotation of sugars
iii. solve problems related to kinetics of inversion of cane sugar
iv. determine standard electrode potential, and strength of a given solution.
v. calculate distribution coefficient of a substance between two liquids.

Reference Books

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical Chemistry, B.P. Lavitt, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science.
4. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
5. Experiments in Physical Chemistry, D.P. Shoemaker
6. Experiments in Physical Chemistry, D.V. Jahagirdhar.
7. Senior Practical Physical Chemistry by B.D. Khosla, V. Garg and A. Gulati.
8. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House.

M Sc CHEMISTRY, SEMESTER II

CODE: ACH-204A

SUBJECT NAME: Green Chemistry (Audit Course)

NO OF CREDITS: 0

		SESSIONAL:	25
L	P	THEORY EXAM:	75
2	0	TOTAL:	100

Course Objectives:

To know eco-friendly methods of synthesis. This helps in planning the synthesis of any type of organic compounds with the revolution of Green Chemistry.

UNIT I
PRINCIPLES & CONCEPT OF GREEN CHEMISTRY
Introduction –Concept and Principles-development of Green Chemistry- Atom economy reactions – rearrangement reactions , addition reactions- atom uneconomic-sublimation-elimination-Wittig reactions-toxicity measures- Need of Green Chemistry in our day to day life.

UNIT II
EMERGING GREEN TECHNOLOGY AND ALTERNATIVE ENERGY SOURCES
Design for Energy efficiency-Photochemical reactions- Advantages-Challenge faced by photochemical process. Microwave technology on Chemistry- Microwave heating –Microwave assisted reactions-Sono chemistry and Green Chemistry –Electrochemical Synthesis-Examples of Electrochemical synthesis.

UNIT III
RENEWABLE RESOURCES
Biomass , Renewable energy, Fossil fuels, Energy from Biomass, Solar Power, Other forms of renewable energy, Fuel Cells, Alternative economics, Syngas economy, hydrogen economy, Some other natural chemical resources.

UNIT IV: INDUSTRIAL CASE STUDIES

Methyl Methacrylate (MMA), Greening of Acetic acid manufacture, Dyeing, Application, Polyethylene, Ziegler-Natta Catalysis, Metallocene Catalysis, Eco friendly Pesticides-Insecticides.

Course Outcomes: After the successful completion of the course the learner would be able to

i understand the meaning and concept of green chemistry

ii design environment sustainable and economical route of a synthesis.

iii appreciate renewable and alternate resources of energy and their utilization

iv realize the importance of concept with respect to industrial processes

Reference Books:

1. Mike Lancaster , Green Chemistry and Introductory text, II Edition
2. P.T.Anastas and J.C Warner,Green Chemistry theory and Practice, Oxford University press, Oxford (1988).
3. P.Tundo*et. al.*, Green Chemistry, Wiley –Blackwell, London (2007).
4. Protti D.Dondi *et.al.,*Green Chemistry
5. T.E Graedel, Streamlined Life cycle Assessment, Prentice Hall, NewJersey (1998).
6. V.K. Ahluwalia,Methods and Reagents of Green Chemistry: An Introduction by Green Chemistry.
7. www.clri.org

M Sc CHEMISTRY, SEMESTER III

CODE: CH -301A

SUBJECT NAME: **Spectroscopy-I**

NO OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

Course Objectives: To learn about the spectroscopic techniques being used as a tool for structural elucidation of organic compounds. To understand the basic concept of UV, IR, NMR and mass spectrometry.

UNIT-I

Ultraviolet and Visible Spectroscopy:

Introduction and understanding of UV phenomenon, Various electronic transitions (185-800 nm), Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds.

Infrared Spectroscopy:

Principle and Theory, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance. FT-IR.

UNIT -II

Nuclear Magnetic Resonance Spectroscopy-I

General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), complex spin-spin interaction between two, three, four and five nuclei (first order spectra), spin system-Pople notation, virtual coupling.

UNIT -III

Nuclear Magnetic Resonance Spectroscopy-II

Stereochemistry, concept of topicity, effect of enantiomeric and diastereomeric protons, hindered rotation, Karplus curve - variation of coupling constant with

dihedral angle. Fourier transform technique and its advantages. Resonance of other nuclei-F, P. Tools for simplification of complex NMR spectrum (chemical and instrumental)**:**-Deuteration, changing solvent, trifluoroacetylation, basification and acidification, lanthanide shift reagents, increased magnetic field strength, double resonance and nuclear overhauser effect (NOE), variable temperature probe. Concept of 2D-NMR spectroscopy.

Carbon-13 NMR Spectroscopy

General considerations, Comparison of ^{1}H-NMR and ^{13}C-NMR, Proton coupled and proton decoupled ^{13}C-NMR, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Nuclear Overhauser effect.

UNIT -IV

Mass Spectrometry

Introduction, ion production - EI, CI, FD and FAB, Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Nitrogen rule, molecular weight determination molecular formula from isotopic ratio data, isotope profile of halogen compounds, fragmentation pattern - simple cleavage, retro-Diels Alder, Hydrogen transfer rearrangement like scrambling, ortho effect, McLafferty rearrangement, fragmentation patterns of hydrocarbons, alcohols, phenols, ethers, aldehydes, ketones, esters, carboxylic acids, amines, nitro, amides, nitriles.

Composite Problems

Problems involving the application of the above spectroscopic techniques (UV/Visible, IR, NMR and Mass) for structural elucidation of organic molecules.

Course Outcomes: After the successful completion of the course the learner would be able to

i. understand the basic principle of all kinds of spectroscopic techniques used in organic chemistry for structural elucidation of organic compounds.
ii. Would be able to predict structure of organic compounds on the basis of its spectral data.
iii. Would be able to interpret various spectral data.

Reference Books

1. Introduction to Spectroscopy- A Guide for Students of Organic Chemistry, 2nd Edn. By Donald L. Pavia, Gary M. Lampman and George S. Kriz. Saunders Golden Sunburst Series. Harcourt Brace College Publishers, New York.
2. Spectrometric Identification of Organic Compounds, R. M. Silverstein, G. C. Bassler and T. C. Morrill, John Wiley.
3. Application of Spectroscopy of Organic Compounds, J. R. Dyer, Prentice Hall.
4. Spectroscopic Methods in Organic Chemistry, D. H. Williams and I. Fleming, Tata McGraw-Hill.
5. Spectroscopy of Organic Compounds by P.S. Kalsi, Wiley Estern, New Delhi.
6. Organic Spectgroscopy by William Kemp, John Wiley.

7. Organic Mass Spectrometry by K.G. Das & E.P. James, Oxford & IBH Publishing Co.
8. Organic Spectroscopy (Principles & Applications) by Jagmohan.

M Sc CHEMISTRY, SEMESTER III

CODE: CH -302A

SUBJECT NAME: **Spectroscopy-II**

NO OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

Course Objectives:
To study the various types of spectroscopy to understand the interaction of radiations with the matter to elucidate the molecular structure. To understand basic to advanced level concepts of X-ray crystallography

UNIT: I

Microwave Spectroscopy
The rotation of molecules, rotational spectra of rigid diatomic molecules, intensities of rotational spectral lines, isotopic effect , non- rigid rotator, spectra of polyatomic linear molecules and symmetric top molecules.

Infrared Spectroscopy
The vibrating diatomic molecule, force constant, zero point energy, simple harmonic vibrator, anharmonicity, Morse potential, overtones, hot bands, diatomic vibrating rotators, P, Q, R branches, vibration of polyatomic molecules, normal mode of vibrations. Fourier transform spectroscopy.

UNIT: II
Nuclear Magnetic Resonance Spectroscopy
Basic principles of NMR, theory of nuclear magnetic resonance, spin lattice relaxation, spin-spin relaxation, experimental techniques chemical shift , the δ-scale of chemical shift , the origin of shielding constant, pattern of coupling, origin of spin -spin coupling, the nuclear overhauser effect .

Nuclear Quadrupole Resonance Spectroscopy
Introduction, energies of quadroupole transitions, effect of magneticfield on the spectra, relationship between electric field gradient and molecular structure, applications, interpretations of structural information from NQR spectra

UNIT: III
Raman Spectroscopy

Classical and quantum theories, pure rotational Raman spectra of linear molecules, vibrational Raman spectra, mutual exclusion principle, polarization of the light and Raman effect, depolarization of Raman lines , technique.

Electron Spin Resonance Spectroscopy

Basic principles of ESR, experimental technique, the g-value hyperfine structure, Instrumentation of ESR and its applications to the study of free radicals and fast reactions, spin densities and McConnell relationship

UNIT: IV

X-ray Crystallography

Symmetry elements in crystals, stereographic projections, point groups (illustration of R, R-bar, Rm, R/m, R-bar/m point groups only), miller indices for planes and directions, criteria for determining unit cell of lattice, space lattices, space groups P1, Pbar1, P2, $P2_1$, Pm, Pc, C2, Cm, Cc X-ray emission spectra, absorption edges, X-ray filters, Reciprocal lattice concept and its importance, Definition of Reciprocal lattice vector (derivation excluded). Interplanar spacing using reciprocal lattice concept for cubic, tetragonal, orthorhombic and hexagonal crystal systems, Equivalence of Bragg's and Laue condition, Structure factor calculations for primitive, base-centered, body-centered and face centered unit cells. Relation of structure factor to electron density and intensities (derivation excluded), Interpretation of powder photographs for cubic crystals, Data reduction, Phase problem – Patterson method and Heavy-atom method, refinement of structure by successive and difference fourier synthesis. Correctness of a structure (Discrepancy index), Characteristic difference between X-ray, electron and neutron diffraction techniques.

Course Outcomes: After the successful completion of the course the learner would be able to

i Illuminate the various structural parameters of molecules by using various spectroscopic technique.

ii Explore the crystallographic structure and orientation of crystal plane in a molecule via XRD technique.

Books Suggested:

1. Fundamentals of Molecular Spectroscopy, C.N. Banwell, Tata McGraw Hill.
2. Modern Spectroscopy, J.M. Hollas, John Wiley.
3. Basic Principles of Spectroscopy, R.Chang, McGraw Hill.
4. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
5. Physical Method in Chemistry, R.S. Drago, Saunders College.
6. Elementary Crystallography, L. Azaroff.

7. Structure Determination by X-ray Crystallography, M. Ladd and R. Palmer
8. X-Ray Structure Determination: A Practical Guide, 2nd Edition by George H. Stout and Lyle H. Jensen.
9. *Essentials of Crystallography*, McKie & McKie, Blackwell Scientific Publications, 1986
10. Handbook of X-rays, Emmett and F. Kaelbse, McGraw Hill.

M Sc CHEMISTRY, SEMESTER III

CODE: CH -303A

SUBJECT NAME: **Analytical Techniques**

NO OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

Course Objectives:
To study about different spectroscopic techniques. To elucidate structure and mode of bonding in inorganic compounds. To study about analytical techniques.

