SRI KRISHNADEVARAYA UNIVERSITY
Department of Chemistry

M. Sc. CHEMISTRY SYLLABUS
Under Choice Based Credit System (CBCS)
(w.e.f. the academic year 2019–20)
Syllabus for I, II, III and IV SEMESTERS

SRI KRISHNADEVARAYA UNIVERSITY
DEPARTMENT OF CHEMISTRY
M.Sc., CHEMISTRY SYLLABUS
(Common to all Specializations and M.Sc., Organic Chemistry)
Under Choice Based Credit System (CBCS)
(Effective from the academic year 2019-2020)

Semester	Code	Title of the Course	Semester Exam	IA	Total	L	T	P	Credits
		Core Theory Papers							
First	CH-101	Inorganic Chemistry-I	70	30	100	4	0	0	4
	CH-102	Organic Chemistry-I	70	30	100	4	0	0	4
	CH-103	Physical Chemistry-I	70	30	100	4	0	0	4
	CH-104	Spectroscopy- I	70	30	100	4	0	0	4
		Core Practical Papers							
	P-101	Inorganic Chemistry Practical –I	50	17	67	0	0	2	2
	P-102	Organic Chemistry Practical –I	50	17	67	0	0	2	2
	P-103	Physical Chemistry Practical-I	50	16	66	0	0	2	2
		Total for First Semester	**430**	**170**	**600**				**22**
Second		**Core Theory Papers**							
	CH-201	Inorganic Chemistry-II	70	30	100	4	0	0	4
	CH-202	Organic Chemistry-II	70	30	100	4	0	0	4
	CH-203	Physical Chemistry-II	70	30	100	4	0	0	4
		Open Elective (to External Students)							
	CH-204	Chemistry of Biological Processes	70	30	100	4	0	0	4
		Core Practical Papers							
	P-201	Inorganic Chemistry Practical –II	50	17	67	0	0	2	2
	P-202	Organic Chemistry Practical –II	50	17	67	0	0	2	2
	P-203	Physical Chemistry Practical –II	50	16	66	0	0	2	2
		Total for Second Semester	**430**	**170**	**600**				**22**
Third		**Core Theory Papers**							
	CH-301	Common Paper -I	70	30	100	4	0	0	4
	CH- 302	Specialization paper - III	70	30	100	4	0	0	4
	CH-303	Specialization Paper-IV	70	30	100	4	0	0	4
		Open Elective (to External Students)							
	CH-304	Environmental Chemistry-I	70	30	100	4	0	0	4
		Core Practical Papers							
	P-301	Specialization Practical –III	70	30	100	0	0	3	3
	P-302	Specialization Practical –IV	70	30	100	0	0	3	3
		Total for Third Semester	**420**	**180**	**600**				**22**
Semester	**Code**	**Title of the Course**	**Semester Exam**	**IA**	**Tota**	**L**	**T**	**P**	**Credits**

Fourth		**Core Theory Papers**							
	CH-401	Specialization paper - V	70	30	100	4	0	0	4
	CH-402	Specialization paper - VI	70	30	100	4	0	0	4
	CH - 403	Specialization paper - VII	70	30	100	4	0	0	4
	CH-404	Specialization paper - VIII	70	30	100	4	0	0	4
		Practical/Project							
	P-401	Specialization Practical-V	75	25	100	0	0	3	3
	MP-401	Major Project	75	25*	100	0	0	3	3
		Total Fourth Semester	**430**	**170**	**600**			**6**	**22**

TOTAL CREDITS = 22x 4 = 88

Total Marks = 2,400; Theory Marks = 1700; Practicals' Marks = 700; Marks for Major Project = 100

Marks for Internal assessment = Theory Paper = 30 (Mid Sem -15 + Online -10+Seminar-05)

I&II Sem. Practicals = 17/16 (Mid Sem-17/16)

III&IV Sem. Practicals = 25 (Mid Sem.)

(L = Lecture; T = Tutorials; P = Practicals; IA= Internal Assesment)

4 Credits of Theory = 4 Hours teaching per week

2 Credits of Practicals = 4 Hours per week

Scheme of Practical Exam for I & II Sem.. Expts-40 Marks, Viva-voce-5 Marks, Record-5 Marks = 50 Marks

3 Credits of Practicals = 6 Hours per week

Scheme of Practical Exam for III & IV Sem.. Expts-60 Marks, Viva-voce-8 Marks, Record-7 Marks = 75 Marks

Major Project: Project Evaluation-75 Marks & Viva-voce-25 Marks = 100 Marks(Total)

At least One Optional Paper from Massive Open Online Courses (MOOCS) as Prescribed by the University/Department of Chemistry.

SRI KRISHNADEVARAYA UNIVERSITY
DEPARTMENT OF CHEMISTRY
M.Sc. CHEMISTRY SYLLABUS
(To all Specializations and M.Sc., Organic Chemistry)
CBCS SYLLABUS (w.e.f. 2019-20)
I SEMESTER
(Consists of FOUR Core Theory Papers and THREE Practicals)

Paper CH 101 INORGANIC CHEMISTRY

Unit- I	:	METAL-LIGANDBONDING, MAGNETIC BEHAVIOUR OF COMPLEXES AND EQUILIBRIUM IN SOLUTION
Unit-II	:	STEREOCHEMISTRY AND BONDING IN MOLECUES
Unit-III	:	METAL π- COMPLEXES
Unit-IV	:	MAIN GROUP ORGANOMETALLICS AND METAL CLUSTERS

Paper CH 102 ORGANIC CHEMISTRY

Unit- I	:	STEREOCHEMISTRY
Unit-II	:	REACTION MECHANISMS - I
Unit-III	:	REACTION MECHANISMS -II
Unit-IV	:	INTRODUCTION TO REACTIVE INTERMEDIATES AND MOLECULAR REARRANGEMENTS

Paper CH 103 PHYSICAL CHEMISTRY

Unit- I	:	THERMODYNAMICS- I
Unit-II	:	ELECTROCHEMISTRY- 1
Unit-III	:	QUANTUM CHEMISTRY – I
Unit-IV	:	CHEMICAL KINETICS-I

Paper CH 104 SPECTROSCOPY

Unit- I	:	SYMMETRY AND GROUP THEORY IN CHEMISTRY
Unit-II	:	UNIFYING PRINCIPLES, MICROWAVE &UV-VISIBLE SPECTROSCOPY
Unit-III	:	VIBRATIONAL SPECTROSCOPY
Unit-IV	:	RESONANCE SPECTROSCOPY

I-SEM PRACTICALS

P- 101	:	INORGANIC CHEMISTRY
P- 102	:	ORGANIC CHEMISTRY
P- I03	:	PHYSICAL CHEMISTRY
	:	

II SEMESTER

(Consists of THREE Core Theory Papers and ONE Open Elective Theory Paper and THREE Practicals)

Paper CH 201 INORGANIC CHEMISTRY

Unit- I	:	REACTION MECHANISM OF TRANSITION METAL COMPLEXES
Unit-II	:	ELECTRONIC SPECTRA OF TRANSITION METAL COMPLEXES
Unit-III	:	MÖSSBAUER & NQR SPECTROSCOPY
Unit-IV	:	BIO-INORGANIC CHEMISTRY

Paper CH 202 ORGANIC CHEMISTRY

Unit-I	:	PERICYCLIC REACTIONS
Unit- II	:	REAGENTS OF SYNTHETIC IMPORTANCE (OXIDATIONS & REDUCTIONS)
Unit-III	:	CONFORMATIONAL ANALYSIS
Unit- IV	:	MASS SPECTROMETRY

Paper CH 203 PHYSICAL CHEMISTRY

Unit-I	:	THERMODYNAMICS-II
Unit- II	:	ELECTRO CHEMISTRY-II
Unit –III	:	QUANTUM CHEMISTRY-II & X-RAY CRYSTALLOGRAPHY
Unit– IV	:	CHEMICAL KINETICS-II

Paper 204 : CHEMISTRY OF BIOLOGICAL PROCESSES

[An Open Elective Paper offered to External Students only]

Unit-I	:	BIO -ANALYTICAL CHEMISTRY
Unit- II	:	BIO -INORGANIC CHEMISTRY
Unit-III	:	BIO-ORGANIC CHEMISTRY
Unit-IV	:	BIO- PHYSICAL CHEMISTRY

II-SEMESTER PRACTICALS

P- 201	:	INORGANIC CHEMISTRY
P-202	:	ORGANIC CHEMISTRY
P-203	:	PHYSICAL CHEMISTRY
	:	

CBCS SYLLABUS (w.e.f. 2020--21)

III SEMESTER

Paper CH 301 : QUANTITATIVE DATA, SEPARATION TECHNIQUES, RADIO-ANALYTICAL, THERMAL AND VOLTAMMETRIC METHODS

[Common to all specializations and to M.Sc., Organic Chemistry (Self-Funding Course)]

Unit- I ; STATISTICS AND DATA HANDLING IN ANALYTICAL CHEMISTRY

Unit-II : SEPARATION TECHNIQUES (Solvent Extraction & Chromatography**)**

Unit-III : RADIO ANALYTICAL METHODS AND THERMAL METHODS OF ANALYSIS

Unit-IV : VOLTAMMETRY AND RELATED TECHNIQUES

III SEMESTER

ANALYTICAL CHEMISTRY

Paper AC 302 : PHYSICAL METHODS IN ANALYTICAL CHEMISTRY

(A Specialization Paper)

Unit- I : PHYSICAL METHODS IN DRUG ANALYSIS

Unit-II : GRAVIMETRY

Unit-III : TITRIMETRIC ANALYSIS

Unit-IV : REDOX AND DIAZOTISATION TITRATIONS

Paper 303 : ANALYTICAL SPECTROSCOPY

(A Specialization Paper)

Unit- I : FLAME EMISSION AND ATOMIC FLUORESCENCE SPECTROSCOPY

Unit-II : AAS, ANALYSIS OF INDUSTRIAL SAMPLES AND ICP-AES

Unit-III : NEPHELOMETRY, TURBIDIMETRY, FLUORIMETRY & PHOSPHORIMETRY

Unit-IV : PHOTOELECTRON SPECTROSCOPY & FLOW INJECTION ANALYSIS

III SEMESTER

INORGANIC CHEMISTRY

Paper IC 302 : STRUCTURAL METHODS IN INORGANIC CHEMISTRY

(A Specialization Paper)

Unit- I ; ELECTRON PARAMAGNETIC (EPR) SPECTROSCOPY AND ITS APPLICATIONS IN CO-ORDINATIION CHEMISTRY

Unit-II : MULTINUCLEAR NMR SPECTROSCOPY

Unit-III : OPTICAL ROTATORY DISPERSION AND CIRCULAR DICHROISM SPECTROSCOPY

Unit-IV : PHOTOELECTRON SPECTROSCOPY

Paper IC 303 : BIOINORGANIC, ORGANOMETALLIC AND INORGANIC POLYMER CHEMISTRY (A Specialization Paper)

Unit- I ; TRANSPORT AND FIXATION PROCESSES IN BIOLOGY

Unit-II : METALLO-PROTEINS AND METALLO-VITAMINS

Unit-III : ORGANOMETALLIC COMPOUNDS OF ‘d ‘ BLOCK METALS

Unit-IV : INORGANIC POLYMERS

III SEMESTER

ORGANIC CHEMISTRY

Paper OC – 302 PHOTOCHEMISTRY AND ORGANIC SYNTHESIS

(A Specialization Paper)

Unit-I : ORGANIC PHOTOCHEMISTRY – I

Unit-II : ORGANIC PHOTOCHEMISTRY – II

Unit-III : PROTECTING GROUPS AND ORGANIC REACTIONS

Unit-IV : NEW SYNTHETIC REACTIONS

Paper OC – 303 ORGANIC SYNTHESIS – II

(A Specialization Paper)

Unit-I : SYNTHETIC STRATEGIES – I

Unit-II : REACTIONS OF SYNTHETIC IMPORTANCE

Unit-III : PRINCIPLES OF ASYMMETRIC SYNTHESIS

Unit-IV : METHODOLOGY OF ASYMMETRIC SYNTHESIS

III SEMESTER

PHYSICAL CHEMISTRY

302 : THERMODYNAMICS AND KINETICS

(A Specialization Paper)

Unit-I : THERMODYNAMICS -III

Unit-II : THERMODYNAMICS - IV

Unit-III : ELEMENTARY REACTIONS IN SOLUTIONS

Unit-IV : SOME REACTION MECHANISMS IN SOLUTION

III SEMESTER

303 : INSTRUMENTAL METHODS

(A Specialization Paper)

Unit-I : INSTRUMENTS USED FOR POLIMER PROCESSING

Unit-II : ATOMIC ABSORPTION SPECTROSCOPY

Unit-III : ATOMIC PLASMA EMISSION SPECTROMETRY

Unit-IV : ELETRO ANALYTICAL TECHNIQUES

III SEMESTER

304 : ENVIRONMENTAL CHEMISTRY

[An Open Elective Paper offered to External Students only]

Unit-I : HYDROSPHERE

Unit-II : ATMOSPHERE

Unit-III : ENVIRONMENTAL TOXICOLOGY AND GREEN CHEMISTRY

Unit-IV : ENVIRONMENTAL MONITORING METHODS

IV SEMESER

ANALYTICAL CHEMITRY (Specialization)

Paper AC 401 :. FUNDAMENTAL TECHNIQUES IN CHEMICAL ANALYSIS

Unit-I : SAMPLING

Unit-II : KINETIC METHODS OF TRACE ANALYASIS

Unit-III : GENERAL CONSIDERATIONS IN ANALYSIS

Unit-IV : ANALYTICAL METHOD DEVELOPMENT AND VALIDATION

Paper AC 402: ANALYSIS OF NATURAL MATERIALS

Unit-I : GAS ANALYSIS

Unit-II : SEWAGE AND ITS DISPOSAL

Unit-III : ANALYSIS OF SOIL, POLLUTANTS, FERTILIZERS AND PESTICIDES

Unit-IV : ANALYSIS OF INDUSTRIAL PRODUCTS

Paper AC – 403: ANALYSIS OF COMMERCIAL MATERIALS

Unit-I : ANALYSIS OF PLANT PIGMENTS AND EXPLOSIVES

Unit-II : ANALYSIS OF FOOD AND DAIRY PRODUCTS & FORENSIC MATERIAL ANALYSIS

Unit-III : CLINICAL CHEMISTRY, ANALYSIS OF DRUGS AND ANTIBIOTICS

Unit-IV : NANO MATERIALS AND LC-MS

Paper AC- 404: APPLIED ENVIRONMENTAL ANALYSIS

Unit-I : HYDROSPHERE

Unit-II : GREEN CHEMISTRY & TOXICOLOGY

Unit-III : AIR POLLUTION MONITORING METHODS & INSTRUMENTAL TECHNIQUES

Unit-IV : INDUSTRIAL POLLUTANTS

IV SEMESER

INORGANIC CHEMITRY (Specialization)

Paper IC 401 : CATALYSIS, PHOTOCHEMISTRY AND APPLICATIONS OF ORGANOMETALLIC COMPOUNDS.

Unit-I : HOMOGENOUS CATALYSIS

Unit-II : HETEROGENEOUS CATALYSIS

Unit-III : PHOTOCHEMISTRY OF COORDINATION COMPOUNDS

Unit-III : ORGANOMETALLIC COMPOUNDS IN BIOLOGY AND ENVIRONMENTAL SCIENCES

Paper IC 402: BIO-INORGANIC AND SUPRAMOLECULAR CHEMISTRY

Unit-I : IRON STORAGE / TRANSPORT AND ROLE OF CALCIUM IN BIOLOGICAL SYSTEMS

Unit-II : METALLOENZYMES

Unit-III : METAL COMPLEXES IN MEDICINE AND THEIR INTERACTION WITH NUCLEIC ACIDS

Unit-IV : SUPRAMOLECULAR CHEMISTRY

Paper IC – 403: SOLID STATE CHEMISTRY

Unit-I : DESCRIPTION OF CRYSTAL STRUCTURES

Unit-II : CRYSTAL DEFECTS AND NON – STOICHIOMETRY

Unit-III : PHASE DIAGRAMS AND PHASE TRANSITIONS

Unit-IV : PREPARATIVE METHODS OF SOLIDS

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Paper IC – 404: CHEMISTRY OF INDUSTRIAL PROCESSES-POLLUTION CONTROL METHODOLOGIES

Unit-I : CEMENT AND ALLIED MATERIALS

Unit-II : GLASS, CERAMICS AND PORCELAIN

Unit-III : METALLURGICAL AND NON-METALLURGICAL ELECTROLYTIC PROCESSES

Unit-IV : INDUSTRIAL EFFLUTENTS-POLLUTION CONTROL PROCESS

IV SEMESTER

ORGANIC CHEMISTRY (Specialization)

Paper OC – 401 ORGANIC SPECTROSCOPY

Unit-I : ^{13}C, ^{19}F and ^{31}P NMR SPECTROSCOPY

Unit-II : MULTIPULSE TECHNIQUES IN NMR

Unit-III : APPLICATIONS OF MASS AND OPTICAL ROTATORY DISPERSION SPECTROMETRY

Unit-IV : SPECTRAL IDENTIFICATION OF NATURAL PRODUCTS

Paper OC – 402 DRUG DESIGN

Unit-I : PRINCIPLES OF DRUG DISCOVERY

Unit-II : SAR STUDIES & SYNTHETIC DRUGS

Unit-III : QSAR STUDIES & ANTIBIOTICS

Unit-IV : COMBINATORIAL SYNTHESIS

Paper OC – 403 HETEROCYCLIC COMPOUNDS AND GREEN CHEMISTRY

Unit-I : HETEROCYCLIC CHEMISTRY – I

Unit-II : HETEROCYCLIC CHEMISTRY – II

Unit-III : NUCLEIC ACIDS

Unit-IV : APPROACHES TO GREEN SYNTHESIS

Paper OC – 404 ADVANCED NATURAL PRODUCTS

Unit-I : CARBOHYDRATES AND ALKALOIDS

Unit-II : TERPENOIDS, CAROTENOIDS AND PORPHYRINS

Unit-III : STERIODS, HARMONES AND PROSTAGLANDINS

Unit-IV : BIOMOLECULES (PROTEINS AND ENZYMES)

IV SEMESTER

PHYSICAL CHEMISTRY (Specialization)

Paper PC – 401 STATISTICAL THERMODYNAMICS

Unit-I : INTRODUCTION

Unit-II : PARTITION FUNCTION AND THERMODYNAMIC FUNCTIONS

Unit-III : CANONICAL ENSEMBLE

Unit-IV : NON – EQUILIBRIUM THERMODYNAMICS

Paper PC – 402 : CHEMICAL DYNAMICS AND ELECTROCHEMISTRY

Unit-I : ACIDITY FUNCTION AND ISOTOPE EFFECTS

Unit-II : HOMOGENEOUS CATALYSIS

Unit-III : ELECTRO KINETICS AND ELECTRO CAPILLARY PHENOMENON

Unit-IV : REACTIONS AT ELECTRODE SURFACES

Paper PC – 403 : PHOTOCHEMISTRY AND NANOMATERIALS

Unit-I : INTRODUCTION TO PHOTOCHEMISTRY

Unit-II : PHYSICAL PROPERTIES OF ELECTRONICALLY EXCITED MOLECULES

Unit-III : PHOTO PHYSICAL PROCESSES

Unit-IV : NANOMATERIALS

Paper PC – 404 : PHYSICAL CHEMISTRY OF POLYMERS

Unit-I : TYPES OF POLYMERIZATION REACTIONS AND TECHNIQUES OF POLYMERIZATION

Unit-II : KINETICS OF POLYMERIZATION

Unit-III : SOLUTION PROPERTIES OF POLYMERS

Unit-IV : FUNCTIONAL POLYMERS

M.Sc., CHEMISTRY
I- SEMESTER
[Under CBCS]
(Effective from the Academic Year 2019-20)

Paper-101 INORGANIC CHEMISTRY

UNIT - 1: METAL-LIGAND BONDING, MAGNETIC BEHAVIOUR OF COMPLEXES AND EQUILIBRIUM IN SOLUTION

Metal ligand Bonding: Crystal Field Theory (CFT) for bonding in transition metal complexes, crystal field splitting of 'd'- orbitals in octahedral, tetrahedral, tetragonal and square planar fields. Crystal Field Stabilization energy (CFSE) and its calculation in six and four coordinated complexes, Spectrochemical series with reference to ligands and metal ions. Factors affecting the magnitude of Δ_o in octahedral complexes, Jahn-Teller effect and its consequences

Magnetic Behaviour of Complexes: Types of magnetic behavior, Temperature independent paramagnetism. Magnetic susceptibility and its determination by Gouy's and Faraday methods. Calculation of magnetic moment from magnetic susceptibility, spin-only formula, Orbital contribution to magnetic moment (Oh and Td Complexes)

Study of complexes in solution: Stability and instability constants. Step-wise and overall formation constants and their relationship. Trends in step-wise constants, Factors influencing stability constants- ligand effects and metal ion effect and its thermodynamic origin, Macrocyclic effect.

