FACULTY OF SCIENCE

Mohanlal Sukhadia University, Udaipur

M.Sc. Chemistry (CBCS) Programme

(valid from session 2015-16 on wards)

1. Duration of the Course

The Master of Science Chemistry programme will be of four semesters duration under Choice based Credit system which will be conducted in two years. Each semester will be of approximately 5 months (minimum 90 working days in a semester) duration.

2. Eligibility:

Candidates seeking admission to the first semester of M.Sc.(CBCS) Chemistry must have a B.Sc. with Chemistry as one of the optional subjects or as a honours subject (10+2+3 scheme) with minimum 48% marks from a UGC recognized University

3. Admissions:

Admissions to the first semester of M.Sc.(Chemistry) will be made as per admission rules for M.Sc.(CBCS)

4. Medium of Instruction

The medium of instruction and examination shall be English.

5. No. of Seats

Total number of normal fee seats: As per information bulletin

6. Curriculum

6.1 M.Sc.(Physics) programme has a two year , four semester prescribed course structure which in general terms is known as curriculum. It prescribes courses to be studied in each semester as given below

6.2 M.Sc.(Physics) programme shall have a curriculum and course contents (syllabi) for the courses recommended by the committee courses in Physics and approved by the academic council of the university.

6.3 The programme shall follow Choice Based Credit System(CBCS) and will be governed by the Common Rules and Regulations of Masters programme under CBCS approved by the Academic Council of the University.

A. Courses of Study and Examination (2015-16)
List of courses

Core Courses: Theory

Course Code	Title of Course
M1CHE 01-CT01	Inorganic Chemistry_I
M1CHE 02-CT02	Organic Chemistry-I
M1CHE 03-CT03	Physical Chemistry_I
M1CHE 04-CT04	Group Theory and Spectroscopy
M2CHE 01-CT05	Inorganic Chemistry-II
M2CHE 02-CT06	Organic Chemistry-II
M2CHE 03-CT07	Physical Chemistry-II
M2CHE 04-CT08	Environmental and Green chemistry
M3CHE 01-CT09	Advanced Spectroscopic Techniques
M3CHE 02-CT10	Bioinorganic, Bioorganic and Biophysical Chemistry
M4CHE 01-CT11	Special methods of analysis
M4CHE 02-CT12	Photochemistry and Supramolecules

Core Courses: Practicals

Course Code	Title of Course
M 1CHE 05-CP01	PR-I:Organic Chemistry
M 1CHE 06-CP02	PR-II:Inorganic and Physical Chemistry
M 2CHE05-CP03	PR-III:Inorganic Chemistry
M 2CHE06-CP04	PR-IV:Organic and Physical Chemistry

M 3CHE05-CP05	PR-V:Inorganic Chemistry and spectral problems
M4CHE05- CP06	PR-VI:Polymer synthesis and extraction of natural products

Discipline Specific Courses: Theory and Practical

Subject code	Tittle of course
Inorganic chemistry discipline (Group A)	
Theory	
M3CHE03-ET01A	Coordination chemistry
M3CHE04-ET02A	Advanced Bio-Inorganic Chemistry
M4CHE03-ET03A	Organometallic chemistry
M4CHE04-ET04A	Inorganic polymers
Practical	
M3CHE06- EP01A	Inorganic Chemistry Practical-I
M4CHE06- EP02A	Inorganic Chemistry Practical-II
Organic chemistry discipline (Group B)	
Theory	
M3CHE03-ET01 B	Modern interfaces of organic chemistry
M3CHE04-ET02 B	Chemistry of heterocyclic compounds
M4CHE03-ET03 B	Medicinal chemistry
M4CHE04-ET04 B	Chemistry of natural products
Practical	
M3CHE06- EP01 B	Organic Chemistry Practical-I
M4CHE06- EP02 B	Organic Chemistry Practical-II
Physical chemistry discipline (Group C)	
Theory	
M3CHE03-ET01C	Chemical kinetics
M3CHE04-ET02C	Nuclear and radiochemistry
M4CHE03-ET03C	Advanced photochemistry and radiation chemistry
M4CHE04-ET04C	Solid state chemistry
Practical	
M3CHE06- EP01C	Physical Chemistry Practical-I
M4CHE06- EP02C	Physical Chemistry Practical-II
Analytical Chemistry Discipline (Group D)	
Theory	
M3CHE03-ET01D	Fundamentals of analytical chemistry
M3CHE04-ET02D	Modern analytical methods
M4CHE03-ET03D	Analytical techniques
M4CHE04-ET04D	Applied analytical methods