UNIT: I

Vibrational Spectroscopy
Symmetry, shapes and number of IR modes AB_2, AB_3, AB_4, AB_5 and AB_6 (Group theoretical treatment) mode of bonding of ambidentate ligands and diketonato or complexes, application of resonance Raman spectroscopy particularly for the study of active- sites of metalloproteins.

Atomic Absorption Spectroscopy
General principles, resonance line, its natural width, Doppler effect, broadening due to pressure, Hollow cathode lamp. Application to alkali and alkaline earth metals.

UNIT: II

Mossbauer Spectroscopy
Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe^{2+} and Fe^{3+} compounds including those of intermediate spin, (2) Sn^{2+} and Sn^{4+} compounds – nature of M-L bond, coordination number, structure and (3) detection of oxidation state.

Photoelectron Spectroscopy
Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules, ESCA, chemical information from ESCA.

UNIT: III

Flame photometry

Theory of flame photometry, flame temperature, Emission Flame photometry - intensity of spectral lines, selection of optimum working conditions, application of flame photometry in trace metal analysis.

Spectrophotometry and Colorimetry
Fundamental concepts, instrumentation for absorption measurements, interferences, application of absorption spectroscopy and Colorimetry to analysis of inorganic substance.

UNIT: IV

Nuclear Magnetic Resonance
Basic Principle of NMR, Nuclear relaxation, Factors affecting nuclear relaxation, effect of chemical exchange on spectrum and evaluation of reaction rate of fast reactions, Double resonance, Lanthanide shift reagents, an overview of NMR of other nuclides with emphasis on ^{31}P, ^{19}F, ^{195}Pt and ^{119}Sn NMR. Application in inorganic chemistry

Electron Spin Resonance Spectroscopy
Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensor, application to transition metal complexes (having one unpaired electron) and inorganic free radicals such as PH_4, F_2^- and $[BH_3]^-$. Double resonance in EPR.

Course Outcomes: After the successful completion of the course the learner would be able to:

i. Understand and interpret vibrational spectra and atomic absorption spectra
ii. Solve problems related to mossbauer spectroscopy and photoelectron spectroscopy
iii. Analyse inorganic substances the technique of flame photometry, spectrophotometry and colorimetry.
iv. Solve problems based on NMR and ESR

Books Suggested:

1. A Textbook of Quantitative Inorganic Analysis, A.I. Vogel; ELBS, London.
2. Fundamentals of Analytical Chemistry; D.A. Skoog, O.M. West and F.J. Holler; W.B. Saunders.
3. Instrumental methods of Analysis; L.L. Merrit, R.H. Willard and J.A. Dean; Van Nostrand-Reinhold.
4. Physical methods in Chemistry; R.S. Drago; Saunders.
5. NMR, NQR, EPR and MB Spectroscopy in inorganic Chemistry, R.V. Parish, Ellis Horwood.
6. Introduction to Magnetic Resonance; McLachan and Carrington; Chapman and Hall.

M Sc CHEMISTRY, SEMESTER III

CODE: CH-304A

SUBJECT NAME: Inorganic Chemistry Lab-Special-I

NO OF CREDITS: 3

		SESSIONAL:	30
L	P	FINAL EXAM:	70
0	6	TOTAL:	100

Course Objectives:
To synthesize inorganic compound in laboratory. To carry out elemental analysis of inorganic compounds. To do spectral studies of inorganic compounds.

1. Preparations:
Preparation of selected Inorganic Compounds and their Characterization by elemental analysis and spectroscopic methods (IR, NMR, EPR, Magnetic moment etc.)

- **I** Choloropentaamminecobalt (III) Chloride
- **II** Nitro/Nitritopentaamminecobalt (III) Chloride (Distinction between nitro and nitrito by IR)
- **III** Potassium trioxalatoferrate (III)
- **IV** Chromous acetate
- **V** Cis and trans $[Co(en)_2Cl_2]$

2 Preparation of some inorganic compounds and their spectral studies.
Tris(acetyl-acetonato) manganese (III)
Tris(acetyl-acetonato) cobaltate (III)
Preparation of Ferrocene
Tris thioureacopper(I) sulfate
Tris(acetylacetonato)chromium(III)

Experiment: 45 marks
Lab Record: 15 marks
Viva-voce: 10 marks

Course Outcomes: After the successful completion of the course the learner would be able to

i. analyse a given salt qualitatively
ii. synthesise an inorganic complex on his own
iii. design and synthesize a complex of interest

iv. do elemental and spectral analysis of a compound

Referece Books:

1. Synthesis and Characterization of Inorganic compounds. W. L. Jolly, Prentice Hall, Englowood.
2. A Text Book of Quantitative Analysis: A. I. Vogel, ELBS, London.
3. Inorganic Preparations: W. G. Palmer.

M Sc CHEMISTRY, SEMESTER III

CODE: CH-305A

SUBJECT NAME: Inorganic Chemistry Lab-Special-II

NO OF CREDITS: 3

		SESSIONAL:	30
L	P	FINAL EXAM:	70
0	6	TOTAL:	100

Course Objectives:
To synthesize inorganic compound in laboratory. To carry out elemental analysis of inorganic compounds. To do spectral studies of inorganic compounds.

Instrumentation Techniques:

I Spectrophotometric Determinations
II Conductometric Titrations
III Flame Photometry
IV Potentiometric/pH-analysis
V Electrogravimetric analysis
VI Polarographic analysis
VII Any other techniques introduced

Experiment: 45 marks
Lab Record: 15 marks
Viva-voce: 10 marks

Course Outcomes: After the successful completion of the course the learner would be able to

i. perform spectrophometric analysis of compounds.
ii. Analysis based on conductometric titrations
iii. Do pH-metry based analysis of compounds and solutions
iv. Handle different instruments for analytical studies

Referece Books:

1. Synthesis and Characterization of Inorganic compounds. W. L. Jolly, Prentice Hall, Englowood.

2. A Text Book of Quantitative Analysis: A. I. Vogel, ELBS, London.
3. Inorganic Preparations: W. G. Palmer.

M Sc CHEMISTRY, SEMESTER III

CODE: CH-306A

SUBJECT NAME: Inorganic Chemistry Lab-Special-III

NO OF CREDITS: 3

		SESSIONAL:	30
L	P	FINAL EXAM:	70
0	6	TOTAL:	100

Course Objectives:
To perform elemental analysis of a mixture of a complex compound in laboratory different methods of analysis including instrumentation techniques. To find out the presence of some specific metals by complexometric titrations

Quantitative analysis:

1. Determination of triple elements in the mixtures, ores, alloys etc. by available analytical techniques.
   - **I** Volumetrically
   - **II** Gravimetrically
   - **III** Instrumentation methods

2. Determination of any one metal ion by volumetric method (Complexometric titration). Ca^{2+}, Mg^{2+}, Zn^{2+}, Cu^{2+} etc.

Experiment: 45 marks
Lab Record: 15 marks
Viva-voce: 10 marks

Course Outcomes: After the successful completion of the course the learner would be able to

i. Perform elemental analysis by volumetric and gravimetric methods
ii. Undertake instrumental techniques for analysis of inorganic compounds and solutions
iii. Understand the concept and application of complexometric titrations
iv. Handle different instruments for analytical studies

Reference Books:

1. Synthesis and Characterization of Inorganic compounds. W. L. Jolly, Prentice Hall, Englowood.
2. A Text Book of Quantitative Analysis: A. I. Vogel, ELBS, London.
3. Inorganic Preparations: W. G. Palmer.

M Sc CHEMISTRY, SEMESTER III

CODE: CH-314A

SUBJECT NAME: Organic Chemistry Lab-Special-I

NO OF CREDITS: 3

		SESSIONAL:	30
L	P	FINAL EXAM:	70
0	6	TOTAL:	100

Course Objectives:
To perform multistep synthesis in lab for important organic compounds and their precursors. Also to monitor the progress of reaction, checking purity of target compound using chromatographic technique.

1. Preparations of Organic compounds involving two and three stages:
Typical preparations from which the two and three stage preparations can be chosen are:

1. Toluene — p-nitrotoluene — p-nitrobenzoic acid — p-amino benzoic acid
2. Hydroquinone — Benzoquinone — 5- Hydroxy benzoxathiole-2-one —5-Acetoxy benzoxathiol-2-one
3. Benzene — Acetopheneone — Acetophenone oxime — Acetanilide
4. Benzaldehyde — Benzoin — Benzil — Benzillic acid
5. Acetylacetone — 4,6-dimethylpyridine-2-mercaptopyrimidine — 4,6-dimethyl-2-hydrazinpyrimidine — 1-(4'-6'-dimethylpyridine-2'yl) 3,5-dimethylpyrazole
6. Nitrobenzene — m-dinitrobenzene — m-nitroaniline — m-nitrophenol
7. Phthalic acid — phthalic anhydride – phthalimide — Anthranilic acid
8. Acetophenone — Benzalacetophenone — epoxide
9. Cyclohexanone —Cyclohexanone oxime—caprolactam
10. Phthalic anhydride—o-benzolylbenzoic acid—anthraquinone.
11. O-Cholobenzoinc acid —N-phenylanthranilic acid —acridone.
12. Cholrobenzene—2,4-dinitrochlorobenzene —2,4-dinitrophenol
13. Bromobenzene—triphenylcarbinol-tritylchloride
14. Resorcinol—resacetophenone — 4-ethyl resorcinol
15. Resorcinol — 4-methyl-7-hydroxycoumarin — 6 and 8- nitro-4-methyl-7-hydroxycoumarin
16. Phenol — salicylaldehyde —coumarin
17. Aniline — 2,4,6-tribromaniline — 1,3,5-tribromobenzene
18. Resorcinol—resacetophenone — Chalcone
19. Any other multi step reaction as per requirement

All the students must check the progress of reaction and purity of Final products for all the stages of preparation by Thin layer Chromatography.

Experiment: 45 marks
Lab Record: 15 marks
Viva-voce: 10 marks

Course Outcomes: After the successful completion of the course the learner would be able to
i. To perform multistep synthesis of organic compounds
ii. Purification of organic compounds by crystalllizaton
iii. propose different synthetic routes for a compound.
iv. To monitor reaction and check purity of organic compounds through TLC.