UNIT-II: STEREO-CHEMISTRY AND BONDING IN MOLECUES

Limitations of crystal field theory, symmetry of atomic and molecular orbitals, molecular orbitals in triatomic molecules- nitrite ion; concept of ligand group orbitals, construction of molecular orbital energy level diagrams for octahedral, tetrahedral and square planar complexes with sigma bonding only; construction of molecular orbital diagrams for octahedral complexes with pi bonding, effct of nature of ligand on π-bonding (F^-, PPh_3); Experimental evidences for π- bonding – Crystallography, Infrared spectroscopy and Photoelectron spectroscopy.

UNIT-III METAL π- COMPLEXES

Nature of π bonding, Classification of π ligands, Effect of π bonding on the ligand field splitting energy of octahedral complexes. π- bonding and spectrochemical series, π-donor ligands and π -acceptor ligands.

Metal Carbonyls: Synthesis of metal carbonyls, Structures of metal carbonyls of the types $M(CO)_n$ (M= Cr, Fe, Ni; n = 4-6), $M_2(CO)_n$ (M= Co, Fe, Mn; n= 8-10), $M_3(CO)_{12}$ (M= Fe, Ru and Os) $M_4(CO)_{12}$ (M= Co, Rh and Ir). IR Spectra of metal carbonyls—(i) Detection of bridging CO ligand, (ii) Determination of molecular symmetry and (iii) Determination of bond angles in metal carbonyls. Synergistic effect , EAN and 18-electron rules as applied to metal carbonyls, Electron counting methods- (i) Oxidation State method and (ii) Neutral Atom method, Applications of Metal Carbonyls.

Metal Nitrosyls: Synthesis of metal nitrosyls, Bonding, Electron donation by nitric oxide, Principles of stochiometry, Models for NO bonding—(i)Covalent model and (ii) Ionic models, Structures of Metal nitrosyls (1) $[IrCl(PPh_3)_2(CO)(NO)]^+$, (2) $[RuCl(PPh_3)_2(NO)_2]^+$, (3)$[(Cp)CrCl(NO)_2]^+$ (4) $[(Cp)_2Cr_2Cl(NO)_4]^+$, (5) $[Co(diars)_2(NO)]^{2+}$ and (6) $[Co(diars)_2(NO)(SCN)]^+$, Detection of bridging NO ligand, Stereochemical control of valency in cobalt complexes, Applications of metal nitrosyls.

UNIT-IV: MAIN GROUP ORGANOMETALLICS and METAL CLUSTERS

(a) Organometalic Chemistry: Classification based on hepticity and polarity of M-C bond. Nomenclature of organometallic compounds, Preparation, properties bonding and applications of methyl and phenyls of magnesium, boron, aluminum and silicon

(b) Metal Clusters: Low nuclearity clusters (LNCCs) (triatomic). Isoelectronic and isolobal relationships. Electron counting schemes of HNCCs- Wade's rules. General Methods for the preparation of HNCCS. Structures of $Os_6(CO)_{18}$, $H_2Os_6(CO)_{18}$, $H_2Os_5(CO)_{16}$, $Os_6(CO)_{21}$, $Rh_6(CO)_{16}$, $[Ni_5(CO)_{12}]^{2-}$, $[Ni_6(CO)_{12}]^{2-}$ and $[Pt_3(CO)_6]n^{2-}$ (n= 2,3 and 5) clusters. Metal halide clusters with M-M multiple bonding, Major structural types (edge sharing bi-octahedra, face sharing bi-octahedra, tetragonal prismatic and trigonal antiprismatic structure)- Quadruple bond, One dimensional solids.

Reference Books

1. Inorganic Chemistry by J.E. Huheey, E.A. Keiter and R.A. Keiter, 4th edition, Addision Wesley Publishing Company, New York,2000.
2. Advanced Inorganic Chemistry by F.A. Cotton, G. Wilkinson, C.A. Murillo and M. Bochmann, 6th edition, Wiley Interscience N.Y, 1999.
3. Coordination Chemistry by F. Basalo and R. Johnson (WA Benjamin Inc)., 1964.
4. Inorganic Chemistry, Principles and Applications by I.S. Butler and I.F. Harper, Benjamin Cummings, Redwood City, CA, 1989.
5. Chemistry of Complex Equilibria , M.T.Beck, Von nostrand Reinhold, London,1990.
6. Metal Complexes in aqueous solutions, A.E.Martell and R.D. Hancock, Plenum Press, New York.,1996.
7. Concise Inorganic chemistry by J.D. Lee, 5th edition, Blackwell Science Ltd. 1996..
8. Organometallic Chemistry by R.C Melhotra and A.Singh. New Age Inernational 2nd ed. 1991
9. Inorganic Chemistry by D.F. Shiver and P.W. Atkins 3rd ed. Oxford University Press, 1991

M.Sc., CHEMISTRY
I –SEMESTER
[Under CBCS]
(Effective from the Academic Year 2019-20)

Paper-102 ORGANIC CHEMISTRY

OC - 1: STREOCHEMISTRY

Chiral point group classifications of stereoisomers based on symmetry and energy considerations- Dissymmetric and asymmetric molecules.

Molecules with tetra-coordinate chiral centre (quarternary ammonium salts, N-oxide, silane derivatives, phosphines and sulfones) . Molecules with tri-coordinate chiral centre (tertiary amines, carbanions, phosphines and sulfoxides). Concept of dynamic enantiomerism .

Molecules with two or more chiral centres, Constitutionally unsymmetrical molecules (with dissimilar chiral carbons) and constitutionally symmetrical molecules (with similar chiral carbons)

Principles of axial chirality, Stereochemistry of allenes, spiranes and biphenyls. Geometrical isomerism in molecules having C=C, C=N, N=N and in cyclopropanes, cyclobutanes & cyclopentane, E,Z nomenclature, Physical, spectral and chemical methods of determining E, Z configuration.

OC – 2 : REACTION MECHANISM –I

A brief review of Nucleophilic Substitution Reactions at saturated carbons. S_N1, S_N2 and S_Ni-mechanisms and stereochemistry – Factors affecting the rate of S_N1 and S_N2 reactions such as substrate structure, nature of leaving group, nucleophile and the solvent.

Neighbouring group participation: Definition, Criteria of determining neighbouring group participation (enhanced reaction rates, retention of configuration, isolation of cyclic intermediates and isotopic labelling) Examples of neighbouring group participation involving halogens, oxygen, sulphur, nitrogen, aryl, cycloalkyl groups with σ and π-bonds. Introduction to non-classical Carbonium ions.

Aromatic nucleophiic substitution; $SN^1(Ar)$, SN^2 (Ar) and benzyne mechanism, Evidence for the structure of benzyne.

Ambident nucleophiles- Definition & Types. SET- Mechanism.

OC - 3: REACTION MECHANISM – II

a) Determination of reaction mechanism, Energy profiles of addition and elimination reactions, transition states, product isolation and structure of intermediate, use of isotopes, chemical trapping, cross over experiments, Use of IR and NMR in the investigation of reaction mechanism.

b) Addition to carbon-carbon multiple bonds- Addition involving symmetrical and unsymmetrical reagents, Addition of halogens to alkenes, evidence for halonium ion intermediacy, stereoselectivity and specificity, *Syn* addition reagents like $KMnO_4$, OsO_4, Anti addition – Epoxidation followed by ring opening.

c) Elimination reactions: E_2, E_1, E_1CB mechanisms. Orientation and stereo -selectivity in E_2 elimination reactions. Pyrolytic *syn* elimination and α elimination. Elimination vs. substitution.

OC – 4: INTRODUCTION TO REACTIVE INTERMEDIATES AND MOLECULAR REARRANGEMENTS

Reactive intermediates- Generation, Structure and stability of (i) carbocations, (ii) carbanions, (iii) carbenes, (iv) nitrenes and (v) free radicals.

Molecular rearrangements: Definition & Classification, Molecular rearrangements involving (i) electron deficient carbon Wagner-Meerwein, Pinacol-Pinacolone and Wolf rearrangements. (ii) Electron deficient nitrogen; Hoffman, Lossen, Curtis, Schimdt and Beckmann rearrangements. (iii) Electron deficient oxygen Baeyer-Villiger oxidation.

Base catalyzed rearrangements, Benzilic acid rearrangement, Favorskii rearrangement, Trans annular and Sommlett-Hauser rearrangement.

Reference Books

1. Stereochemistry of carbon compounds by Ernest L. Eliel, Mc Graw-Hill, New York, 1962.
2. Stereochemistry by V.M. Potapov, Mir Publishers. Moscow)
3. Stereochemistry of organic compounds – Principles and applications by D. Nasipuri, New Academic Science; 4th Revised edition
4. Stereochemistry, Conformation and Mechanism by P.S. Kalsi, New Age International, 2005

5. The third dimension in organic Chemistry by Alan Bassindale, John-Wiely & sons Inc., New York 1984
6. Organic Chemistry by T.J. Solmons, John Wiley & Sons Inc 2007
7. Organic Chemistry by Robert T. Morrison and Robert N. Boyd, Amazon publishers
8. A guide book to mechanism in Organic Chemistry by Peter Sykes, Pearson (2003)
9. Advanced Organic Chemistry : Reactions, Mechanism & Structure by Jerry March. Amazon publishers, 1992.
10. Reactive Intermediates by Issac
11. Mechanism and structure in Organic Chemistry by S. Mukherjee
12. Name Reactions by Jie Jack Li, 3rd edition, Springer.
13. Advanced organic chemistry Part- A Structure and Mechanisms, 5th edition, Francis A. Carey & Richard J. Sundberg.
14. Advanced organic chemistry Part- B Reactions and Synthesis, 5th edition, Francis A. Carey & Richard J. Sundberg.
15. Oxford organic chemistry by Clayden, Greeves Warren & Worthers.
16. Modern Methods of organic synthesis, 4th edition by William Carruthers & Lain Coldham.

M.Sc., CHEMISTRY
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(w.e.f the Academic Year 2019-20)

Paper-103: PHYSICAL CHEMISTRY

UNIT - 1: THERMODYNAMICS- I

(a) Brief review of concepts of I & II Laws of thermodynamics, Concepts of entropy as state function, entropy changes in ideal gas, Entropy changes of mixing of ideal gases, Entropy change as a criterion for spontaneity and equillibrium , Entropy change and phase change, Entropy and disorder.

(b) Free energy and work function, free energy work function relationships, Gibbs Helmholtz partial relations. Maxwell relationships, Free energy change for spontaneous and Equilibrium conditions, Partial molal free energy—Chemical potential

(c) Third law of thermodynamics, Determination of entropies of solids, liquids and gases using heat capacity data, Standard entropies. Tests for third law, Entropy of nitrogen at its boiling point.

UNIT-2: ELECTROCHEMISTRY- 1

Thermodynamic and kinetic derivation of Nernst equation, Chemical and concentration cells with and without transference, Liquid junction potential, Derivation of the expression for liquid junction potential—its determination and elimination, Applications of emf measurements, (i) solubility product, (ii) pH determination and (iii) potentiometric titrations.

Theory of electrolytic conductance, Derivation of Debye-Huckel equation and its verification, Debye Falken - Hagen effect and Wein effect, calculation of solubility of sparingly solube salt from conductance measurements, conductometric titrations – (i) strong acid-strong base, (ii) weak acid-strong base, (iii) mixture of acids (HCl + CH_3COOH vs NaOH) and (iv) Precipitation titrations.

UNIT-3: QUANTUM CHEMISTRY – I

Brief review of photoelectric effect- Black-body radiation, Plank's concept of quantization, Plank's equation, Wave particle duality and uncertainty principle, Significance of these microscopic entities, Emergence of quantum mechanics, Hydrogen emission spectrum, Bohr's model of the atom (without derivation)

Operators- Operator algebra, Communication of Operators, Linear operators, Complex functions, Hermitian operators, Operators Ψ & Ψ^2 , Eigen values and Eigen functions, degeneracy. Linear combination of Eigen functions of an operator. Well behaved functions, Normalized and orthogonal functions.

Postulates of quantum mechanics: Physical interpretation of wave function, Observables and operators, Measurability of operators, Average values of observables. The time dependant Schrodinger equation, Separation of variables and the time independent Schrodinger equation.

UNIT – 4 : CHEMICAL KINETICS--I

Review of kinetic concepts: Order, molecularity, rate and rate constant, Theories of reaction rates, Collision theory, steric factor, Theory of absolute reaction rates, Reaction coordinate and the transition state, Thermodynamic formulation of reaction rates

Unimolecular reactions—Lindemann's theory and its drawbacks. Complex reactions, rate expressions for opposing, parallel and first order reactions (all first order type)

Chain reactions- General characteristics, Detection and estimation of atoms and radicals- methods, steady state treatment of H_2- Br_2, H_2- Cl_2 reactions, Comparison of hydrogen-halogen reactions, Rate expressions for chain reactions.

Fast reactions : Flow systems- temperature and pressure jump methods- relaxation techniques

Reference Books

1. Thermodynamics for Chemists by Glasstone
2. An introduction to thermodynamics by Rastogi & Misra
3. Thermodynamics for students of chemistry by J. Kuriakose & Rajaram
4. Basic thermodynamics by Guha
5. Chemical kinetics by K.J. Laidler
6. Kinetics and mechanisms of Chemical transformations by J. Rajaraman and J. Kuriakose
7. Introduction to electrochemistry by S. Glasstone
8. Modern Electrochemistry by J.O.M. Bockris and A.K.N. Reddy
9. Soviet Electrochemistry by C Ansvipov
10. Quantum Chemistry by A.K. Chandra
11. Quantum Chemistry by R.K. Prasad
12. Quantum Chemistry by N. Levine

M.Sc., CHEMISTRY
I- SEMESTER
[Under CBCS]
(w.e. f the Academic Year 2019-20)

Paper-104 SPECTROSCOPY

UNIT- 1 : SYMMETRY AND GROUP THEORY IN CHEMISTRY (15 hours)

Symmetry elements and symmetry operations; Point groups: Mathematical requirements for a point group; schoenflies notations point groups; Systematic assignment of molecules to point groups; Sub-groups; Classes; Matrix representation of symmetry elements; Matrix representation of C_{2v}, C_{3v} and C_{4v} point groups; Reducible and Irreducible Representations; Properties of Irreducible representations; Construction of character tables (C_{2v} and C_{3v} point groups); Mulliken symbolism rules for IRs; The standard reduction formula; The Direct product; Symmetry criteria for Optional activity; Symmetry restrictions on Dipole moments; Symmetry and Stereo-isomerism; Prediction of IR and Raman spectral activity of H_2O molecule.

UNIT-II : UNIFYING PRINCIPLES, MICROWAVE & UV-VISIBLE SPECTROSCOPY (15 hours)

Unifying principles : Electromagnetic radiation and its interaction with matter –Absorption and Emission. Quantization of energy –Regions of the electromagnetic spectrum and the mode of interactions with molecules. Representation of spectra . Signal to noise ratio. Factors influencing the intensity and width of spectral lines.

Microwave spectroscopy: Classification of rotating molecules-Diatomic molecules –rigid rotor model, intensity of spectral lines. Selection rules and instrumentation. Stark effect . Applications: calculation of bond length of diatomic molecules .

UV& Visible spectroscopy: Electronic spectra of diatomic molecules. The Franck Condon principle . Rotational fine structure of electronic vibration transitions. Chemical analysis by electronic spectroscopy- Beer- Lambert ‘s law. Deviations from Beer’s law .Quantitative determination of metal ions (Mn^{+2}, Fe^{+2}) Simultaneous determination of Chromium and Manganese in a mixture.

UNIT-III : VIBRATIONAL SPECTROSCOPY (15 hours)

A: IR spectroscopy:

Basic Principles: Vibrational energy levels of Diatomic molecules, simple harmonic oscillator and an harmonic oscillator. Morse curve, Fundamental, overtone and hot bands. Zero point energy. Selection rules. Vibrational Spectra of Polyatomic molecules: Normal modes of vibration , Concept of group frequencies , Characteristic vibrational frequencies of functional groups. Applications of IR spectroscopy – determination of Force constant.

B: Raman spectroscopy:

Introduction, Raman & IR spectra comparative treatment, Mechanism of Raman Effect (Classical and Quantum theory), Mathematical explanation of Stokes and Anti-Stoke lines.

Vibrational- Rotational Raman Spectra, Selection Rules. Mutual Exclusion Principle; Merits of Raman spectroscopy. Applications:- Structural determination of $\mathbf{XY_2}$(CO_2, CS_2), $\mathbf{XY_3}$(NO_3^-, ClF_3).

UNIT-IV : RESONANCE SPECTROSCOPY (15 hours)

A. Nuclear Magnetic Resonance spectroscopy

Nuclear spin, Principles of NMR-Classical and Quantum Mechanical methods, Magnetic moment and Spin angular momentum. *Larmour Frequency*. Instrumentation. Relaxation, spin-spin & spin- lattice relaxation. Shielding constants, Chemical shifts, Shielding and Deshielding mechanism-Factors influencing Chemical shift. Spin-Spin interactions AX, AX_2 and AB types. Vicinal, Geminal and Long range coupling- Spin decoupling, Chemical shift reagents and Nuclear Overhauser effect. Principles of FT-NMR and its advantages, Applications: Biomedical (MRI) & Reaction kinetics.

B. Electron Spin Resonance Spectroscopy

Basic Principles, Theory of ESR, Comparison of NMR & ESR. Instrumentation, determination of 'g' value, factors affecting the 'g' value,. Hyper fine splitting coupling constants. Zero field splitting and Kramer degeneracy. Instrumentation, Applications: (i) Free radical and (ii) Methyl radical.

References :

1. Symmetry and Spectroscopy Molecules- K. Veera Reddy, New Age Publications, New Delhi.
2. Chemical Applications of Group Theory by Bhattacharya.
3. Group Theory by Habl Bishop.
4. Vogel's text book of Quantitative Chemical Analysis revised by G.H. Jeffrey et al., (5^{th} Edition ELBS Longman Group, New York)
5. Instrumental Methods of Analysis, 6^{th} Edition- Willard, Merritt, Dean, Settle, CBS Publications, 1986.
6. Physical Methods in Chemistry- Russell S. Drago, Reinhold Publishing Co, 1965.
7. Fundamentals of Molecular Spectroscopy- C.N. Banwell and E.A. Mc cash, 4^{th} Edition, Tata Mc Graw Hill Publishing Co.,Ltd.1994
8. Molecular Structure and Spectroscopy- G. Aruldhas, Prentice Hall of India Pvt. Ltd, New Delhi, 2001.
9. NMR, NQR, EPR and MÖssbauer Spectroscopy in inorganic chemistry – R.V Parish, Ellis, Harwood.
10. Physical Methods in Chemistry- Russell S. Drago, W.B. Saunders., Co. 1997.
11. Modern Spectroscopy- J.M. Hollas, John Willey.
12. Introduction to Molecular Spectroscopy- G.M. Barrow, Mc Graw Hill.

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M.Sc. CHEMISTRY

INORGANIC CHEMISTRY PRACTICALS

[Under CBCS]
(I SEMESTER)

(w.e.f the Academic year 2019-20**)**

I. Semi-micro qualitative analysis

Systematic semimicro qualitative analysis of inorganic mixtures containing four cations including one rare element

II. Preparation of Metal Complexes:

(i) Tetra(ammine) copper (II) sulphate.

(ii) Mercury tetra(thiocyanato) cobaltate(II).

(iii) Hexa(ammine) Nickel (II) chloride.

(iv) Tris(acetylacetonato) Manganese (III) chloride.

(v) Tris (ethylenediammine) Nickel (II) thiosulphate

M.Sc. CHEMISTRY
ORGANIC CHEMISTRY PRACTICALS
[Under CBCS]
(I SEMESTER)
(w.e.f the academic year 2019-20)

Preparation of Organic Compounds :

Preparation of organic compounds involving common organic reactions – Aspirin (Acetylation), β–naphthylmethylether (Methylation), Benzoic acid and Benzyl alcohol (Cannizzaro reaction), Benzophenone oxime and Benzanilide (Beckmann rearrangement), Benzil and Benzilic acid (Oxidation and Benzilic acid rearrangement), p-bromo acetanilide and p-bromo aniline (Bromination and hydrolysis), Benzil and Phenytion (Oxidation and condensation and Pinacol-Pinacolone rearrangement).

