PANJAB UNIVERSITY CHANDIGARH-160 014 (INDIA)

(Estted. Under the Panjab University Act VII of 1947 enacted by the Govet. Of India)

FACULTY OF SCIENCE

SYLLABI

FOR
M.Sc. (TWO YEAR COURSE)

IN

CHEMISTRY

1st to 2nd YEAR (Semester System)

EXAMINATIONS 2019-20, 2020-21 and 2021-22

OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR M.Sc. FIRST YEAR *(SEMESTER-I)* EXAMINATION 2019-20, 2020-21 and 2021-22

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1st Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

First Year: There will be two Semesters in a year. Examination will be held at the end of each semester.

M.Sc. (Chemistry) 1st Year (1st Semester) (Marks: 500)

Paper	Course No.	Course	Hours	Marks		
				Semester 1st Exam.	Internal Assessment of House Test	Total
I	CH-411	Inorganic Chemistry 1	60	80	20	100
II	CH-412	Organic Chemistry 1	60	80	20	100
III	CH-413	Physical Chemistry 1	60	80	20	100
IV	*CH-414	(a) Mathematics for Chemists (b) Biology for Chemists (c) Computer for Chemists	30 30 30	40 40 40	10 10 10	100
V	CH-415	Laboratory Course (Inorganic Chemistry)				33
VI	CH-416	Laboratory Course (Organic Chemistry)				34
VII	CH-417	Laboratory Course (Physical Chemistry)				33

***There are three categories in this course**

Category I: Students without Mathematics in B.Sc. will opt (a) Mathematics for chemists and (c) Computer for Chemists.

Category 2: Students without Biology in B.Sc. will opt (b) Biology for chemists and (c) Computer for Chemists.

Category 3: Students without Mathematics and Biology in B.Sc. will opt (a) Mathematics for chemists and (b) Biology for Chemists.

The paper CH 414 will be of 80 marks of three hours. In this paper two separate answer sheets and papers either (a) and (c), (b) and (c), (a) and (b) will be provided to the students. Each (a), (b), (c) papers will be of 40 marks.

Subject: INORGANIC CHEMISTRY
PAPER: (1) CH-411

OBJECTIVE OF THE COURSE

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Time 3 hours
Max marks 80+20
(4 Hrs./Week)
(60 Hrs.)

UNIT 1

Stereochemistry And Bonding In Main Group Compounds (15 Hrs.)
VSEPR, Walsh diagrams (tri and tetra-molecules), d π-p π bonds, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules..

UNIT 2

Metal Ligand Bonding (15 Hrs.)
Limitations of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π bonding and molecular orbital theory.

UNIT 3

Metal-Ligand Equilibria In Solution (15Hrs.)
Stepwise and overall formation constant and their interaction, trends in stepwise constants, factors affecting the 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 spectrophotometry.

Reaction Mechanism of Transition Metal Complexes-I
Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valance bond and crystal field theories, kinetics of octahedral substitution.

UNIT 4

Reaction Mechanism of Transition Metal Complexes –II (15Hrs.)
Acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, reactions without metal-ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of substitution reaction, Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus Hush Theory, inner sphere type reactions.

Instructions for paper setters and candidates:

I. ***Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.***
II. ***The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.***
III. ***All questions carry equal marks.***

ESSENTIAL BOOKS:

1. Cotton, F.A.; Wilkinson *Advanced Inorganic Chemistry*, 6th edition, John Wiley& Sons, 1999.

2. Huheey, James E. *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th edition, Harper Collins College Publishers, 1993.

3. Greenwood, N.N. and Earnshaw, A. *Chemistry of the Elements*, 2nd edition, Butterworth-Heinemann, A division of Read Educational & Professional Publishing Ltd., 2001.

4. Lever, A.B.P. *Inorganic Electronic Spectroscopy*, 2nd edition, Elsevier Science Publishers B.V., 1984.

5. Carlin, Richard L. and Duyneveldt, A.J.Van *Magnetic Properties of Transition Metal Compounds*, Inorganic Chemistry Concepts 2, Springer-verlag New York Inc., 1977.

BOOKS FOR FURTHER READING:

1. Shriver, D.F.; Atkins, P.W. *Inorganic Chemistry*, 1st edition, Oxford University Press, 2006.

2. Earnshaw, A. *Introduction to Magnetochemistry*, Academic Press, 1968.

3. Dutta, R.L.; Syanal, A. *Elements of Magneto chemistry*, 2nd edition, Affiliated East West Press, 1993.

4. Drago, Russell S. *Physical Methods for Chemists*, 2nd edition, Saunders College Publishing, 1992.

Subject: ORGANIC CHEMISTRY
Paper : (II) CH-412

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1st Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 3 hours
Max marks 80+20
(4 Hrs./Week)
(60 Hrs.)

UNIT 1

Nature of Bonding in Organic Molecule (15 Hrs.)

Delocalized chemical bonding, conjugation, Cross conjugation, resonance hyper conjugation, Bonding in fullerenes, Tautomerism, Aromaticity in benzenoid and non benzenoid compd. Alternant and non alternant hydrocarbons, Huckel's rule. Energy level of π M.O., Annulenes, anti aromaticity, aromaticity, Homo aromaticity, PMO approach.

Bonds weaker than covalent, addition compound, crown ether complexes and cryptands, Inclusion compound, cyclo dextrins, Catenanes & rotaxanes.

Effect of structure on reactivity-resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation.

UNIT 2

Stereochemistry (15 Hrs.)

Conformational analysis of cyclo alkanes, decalins, effect of confirmation on reactivity. Confirmation of sugars, Steric strain due to undesirable crowding of resolution, entatiotropic and diasterotropic atoms. Stereo specific and stereo selective synthesis, chirality due to helical shape. Stereochemistry of compounds containing N,S,P.

UNIT 3

Aliphatic Nucleophilic Substitution (10 Hrs.)

The S_N2, S_N1, mixed S_N1 and S_N2 and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, Classical and non-classical carbocations, norbornyl system. common carbocation rearrangements. The S_Ni mechanism. Nucleophilic substitution at an allylic, aliphatic, trigonal and a vinylic carbon.

Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis, ambident nucleophile, regioselectivity.

Aliphatic Electrophilic Subsitution (5 Hrs.)

Biomolecular mechanisms-S_E2 and S_Ei. The S_E1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

UNIT 4

Aromatic Electrophilic Substitution (8 Hrs.)

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. Diazonium coupling, Vilsmeyer reaction, Gattermann-Koch reaction.

Aromatic Nucleophilic Substitution (7Hrs.)

The S_NAr, S_N1, benzyne and $S_{RN}1$ mechanisms, Reactivity-effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet-Hauser and smiles rearrangements.

Instructions for paper setters and candidates:

I. ***Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.***
II. ***The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.***
III. ***All questions carry equal marks.***

ESSENTIAL BOOKS:

1. March, Jerry *Advanced Organic Chemistry: Reactions, Mechanism and Structure*, 6th edition, John Wiley, 2007.
2. Carry, F. A.; Sundberg, R.J. *Advanced Organic Chemistry*, 3rd edition, Plenum, 1990.
3. Sykes, Peter *A Guide Book to mechanism in Organic Chemistry*, 6th edition, Longman, 1989.
4. Morrison, R. T.; Boyd, R. N. *Organic Chemistry*, 6th edition, Prentice Hall, 1992.
5. Kalsi, P. S. *Organic Reactions and their Mechanisms*, 2nd edition, New Age International Publishers, 2000.

BOOKS FOR FURTHER READING:

1. Mukherji, S.M.; Singh, S.P. *Reactions Mechanism in Chemistry*, Vol. I, II, III, Macmillan, 1985.
2. Nasipuri, D. *Stereochemistry of Organic Compound*s, 2nd edition New Age International Publishers, 1994.
3. Kalsi, P.S. *Stereochemistry of Organic Compounds*, 2nd edition, New Age International, 1993.
4. Kalsi, P.S. *Stereochemistry: Conformation and Mechanism*, 2nd edition, Wiley Eastern Limited, 1993.

Subject: PHYSICAL CHEMISTRY
Paper : (III) CH-413

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1st Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 3 hours

Max marks 80+20

(4 Hrs./Week)
(60 Hrs.)

UNIT 1

Quantum Chemistry **(15 Hrs.)**

Application of Schrodinger wave equation to particle in three dimensional box, simple harmonic oscillator and rigid rotator.

Approximate Methods: The variation theorem, Linear variation Principle, perturbation theory (first order, second order and Non degenerate), Applications of variation method and perturbation theory to the Helium atom. Self-Consistent-Field theory.

UNIT 2

Angular Momentum: **(15 Hrs.)**

Ordinary ang. momentum, generalized angular momentum,eigenfunctions for angular momentum, eigcuvalues of angular momentum, operator using ladder operators, addition of angular-momenta, spin, anti symmetry and Pauli exclusion principle.

Molecular Orbital Theory :

Huckel theory of conjugated systems, bond order and charge density calculations, application to ethylene, allyl, butadiene, cyclopropenyl system, cylobutadiene etc.

UNIT 3

Thermodynamics: **(15 Hrs.)**

Classical Thermodynamics:

Partial molal proporties, partial molal free energy, volume & heat content and their significance, Determination of these quantities, concept of fugacity and determination of fugacity. Non ideal systems, excess functions for non ideal solutions, Activity, Activity coeff, Debye huckel theory for activity coeff. electrolyte solutions, determination of activity & activity coeff, ionic strength. Application of phase rule to 3-component system, second order phase transitions.

Statistical Thermodynamics:

Concept of distribution, thermodynamic probability & most probable distribution, ensemble averaging, postulates of ensemble averaging, canonical, grand canonical & micro canonical ensembles.

UNIT 4

Statistical Thermodynamics: (15 Hrs.)

Corresponding distribution laws (using Lagrange's method of undetermined multipliers) Partition functions: Translational, Rotational, Vibrational, Electronic partitions functions. Calculation of Thermodynamic properties in terms of partition functions. Heat capacity, behaviour of solids chemical equilibria and equilibrium constant in terms of partition function, F.D. statistics, distribution law and application to metals. Bose Einsteins statistics. Distribution law & application to Helium**.**

Instructions for paper setters and candidates:

I. ***Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.***
II. ***The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.***
III. ***All questions carry equal marks***

ESSENTIAL BOOKS:

1. Atkins, P.W. *Physical Chemistry*, 3rd edition, ELBS, 1987.
2. Chandra, A.K *Introductions to Quantum Chemistry*, 4th edition, Tata McGraw Hill, 1994.
3. Young, R-J; Lovell, P.A. *Introduction to Polymers*, 2nd edition, Replika Press Pvt. Ltd., 1991.
4. Flory, P.J. *Principles of Polymer Chemistry*, 1st edition, Asian Book Private Ltd., 2006.
5. Crow, D.R. *Principles and Applications of Electrochemistry*, 4th edition, Chapman and Hall, London, 1994.

BOOKS FOR FURTHER READING:

1.Levine, Ira N. *Quantum Chemistry*, 5th edition, Prentice-Hall International, Inc., 2000.