Reference Books:

1. "Elementary Practical Organic Chemistry by Arthur I.Vogel Longmans, Green and Co. 1958.
2. "An Introduction to Practical Biochemistry", by David T. Plummr, Tata McGraw Hill Publishing Company, Ltd., N. Delhi, 1988.
3. Practical Organic Chemistry' by Mann and Saunders.
4. Text Book of Vogel's Practical Organic Chemistry by Longman Group, B.S. Furness et al., Ltd.
5. "Experiments in Organic Chemistry" Louis F. Fieser O.C. Heath and Company Boston, 1955.
6. "Organic Synthesis" Collective Vol. I.
7. Laboratory Manual in Organic Chemistry' by R.K. Bansal, Wiley Eastern Ltd., New Delhi-1980.
8. "A Handbook of Organic Analysis Qualitative and Quantitative" by H.T. Clarke and revised by B.Maynes, Edward Arnold (Pub.)., Ltd. London, 1975).
9. "Systematic Qualitative Organic Analysis" by H.Middleton, Edward Arnold (Publishers) Ltd., London 1959.
10. "A Text Book of Practical Organic Chemistry including Qualitative Organic Analysis" by Arthur I. Vogel, Longmans Green and Co., Ltd., London 1966.
11. "Elementary Practical Organic Chemistry" by Arthur I. Vogel, CBS Publishers & Distributors.
12. "A Guide to spectroscopy in Organic Chemistry' by PAVY
13. "Spectrometric Identification of Organic Compounds", Fifth Ed., R.M. Silverstein, G.S. Bassler and T.C.Morrile, John Wiley and Sons, New York.
14. "Organic Spectroscopy', 3rd Ed., by William Kamp. John Wiley & Sons.
15. "Spectroscopic" Methods in Organic Chemistry, D.H. William & Ian Fleming.
16. Vogel's Text Book of Practical Organic Chemistry by B.S. Furners et. al., Longman Group Ltd. "A Handbook of Organic Analysis Qualitative and Quantitative" by H.T. Clarke and revised by B.Maynes, Edward Arnold (Pub.)., Ltd. London, 1975).

17. "Systematic Qualitative Organic Analysis" by H.Middleton, Edward Arnold (Publishers) Ltd., London 1959.

M Sc CHEMISTRY, SEMESTER III

CODE: CH 315A

SUBJECT NAME: Organic Chemistry Lab-Special-II

NO OF CREDITS: 3

		SESSIONAL:	30
L	P	FINAL EXAM:	70
0	6	TOTAL:	100

Course Objectives:
To perform qualitative estimation of different functional groups in organic compuonds.

1. Quantitative estimation of the followings: Amino group, hydroxyl group, acetoxy group, carbonyl group, unsaturation, reducing and non-reducing sugars,

2. Saponification value and iodine value of fats and oils, formalin and glycine, Determination of the molecular weight of an acid by titration and by the silver salt method.

Experiment: 45 marks
Lab Record: 15 marks
Viva-voce: 10 marks

Course Outcomes: After the successful completion of the course the learner would be able to
i. To perform estimation of organic functional groups present in organic compounds.
ii. Understand the qualitative aspect of organic chemistry.

Reference Books:

1 "Elementary Practical Organic Chemistry by Arthur I.Vogel Longmans, Green and Co. 1958.
2 "An Introduction to Practical Biochemistry", by David T. Plummr, Tata McGraw Hill Publishing Company, Ltd., N. Delhi, 1988.
3 Practical Organic Chemistry' by Mann and Saunders.
4 Text Book of Vogel's Practical Organic Chemistry by Longman Group, B.S. Furness et al., Ltd.
5 "Experiments in Organic Chemistry" Louis F. Fieser O.C. Heath and Company Boston, 1955.
6 "Organic Synthesis" Collective Vol. I.
7 Laboratory Manual in Organic Chemistry' by R.K. Bansal, Wiley Eastern Ltd., New Delhi-1980.

8 "A Handbook of Organic Analysis Qualitative and Quantitative" by H.T. Clarke and revised by B.Maynes, Edward Arnold (Pub.)., Ltd. London, 1975).
9 "Systematic Qualitative Organic Analysis" by H.Middleton, Edward Arnold (Publishers) Ltd., London 1959.
10 "A Text Book of Practical Organic Chemistry including Qualitative Organic Analysis" by Arthur I. Vogel, Longmans Green and Co., Ltd., London 1966.
11 "Elementary Practical Organic Chemistry" by Arthur I. Vogel, CBS Publishers & Distributors.
12 "A Guide to spectroscopy in Organic Chemistry' by PAVY
13 "Spectrometric Identification of Organic Compounds", Fifth Ed., R.M. Silverstein, G.S. Bassler and T.C.Morrile, John Wiley and Sons, New York.
14 "Organic Spectroscopy', 3rd Ed., by William Kamp. John Wiley & Sons.
15 "Spectroscopic" Methods in Organic Chemistry, D.H. William & Ian Fleming.
16 Vogel's Text Book of Practical Organic Chemistry by B.S. Furners et. al., Longman Group Ltd. "A Handbook of Organic Analysis Qualitative and Quantitative" by H.T. Clarke and revised by B.Maynes, Edward Arnold (Pub.)., Ltd. London, 1975).
17 "Systematic Qualitative Organic Analysis" by H.Middleton, Edward Arnold (Publishers) Ltd., London 1959.

M Sc CHEMISTRY, SEMESTER III

CODE: CH-316A

SUBJECT NAME: Organic Chemistry Lab-Special-III

NO OF CREDITS: 3

		SESSIONAL:	30
L	P	FINAL EXAM:	70
0	6	TOTAL:	100

Course Objectives:
To analyse a given mixture of compounds qualitatively in laboratory. To synthesise various organic compounds in laboratory.

1. **Qualitative Analysis**: Separation of components of a binary (liquid-liquid, liquid-solid or solid-solid) organic mixture using physical and chemical methods and characterization of the components with the help of chemical analysis
2. Spectroscopic confirmation of the binary mixtures using IR and NMR (IR & NMR spectra will be provided).

Experiment: 45 marks
Lab Record: 15 marks
Viva-voce: 10 marks

Course Outcomes: After the successful completion of the course the learner would be able to

i. analyse a given mixture of compounds qualitatively by experiments
ii. Structural elucidation of organic compounds spectroscopically.
iii. Interpretation of various spectroscopic tools

Reference Books:

1. "Elementary Practical Organic Chemistry by Arthur I.Vogel Longmans, Green and Co. 1958.
2. "An Introduction to Practical Biochemistry", by David T. Plummr, Tata McGraw Hill Publishing Company, Ltd., N. Delhi, 1988.
3. Practical Organic Chemistry' by Mann and Saunders.
4. Text Book of Vogel's Practical Organic Chemistry by Longman Group, B.S. Furness et al., Ltd.
5. "Experiments in Organic Chemistry" Louis F. Fieser O.C. Heath and Company Boston, 1955.
6. "Organic Synthesis" Collective Vol. I.
7. Laboratory Manual in Organic Chemistry' by R.K. Bansal, Wiley Eastern Ltd., New Delhi-1980.

8. "A Handbook of Organic Analysis Qualitative and Quantitative" by H.T. Clarke and revised by B.Maynes, Edward Arnold (Pub.)., Ltd. London, 1975).
9. "Systematic Qualitative Organic Analysis" by H.Middleton, Edward Arnold (Publishers) Ltd., London 1959.
10. "A Text Book of Practical Organic Chemistry including Qualitative Organic Analysis" by Arthur I. Vogel, Longmans Green and Co., Ltd., London 1966.
11. "Elementary Practical Organic Chemistry" by Arthur I. Vogel, CBS Publishers & Distributors.
12. "A Guide to spectroscopy in Organic Chemistry' by PAVY
13. "Spectrometric Identification of Organic Compounds", Fifth Ed., R.M. Silverstein, G.S. Bassler and T.C.Morrile, John Wiley and Sons, New York.
14. "Organic Spectroscopy', 3rd Ed., by William Kamp. John Wiley & Sons.
15. "Spectroscopic" Methods in Organic Chemistry, D.H. William & Ian Fleming.
16. Vogel's Text Book of Practical Organic Chemistry by B.S. Furners et. al., Longman Group Ltd. "A Handbook of Organic Analysis Qualitative and Quantitative" by H.T. Clarke and revised by B.Maynes, Edward Arnold (Pub.)., Ltd. London, 1975).
17. "Systematic Qualitative Organic Analysis" by H.Middleton, Edward Arnold (Publishers) Ltd., London 1959.

M Sc CHEMISTRY, SEMESTER III

CODE: CH-324A

SUBJECT NAME: Physical Chemistry Lab-Special-I

NO OF CREDITS: 3

		SESSIONAL:	30
L	P	FINAL EXAM:	70
0	6	TOTAL:	100

Course Objectives:

To determine the equivalent conductance of given weak/strong acid conduct metric titration. To determine the critical micelle concentration (CMC) of a surfactant by conductivity method. To determine various parameters like activity coefficient, cell potential, ionization constant and strength of given mixture of strong and weak acid / base by potentiometric titration. To study the relative strength of acids polarimetrically.

Potentiometry

1. Determination of activity coefficient of Ag^+ in a solution of silver nitrate and to study the effect of potassium nitrate on the activity coefficient of silver nitrate.
2. Determination of the cell Pt, $H_2|HCl$ $AgCl|Ag$ with various concentrations of HCl and to obtain the activity coefficient of HCl.
3. Determination of solubility of silver halides in water.
4. Determination of first and second ionization constant of phosphoric acid.
5. Study of silver-ammonia complex and determination of the stability constant.
6. Determination of strength of ferrous ammonium sulphate using potassium dichromate or ceric sulphate and determination of redox potential.
7. Determination of strength of HCl and CH_3COOH in a mixture using NaOH.
8. Titration of weak/strong acid with strong base using quinhydrone and determination of dissociation constant of the acid.
9. To determine the degree of hydrolysis of aniline hydrochloride.

Polarimetry

1. Determine the percentage of two optically active substances in a mixture polarimetrically.
2. Determination of relative strength of acids by the study of inversion of sucrose.

Conductometry

1. Determination of the equivalent conductance of weak acid (benzoic and acetic acid) at several concentrations and the dissociation constant of the acid.
2. Determination of the equivalent conductance of strong electrolytes such as HCl, KCl, KNO_3 and NaCl and the validity of Onsagar equation.
3. Study of degree of hydrolysis of aniline hydrochloride.
4. Determine the critical micelle concentration (CMC) of a surfactant (sodium lauryl sulphate) by conductivity method.

Experiment: 45 marks
Lab Record: 15 marks
Viva-voce: 10 marks

Course Outcomes: After the successful completion of the course the learner would be able to:

i find out the equivalent conductance of given weak/strong acid conductometrically
ii solve problems related to the critical micelle concentration (CMC) of a surfactant by conductometric titration.
iii determine various parameters of reaction associated with potentiometre via potentiometrically
iv determine the relative strength of acids via polarimetre

Reference Books:

1. Practical Physical Chemistry, S.R. Palit and S.K. De, Science.
2. Experimental Physical Chemistry, R.C. Das and B. Behera,McGraw Hill.
3. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman. Findley's Practical Physical Chemistry, B.P. Lavitt, Longman.

M Sc CHEMISTRY, SEMESTER III

CODE: CH-325A

SUBJECT NAME: Physical Chemistry Lab-Special-II

NO OF CREDITS: 3

		SESSIONAL:	30
L	P	FINAL EXAM:	70
0	6	TOTAL:	100

Course Objectives:

To study the Lambert-Beer's law and determine the composition of various mixtures by using Colorimetry/Spectrophotometry technique. To determine degree of hydrolysis and preparation of various buffer solutions with appropriate pH value by using pH-metric titration. To study the chemical kinetics of some reactions.