Recommended Books

1. A textbook of practical organic chemistry by A.I. Vogel, Vol. I and II.
2. Laboratory Manual of Organic Chemistry by B. B. Dey, M. V. Sitaraman Revised by T. R. Govindachari.
3. Unitized experiments in organic chemistry by R.Q. Brewster and others.
4. Practical Organic Chemistry by Mann and Saunders.

M.Sc. CHEMISTRY
PHYSICAL CHEMISTRY PRACTICALS
[Under CBCS]

(I SEMESTER)
(w.e.f the academic year 2019-20)

1.Physical properties

(i) Determination of density, surface tension and viscosity of liquids.

2. Distribution

(i) Distribution of benzoic acid between benzene and water

(ii) Distribution of acetic acid between n-butanol and water.

(iii) Distribution of iodine between CCl_4 and water.

(iv) Distribution of iodine between CCl_4 and KI.

$$(KI + I_2 \rightleftharpoons KI_3)$$

3. Chemical Kinetics

(i) Acid catalyzed hydrolysis of methyl acetate.

(ii) Acid catalyzed Iodination of acetone

4. Critical Solution Temperature (CST)

(i) Determination of critical solution temperature of Phenol-water system.

(ii) Effect of NaCl on CST

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M.Sc. CHEMISTRY

II SEMESTER

(CBCS Syllabus, w.e.f **2019-20**)

Paper-201 : INORGANIC CHEMISTRY

UNIT-I : REACTION MECHANISM OF TRANSITION METAL COMPLEXES

Reactivity of metal complexes. Inert and Labile complexes. Concept of Labile and Inert complexes in terms of Valence bond and Crystal Field theories. Taube's classification of inner orbital complexes as labile and inert complexes. Nucleophilic and electrophilic substitution reactions, Dissociative (D) and Dissociative interchange Mechanism (Id) & Associative (A) and Associative interchange Mechanism (Ia). Ligand substitution reactions of octahedral complexes. Acid hydrolysis. Factors affecting acid hydrolysis, Base hydrolysis. Dissociative conjugate base mechanism (D-CB). Nucleophilic substitution reactions in square planar complexes. The Trans effect. Applications of Trans effect in synthesis and distinguishing the isomeric complexes. Theories of Trans effect polarization and π-bonding theories. Complementary and non-complimentary reactions. Electron transfer reactions of complexes. Bridged or inner sphere Mechanism. Tunneling or outer sphere Mechanisms.

UNIT-II: ELECTRONIC SPECTRA OF TRANSITION METAL COMPLEXES

Free Ion Terms and Energy Levels: Configurations, Terms, States and Microstates. Calculation of Microstates for p^2 and d^2 configuration, L-S (Russell-Saunders) Coupling Schemes, J-J Coupling scheme, derivation of terms for p^2 and d^2 configuration. Hole Formulation, Energy ordering of terms (Hund's Rules), Selection rules: Laporte orbital selection rule, spin selection rules. Splitting of energy levels and spectroscopic states Orgel diagrams of d^1 to d^9 metal complexes. Interpretation of electronic spectra of aquo complexes of Ti(III), V(III), Cr(III), Mn(II), Fe(II), Fe(III), Co(II), Ni(II) and Cu(II). Calculation of interelectronic and spectral parameters for d^8 metal complexes. ***Tanabe-Sugano*** diagrams for d^2 and d^6 octahedral complexes. Charge transfer (L→M and M→L) spectra of metal complexes.

UNIT-III: MÖSSBAUER & NQR SPECTROSCOPY

(A)Mössbauer spectroscopy: Principles of Mössbauer spectroscopy, Resonance line shifts or isomer shift, Quadruple interactions and Magnetic interactions. Instrumentation, Lamb MÖssbauer factor, presentation of spectrum, Selection rules. Applications: Low spin, high spin Fe(II) and Fe(III) complexes, diamagnetic and covalent compounds, biological systems, Investigation of dithiocarbamate and Ruthenium complexes, structure determination of $Fe_3(CO)_{12,}$ Nature of chemical bond, detection of oxidation state, Applications MÖssbauer spectroscopy to Tin and Iodine compounds.

(B) Nuclear quadruple resonance spectroscopy: Quadruple nuclei, Instrumentation, Quadruple moments, electric field gradient, coupling constant, splitting. Applications: Nature of Chemical Bond, Study of Chloromethane and Chloroacetyl chlorides, Study of Charge Transfer compounds. Halogen Quadruple Resonance, Quadruple Resonance of Minerals, Nitrogen Quadrupole Resonance, NQR group frequencies, Hydrogen Bonding.

UNIT-IV BIOINORGANIC CHEMISTRY

i) Essential and trace elements in biology: Classification, Concept of essentially, Evolution of essential trace elements, Role of bulk (structural) elements and minerals, working of essential trace elements, Deficiency signs and specific function of essential trace elements (Fe, Cu, Co, Ni, Zn, F, I, Se). Antagonism and Synergism among essential trace elements.

ii) Oxygen uptake proteins : Structural and functional aspects of Haemoglobin (Hb), Myoglobin (Mb), Haemoerythrin (He) and Haemocyanine (Hc). Oxygen binding curves for Hb and Mb, Structure-function relationships.

iii) Photosynthesis: Structure of Chlorophyll, Photosynthesis in bacteria and in green plants (Z-scheme involving PS I & PS II).

References:

1. Symmetry and Spectroscopy of Molecules, by K. Veera Reddy, New Age International Publishers, New Delhi, 1998.
2. Concise Inorganic Chemistry by J. D. Lee, ELBS, 4th edition, 1994.
3. Advanced Inorganic Chemistry by F.A. Cotton and G. Welkinson, 5th Edn., John Wiley and Sons, New York.
4. Inorganic Chemistry by J. E. Huheey, E.A. Keiter and R.A. Keiter, 4th edition, Addison Wesley Publishing Company, New York, 2000.
5. Bioinorganic Chemistry, R.W. Hay, Ellis Horwood Ltd., Chichester, New York. 1984.
6. Bioinorganic Chemistry, K. Hussain Reddy, New Age International Publishers, New Delhi, 2003.
7. Reaction Mechanism of metal complexes, Robert W. Hay, Harwood Publishers, Chichester, England, 2000.
8. Inorganic Reaction Mechanisms, M.L. Toba and John Burgess, Addision Wesley, Longman, 1999.
9. Mechanism of Reactions in transition metal sites, Richard A. Henderson, Oxford Science Publications, London, 1993.
10. Kinetics and Mechanisms of Reactions of Transition metal complexes, R.G. Wilkins, 2nd Ed., V.C.H. Publications, 1991.
11. Mechanisms of Inorganic Reactions, F. Basalo and R.G. Pearson, Wiley Easter, 2nd Ed., 1997.
12. Inorganic Electronic Spectroscopy by A. B.P. Lever Elsevier.

M.Sc. CHEMISTRY
II- SEMESTER
CBCS Syllabus
(Effective from Academic year **2019-20**)
Paper-202 : ORGANIC CHEMISTRY (60 hrs.)

OC - 1 : PERICYCLIC REACTIONS

Characteristics --- Types of pericyclic reactions – Electrocyclic , cycloaddition – cycloreversion and sigmatropic reactions-examples – 4n and 4n+2 electron type – stereo-specificity. Theories involved in understanding pericyclic reactions.

(a) Frontier Molecular Orbital Theory concept – Woodward – Hoffmann selection rules for electrocyclic, cycloaddition—cycloreversion and sigamatropic reactions based on FMO approach. Examples

(b) Conservation of Molecular Orbitals Theory concept – Framing of Woodward – Hoffmann selection rules for electrocyclic, cycloaddition and cycloreversions based on conservation of Molecular Orbitals approach.

(c) Aromatic Transition state Theory – concept – Woodward- Hoffmann selection rules for electrocyclic reactions, cycloaddition-cycloreversions and sigmatropic reactions based on ATS aromatic transition state (Huckel-Mobius) approach. Examples.

OC -2 : REAGENTS OF SYNTHETIC IMPORTANCE (oxidations & reductions)

(a) Oxidations : (i) Alcohols to carbonyls : Cr(VI) oxidants, Swern oxidation, Silver Carbonate. (ii) Prevost and Woodward oxidation. (iii) Oxidations of allylic and benzylic C-H bonds: DDQ and SeO_2.

(b) Reductions : (i) Catalytic hydrogenation: Homogeneous hydrogenation-Use of Wilkinsons catalyst. (ii) Dissolving metal reductions including Birch reduction. (iii) Nucleophilic metal hydrides : $LiAlH_4$, $NaBH_4$, and their modifications. Electrophilic metal hydrides : BH_3, and AlH_3. (iv) Hydrogenolysis, use of tri-n-butyltin hydride.

(c) Organometallic reagents: Preparation and application of the following in organic synthesis : (i) Organo lithium and Organo copper reagents. (ii) Organo boranes in C—C bond formation.

OC - 3 : CONFORMATIONAL ANALYSIS

Introduction to conformational isomerism and the concept of dynamic stereochemistry, Study of conformations in ethane and 1,2-disubstituted ethane derivatives like butane, dihalobutane halohydrin, ethylene glycol, butane-2,3-diol, amino alcohols and 1,1,2,2-tetrahalobutanes. Klyne-Prolog terminology for conformers and torsion angles. Conformations of unsaturated acylic compounds (1-butene, propionaldehyde and butanone). Conformational diastereoisomers and conformational enantiomers. Factors affecting the conformational stability and conformational equilibrium-attractive and repulsive interactions. Use of physical and spectral methods in conformational analysis.

Conformational effects on the stability and reactivity of acyclic diastereoisomers-steric and stereo electronic factors-examples. Conformation and reactivity. The Winstein-Holness equation and the Curtin-Hammett principle.

Conformations of cyclohexanes, mono and di substituted cyclohexanes. Stereochemistry of decalins. Factors governing the reactivity of axial and equatorial substituents in cyclohexanes. Stereochemistry of addition to the carbonyl group of rigid cyclohexane ring.

OC - 4 : MASS SPECTROMETRY

Basic Principles – instrumentation – magnetic sector instruments – unit and high resolution mass spectrometers-quadrupole mass spectrometry-quadrupole mass filter-quadrupole ion storage-time of flight (TOF), FT-ICR. Ion – production – EI, CI, FD, FAB, ESI and MALDI. Mass spectrum – Molecular ion – types of ions in mass spectra, effect of isotopes on mass spectra – Determination of molecular formula – Mc Lafferty of rearrangement – ortho effect - Meta stable ions – Doubly charged ion - Nitrogen rule – General fragmentation modes – Mass spectra of hydrocarbons – Alkanes (n–nonane and 3,3–dimethyl heptanes), cycloalkanes (n–propyl cyclohexane), alkenes (β–Myrcene), alkynes (1–butyne) – Aromatic hydrocarbons (Ethyl benzene and n–butylbenzene). Alcohols (1–pentanol, 2–pentanol, 2–methyl–2–butanol)– phenols (o–ethyl phenol), Thio phenol.

References:

1. Conservation of orbital symmetry by Woodward and Hoffmann
2. Organic reactions and orbital symmetry by Gilchrist and Storr
3. Pericyclic reactions—a problem solving approach by Lehr and Merchand
4. Pericyclic reactions by Mukherjee
5. Mechanism and structure in organic chemistry by S, Mukherjee
6. Some modern methods of organic synthesis by W. Carruthers
7. Guide book of organic synthesis by R. K. Meckie, D. M. Smith & R. A. Atken
8. Reagents in organic synthesis by B. P. Munday and others
9. Organic synthesis by O. House
10. Organic synthesis by Michael B. Smith
11. Reagents for organic synthesis by Fieser & Fieser, Vol. 1-11 (1984)
12. Hand book of reagents for organic synthesis by Reich and Rigby Vol. I & IV
13. Organic Synthesis by Robert E Ireland
14. The third dimension in organic chemistry by Alan Bassindale
15. Stereochemistry of carbon compounds by Ernest L. Eliel
16. Stereochemistry by V. M. Potapov
17. Stereochemistry of Organic compounds- Principles and Appplications by D. Nasipuri
18. Stereochemistry, Conformational and Mechanism By P. S. Kalsi.
19. Advanced organic chemistry Part- A Structure and Mechanisms, 5th edition, Francis A. Carey & Richard J. Sundberg.
20. Advanced organic chemistry Part- B Reactions and Synthesis, 5th edition, Francis A. Carey & Richard J. Sundberg.
21. Oxford organic chemistry by Clayden, Greeves Warren & Worthers.
22. Modern Methods of organic synthesis, 4th edition by William carruthers & Lain coldham.

M.Sc. CHEMISTRY
II-SEMESTER
CBCS Syllabus
(Effective from the Academic year **2019-20**)
Paper-203 : PHYSICAL CHEMISTRY (60 hrs.)

Unit-1 : THERMODYNAMICS-II

Chemical potential – its significance-applications. Thermodynamic derivation of phase rule. Applications of phase rule to two component systems-azeotropes. Compound formation-AB type. Simple eutectic systems. Three component systems- Phase equilibrium diagrams of systems with two salts and water.

Partial molar properties-physical significance of partial molar properties- Determination- (i) direct method (ii) Using apparent molar properties. Determination of partial molar volume using densities.

Phase equilibria – Fusion, Vaporisation and transition equilibria. Derivation of Clapeyron equation and its extension to Clausius-clapeyron equation-Differential and integral forms-Application-Determination of $\Delta H_{f.}$

Free energy change and equilibrium constant- Van't Hoff reaction isotherm. Direction of chemical change. Determination of standard free energies.

Unit-2 : ELECTRO CHEMISTRY-II

Concept of activity and activity coefficient of an electrolyte- Forms of activity and activity coefficient-The mean ionic activity coefficient-calculation of mean ionic activity coefficient (i) from solubility (ii) from emf measurements.

Debye Huckel limiting law and its verification—Determination of activity and activity coefficient.

The deposition and corrosion of metals-factors effecting metal deposition (i) current density (ii) concentration of electrolyte (iii) temperature (iv) colloidal matter (v) electrolyte (vi) Basis metal.

Electrochemical, chemical and mechanical passivity-electrochemical corrosion of metals-classification of corrosion processes. Methods of corrosion prevention.

(i) Electrical methods (ii) methods based on changing the properties of corroding metal (iii) methods based on changing the properties of corroding medium (iv)combination methods.

Unit-3: QUANTUM CHEMISTRY-II & X-RAY CRYSTALLOGRAPHY

A. Quantum Chemistry : Particle in a box- One dimensional and three dimensional. Plots of ψ and ψ^2 discussions. Degeneracy of energy levels. Comparison of classical and quantum mechanical treatments. Calculations using wave functions of the particle in a box model-orthogonility, measurability of energy and position- Application to the spectra of conjugated molecules.

Schrodinger equation for the hydrogen atom-Separation of Variables. Quantum numbers, n, l, and m and their significance. Hydrogen like wave functions. Radial and angular functions. The radial distribution functions- Hydrogen like orbitals and their representation. Polar plots, contour plots and boundary diagrams.

B. X-ray Crystallography: Crystal lattice. Unit cell. Crystal planes. Miller indices. Distance between lattice planes (cubic). Bragg's law of diffraction. Powder method. Debye – Scherrer method. Powder diffractometer. Indexing of planes. Systematic absence. Structure of KCl and NaCl.

Unit- 4 : CHEMICAL KINETICS-II

Acid Base catalysis : specific acid catalysis - hydrolysis of an ester and ethers. Effect of pH. Skrabal diagrams. Specific base catalysis and general base catalysis. Protolytic and prototropic mechanism.

Free radicals in chemical reactions-Hydrogen-Oxygen reaction. Upper and lower explosion limits (electronic theories of chemisorptions and heterogeneous catalysis)

Reactions on surfaces and in solid state-adsorption and adsorption isotherms- Langmuir adsorption isotherm. Competitive adsorption-deviations from ideal behavior.

Chemical reactions on surfaces, mechanism of surface reactions, unimolecular surface reactions-inhibition. Bimolecular surface reactions, reactions between two adsorbed molecules, reaction between a gas molecule and an adsorbed molecule; Adsorption of two gases without mutual displacement, ethylene-hydrogen reaction, ethylene-deuterium exchange reactions.

Reference Books

1) Thermodynamics for chemistry by S. Glasstone.
2) An introduction to thermodynamics by Rastogi & Misra.
3) Thermodynamics for students of chemistry by J. Kuriakose & Rajaram.

4) Basic thermodynamics by Guha.
5) Chemical kinetics by K. J. Laidler.
6) Kinetics and Machanism of chemical transformations by J. Rajaram & J. Kuriakose.
7) Introduction to electrochemistry by S. Glasstone.
8) Modern Electrochemistry by J. O. M. Bockris and A. K. N. Reddy.
9) Soviet Electrochemistry by C. Ansvipov.
10) Quantum chemistry by A.K. Chandra.
11) Quantum chemistry by R.K. Prasad.
12) Quantum chemistry by N. Levine.

M.Sc. CHEMISTRY
II-SEMESTER
CBCS Syllabus
(Effective from Academic year **2019-20**)
Open Elective Paper : Chemistry of Biological Processes (60 hrs.)

(To External Students only)

UNIT -I: BIOANALYTICAL CHEMISTRY (15 Hrs) **(a)**

Clinical analysis: Collection, Preservation and composition of blood sample, .Clinical analysis of blood glucose, blood urea nitrogen and immunoassay. The blood gas analyzer, Determination of trace elements(Fe, Cu, Zn) in blood sample.

b) Drug analysis : Classification and nomenclature of Natural Drugs; Biological and Chemical classification of drugs, Analysis of drugs using TLC, GC, and HPLC . spectrophotometric methods for the analysis of drugs. Determination of the concentration of ethyl alcohol in pharmaceutical preparation and alcoholic beverages.

(c) Antibiotics and sulpha drugs: Classification of antibiotics based on chemical structures; Synthesis, Structure, properties, and assay of some antibiotics: 1) Chloramphenacol (2) Penicillin (3) Streptomycin (4) Cibazole

UNIT -II: BIOINORGANIC CHEMISTRY (15 Hrs)

(a) Essential and Trace Elements: Role of metal ions in Biological processes, Na^+/K^+ Pump.

(b) Photosynthesis: Structure of Chlorophyll, Photosynthetic mechanism in bacteria and in green Plants(Z-Scheme, PS-I & PS-II), Role of manganse complex in the cleavage of water, Model systems.

(c) Respiration (Transport and storage of dioxygen): Structure and functions of myoglobin, hemoglobin, hemertythrin and hemocyanin, model systems.

(d) Biological nitrogen Fixation: Molybdenum nitrogenase, Mechanisms of biological N_2 fixation, model systems.

UNIT -III: BIOORGANIC CHEMISTRY (BIOMOLECULES) (15 hrs)

(a) Nucliec acids : Introduction. Isolation of nucleic acids. Hydrolysis products of nucleic acids. Structure of heterocyclic bases - Adenine, Guanine, Cytosine, Thymine and Uracil. Structure of sugars – Ribose and 2-deoxyribose. Primary, econdary and tertiary structure of DNA, Types of RNA - mRNA, tRNA and rRNA. Replication, transcription and translation. Genetic code. Protein biosynthesis.

(b)Enzymes : Introduction. Definition. Composition. Nomenclature and Classification based on mode of action. Mechanism of enzyme activity, Factors affecting enzyme catalysis. Lock and Key model and Induced–Fit model, Enzyme inhibition– Irreversible inhibition, Competitive inhibition and Noncompetitive inhibition, Immobilized enzymes.

UNIT -IV: BIOPHYSICAL CHEMISTRY (Bio Membranes & Bioenergetics) (15 Hrs)

(a)Biological membranes: Chemical composition of cell membranes; Membrane Models; Functions of cell membrane; Mechanism of ATP Synthesis

(b)Bioenergetics : Importance of Bioenergetics; Energy and its Various forms; Principles of Thermodynamics; Entropy; Free Energy; Relation between $\triangle G$ and $\triangle S$; Relationship between Standard Free Energy Change and Equilibrium Constant; Bio –Chemist's standard state; Standard Free Energy changes at pH 7 of $\triangle G^{0'}$; Difference between $\triangle G$ and $\triangle G^{0'}$; Standard free energy values of Chemical reactions are additive; Coupled Reactions;

Recommended Books

1. Standard methods of Chemical analysis by Welcher.
2. Inorganic Chemistry by J. E. Huheey, E.A. Keiter and R.A. Keiter, 4th edition, Addison Wesley Publishing Company, New York, 2000.
3. Bioinorganic Chemistry, R.W. Hay, Ellis Horwood Ltd., Chichester, New York. 1984.

