YMCA UNIVERSITY OF SCIENCE AND TECHNOLOGY FARIDABAD

SYLLABUS

M.Sc. CHEMISTRY

(w.e.f. 2016-2017)

(2 Years Full Time, 4 Semesters Programme)

VISION AND MISSION OF THE UNIVERSITY

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.

VISION AND MISSION OF THE 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.

ABOUT THE PROGRAM

Post-graduate education in Science can create highly skilled manpower in specific areas, which will lead to generation of new knowledge and creation of wealth for the country. 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. Chemistry is important to the world economy as well. The developments in Chemistry during last few decades are phenomenal. It is also seen that these developments are crossing the traditional vertical boundaries of scientific disciplines; the more inclination is seen towards biological sciences. 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.

The practice of Chemistry, as is witnessed, over a span of more than a century has also created concomitant and perhaps unavoidable impacts of human environment. The adverse effects were particularly noted during last few decades. The concept of sustainable development is now well accepted. Though not a separate branch of Chemistry, Green Chemistry has emerged as a new approach to the practice of Chemistry on the background of sustainability. The Chemical Industry is now pressurized from both the Government and the Society to develop ecofriendly processes and products which will reduce waste and prevent toxic substances from entering the environment. The principles and applications of Chemistry should be learnt on this background

OBJECTIVES OF THE PROGRAM

- To impart training in Chemistry at advanced level in a more wholistic way and enthuse the students for the subject;
- To train the students to make them 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.

Scheme and Syllabi for M Sc CHEMISTRY (Four Semesters) Course

w.e.f. from 2016-17

SEMESTER I

Subject Code	Title	Teaching Hours per week			Maximum Marks			Credits	Category Code
		L	T	P	Internal Assessment	End-semester Examination	Total Marks		
CH 101	Inorganic Chemistry (General-I)	4			40	60	100	4	DCC
CH 102	Organic Chemistry (General-I)	4			40	60	100	4	DCC
CH 103	Physical Chemistry (General-I)	4			40	60	100	4	DCC
CH 104 A*	Mathematics for Chemists	3			25	50	75	3	Foundation Course
CH 104 B*	Chemistry of life processes	3			25	50	75	3	Foundation Course
CH 105	Inorganic Chemistry Lab-I			6	25	50	75	3	DCC
CH 106	Organic Chemistry Lab-I			6	25	50	75	3	DCC
CH 107	Physical Chemistry Lab-I			6	25	50	75	3	DCC
						Total	**600**	**24**	

***** Candidates with Biology background will appear for 104 A and Candidates with Mathematical background will appear for 104 B

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 201	Inorganic Chemistry (General-II)	4			40	60	100	4	DCC
CH 202	Organic Chemistry (General-II)	4			40	60	100	4	DCC
CH 203	Physical Chemistry (General-II)	4			40	60	100	4	DCC
CH 204	Computational Techniques	3			25	50	75	3	Foundation Course
CH 205	Soft Skills and Personaliy Development	2			40	60		0	MAC
CH 206	Inorganic Chemistry Lab-II			6	25	50	75	3	DCC
CH 207	Organic Chemistry Lab-II			6	25	50	75	3	DCC
CH 208	Physical Chemistry Lab-II			6	25	50	75	3	DCC
						Total	**600**	**24**	

SEMESTER III

Subject Code	Title	Teaching Hours per week			Maximum Marks				
		L	T	P	Internal Assessment	End-semester Examination	Total	Credits	Category Code
CH 301	Spectroscopy-I	4			40	60	100	4	DCC
CH 302	Spectroscopy-II	4			40	60	100	4	DCC
CH 303	Analytical Techniques	4			40	60	100	4	DCC
CH-304/314/324	Open Elective Course	3			25	50	75	3	OEC
CH-305/315/325	Inorganic / Organic / Physical Chemistry Lab-Special-I			6	25	50	75	3	DEC
CH-306/316/326	Inorganic / Organic / Physical Chemistry Lab -Special-II			6	25	50	75	3	DEC
CH-307/317/327	Inorganic / Organic / Physical Chemistry Lab -Special-III			6	25	50	75	3	DEC
						Total	**600**	**24**	