Practical	
M3CHE06- EP01D	Analytical Chemistry Practical-I
M4CHE06- EP02D	Analytical Chemistry Practical-II
Skill Based Courses	
CHE-SP01	Green methods in chemistry
CHE-SP02	Basic analytical chemistry
CHE-SP03	Basics in pharmaceutical chemistry

Course Code

Course codes are written in the following format

Masters programme (M)+Semester (1,2,34)+CHE (Chemistry Discipline)+Serial Number of Course in the Semester(01,02,03 etc)+ hyphen("-") +Course type [Core Theory (CT), Core Practical(CP), Discipline Specific Theory (ET), Discipline Specific Practical (EP), Skill Practical(SP)]+Group Code (A,B,C etc)

For example the Course code M1CHE 01-CT01 should read as Master Programme First Semester Chemistry First Course-Core Theory Course-01

In the Course code M3CHE06- EP01A should read as Master Programme Third Semester Chemistry Sixth Course-Discipline Specific Elective Practical Course-01 Group-A

Note: -

1. Skill based courses will be offered on payment basis, which is Rupees 5000 per course with a minimum intake of 10 students in each course.

2. Candidate has to select two papers from any group A/B/C/D in the III semester, the selected group will continue in the IV semester. Group D courses are available only at Vidhya Bhawan Rural Institute and Government College, Chittorgarh.

3. Practical examinations will be conducted by the board of examiners consisting of one internal (to be appointed by the Head of Department) and one external examiner (to be appointed by the University).

THE COURSES OF STUDY

M.Sc. CHEMISTRY (2015-2016)

Semester I

S. No.	Course code	Title of the course	L-T-P	No. of credits	Max. marks 100		
					Uni. Exam	Int. exam	Total
1	M1CHE 01-CT01	Inorganic Chemistry-I	3-1-0	4	80	20	100
2	M1CHE 02-CT02	Organic Chemistry-I	3-1-0	4	80	20	100
3	M1CHE 03-CT03	Physical Chemistry-I	3-1-0	4	80	20	100
4	M1CHE 04-CT04	Group Theory and Spectroscopy	3-1-0	4	80	20	100
5	M1CHE 05-CP01	PR-I: Organic Chemistry	0-0-8	4	80	20	100
6	M1CHE 06-CP02	PR-II-Inorganic and Physical Chemistry	0-0-8	4	80	20	100
		Total		24	480	120	600

Semester II

S. No.	Course code	Title of the course	L-T-P	No. of credits	Max. marks 100		
					Uni. Exam	Int. exam	Total
1	M2CHE01-CT05	Inorganic Chemistry-II	3-1-0	4	80	20	100
2	M2CHE02-CT06	Organic Chemistry-II	3-1-0	4	80	20	100
3	M2CHE03-CT07	Physical Chemistry-II	3-1-0	4	80	20	100
4	M2CHE04-CT08	Environmental and Green Chemistry	3-1-0	4	80	20	100
5	M2CHE05-CP03	PR-III: Inorganic Chemistry	0-0-8	4	80	20	100
6	M2CHE06-CP04	PR-IV: Organic and Physical Chemistry	0-0-8	4	80	20	100
7	M2CHE07-SP01	Skill Course Elective Practical	1-0-3	2	80	20	100
		Total		26	560	140	700

Semester III

S. No.	Course code	Title of the course	L-T-P	No. of credits	Max. marks 100		
					Uni. Exam	Int. exam	Total
1	M3CHE01-CT09	Advanced Spectroscopic Techniques	3-1-0	4	80	20	100
2	M3CHE02-CT10	Bioinorganic, Bioorganic and Biophysical Chemistry	3-1-0	4	80	20	100
3	M3CHE03-ET01X X = A/B/C/D	Discipline Specific Elective- I	3-1-0	4	80	20	100
4	M3CHE04-ET02X X=A/B /C /D	Discipline Specific Elective- II	3-1-0	4	80	20	100
5	M3CHE05-CP05	PR-V:Inorganic Chemistry and spectral problems	0-0-8	4	80	20	100
6	M3CHE06- EP01 X= A/B/ C/ D	Discipline Specific Practical- I	0-0-8	4	80	20	100
		Total		24	480	120	600