4. Bioinorganic Chemistry, K. Hussain Reddy, New Age International Publishers, New Delhi, 2003.
5. Organic Chemistry Vol. 2 Stereochemistry and the Chemistry of Natural Products 5th Edition by I. L. Finar.
6. CHEMISTRY – General, Organic, Biological by Jacqueline I. Kroschwitz an Melvin Winokur.
7. Bio Chemistry by Pawar Chatwal.
8. Bio Physical Chemistry by M.Satake, Y. Hayashi, M.S. Sethi & S.A. Iqhal.

M.Sc. CHEMISTRY

INORGANIC CHEMISTRY PRACTICALS

(II SEMESTER)

(CBCS w. e. f **2019-20**)

I. Analysis of two component mixtures:

(i) Determination of Al (III) and Fe (III)

(ii) Determination of Cu (II) and Zn (II)

(iii) Determination of Ca (II) and Mg (II)

(iv) Determination of Cu (II) and Ni (II)

(v) Determination of Ferrocyanide and Ferricyanide

II. Analysis of Complex Materials:

(i) Estimation of free Chlorine in bleaching powder

(ii) Estimation of dissolved oxygen in water

(iii) Estimation of Calcium in milk,

(iv) Estimation of chromium in alloy steels.

M. Sc., CHEMISTRY

Under CBCS (w.e.f. **2019-20**)

SECOND SEMESTER

ORGANIC CHEMISTRY LAB COURSE

Systematic Analysis of Simple Organic compounds and Separation of mixture of Organic compounds :

1. Identification of the organic compounds by a systematic study of the physical characteristics (mp/bp), solubility, extra elements (nitrogen, halogens and sulfur), functional groups, preparation of crystalline derivatives and identification by referring to literature.
2. Separation of two component mixtures by chemical methods - Separation by using solvent water, ether, 5% aq. sodium bicarbonate, 5% aq.. hydrochloric acid and 5% sodium hydroxide solutions.

Recommended Books

1. A text-book of practical organic chemistry by A.I. Vogel, Vol. I and II.
2. Laboratory Manual of Organic Chemistry by B. B. Dey, M. V. Sitaraman Revised by T. R. Govindachari.
3. Unitized experiments in organic chemistry by R.Q. Brewster and others.
4. Practical Organic Chemistry by Mann and Saunders.

M. Sc., CHEMISTRY

(Effective from Academic year **2019-20**)

SECOND SEMESTER

PHYSICAL CHEMISTRY LAB COURSE

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1. Conductometry

Determination of cell constant.

Verification of onsagar equation using KCl.

Titration of strong acid vs strong base (HCl vs NaOH)

Titration of weak acid vs strong base (AcOH vs NaOH)

Precipitation titration (KCl vs $AgNO_3$)

2. Potentiometry

Determination of single electrode potential.

Titration of a strong acid vs strong base (HCl vs NaOH)

Titration of weak acid vs strong base (AcOH vs NaOH)

Precipitation titration (KCl vs $AgNO_3$)

3. Colorimetry

(i) Determination of absorption maxima of chromophores

(ii) Determination manganese using periodate method

(iii) Determination of copper using EDTA reagent

M.Sc., CHEMISTRY
III SEMESTER
(CBCS w. e. f. 2020-21)

A COMMON PAPER TO ALL SPECIALIZATIONS IN CHEMISTRY AND TO ORGANIC CHEMISTRY (Self Funding Course)

PAPER : CH 301: QUANTITATIVE DATA, SEPARATION TECHNIQUES, RADIO-ANALYTICAL, THERMAL AND VOLTAMMETRIC METHODS

UNIT-I: STATISTICS AND DATA HANDLING IN ANALYTICAL CHEMISTRY

Precision and accuracy, relative accuracy, standard deviation, coefficient of variation, confidence interval, Types of errors-- Sources of determinate errors and their elimination, random errors and their distribution, propagation of determinate errors and random errors, Control charts, Statistical tools – 'F' test, 't' test and 'Q' test; Method of least squares; Correlation coefficient and coefficient of determination; Limit of detection(LOQ) ; Limit of determination(LOD) Sensitivity and selectivity of an analytical method.

UNIT-II: SOLVENT EXTRACTION & CHROMATOGRAPHY

(a) Solvent extraction: General introduction -factors favouring solvent extraction. Quantitative treatment of solvent extraction - Extraction reagents. Concept of synergistic extraction. Applications:- (i). Determination of ferric ion as chloride.(ii).Determination of nickel by synergistic extraction using dithiozone and 1,10-phenanthroline. (iii). Determination of Molybdenum by thiocyanate method.

(b) Chromatography—Introduction, Definitions, Classification of chromatographic methods

(i) Gas chromatography: Principle and theory, Instrumentation - Carrier gas. Sample injection system, derivatization of the sample, columns, Detectors - thermal conductivity detectors, Procedure in GC, Evaluation and identification of Gas chromatogram.. Applications of Gas Chromatography Qualitative and Quantitative Analysis, Elemental Analysis---Determination of C, H and N - Determination of Sulphur; determination of Total organic Carbon. Principles and applications of (i) GC-MS and (ii) GC-FT IR.

(ii) High Performance Liquid Chromatography(HPLC): Introduction. Characteristic

features of HPLC. Instrumentation for HPLC. Comparison of HPLC with other chromatographic techniques. Quantitative analysis and data display. Applications - Separation of cations - separation of pharmaceutical drugs, Vitamins, carbohydrates Analysis of pesticides- Principle and applications of HPLC-MS

UNIT-III: RADIO ANALYTICAL METHODS AND THERMAL METHODS OF ANALYSIS.

(a)Radioanalytical Methods: Definition and measurement of radioactivity. Devices G.M counter and scintillation counter. Radio active tracers. Typical applications of radio isotopes as tracers. Chemical investigation. Physico-chemical research. Age determination. Medical applications. Biological applications. Radio dosimetry. Radialysis of water.

(b)Thermal Methods of Analysis: Introduction - Thermogravimetric analysis (TGA), Differential thermal analysis (DTA) and differential scanning calorimetry (DSC) - Instrumentation, methodology and applications of the techniques. Derivatogram of Ni $(Py)_4(SCN)_2$ complex. Thermometric titrimetry and its applications.

UNIT-IV: VOLTAMMETRY AND RELATED TECHNIQUES

A. **Introduction to Voltammetric techniques and its Basic concepts:** Basic Principles of DC Polarography, Schematic diagram of Polarograph, Advantages of DME, Polarographic Currents- Diffusion Current, Residual Current, Migration Current, Illustration of Typical Polarogram, Half- Wave Potential, Factors affecting the Diffusion Current (Ilkovic Equation), Polarographic Wave Equation and its significance in analysis, Polarographic Maxima and types, Elimination of Maxima- Role of Maximum Suppressors, Role of Supporting Electrolyte in analysis, Role of Oxygen and its removal in analysis, Types of Electrode Reactions (Reversible and Irreversible systems), Principles of Cyclic Voltammetry and its applications – Reversible, quasi-reversible and irreversible processes.

B. **Applications of Voltammetric Techniques:** Advantages of Polarographic methods of analysis, Qualitative Polarographic Analysis, Quantitative methods of Analysis (Calibration Plot Method and Standard Addition Method) Application to Inorganic Compounds, Determination of Ligand Number and Stability Constant of a Complex for reversible systems (Lingane Method). Determination of Cadmium and Lead in Steel, Determination of Traces of Metals in Distilled Water. Applications in Organic Analysis: Polarographic Studies on Organic Compounds-Reduction of carbonyl compounds.

References

1.Analytical Chemistry by Robert Dilts.

2.Quantitative Analysis, by R.A. Day and A.L. Underwood

3.Analytical Chemistry by G.D. Christian

4.Instrumental methods of analysis by Scoog and West.

5.Vogel's text book of quantitative inorganic analysis.

6.Programming in Basic by E. Balaguruswamy.

7.Chromatography by H. Kaur, Pragati Prakashan 2nd Edition, 2007

8.Analytical chemistry by Skoog, West and Hosler.

9.Separation techniques by M.N. Sastri

10.Chemical separation methods by J.A. Dean

11. Basic concepts Analytical chemistry S.M. Kopkar.

12.Instrumental methods of Analysis by Willard, Merit, Dean and Seattle.

13.Principles of Polarography by J. Heyrovsky.

14. Polarography and allied techniques by V. Suryanarayana Rao.

15. Polarographic methods of Analysis by Sarabhai Series.

M.Sc. CHEMISTRY – III SEMESTEER

ANALYTICAL CHEMISTRY

Under CBCS (w.e.f. **2020-21**)

AC-302 : Physical methods in Analytical Chemistry

UNIT – I : (a) Physical methods of Drug Analysis : Identification, Melting point, Solubility, Polymorphism, Water content or moisture content, Residue on ignition, Heavy metals, for drug products, Disintegration test, Hardness test, Hardness Measurements.

Quality Management System: The laboratory product, Laboratory process, Laboratory Customer, Satisfaction, Improvement, Documentation Requirements, Management Responsibility-Quality Policy, Responsibility, Authority and Communication, Resource Management, Product Realization, Measurement, Analysis and Improvement, Tools and Mechanism, Laboratory Environment.

Reference book for Unit- 1 to be provided

UNIT – II : GRAVIMETRY

(a) Homogenous precipitation: Methods of precipitation, Co-precipitation, Post precipitation and effect of pH, precipitation of Mg with oxine (8-hydroxy quinoline). Ni with DMG, Cu precipitation with benzoin, Ion Release. Precipitation of Cd, Mg, Fe and Ag. Change of oxidation state, Ce^{+3}. Precipitation of Pb as chromate by oxidation of Cr^{+3}.

(b) Organic reagents in Inorganic Analysis: Theoretical principles involved in the use of organic reagents in inorganic precipitation analysis. (i) DMG (ii) Cuferon (iii) 8-hydroxy quinoline.

UNIT – III : TITRIMETRIC ANALYSIS

(a) Complexometric Titrations: Introduction, Stability of complexes, factors influencing the stability of complexes, stability constants of EDTA complexes. Titration curves, Types of EDTA curves, Representative methods, Qualitative applications. Titration of mixtures, Sensitivity, Masking and Demasking agents.

(b)Precipitation Titrations: Titration curves, feasibility of precipitation titration, factors affecting shape-titrant and analyte concentration, Selection and Evaluation of External and Adsorption Indicators of end points. Quantitative application of precipitation titrations.

UNIT – IV : REDOX AND DIAZOTIZATION TITRATIONS

(a) Redox Titrations: Analytical chemistry of some selected redox systems. Formal and Standard potentials in various media, stability of solutions, species responsible for oxidizing and reducing properties, standardization, requirement for the selection of oxidants and reductants.

Oxidizing Systems: Ce(IV) and Periodate

Reducing Systems: Cr(II), V(II), Hydroquinone. Selection of Suitable Indicators for Oxidant and Reductant systems. Estimation of Drugs and Pesticides by volumetric method.

Applications of Redox titrations by using CAS.

(b) Diazotization Titrations: Principles, Preparation and standardization of 0.1 M $NaNO_2$ solution, Procedure for diazotization titrations, Types of diazotization titrations-Direct, Reverse, Special methods, Applications of diazotization titrations-Direct titrations Conversion to amino group by chemical reactions by reduction and by Hydrolysis.

References:

1. Analytical Chemistry by Gary D. Christian, 6th Edition.
2. Analytical Chemistry and Principles by T.H. Kennedy, 2nd Edition.
3. Fundamentals of Analytical chemistry by David Harvey, mc Graw Hill – 2003.
4. Vogel's text book of Quantitative analysis, V Edition, Longman publications.
5. Principles and methods of chemical Analysis by Walton 3rd Edition.
6. Text book of Pharmaceutical Analysis by Dr. S. Ravi Sankar, Rx Publications.

M. Sc. CHEMISTRY – III SEMESTEER

ANALYTICAL CHEMISTRY

Under CBCS (w.e.f. **2020-21**)

PAPER AC-303 : Analytical Spectroscopy

UNIT – I : FLAME EMISSION AND ATOMIC FLUORESCENCE SPECTROSCOPY

(a) Flame Emission Spectroscopy: Principles, Interferences, evaluation methods, types of instruments used, flame photometer and experimental technique, chemical reactions in flames. Dissociation equilibria, ionization in flames, use of organic solvents. Applications, advantages, procedure for determinations, limitations and disadvantages.

(b)Atomic Fluorescence Spectroscopy (AFS): Introduction, Mathematical relationships, AFS Transitions, Instrumentation Analysis, Atomic Fluorescence Spectroscopy as an analytical tool, Types of Fluorescence, Advantages of Atomic Fluorescence, Limitations of Atomic Fluorescence Spectroscopy, Interferences-Chemical Interferences, Spectral Interferences, Accuracy, Precision, Detection limits, Multi-elemental Analytical Applications.

UNIT – II : AAS, ANALYSIS OF INDUSTRIAL SAMPLES AND ICP-AES

(a) Atomic Absorption Spectroscopy: Introduction, Principles, relation between emission and absorption and band width, Instrumentation, Interferences, background correction, accuracy, precision, sensitivity and detection limits. Applications, indirect determination of AAS elements, special consideration to chromium, Be, Hg, Mo, analysis of water.

(b)Analysis of Industrial samples : Lead in paint, Hg in Hg containing pharmaceuticals, Heavy metals in fertilizers, Determination of Pb in gasoline and street air, Cu compound in human serum

(c) Inductively Coupled Plasma Emission Spectroscopy: Principles of plasma emission spectroscopy, process of atomization and excitation plasma as an excited source, inductively coupled plasma source, ICP-AES, instrumentation, application of plasma spectroscopy, comparison of ICP-AES with AAS.

UNIT – III : NEPHELOMETRY, TURBIDIMETRY, FLUORIMETRY & PHOSPHORIMETRY

(a) Nephelometry and Turbidimetry: Light scattering in Nephelometry and Turbidometry -Choice between Nephelometry and Fluorometry, theory effecting concentration particle size and wavelength on scattering. Instrumentation, applications of Nephelometry and turbidometry, Turbidometric titration. Analysis of sulphate, phosphate, phosphate by Nephelometric titrations.

(b) Fluorometry and Phosphorimetry: Introduction, principles, fluorescence and phosphorescence, basic instrumentation, selection of excitation wavelength analysis of responding. Fluorescence spectra, application of fluorometric titration, qualitative and quantitative analysis, analysis of Aluminum, Zinc, Chemiluminescence.

UNIT –IV : PHOTOELECTRON SPECTROSCOPY & FLOW INJECTION ANALYSIS

(a) Photoelectron Spectroscopy: Introduction, Principles, instrumentation theory, application and comparison with other methods, Auger electron spectroscopy and electron spectroscopy for chemical analysis – principles and applications.

(b) Flow injection analysis: Specification of methods of analysis, classification of method and analysis, application of automated analysis, flow injection analysis, theoretical consideration of FIA, factors affecting of peak height, application of flow injection analysis.

References:

1. Spectroscopy by Chatwal & Anand, Himalaya Publishing House.
2. Analytical Chemistry Instrumental Techniques by Mahinder Singh, Dominant Publishers.
3. Analytical atomic Absorption spectroscopy by Jon C. Von Loon, Academic press, 1980, London.
4. Principles of Instrumental analysis. 5th Edition by James B. Robinson.
5. Undergraduate Instrumental analysis. 3rd Edition by James B. Robinson.
6. Fundamentals of Analytical Chemistry by Skoog West and Holler, Saunder's Publications.
7. Basic concepts of Analytical Chemistry by S.M. Khopkar, 2nd Edition, New Age international Publishers.
8. Spectroscopy by Kaur, Goel Publications.
9. Instrumental methods of chemical analysis. 5th Edition by Ewing, Mc Graw Hill International Edition.
10. Instrumental methods of analysis. By Willard, Merit and Dean 7th Edition.
11. Vogel's text book of Quantitative Inorganic analysis, English Language Book Society.
12. Instrumental methods of chemical analysis by M.S. Yadav, Campus Books International, New Delhi.
13. Handbook of Analytical Instrumentation by R.S. Khandpur, Tata Mc Graw Company.

ANALYTIC CHEMISTRY PRACTICAL EXAMINATION SYLLABUS FOR III Sem.

PRACTICAL -1

Spectroscopic Identification of Organic compounds by using IR,UV,^{1} H-NMR.^{13} C-NMR and Mass Spectra.

1. Acetone
2. Acetic Acid/Propoinic acid/Chloroacetic Acid
3. Methyl acetate
4. Ethyl benzoate
5. Acetamide
6. Acetylene
7. Acetophenone
8. 2-Butanone
9. Benzaldehyde
10. Neopentylamine
11. 1,3 dibromopropane
12. P-toulidine
13. Isobutylalcohal
14. Butaraldehyde
15. Pyridine/lutidine/2-aminopyridine/furfural

Practical-2 :-

1. **Analysis of Metal Complexes :**
   - i) Estimation of Zinc
   - ii) Estimation of Copper
   - iii) Estimation of Magnesium
2. Determination of Chloride ion in a given water sample by Argentometri method (mohr's method).
3. Hardness of Water.
4. Soil Extraction.
5. Assay of Paracetamol Tablet.
6. Analysis of Carbonates and bicarbonates in baking soda by Acid-Base titrations.

M.Sc. CHEMISTRY-III SEMESTER

INORGANIC CHEMISTRY
Under CBCS (w.e.f. **2020-21**)

Paper IC-302: STRUCTURAL METHODS IN INORGANIC CHEMISTRY

UNIT - I : ELECTRON PARAMAGNETIC (EPR) SPECTROSCOPY AND ITS APPLICATIONS IN CO-ORDINATIION CHEMISTRY

Basic principles, scope of EPR Spectroscopy, The nature of EPR spectrum and its illustration. Hyperfine Interactions and Qualitative Analysis, EPR investigation of complexes, Applications to Transition Metal complexes with respect to electron delocalization, Bonding parameters and structure determination. The EPR spectrum of bis(salicylidimine)-copper(II) complex, Study of inorganic free radicals, Biological applications of Electron Spin Resonance (Study of substrate free radicals and Iron-sulfur proteins)

Referenes:

1. Coordination Chemistry and Experimental methods by K. Burger London Butterworths Ltd., London – 1975.
2. Physical Methods in Inorganic Chemistry by R.S. Drago
3. Spectroscopy by B.K. Sharma
4. Molecular Spectroscopy by Singh and Dikshit

UNIT - II : MULTINUCLEAR NMR SPECTROSCOPY

Fundamental aspects of ^{1}H, ^{13}C, ^{19}F and ^{31}P NMR spectra – Ranges of chemical shifts - Homo and heteronuclear coupling – Second order coupling – Exchange and Relaxation processes – Spin dilute systems – Satellites in *cis* – $Pt(Et_3)_2 Cl_2$ and $Sn(CH_3)_4$ complexes. NMR Time scale and its use in studying stereochemical non-rigidity of metal complexes. Use of chemical shifts and coupling constants for structure determination of simple inorganic and co-ordination compounds containing one or more of ^{1}H, ^{13}C, ^{19}F and ^{31}P nuclei – PF_3R_2, Rh (PPh_3)$_3$ Cl, Fe_3 (CO)$_{12}$, Phosphine complexes of Palladium, *mer* – [Ir $(CO)_3$ F_2], *Tris* (N – Methyl – 2 – hydroxy acetophenimine) Cobalt(III) complex.

References :

1. Multinuclear NMR Spectroscopy by Kemp.
2. NMR Spectroscopy in Inorganic Chemistry by J. Iggo, Oxford Science Publications, New York, Vol. 83.
3. Inorganic Spectroscopic methods by Alan K. Bridson, Oxford Science Publications, New York, 1998, Vol. 62.
4. Organic Spectroscopy – Pavia (Thomson Publications)

UNIT - III : OPTICAL ROTATORY DISPERSION AND CIRCULAR DICHROISM SPECTROSCOPY

Optically active molecules, Optical rotatory dispersion, Circular dichroism, Cotton effect; Octant rule; Faraday and Kerr effects; Instrumentation – Automatic recording spectropolarimeters (Rudolph and Cary spectropolarimeters); Instruments for circular dichroism measurements.

Applications : Optically active complexes optical activity of metal complexes, determination of the configuration of complexes, mixed complexes of transition metals, the study of outer sphere complexes, interpretation of the optical activity of transition metal complexes, the use of circular dichroism curves for the interpretation of optical absorption spectra.

Reference:

1. Coordination Chemistry : Experimental methods by K. Burger, London Butterworths Ltd., London – 1975.

UNIT - IV : PHOTOELECTRON SPECTROSCOPY

Basic principles of Photoionization, X-ray fluorescence and Auger processes, Photoelectron spectra (PES) of Argon, Dinitrogen and Hydrogen bromide, Core binding energies of second period elements,

Experimental techniques – Experimental aspects of PES, Ionization Energies and Orbital energies – the importance of Kooppman's rule; Chemical shifts in X-PES and structural applications; PES of transition metal complexes, Applications- Study of catalytic activity of vanadyl acetylacetonate, structural studies of Biguanide complexes; Studies on the nature of back-bonding in metal carbonyls.