Colorimetry/Spectrophotometry

1. Verification of the Lambert-Beer's law using solutions such as $K_2Cr_2O_7$, $CuSO_4$, $KMnO_4$ in water and I_2 in CCl_4.
2. Study of iron-tiron and iron-salicylic acid complexes.
3. Determination of the composition of various mixtures spectrophotometrically:
   (i) Potassium dichromate and potassium permanganate
   (ii) Crystal violet and aurine
4. Determine the dissociation constant of an indicator spectrophotometrically.

pH-metry

1. Preparation of buffer solution of various pH and the determination of their pH values.
2. Determination of the degree of hydrolysis of aniline hydrochloride.
3. Determine the Hammett constant of a given substituted benzoic acid by pH measurements.

Chemical Kinetics

1. Determination of the velocity constant and energy of activation of the reactions between H_2O_2 and HI.
2. Investigation of the reaction between acetone and iodine (with respect to H^+, I_2 and acetone).

3. Determination of the order and velocity of the reaction between potassium persulphate and potassium iodide.
4. Study the rate of reaction between ethyl bromoacetate and sodium thiosulphate kinetically.

Experiment: 45 marks
Lab Record: 15 marks
Viva-voce: 10 marks

Course Outcomes: After the successful completion of the course the learner would be able to:

i. handle the UV/Visible spectrophotometer and able to find out the various parameters associated with UV/Visible spectrophotometer.
ii. find out the degree of hydrolysis of solution by pH-metry.
iii. determine the kinetic parameter of reaction.

Reference Books:

1. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
2. Practical Physical Chemistry, B.P. Levitt and Zindley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, Shoemaker and Gailand McGraw Hill.
6. Systematic experimental Physical Chemistry, T.K. Chandershekhar & S.K. Rajbhoj
7. Experimental Physical Chemistry, V.D.Athawale and Parul Mathur, New Age International.

M Sc CHEMISTRY, SEMESTER III

CODE: CH-326A

SUBJECT NAME: Physical Chemistry Lab-Special-III

NO OF CREDITS: 3

		SESSIONAL:	30
L	P	FINAL EXAM:	70
0	6	TOTAL:	100

Course Objectives:

To determine the half wave potential of ionic mixtures by polarography. to determine the speed of sound by interferrometry. to determine the ionic concentration via flame photometrically. determination of dielectric constant and dipole moment of unknown mixture. Able to handle the data in Excel and origin based software.

Polarography

1. To determine dissolved oxygen in aqueous solution of organic solvent.
2. Determination of half wave potentials of some cations in aqueous and in non-aqueous solutions.
3. Determination of half wave potentials of ions in mixtures.
4. Amperometirc titrations involving: (i) $Pb(NO_3)_2$ vs. $K_2Cr_2O_7$ and (ii) $Pb(NO_3)_2$ vs. K_2SO_4.

Interferrometry

Determination of speed of sound of pure liquids/mixtures using interferrometer.

Flame Photometry

Determination of Na^+, K^+ Ca^{2+} and Mg^{2+} in tap water, juice, electrical etc.

Dielectric Constant and Dipole Moment

1. Determination of dielectric constants of some organic liquids and composition of unknown mixtures.
2. Determination of dipole moments of some organic liquids.

Data-Handling/Representation

1. Using origin-Lab draw data in different styles of graphs.
2. Linear Curve fitting and calculation of regression coefficient using EXCEL worksheet.
3. Calculate activation energy using /thermal analysis data by single/multiple heating rate methods using EXCEL worksheet.

Note: Any experiment may be introduced / deleted in the practical class based on the availability/non-availability of the instruments/chemicals.

Experiment: 45 marks
Lab Record: 15 marks
Viva-voce: 10 marks

Course Outcomes: After the successful completion of the course the learner would be able to:

vi. find out the half wave potential of ionic mixtures polarographically.
vii. find out speed of sound by interferrometry.
viii. determine the ionic concentration via flame photometrically.
ix. work on the data in Excel and origin software

Reference Books:

1. Practical Chemistry, A.M. James and F.E. Pricherd, Longman.
2. Practical Physical Chemistry, B.P. Levitt and Zindley's, Longman.
3. Practical Physical Chemistry, S.R. Palit and S.K. De, Science Book Agency.
4. Experimental Physical Chemistry, R.C. Das and B. Behra, McGraw Hill.
5. Experiments in Physical Chemistry, Shoemaker and Gailand McGraw Hill.
6. Systematic experimental Physical Chemistry, T.K. Chandershekhar & S.K. Rajbhoj
7. Experimental Physical Chemistry, V.D.Athawale and Parul Mathur, New Age International.

M Sc CHEMISTRY, SEMESTER III

CODE: OCH-307A

SUBJECT NAME: Chemistry for Sustainable Development

(Open Elective)

NO OF CREDITS: 3

L	P	SESSIONAL:	25
3	0	THEORY EXAM:	75
		TOTAL:	100

Course Objectives:

To study about chemical aspects of environment. To learn about chemistry of different atmospheric components. To study about thermoanalytical techniques. To learn various chromatographic techniques. To have an idea of food analysis

UNIT:I

Hydrosphere

Hydrological cycle of water, Water pollution – inorganic, organic, pesticide, agricultural, industrial and sewage, detergents, oil spills and oil pollutants. Water quality parameters – dissolved oxygen, biochemical oxygen demand, solids, metals, content of chloride, sulphate, phosphate, nitrate and micro-organisms. Water quality standards.

UNIT:II

Atmosphere

Chemical composition of atmosphere – particles, ions and radicals and their formation, Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S and their effect, air pollution controls and their chemistry.

UNIT:III

Thermoanalytical methods:

Introduction, Thermogravimetric analysis (TGA), Derivative Thermogravimetric analysis (DTGA), factors affecting TGA and applications, Differential thermal analysis (DTA): theory, factors affecting DTA and applications.

UNIT:IV

Chromatography

Introduction, Classification of chromatographic methods; Adsorption and Partition Chromatography (Column, Paper and Thin Layer Chromatography), ion exchange chromatography: Principles and Applications.

Analysis of Food

Importance of Food analysis, Determination of approximate composition: Moisture, Fat, Protein, Fiber, Carbohydrate etc.

Course Outcomes: After the successful completion of the course the learner would be able to

i. Understand role of chemistry and chemical reactions in environment

ii. Understand the concept of thermoanalytical techniques and their application

iii. Perform chromatographic analysis

iv. Perform basic food analysis

Reference Books:

1. Environmental Chemistry; A. K. De, Wiley Eastern.
2. Environmental Pollution Analysis; S. M. Khopkar, Wiley Eastern.
3. Environmental Chemistry; S. K. Banerji: Prentice – Hall.
4. Dynamics of Chromatography Part I; J. C. Gidding; Dekker, New York.
5. Instrumental methods of Analysis; L. L. Merits, R. H. Willard and J. A. Dean; Van Nostrand-Reinhold.

M Sc CHEMISTRY, SEMESTER III

CODE: OCH-308A

SUBJECT NAME: Applied Chemistry (Open Elective)

NO OF CREDITS: 3

L	P	SESSIONAL:	25
3	0	THEORY EXAM:	75
		TOTAL:	100

Course Objectives:

To study about polymer chemistry. To learn about properties and application of polymers. To study about different types of medicines and associated chemistry.

UNIT:I

Polymer Chemistry-I

Polymer basic concepts: monomers, degree of polymerization, classification of polymers, types of polymerization, Concept of no. average molecular weight and mass average molecular weight, Methods of determining molecular weights, concept of kinetic chain length Polydispersity index, kinetics of polymerization (addition and chain polymerization)

UNIT:II

Polymer Chemistry-II

Thermal properties of polymers, Flame retardant polymers, Flame retarding Thermoplastics and Thermosets, physical properties of polymers (glass transition temperature, crystalline melting point), factors affecting T_g and T_m Polymer composites, its classification, polymer composites using filler reinforcement, Biocomposites, application of biocomposites in automobiles and in construction materials. Polymer nanocomposites, Properties of polymer nanocomposites, application of polymer nanocomposites

UNIT:III

Medicinal Chemistry-I

Concept of drug and drug development, lead compound and lead modification, prodrugs and soft drugs, an elementary idea of structure reactivity relationship (SAR), Elementary idea about drug action: the receptor role, neurotransmitters and receptors, ion channels and their control, membrane bound enzymes-activation/deactivation, chemical basis of messenger induced change of shape by the receptor

UNIT:IV

Medicinal Chemistry-II

Definition, uses and side effects of the following categories of drugs:

Antipyretics, analgesics & anti-inflammatory agents (paracetamol, asprin, mefenamic acid, ibuprofen and diclofenac), antimalarial (Chloroquine, chloroguanide), Anticancer (Chlorambucil, cyclophosphamide), Cardiovascular drugs (sorbitrate, diltiazem), Antifertility agents (introduction to hormonal and nonhormonal contraception only).

Course Outcomes: After the successful completion of the course the learner would be able to

I understand chemistry of polymers and polymerization

Ii understand and analyze thermal physical and chemical properties of polymers

Iii know about drug and drug design

iv have an analytical view against different types of medicines, their uses and side effects

Reference Books:

1. Polymer Chemistry, Billmayer
2. Polymer Chemistry, Gowarikar
3. Principles of Polymerization, Geroge Odian
4. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Ed. Robert F. Dorge.
5. Burger's Medicinal Chemistry and Drug Discovery, Vol-I, Ed. M.E. Wolf, John Wiley.
6. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.

MSc CHEMISTRY, SEMESTER IV
CODE: CH 401
SUBJECT NAME: **Inorganic Chemistry Special-I**

NO OF CREDITS: 4

L	P
4	0

SESSIONAL	25
THEORY EXAM	75
TOTAL	100

Course Objectives:
To understand different types of reaction and their mechanism in Inorganic chemistry. To learn about photochemical reactions, associated mechanism and principles. To understand nuclear chemistry, different types of nuclear reactions and radiochemical techniques.

UNIT I

Reaction Mechanism of Transition Metal Complexes

Energy profile of a reaction, reactivity of metal complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favor of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage.

Electron Transfer Reactions

Kinetics and mechanism of one electron transfer reactions, outer-sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions, two electron transfer reactions, metal ion catalysed reactions, mixed valence complexes and their electron transfer.

UNIT II

Reactions of metal complexes

Reactivity of coordinated hydrocarbons: a) Nucleophilic and electrophilic addition and substitution b) Rearrangement reactions, Redistribution reactions, **Fluxional Organometallic compounds:** Fluxionality and dynamic equilibria in compound such as η^2-olefin, η^3-allyl and dienyl complexes, Carbonyl scrambling.

Isopoly and Heteropoly Acids and Salts

Isopoly and Heteropoly acids and salts of Mo and W: Structures of isopoly and heteropoly anions.

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UNIT III

Photochemistry

Absorption, excitation, photochemical laws, quantum yield, electronically excited states- life times-measurements of the times. Energy dissipation by radiative and non radiative processes, bimolecular quenching, absorption spectra, Franck condon principle, photochemical kinetics, photochemical stages-primary and secondary.