2.McWeeny, R. *Coulson's Valence*, 3rd edition, ELBS, Oxford University Press, 1979.

3. Moore, J.W.; Pearson, R.G. *Kinetics and Mechanism*, 2nd edition, John Wiley and Sons, 1981.

4.Y. Moroi *Micelles: Theoretical and Applied Aspects*, 1st edition, Plenum Press, 1992.

5.Bockris, John O'M; Reddy, Amulya K.N. *Modern Electro-Chemistry*, 2nd edition, Plenum Press, New York, 1998.

6.Adamson, Arthur W. *Physical Chemistry of Surfaces*, 4th edition, A Wiley-Interscience Publication, 1982.

Subject: MATHEMATICS FOR CHEMISTS
Paper: (IV) CH-414 (a)

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1st Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time $1^{1/2}$ hours
Max marks 40+10
(2 Hrs./Week)
(30 Hrs.)

UNIT 1

Vectors **(15 Hrs.)**

Vector, dot, cross and triple products etc. The gradient, divergence and curl. Vector calculus.

Matrix Algebra

Addition and multiplication; inverse, adjoint and transpose of matrices, special matrices (Symmetric, skew-symmetric, Hermitian, unit, diagonal, unitary, etc.) and their properties. Matrix equation: Homogeneous, non-homogenous linear and conditions for the solution, linear dependence and independence. Introduction to vector spaces, matrix eigen values and eigen vectors, diagonalization, determinants (examples from Huckel theory).

Elementary Differential Equations

Variables-separable and exact, first-order differential equations, homogenous, exact and linear equations. Applications to chemical kinetics, secular equilibria, quantum chemistry, etc. Solutions of differential equations by the power series method, second order differential equations and their solutions.

UNIT 2

Differential Calculus **(15 Hrs.)**

Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc), exact and inexact differentials with their applications to thermodynamic properties. Integral calculus, basic rules for integration, integration by parts, partial fraction and substitution. Reduction formulae, applications of integral calculus. Functions of several variables, partial differentiation, co-ordinate transformations (e.g. Cartesian to spherical polar), curve sketching.

Permutation And Probability

Permutations and combinations, probability and probability theorems, probability curves, average, root mean square and most probable errors, examples from the kinetic theory of gases etc., curve fitting (including least squares fit etc.) with a general polynomial fit.

Instructions for paper setters and candidates:

1. Examiners will set total five questions comprising two question form each unit of sixteen marks and one compulsory question of short answer type of eight marks covering whole syllabi.

2. The students are required to attempt three questions in all. One question from each unit and the compulsory question.

ESSENTIAL BOOKS:

1. Steiner, E. *The Chemistry Mathematics*, 1st edition, Oxford University Press.

2. Doggett; Sucliffe *Mathematics for Chemistry*, 1st edition, Longman, 2003.

3. Daniels, F. *Mathematical Preparation for Physical Chemistry*, McGraw Hill.

4. Hirst, D.M. *Chemical Mathematics*, Longman.

5. Barrante, J. R. *Applied Mathematics for Physical Chemistry*, 3rd edition, Prentice Hall, 2004.

6. Tebbutt *Basic Mathematics for Chemists*, 1st edition, John Wiley, 1994.

Subject: BIOLOGY FOR CHEMISTS
PAPER: (IV) CH-414 (b)

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1^{st} Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time $1^{1/2}$ hours
Max marks 40+10
(2 Hrs./Week)
(30 Hrs.)

UNIT 1

Cell Structure and Functions: **(15Hrs.)**

Structure of prokaryotic and eukaryotic cell, intracellular organelles and their functions, comparison of plant and animal cells. Overview of metabolic processes –catabolism and anabolism. ATP-the biological energy currency. Origin of life – unique properties of carbon, chemical evolution and rise of living systems. Introduction to biomolecules, building blocks of bio-macromolecules.

Carbohydrates:

Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars. N-acetylmuramic acid, sialilic acid, disaccharides and polysaccharides. Structure and biological functions of glucosaminoglycans or muco-polysaccharides. Carbohydrates of glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid. Carbohydrate metabolism- kreb's cycle, glycolsis, glycognesis and glycogenolysis, gluconeogenenis, pentose phosphate pathway.

UNIT 2

Lipids: **(15 Hrs.)**

Fatty acids, essential fatty acids, structure and function of triacylglycerols, glyerophosphplipids, cholesterol, bile acids, prostaglandins, lipoproteins-composition and function, role in atherosclerosis. Properties of lipid aggregates micelles, bilayers, liposomes and their possible biological functions. Bioligical membrans. Fluid mosaic model of membrane structure. Lipid metabolism - beta oxidation of fatty acid.

Amino-acids, Peptides and Proteins:

Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins forces responsible for holding of secondary structures. Alpha helix, Beta sheets, secondary structure, triple helix structure of collagen. Tertiary structure of protein-folding and domain structure. Quaternary structure. Amino acid metabolism- degradation and biosynthesis of amino acids, sequence determination chemical enzymatic mass spectral, racemization detection. Chemistry of oxytocin and tryptophan releasing hormone.

Nucleic Acids:
Purines and pyrimidines bases of nucleic acids, base pairing via H-bonding.
Structure of ribonucleic acids RNA and deoxyribonucleic acids DNA, double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for hereditary, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside.

Instructions for paper setters and candidates:

1. Examiners will set total five questions comprising two question form each unit of sixteen marks and one compulsory question of short answer type of eight marks covering whole syllabi.

2. The students are required to attempt three questions in all. One question from each unit and the compulsory question.

ESSENTIAL BOOKS:

1. Lehninger, A.L. *Principles of Biochemistry*, Worth Publishers.

2. Stryer, L. *Biochemistry*, W.H. Freeman

3. Rawn, J. David *Biochemistry*, Neil Patterson.

4. Voet; Voet *Biochemistry*, John Wiley.

5. Conn, E.E.; Stumpf, P. K. *Outlines of Biochemistry*, John Wiley.

Subject: COMPUTER FOR CHEMISTS
PAPER: (IV) 414 (c)

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1st Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time $1^{1/2}$ hours
Max marks 40+10
(2 Hrs./Week)
(30 Hrs.)

UNIT I

Introduction To Computers And Computing: (15 Hrs.)

Basic structure and functioning of computers with a PC as an illustrative examples. Memory I/O devices secondary storage. Computer languages. operating system with DOS as an example. Introduction to UNIX and WINDOWS. Data processing, principles of programming, Algorithms and flow charts.

Use of Computer To Programmes:

The students will learn how to operate a PC and how to run standard programmes and packages. Execution of linear regression, X-Y plot, numerical integration and differentiation as well as differential equation solution programmes. Programmes with data preferably from Physical laboratory. Word processing Software such as WORDSTAR/MS-WORD / EXCEL.

UNIT 2

Programming in Chemistry: (15 Hrs.)

Development of small computer codes involving simple formulae in chemistry, such as Vander Waals equation, pH titration, kinetics, radio active decay evaluation of lattice energy and ionic radii from experimental data. Linear simultaneous equations to solve secular equations within the Huckel theory elementary structural features such as bond lengths, bond angles, dihedral angles etc. of molecules extracted from a data base such as Cambridge data base.

Computer Programming In FORTRAN/C/BASIC

Elements of the computer language. Constants and variables operators and variable symbols expressions. Arithmetic assignment statement.
Statement Input and output. Format statements Termination statements. Branching statement such as IF or go to statement. Logical variable Double precision variables. Subscripted variables and DIMENSION. DO statement. Function and SUBROUTINE. COMMON and DATA statements.

Instructions for paper setters and candidates:

1. Examiners will set total five questions comprising two question form each unit of sixteen marks and one compulsory question of short answer type of eight marks covering whole syllabi.

2. The students are required to attempt three questions in all. One question from each unit and the compulsory question.

ESSENTIAL BOOKS:

1. Hunt, R.; Shelley, J. *Computers and Common Sense*, Prentice Hall.

2. Norris, A.C. *Computational Chemistry*, 1st edition, John Wiley & Sons, 1981.

3. Killingbeck, J.P.; Hilger, Adam *Microcomputer Quantum Mechanics*.

4. Rajaraman, V. *Computer Programming in FORTRAN IV*, 4th edition, Prentice Hall India Pvt. Ltd., 1997.

5. Rajaraman, V.; RadhaKrishnan, V. *An Introduction to Digital Computer Design*, Prentice Hall.

LABORATORY COURSE (INORGANIC CHEMISTRY)
PAPER: (VI) CHP-415

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1st Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 4 hours
Max marks 33
(6 Hrs./Week)

1. Gravimetric Estimation of two constituents when present together in a given complex.
2. Analysis of two cation-system using EDTA.

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ESSENTIAL BOOKS:

1. Pass, G.; Sutcliffe *Practical Inorganic Chemistry*, 1st edition, Chapmann and Hall Ltd., 1968.
2. Jolly, W.L. *Synthetic Inorganic Chemistry*, 2nd edition, Prentice Hall, Inc., 1961.
3. Nakamoto, Kazuo *Infrared and Raman Spectra of Inorganic and Coordination Compounds: Part A and B*, 5th edition, John Wiley and Sons, 1997.
4. Mendham, J; Denney, R.C.; Barnes, J.D.; Thomas, M. *Vogel's Textbook of Quantitative Chemical Analysis*, 6th edition, Pearson Education, Ltd., 2000.

LABORATORY COURSE (ORGANIC CHEMISTRY)
PAPER: (VII) CHP-416

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1st Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 4 hours
Max marks 34
(6 Hrs./Week)

1. Organic Lab.(i) Safety: Eye, Fire and Chemicals
   (ii) Glassware
   (iii) Non-glass equipment
   (iv) Heating devices
   (v) Cleaning Glassware
2. To determine corrected melting points of an unknown organic compound (calibration of thermometer).
3. Adipic acid from cyclohexanol (oxidation).
4. p- Iodonitrobenzene from p-nitroaniline.
5. Preparation of benzyl alcohol and benzoic acid (Cannizzaro's reaction).
6. N- Bromo succinimide (Bromination).
7. Dibenzal acetone from benzaldehyde (Claisen-Schmidt reaction).
8. Cinnamic acid from benzaldehyde (Knoevenaegal reaction).
9. Acetanilide, bromoacetanilide, bromoaniline.
10. Diphenylmethane from benzylchloride (Friedel Craft's reaction).
11. Benzanilide (Schotten-Baumann reaction).
12. o-Benzoylbenzoic acid (Friedel Craft's reaction).

ESSENTIAL BOOKS:

1. Harwood, L.M., Moody, C.J. *Experimental Organic Chemistry*, 1st edition, Blackwell Scientific Publishers, 1989.
2. Vogel, A.I. *Text Book of Practical Organic Chemistry*, ELBS, IVth edition, Longman Group Ltd., 1978.
3. Mann, F.G.; Saunders, B.C. *Practical Organic Chemistry*, 4th edition, New Impression, Orient Longman Pvt. Ltd., 1975.
4. Tewari, K.S.; Vishnoi, N.K.; Mehrotra, S.N. *A Textbook of Organic Chemistry*, 2nd edition, Vikas Publishing House, 1976.
5. Leonard, J.; Lygo, B. *Advanced Practical Organic Chemistry*, Chapman and Hall, 1995.