Reference:

1. Introduction to Photoelectron Spectroscopy by P.K.Ghosh, (John Wiley, New York), 1983.
2. Fundamentals of molecular Spectroscopy C.N. Banwell and E.M.Mc Cash (4th Edition), Tata Mc-Graw Hill Publishing Company Ltd., New Delhi – 1994.
3. Instrumental Methods of Chemical analysis, G.W. Ewin, Mc Graw – International Editions, 5th Edition, 1985.
4. Vibrational spectroscopy – D.N. Satyanarayana (New Age Publications) 2nd Edition.

M.Sc. CHEMISTRY-III SEMESTER

INORGANIC CHEMISTRY
Under CBCS (w.e.f. 2016-2017)

Paper IC-303: Bioinorganic, Organometallic and Inorganic polymer Chemistry

UNIT - I : TRANSPORT AND FIXATION PROCESSES IN BIOLOGY

Transport of alkali metal ions, Biological role and Co-ordination Chemistry of alkali metal ions, selectivity patterns, Ionic Gradient, Relationship between ionic specificity and field strength, Na+/K+ pump and ATP Cycle Active transport of Cations, Mechanisms of ion transport. Alkali cation complexes of natural antibiotics and Crown ethers.

Nitrogen fixation processes – (1) Biological nitrogen fixation- Nitrogen fixing microorganism, Nitrogenase--Reactivity and Redox properties of nitrogenase, Postulated mechanisms of nitrogen fixation.

UNIT - II : METALLO - PROTEINS AND METALLO -VITAMINS

Iron Sulphur Proteins- Rubredoxin, Ferridoxin, High potential Iron Sulphur Protein, Synthetic analogues of Fe_4S_4 clusters.

Blue – Copper Proteins : Types of metal centers, *Oxidases* – laccase, Ceruplasmin and Ascorbic acid oxidase. *Electron carriers* – Azurin and Plastocyanin,

The Chemistry of vitamin B_{12} and Model Compounds – Structure and biochemical functions of coenzyme B_{12}, Derivatives and oxidation states of B_{12}. Reactivity of B_{12S} , Model compounds. Electrochemistry of B_{12} and model compounds. Synthesis of alkyl B_{12}, Axial isomers of B_{12}, Alkyl transfer reactions, Coordination chemistry and Photochemistry B_{12} derivatives and model compounds.

References for I and II Units :

1. R.W. Hay : Bioinorganic Chemistry, Ellis Harwood, New York, 1984.
2. S.J. Lippard (Editor) :Progress in Inorganic Chemistry Vol.18 (John Wiley, New York) 1973.
3. K. Hussain Reddy : Bioinorganic Chemistry, New Age International (P) Ltd., New Delhi, 2003.

UNIT - III : ORGANOMETALLIC COMPOUNDS OF 'd ' BLOCK METALS

(i) Olefin – Metal complexes - mono olefin complexes – Preparation, Structure and bonding in Zeise's salt.

(ii) Cyclopentadienyl complexes – Preparation, Structure and Bonding in Ferrocene

(iii) Arene complexes – Preparation, Structure and Bonding in Bis (Benzene) chromium complex.

UNIT - IV : INORGANIC POLYMERS

Synthesis, structure and applications of Polyphosphazenes, Polysilanes and Polysiloxanes – Metal Chelate Polymers**.**

References for Units III & IV

1. Theoretical Basis of Inorganic Chemistry by A.K. Barnard, Tata McGraw-Hill Publishing Company Ltd.
2. Advanced Inorganic Chemistry by Cotton and Wilkinson, 5th Edition.
3. Organometallic Chemistry – A Unified Approach by R. C. Mehrotra and A. Singh.
4. Modern Inorganic Chemistry by William L. Jolly, 2nd Edition.
5. Inorganic Polymers, J.E. Mark, H.R. Allock and R. West, Prentice Hall 1992.

M.Sc. CHEMISTRY – III SEMESTER

CBCS Syllabus (w.e.f 2016-2017)

INOORGANIC CHEMISTRY

Practical – I: Spectroscopic Identification of Organic Ligands and Metal complexes

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Spectroscopic Identification Organic ligands using IR, UV, ^{1}H- NMR, ^{13}C -NMR and Mass spectra.

1. Acetone
2. Acetic acid/ propionic acid/ chloroacetic acid
3. Methyl acetate
4. Ethyl benzoate
5. Acetamide
6. Acetylene
7. Acetophenone
8. 2-Butanone
9. Benzaldehyde
10. Neopentylamine
11.1,3-dibromopropane
12. p-toulidine
13. Isobutylalcohol
14. Butaraldehyde
15.Pyridine/lutidine/ 2-aminopyridine/furfural

List of Experiments:

I. Conductometry

1. Determination of Molar conductivity of simple Coordination Compounds
2. Conductometric titrations

a). Mixture of acids- Strong acid and weak acid Vs Strong base.

b). Mixture of bases – Strong base and weak base Vs Strong acid.

c). Mixture of Halides- KCl and KI Vs $AgNO_3$.

II. Colorimetry

1. Determination of the formula and stability constant of a metal complex by

   a). Job's method, b).Molar ratio method and c).Slope ratio methods

2. Estimation of Mn^{+2} ion as permanganate.
3. Estimation of Fe^{+3} ion using thiocyanate as a complexing agent.
4. Estimation of Ferrous ion by using 1, 10-phenanthroline.
5. Determination of the amount of Iron by Photometric titration method.

III. Potentiometry

1. Potentiometric titrations.

   a). Mixture of acids (Strong acid + weak acid) Vs Strong base.

   b). Mixture of Halides (KCl +KI) Vs $AgNO_3$

2. Redox titrations- Ferrous and Vanadyl using Ce^{4+}.

IV. Electrochemistry

1. Polarography of coordination compounds
2. Cyclicvoltammetry of metal complexes

Paper OC – 302 : PHOTOCHEMISTRY AND ORGANIC SYNTHESIS – I

UNIT-1 : ORGANIC PHOTOCHEMISTRY – I

Organic photochemistry : Molecular orbitals, carbonyl chromophore–triplet states, Jablonski diagram, inter–system crossing. Energy transfer. Energies properties and reaction of singlet and triplet states of and transitions.

Photochemical reactions : (a) Photoreduction, mechanism, influence of temperature, solvent, nature of hydrogen donors, structure of substrates on the course of photo reduction, (b) F.B. reaction mechanism, stereochemistry, side reaction due to variations of the triplet energy of the carbonyl component and the nature of the olefin component.

UNIT-2 : ORGNAIC PHOTOCHEMISTRY – II

Norrisch cleavages, type I : Mechanism, acyclic cyclic diones, influence of sensitizer, photo Fries rearrangement. Norrisch type II cleavage : Mechanism and stereochemistry, type II reactions of esters : 1, 2 diketones, photo decarboxylation.

Photochemistry of unsaturated ketones – Olefin photochemistry, cyclic olefins – Photochemistry – of conjugated dienes; electrocyclisations, influence of triplet energy of sensitizer, sensitized and unsensitized electrocyclisations. Electrocyclisations of dienes in crossed sense – Photochemistry of benzene derivatives – formation of derivatives of benzavalene, fluvene and Dewar benzene, cyclo addition of benzene to olefins and dienes – Decomposition of nitrites – Barton reaction. Di - π methane rearrangement.

UNIT-3 : PROTECTING GROUPS AND ORGANIC REACTIONS

Principles of (1) Protection of alcohols – ether formation including silyl ethers – ester formation, (2) Protection of diols – acetal,ketal and carbonate formation, (3) Protection of carboxylic acids – ester formation, benzyl and t–butyl esters, (4) Protection of amines – acetylation, benzoylation, benzyloxy carbonyl, triphenyl methyl groups and fmoc, (5) Protection of carbonyl groups – acetal, ketal, 1,2–glycols and 1,2–dithioglycols formation.

Synthetic reactions : Mannich reaction – Mannich bases – Robinson annulations. The Shapiro reaction, Stork–enamine reaction. Use of dithioacetals – Umpolung, phase transfer catalysis – mechanisms and use of benzyl trialkyl ammonium halides. Witting reaction.

UNIT-4 : NEW SYNTHETIC REACTIONS

Baylis–Hillman reaction, RCM olefm metathesis, Grubb catalyst, Mukayama aldol reaction, Mitsunobu reaction, McMurrey reaction, Julia–Lythgoe olefination, and Peterson's stereo selective olefination, Heck reaction, Suziki coupling, Stille coupling and Sonogishira coupling, Buchwald–Hartwig coupling. Ugi reaction, Click reaction.

References

1. Molecular reactions and Photochemistry by Charles Dupey and O.L. Chapman.
2. Molecular Photochemistry by Turru.
3. Importance of antibonding orbitals by Jaffe and Orchin.
4. Text Book of Organic Chemistry by Cram,. Hammand and Henrickson.
5. Some modern methods of organic synthesis by W. Carruthers.
6. Guide Book to Organic Synthesis by R.K. Meckie, D.M. Smith and R.A. Atken.
7. Organic Synthesis by O.House.
8. Organic synthesis by Michael B. Smith.
9. Organic Chemistry Claydon and others 2005.
10. Name Reactions by Jie Jack Li
11. Reagents in Organic synthesis by B.P. Mundy and others.
12. Tandem Organic Reactions by Tse–Lok Ho.

M.Sc. CHEMISTRY – III SEMESTER

ORGANIC CHEMISTRY

Under CBCS (w.e.f. **2020-21**)

Paper OC – 303 : ORGANIC SYNTHESIS – II

UNIT- 1 : SYNTHETIC STRATEGIES – I

Introduction to organic synthesis. Target selection. Disconnection approach – examples – Terminology – Definition of target molecule, functional group intercoversion (FGI), disconnection product, disconnection, synthesis, reagents, transformation and retrosynthesis. Chemoselectivity, regioselectivity and stereoselectivity. Synthetic tree – Linear and convergent synthesis. Importance of order of events in organic synthesis – examples. One group C – X and two group C – X disconnections – examples – Reversal of polarity – cyclization reactions and amine synthesis.

UNIT-2: REACTIONSOF SYNTHETIC IMPORTANCE

Mechanism and applications of following reactions of synthetic importance-
Reactions involving aromatic electrophilic substitution-Reimer-Tiemann reaction, Vilsmeier-Haak reaction, Gatterman-Koch reaction, Hoesch reaction, Bischler-Napieralski reaction, Fries rearrangement.
Aromatic nucleophilic substitution-Von-Richter rearrangement, Smiles rearrangement.
Mechanism of condensation reactions involving enolates-Aldol, Knoevenagel, Claisen, Dieckmann condensation, Mannich, Benzoin and Perkin reactions, Stobbe condensation, Michael addition.
Wittig reaction, Baker-Venkataraman rearrangement.

UNIT-3 : PRINCIPLES OF ASYMMETRIC SYNTHESIS

Interlocution and terminology : Topocity in molecules Homotopic, stereoheterotopic (enantiotopic and diastereotopic) groups and faces – symmetry, substitution and addition criteria. Prochirality nomenclature : Pro–R, Pro–S, Re and Si.

Selectivity in synthesis : Stereospecific reactions (substrate stereoselectivity). Stereoselective reactions (product stereoselectivity) : Enantioselectivity and diastereoselectivity.

Conditions for stereoselectivity: Symmetry and transition state criteria, kinetic and thermodynamic control. Methods for inducing enantio and diastereoselectivity.

Analytical methods: % Enantiomer excess, % enantioselectivity, optical purity, % diastereomeric excess and % diastereoselectivity. Techniques for determination of enantioselectivity : Specific rotation, Chiral ^{1}H NMR, Chiral lanthanide shift reagents and Chiral HPLC.

UNIT-4 : METHODOLOGY OF ASYMMETRIC SYNTHESIS

Nucleophilic addition to chiral carbonyl compounds. 1,2–asymmetric induction, Cram's rule and Felkin–Ahn model. Chiral auxiliary controlled Diels–Alder reaction.

Chiral catalyst controlled asymmetric synthesis :Sharpless and Jacobsen epoxidations. Sharpless asymmetric dihydroxylation. Asymmetric hydrogenations using chiral Wilkinson biphosphine. Chiral catalyst controlled Diels–Alder reactions.

Asymmetric aldol reaction-Diastereoselective aldol reaction and its explatnation by Zimmerman–Traxel model.

Recommended Books

1. Organic synthesis by Robert E. Ireland.
2. Organic synthesis : the disconnection approach by Stuant Warren.
3. Guide Book to Organic synthesis by R.K. Hackie, D.M. Smith and R.A. Atken.
4. Asymmetric synthesis by Nagradi.
5. Stereochemistry of organic compounds – Principles and applications by D. Nasipuri.
6. Asymmetric Organic reactions by J.D.Morrison and H.S.Moschee.
7. Stereo diffractionating reactions by Izumi.
8. Organic Chemistry by Vol. 1 and 2, I.L. Finar.
9. Organic Synthesis by C.Willis and M. Willis.

M.Sc. CHEMISTRY – III SEMESTER

CBCS Syllabus (w.e.f **2020-21**)

ORGANIC CHEMISTRY

Practical – I : Spectroscopic Identification of Organic Compounds

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Identification of unknown organic compounds by interpretation of IR, UV, ^{1}H NMR, ^{13}C NMR and mass spectra.

3-bromo propanoic acid, Aryloxy propanoic acid, m-cresol, 2,6-ditertiary butyl-4-methyl phenol, Salicylaldehyde, p-toluidine, N-methyl benzylamine, N,N-dimethyl aniline, Nicotinamide, Phenyl acetaldehyde, Furan-2-aldehyde, 4-chloro acetophenone, Methyl propionate, 2-phenyl ethanol, Benzyl phenyl ether, Phenyl isopropyl sulphide, Benzyl nitrile, Phenyl acetylene, meta dinitro benzene, 1,2-dibromo benzene.

(Note:- A minimum of 20 representative examples should be studied).

Recommended Books

1. The systematic identification of organic compounds by R.L.Shriner, R.C.Fusion and D.Y. Curtin
2. Spectroscopic identification of organic compounds by Silverstein, Bassler and Morril 5th Edition.
3. Practical Pharmaceutical Chemistry, A.H.Beckett and J.B. Stenlake.
4. Spectral identification of organic compounds, Bassler, Silverstein 5th Edition.

M.Sc. CHEMISTRY – III SEMESTER

CBCS Syllabus (w.e.f **2020-21**)

ORGANIC CHEMISTRY

Practical – II : Quantitative Organic Analysis and Isolations

1. Estimation of following drugs :

Aspirin (titrimetry), Ibuprofen (titrimetry).

2. Estimations:

Estimation of Glucose, Phenol, Anline, Methyl Ketone, Saponification of oils, Iodine value of oils and Acid value.

3. Isolation of the following natural products :

Starch from Potato, Lactose from Milk, Eucalyptus oil from leaves (steam distillation), piperine from pepper (Soxhlet extraction), Caffeine from tea leaves (solvent extraction) and eugenol from cloves (steam distillation).

Recommended Books

1. The systematic identification of organic compounds by R.L.Shriner, R.C.Fusion and D.Y. Curtin .I
2. A textbook of practical organic chemistry by A.I. Vogel, Vol. I and II.
3. Unitized experiments in organic chemistry by R.Q. Brewster and others.
4. Practical Organic Chemistry by Mann and Saunders.
5. Spectroscopic identification of organic compounds by Silverstein, Bassler and Morril 5th Edition.
6. Practical Pharmaceutical Chemistry, A.H.Beckett and J.B. Stenlake.
7. Spectral identification of organic compounds, Bassler, Silverstein 5th Edition.

M.Sc CHEMISTRY – III SEMESTER :
PHYSICAL CHEMISTRY
CBCS Syllabus (w.e.f. 2020-21)
Paper PC – 302: Thermodynamics and Kinetics

UNIT – I Thermodynamics – III

A. Fugacity-Definition and importance. Fugacity of a single gas. Determination of fugacity (a) graphical method (b) from equation of state. Approximate calculation of fugacity. Variation of fugacity with temperature and pressure. Fugacity of solids and liquids.
B. Fugacity of mixture of gases – mixture of ideal gasess. Mixture of real gases. Variation of fugacity with pressure.

UNIT – II Thermodynamics – IV

A. Activity and activity coefficients – standard states – choice of standard state – convenient standard state – (1) gases, (2) liquids or liquid solvent. Solvents – (a) pure liquid as a standard state (b) infinitely dilute solution as reference state: composition in mole fraction (c) composition in molality and molarity.
B. The properties of solutions: Ideal solutions. Properties of ideal solution. The Duhem Margules equation. Application of Raoult's law to both components of an ideal solution. Vapour pressure curves. Composition of liquid and vapour in equilibrium, influence of temperature.

UNIT – III Elementary reactions in solution

A. Comparision of gas phase and solution phase reactions. Comparison between reactions in different solvents. Reactions between ions: Effect of solvent; double sphere and single sphere activated complex models. Effect of ionic strength. Bronstead-Bjerrum equation.
B. Influence of substituents on reaction rates: Linear free energy relationships: First Hammet plots, the Hammet equation derivation; Substituent constant, Reaction constant, Physical significance of substituent constant, Physical significance of reaction constant, Use of Hammet plots. Taft's equation, Steric effects and Solvent effects.

UNIT – IV Some reaction mechanisms in solution

Organic substitution reactions, hydrolysis of aryl halides, hydrolysis of esters, hydrolysis of other compounds: hydrolysis of acetals, hydrolysis of amides, hydrolysis of epoxides, halogenation of acetone, aldol condensation, aromatic substitution, Polymerization, Electron-transfer reactions, theories of electron transfer, rapid proton transfer reactions.

References:

1. Thermodynamics by Kuriacose and Rajaram
2. Thermodynamics-A core course- R.C. Srivastava-S.K. Saha and A.K. Jain
3. Chemical Kinetics by Keith J. Laidler.

M.Sc CHEMISTRY:: III SEMESTER

PHYSICAL CHEMISTRY
CBCS Syllabus (w.e.f. 2020-21)

Paper PC – 303: Instrumental Methods

UNIT – I: Atomic absorption spectroscopy:-

Principle, characteristics of flames, types of flames and their temperatures. Types of burners- premix and Laminar flow burners Electrothermal atomizers. Hydide atomization. Sequence of events in a flame. Background correction: Zeeman effect, continuum source correction method and source self reversal. Interferences: Spectral, chemical and physical.

Instruments – Single beam and double beam instruments. Sources – Hallow cathode lamp, electrode less discharge tube.

Analytical techniques:- Sample preparation, organic solvents, calibration curves. Standard addition method, detection limits and accuracy. Applications.

UNIT – II : Atomic plasma emission spectrometry:-

Principle (a) Inductively coupled plasma sources – sample introduction, plasma appearance and spectra. Analyte atomization and ionization. Direct current plasma source.

Plasma source spectrometers: Sequential, multichannel and Fourier transform types.

Applications: Sample preparation, elements determined, line selection, calibration curves, Interferences. Detection limits.

(b) Atomic fluoresuence spectroscopy:- Principle, sources. Instrument, interferences and applications

UNIT – III:- Electro Analytical Techniques:-

Advances in DC pology raphy. Rapid DC polarography: Current – sampled DC polarography (Fast polarography). Derivative DC polarography, Pulse polarography. Characterization of electrode reversibility by pulse polarography. Pulse voltammetry at stationary electrodes. Normal pulse voltammetry. Alternating current-polarography. Square wave polarography.

Cylic voltammetry: Principle only, Stripping voltammetry: Introduction. Types of stripping analysis. Pre-concentration step and mass transport in voltammetry. Electroanalytical stripping techniques: Linear potential sweep voltammetry. Differential pulse anodic stripping voltammetry. Potentiometric stripping analysis.

Unit IV – Instruments used for polymer processing

Introduction, Plastics Electronic and fiber, Compounding, Processing techniques- Calendaring, Die Casting, Rotational Casting, Film Casting, Compression Moulding, Injection Moulding, Blow Moulding, Extrusion Moulding, Thermoforming, Foaming, Reinforcing and Fiber Spinning.

Reference:

1. Electro analytical chemistry: Theory and applications by R.T. Sane & A.P. Joshi.
2. Introduction to Photoelectron Spectroscopy by P.K.Ghosh, (John Wiley, New York), 1983.
3. Polymer Science by V.R. Gowariker, N.V.Viswanathean, Jayadev Sreedhar, New Age International Publishers.