Excited States of Metal Complexes

Electronically excited states of metal complexes: charge-transfer spectra, charge transfer transition, photosubstitution reactions, photorearrangements, photoisomerisation, photoredox processes conditions of excited states to be useful redox reactant. Transformation of chemical energy into light energy.

UNIT IV

Nuclear Binding Energy: Justifications and applications; nuclear stability rules and decay of unstable nuclei.

Nuclear Reactions: Energetics of nuclear reactions; various types of nuclear reactions including photonuclear, thermonuclear and spallation reactions; mechanism of nuclear reaction by compound nucleus model.

Nuclear fission – Fission probability; energy release; theories of fission.

Nuclear Fussion: Brief idea about breeder reactors,; accelerators and cyclotron.

Radiochemical Techniques: NAA - Principle, Application and Limitation

IDA - Principle, Application and Limitation; Radiometric titrations.

Course Outcomes: After the successful completion of the course the learner would be able to

iv. Explain differet types of chemical reactions of inorganic chemistry.
v. explain photochemical reactions.
vi. Solve problems related to nuclear chemistry
vii. Propose new synthetic routes for the compounds

Books Suggested:

1. Mechanism of Inorganic Reactions; F.Basolo and R.G. Pearson, John Wiley and Sons, New York.
2. Inorganic Reaction Mechanism; M.L. Tobe; Nelson, Wlaton and Thames
3. Inorganic Chemistry; K.F. Purcell, J.C. Kotz; Holt-Sanders International Editions; Philadelphia.
4. The Chemistry of Molten Salts; H. Bloom Benjamin, New York.
5. Principles and Application of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
6. The Organometallic Chemistry of the Transition Metals; R.H. Crabtree, John Wiley.
7. Organometallic Chemistry, R.C. Mehrotra and A. Singh, New Age International
8. Coordination Chemistry; Banerjea; Tata McGraw Hill.

9. Inorganic Chemistry, A Modern Introduction; T. Moeller; John Wiley and Sons.
10. Concepts and Models of Inorganic Chemistry; B. Douglas, D.H. McDaniel and J.J. Alexander; John Wiley and Sons Inc.
11. Essentials of Nuclear Chemistry – H. J. Arnikar.
12. Radio Chemistry & Nuclear Chemistry – G.Choppin, J.O. Liljenzin & J.Rydberg.
13. Nuclear Chemistry – M. Sharon.
14. Modern Nuclear Chemistry – W.D. Loveland, D.J. Morrissey & G.T. Seaborg.
15. Handbook of Nuclear Chemistry: Instrumentation, Separation Techniques, Environmental issues – A. Vertes, S. Nagy & Z. Klencsar.
16. Concepts of Inorganic Photochemistry, A.W. Adamson and P.D. Fleischauer, Wiley.
17. Photochemistry of coordination compounds, K.Balzani and V.Carassti, Academic press.
18. Elements of Inorganic Photochemistry; G.J. Ferraudi, Wiley.

MSc CHEMISTRY, SEMESTER IV
CODE: CH 402
SUBJECT NAME: **Inorganic Chemistry Special-II**

NO OF CREDITS: 4

L	P
4	0

SESSIONAL	25
THEORY EXAM	75
TOTAL	100

Course Objectives:
To develop an understanding about organometallic compounds with an emphasis on their structure, bonding and synthesis. To learn about inorganic catalysts and their action. To have an idea about electro-analytical techniques of analysis.

UNIT I

Alkyls and Aryls of Transition Metals: Types, routes of synthesis, stability and decomposition pathways, organocopper in organic synthesis.
Compounds of Transition Metal-Carbon Multiple Bonds: Alkylidenes, alkylidynes, low valent carbenes and carbynes- synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions on the ligands, role in organic synthesis

UNIT II

Transition Metal π-Complexes
Transition metal π-complexes with unsaturated organic molecules, alkenes, alkynes, allyl, diene, dienyl, arene and trienyl complexes, preparations, properties, nature of bonding and structural features. Important reactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis.

UNIT III

Homogeneous Catalysis

Stoichiometric reactions for catalysis, homogeneous catalytic hydrogenation, alkene hydrogenation-Wilkinson's catalysis, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxo reaction), oxidation of olefins-Wacker's process; oxopalladation reactions, activation of C-H bond.

UNIT IV

Electro analytical methods of Analysis

Electrogravimetry: Current-voltage relationship during an electrolysis, decomposition potential, constant current electrolysis, constant cathode potential electrolysis, apparatus, electrodes, mercury cathode, applications physical properties of electrolytic precipitates, chemical factors of importance in electrodeposition.
Electrolytical methods without cathode potential control
Coulometric analysis: Coulometric methods of constant electrode potential and coulometric titrations. Apparatus and applications.
Amperometric titrations, anodic stripping voltammetry, and cyclic voltammetry

Course Outcomes: After the successful completion of the course the learner would be able to

i. Explain structure and bonding of organometallic compounds and further can synthesize new such compounds.
ii. Suggest catalysts and catalytic action for various reactions.
iii. Solve problems related to analysis of compounds using electro-analytical methods.

Books Suggested

1. Mechanism of Inorganic Reactions; F.Basolo and R.G. Pearson, John Wiley and Sons, New York.
2. Inorganic Chemistry; K.F. Purcell, J.C. Kotz; Holt-Sanders International Editions; Philadelphia. .
3. Principles and Application of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
4. The Organometallic Chemistry of the Transition Metals; R.H. Crabtree, John Wiley.
5. Organometallic Chemistry, R.C. Mehrotra and A. Singh, New Age International.
6. Coordination Chemistry; Banerjea; Tata McGraw Hill.
7. Concepts and Models of Inorganic Chemistry; B. Douglas, D.H. McDaniel and J.J. Alexander; John Wiley and Sons Inc.
8. A Textbook of Quantitative Inorganic Analysis, A.I. Vogel; ELBS, London.
9. Fundamentals of Analytical Chemistry; D.A. Skoog, O.M. West and F.J. Holler; W.B. Saunders.
10. Instrumental methods of Analysis; L.L. Merrit, R.H. Willard and J.A. Dean; Van Nostrand-Reinhold.
11. Basic concepts of Analytical Chemistry – S.M. Khopkar

MSc CHEMISTRY, SEMESTER IV
CODE: CH 403
SUBJECT NAME: **Inorganic Chemistry Special-III**

NO OF CREDITS: 4

L	P
4	0

SESSIONAL	25
THEORY EXAM	75
TOTAL	100

Course Objectives:
To understand about role of inorganic compounds in biological system. To learn about importance of metals in biological system and enzymes. To know about medicinal importance of metals and their compounds.

UNIT I

Transport and Storage of Dioxygen: Porphyrins**,** metalloporphyrins, Heme proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, hemocyanins and hemerythin, model synthetic complexes of iron and cobalt.
Electron Transfer in Biological Systems: Structure and function of metalloproteins in electron transport processes-cytochromes and iron-sulphur proteins, synthetic models.

UNIT II

Alkali and alkaline earth metals in biological systems: Ionophores, active transport of cations across membranes, sodium pump, Calcium pump, Calcium carriers, role of carriers in muscle contraction, blood clotting and hormones.
Interaction of metal ions with Nucleotides: metal ions in nucleotide systems, effect of metal ions on nuclei acids.
Nitrogen fixation: Biological nitrogen fixation, Nitrogenase, model for nitrogenase, metal-N_2 complexes, photosynthesis and chlorophyll.

UNIT III

Metalloenzymes*:*
Zinc Enzymes – Carboxypeptidase & Carbonic anhydrase
Iron Enzymes – Catalase, peroxidase & cytochrome P- 450
Copper Enzymes – Superoxide dismutase, blue copper- proteins
Coenzymes – Vitamins B12
Molybdenum oxatransferase enzymes – Xanthine oxidase

UNIT IV

Metals in Medicine: Biochemical bases of essential metal deficient diseases; Iron, copper and zinc deficiencies and their therapies, carcinogens and carcinostatic agents, zinc in tumour growth and inhibition, anticancer activity and mechanism of platinum complexes, anticancer activity of Rhodium, copper and Gold complexes, anticancer activity of Selenium, antibacterial and antiviral properties of metal complexes, polyamino carboxylic acids and polyethylene amines as chelating drugs.

Ligand Therapy: Ligand induced toxicity, interference with haemoglobin in oxygen transport system, intefererence with metallo-enzymes, beneficial effects of ligand chelation; carcinogenic ligands, carcinostatic ligands, alkylating agents as anticancer drugs, Thiosemicarbazones as anticancer drugs.

Course Outcomes: After the successful completion of the course the learner would be able to

i. Appreciate importance of metals and their compounds in biological world.
ii. Correlate many biological deficiencies/abnormalities with metallic mechanism
iii. Design new medicines/drugs using concepts of bioinorganic and medicinal chemistry

Books Suggested:

1. Principles of Bioinorganic Chemistry: S. J. Lippard and J. M. Berg, University Science Books.
2. The Inorganic Chemistry of Biological Process; M. N. Huges; John Wiley & Sons.
3. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.
4. A Text Book on Medicinal Aspects of Bio-Inorganic Chemistry – A.K. Das.
5. Bioinorganic Medicinal Chemistry – E.Alessio.
6. Bioinorganic Chemistry – K.H. Reddy.
7. Inorganic Chemistry: Principle of Structure Reactivity – J.E. Huheey, E.A. Keiter & R.L.Keiter.
8. Handbook of Radiopharmaceuticals: Radio Chemistry & Applications – M.J. Welch & C.S. Redvanly.
9. Perspectives on Bioinorganic Chemistry – R.W. Hay, J.R. Dilworth & K.B. Nolan.

MSc CHEMISTRY, SEMESTER IV
CODE: CH 404
SUBJECT NAME: **Inorganic Chemistry Special-IV**

NO OF CREDITS: 4

L	P
4	0

SESSIONAL	25
THEORY EXAM	75
TOTAL	100

Course Objectives:
To understand about the concept of self assembly and supramolecular chemistry. To learn about structure and synthesis of various types of nanomaterials. To have an insight of crystal structures and non aqueous solvents. To know about cement chemistry and associated technologies.

UNIT I
Supramolecular Chemistry
Concepts and language.
Molecular recognition: Molecular receptors for different types of molecules including anionic substrates, design and synthesis of co-receptor molecules and multiple recognition. Supramolecular reactivity and catalysis. Transport processes and carrier design. Supramolecular devices. Some example of self-assembly in supramolecular chemistry

UNIT II
Nano materials Technology:
Nano materials and their historical perspective. Applications of nanoscience and nanotechnology in various fields. Unique properties of nanomaterials due to their nanosize, Quantum dots, Nanotubes, Fullerenes; Techniques for their synthesis:- Hydrothermal, Solvothermal, Microwave irradiation, sol-gel, Precipitation, Reverse Micelle Synthesis, Physical Vapour deposition (PVD), Chemical Vapour Deposition (CVD), Electro deposition, Properties of nanostructured materials: optical, magnetic, chemical and photo catalytic properties. Reactions of Mg & Ag nanoparticles.