LABORATORY COURSE (PHYSICAL CHEMISTRY)
PAPER: (VIII) CHP-417

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1st Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 4 hours
Max marks 33
(6 Hrs./Week)

1. Viscosity:

(i) Determination of percentage composition of a liquid mixture by viscosity measurement.

(ii) Determination of molecular weight of a high polymer (say polystyrene) by viscosity measurement.

2. Surface Tension:

(i) Determination of Parachor value of $>CH_2$ group.

(ii) To measure interfacial tension and to test the validity of Antonoff's rule.

(iii) To compare cleansing power of two detergents.

(iv) To determine the critical micelle concentration of a soap by surface tension method.

3. Solubility:

(i) Determination of solubility of an inorganic salt in water at different temperatures and hence to draw the solubility curve.

(ii) To study the effect of addition of an electrolyte on the solubility of an organic acid.

(iii) To study the variation of solubility of Ca $(OH)_2$ in NaOH solution and hence determine the solubility product.

4. Colloidal State:

(i) To compare the precipitation power of Na^+, Ba^{+2} & $A1^{+3}$ ions for As_2S_3 sol.

(ii) To study interaction between arsenious sulphide and ferric hydroxide sol.

5. Density:

Determine the partial molar volume of ethanol in dil. aqueous solution at room temperature.

ESSENTIAL BOOKS:

1. Levitt, B.P. *Findlay's Practical Physical Chemistry*, 9th edition, Longman Group Ltd., 1973.
2. Matthews, G. Peter *Experimental Physical Chemistry,* 1st edition, Oxford University Press, 1985.
3. Shoemaker, D.P.; Garland, C.W.; Nibler, J.W. *Experiments in Physical Chemistry*, 6th edition (International Edition) McGraw Hill Inc., 1996.
4. Khosla, B.D.; Garg, V.C. Gulati, A. *Senior Practical Physical Chemistry*, 11th edition, R. Chand and Co., 2002.

OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR M.Sc. FIRST YEAR *(SEMESTER-II)* EXAMINATION OF 2019-20, 2020-21 and 2021-22

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1st Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

First Year: There will be two Semesters in a year. Examination will be held at the end of each semester.

M.Sc. (Chemistry) 1st Year (2nd Semester) (Marks: 500)

Paper	Course No.	Course	Hours	Marks		
				Semester 2nd Exam.	Internal Assessment of House Test	Total
I	CH-421	Inorganic Chemistry 1	60	80	20	100
II	CH-422	Organic Chemistry 1	60	80	20	100
III	CH-423	Physical Chemistry 1	60	80	20	100
IV	CH-424	Group Theory, Spectroscopy and Diffraction Methods	60	80	20	100
V	CH-425	Laboratory Course (Inorganic Chemistry)				33
VI	CH-426	Laboratory Course (Organic Chemistry)				34
VII	CH-427	Laboratory Course (Physical Chemistry)				33

Instructions for paper setters and candidates:

I. ***Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.***
II. ***The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.***
III. ***All questions carry equal marks.***

Subject: INORGANIC CHEMISTRY
PAPER: (1) CH-421

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1^{st} Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 3 hours
Max marks 80+20
(4 Hrs./Week)
(60 Hrs.)

UNIT 1

Electronic Spectra and Magnetic Properties Of Transition Metal Complexes-I **(15 Hrs.)**

Spectroscopic ground states, correlation, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculations of D_q, B and β parameters, charge transfer spectra and Heteropoly Acids And Salts

UNIT 2

Electronic Spectra and Magnetic Properties Of Transition Metal Complexes-II **(15 Hrs.)**

Spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereo chemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

UNIT 3

Metal II–Complexes **(15 Hrs.)**

Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structure elucidation, important reaction of metal carbonyls. Preparation, bonding structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes, tertiary phosphine as ligand.

UNIT 4

Metal Cluster **(15 Hrs.)**

Higher boranes, carboranes, metallobranes and metallocarboranes, metal carbonyl and halide clusters, compounds with metal-metal multiple bonds.

Instructions for paper setters and candidates:

I. ***Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.***
II. ***The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.***
III. ***All questions carry equal marks.***

ESSENTIAL BOOKS:

1. Cotton, F.A.; Wilkinson *Advanced Inorganic Chemistry*, 6th edition, John Wiley& Sons, 1999.
2. Huheey, James E. *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th edition, Harper Collins College Publishers, 1993.
3. Greenwood, N.N. and Earnshaw, A. *Chemistry of the Elements*, 2nd edition, Butterworth-Heinemann, A division of Read Educational & Professional Publishing Ltd., 2001.
4. Lever, A.B.P. *Inorganic Electronic Spectroscopy*, 2nd edition, Elsevier Science Publishers B.V., 1984.
5. Carlin, Richard L. and Duyneveldt, A.J.Van *Magnetic Properties of Transition Metal Compounds*, Inorganic Chemistry Concepts 2, Springer-verlag New York Inc., 1977.

BOOKS FOR FURTHER READING:

1. Shriver, D.F.; Atkins, P.W. *Inorganic Chemistry*, 1st edition, Oxford university Press, 2006.
2. Earnshaw, A. *Introduction to Magnetochemistry*, Academic Press, 1968.
3. Dutta, R.L.; Syanal, A. *Elements of Magneto chemistry*, 2nd edition, Affiliated East West Press, 1993.
4. Drago, Russell S. *Physical Methods for Chemists*, 2nd edition, Saunders College Publishing, 1992.

Subject: ORGANIC CHEMISTRY

Paper : (II) CH-422

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1st Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 3 hours
Max marks 80+20
(4 Hrs./Week)
(60 Hrs.)

UNIT 1

Reaction Mechanism, Structure and Reactivity (8 Hrs.)

Types of mechanism, types of reactions, thermodynamics and kinetic requirement. Kinetic and thermodynamics control, Hammond's postulate, Curtin-Hammett Principle, Potential energy diagrams, transition states and intermediates, method of determining mechanisms, isotope effects.

Addition to Carbon-Carbon Multiple Bonds (7 Hrs.)

Mechanistic and stereochemical aspects of addition reaction involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, orientation and reactivity.
Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic ring. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation.

UNIT 2

Addition To Carbon-Heteroatom Multiple Bonds (15 Hrs.)

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.

UNIT 3

Free Radical Reactions (8 Hrs.)

Type of free radical reactions, free radical substitution mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity.
Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation.
Coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free Radical Rearrangement. Hunsdiecker reaction.

Elimination Reaction **(7 Hrs.)**

The E2, E1 and E1cB mechanisms and their spectrum, Orientation of the double bond. Reactivity effects of substrate structure, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

UNIT 4

Pericyclic Reactions **(15Hrs.)**

Molecular orbital symmetry, frontier orbitals of ethylene, 1,3-butadiene, 1, 3, 5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions conrotatory and disrotatory motions 4n, 4n +2 and allyl system. Cycloadditions-antarafacial suprafacial additions, 4n and 4n+2 systems, 2+2 additiion of ketenes, 1, 3-dipolar cycloadditions and cheleotropic reactions.

Sigmatropic rearrangements-Suprafacial and antarafacial shifts of H.

Sigmatropic shifts involving carbon moieties, [3, 3]-and [5, 5]- sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangement. Fluxional tautomerism. Ene reaction.

Instructions for paper setters and candidates:

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.

ESSENTIAL BOOKS:

1. March, Jerry *Advanced Organic Chemistry: Reactions, Mechanism and Structure*, 6th edition, John Wiley, 2007.

2. Carry, F. A.; Sundberg, R.J. *Advanced Organic Chemistry*, 3rd edition, Plenum, 1990.

3. Sykes, Peter *A Guide Book to mechanism in Organic Chemistry*, 6th edition, Longman, 1989.

4. Morrison, R. T.; Boyd, R. N. *Organic Chemistry*, 6th edition, Prentice Hall, 1992.

5. Kalsi, P. S. *Organic Reactions and their Mechanisms*, 2nd edition, New Age International Publishers, 2000.

BOOKS FOR FURTHER READING:

1. Mukherji, S.M.; Singh, S.P. *Reactions Mechanism in Chemistry*, Vol. I, II, III, Macmillan, 1985.
2. Nasipuri, D. *Stereochemistry of Organic Compound*s, 2nd edition New Age International Publishers, 1994.
3. Kalsi, P.S. *Stereochemistry of Organic Compounds*, 2nd edition, New Age International, 1993.
4. Kalsi, P.S. *Stereochemistry: Conformation and Mechanism*, 2nd edition, Wiley Eastern Limited, 1993.

Subject: PHYSICAL CHEMISTRY
Paper : (III) CH-423

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1st Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 3 hours
Max marks 80+20
(4 Hrs./Week)
(60 Hrs.)

UNIT 1

Chemical Dynamics: (15 Hrs.)

Methods of determining rate laws, ionic reactions*, kinetic salt effects, steady state kinetics, kinetic & thermodynamic control of reactions, treatments of unimolecular reactions, Dynamic chain (pyrolysis of acetaldehyde composition of ethane), photochemical (H2-cl2) reactions & oscillatory reactions (Belousov-Zhabotinsky reaction), homogeneous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis, and NMR method, dynamics of molecular motion, probing the transition state, dynamics of barrierless chemical reactions in solution, dynamics of unimolecular reaction (Lindemann-Hinshelwood and Rice-Ramsperger-Kassel-Marcus Theories of unimolecular reactions)

UNIT 2

Non-equilibrium Thermodynamics: (15 Hrs.)

Thermodynamic criteria for non eqbm states, entropy production and entropy flow, entropy balance eqns for different irreversible processes (eg. heat flow, chemical reaction etc.), transformation of generalized fluxes and forces, noneqbm stationary states, phenomenological equators, microscopic reversibility and onsager's reciprocity relations, electro kinetic phenomenon, diffusion, electrical conduction, irreversible thermodynamics for biological system, coupled reactions.

Macromolecules:

Electrically conducting, fire resistant, liquid crystal polymers, Kinetics of polymerization, mechanism of polymerization, mol.mass determination (osmometry, viscometry, diffusion & light scattering methods), sedimentation, chain config. of macromolecules, calculation of average dimensions.

UNIT 3

Surface Chemistry **(15 Hrs.)**

Adsorption: Surface tension, capillary action, pressure difference across curved surface (Laplace eqn), vapour pressure of droplets, (Kelvin eqn), Gibb's adsorption isotherm, estimation of surface area (BET eqn), surface films on liquids (electro kinetic phenomenon), catalytic activity at surfaces.

Micelles: Surface active agents, classification of surface active agents, micellisation, hydrophobic interactions, critical micellar comentration, factors affecting CMC of surfactants, counter ions binding to micelles, thermodynamics of micellization-phase separation & mass action models, solubilization, microemulsion, reverse micelles.