M.Sc. Chemistry (Physical) III Semester Practicals

CBCS Syllabus (w.e.f. **2020-21)**

Practical - I : *Spectroscopy*

List of Experiments:

1. Spectroscopic Identification of Organic Compound ---- Diethyl ether
2. Spectroscopic Identification of Organic Compound ---- Benzaldehyde
3. Spectroscopic Identification of Organic Compound ---- Chloroacetic acid
4. Spectroscopic Identification of Organic Compound ---- Ethyl cyanoacetate
5. Spectroscopic Identification of Organic Compound ---- Isobutyl alcohol
6. Spectroscopic Identification of Organic Compound ---- Anisole
7. Spectroscopic Identification of Organic Compound ---- Ethyl benzene
8. Spectroscopic Identification of Organic Compound ---- Diethyl benzene
9. Spectroscopic Identification of Organic Compound ---- Acetanilide
10. Spectroscopic Identification of Organic Compound ---- Benzoic acid
11. Spectroscopic Identification of Organic Compound ---- Hexane dione.
12. Spectroscopic Identification of Organic Compound ---- Methyl ethyl ketone.

M.Sc. Chemistry (Physical) III Semester Practicals

CBCS Syllabus (w.e.f. 2020-21)

Practical II: *Chemical Kinetics*

List of Experiments:

1. Kinetics of Halogenation of Acetone - Determination of the rate of the reaction with respect to Acid and Acetone.
2. Effect of mineral acid concentration on the rate of Halogenation of Acetone.
3. Effect of ionic strength on the rate of reaction between persulphate and iodide.
4. Effect of Dielectric constant of the medium on the rate of reaction between
   a) Persulphate and iodide.
   b) Hydrolysis of Ethyl benzoate
5. a) Determination of rate of reaction of oxidation of Oxalic acid by Chromic acid with respect to Chromium (VI) and Oxalic acid
   b) Effect of temperature on rate of oxidation of Oxalic acid by Chromic acid- Determination of activation parameters.
6. Determination of partial molar volumes.

M.Sc., CHEMISTRY
III-SEMESTER
CBCS Syllabus

(Effective from Academic year **2020-21**)

Open Elective Paper : ENVIRONMENTAL CHEMISTRY (60 hrs.)

(To External Students only)

UNIT – I HYDROSPHERE

Introduction to Chemical composition of Environment- Bio distribution of elements Chemical composition of water bodies- lakes, streams, rivers and wet lands, Hydrological cycle. Aquatic pollution, inorganic, organic pesticides, agricultural, industrial and sewage, detergents. oil spills and oil pollutants, Water quality parameters,- DO, COD, BOD. Solids, metals, Contents of Chloride, sulphate, phosphate nitrate and micro organisms. Analytical methods of measuring BOD, DO, COD, METALS (As, Cr, Cd, Hg, Pb, Se) residual chloride and chlorine demand. Purification and treatment of water.

UNIT-II: ATMOSPHERE

Chemical composition of Atmosphere- particles, ions and radicals and their formation, Chemical and photochemical reactions in atmosphere, smog formation, Oxides of N,C,S and their effects, pollution by chemicals, petroleum and minerals, chlorofuorocarbons, Green House effect, Chemical reaction in ozone depletion, Acid rain, Analytical methods for measuring air pollutants, Air pollution monitoring. Air pollution control methods

UNIT – III: ENVIRONMENTAL TOXICOLOGY AND GREEN CHEMISTRY

(a) Toxicological Chemistry: Introduction to toxicological chemistry, dose response relationship, relative toxicities. Teratogenesis, mutagenesis, carcinogenesis, Immune system effects, Health hazards, Toxic elements and elemental farms, Toxic inorganic compounds, Toxicology of organic compounds, Effect of Toxic chemicals on enzymes, biochemical effects of As, Cd, Hg and Oxides of Sulphur and nitrogen.

(b)Green Chemistry: Definition of Green Chemistry, Principles of Green Chemistry, Experimental systems. This measurement of greenness environmental factor, Historical approach, tools of green Chemistry, Catalysis and bio-catalysis of Green Chemistry, examples of Green Chemistry, Pharmaceutical industry and Green Chemistry, Pesticides, Solvents, Green Chemistry, Sugar and distilleries, wastes and future trends in Green Chemistry.

UNIT – IV ENVIRONMENTAL MONITORING METHODS:

(a) Monitoring of Air pollutants: Analysis of gaseous pollutants –SO_2, H_2S, NO, NO_X, NH_3, CO, CO_2, Ozone, organic gases and vapours. Continuous monitoring of air pollutants –principles, monitoring instruments, monitoring of SO_2,H_2S,NO-NO_X, CO,CO_2,hydrocarbons ozone suspended particulate matter, chemical and photo chemical reactions in atmospheres.

(b) Monitoring of water pollutants: Analysis of polluted water samples using AAS, HPLC and ICP methods

References

1. Environmental Chemistry by Moore & Moore.
2. Environmental Chemistry by Mahanan, VIth Edition, Lewis Publications.
3. Environmental Chemistry by B.K.Sharma. Goel Publications.
4. Environmental Chemistry by Ohra & Thyogi.
5. Environmental Chemistry by Benrgia.
6. Environmental Pollution and control in chemical process and industries by S.K.Bhatia.
7. Environmental Pollution by S.S. Dara.
8. Environmental Pollution analysis by S.M.Khopkar.
9. Industrial chemistry by B.K Sharma;Goel Publications
10. Introduction to Nanoscale Science.and Technology(ed)Massimiliano D. Ventra (kluwer academic).

M.Sc. CHEMISTRY – IV SEMESTER

CBCS Syllabus (w.e.f 2020-21)

ANALYTICAL CHEMISTRY

Paper AC-401: FUNDAMNTAL TECHNIQUES IN CHEMICAL ANALYSIS

UNIT – I: SAMPLING

Definition of terms, involving, purpose of sampling, sampling of gases, ambient and stock sampling, sampling of liquids, sampling of Heterogeneous and Homogeneous liquids. Sampling of static and flowing liquids. Sampling of solids, sample size. Gross sample, representative sample, Size or reduction, Different sampling equipments and methods of sample, treatment of laboratory sample.

UNIT – II: KINETIC METHODS OF TRACE ANALYASIS

Rate laws, some terms and symbols used in chemical kinetics, Analytical use of reaction rates, First and second order reactions, relative rate of reactions. Determination of reaction rates. Analytical utility of first and pseudo first order reactions. Types of kinetic methods, differential, integral, logarithmic, extrapolation method. Evaluation of kinetic methods – Scale of Operation, Accuracy, Precision, Sensitivity, Selectivity, time, Cost and equipment. Catalyzed reactions, measurement method for catalyzed reaction. Micro determination of Inorganic species like Iodine and Hg in complex materials. Determination of organic species. Kinetics of enzyme, catalyzed reactions. Michael's constant factors affecting the rate of enzyme, Catalyzed reactions, Enzyme characteristics and applications of Kinetic methods of trace analysis.

UNIT –III: GENERAL CONSIDERATIONS IN ANALYSIS

Sensitivity and Detection limits, precision and accuracy, Comparison of standards. Standard addition and subtraction, Data handling. Automation and mechanization, continuous flow systems.

Quality and quality assurance

Quality control, internal methods of quality assessments, external methods of quality assessment, evaluating quality assurance data, prospective and performance based upon the apparatus and basic approach.

UNIT – IV: ANALYTICAL METHOD DEVELOPMENT AND VALIDATION

Back ground, Introduction; Specifications and their influence on Method Development, International Guidelines and their Influence on Method Development, The Method Development Life Cycle-Over view. Planning; Review Company Policy on Method Development/Validation, defining the Objectives/ Requirements of the method , Illustration of method Requirements, Information gathering, Resource Gathering Resources/Instrumentation/Materials and Standards, Documentation: Development Plan. Method development-General considerations; Initial Method Development ,method Optimization, method Pre-validation evaluation, robustness system suitability .Method Development-Experimental Considerations; Introduction, General Components of HPLC method Development, Obtaining Sufficient Resolution- Considering method Requirements.

References:

1. Treatise Analytical Chemistry by I.M.KOLTHOFF, part-I, Chapter-2, Sampling.
2. Principles of Analytical Chemistry by Skoog West and Holer, 4th Edition.
3. Environmental Chemistry by i.M.Mahanam.
4. Fundamental concepts of Analytical Chemistry by C.D.GARY.
5. Instrumental method of Chemical analysis – Galen.W.Ewing.
6. Modern Analytical Chemistry by David and Harvey Mc Graw Hill Publications.
7. Quantitative analysis by Day and Underwood, 4th Edition, Mc Graw Hill Publications.
8. Environmental Chemistry by A.K.De.
9. A Text book of Qualitative analysis by C.T.Kenner.
10. Environmental Chemistry by Ohra and Thyagi.

M.Sc. CHEMISTRY –IV SEMESTER

CBCS Syllabus (w.e.f 2020-21)

ANALYTICAL CHEMISTRY

Paper AC-402: ANALYSIS OF NATURAL MATERIAL

UNIT – I: **GAS ANALYSIS**

Gas sampling, Voltammetric methods, absorbing reagents of gas, separation and determination of gaseous mixtures by

1. Hamples
2. Buntes
3. Orsat and
4. Thermal conductivity method, types of gas analyzers and principles of gas analysis

UNIT – II: **SEWAGE AND SEWAGE DISPOSAL & BIODEGRADABILITY**

(a) Sewage and Sewage Disposal: Introduction, objectives of sewage treatment, collection of sewage treatment methods, sewage and its decomposition, bacteriology of sewage treatment, properties of sewage, purpose of sewage treatment, methods of sewage treatments, primary or mechanical treatment, secondary or biological treatment, cycle of decomposition, analysis of sewage, physical test, chemical test, sewage disposal, methods of sewage disposals.

(b) Biodegradability: Classification of hazardous substances and waste. Chemical classes of hazardous wastes. Hazardous substances to health better industrial process. Hazardous substance analysis, Nature, Source, treatment and disposal of hazardous waste classification of hazardous substances and wastes, origin, toxic substances, chemical classification hazardous wastes, physical and chemical methods of waste treatment and preparation of waste and ultimate disposal of hazardous waste.

UNIT – III: ANALYSIS OF SOIL, POLLUTANTS, FERTILIZERS AND PESTICIDES

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(a) Soil analysis and Pollutants

Sampling, Classification of Soils, Determination of soil reactions. Total combined oxides of iron, aluminum and titanium. Analysis of micro constituents such as calcium, magnesium, potassium, sodium and fertility of the soil.

(b) Soil Pollutants:

Sources of soil pollution, soil sediments as pollutants, treatment and remedial measurements of soil pollution. Soil loss and degradation.

(c) Analysis of Fertilizers and Pesticides:

Introduction, determination of moisture, determination of ammonia, nitrogen and albunoid nitrogen, determination of total phosphates as phosphorous pentoxide and estimation of micro nutrients in fertilizers.

Analysis of organo chlorine pesticides by gas chromatography, analysis of organo phosphorous. Determination of DDT residue in vegetable and food grains. Analysis of cation and anions present in different fertilizer.

UNIT IV: ANALYSIS OF INDUSTRIAL PRODUCTS

(a) Analysis of steel (Carbon, Silicon, Sulphur and phosphorus),Analysis of non ferrous alloys, brass, Bronze, solder. Analysis of Ferro manganese, ferro- silicon, Ferro-vanadium and silico -manganese.

Analysis of Oils:

Natural fats, edible and industrial oils, unsaturated oils, saponification value, iodine number acid values, refractive indexes values.

(b) ANALYSIS OF EXPLOSIVES;

Introduction, Classification, Deflagrating or low explosives, Characteristics of explosives, Nitrocellulose, PETN or PENTHRIT, Di-nitrobenzene (DNB), Trinitrobenzene (TNB), Trinitrotoluene (TNT), Picric acid, Ammonium picrate, Nitroglycerine and dynamite, Cordite, Gun powder, RDX or cyclonite, EDNA, HMX, Tetryl, Petryl, Hexyl, Lead azide, Dinol, Tetracene.

REFERENCE BOOKS:

1. Vogel's Text book of Quantitative analysis 3rd Edition.
2. Environmental Chemistry by Mahanan, 6th Edition.
3. Environmenal Chemistry by A.K.De.
4. Solid chemical Analysis by M.L.Jackson, Printice-Hall, London.
5. Environmental Chemical Analysis by B.K.Sharma, H.Kaur, Goel Publications.
6. Standard chemical analysis by Velchear.
7. Water and water analysis by M.V.Subba Rao, Published by Environmental research academy International.
8. Engineering Chemistry by Jain & Jain.
9. Environmental Chemistry by Moore & Moore.
10. Standard methods of chemical analysis by Scott & Scott.
11. Environmental Pollution and Control in Chemical process industries by S.K.Bhatia.

M.Sc., CHEMISTRY-IV SEMISTER
CBCS Syllabus (w.e.f 2020-21)

ANALYTICAL CHEMISTRY

Paper AC-403: ANALYSIS OF COMMERCIAL MATERIAL

UNIT I : **ANALYSIS OF PLANT PIGMENTS AND EXPLOSIVES**

(a) Analysis of plant pigments Preliminary inspection of the sample, non-volatile matter, water contents in the paint, used paint products. General separation of pigment binder and thinner of solvent types and latex type of paint products. Analysis of lamp black and carbon black. General procedure for analysis of white tinted pigments.

(b)Analysis of port land cement:

Loss on ignition insoluble residue; total silica sesquioxides lime, magnesia, ferric oxide, sulphuric anhydride. Air and dust pollution from cement plants, atmospheric dispersion of pollutants in cement industry.

UNIT -II : ANALYSIS OF FOOD AND DAIRY PRODUCTS & FORENSIC ANALYSIS

(a) Food Analysis: Moisture, ash, crude protein fat, crude fiber carbohydrate, calcium, potassium, sodium and phosphate . Food adulteration common adulteration of food, contain of food contain of food stuff microscopic contention of foods for adulterations, food stuffs pesticide analysis in food products , extraction and purification of food sample the tests in the presence of carbohydrates fats, and proteins in food stuffs rice, butter milk and boiled eggs ,grapes, potato's and apple and estimate in the percentage (%) of ACITIC ACID in vinegar . HPLC and gas chromatography food processing

(b) Analysis of dairy products : Composition of the milk, determination of some physical chemical properties of milk, determination viscosity, pH by chemical methods, determination of fat, alcohol test, estimation of calcium, magnesium, potassium , sodium, minerals separation and identification. Analysis of fat and butter.

(c) Forensic analysis: General discussion of poisons, organo phosphates and snake venom, estimation of poisonous materials such as lead, Hg and Barbiturates in biological materials.

UNIT -III: CLINICAL CHEMISTRY, ANALYSIS OF DRUGS AND ANTIBIOTICS

i) (a) Clinical Chemistry: Clinical analysis of the composition of blood collection and prevention of the sample. Clinical analysis blood glucose, blood urea nitrogen, immunoassay. The blood gas analyzer, trace elements in the body. **b) Drug analysis:** Natural and some of drugs, study of drugs, Classification and nomenclature; Biological and Chemical classification of drugs, gas and TLC. Screaming test and spectrophotometric methods for measurement drugs. Determination of the concentration of ethyl alcohol in pharmaceutical preparation and alcoholic beverage.

(ii) Antibiotics and Sulpha Drugs: Classification of antibiotics based on terms chemical structures;, Synthesis Structure properties, and assay of some antibiotics. (1) Chloramphenacol (2) Penicillin (3) streptomycin (4) Cibazole

UNIT –III : NANO MATERIALS AND LC-MS

a) Nano Materials: Nanometerial definition. The characteristics of nanomaterials. Behaviour of nanoscale materials and its differences from large materials, size, surface/interface-to-volume ratio and grain shapes of nano materials. Electrical, optical, thermodynamic, mechanical and chemical properties of nano materials. Aplications of nanometerials

(b) LCMS; Introduction on LC-MS and principles involved in LC-MS, Different sources used in LC-MS/Ions formation procedure in source, Type of analyzers used in LC-MS/Ions separation in mass analysers, Difference between LC-MS and LC-MS/MS, Advantages and disadvantages of analyzers in Mass, Detectord used in LC-MS, Applications of LC-MS and LC-MS/MS.

References:

1. Standard methods of Chemical analysis by Welcher.
2. Text book of quantitative analysis by A.I.Vogel, IIIrd Edition.
3. Food Chemistry by lllin Hoagland Meyer, CBS Publishers.
4. Introduction to the chemical analysis of foods by Suzanne Nielson, CBS Publishers.
5. Engineering Chemistry by Jain & Jain.
6. Fundamental of Analytical Chemistry by Christon Genus D
7. Environmental Pollution and control in Chemical process Industries by S.C. Bhatia.
8. Industrial Chemistry by B.K.Sharma, Giocal Publications.
9. Standard Methods of Chemical analysis by Scott and Ferman.
10. Food Science experiments and Applications by Mohan Sethi, E.S.Rao, CBA Publications.
11. Comprehensive experimental Chemistry by V.K. Ahluwalia and Sudha Ragav, New Age International, New Delhi. Fundamental of Dairy Chemistry by Webb Joharsen and CBS Publication second Edition.

M.Sc. CHEMISTRY –IV SEMESTER

CBCS Syllabus (w.e.f **2020-21**)

ANALYTICAL CHEMISTRY

Paper AC-404: APPLIED ENVIRONMENTAL ANALYSIS

UNIT – I HYDROSPHERE

Chemical composition of water bodies, streams and wet lands, Hydrological cybers. Aquatic pollution, organic pesticides, agricultural, industrial and sewage detergents. Oil spills and pollutants, Water quality parameters, DO, COD, BOD. Solids metals, Constants of Chloride, Sulphate, Phosphate nitrate and micro organisms. Analytical methods of measuring BOD, COD, DO, f, OILS, METALS (As, Cr, Cd, Hg, Pb, Se) residual chlorine and chlorine demand. Purification and treatment of water.

UNIT – II: GREEN CHEMISTRY & TOXICOLOGY

(a) Introduction to Green Chemistry: Definition of Green Chemistry, Principles of Green Chemistry, Experimental systems. This measurement of greenness environmental factor, Historical approach, tools of green Chemistry, Catalysis and bio catalyses of Green Chemistry, examples of Green Chemistry, Pharmaceutical industry and Green Chemistry, Pesticides, Solvents, Green Chemistry, Sugar and distilleries, wastes and future trends in Green Chemistry.

(**b**) **Environmental Toxicological Chemistry:** Introduction to toxicological chemistry, dose response relationship, relative toxicities. Teratogenesis, mutagenesis, carcinogenesis, Immune system effects, Health hazards, Toxic elements and elemental forms, Toxic inorganic compounds, Toxicology of organic compounds, Effect of Toxic chemicals on enzymes, biochemical effects of As, Cd, Hg and Oxides of Sulphur and nitrogen.

UNIT – III: AIR POLLUTION MONITORING METHODS & INSTRUMENTAL TECHNIQUES

(a) Air Pollution Monitoring Methods: Analysis of gaseous pollutants –SO_2 H_2S, NO-NO_X, NH_3, CO, CO_2, Ozone, organic gases and vapours. Continuous monitoring of air pollutants –principles, monitoring instruments, monitoring of SO_2,H_2S,NO-NO_X, CO,CO_2,hydrocarbons ozone suspended particulate matter, chemical and photo chemical reactions in atmospheres.

b) Instrumental Techniques in Environmental Chemical Analysis: Basic Principles, Instrumentation, outlines of procedures and applications of the following techniques

1. AAS
2. X-ray fluorescence
3. HPLC
4. Neutron activation analysis
5. ICPES with AAS

UNIT – IV: INDUSTRIAL POLLUTANTS

(a) Petrochemical Industry and Pollution control Methods

Introduction, Raw materials, Saturated hydro carbons from natural gas, Uses of saturated hydro carbons, Unsaturated hydro carbons-Acetylene, Ethylene, Propylene, Butylenes. Aromatic hydro carbons, Toluene Xylene , Chemical processing of paraffin hydro carbons, Chemical processing of ethylene hydro carbons, Chemical processing of acetylene, Chemical processing of Aromatic hydrocarbons.

Pollution control in petro chemical manufacture; water pollution control, air pollution control, solid waste disposal.

(b) Sugar Industry, Paper and pulp industry, polymer drugs, radio nuclide analysis, disposal of waste and their management.

References

11. Environmental Chemistry by Moore & Moore.
12. Environmental Chemistry by Mahanan, VIth Edition, Lewis Publications.
13. Environmental Chemistry by B.K.Sharma. Goel Publications.
14. Environmental Chemistry by Ohra & Thyogi.
15. Environmental Chemistry by Benargi.
16. Environmental Pollution and control in chemical process and industries by S.K.Bhatia.
17. Environmental Pollution by S.S.Dara.
18. Environmental Pollution analysis by S.M.Khopkar.
19. Industrial chemistry by B.K Sharma;Goel Publications
20. Introduction to Nanoscalescience.and technology(ed)Massimiliano D. Ventra kluwer academic.