UNIT III
Crystal Structures
Structures of some binary and ternary compounds such as fluorite, antifluorite, rutile, antirutile, crystobalite, layer lattices- CdI_2, BiI_3; ReO_3, Mn_2O_3, corundum, pervoskite, Ilmenite and Calcite, band theory of solids.
Non-aqueous Solvents: Reaction in non-aqueous media with respect to H_2SO_4, BrF_3, N_2O_4 and phosphoryl chloride; Kinetics and mechanism of coordination reactions in non-aqueous media.

UNIT IV

Cement Chemistry: Indian Cement Industry, Cement Manufacturing Process, Cement Raw Materials, Corrective Materials/ Additives. Raw Mix Proportioning, Raw Mix Design, Modulii Values and their effects. Burnability, Absorption and effect of Coal Ash. Chemical and Phase Composition of Clinker, Bogue Calculation, Clinker Reaction during Clinkerization, Fuels, Mineralisers and Fluxes. Hydration of Cement, Setting, Hardening and Strength gain, Role of various Clinker Phases. Use of Waste Materials – Fly ash and Slag etc., Pozzolanic Reaction, Hydration of Slag. Types of Cement, BIS specifications of various types of Cement. Quality Control in Cement Manufacture. Physical and Chemical Testing of Cement.

Course Outcomes: After the successful completion of the course the learner would be able to

i. Suggest better catalysis on the basis of supramolecular chemistry
ii. Synthesize and characterize nanoparticles.
iii. Design and control coordination reactions in non aqueous solvents
iv. Explain various characteristics of cement and can propose some further research in this area.

Books Suggested:

1. Supramolecular chemistry, J.M. Lehn, VCH
2. Introduction to nanotechnology : Charles P. Poole, Jr. Frank, J. Owens : Wiley India
3. Basics of nanochemistry., Sachdeva, Mamta V
4. Nanochemistry, Sergeev, G. B. and K. L. Klabunde, Elsevier, 2013.
5. Concise Inorganic Chemistry – J.D. Lee
6. Inorganic Chemistry – T. Moeller.
7. Modern Aspects of Inorganic Chemistry – H.J. Emeleus & A.G. Sharpe.
8. The Chemistry of Cement and Concrete, F. M. Lea
9. Cement Chemistry, H.F.W. Taylor

M Sc CHEMISTRY, SEMESTER IV
CODE: CH-411
SUBJECT NAME: ORGANIC CHEMISTRY SPECIAL-I
NO OF CREDITS: 4

L	P
4	0

SESSIONAL	25
THEORY EXAM	75
TOTAL	100

Course Objectives:
To learn and understand name reactions and rearrangements in detail, the principle and application of redox reactions, methods of synthesis and applications of metal based reagents with their mechanism of action. To have and elementary idea of superamolecular chemistry as an emerging field in research.

UNIT I
Name Reactions & Rearrangements
A detailed study including mechanism of Beckmann, Hofmann, Curtius, Lossen, Schmidt, Favorskii, Neber, Fritsch-Butenberg-Wiechell, Baeyer-Villiger, Benzil benzillic acid rearrangements, Arndt-Eistert synthesis, Darzens synthesis, stroke enamine synthesis, Shapiro reaction, Sharplcss asymmetric epoxidation.

UNIT II
Redox Reactions
Oxidation - Introduction, Different oxidative processes for the followings: Hydrocarbons- alkenes, aromatic rings, saturated C-H groups (activated and unactivated). Alcohols, diols, aldehydes, ketones, and carboxylic acids.

Reduction – Introduction, Different reductive processes for followings: Hydrocarbons – alkanes, alkenes, alkynes and aromatic rings. Carbonyl compounds – aldehydes, ketones, acids and their derivatives. Nitro compounds. Hydrogenolysis.

UNIT III
Organometallic Reagents-I
Principle, preparations, properties and applications of the reagents of the following metals/non-metals (Main group elements) in organic synthesis with mechanistic details;
Li, Mg, Cd, Zn, Cu, S, Si, B and I.

UNIT IV
Organometallic Reagents-II
Principle, preparations, properties and applications of the reagents of the following metals (transition metal reagents) in organic synthesis with mechanistic details Pd, Fe, Co, Rh, Cr and Ti compounds.

Supramolecular chemistry

An idea of supramolecular chemistry, Phase Transfer Catalysis, Crown ethers, cryptates, cyclodextrins , calixarenes , and micelles.

Course Outcomes:

After the successful completion of the course the learner would be able to

i. understand some of the name reactions and rearrangements with their mechanism and applications in organic synthesis.
ii. understand different oxidative and reductive processes for inter-conversions of various organic moieties including their role in organic synthesis.
iii. undestand the synthesis of organometallic reagents with their mechanism of action and application in organic synthesis and various conversions.
iv. understand the principle and applications of supramolecular chemistry.

Books Suggested:

1. Modern Synthetic Reactions, H.O. House, W.A. Benzamin.
2. Some Modern Method of Organic Synthesis, W. Carruther, Cambridge Univ. Press.
3. Advanced Organic Chemistry, Reactions Mechanism and Structure, J. March, John Wiley.
4. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional
5. Handbook of Green Chemistry- Gre en Catalysis- Paul T. Ana sta s, Robert H. Crabtree, Wiley-VCH
6. Methods and Reagents for green synthesis: An introduct ion, Pietro Tundo, Alvis e Perosa, F. Zecchin, Wiley

M Sc CHEMISTRY, SEMESTER IV
CODE: CH-412
SUBJECT NAME: ORGANIC CHEMISTRY SPECIAL-II
NO OF CREDITS: 4

L	P
4	0

SESSIONAL	25
THEORY EXAM	75
TOTAL	100

Course Objectives:
To learn and understand pericyclic reactions and photochemistry in organic synthesis with detailed mechanistic and stereochemical aspects. To have an elementary idea of the green chemistry and nano-chemistry with their applications.

UNIT I
Pericyclic Reactions - I

Molecular orbital symmetry, frontier orbital of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system classification of pericyclic reactions, Woodward - Hoffmann correlation diagram. FMO & PMO approach, Electrocylic reaction - conrotatory and disrotatory motions. 4n, 4n+2, allyl systems, Ring opening of cyclopropyl halides and tosylates, cycloadditions-antarafacial and suparafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3-dipolar cycloadditions and cheleotropic Reactions.

UNIT II
Pericyclic Reactions - II

Sigmatropic Rearrangements-suprafacial and entarafacial shifts of H, sigmatropic shifts involving carbon moieties, retention and inversion of configuration, [3,3] and [5,5] sigmatropic rearrangements, detailed treatment of Sommelet-Hauser, Claisen and Cope rearrangements introduction to ene reactions. Simple problems on Pericyclic reactions, Group transfers and eliminations.

Green chemistry

Basic Principle and need of green chemistry, Different tools for green synthesis (Elementary idea of green reagent, green solvent, green catalyst, solid phase, mw and ultrasound assisted) atom economy, green synthesis of BHC.

UNIT III
Photochemistry - I

Excitation and excited states, Franck-Condon Principle, Jablonski diagram, energy transfer photsensitization, quenching, quantum efficiency and quantum yield.

Photochemistry of carbonyl compounds (Norrish type I and type II changes, photoreaction of cyclic ketones, Paterno-Buchi reaction and Photoreducation. Photochemistry of olefins and 1,3-Butadiene (cis-trans isomerisation, dimerisation and cycloadditions). Di-π-methane rearrangement, enone and dienone rearrangements.

UNIT III
Photochemistry - II

Photochemistry of aromatic compounds (substitution, isomerization, cyclization and cycloaddition reactions), Photo-Fries rearrangement, photolysis of nitrile esters and Barton reaction, Hoffman-Loeflller-Freytag reaction.

Nano-Chemistry
Introduction to nano-chemistry - fullerenes, nanotubes, carbon nano-particles, graphenes.

Course Outcomes:
After the successful completion of the course the learner would be able to

i. undestand the basics of pericyclic reactions and determine the stereochemistry of their products under different reaction conditions (thermal and photochemical).
ii. understand the various phenomena regarding absorption of light energy by organic compounds and thereby the structural changes produced in them.
iii. understand the role of photochemical reactions in organic synthesis.
iv. understand basic principles and applications of green chemistry and nanochemistry.

Books Suggested:

1. Pericyclic Reactions, S.M. Mukherji Macmilan India.
2. Organic Photochemistry, J Coxan & B. Halton, Cambridge University Press.
3. Introductory Photochemistry,.A. Cox and T. Camp McGraw Hill.
4. The Conservation of Orbital Symmetry, R.B. Woodward and R. Hoffmann" Verlag Chemie Academic Press.
5. Problem Solving approach to Orbital Symmetry, R.E. Lehr and A.P. Merchand
6. Organic Reactions and Orbital Symmetry, T.L. Gilchrist and R.C. Storr, Cambridge University Press, Cambridge, 2nd Edn. 1979.
7. Handbook of Green Chemistry- Green Catalysis- Paul T. Anastas, Robert H. Crabtree, Wiley-VCH

8. Methods and Reagents for green synthesis: An introduction, Pietro Tundo, AlvisePerosa, F. Zecchin, Wiley

M Sc CHEMISTRY, SEMESTER IV
CODE: CH-413
SUBJECT NAME: ORGANIC CHEMISTRY SPECIAL-III
NO OF CREDITS: 4

L	P
4	0

SESSIONAL	25
THEORY EXAM	75
TOTAL	100

Course Objectives: To learn and understand synthetic aspects of organic chemistry through retro-synthetic analysis. Also to understand the chemistry of heterocyclic compounds and natural products.

UNIT I
Disconnection Approach-I
An introduction of synthons and synthetic equivalents, general principles of the disconnection approach, functional group interconversions, the importance of order of events in organic synthesis, one group C-X and two group C-X disconnections, one group C-C disconnection, chemoselectivity, regioselectivity, regiospecificity, stereoselectivity and stereospecificity, reversal of polarity.

UNIT II
Disconnection Approach-II
Principle of protection of alcoholic, amino, carbonyl and carboxylic groups. Two group C-C disconnection- Diels Alder reactions, 1,3-difunctionalized compounds and α,β unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalized compounds-Michael addition and Robinson Annelation.
Disconnection approach towards the synthesis of juvabione and cortinsone.

UNIT III
Heterocyclic compounds
Systematic (Hantzsch-Widman) nomenclature for monocylic and fused ring systems. General synthesis and reactions (including mechanism) of the followings: Three-membered heterocycles: oxirane, azirane, Four-memebered heterocycles: Oxetane and azetidine, Five-membered heterocycles: pyrazole, imidazole, oxazole, thiazole; Comparison of their basic character.