UNIT 4

Electrochemistry: **(15 Hrs.)**

Electrochemistry of solutions, Debye-Huckel treatment, and its extension, ion solvent interaction, Debye-Huckel-Jerrum model, Thermodynamics of electrified interface equations, derivation of electrocapillarity, Lippmann equations (surface excess), Methods of determining structures of electrified interfaces, Guoy-Chapman, Stern. Over potentials, exchange current density, derivation of Butler-volmer equation. Tafel plots. Quantum aspects of charge transfer at electrode solution interfaces, quantization of charge transfer, tunnelling Semiconductor interfaces- theory of double layer interfaces, effects of light at semiconductor solution interface.

Electrocatalysis :

Influence of various parameters, H-electrode, polarography, theory Ilkovic eqn, (excluding derivation), Half wave potential & its significance, electrocardiography, introduction to corrosion, homogeneous, theory, forms of corrosion, corrosion monitoring.

Instructions for paper setters and candidates:

I. ***Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.***
II. ***The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.***
III. ***All questions carry equal marks.***

ESSENTIAL BOOKS:

1. Atkins, P.W. *Physical Chemistry*, 3rd edition, ELBS, 1987.
2. Chandra, A.K *Introductions to Quantum Chemistry*, 4th edition, Tata McGraw Hill, 1994.
3. Laidler, Keith J. *Chemical Kinetics*, 3rd edition, Harper & Row, Publishers, New York, 1987.
4. Young, R-J; Lovell, P.A. *Introduction to Polymers*, 2nd edition, Replika Press Pvt. Ltd., 1991.
5. Flory, P.J. *Principles of Polymer Chemistry*, 1st edition, Asian Book Private Ltd., 2006.
6. Crow, D.R. *Principles and Applications of Electrochemistry*, 4th edition, Chapman and Hall, London, 1994.

BOOKS FOR FURTHER READING:

1. Levine, Ira N. *Quantum Chemistry*, 5th edition, Prentice-Hall International, Inc., 2000.
2. McWeeny, R. *Coulson's Valence*, 3rd edition, ELBS, Oxford University Press, 1979.
3. Moore, J.W.; Pearson, R.G. *Kinetics and Mechanism*, 2nd edition, John Wiley and Sons, 1981.
4. Y. Moroi *Micelles: Theoretical and Applied Aspects*, 1st edition, Plenum Press, 1992.
5. Bockris, John O'M; Reddy, Amulya K.N. *Modern Electro-Chemistry*, 2nd edition, Plenum Press, New York, 1998.
6. Adamson, Arthur W. *Physical Chemistry of Surfaces*, 4th edition, A Wiley-Interscience Publication, 1982.

Subject: GROUP THEORY, SPECTROSCOPY AND DIFFRACTION METHODS
Paper : (IV) CH - 424

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1^{st} Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 3 hours
Max marks 80+20
(4 Hrs./Week)
(60 Hrs.)

UNIT 1

Symmetry And Group Theory In Chemistry: (15 Hrs.)

Symmetry elements & symmetry operation, definitions of group, subgroup, relation between orders of a finite group & its sub groups. Point group symmetry. Representations of groups by matrices (representation for the C_n, C_{nv}, C_{nn}, D_{nn} etc. group) character of a representation. The great orthogonality theorem and its importance character tables and there use-in spectroscopy.

UNIT 2

Microwave Spectroscopy: (15 Hrs.)

Classification of molecules rigid rotor model, effect of isotopes; non rigid rotor Stark effect, nuclear and electron spin interaction & effect of external field.

Vibrational Spectroscopy:

Infrared Spectroscopy:- Linear Harmonic Oscillator, Vibrational energy of diatomic molecule zero point energy, force constants & bond lengths anharmonicity, morse potential energy diagram. Vibrational rotational spectroscopy, P, Q, R, branches. Selection rules Normal modes of vibration, group frequencies, overtones, hot bands,

Raman Vibrational:- Classical & quantum theories of Raman effect pure rotational, vibrational and vibrational. Rotational Raman spectroscopy. Coherent anti stokes Raman spectroscopy.

UNIT 3

Molecular Spectroscopy: (15 Hrs.)

Energy levels, molecular orbital, Frank Condon's Principles, electronic spectra of polyatomic molecules emission spectra; radiative & non radiative decay. Spectra of transition metal complexes; change transfer spectra.

Basic Principles Photoelectric Effect, Ionization Process:

Koopman's theorem, photoelectron spectra of simple molecule. Auger electron spectroscopy.

Diffraction:

Bragg's condition, Miller indices. Debye-Scherrer method for structure analysis.

Principal and applications of neutron diffraction and electron diffraction

UNIT 4

Magnetic Resonance Spectroscopy: (15 Hrs.)

Nuclear Magnetic Resonance Spectroscopy:-

Nuclear spin, Nuclear resonance, shielding of magnetic nuclei, chemical shifts deshielding, spin-spin interactions, (ABX, AMX, ABC, A_2 B_2) spin decoupling.

Nuclear Quadrupole Resonance spectroscopy:-

Quadrupole Nuclear moments, electic field gradient complex constants applications.

Instructions for paper setters and candidates:

I. ***Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.***
II. ***The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.***
III. ***All questions carry equal marks.***

ESSENTIAL BOOKS:

1. Windawi, H.; Ho, F.L. *Applied Electron Spectroscopy for Chemical Analysis*, Wiley Interscience.
2. Parish, R.V. *NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry*, 1st edition, Ellis Harwood, 1990.
3. Drago, Russell S. *Physical Methods for Chemists*, 2nd edition, Saunders College Publishing, 1992.
4. Cotton, F.A. *Chemical Applications of Group Theory*, 3rd edition, Wiley Inter Science Publication, 1971.
5 Ghosh, P.K. *Introduction to Photoelectron Spectroscopy*, 1st edition, John Wiley Inter Science, 1982.
6. Glusker, J.P. *Crystal Structure and Analysis: a Primer*, Oxford University Press, 1985.
7. Reddy, K.V. *Symmetry and Spectroscopy of Molecules*, 1st edition, New Age International (P) Ltd., 1998.
8. Banwell, C.N. *Fundamentals of Molecular Spectroscopy*, 4th edition, Tata McGraw-Hill Publishing Company Ltd., 1994.

BOOKS FOR FURTHER READING:

1. Hollas, J.M. Modern Spectroscopy, 4th edition, John Wiley, 2004.
2. Barrow, G.M. Introduction to Molecular Spectroscopy, 1st edition, McGraw Hill, 1962.
3. Chang, R. Basic Principles of Spectroscopy, 2nd edition, McGraw Hill, 1971.
4. Jaffe, H.H. and Orchin, M. Theory and Applications of UV Spectroscopy, 1st edition, John Wiley, 1962.
5. Jackman, L.M.; Sternhell, S. Applications of Nuclear Magnetic Resonance Spectroscopy in Organic Chemistry, Pergamon Press, 1969.
6. Kemp, William Organic Spectroscopy, 3rd edition, Macmillan Press Ltd., 1991.
7. Ebsworth, E.A.V.; Rankin, D.W.H.; Cracock, S. Structural Methods in Inorganic Chemistry, 1st edition, ELBS, 1987.

LABORATORY COURSE (INORGANIC CHEMISTRY)
PAPER: (VI) CHP-425

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1^{st} Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 4 hours
Max marks 33 **(6 Hrs./Week)**

1. Preparation of hexamminecobalt(III) chloride and determine the percentage of cobalt in the product iodimetrically.
2. Preparation of chloropentaammine cobalt (III) chloride and interpretation of electronic spectrum and magnetic properties.
3. Preparations of nitropentamminecobalt (III) chloride from chloropentaamminecobalt (III) chloride and interpretation of electronic spectrum and magnetic properties.
4. Preparations of nitritopentamminecobalt (III) chloride from chloropentaamminecobalt (III) chloride and interpretation of electronic spectrum and magnetic properties.
5. Preparation of cis-and trans isomers of $[Co(en)_2Cl_2]Cl$ and interpretation of electronic spectra and magnetic properties.
6. Preparations of $Cu_2(CH_3COO)_4\ (H_2O)_2$ from $CuSO_4.5H_2O$ and interpretation of electronic spectrum and magnetic properties.
7. Preparation of cis-and trans isomers of $K[Cr(C_2O_4)(H_2O)_2].2H_2O$ and interpretation of electronic spectra and magnetic properties.
8. Preparation of Tris(thiourea)cuprous (I) sulphate $[Cu(tu)_3]_2SO_4.2H_2O$ (Where tu stands for thiourea) and determine the percentage of copper in the product iodimetrically.
9. Preparation of $[Co(acac)_3]$ and interpretation of electronic spectrum and magnetic properties.
10. Preparation of potassium trioxalatoaluminate(III) and tris(acetylacetonato)aluminium(III).

ESSENTIAL BOOKS:

1. Pass, G.; Sutcliffe *Practical Inorganic Chemistry*, 1^{st} edition, Chapmann and Hall Ltd., 1968.
2. Jolly, W.L. *Synthetic Inorganic Chemistry*, 2^{nd} edition, Prentice Hall, Inc., 1961.
3. Kolthoff, I.M.; Sanddl, E.B. *Text Book of Quantitative Inorganic Analysis*, Revised Edition, London Macmillan and Co. Ltd., 1950.
4. Nakamoto, Kazuo *Infrared and Raman Spectra of Inorganic and Coordination Compounds: Part A and B*, 5^{th} edition, John Wiley and Sons, 1997.
5. Mendham, J; Denney, R.C.; Barnes, J.D.; Thomas, M. *Vogel's Textbook of Quantitative Chemical Analysis*, 6^{th} edition, Pearson Education, Ltd., 2000.

LABORATORY COURSE (ORGANIC CHEMISTRY)
PAPER: (VII) CHP-426

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1st Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 4 hours
Max marks 34
(6 Hrs./Week)

Qualitative Analysis of mixtures of two organic solids:
Separation of the compounds and their identification through various steps, derivative preparation, checking the purity of components by melting point.

ESSENTIAL BOOKS:

1. Harwood, L.M., Moody, C.J. *Experimental Organic Chemistry*, 1st edition, Blackwell Scientific Publishers, 1989.

2. Vogel, A.I. *Text Book of Practical Organic Chemistry*, ELBS, IVth edition, Longman Group Ltd.,1978.

3. Mann, F.G.; Saunders, B.C. *Practical Organic Chemistry*, 4th edition, New Impression, Orient Longman Pvt. Ltd., 1975.

4. Tewari, K.S.; Vishnoi, N.K.; Mehrotra, S.N. *A Textbook of Organic Chemistry*, 2nd edition, Vikas Publishing House, 1976.