IV Semester – Analytical Chemistry Specialization Practical's

Practical –I

1. **Conductomestric titrations**
   - i) Mixture of acids-Strong acid vs Strong base
   - ii) Mixture3 of bases-Weak acid vs Strong base
   - iii) Mixture of Halides, KCl and Kl Vs$AgNO_3$
   - iv) Precipitation Titrations
2. **Potentiometry**
   - i) $AgNO_3$, vs KCl
   - ii) $AgNO_3$ vs Kl
   - iii) Mixture of Halides
3. **Colorimetry**
   - i) Determination of Mn
   - ii) Determinationo of Fe
   - iii) Slope-ratio Method
   - iv) Mole-ratio Method
   - v) Job's Method
4. **Flurometry**
   - i) Quinine sulphate estimation by fluorometry

M.Sc. CHEMISTRY - IV SEMESTER
INORGANIC CHEMISTRY

CBCS Syllabus (w.e.f **2020-21**)

Paper IC-401: CATALYSIS, PHOTOCHEMISTRY AND APPLICATIONS OF ORGANOMETALLIC COMPOUNDS.

UNIT - I : HOMOGENOUS CATALYSIS

Homogenous catalytic synthesis of organic chemicals by transition metal complexes - types of reactions; dissociation and addition; oxidative addition and reductive elimination; and insertion reactions - Olefin hydrogenation, dimerization and isomerization - Hydroformylation - water gas shift reaction – Template synthesis;

UNIT - II : HETEROGENEOUS CATALYSIS

Heterogeneous catalytic synthesis of Chemicals - Effects of surface site on adsorption - The Fischer – Tropseh Process ; Ziegler – Natta olefin polymerization - Ammonia synthesis - The photographic process – electrode surface modification.

UNIT - III : PHOTOCHEMISTRY OF COORDINATION COMPOUNDS

Types of photochemical reactions – Photo oxidation-Reduction reactions; Photo-substitution and related reactions like photo dissociation, photosolvation, photoanation, photoexchange reactions – Photoisomerization reactions. Photochemistry of transition metal complexes – types of states – Photochemistry of chromium, manganese, Iron, cobalt, copper and platinum – Photochemistry of carbonyl complexes – photochemical decomposition of water.

UNIT-IV : BIOLOGICAL APPLICATIONS AND ENVIRONMENTAL ASPECTS OF ORGANOMETALLIC COMPOUNDS

Introduction - Organometallics in Medicine – Organometallic Compounds in Agriculture and Horticulture – Organometallics in Industry – Environmental Aspects of Organometallic Compounds.

References:

1. Advanced Inorganic Chemistry by Cotton and Wilkinson, 5th Edition.
2. Modern Inorganic Chemistry by William L. Jolly, 2nd Edition.
3. Photochemistry of coordination compounds by V. Balanzi V. Carassiti.
4. Concepts of Inorganic Photochemistry by A.W. Adamson and P.O. Fleischamer.
5. The Organometallic chemistry of the Transition metals by Robert. H. Crabtree.
6. Organometallic Chemistry – A Unified Approach by R. C. Mehrotra and A. Singh.

INORGANIC CHEMISTRY

Paper IC-402: BIO-INORGANIC AND SUPRAMOLECULAR CHEMISTRY

UNIT - I : IRON STORAGE / TRANSPORT AND ROLE OF CALCIUM IN BIOLOGICAL SYSTEMS

Basic principles and importance of metal management; Transferrin – metal binding sites – release of iron from transferrin; Ferritin – Structure – uptake of iron into ferritin – Iron transport in microbes siderphores – phenolate siderphores and hydroxomate siderphores – models for siderphores.

Intra and extracellular functions of calcium; Transport and regulation of calcium ions in higher organisms – Calcium uptake and secretion – Intracellular calcium transport (Ca – ATPases); Calcium binding proteins – Calmodulin and Troponin C.

UNIT - II : METALLOENZYMES

Zinc enzymes – Structure, mechanism of action and model compounds of Carboxypeptidase A , Carbonic anhydrase and Liver alcohol dehydrogenase,

Iron enzymes – Catalase, Peroxidase and Cytochrome P – 450

Copper enzymes – Structure, mechanism of action and model compounds of Superoxide Dismutase (SOD) The chemistry of cytochromes: cytochrome c, cytochrome c oxidase.

UNIT - III : METAL COMPLEXES IN MEDICINE AND THEIR INTERACTION WITH NUCLEIC ACIDS

Coordination compounds in medicine – Chelation therapy – Gold compounds as anti-arthritic agents – Platinum complexes and anticancer activity – Metal complexes as Radio diagnostic agents – Use of Metal complexes in Magnetic Resonance Imaging (MRI)

Metal – DNA Interactions – Structure of DNA – Types of interactions between metal complexes and DNA, Fundamental reactions of metal complexes with DNA (Redox Chemistry and Hydrolytic Chemistry) Techniques to monitor Metal – DNA Interactions, Applications of metal – DNA interactions.

UNIT - IV : SUPRAMOLECULAR CHEMISTRY

Concepts and language of Supramolecular Chemistry

A. Molecular recognition – cation binding, Anion binding and Simultaneous cation and anion binding – Design and synthesis of receptor molecules.

B. Supramolecular reactivity and Catalysis – Catalysis of Cation and Anion Receptors.

C. Supramolecular devices – Ionic, switching and electronic devices, some examples self – assembly in Supramolecular Chemistry.

Reference:

1. l. Bertini, H.B.Gray, S.J.Lippard and J.S.Valentine, Bioinorganic Chemistry, University Science Books, Sausalito, CA, USA, 1998.
2. J.M.Lehn, Supramolecular Chemistry – Concepts and Perspectives, VCH, Weinheim, 1995.
3. P.D.Beer, P.A.Gale and D.K.Smith, Supramolecular Chemistry. Oxford University Press, Oxford, 1999.
4. K. Hussain Reddy, Bioinorganic Chemistry, New Age International, New Delhi, 2003

M.Sc. CHEMISTRY - IV SEMESTER

CBCS Syllabus (w.e.f **2020-21**)

INORGANIC CHEMISTRY

Paper IC – 403: SOLID STATE CHEMISTRY

UNIT – I: DESCRIPTION OF CRYSTAL STRUCTURES

Close packed structures – Cubic close packing (CCP) and hexagonal close packing (HCP); Paulings electrostatic valance rule; Some important crystal structure types – AX type [NaCl, ZnS (Sphalarite), CsCl]. AX_2 type [TiO_2, $CdCl_2$, CdI_2], ABX_3 type [$BaTio_3$ (perovskite)] and A_2BX_4 type ($MgAl_2O_4$) (normal and inverse spinals).

UNIT – II: CRYSTAL DEFECTS AND NON – STOICHIOMETRY

Perfect and imperfect crystals; Types of crystal defects:- Point defects – Schottky defect, Frenkel defect; thermodynamics of Schottky and Frenkel defect formation; colour centers, vacancies and interstitials in non – stoichiometry crystals; Extended defects – the crystallographic shear structures, stacking faults, sub – grain boundaries and antiphase domains; Non – stoichiometry and defects – general comments; Dislocations.

UNIT – III: PHASE DIAGRAMS AND PHASE TRANSITIONS

Phase diagrams of one component system (H_2O); Two-component condensed system (Simple eutectic system); Three-component condensed system (simple eutectic system without binary and ternary compounds);

Phase transition in solids; Burger's classification (Reconstructive and displacive transitions); Ubbelohde's classification (ontinuous and discontinuous transitions); Representation of phase transitions on phase diagrams; structural change with increasing temperature and pressure; Martenstic transformations; order-disorder transitions.

UNIT – IV: PREPARATIVE METHODS OF SOLIDS

Crystallization of solutions melts and Gels: solution and gels: Zeolite synthesis; Melts: Glasses; vapour-phase transport methods; Electrochemical reduction methods; preparation of thin films: - Chemical and Electrochemical methods, Physical Methods.

Growth of single crystals: Czochralski method; Bridgman and Stock barger methods; Zone melting; Precipitation from solution or melt; flux methods; Epitaxial growth of thin layers, verneuil flame fusion methods; Hydrothermal methods; Dry high pressure methods.

References:

1. Solid State Chemistry and its applications by A.R. West; John Wiley and Sons, New York, 1984.

M.Sc. CHEMISTRY-IV SEMESTER
INORGANIC CHEMISTRY
CBCS Syllabus (w.e.f **2020-21**)

Paper: IC-404: CHEMISTRY OF INDUSTRIAL PROCESSES-POLLUTION CONTROL METHODOLOGIES

UNIT-I : CEMENT AND ALLIED MATERIALS

Types of Portland Cement-Raw Materials-Manufacture of Cement-Reactions in the Kiln-Setting of Cement-
Testing Properties and ISI specifications of Cement, Gypsum, Plaster of Paris and Lime-Manufacture of Lime- Raw Materials in India.

UNIT-II : GLASS, CERAMICS AND PORCELAIN

Glass-Physical and Chemical Properties of Glass- Raw Materials- Methods of manufacturing of Glass-Some Special Glasses.
Ceramics- General Properties of Ceramics- Basic Raw materials- Manufacture of Ceramics-Glaring in Ceramics. Applications of colors to the pottery- Porcelain-Raw Materials-Manufacture of Porcelain.

UNIT-III: METALLURGICAL AND NON-METALLURGICAL ELECTROLYTIC PROCESSES

A) **Metallurgical electrolytic process:** Electrometallurgy in aqueous solutions: Introduction-Types of metallic deposits-Electrolytic refining of Copper-Electrometallurgy in molten electrolysis-Metallic Clouds (Formation and Prevention).Electrolytic Preparation of Aluminium and Magnesium.
B) **Non-metallurgical electrolytic process:** Electrolytic production of Sodium Hydroxide and chlorine gas from aqueous sodium chloride-The Membrane Cell method and Asbestos Diaphragm Process. Electrolytic production of Hypochlorite, Chlorate, Perchlorate and Permanganate.

UNIT-IV: INDUSTRIAL EFFLUTENTS-POLLUTION CONTROL PROCESS

A) **Gaseous Inorganic Air Pollution:** Introduction, Primary Air Pollutants-Sources-Production and Control of Carbon Monoxide, Sulphur Dioxide sources and Control of SO_x emissions, Nitrogen Oxides in the Atmosphere-Atmospheric reactions of NO_x-Control of NO_x emissions.Acid Rain and its effects.

B) **Environmental Problems and Pollution Control in Process Industries:** Pollution control in chemical industries-General considerations-Fertilizer Industries-Cement Industries-Ammonia plant effluents, Pulp and Paper Industries and associated environmental problems. Effects of Heavy Metal Pollutants (As, Se, Pb,Cd & Hg) on human health.

References:

1. Industrial Chemistry by B.K.Sharma, Goel Publishing House, Meerut, 11th Edition, 2000.
2. Electrochemistry by G.Milazo, Elseview Publishing Company.
3. Environmental Chemistry by S.C.Bhatia, CBS Publisheres, New Delhi,1st Edition, 2002.
4. Environmental Chemistry by A.K.DE, New Age International(P)Limited, 6th Edition,2007.
5. A Textbook of Environmental Chemistry and Pollution Control by S.S. DARA, S.Chand &Company Ltd.,5th revised edition,2002.

Practical- I: Synthesis and characterization of Complexes

List of EXPERMENTS

1. Preparation of Complexes

1. Chloropetaammine cobalt(III) chloride
2. Nitro- and Nitrito-pentaammine cobalt(III) chloride
3. Tris(ethylenediamine)nickel(II) chloride
4. Potassium bis(oxalato)cuprate(II) dihydrate
5. *Cis*-and *trans* bis(glycinato)copper(II) monohydrate
6. Potassium tris(oxalato) ferrate(III) trihydrate
7. Sulphato tris(thiourea) zinc(II) complex
8. Metal complexes of dimethylsulphoxide
9. Ethylpyridine cobaloxime
10. Co-Salen complex

II . Analysis Metal complexes

11. Estimation of oxalate in Potassium bis(oxalto)cuprate(II) dihydrate
12. Estimation of cobalt in Chloropetaammine cobalt(III) chloride
13. Estimation of nickel in *Tris*(ethylenediamine)nickel(II) chloride
14. Estimation of zinc in Sulphato *tris*(thiourea) zinc(II) complex
15. Estimation of copper in *cis*- bis(glycinato)copper(II) monohydrate

III. Spectral Analysis of Metal complexes

16. Verification of *spectrochemical* series using electronic spectra
17. Determination of binding modes of DMSO in metal complexes
18. Determination of molecular symmetry (cis-trans isomerism) using IR spectra.
19. Electronic spectra of Cobalt(III) complexes and T-S diagram.
20. Investigation of linkage isomerism using IR spectra
21. ESR spectra of copper(II) -Schiff base complex.

Practical –II

PROJECT WORK

M. Sc. CHEMISTRY - IV SEMESTER

[Under CBCS] (w.e.f. 2019-20)

ORGANIC CHEMISTRY

Paper OC – 401 : ORGANIC SPECTROSCOPY

Unit- 1 : ^{13}C, ^{19}F and ^{31}P NMR SPECTROSCOPY

^{13}CNMR – Spectroscopy – CW and PFT techniques. Types of CMR spectra–undecoupled proton decoupled. Off–resonance decoupled (SFORD): Selective decoupled and gated decoupled spectra ^{13}C–chemical shifts, factors affecting the chemical shifts Homonuclear (^{13}C – ^{13}CJ), and heteronuclear (^{13}C–1H, ^{13}C–2HJ) couplings. Applications of ^{13}C–NMR Spectroscopy in confirmation of structure and stereochemistry of organic molecules and in determining the reaction mechanism and dynamic processes of organic reactions – examples.

Introduction to ^{19}F and ^{31}P NMR Spectroscopy – Principle, chemical shifts and coupling constants and their applications in Organic chemistry.

Unit- 2 : MULTIPULSE TECHNIQUES IN NMR

Magnetization transfer experiments and their applications : ^{13}C – spectral editing techniques – APT, INEPT and DEPT methods.

Introduction to 2D – NMR : Classification of 2D experiments. 2D–J–resolved spectroscopy HOMO and HETERO – 2D–J– resolved spectra. Correlation spectroscopy (COSY) – HOMO – COSY, HETERO – COSY, 2D – INADEQUATE and NOESY Explanation of the principle, application to structure elucidation and stereochemistry of simple organic molecules.

Unit-3 : APPLICATIONS OF MASS SPECTROMETRY AND OPTICAL ROTATORY DISPERSION

Applications of mass spectrometry: Mass spectra of ethers (Ethyl sec–butyl ether and anisole). Ketones (2–pentanone, cyclohexanone and p–chlorobenzophenone), Aldehydes (butyraldehyde and benzaldehyde), Acids (Hexanoic acid and O–hydroxyl benzoic acid). Esters (Methyl butanoate and Ethyl benzoate). Amines (p–toluidine and Diethylamine). Amides (benzamide), Aromatic nitro compounds (nitrobenzene). Chlorides and bromides (2–cholorpropane and 1,3– dibromopropane) and Amino acids (Leucine).

Optical rotatory dispersion : Optical rotation, circular birefringence, circular dichroism and cotton effect. Plain curves and anomalous curves and their applications Axial halo ketone rule and octant rule. Application to the study of configuration and conformations of organic molecules.

Unit-4 : SPECTRAL IDENTIFICATION OF NATURAL PRODUCTS

Spectral identification of natural products : Use of spectroscopic methods UV, IR, ^{1}H and ^{13}C–NMR and Mass spectra in the structure elucidation of natural products. Illustration with suitable compounds like chrysin (flavones). 2,3–dihydroflavone (flavanone), diadzein (isoflavone).

Umbelliferone (coumarin), Camphor (Terpenoid) and Papaverine (alkaloid). Cholesterol (steroid). Glucose (carbohydrates). PGE_2 (prostaglandins).

Recommended Books

1. Spectroscopic identification of Organic Compounds by R. M. Silverstein G. C. Bassier and T. E. Morrill.
2. Spectroscopic Identification of Organic Compounds by R. M. Silversten and Webster.
3. Organic Spectroscopy by Willam Kemp
4. NMR in Chemistry – A Multinuclear introduction by William Kemp.
5. Spectroscopic Identification of Organic Compounds by P. S. Kalsi.
6. ^{13}C NMR for Organic Chemists by G. C. Levy and G. L. Nelson.
7. Optical rotatory dispersion by C. Djerassi.
8. Optical rotatory dispersion circular dichroism by P. Crabbe.
9. Stereochemistry of Organic Compounds – Principles & Applications by D. Nasipuri.
10. Stereochemistry confirmation and mechanism by P. S. Kalsi.
11. Stereochemistry of Organic Compounds by Eliel.

M.Sc. CHEMISTRY – IV SEMESTER

CBCS Syllabus (w.e.f **2020-21**)
ORGANIC CHEMISTRY

Paper OC – 402 : DRUG DESIGN

Unit-1 : PRINCIPLES OF DRUG DISCOVERY

Introduction to drug discovery.Drug discovery without lead – serendipity – Pencillins and Librium as examples. Lead discovery – random and non–random screening of natural products – medical folklore, synthetic banks. Existing drugs from natural ligand or modular combinatorial synthesis. Computer aided designing (introductory treatment only).

Drug metabolism studies – Phase I and Phase II metabolism. Clinical observations. Phase – I, Phase – II, Phase – III and Phase – IV trials (introductory treatment only).

Principle of drug design against agonist, antagonist drugs.Structure pruning technique in drug design (ex morphine – pharmacophore).Development of cimetidine and captoprill from lead molecules.

Unit - 2 : SAR STUDIESAND SYNTHETIC DRUGS

Introduction to structure – activity relationship (SAR) studies – (i) binding role of hydroxyl, amino, aromatic ring, double bond, ketones and amides (ii) Variation of substituents – alkyl and aromatic substituents extension of structure, chain extension/contraction, ring expansion/ contraction, ring variation and ring fusion. Isostres (iii) simplification of structure, rigidification, conformational blockers, X–ray crystallographic studies.

Definition and Synthesis of following drugs: Sedatives and hypnotics-Phenobarbital;Anticonvulsants-Phenytoin;Antipyretics and analgesics-Paracetamol, Phenacetin, Aspirin; Antihypertensive drugs-Methyldopa;Antihistaminics-Promethiazine;Antimalarials-Chloroquine;Antineoplastics-Fluorouracil.

Unit – 3 : QSAR STUDIES DRUGS AND ANTIBIOTICS

Introduction to Quantitative structure activity relationship studies.QSAR parameters –

Methods in QSAR studies (i) Linear free energy relationship (LFER) Application of Hammet equation. Hansch analysis – significance of slopes and intercepts in Hansch analysis (ii) Craig's plot (iii) Topliss scheme (iv) Cluster significant analysis.

Antibiotics:Introduction-Penicillins-naturally occurring penicillins-structure of the penicillins-synthesis of penicillin-structure of ampicillin (only structural features).
Aminoglycoside antibiotics-structures of streptomycin and neomycin (only structural features).
Structure and synthesis of chloramphenicol.
Tetracyclines-structre and general characteristics of the tetracyclines-tetracycline and oxytetracycline, chlortetracycline hydrochloride.

Unit--4 : COMBINATORIAL SYNTHESIS

Introduction Combinatorial approach, libraries, technologies, solid phase synthesis requirements – resins, linkers, reactants for solid phase synthesis. Methods of parallel synthesis – Houghtons tea bags procedure, automated parallel synthesis, methods in mixed combinatorial synthesis – general principles. Structure determination of the active compounds.Examples of combinatorial chemistry.Planning and designing of a combinatorial synthesis – spider like scaffolds drug molecules, analytical characterization of compounds in synthetic organic libraries automation in combinatorial chemistry, high throughput screening.

Recommended Books

1. Burger's Medicinal Chemistry and drugs discovery by Manfred E. Wolf.
2. Introduction to Medicinal Chemistry by G. Patrick.
3. Bio chemical approach to Medicinal Chemistry by Thomas Nogrady.
4. Introduction to drug design by Silverman.
5. Principles of Medicinal chemistry by William Foye.
6. Principles of Medicinal chemistry Vol. I & II by Kadam et al.
7. Organic and Pharmaceutical chemistry by Delgrado.
8. Organic pharmaceutical chemistry by Harikishan Singh.
9. Medicinal Chemistry by Ashtoshkar.
10. Medicinal Chemistry by Chatwal.