UNIT IV
Natural products
Terpenoids

General aspects of structure determination of terpenoids. Structure elucidation and synthesis of Geraniol, α-pinene. Biogenetic isoprene rule and biogenesis of terpenoids.

Steroids

Structure and biological role of Cholestrole with absolute configuration (synthesis and structural elucidation excluded).

Methods for the following conversions.

i) Cholesterol → Testosterone
ii) Cholesterol → Progesterone
iii) Cholesterol → 5-α and 5-β cholanic acids.

Alkaloids

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring.
Structure, stereochemistry, synthesis and biosynthesis of the followings: Ephedrine, Nicotine.

Course Outcomes:

After the successful completion of the course the learner would be able to

i. undestand the basic principle of retro-synthesis for designing the synthesis of organic compounds.
ii. understand the use of protection-deprotection for various functional group interconversions.
iii. design and synthesize simple organic coumpounds in lab.
iv. understand the introduction, nomenclature and synthesis and reactions of different classes o heterocylic comounds.
v. understand the general aspects of natural products including structures, stereochemistry and synthesis .

Book Suggested:

1. Designing Organic Synthesis, S.Warren, Wiley.
2. Organic Chemistry, Vol. 2, I.L. Finar, ELBS.
3. Heterocylic Chemistry, T.L. Gilchrist, Longman Scientific Technical.
4. Comprehensive Heterocyclic Chemistry, A.R. Katritzky and C.W. Rees, eds. Pergaman Press.
5. Natural Products: Chemistry and Biology Significance, J.Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.

M Sc CHEMISTRY, SEMESTER IV
CODE: CH-414
SUBJECT NAME: **ORGANIC CHEMISTRY SPECIAL-IV**
NO OF CREDITS: 4

L	P
4	0

SESSIONAL	25
THEORY EXAM	75
TOTAL	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

Course Objectives: To learn and understand biochemical aspects of enzymes and coenzymes with their mechanism of action, elementary idea of antibiotics. Also to learn and understand basic principle of drug design and synthesis, general mode of action and medicinal uses of some important drugs.

UNIT I

Enzymes

Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling. Enzyme kinetics, Michaelis-Menten and Lineweaver-Burk plots, reversible and irreversible inhibition.

Mechanism of Enzyme Action

Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion, Mechanism of action of chymotrypsin.

UNIT II

Co-Enzyme Chemistry

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate (TPP), pyridoxal phosphate (PLP), NAD^+, $NADP^+$, FMN, FAD. Mechanisms of reactions catalyzed by the above cofactors

Antibiotics

Cell wall biosysnthesis and protein synthesis inhibitors: Penicillins and semi-synthetic penicillins. Medicinal uses of penicillin G, problems of sensitivity to

acids, β-lactamases and narrow spectrum of activity, solving these problems leading to the development of penicillin V. Introduction and discovery of cephalosporins (structure elucidation and synthesis excluded).

UNIT III

Drug Design

Classification and discovery of new drugs, history and development of chemotherapeutic agents, therapeutic index, LD50 and ED50, naming of (new) drugs.

Elementary idea about drug action: the receptor role, neurotransmitters and receptors, ion channels and their control. Membrane bound enzymes-activation/deactivation. Chemical basis of messenger induced change of shape by the receptor. Design of agonists, antagonists and partial agonists

Drug development: screening of natural products, isolation and purification, structure determination, structure-activity relationships (SAR), synthetic analogues, isosteres and bioisosteres, concept of lead compounds.

Brief overview of pharmacokinetics and pharmacodynamics, concept of prodrug and synergism.

UNIT IV

Synthesis, General Mode of Action and Medicinal Uses of Important Drugs in the Following Categories.

Antineoplastic Agents: Mechlorethamine, Chlorambucil, cyclophosphamide, aminopterin, 6-mercaptopurine, paclitaxel (synthesis of paclitaxel excluded)

Antimalarials: Chloroquine, primaquine, chloroguanide, pyrimethamine

Analgesics, Antipyrics and Antiinflammatory agents: Morphine and related compounds (codeine and heroin), meperidine, methadone, aspirin, acetaminophen, indomethacin, phenylbutazone, mefenamic acid, ibuprofen, diclofenac, celecoxib.

Antifertility agents: Ovulation inhibitors and related hormonal contraceptives - norethindrone, norethynodrel, estradiol, mestranol, non hormonal contraceptive-centchroman (synthesis of all the drugs excluded).

Cardiovascular Drugs: Calcium channel blockers and β-blockers: sorbitrate, diltiazem, atenolol and verapamil.

AIDS and drugs against HIV: HIV infection to the system, structure and mode of action of important drugs against HIV (nucleoside reverse transcriptase inhibitors) - AZT, ddI, ddC, d4T and 3TC (synthesis only of AZT).

Course Outcomes:

After the successful completion of the course the learner would be able to

i. undestand the basics of enzymes (classification and nomenclature) and their role in biological systems.
ii. understand basics of conenzyme chemistry and mechanism of the bio-chemical reactions catalysed by them.
iii. understand the basics of antibiotics mainly focussing to the penicillins.

iv. understand mode of drug action, drug development basics and synthesis of important drugs.

Books Suggested:

1. Organic Chemistry, Vol 2, I. L. Finar, ELBS.
2. Natural Products: Chemistry and Biology Significance, J.Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
3. Biochemistry, A.L. Lehninger.
4. Outlines of Biochemistry, Cohn & Stumpf.
5. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Ed. Robert F. Dorge.
6. Burger's Medicinal Chemistry and Drug Discovery Vol-I Ed. M.E. Wolf, John Wiley.
7. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.

M.Sc CHEMISTRY, SEMESTER IV
CODE: CH 421
SUBJECT NAME: **Physical Chemistry (Special-I)**
NO OF CREDITS: 4

L	P
4	0

SESSIONAL	25
THEORY EXAM	75
TOTAL	100

Course Objectives:
To study the advanced concept of quantum mechanics and quantum statistics. To understand theories and basic concepts of statistical thermodynamics.

UNIT- I
Quantum Mechanics-I
Problem of two electrons exchange interactions. Approximate methods: First order time-independent perturbation theory for non-degenerate states. Variation theorem and variational methods. Ground and excited state of helium atom. Coupling of angular momentum for many electron system, spin -orbit coupling, Molecular Term symbols. Born-Oppenheimer approximation, the hydrogen molecule ion, the hydrogen molecule, their symmetric and antisymmetric solution (without actual evaluation of various integrals).

UNIT- II
Quantum Mechanics-II
Valence bond and MO (LCAO) treatment of hydrogen molecule. Comparison of the MO and VB treatments and their equivalence limit. Configuration Interaction. Extension of MO theory to other systems - Homonuclear and heteronuclear diatomics, simple polyatomic molecules.
The pi-electron approximation, Huckel theory of conjugated systems. Applications to ethylene, butadiene, cyclobutadiene and cyclopropenyl molecules. Calculation of properties- Delocalization energy, electron density, bond order.

UNIT- III
Quantum Mechanics - III
Time-independent perturbation theory for degenerate systems with examples. Applications of Time -dependent perturbation theory. Radiative transitions. Einstein coefficients. Quantum mechanical theory of absorption of light by molecules. Transition moment integral. Oscillator strength, rules governing the transition between two energy states. Self-consistent field method. Abinitio and Semi- empirical Methods for Closed Shell Systems .

Quantum Statistics
The Bose-Einstein statistics, statistics of a photon gas, the Fermi-Dirac statistics, Fermi-Dirac systems, extreme gas degeneration, slight gas degeneration, electron gas in metals, thermionic emission and comparison of two statistics, non-degenerate and degenerate systems.

UNIT- IV

Statistical Thermodynamics

Partition function and thermodynamic properties, partition function and factorization of partition function, translational partition function, translational thermodynamic function, atoms and monoatomic molecules, Sackur-Tetrode equation, diatomic molecules , separation of internal partition function. Rotational and vibrational energies, entropy due to internal degrees of freedom. Rotational partition function, rotational partition function for polyatomic molecules, vibrational partition function.

Course Outcomes:

After the successful completion of the course the learner would be able to

i. undestand the quantum chemisty of microscopic particles and quantum statistics.

ii. and can understand the knowledge of statistical thermodynamics.

Reference Books

1. Theoretical Chemistry, S. Glasstone, Affiliated East -West Press .
2. Quantum Mechanics, H.L. Strauss, Prentice Hall.
3. Quantum Chemistry, B. K. Sen, Kalyani Publishers
4. Quantum Chemistry, R. Prasad, New Age International.
5. A textbook of Phys ica l Chemistry, Vol. 4, K.L. Kapoor, MacMillan India Ltd.
6. Quantum Chemistry, C.R. Ga tz, E.M. Co.
7. P.W. Atkins and R.S. Fr iedman, Molecular Quantum Mechanics, 3 rd edition (1997), Oxford University Pr ess. Oxford.
8. H. Eyring, J.Walter and G.E. Kimball, Quantum Chemistry, (1944) John Wiley, New York.
9. I.N. Levine, Quantum Chemistry, 5th edit ion (2000), Pearson Educ., Inc., New Delhi.
10. Mic elles, Theoret ica l and Applied Aspects, V. Moroi, Plenum.
11. Significance of liquid st ructures , H. Eyring

M.Sc CHEMISTRY, SEMESTER IV
CODE: CH 422
SUBJECT NAME: **Physical Chemistry (Special-II)**
NO OF CREDITS: 4

L	P
4	0

SESSIONAL	25
THEORY EXAM	75
TOTAL	100

Course Objectives:
To study the polymer properties and molecular weight of polymers and material chemistry. To understand the theory of liquid crystal, concept of corrosion and advanced solid state chemistry

UNIT- I
Polymers
Hyperbranched–star, polymers, Dendrimers, Plasticizers, Polymer composites.Glass transition temperature (Tg), factors influencing the glass transition temperature, effect of molecular weight and melting point on glass transition temperature, importance of glass transition temperature.
Average end-to-end distance, average radius of gyration of polymer chains, statistical distribution of end-to-end dimensions, freely jointed chain in three dimensions, influence of bond angle restrictions.

Determination of Molecular Weight of Polymers
Molecular weight determination of polymers. Osmotic pressure: Membrane osmometer, high speed osmometer and vapour pressuree osmometer. Sedimentation or ultracentrifugation: Sedimentation velocity method, sedimentation equilibrium method. Light scattering: Scattering of light by small molecules and polymer solutions, asymmetric scattering, Debye method, Zimm plot method, comparison of Zimm and Debye methods, Determination of molecular weight by Gel Permeation Chromatography.

UNIT- II
Material Chemistry
Electronic structure and optical, electrical and magnetic properties, diffusion and chemical behaviour, applications of nanomaterials. Various techniques for the preparation of nanomaterials,Thermodynamics and Kinetics of Nucleation, Thin Films and Langmuir-Blodgett films - Preparation techniques, evaporation/sputtering, chemical processes, MOCVD, sol-gel. Langmuir-Blodgett (LB) film, growth techniques, photolithography, properties and applications of thin and LB films.