SEMESTER IV

Subject Code	Title	Teaching Hours per week			Maximum Marks			Credits	Category Code
		L	T	P	Internal Assessment	End-semester Examination	Total		
CH-401/411/421	Inorganic / Organic / Physical Chemistry Special-I	4			40	60	100	4	DEC
CH-402/412/422	Inorganic / Organic / Physical Chemistry Special-II	4			40	60	100	4	DEC
CH-403/413/423	Inorganic / Organic / Physical Chemistry Special-III	4			40	60	100	4	DEC
CH-404/414/424	Inorganic / Organic / Physical Chemistry Special-IV	4			40	60	100	4	DEC
CH 431	Project				50	150	200	8	DCC
						Total	**600**	**24**	

Abbreviation

DCC: Discipline Core Course

DEC: Discipline Elective Course

OEC: Open Elective Course

MAC: Mandatory Audit Course

M Sc CHEMISTRY, SEMESTER I

CODE: CH 101

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

NO OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	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 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 102

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

NO OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	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 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 103

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

NO OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	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 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 104 A

SUBJECT NAME: **Mathematics for Chemists**

NO OF CREDITS: 3

		SESSIONAL:	25
L	P	THEORY EXAM:	50
3	0	TOTAL:	75

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 104 B

SUBJECT NAME: **Mathematics for Chemists**

NO OF CREDITS: 3

		SESSIONAL:	25
L	P	THEORY EXAM:	50
3	0	TOTAL:	75

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

- 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 105

SUBJECT NAME: Inorganic Chemistry Lab-I

NO OF CREDITS: 3

		SESSIONAL:	25
L	P	FINAL EXAM:	50
0	6	TOTAL:	75

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: 35 marks
Lab Record: 10 marks
Viva-voce: 5 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 106

SUBJECT NAME: Organic Chemistry Lab-I

NO OF CREDITS: 3

	SESSIONAL:	25
L P	FINAL EXAM:	50
0 6	TOTAL:	75

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: 35 marks
Lab Record: 10 marks
Viva-voce: 5 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 107

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

NO OF CREDITS: 3

		SESSIONAL:	25
L	P	FINAL EXAM:	50
0	6	TOTAL:	75

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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 ac id 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 AgNO3 conductometrically.
v. Determine the basicity of mono- , di- and tri-basic acids conductometrically.
vi. Determine solubility and solubility product of sparingly soluble salts like PbSO4, BaSO4.

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: 35 marks
Lab Record: 10 marks
Viva-voce: 5 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 201

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

NO OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	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 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 meta l 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 meta l carbonyls; preparation, bonding, structure and important reactions of transit ion 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 202

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

NO OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	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 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 203

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

NO OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	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 study about the various aspects and details of quantum mechanics. To understand the chimstry 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 204

SUBJECT NAME: **Computational Techniques**

NO OF CREDITS: 3

		SESSIONAL:	25
L	P	THEORY EXAM:	50
3	0	TOTAL:	75

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 205

SUBJECT NAME: Inorganic Chemistry Lab-II

NO OF CREDITS: 3

		SESSIONAL:	25
L	P	FINAL EXAM:	50
0	6	TOTAL:	75

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: 35 marks
Lab Record: 10 marks
Viva-voce: 5 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 206

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

NO OF CREDITS: 3

		SESSIONAL:	25
L	P	THEORY EXAM:	50
3	0	TOTAL:	75

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: 35 marks
Lab Record: 10 marks
Viva-voce: 5 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 207

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

NO OF CREDITS: 3

		SESSIONAL:	25
L	P	THEORY EXAM:	50
3	0	TOTAL:	75

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: 35 marks
Lab Record: 10 marks
Viva-voce: 5 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. 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.