5. Leonard, J.; Lygo, B. *Advanced Practical Organic Chemistry, Chapman and Hall, 1995.*

LABORATORY COURSE (PHYSICAL CHEMISTRY)
PAPER: (VIII) CHP-427

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (1^{st} Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 4 hours
Max marks 33
(6 Hrs./Week)

1. **Polarimetry:** (i) To study the inversion of cane sugar by optical rotation measurement.
   (ii) To determine the specific and molecular rotations of optically active substances.
2. **Potentiometry:**
   (i) Determination of valence of mercurous ion.
   (ii) Determination of pH value using quinhydrone electrode.
   (iii) Determination of heat of reaction, equilibrium constant and other thermodynamic functions for:
   (a) $Zn + Cu^{+2}$ $Zn^{+2}+Cu$
   (b) $Zn+Pb^{+2}$ $Zn^{+2}+Pb$
   (iv) Determination of hydrolysis constant of aniline hydrochloride / ammonium chloride electrometrically.
3. **Flame Photometry:**
   (i) Determination of Na^+ & K^+ when present together.
   (ii) Determination of Lithium/Calcium/Barium/Strontium.

ESSENTIAL BOOKS:

1. Levitt, B.P. *Findlay's Practical Physical Chemistry*, 9^{th} edition, Longman, 1973.
2. Matthews, G. Peter *Experimental Physical Chemistry,* 1^{st} edition, Oxford University Press, 1985.
3. Shoemaker, D.P.; Garland, C.W.; Nibler, J.W. *Experiments in Physical Chemistry*, 6^{th} edition (International Edition) McGraw Hill Inc., 1996.
4. Khosla, B.D.; Garg, V.C. Gulati, A. *Senior Practical Physical Chemistry*, 11^{th} edition, R.Chand and Co., 2002.

OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR M.Sc. 2nd YEAR (SEMESTER-3rd) EXAMINATION OF 2019-20, 2020-21 and 2021-22

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Second year: There will be two Semesters in a year. Examination will be held at the end of each semester.

M.Sc. (Chemistry) 2nd Year (3rd Semester) (Marks: 500)

Paper	Course No.	Course	Hours	Marks		
				Annual Exam.	Internal Assessment of House Test	Total
I	CH-511	Applications of Spectroscopy	60	80	20	100
II	CH-512	Organotransition Metal Chemistry	60	80	20	100
III	CH-513	Heterocyclic Chemistry	60	80	20	100
IV	CH-514	Environmental Chemistry	60	80	20	100
V	CH-515	Inorganic Chemistry (Laboratory Course)				33
VI	CH-516	Organic Chemistry (Laboratory Course)				34
VII	CH-517	Physical Chemistry (Laboratory Course)				33

Instructions for Paper setters and Candidates:

I. ***Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.***
II. ***The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.***
III. ***All questions carry equal marks.***

SUBJECT: APPLICATIONS OF SPECTROSCOPY
PAPER: (1) CH-511

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 3 hours
Max marks 80+20
(4 Hrs./Week)
(60 Hrs.)

UNIT 1

Electron Spin Resonance Spectroscopy (8 Hrs.)

Hyperfine coupling, spin polarization for atoms and transition metal ions , spin orbit coupling and significance of g-tensors , application of transition metal complexes (having one unpaired electron) including biological systems and to inorganic free radicals such as:

$\cdot OH$ $SO_4^{\cdot -}$ $H_2PO_4^{\cdot}$ $PO_4^{\cdot 2-}$ $HPO_4^{\cdot -}$

Nuclear Magnetic Resonence of Paramagnetic Substances in Solution (7Hrs.)

The contact and psedo contact shifts, factors affecting nuclear relaxation, some applications including biochemical systems, an overview of NMR of metal nuclides with emphasis on ^{195} Pt and ^{119} Sn NMR.

UNIT 2

Mossbauer Spectroscopy (6 Hrs.)

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 and inequivalent MB atoms.

Vibrational Spectroscopy (5 Hrs.)

Mode of bonding of ambidentate ligands , ethylenediamine and diketonato complexes, applications of resonance Raman spectroscopy particularly for the study of active sites of metalloproteins.

Organic chemistry

Ultraviolet and Visible Spectroscopy (4 Hrs.)

Various electronic transitions (185-800nm),Beer-Lambert law, effect of solvent on electronic transition, ultraviolet bands for carbonyl compounds,unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser- Woodwared rules for conjugated dienes and carbonyl , ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyles.

UNIT 3

Infrared Spectroscopy (5 Hrs.)

Instrumentation and sample handling. Characteristics vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols ,ethetrs fhenols and amines .Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters amids acids, anhydrides, lactones, lactans and conjugated carbonyl compounds). Effect of hydrogrn bonding of solvent effect on vibrational frequencies , overtones, combination bands and Fermi resonance. FT-IR of gaseous, solid and polymeric materials.

Nuclear Magnetic Resonance Spectroscopy (10 Hrs.)

General introduction and definition, chemical shift, spin spin interaction,shielding mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic,olefinic,aldehydic and aromatic) anothernuclei (alcoholic, phenols, enols, carboxlicacids, amines, amides & mercapto),chemical exchange,effect of deuteration,complex spin-spin interaction between two, three, four, five nuclei (first order sperctra) virtual coupling, stereochemistry, hindered rotation, karplus curve variation of coupling constant with dihedral angle. simplification of complex spectra- nuclear magnetic double reasonane, contact shift reagents, solvent effects,fourier tansform tecnhnique, nuclear overhauser effect (NOE) resonance of other nuclei –F,P

UNIT 4

Carbon-13 NMR spectroscopy (6 Hrs.)

General considration chemical shift (aliphatic olefinic alkyne aromatic eteroaromatic and carbonyl carbon)coupling constants.Two dimension
NMRspect- roscopy –COSY,NOESY,DEPT,APT, and INADEQUATE technique.

Mass Spectrometry (9 Hrs.)

Introduction, ion production –EI,CI,FD and FAB, factors affecting fragmentation,ion analysis,ion abundance.Mass septracl fragmentation of organic compounds,common functional group,molecular ion peak,metastabl peak,Mclafferty rearrangement. nitrogen rule,high resolution mass spectrometery.Example of mass spectral fragmentation of organic compounds with respect to their structure determination.

ESSENTIAL BOOKS:

1. Drago, Russell S. *Physical Methods for Chemists*, 2nd edition, Saunders College Publishing, 1992.
2. Ebsworth, E.A.V.; Rankin, D.W.H.; Cracock, S. *Structural Methods in Inorganic Chemistry*, 1st edition, ELBS, 1987.
3. Cotton, F.A.; Lippard, S.J. *Progress in Inorganic Chemistry,* Vol. 8, Vol. 15, Wiley Internationals.
4. Lever, A.B.P. *Inorganic Electronic Spectroscopy*, 2nd edition, Elsevier Science Publishers B.V., 1984.
5. Parish, R.V. *NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry*, 1st edition, Ellis Harwood, 1990.
6. Silverstein, R.M.; Bassler, G.C.; Morrill, T.C. *Spectrometric Identification of Organic Compounds*, 6th edition, John Wiley, 2002.
7. Abraham, R.J.; Fisher, J.; Loftus, P. *Introduction to NMR Spectroscopy*, Wiley.
8. Dyer, J.R. *Application of Spectroscopy of Organic Compounds*, Prentice Hall.
9. Nakamoto, Kazuo *Infrared and Raman Spectra of Inorganic and Coordination Compounds: Part A and B*, 5th edition, John Wiley and Sons, 1997.

BOOKS FOR FURTHER READING:

1. Carlin, R.I. *Transition Metal Chemistry*, Vol. 3, Dekker.
2. Martin, M.L.; Delpeuch, J.J.; Martin, G.J. *Practical NMR Spectroscopy*, Heyden.
3. Williams, D.H.; Fleming, I. *Spectroscopic Methods in Organic Chemistry*, Tata McGraw-Hill.

SUBJECT: ORGANOTRANSITION METAL CHEMISTRY
PAPER: (II) CH-512

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 3 hours
Max marks 80+20
(4 Hrs./Week)
(60 Hrs.)

UNIT 1

Compounds of Transition Metal-Carbon Multiple Bonds (12 Hrs.)

Alkylidenes, alkylidynes, low valent Carbenes and carbynes-Synthesis, nature of bond, Structural Characteristics, nucleophilic and Electrophilic reaction on the ligands, role in organic synthesis

Transition Metal Compounds with Bonds to Hydrogen (3 Hrs.)

Transition metal Compounds with bonds to hydrogen

UNIT 2

Transition Metal Complexes (15 Hrs.)

Transition Metal Complexes with unsaturated Organic molecules, alkenes, alkynes, Allyl, diene, dienyl, arene and trienyl complexes, preparations, properties, nature of bonding and structural features importantreactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis.

UNIT 3

Alkyls and Aryls of Transition Metals (6 Hrs.)

Types, routes of synthesis, Stability and decomposition Pathways, organocopper in Organic Synthesis.

Fluxional organometallic compounds (9 Hrs.)

Fluxionality and dynamic equilibria in compounds such as η^2 Allyl and dienyl Complexes.

UNIT 4

Homogeneous Catalysis (15 Hrs.)

Stoichiometric reaction for catalysis, homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reations involving carbon monoxide such as hydrocarbonylation of olefins (oxo reaction) oxopalladation reactions, activation of C-H bond. Monsanto acetic acid synthesis, water gas shift reaction and Fischer–Tropsch Synthesis**.**

Instructions for Paper setters and Candidates:

I. ***Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.***
II. ***The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.***
III. ***All questions carry equal marks.***

ESSENTIAL BOOKS:

1. Collman, J.P.; Norton, J.R.; Hegsdus, L.S.; Finke, R.G. *Principles and Application of Organotransition Metal Chemistry*, University Science Books.
2. Crabtree, R.G. *The Organometallic Chemistry of the Transition Metals*, 4th edition, John Wiley, 2005.
3. Mehrotra; Singh, A. *Organometallic Chemistry*, 2nd edition, New Age International, 2005.
4. Cotton, F.A.; Wilkinson *Advanced Inorganic Chemistry*, 6th edition, John Wiley, 1999.

BOOKS FOR FURTHER READING:

1. Pearson, A.J. *Metallo-Organic Chemistry*, Wiley.

SUBJECT: HETEROCYCLIC CHEMISTRY
PAPER: (II) CH-513

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 3 hours
Max marks 80+20
(4 Hrs./Week)
(60 Hrs.)

UNIT 1

Nomenclature of Heterocycles **(4 Hrs.)**

Replacement and systematic nomenclature (Hantzsch-widman System) for monocyclic fused and bridged hetrocycles

Aromatic Heterocycles **(5 Hrs.)**

General chemical behaviour of aromatic heterocycles classification (structural type) criteria of aromaticity(bond length ring current and chemical shift in H NMR- Spectra empirical resonance energy delocalization energy and Dewar resonance energy Diamagnetic susceptibility exaltations)

Non- aromatic Heterocycles **(6 Hrs.)**

Strain-bond angle and torsional strains and their conseqences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular Geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction. Stereo-electronic effects-anomeric and related effects Attractive interactions-hydrogen bonding and intermolecular nucleophilic-electrophilic interactions.