UNIT- III
Liquid Crystals

Liquids as dense gases, liquids as disordered solids, some thermodynamics relations, internal pressure and its significance in liquids, equation of state, critical constants, Different types of intermolecular forces in liquids, Different potential functions for liquids, additivity of pair potential approximation. Mesmorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases; smectic – nematic transition and clearing temperature – homeotropic, planar and schlieren textures, twisted nematics, chirals nematics, molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals.

UNIT- IV

Corrosion: Forms of corrosion, Corrosion monitoring and prevention methods. Batteries and Fuel cells: Introduction. Nanostructured and surface modified electrodes: Introduction and their applications. Environmentally oriented electrochemistry: Electrochemistry of water splitting, electrolysis of sea water, electrochemical reduction of CO_2, Electrochemical sewage disposal, electrochemical decontamination of soil.

Solid State Chemistry

Free electron theory of metals, Quantum mechanical treatment explaining the origin of band gaps, density of states, Band theory, Bloch theorem, Brillouin zones, effective mass of charge carriers, Semiconductors: Direct and indirect band gap semiconductors, hole concept, temperature dependence of mobility and electrical conductivity, free carrier concentration in intrinsic and extrinsic semiconductors, mass active law, Generation of carriers and their recombination in semiconductors. Types of junctions (metal-semiconductor, semiconductor-semiconductor, junctions in organic materials), Analysis of p-n junction including I-V characteristics.

Course Outcomes: After the successful completion of the course the learner would be able to

i. understand the polymer chemistry and its importance.
ii. Understand the material chemistry and liquid crystals.
iii. knowledge of corrosion and solid state chemistry.

Reference Books

1. Polymer Chemistry, P.J. Flory.
2. Physical Chemistry of Polymers, A.Tager.
3. Physical Chemistry of Ma cromole cules , C.Tanford.
4. Polymer Chemistry by Gowalikar
5. Scaling Concepts in Polymer Physics , Pierre-Gilles Gennes
6. Introduction to Polymers, Third Edition, Robert J. Young and Peter A. Lovell
7. Polymer Physics (Chemistry), M. Rubinstein, Ralph H. Colby
8. Statistical Mechanics by Donald A McQuarrie

M.Sc CHEMISTRY, SEMESTER IV
CODE: CH 423
SUBJECT NAME: Physical Chemistry (Special-III)
NO OF CREDITS: 4

L	P
4	0

SESSIONAL	25
THEORY EXAM	75
TOTAL	100

Course Objectives:
To study the statistical mechanics, advanced statistical mechanics and photochemistry. To understand theories and basic concepts of biophysical chemistry and renewable energy sources.

UNIT- I
Statistical Mechanics
Ensemble averaging, postulates of ensemble averaging. Microcanonical, canonical and grand canonical ensembles , corresponding distribution laws (using Lagrange's method of undetermind multipliers). Maxwell- Boltzmann statistics, Boltzmann distribution, derivation of the Boltzmann distribution expression, determination of the Boltzmann constant, Maxwell distribution law of velocities from Boltzmann distribution expression**.**

Advanced Statistical Mechanics
Real gases, intermolecular potential and virial coefficients.Structure of liquids-definition of distribution and correlation functions, Thermodynamic functions of a fluid and radial distribution function, Spectroscopic techniques for liquid dynamic structure studies. Random walk problem in 1D. Theory of Brownian motion, Langevin theory, Fokker-Planck equation.

UNIT- II
Photochemistry
Revision of basic concepts of photochemistry, Life times of excited electronic states of atoms and molecules. Charge transfer transitions, The Frank-Condon principle, emission spectra, environment effect on absorption and emission spectra, Wigner's spin conservation rule. Modes of decay of excited states, quenching of fluorescence, delayed fluorescence, collisional quenching, Stern–Volmer equation. Excimer and exciplex formation and decay. Techniques for the study of transient species in photochemical reactions. Applications of Lasers in photochemical kinetics.

UNIT- III

Biophysical Chemistry

Chemical bonds in biological systems; Properties of water; Thermodynamic principles in biological systems; Osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechanochemical system. Introduction to protein folding problem.Cell Membrane and Transport of Ions: Structure and functions of cell membrane. Active transport across cell membrane, irreversible thermodynamics treatment of membrane transport.

Optical methods and applications: Optical techniques in biological systems: Absorption spectroscopy, Fluorescence spectroscopy, Linear and Circular Dichroism.

UNIT- IV

Renewable energy sources

Renewable energy resources: Biomass-Biofuels, Hydrogen, Solar energy. Related environmental and economical issues. Introduction to Photovoltaics. Basic PV system design. Design and physics of solar cells, I-V characteristics, external and internal quantum efficiency. Thermodynamics of light conversion. Solar radiation and conversion efficiency. Factors influencing solar cell efficiency. Future trends in PV energy conversion. Silicon solar cells, alternatives to silicon, III-V materials for solar cells, thin film solar cells and third generation solar cells. Concentrator photovoltaics. Thermodynamic limit of light concentrators, Photovoltaics storage system.

Course Outcomes: After the successful completion of the course the learner would be able to

i. understand the statistical mechanics and advanced statistical mechanics.

ii. Understand the photochemistry and biophysical chemistry.

iii. knowledge of renewable energy sources.

Reference Books

1. Introduction to Statistical Thermodynamics, H.Dole.
2. Theoretical Chemistry, S.Glasstone, Affiliated East-West Press.
3. Thermodynamics, Lewis and Randall.
4. Chemical Physics, J.C. Slater.
5. Non-equilibrium Thermodynamics , C. Kalidas

M.Sc CHEMISTRY, SEMESTER IV
CODE: CH 424
SUBJECT NAME: **Physical Chemistry (Special-IV)**
NO OF CREDITS: 4

L	P
4	0

SESSIONAL	25
THEORY EXAM	75
TOTAL	100

Course Objectives:
To study the advanced chemical kinetics, reaction dynamics, solution kinetics and kinetics of fast reactions and concept of micelles. To understand theories and basic concepts of non equilibrium thermodynamics and advanced electrochemistry.

UNIT- I
Advanced Chemical Kinetics
London-Eyring-Polanyi method of calculation of energy of activation. Application of activated complex theory of reaction rates. Temperature dependence of pre-exponential factor. Thermodynamic aspects of reaction rates. Kassel's theory (RRK), Rice-Ramsperger-Kassel-Marcus (RRKM) theory, unimolecular reactions and its validity.

Reaction Dynamics
Molecular beams, principle of crossed-molecular beams. Molecular encounters and principal parameters, e.g. Impact parameter, Collision cross-section, Reaction cross-section and relation between reaction cross-section and reaction rate (single velocity). Dependence of collisional cross-section on translational energy.

UNIT- II
Solution Kinetics and Kinetics of Fast Reactions
Ion-ion reaction, ion-dipole reaction and enzyme kinetics (effect of pH and temperature). Lineweaner-Burk plot for the analysis of enzymolysis. Reactions between polar molecules, kinetic salt, salt effect. Modern techniques in gas phase and in solution, flash photolysis, flow methods, relaxation techniques (temperature jump, pressure jump) and shock tube technique.

Micelles
Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solubilization, emulsions, micro emulsion: Mechanism of formation and their stability, reverse micelles. Micellar catalysis

UNIT- III

Non-equilibrium Thermodynamics

General theory of non equilibrium thermodynamics, entropy production in heat flow, matter flow and electric current, the Onsager's reciprocal relations, their proof, transport parameters, thermoelectric effects, thermomechanical phenomena and thermocells**.** Determination and calculation of thermodynamic properties i.e. internal energy, entropy, Helmholtz and Gibbs free energy, ortho and para hydrogen states, free energy functions. Partition function and equilibrium constant, effect of nuclear spin, isomolecular reaction, isotopic exchange reactions. Einstein theory and Debye theory of heat capacities of monatomic solids.

UNIT- IV

Advanced Electrochemistry

Advanced concepts: Overpotential concept, Exchange current density, Butler-Volmer equation, Polarizable and non-polarizable interfaces. Tafel equations. Electrochemical Processes: Difference between kinetically and mass transport controlled electrochemical processes. Difference between single step and multiple step electrode reactions. Brief introduction and applications of various electrochemical methods: Principle of electrochemical methods such as chronoamperometry, cyclic voltammetry, chronopotentiometry, coulometry, ac-impedance, spectroelectrochemistry and hydrodynamic methods. Electrocatalysis: Introduction to electrocatalysis. Homogeneous and heterogeneous electrocatalysis.

Course Outcomes: After the successful completion of the course the learner would be able to

i. understand the advanced chemical kinetics and reaction dynamics.
ii. Understand the solution of kinetics and kinetics of fast reactions.
iii. knowledge of micelles and non- equilibrium thermodynamics.
iv. knowledge of advanced electrochemistry.

Reference Books

1. Principles of the Solid State, H.V. Kee r, Wiley Eastern.
2. Solid Sta te Physics, C.Kittel, John Wiley
3. Solid Sta te Physics by Neil W. Ashcroft and N. David Mermin
4. The Physics of Solar Cells (Properties of Semiconductor Materials) by Jenny Nelson
5. Physics of Solar Cells: From Basic Principles to Advanced Concepts (Physics Textbook) by Peter Würfel
6. Optoelectronics of Sola r Cells (SPIE Press Monograph Vol. PM115), Greg P. Smestad
7. Electrochemical Methods: Fundamenta ls and Applica tions , 2 nd Ed., A. J. Bard and L. R. Faulkner John Wiley & Sons: New York, 2002.
8. Modern Electrochemistry 1: Ionics 2nd Ed., Springer (1998), J. O' M. Bockris & A. K. N. Reddy.
9. Modern Elect rochemistry 2B: Electrodics in Chemistry, Engineering, Biology and Environmental Science 2nd Ed., Springer (2001), J. O' M. Bockris & A. K. N. Reddy.

10. Modern Elect rochemistry 2A: Fundamentals of Electrodics 2nd Ed., Springer (2001), J. O' M. Bockris, A. K. N. Reddy and M. E. Gamboa -Aldeco.
11. Instrumental methods of analysis:Willard, Merritt & Dean
12. Advanced Analytical Chemistry: Meiter and Thomas
13. Instrumenta l methods of chemical analys is : Braun
14. Principles of Instrumenta l analysis, 5 th edition, D. A. Skoog, F. J. Holler, T. A. Nieman, Brooks Cole.

Grading System

The Grading system shall be as per the UGC guidelines as given below:

Marks Percentage	Grade	Grade Points	Category
90-100	O	10	Outstanding
80≤ marks<90	A+	9	Excellent
70≤ marks<80	A	8	Very Good
60≤ marks<70	B+	7	Good
50≤ marks<60	B	6	Above Average
45≤ marks<50	C	5	Average
40≤ marks<45	P	4	Pass
< 40	F	0	Fail
----------	Ab	0	Absent

The procedure to Compute the SGPA and CGPA will continue as per the existing system which is similar as recommended by UGC and further percentage will also be calculated by the same formula(CGPA*9.5).