M.Sc. CHEMISTRY – IV SEMESTER

CBCS Syllabus (w.e.f **2020-21**)

ORGANIC CHEMISTRY

(Effective from the Academic Year 2016-2017)

Paper OC – 403 HETEROCYCLIC COMPOUNDS AND GREEN CHEMISTRY

OC – 25 : HETEROCYCLIC CHEMISTRY – I

Importance of heterocyclic compounds-Nomenclature-Classification base on nature of hetero atoms and size of the ring-IUPAC nomenclature for fused heterocycles (Bicyclic and tricyclic)-π excessive and π deficient systems. Important methods of synthesis and reactions of the following heterocycles-Indole, Benzofuran, Benzothiophene, Quinoline, Isoquinoline, Coumarin, Chromone, Carbazole and Acridine.

OC – 26 : HETEROCYCLIC CHEMISTRY – II

Different types of strains, interactions and conformational aspects of non aromatic heterocycles. Synthesis, reactivity and importance of Aziridines, Oxiranes, Thiranes, Azetidines, Oxetanes and Thietanes.
Synthesis, reactivity, aromatic character and importance of the following heterocycles-Pyrazole, Oxazole, Thiazole, Pyridazine, Pyrimidine and Pyrazine.

OC – 27 : NUCLEIC ACIDS

Introduction-Hydrolysis of nucleic acids, structure and synthesis of adenine, guanine, cytosine, uracil and thiamine. Structure and synthesis of nucleosides and nucleotides. Deoxyribonucleic acid (DNA)-Primary, Secondary and tertiary structure of DNA. A, B, C and Z forms of DNA. Structure of RNA. Types of RNA-mRNA, rRNA and tRNA.
Definition and explanation of replication, transcription and translation. Genetic code-codons-Protein biosynthesis.

OC – 28 : APPROACHES TO GREEN SYNTHESIS

Basic principles of green synthesis. Different approaches to green synthesis - (a) Use of green reagents in green synthesis–dimethyl carbonate, polymer supported reagents–peracids, polymer peptide coupling reagents. (b) Green catalysts-acid catalysts, oxidation catalysts, basic catalysts, polymer supported catalysts. (c) Phase transfer catalysts in green synthesis-benzyl trimethyl ammonium chloride or bromide. Advantages of PTC reactions in green synthesis. Applications of PTCs in C-alkylation, N-alkylation, 3-alkyl coumarins. (d) Ionic liquids as green solvents-green solvents, reactions in acidic ionic liquids and neutral ionic liquids-Diels-Alder reaction, methylene insertion. Synthesis of Pravadoline. (e) Basic principles of Microwave induced green synthesis-applications microwave synthesis in oxidation of toluene, oxidation of alcohols,esterification of carboxylic acids, Diels-Alder reaction, deacetylation. (f) Basic principle of Ultrasound assisted green synthesis-applications ultrasound assisted synthesis in saponification, alkylation, Strecker synthesis.

Recommended Books

1. Heterocyclic chemistry, 3rdEdn. J. A. Joule, K. Mills and G. F. Smith, Stanley Thornes Ltd,.,UK, (1998).
2. Heterocyclic Chemistry by T.L. Gilchrist.
3. Heterocyclic Chemistry by J.A. Joule and K.Mills.
4. An Introduction to the Chemistry of Heterocyclic compounds, R.M. Acheson.
5. Principles of Modern Heterocyclic Chemistry,A. Paquette.
6. Handbook of Heterocyclic Chemistry, A.R. Katritzky
7. Heterocyclic chemistry, T. L. Gilchrist, Longman UK Ltd., London(1985)
8. The Chemistry of Indole, R. J. Sunderberg, Academic Press, New York (1970)
9. Benzofurans, A. Mustafa, Wiley- Interscience, New York (1974)
10. Organic synthesis in water, By Paul A. Grieco Blackie.
11. Green chemistry, Theory and Practical, Paul T. Anastas and John C. Warner.
12. New trends in green chemistry, By V.K. Ahluwalia and M. Kidwai.
13. Organic Synthesis : Special techniques. V.K. Ahluwalia and RenuAggarwal.
14. Text book of Organic Chemistry Vol II by I. L. Finar.

M.Sc. CHEMISTRY – IV SEMESTER

CBCS Syllabus (w.e.f 2020-21)

ORGANIC CHEMISTRY

(Effective from the Academic Year 2016-2017)

Paper OC – 404 ADVANCED NATURAL PRODUCTS

OC – 29 : CARBOHYDRATES AND ALKALOIDS

Carbohydrates : Occurrence, importance. Structure elucidation and synthesis of sucrose. Conformational structures of D(+)ribose, 2-deoxy D-ribose, sucrose, lactose, maltose and cellobiose. Structural features of starch, cellulose and chitin (structure elucidation not expected).

Alkaloids : Definition, medicinal importance occurrence and classification of alkaloids. General methods used for structural determination of alkaloids. Isolation, structural elucidation, stereochemistry and total synthesis of (i) Quinine (ii) Morphine.Biosynthesis of morphine.

OC – 30 : TERPENOIDS, CAROTENOIDS AND PORPHYRINS

Classification – isoprene and special isoprene rules. Occurrence, isolation, structure elucidation, stereochemistry and total synthesis of (i) santonin (ii) abeitic acid and (iii) β–carotene.Biosynthesis of mono and diterpenoids, synthesis of Haem and chlorophyll.

OC – 31 : STERIODS, HARMONES AND PROSTAGLANDINS

Occurrence, isolation, structure determination, stereo chemistry and total synthesis of (i) cholesterol (ii) androsterone (iii) testosterone (iv) estrone and (v) progesterone. Biosynthesis of cholesterol.

Occurrence, classification and physiological activity of prostaglandins.Structure determination and synthesis of PGE1 and PGE2.

OC – 32 : BIOMOLECULES (PROTEINS AND ENZYMES)

Proteins : Acid and enzymatic hydrolysis of proteins. Determination of amino acid sequence in polypeptides by end group analysis.Chemical synthesis of di and tri peptides.

Enzymes : Definition, Classification based on mode of action. Mechanism of enzyme catalysis.Lock and Key model and Induced–Fit model.Enantiomer discrimination by Three–point Contact model.Factors affecting enzyme catalysis.Enzyme inhibition–reversible and irreversible inhibition.Enzymes in organic synthesis.Immobilized enzymes.

Recommended Books

1. Comprehensive Organic Chemistry by D.R. Barton and W.D. Ollis.
2. Standard methods in plant analysis by Reach and Tracey
3. Natural production by Kalsi.
4. Text book of Organic Chemistry Vol II by I. L. Finar.
5. An introduction to the chemistry of terpenoids and Steroids by William templetion.
6. Systematic identification of flavonoid compounds by Mabry &Markhan.
7. Steroids by Fieser and Fieser
8. Alkaloids by Manske
9. Alkaloids by Bently
10. The Chemistry of terpenes by A.R. Pinder
11. The Terpenes by Simenson
12. Terpenoids by Mayo

M.Sc. CHEMISTRY – IV SEMESTER

CBCS Syllabus (w.e.f **2020-21**)

ORGANIC CHEMISTRY

PRACTICALS

PRACTICAL – I : Separation and identification of organic compounds

1. Separation of two component mixtures by chemical methods and their identification by chemical reactions — separation by using solvent ether, 5% aq.. hydrochloric acid, 5% aq. sodium bicarbonate and 5% sodium hydroxide solutions, checking the purity of the two components by TLC, identification of the compounds by a systematic study of the physical characteristics (mp/bp), extra elements (nitrogen, halogens and sulfur), solubility, functional groups, preparation of crystalline derivatives and identification by referring to literature. A minimum of 5 mixtures should be separated and analyzed by these procedures.

2. Thin layer chromatography :

Determination of purity of a given sample, identification of unknown organic compounds by comparing the R_f values of known standards and preparative TLC for separation of mixtures.

3. Separation by column chromatography :

Separation of a mixture of ortho and para–nitroanilines using silicagel as adsorbent and chloroform as the eluent.

Recommended Books

1. The systematic identification of organic compounds by R.L.Shriner, R.C.Fusion and D.Y. Curtin .I
2. A textbook of practical organic chemistry by A.I. Vogel, Vol. I and II.
3. Unitized experiments in organic chemistry by R.Q. Brewster and others.
4. Practical Organic Chemistry by Mann and Saunders.
5. Spectroscopic identification of organic compounds by Silverstein, Bassler and Morril 5th Edition.
6. Practical Pharmaceutical Chemistry, A.H.Beckett and J.B. Stenlake.
7. Spectral identification of organic compounds, Bassler, Silverstein 5th Edition.

Practical –II

PROJECT WORK

M.Sc. CHEMISTRY – IV SEMESTER

CBCS Syllabus (w.e.f **2020-21**)

PHYSICAL CHEMISTRY

Paper PC-401: STATISTICAL THERMODYNAMICS

UNIT - I : INTRODUCTION :

(A) The Language of statistical thermodynamics. Statistical thermodynamic formulation of Boltzmann equation.

(B) Partition function and thermodynamic functions. Separation of partition function according to forms of energy. Translational, vibrational, rotational and electronic partition function.

(C) Equations relating to these partition functions. Problems based on partition function.

UNIT - II : PARTITION FUNCTION AND THERMODYNAMIC FUNCTIONS

(A) Partition function and energy. Translational, vibrational, rotational energies. Equations relating to these energies.

(B) Partition function and entropy. Translational, vibrational, rotational and nuclear spin entropies. Equations relating to these entropy concepts.

(C) Partition function and free energy. Partition function and equilibrium constant. Treatment of equilibrium constant of I_2 $\rightleftharpoons$ 2 I equilibrium.

UNIT - III : CANONICAL ENSEMBLE

(A) Theories of heat capacities of solids and gases. Einstein and Debye equations. Classical treatment.

(B) Statistical mechanics of ensembles. Canonical and grand canonical ensembles. Introduction, what is meant by ensemble. Canonical ensemble. The thermodynamic functions.

(C) Properties of canonical ensemble partition function. Grand canonical ensemble partition function. Systems with more than one component. Micro canonical ensemble. Ortho and para hydrogen. Ortho and para nuclear states. Ratio of ortho to para hydrogen.

UNIT - IV : NON – EQUILIBRIUM THERMODYNAMICS

(A) Introduction, entropy production. Entropy production in chemical reactions. Entropy production and entropy flow in open systems.

(B) Onsager's theory. Validity of Onsager's theory and its verification.

(C) The principle of microscopic reversibility and the Onsager's reciprocal relations. Thermoelectricity, irreversible thermodynamics and biological systems.

References :

1. Thermodynamics for students of Chemistry by KURIAKOSE and RAJARAM.
2. An introduction to chemical thermodynamics by R.P. RASTOGI and R.R. MISRA.
3. Thermodynamics for Chemists by S.GLASSTONE.
4. Statistical thermodynamics by M.C.GUPTA.
5. Basic thermodynamics by EVERYN GUHA.

M.Sc. CHEMISTRY – IV SEMESTER

CBCS Syllabus (w.e.f **2020-21**)

PHYSICAL CHEMISTRY

PAPER-PC-402: CHEMICAL DYNAMICS AND ELECTROCHEMISTRY

UNIT - I : ACIDITY FUNCTION AND ISOTOPE EFFECTS

(A) Acidity functions, Zucker – Hammett, Bunnet and Yate's hypothesis in elucidation of mechanism of acid catalyzed reactions.

(B) Equilibrium isotope effects; Equilibrium in solution; Primary kinetic isotope effects; Semi classical treatments, Quantum mechanical tunneling; Reactions of the type $H + H_2$; Transfer of H^+, H and H^- ; Reactions of Muonium; Isotope effects with heavier atoms; Secondary kinetic isotope effects.

UNIT - II : HOMOGENEOUS CATALYSIS

(A) Homogenous catalysis. Catalysis by transition metal ions and their complexes. Homogeneous catalytic hydroganation processes leading to activation of subtracts: Oxidative addition and reductive elimination, ligand dissociation and insertion (ligand migration) reaction. Industrially important processes. Supported transition metal complexes as catalysts.

(B) Reactions with solid reactants. Introduction, Extent of reaction with time. The process of nucleation. Thermo gravimetric studies.

UNIT – III : ELECTRO KINETICS AND ELECTRO CAPILLARY PHENOMENON

(A) Electrical double layer, Helmholtz – Perin and Stern theories of electrical double layer. Electro kinetic phenomena : Electro-osmosis, electrophoresis, streaming potential, sedimentation potential and their relations to zeta potential.

(B) Determination of zeta potential from electrophoretic measurements – Tiselius apparatus - Micro and macroscopic methods. Influence of ions on electro kinetic phenomena.

Unit - IV : REACTIONS AT ELECTRODE SURFACES

(A) Reactions at electrode surfaces. Introduction, electrical double layer at the interface. Different aspects of electrochemical reactions. Butler-volmer reaction. Electrochemical methods used in electrode kinetics.

(B) A general approach to the elucidation of the mechanism of an electrode reaction. Effect of adsorption of ions on the electrode surface on the rate of electrode reactions. Double layer effects on rates of electrochemical reaction.

References:

1. Chemical Kinetics by K.J. Laidler
2. Kinetics and mechanisms of chemical transformations by J.Rajaram & J.C.Kuriocose
3. An introduction to Electro Chemistry – S. Glasstone.
4. Theoretical Electro Chemistry – Antropov.

M.Sc. CHEMISTRY – IV SEMESTER

CBCS Syllabus (w.e.f **2020-21**)

PHYSICAL CHEMISTRY

PAPER-PC-403: PHOTOCHEMISTRY AND NANOMETERIALS

UNIT-I : INTRODUCTION TO PHOTOCHEMISTRY:

Importance of photochemistry, Laws of photochemistry, photochemistry and spectroscopy, units and dimension. Quantum yields, Interaction between light and matter, wavelength of radiation, Particle nature of radiation, Dual nature of radiation, electronic energy states of atom, the selection rules , Diatomic and polyatomic molecules, Spectrophotometric terms for electro state, Orbital symmetry and molecular symmetry, Notation for excited state of organic molecules and Energy levels for inorganic complexes. Types of chemical reaction: Photo-dissociation, pre-dissociation, induced pre-dissociation. Photo sensitization. Chemiluminescence.

UNIT- II : PHYSICAL PROPERTIES OF ELECTRONICALLY EXCITED MOLECULES:

Nature of changes on electronic excitation, potential energy diagram shapes of absorption bands and Franck Condon principle, Non crossing rule of Teller Emission spectra, Environmental effect on absorption and emission spectra ,Excited state dipole moment, Excited state acidity constants pk* values, Excited state redox potential, Wigner's spin correlation rule

UNIT-III : PHOTO PHYSICAL PROCESSES

Jablonski diagram, Quenching and collision deactivation, Stern-Volmer plot, Types of photo physical pathways radiationless transitions, internal-conversion, external conversion and intersystem crossing, fluorescence emission, triplet state and phosphorescence emission, emission property and the electron configuration state diagram. Lasers excimers and exciplexes.

UNIT- IV : NANOMATERIALS

Introduction and definition of nanoparticles and nanomaterials, Classification of nanomaterials. Synthesis of nanomaterials-chemical vapour deposition, self assembly, sol-gel methods. Properties of nanomaterials-maganetic, electrical, optical and mechanical properties. Applications of nanomaterials – bio-medicinal, chemical and environmental.

REFERENCES:

1. Fundamentals of photochemistry, K.K.Rohatgi Mukhaergee, Wiley Eastern Limited (1986)
2. Photochemistry, Carol E Wayne and Richard P Wayne Oxford University Press (1996)
3. Organic Photochemistry, J M Cozen and B Halton, Cambridge University Press (Ist Edition) (1974).
4. Concept of Inorganic Photochemistry, A.W.Adamson and P.D.Fleischaves Wiley.
5. Physical Chemistry, P.W.Atkins, Julio de Paula ELBS 7th Edition (2002)
6. Nanotechnology: Nanostructures and Nanomaterials M.Balakrishna Rao, K.Krishna Reddy Campus books international First Edition (2009)
7. Charles P. Poole Jr Frank .J Owens, Introduction to Nanotechnology (2nd Edition), Wiley-India Edition. Delhi 2008

M.Sc. CHEMISTRY – IV SEMESTER

CBCS Syllabus (w.e.f **2020-21**)

PHYSICAL CHEMISTRY

Paper PC-404: PHYSICAL CHEMISTRY OF POLYMERS

UNIT – I: TYPES OF POLYMERIZATION REACTIONS AND TECHNIQUES OF POLYMERIZATION.

Polymers and their importance, Classification of polymers, average Molecular weight, Number average molecular weight, Weight average molecular weight, weight average concept, sedimentation and viscosity average molecular weight, molecular weight and degree of polymerization, poly dispersity and molecular weight distribution in polymers.

Types of Polymerization: chain polymerization, free radical polymerization, ionic polymerization, co-ordination polymerization, poly condensation, polyaddition polymerization, ring opening polymerization, and group transfer polymerization.

Techniques of polymerization: Bulk, solution, suspension and emulsion polymerization.

UNIT – II: KINETICS OF POLYMERIZATION

Free radical chain polymerization, Kinetic chain length, degree of polymerization, chain transfer reactions, Mayo equation and chain transfer constant, ceiling temperature, cationic polymerization, anionic polymerization, poly condensation, non-catalyzed and acid catalysed poly condensation, molecular weight distribution, degree of polymerization.

Kinetics of co-polymerization: free radical copolymerization, reactivity ratios, the Q-e Scheme of Alfrey and price, ionic copolymerization, co-poly condensation, block and graft copolymerization, step growth poly condensation.

UNIT - III: SOLUTION PROPERTIES OF POLYMERS

Thermodynamic of polymer dissolution, effect of molecular weight on solubility, solubility of crystalline and amorphous polymers, heat of dissolution and solubility parameter, Florry-Huggins theory of polymer solutions.

Viscosity of polymer solutions: Relative, specific and Intrinsic Viscosities, Experimental measurements of Viscosity of dilute polymer solutions. Discussion of Huggins, Kraemer and Mark-Houwink equations.

UNIT – IV: FUNCTIONAL POLYMERS.

Conducting polymers, Electrically conducting polymers and their uses (polyanilines, Polypyrrole, Polyacetylene and Polythiophene). Photoconductive Polymers. Liquid Crystal Polymers – Smectic, nematic and Cholesteric structures.

Ion exchange polymers. Cationic and anionic exchange polymers and their uses. Eco-friendly polymers. Membrane separation filtration – micro, Ultra and nanofiltration, separation of gases – permeselectivity and gas permeability of representative polymers. Liquid separation dialysis, Electro osmosis and reverse osmosis.

REFERENCES:

1. Physical Chemistry of Polymers, A. Tager, Mir Publications.
2. Polymer Science, V.R. Gowarikar, N.V. Viswanatham and Jayadev Sreedhar, New Age publications.
3. The elements of polymer Science and Engineering by Alfred Rudin, Academic Press. Inc, London (1982).
4. Text book of Polymer Science by Fred W. Billmeyer Jr., John Wiley Science Publishers.
5. Contemporary Polymer Chemistry, H.R. Alcock and F.W. Lambe, Prentice Hall.

M.Sc. Chemistry (Physical) IV Semester Practicals

CBCS Syllabus (w.e.f. **2020-21)**

Practical -I: INSTRUMENTATION

List of Experiments:

I.Conductometry

1. Conductometric titrations

a). Mixture of acids- Strong acid and weak acid Vs Strong base.

b). Mixture of bases – Strong base and weak base Vs Strong acid.

c). Mixture of Halides- KCl and KI Vs $AgNO_3$.

2. Verification of Onsagar equation in the case of KCl solution.

3. Determine the solubility of sparingly soluble salt ($BaSO_4$).

4. Determine the dissociation constant of a weak acid.

II. Colorimetry

1. Estimation of Mn^{+2} ion as permanganate.

2. Estimation of Fe^{+3} ion using thiocyanate as a complexing agent.

3. Estimation of Ferrous ion by using 1, 10-phenanthroline.

4. Determination of the formula and stability constant of a metal complex by

a). Job's method

b).Molar ratio method

c).Slope ration method

5. Determination of the amount of Iron by Photometric titration method.

III. Potentiometry

1. Potentiometric titrations.

a). Mixture of acids- Strong acid and weak acid Vs Strong base.

b).Mixture of Halides- KCl and KI Vs $AgNO_3$

2. Redox titrations- Ferrous and Vanadyl using Ce^{4+}.

3. Determination of solubility of sparingly soluble salt.

4. Determination of Dissociation constant of a dibasic acid

IV. Determination of Partial molar volumes of an electrolyte (NaCl) solution.

Practical –II

PROJECT WORK

NO

END

FOR KNOWLEDGE