UNIT 2

Heterocyclic synthesis **(8 Hrs.)**

Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition Reactions. Three- membered and four-membered heterocycles-synthesis and reactions of aziridines , oxiranes, thiiranes, azetidines, oxetanes and thietanes

Benzo-Fused Five-Memberd Heterocycles **(7 Hrs.)**

Synthesis and reaction including medicinal applications of benzopyrroles, benzofurans and benzothiophenes

UNIT 3

Meso-ionic Heterocycles **(5 Hrs.)**

General classification chemistry of some important meso-ionic heterocycles of type-A and B and their applications

(5 Hrs)

Synthesis of pharmaceutical compounds having heterocyclic ring with one or more heteroatom.

Pencillin-V, Cephalosporin –C, Benzodiazepine (Midazolam, Diazepam), (Antidepressant Fluoxetine, Escitalopram), Proton Pump inhibitors (Omeprazole, Pentoperazole), Antihypertensive (Nifedipine, Losartan)

Six-Membered Heterocycles with Two or More Hetroatoms **(5 Hrs.)**

Synthesis and reactions of diazines, triazines, tetrazines and thiazines

UNIT 4

1,2-Azoles: pyrazoles, isothiazoles and isoxazoles (7 Hrs.)

Introduction to 1,2-azoles, synthesis of 1,2-azoles. Addition on nitrogen: protonation, N-alkylation, N-acylation. Reaction with electrophilic and nucleophilic reagents. Reaction with bases: reaction of N-metallated pyrazole, reaction of C-metallated 1,2-azoles. Reaction with oxidizing and redusing agents.

1,3-Azoles: imidazoles, thiazoles and oxazoles (8 Hrs.)

Introduction to 1,3-azoles, synthesis of 1,3-azoles. Addition at nitrogen: protonation, N-alkylation, N-acylation. Reaction with electrophilic and nucleophilic reagents.Reaction with bases: reaction of N-metallated imidazole, reaction of C-metallated 1,3-azoles.Reaction with oxidizing and redusing agents. Synthesis and reaction of quaternary 1,3-azolium salt and 1,3-azole-N-oxide.

Instructions for Paper setters and Candidates:

I. ***Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.***
II. ***The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.***
III. ***All questions carry equal marks.***

ESSENTIAL BOOKS:

1. Gupta, R.R.; Kumar, M.; Gupta, V *Heterocyclic Chemistry,* Vol.1-3, Springer Verlag, 1998.
2. Joule, J.A.; Mills, K.; Smith, G. F. *Heterocyclic Chemistry*, 3rd edition, Chapman and Hall, 1998.
3. Acheson, R.M. An *Introduction to the Heterocyclic Compounds*, John Wiley.
4. Katrizky, A.R.; Rees, C.W. *Comprehensive Heterocyclic Chemistry*, Pergamon Press.
5. Sriram,D.; Yogeeswari, P. Medicinal Chemistry 2nd Ed. Pearson

BOOKS FOR FURTHER READING:

1. Eicher, T.; Hauptmann, S.; Thieme *The Chemistry of Heterocycles*.
2. Gilchrist, T.L. *Heterocyclic Chemistry*, 3rd edition, Longman Scientific Technical, 1992.
3. Newkome, G.R.; Paudler, W.W. *Contemporary Heterocyclic Chemistry*, Wiley-Inter Science.
4. Katrizky, A.R.; Rees, C.W. *Comprehensive Heterocyclic Chemistry*, Pergamon Press.

SUBJECT: ENVIRONMENTAL CHEMISTRY
PAPER: (IV) CH-514

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 3 hours
Max marks 80+20
(4 Hrs./Week)
(60 Hrs.)

UNIT 1

Environment **(6 Hrs)**

Introduction. Ccomposition of atmosphere, vertical temperature, heat budget of the Earth atmospheric system, vertical stability atmosphere. Biogeochemical cycles of C,N,P,S and O. Biodistribution of elements.

Environmental Toxicology **(9 Hrs.)**

Chemical solutions to environmental problems, biodegradability, principles of decomposition ,better industrial processes. Bhopal gas tragedy, Chernobyl, Three mile island, Sewozo

UNIT 2

Industrial Pollution **(15 Hrs.)**

Cement sugar, distillery, drug, paper, thermal power plants, nuclear Power plants, metallurgy. Polymers, drugsetc. Radionuclide analysis. Disposal of wastes and their management.and Minamata disasters.

Soils

Composition, micro and macro nutrients, pollution- fertilizers, pesticides, plastic and metals. Waste treatment

UNIT 3

Hydrosphere **(15 Hrs.)**

Chemical composition of water bodies-lakes, streams, rivers and wet lands etc. Hydrological cycle. Aquatic 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. Analytical methods for measuring BOD,DO,COD,F,Oils,metals (As,Cd,Cr, Hg,Pb,Se etc.), residual chloride and chlorine demand. Purification and treatment of water.

UNIT 4

Atmosphere **(15 Hrs.)**

Chemical composition of atmosphere – particles, ions and redicals and their formation. Chemical and photochemical reactions in atmosphere, smog formation, oxides of Chlorofluorohydrocarbons, Ozone depletion, Global warming. Green house effect, acid rain, air pollution controls and their chemistry. Analytical methods for measuring air pollutants. Continuous monitoring instruments.

Instructions for Paper setters and Candidates:

I. ***Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.***
II. ***The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.***

III. All questions carry equal marks.

ESSENTIAL BOOKS:

1. Manahan, S.E. *Environmental Chemistry*, Lewis Publishers.
2. Sharma; Kaur *Environmental Chemistry*, Krishna Publishers.
3. De, A.K. *Environmental Chemistry*, Wiley Eastern.
4. Khopkar, S.M. *Environmental Pollution Analysis*, Wiley Eastern.
5. Welcher, F.J. *Standard Method of Chemical Analysis*, Vol. III.
6 Rose, J. *Environmental Toxicology*, Gordon and Breach Science Publication.
7. Landsberger, S. *Elemental Analysis of Airborne Particles*, Gordon and M. Creatchman and Breach Science Publication.
8. Baird, C. *Environmental Chemistry*, W. H. Freeman, 1995.
9. Yadav, J.S.; Sobti, R.C.; Kohli, R.K. *An Elementary Book on Environmental Education*, Panjab University Publication.

BOOKS FOR FURTHER READINGS:

1. Chandana, R.C. *Environmental Awareness*, Kalyani Popular Science.

LABORATORY COURSE (INORGANIC CHEMISTRY)
PAPER: (V) CH-515

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, 3rd Semester) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 4 hours
Max marks 33
(6 Hrs./Week)

1. Colorimetric estimation of cations and anions.
2. Separation techniques
(i) Ion exchange (ii) Solvent extraction (iii) Column and paper chromatography

ESSENTIAL BOOKS:

1. Pass, G.; Sutcliffe *Practical Inorganic Chemistry*, 1st edition, Chapmann and Hall Ltd., 1968.
2. Jolly, W.L. *Synthetic Inorganic Chemistry*, 2nd edition, Prentice Hall, Inc., 1961.
3. Mauritis Kolthoff's and Sanddle Text Book of Quantitative Inorganic Analysis.
4. Vogel, A.I. *Text Book of Practical Organic Chemistry*, ELBS, 5th edition, Longman

LABORATORY COURSE (ORGANIC CHEMISTRY)
PAPER: (VI) CH-516

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, 3rd Semester) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 4 hours
Max marks 33
(6 Hrs./Week)

A. Preparation of the following organic compounds:

1. 2-Hydroxy-1-naphthaldehyde (Reimer tiemann Reaction)
2. Thiamine hydrochloride catalyzed synthesis of benzoin and conversion to benzil and benzylic acid
3. Photoreduction of benzophenone to benzopinacol and subsequent conversion to benzopinacolone
4. Preparation of 1, 1-bis-2-naphthol from 2-naphthol (Radical coupling reaction)
5. Synthesis of dihydropyrimidinone (Three component coupling reaction)
6. Synthesis of 4-nitrosalicylic acid from salicylic acid using calcium nitrate and acetic acid.
7. Benzophenone, Benzophenone oxime, Benzanilide (Beckmann Rearrangement).
8. Trinitrophenol (picric acid) and picrate derivative.

B. Studies of TLC, column chromatography and paper chromatography for organic mixture.

ESSENTIAL BOOKS:

1. Harwood, L.M., Moody, C.J. *Experimental Organic Chemistry*, 1st edition, Blackwell Scientific Publishers, 1989.
2. Vogel, A.I. *Text Book of Practical Organic Chemistry*, ELBS, 5th edition, Longman Group Ltd.,1989.
3. Mann, F.G.; Saunders, B.C. *Practical Organic Chemistry*, 4th edition, New Impression, Orient Longman Pvt. Ltd., 1981.
4. Tewari, K.S.; Vishnoi, N.K.; Mehrotra, S.N. *A Textbook of Organic Chemistry*, 2nd edition, Vikas Publishing House, 1976.
5 Leonard, J.; Lygo, B. *Advanced Practical Organic Chemistry*, Chapman and Hall, 1995.
6. Monograph of Green Chemistry Experiments, *www.dst.gov.in/green-chem.pdf*

LABORATORY COURSE (PHYSICAL CHEMISTRY)
PAPER: (VII) CH-517

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, 3rd Semester) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 4 hours
Max marks 33
(6 Hrs./Week)

1. Conductometric Measurements :

(i) Determination of cell constant of a cell.
(ii) Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid like acetic acid.
(iii) Verification of Debye-Huckel Onsager equation.
(iv) Conductometric titration of a mixture of HNO_3 and H_2SO_4
(v) Determination of degree of hydrolysis.
(vi) To study the kinetics of saponification of ethyl acetate by NaOH conductometrically.
(vii) To titrate conductometrically mixtures of HCL/NH_4Cl and NH_4OH/NH_4Cl.

2. Chemical Kinetics :

(i) To compare the strengths of two acids by studying hydrolysis of an ester.
(ii) To study the kinetics of hydrolysis of ethyl acetate by NaOH.

3. Phase Equilibrium :

(i) To determine the equilibrium constant of KI_3 complex formation $KI + I_2 - KI_3$ by distribution method.
(ii) To determine critical solution temperature of phenol-water system in the presence of (a) 1% NaCl (b) 0.5% naphthalene (c) 1% succinic acid

ESSENTIAL BOOKS:

1. Levitt, B.P. *Findlay's Practical Physical Chemistry*, 9th edition, Longman Group Ltd., 1973.
2. Matthews, G. Peter *Experimental Physical Chemistry,* 1st edition, Oxford University Press, 1985.
3. Shoemaker, D.P.; Garland, C.W.; Nibler, J.W. *Experiments in Physical Chemistry*, 6th edition (International Edition) McGraw Hill Inc., 1996.
4. Khosla, B.D.; Garg, V.C. Gulati, A. *Senior Practical Physical Chemistry*, 11th edition, R. Chand and Co., 2002.

OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR M.Sc. 2nd YEAR (SEMESTER-4th) EXAMINATION OF 2019-20, 2020-21 and 2021-22

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Second year: There will be two Semesters in a year. Examination will be held at the end of each semester.