Semester IV

S. No.	Course code	Title of the course	L-T-P	No. of credits	Max. marks 100		
					Uni. Exam	Int. exam	Total
1	M4CHE01-CT11	Special methods of Analysis	3-1-0	4	80	20	100
2	M4CHE02-CT12	Photochemistry and Supramolecules	3-1-0	4	80	20	100
3	M4CHE03-ET03X X=A/B /C /D	Discipline Specific Elective- III	3-1-0	4	80	20	100
4	M4CHE04-ET04X	Discipline Specific	3-1-0	4	80	20	100

	X=A/B /C /D	Elective- IV					
5	M4CHE05- CP06	PR-VI:Polymer Synthesis and Extraction of Natural Products	0-0-8	4	80	20	100
6	M4CHE06-EP02X X=A/ B /C /D	Discipline Specific Practical- II	0-0-8	4	80	20	100
7	M4CHE07-SP02	Skill Course Elective Pratical	1-0-3	2	80	20	100
		Total		26	560	140	700

Credits for all four semesters	100
No. of Core Course Credits	72
No. of Discipline Specific Course Credits	24
No.of Credits for SGPA and CGPA calculation	96
No. of Skill course credits	04

M.Sc. Chemistry (CBCS) Programme

(Valid from session 2015-16 on wards)

Syllabus

SEMESTER I

M1CHE 01-CT01: Inorganic Chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Stereochemistry and Bonding in Main Group Compounds, VSEPRT, Walsh diagrams (tri and penta-atomic molecules), dπ-pπ bonds, Bent rule and enegretics of hybridization, some simple reactions of covalently bonded molecules

Metal-Ligand Bonding: Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory.

UNIT-II

Metal-Ligand Equilibria in Solution: Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry

UNIT-III

Reaction Mechanism of Transition Metal Complexes: Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid

hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favor of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage

UNIT-IV

Substitution reactions in square planar complexes, the trans effect, mechanism of the subtitution reaction. Redox reactions, electron transfer reactions, mechanism of the subtitution reaction, Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outersphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.

UNIT-V

Electronic Spectra and Magnetic Properties of Transition Metal Complexes: Spectroscopic ground states, correlation, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d1-d9 states), Calculations of Dq, B and â parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

Books Recommended:

1. Advanced Inorganic Chemistry, F.A.Cotton and Wilkinson, John Wiley

2. Inorganic Chemistry, J.E.Huhey, Harpes & Row

3. Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon.

4. Inorganic Electronic Spectroscopy, ABP Lever, Elseview

5. Magnetochemistry, R.L. Carlin, Springer Verlag

SEMESTER-I

M1CHE 02-CT02: Organic Chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits 4

UNIT-I

Nature of bonding in organic molecules: Delocalized chemical bonding-conjugation, cross conjugation, bonding in fullerenes, aromaticity in benzenoid and non-benzenoid compounds, annulenes, ferrocenes and helicenes, alternant and non-alternant hydrocarbons, Huckel's rule, energy level of Π-molecular orbitals, anti-aromaticity, homo-aromaticity, PMO approach.

UNIT-II

Reaction mechanism, structure and reactivity - A review of types of mechanisms and reaction, Methods of determining mechanisms, Kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle, potential energy diagrams, transition states and intermediates, isotope effects, effect of structure on reactivity-resonance and field effects, steric effect, steric inhibition to resonance, substituent and reaction constants, Taft equation.

UNIT-III

Aliphatic reaction Mechanism

(i) Nucleophilic substitution - The S_N2, S_N1, mixed S_N2 and S_N1, S_Ni and SET mechanisms, Neighbouring group participation.

Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation, rearrangements, nucleophilic substitution at allylic, trigonal and vinylic carbon, reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, ambient nucleophile, regioselectivity.

(ii) Electrophilic substitution – S_E2 and S_E1 mechanism, electrophilic substitution accompanied by double bond shift, effect of substrates, leaving group and the solvent polarity on reactivity.

UNIT-IV

Aromatic reaction Mechanism

(i) Electrophilic substitution - The arenium ion mechanism, orientation and reactivity, energy profile diagrams, the ortho/para ratio, ipso attack, orientation in other ring systems, diazonium coupling, Vilsmeir - Haak reaction, Bischler-Napieralski reaction, Pechmann reaction.

(ii) Nucleophilic substitution - The S_NAr, S_N1, benzyne and SR_N1 mechanisms, reactivity - effect of substrate structure, leaving group and attacking nucleophile. Von Richter, Sommelet-Hauser and Smiles rearrangements.

(iii) Free radical reaction - Types of free radical reactions, free radical substitution mechanism, neighboring group assistance, reactivity for aliphatic and aromatic substrate at a bridgehead, reactivity in the attacking radicals, the effect of solvents on reactivity, allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, autooxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction, free radical rearrangement, Hunsdiecker reaction.