M.Sc. (Chemistry) 2nd Year (4th Semester) (Marks: 500)

Paper	Course No.	Course	Hours	Marks		
				Annual Exam.	Internal Assessment of House Test	Total
I	CH-521	Biophysical chemistry	60	80	20	100
II	CH-522	Organic Synthesis - I	60	80	20	100
III	CH-523	Chemistry of Natural Products	60	80	20	100
IV	CH-524	Photo Chemistry and Solid State Chemistry	60	80	20	100
V	CH-525	Inorganic Chemistry (Laboratory Course)				33
VI	CH-526	Organic Chemistry (Laboratory Course)				34
VII	CH-527	Physical Chemistry (Laboratory Course)				33

Instructions for Paper setters and Candidates:

I. ***Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.***
II. ***The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.***
III. ***All questions carry equal marks.***

SUBJECT: BIOPHYSICAL CHEMISTRY
PAPER: (I) CH-521

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 3 hours
Max marks 80+20
(4 Hrs./Week)
(60 Hrs.)

UNIT 1

Biological Cell and its Constituents **(4 Hrs.)**

Biological cell, DNA and RNA in living systems. Basic consideration. Proximity effects and molecular adaptation.

Enzymes **(6 Hrs.)**

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 and enzyme modification by site-directed mutagenesis . Enzyme kinetics, Michaelis-Menten and Lineweaver-Burk plots, reversible and irreversible inhibition.

Mechanism of Enzyme Action **(5 Hrs.)**

Transition state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion . Examples of some typical enzyme mechanisms for Chymotrypsin, ribonuclease, lysozyme and carboxypeptidase A.

UNIT 2

Kinds of Reactions Catalysed by Enzymes **(5 Hrs.)**

Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reaction, enolic intermediates in isomerization reactions, □-cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.

Co-Enzyme Chemistry **(5 Hrs.)**

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological function of coenzyme A, thiamine pyrophosphate, Pyridoxal phosphate, NAD^+,$NADP^+$,FMN, FAD, lipoic acid, vitamin B_{12}. Mechanism of reaction catalyzed by the above cofactors.

Biological Macromolecules **(5 Hrs.)**

Basic features of macromolecules, their configurations and conformations.

Proteins: Amino acids, the unique protein sequence, secondary structures of proteins, helical symmetry, effect peptide bond on protein conformations, the structure of globular proteins.

UNIT 3

Biological Macromolecules (4 Hrs.)

The Nucleic Acids: Nucleotide, torsion angles in poly nucleotide chains, the helical structure of polynucleic acids, high order structure in polynucleotides.

Interactions in Macromolecules: (4 Hrs.)

Basic principles of interaction between molecules, water structure and its interaction with biomolecules, dipole interactions, side chain interactions, electrostatic interactions, base pairing in nucleic acids, base stacking, hydration and the hydrophobic effect.

Structural Transition in Biomacromolecules: (3Hrs.)

Coil – helix transitions in proteins, statistical methods for predicting protein secondary structures; melting and annealing of polynucleotide duplexes, helical transitions in double stranded DNA, super coil dependent DNA transitions predicting helical structures in genomic DNA.

Separation and Characterization of Macromolecules (4 Hrs.)

Sedimentation, moving boundary sedimentation, zonal sedimentation, general principles of electrophoresis, electrophorsesis of proteins and nucleic acids, capillary electrophoresis.

UNIT 4

Bioenergetics and ATP cycle (8 Hrs.)

Standard free energy change in biochemical reaction, exergonic, endergonic reactions. Hydrolysis of ATP, sythesis of ATP from ADP, metal complexes and transition of energy, chlorophyls, photo system I and photo system II in cleavage of water.

Thermodynamics of Biopolymer Solutions (4 Hrs.)

Thermodynamics of biopolymes solutions, osmotic pressure, membrane equilibrium, muscular contraction and engery generations in mechanochemical system.

Cell Membranes And Transport Of Ions (3 Hrs.)

Structure and function of cell membrane, ion transport through cell membrane, Na^+ /K^+ Pump. Irreversible treatment of memhrane transport. Nerve conduction.

Instructions for Paper setters and Candidates:

1. ***Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.***

II. ***The students are required to attempt <u>FIVE</u> questions in all, <u>ONE</u> question from each unit and the Compulsory question.***
III. ***All questions carry equal marks.***

ESSENTIAL BOOKS:

1. Lehninger, A.L. *Principles of Biochemistry*, Worth Publishers.
2.Voet; Voet *Biochemistry*, John Wiley, 1995.
3.Conn, E.E.; Stumpt, P.K. *Outlines of Biochemistry*, John Wiley.
4.Dugas, Hermann; Penny, C. *Bioorganic Chemistry: Chemical Approach to Enzyme Action*, Springer Verlag, 1982.
5.Page, M.I.; Williams, A. *Enzyme Mechanisms*, Royal Society of Chemistry.
6.Silverman, Richard B. *Organic Chemistry of Enzyme Catalyzed Reaction.*
7. Bertini, I.; Gray, H.B.; Lippard, S. J.; Valentine, J.S. *Bioinorganic Chemistry*, University Science Books.
8.Jolley, William *Bioinorganic Chemistry.*
9.Holde, K.E. Van; Johnson, W.C.; Ho, P.S. *Principles of Physical Biochemistry*, Prentice Hall, 1998.

BOOKS FOR FURTHER READING:

1. Stryer, L. *Biochemistry*, W.H. Freeman.
2. Rawn, J .David *Biochemistry*, Neil Patterson.
3. Wold, F. *Macromolecules: Structure and Function*, Prentice Hall.
4. Cantor, C.R.; Schimmel, P.R. *Biophysical Chemistry*, Vol. 1-3, Freeman, 1980.

SUBJECT: ORGANIC SYNTHESIS – I
PAPER: (III) CH-522

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 3 hours
Max marks 80+20
(4 Hrs./Week)
(60 Hrs.)

UNIT 1

Organometallic Reagents **(15 Hrs.)**

Principle, Preparations, properties and applications of the following in organic synthesis with mechanistic details

Organolithium and organomagnesium compounds : Zn and Ce Compounds
Transition metals: Cu,Pd,Ni, Fe , Co, Rh and Ti Compounds
Other elements : Si ,B and iodine (I) Compounds

UNIT 2

Organic Synthesis **(15 Hrs.)**

Linear & Conversion Synthesis, Reterosynthetic Approach, Umpolung, Regeoselectivity, Chemoselectivity and Diastereoselectivity, Cram's Rule, Felkin-Ahn Model (with relevant examples)

UNIT 3

Oxidation **(7 Hrs.)**

Introduction . Different oxidative Processes Hydrocarbon-alkenes, aromatic rings, saturated C-H groups(activated and Unactivated)
Alcohols, diols, aldehybes, ketones, ketals and carboxylic acids, amines,
hydrazines, and sulphides. Oxidation with ruthenium tetaoxide,
iodobenzene diacetate and Thallium(III) nitrate.

Reduction **(8 Hrs.)**

Introduction Different reductive processes Hydrocarbons-alkanes, alkenes, alkynes and aromatic rings carbonyl compounds-aldehydes, ketones, acids and their derivatives. epoxides. nitro, nitroso, azo and oxime groups. Hydrogenolysis.

UNIT 4

Rearrangements **(15 Hrs.)**

General mechanistic considerations-nature of migration, migratory aptitude, memory effects A detailed Study of the following rearrangements Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil- Benzilic Acid, Favorskii, Arndt Eistert synthesis, Neber, Beckmann, Hofman, Curtius, Schmidt, Baeyer- Villiger, Shapiro reaction.

Instructions for Paper setters and Candidates:

I. ***Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.***
II. ***The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.***
III. ***All questions carry equal marks.***

ESSENTIAL BOOKS:

1. Norman, R.O.C.; Coxon, J.M. *Principles of Organic Synthesis*, Blackie Academic & Professional.
2. March, Jerry *Advanced Organic Chemistry - Reactions, Mechanism and Structure*, 6th edition, John Wiley, 2007.
3. Warren, S. *Organic Synthesis: The Disconnection Approach*, John Wiley.
4. Cheng, Xue-Min; Corey, E.J. *The Logic of Chemical Synthesis*, John Wiley.

BOOKS FOR FURTHER READING:

1. Carry, F. A.; Sundberg, R.J. *Advanced Organic Chemistry*, Vol. 2, 3rd edition, Plenum Press, 1990.
2. Ingold, C.K. *Structure and Mechanism in Organic Chemistry*, Cornell University Press.
3. House, H. O. *Modern Organic Synthesis*, Blackie Academic & Professional.
4 Carruthers, W. *Some Modern Methods of Organic Synthesis*, Cambridge University Press.
5 Kalsi, P.S. *Organic Reactions and their Mechanisms*, 2nd edition, New Age International.
6 Morrison, R. T.; Boyd, R. N. *Organic Chemistry*, 6th edition, Prentice Hall, 1992.
7 Aggarwal, O.P. *Reactions and Reagents in Organic Chemistry*.

SUBJECT: CHEMISTRY OF NATURAL PRODUCTS
PAPER: (III) CH-523

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 3 hours
Max marks 80+20
(4 Hrs./Week)
(60 Hrs.)

UNIT 1

***Terpenoids and Carotenoids (15 Hrs.)**

Classification, nomenclature occurrence isolation general methods of structure Determination, isoprene rule. Structure determination, Biosynthesis and synthesis of the following representative molecules: citral, Terpeneol, Farnesol, longifoline, phytol, Abietic Acid and Beta-Carotene

UNIT 2

Alkaloids (15 hrs.)

Definition, nomenclature and physiological action occurrence isolation general method of structure elucidation degradation classification based on nitrogen heterocyclic ring role of alkaloids in plants. Structure stereochemistry synthesis and biosynthesis of the following:

Ephedrine, (+)- Conine, Nicotine, Atropine, Quinine and Morphine

UNIT 3

Steroids (15 Hrs.)

Occurrence nomenclature basic skeleton. Diel's hydrocarbon and Stereochemistry Isolation structure determination and synthesis of cholesterol Bile acids Testosterone, Estrone Progestrone Aldosterone Biosynthesis of Steroids

UNIT 4

*** Plant Pigments (5 Hrs.)**

Occurrence nomenclature and general methods of structure determinations, isolation and synthesis ,Quercetin , Quercetin-3-Glucoside, Cyanidin-7-arabinoside cyanidine, Hirsutidin Biosynthesis of Flavonoids: Acetate path way and shikimic acid path way.

Porphyrins (3 Hrs.)

Structure and synthesis of Haemoglobin and chlorophyll

Prostaglandins (5 Hrs.)

Occurrence, nomenclature, classification, biogenesis and physiological effects Synthesis of PGE2 and PGF 2

Pyrethroids and rotenones : **(2 Hrs.)**

Synthesis and reaction of Pyrethroids and rotenones

Note : *****Geraniol, Menthol, Zinigiberene, apigenin, luteolin, myrcetin, butin, aureusin are deleted because geraniol similar to citral ,*Menthol similar to Alpha-Terpeneol* , Zinigibrene similar to farnesol ,Apigenin, luteolin, myrcetin similar to quercetin, butin, aureusin similar to cyaniding

Instructions for Paper setters and Candidates:

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.

ESSENTIAL BOOKS:

1. Finar, I.L. *Organic Chemistry*, Vol. 2, 5th edition, ELBS, 1975.
2. Nogradi, M. *Stereoselective Synthesis: A Practical Approach*, VCH.
3. Coffey, S. *Rodd's Chemistry of Carbon Compounds,* Elsevier.
4. Hostettmann, Kurt; Gupta, M.P.; Marston, A. *Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas*, Harwood Academic Publishers.
5. Aggarwal, O.P. *Chemistry of Organic Natural Products*, Vol. 1 & 2.

BOOKS FOR FURTHER READING:

1. Rohm, B.A. *Introduction to Flavonoids*, Harwood Academic Publishers.
2. Rahman, Att-ur-; Choudhary, M.I. *New Trends in Natural Product Chemistry*, Harwood Academic Publishers.
3. Dev, Sukh *Insecticides of Natural Origin*, Harwood Academic Publishers.
4. Mann, J.; Davidson, R.S.; Hobbs, J.B.; Banthrope, D.V.; Harborne, J.B. *Natural Products: Chemistry and Biological Significance*, Longman, Essex.

SUBJECT: PHOTOCHEMISTRY AND SOLID STATE
PAPER: (IV) CH-524

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, General, Semester System) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 3 hours
Max marks 80+20
(4 Hrs./Week)
(60 Hrs.)

UNIT 1

Photochemistry

Photochemical Reactions **(4 Hrs.)**

Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield ,transfer of excitation energy, actinometry

Determination of reaction mechanism **(5Hrs.)**

Classification, rate constants and life times of reactive energy states –determination of rate constants of reaction .Effect of light intensity on the rate of photochemical reactions. Types of photochemical reaction –photo-dissociation, gas –phase photolysis.

Photochemistry of Alkenes **(6 Hrs.)**

Interamolecularreaction of the olefinic bond-geometrical isomerism, cyclisation reaction ,rearrangementof 1,4- and 1,5-dienes

UNIT 2

Photochemistry of Carbonyl compound **(7Hrs.)**

Intramolecular reaction of carbonyl compounds-saturated,cyclic and acyclic β γ unsaturated and α-β unsaturated compounds.Cyclohexadienes. intermolecular cycloadditio reactions—dimerisation and oxetane formation.

Photochemistry of aromatic compounds **(4 Hrs.)**

Isomerisations, additions and substitutions.

Miscellaneous photochemical reactions **(4 Hrs.)**

Photofries reactions of anilids. photo-fries rearrangement. Barton reaction. singlet molecular oxygen reactions. photochemical formation of smog. photodegradation of polymers. photochemistry of vision.

UNIT 3

Solid state chemistry

Solid state reactions **(4 Hrs.)**

General principles ,experimental procedures, co-precipitation as a precursor to solid state reactions, kinetics of solid state reactions.

Crystal defects and non-stochiometry **(6 Hrs.)**

Perfect and imperfect crystals, intrinsic and extrinsic defects-point defect, line defects, vacancies-Schottky defects and Frenkel defects. Thermodynamics of Schottky defects and Frenkel defect formation, colour centers, non-stoichiometry and defects.

Organic solids **(5 Hrs.)**

Electrically conducting solids, organic charge transfer complex, organic metals, new superconductors.

UNIT 4

Electronic properties and Band Theory (15 Hrs.)

Metals, insulators and semiconductors, electronic structure of solids-band theory of metals, insulators and semiconductors, intrinsic and extrinsic semiconductors. doping semiconductors, p-n junctions, superconductors. Optical properties-Optical reflectance, photoconduction-photoelectric effects. Magnetic properties-Classification of materials: Quantum theory of paramagnetics- cooperative phenomena-magnetic domains, hysteresis.

Instructions for Paper setters and Candidates:

I. ***Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.***
II. ***The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.***
III. ***All questions carry equal marks.***

ESSENTIAL BOOKS:

1. Cox, A.; Camp, T. *Introductory Photochemistry*, McGraw-Hill.
2. Kundall, R.P.; Gilbert, A. *Photochemistry*, Thomson Nelson.
3. Coxon, J.; Halton, B. *Organic Photochemistry*, Cambridge University Press.
4. West, A.R. *Solid State Chemistry and its Applications*, Plenum.
5. Keer, H.V. *Principles of the Solid State*, Wiley Eastern.
6. Hannay, N.B. *Solid State Chemistry*.
7. Chakrabarty, D.K. *Solid State Chemistry*, New Age Internationals.

BOOKS FOR FURTHER READING:

1. Singh, Jagdamba; Singh, Jaya *Photochemistry and Pericyclic Reactions*, New Age International Publishers.
2. Pavia; Lampman, D.L.; George, Gary M; Kriz, S. *Introduction to Spectroscopy*, 3rd edition, Harcourt College Publication, 2001.
3. Gilbert, A.; Beggott, J. *Essentials of Molecular Photochemistry*, Blackwell Scientific Publication.
4. Turro, N.J.; Benjamin, W.A. *Molecular Photochemistry*.

LABORATORY COURSE (INORGANIC CHEMISTRY)
PAPER: (V) CH-525

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, 4th Semester) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 4 hours
Max marks 33
(6 Hrs./Week)

1. **Amperometric determination of**
   (i) Zn^{+2} with EDTA
   (ii) Thiosulphate with iodine.
2. **Analysis of water**
   (i) Hardness
   (ii) Different type of nitrogen (NO_3^- ions, NH_4^+ ions) and oxygen (Residual oxygen, BOD/COD)
   (iii) Residual chlorine
   (iv) Removal of hardness.
3. **Oxidation-Reduction Titrations**
   (i) Preparation of 0.1M cerium (IV) sulphate and its standardization with ammonium iron(II) sulphate or sodium oxalate.
   (ii) To determine the concentration of the nitrite ions in the sample solution using standardized cerium (IV) sulphate
   (iii) To determine the percentage purity of the $NaNO_2$ using standardized cerium (IV) sulphate.
4. **Precipitation Titrations**
   (i) Preparation of 0.1M silver nitrate and its standardization with Mohr's method using potassium chromate/adsorption indicator.
   (ii) Determination of chloride in neutral solution by titration with standard 0.1 M silver nitrate
5. **Oxidation and reduction processes involving iodine**
   (i) Preparation of sodium thiosulphate ($Na_2S_2O_3,5H_2O$) and its standardization with potassium iodate / potassium dichromate.
   (ii) Determination of copper in crystallized copper sulphate using standardized Sodium thiosulphate solution.

ESSENTIAL BOOKS:

1. Vogel, A.I. *Text Book of Practical Organic Chemistry*, ELBS, 5th edition, Longman Group 1989.
1. Pass, G.; Sutcliffe *Practical Inorganic Chemistry*, 1st edition, Chapmann and Hall Ltd., 1968.
2. Jolly, W.L. *Synthetic Inorganic Chemistry*, 2nd edition, Prentice Hall, Inc., 1961
3. Vogel, A.I. *Text Book of Practical Organic Chemistry*, ELBS, 5th edition, Longman

LABORATORY COURSE (ORGANIC CHEMISTRY)
PAPER: (VI) CH-526

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, 4th Semester) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 4 hours
Max marks 34
(6 Hrs./Week)

A. Extraction of organic compound from natural sources

1. Isolation of caffeine from Tea leaves
2. Isolation of Casein and lactose from milk
3. Isolation of Lcycopene from tomatoes
4. Isolation of Hippuric acid from urine

B. Estimations

1. To estimate the strength of given glucose and sucrore solution. (Fehling's method)
2. To determine saponification & iodine values of oils and fats.
3. Estimation of formaldehyde.
4. Estimation of glycin

ESSENTIAL BOOKS:

1. Harwood, L.M., Moody, C.J. *Experimental Organic Chemistry*, 1st edition, Blackwell Scientific Publishers, 1989.
2. Vogel, A.I. *Text Book of Practical Organic Chemistry*, ELBS, 5th edition, Longman Group Ltd.,1989.
3. Mann, F.G.; Saunders, B.C. *Practical Organic Chemistry*, 4th edition, New Impression, Orient Longman Pvt. Ltd., 1981.
4. Tewari, K.S.; Vishnoi, N.K.; Mehrotra, S.N. *A Textbook of Organic Chemistry*, 2nd edition, Vikas Publishing House, 1976.
5. Leonard, J.; Lygo, B. *Advanced Practical Organic Chemistry*, Chapman and Hall, 1995.

LABORATORY COURSE (PHYSICAL CHEMISTRY)
PAPER: (VII) CH-527

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Chemistry and their applications. The syllabus pertaining to M.Sc. (2nd Year, 4th Semester) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh and affiliated colleges. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Time 4 hours
Max marks 33
(6 Hrs./Week)

1. **Current Potential Relationships** :
   (i) To determine half wave potentials of Zn^{2+} and Cd^{2+} ions.
   (ii) To find formation constant of copper glycinate polarographically.
   (iii) To plot a polarogram of a mixed soln. of Cd^{2+}, Zn^{2+}, Mn^{2+} ions in 0.1M KCl.

OR

Spectro-photometric analysis:

(i) Determination of the absorption curve and concentration of a substance (potassium nitrate).
(ii) The effect of substituents on the absorption spectrum of benzoic acid.
(iii) Spectrophotometric determination of the pK value of an indicator (The acid dissociation constant of methyl red/ phenolphthalein).

2. **Colorimetry :**
   (i) Determination of iron in water using a colorimeter.
   (ii) To measure concentration of KMnO4 and K2Cr2O7 present in same solution.
   (iii) To find composition of ferric ions-salicylic acid complex by Job's method.

3. **Refractometry:**
   (i) Determination of molar refractivity of ethyl acetate, methyl acetate, ethylene chloride and chloroform and calculation of the atomic refractivities of the C, H and Cl.
   (ii) Measurement of the average electronic polarizabilities of some of the common solvents refractometrically.
   (iii) To find the composition of binary mixtures refractometrically.

4. **Chromatography :**
   (i) To prepare citric acid from sodium citrate and aniline from aniline hydrochloride using cation and anion exchangers.
   (ii) To differentiate common sugars/amino acids by paper chromatography.

5. **Computer Programming :**
   Elementary exercise in computer graphics an illustrative experiment solving the interactive equation. Plotting the time series: Xn,(t) Versus n. (for all experiments. Students should be encouraged to analyze data (graphics etc.) on a computer).

ESSENTIAL BOOKS:

1. Matthews, G. Peter *Experimental Physical Chemistry,* 1st edition, Oxford University Press, 1985.
2. Shoemaker, D.P.; Garland, C.W.; Nibler, J.W. *Experiments in Physical Chemistry*, 6 th edition (International Edition) McGraw Hill Inc., 1996.
3. Khosla, B.D.; Garg, V.C. Gulati, A. *Senior Practical Physical Chemistry*, 11th edition, R. Chand and Co., 2002.
4. Vogel, A.I. *Text Book of Practical Organic Chemistry*, ELBS, 5th edition, Longman Group 1989.