UNIT-V

Addition Reaction

Carbon-Carbon multiple bonds - Mechanistic and stereochemical aspects of addition reaction involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, orientation and reactivity, addition to cyclopropane ring, hydrogenation of double bond, triple bonds and aromatic rings, hydroboration, Michael reaction.

Carbon-Hetero multiple bonds - Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds, Wittig reaction, mechansim of condensation reaction involving enolates- Aldol, knoevengel, Mannich, Benzoin, Perkin and Stobbe reactions.

Elimination reaction - The E2, E1, ElcB and E2cB mechanisms and their spectrum, orientation of the double bond, reactivity-effect of substrate structures, attacking base, the leaving group and the medium, stereochemistry, elimination v/s substitutions, pyrolytic eliminations.

Books Recommended :

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.

2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum

3. A Guide book of Mechanism in Organic Chemistry, Peter Sykes, Longman

4. Structure and Mechanism in Organic Chemistry, Peter Sykes, Longman

5. Modern Organic Reactions, H.O. House, Benjamin

6. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional

7. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh Macmillan.

8. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.

9. Stereochemistry of Organic Compounds, P.S Kalsi, New age International

10. Organic Reaction and Their Mechanisms, P.S. Kalsi, New Age International

11. Organic Reaction Mechanism, V.K. Ahluwalia and R.K. Parshar, New Age International.

SEMESTER-I
M 1 CHE 03-CC 03
Physical Chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits 4

ESSENTIAL –All students must have knowledge of these topics of mathematics-

Differentiation and Integration of some simple terms, Differential equations, partial differential equations, series solutions and special functions, linear vector spaces, transformation of coordinate matrix, representation of operators, eigenvalue problem, orthonormal sets, Fourier and Laplace transforms.

UNIT-I

Quantum chemistry: The Schrodinger equation and the postulates of quantum mechanics, solutions of the Schrodinger equation to some model system viz. particle in a box, the harmonic oscillator.

Approximate methods: First order time-independent perturbation theory for non- degenerate states. Variation theorem and variational methods. Use of these methods illustrated with some examples (particle in a box with a finite barrier, anharmonic oscillator, approximate functions for particle in a box and hydrogen atom).

UNIT-II

Angular momentum: Ordinary angular momentum, generalized angular momentum, eigen functions and eigen values of angular momentum, operators, algebra of operators, ladder operators, addition of angular momenta, spin, antisymmetry and Pauli's exclusion principle.

Electronic structure of atoms: Electronic configuration, Russell-Saunder's terms and coupling schemes, molecular orbital theory, Huckel theory of conjugated systems, bond order and charge density calculations, application to ethylene and butadiene.

UNIT-III

Chemical dynamics: Methods of determining rate laws and mechanism, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and thermodynamic parameters, ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, general features of fast reactions.

UNIT IV

Homogeneous catalysis, kinetics of enzyme reactions, chain reactions, photochemical reactions (Hydrogen-bromine and hydrogen-chlorine reactions) oscillatory reactions (Belousov-Zhabotinsky reaction),

UNIT V

Macromolecules: Definition, types of polymers, electrically conducting, fire resistant and liquid crystal polymers, kinetics of polymerization, mechanism of polymerization, molecular mass, number and mass average molecular mass, molecular mass determination (osmometry, viscometry, diffusion and light scattering methods,GPC), sedimentation.

Books Recommended:

1. Lowe, J. P. & Peterson, K. Quantum Chemistry Academic Press (2005).

2. McQuarrie, D. A. Quantum Chemistry Viva Books Pvt. Ltd.: New Delhi (2003).

3. Mortimer, R. G. Mathematics for Physical Chemistry 2nd Ed. Elsevier (2005).

4. Pilar, F. L. Elementary Quantum Chemistry 2nd Ed., Dover Publication Inc.: N.Y. (2001).

5. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press

6. Levine, I. L Quantum Chemistry 5th Ed., Prentice-Hall Inc.: New Jersey (2000).

7. Engel, T. & Reid, P. Physical Chemistry Benjamin-Cummings (2005).

8. McQuarrie, D. A. & Simon, J. D. Physical Chemistry: A Molecular Approach 3rd Ed., Univ. Science Books (2001).

9. Chemical Kinetics, K.J. Laidler, Mcgraw-Hill.

10. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.

SEMESTER-I
M 1 CHE 04-CC 04
Group Theory and Spectroscopy

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits 4

UNIT I

Symmetry and Group theory in Chemistry:

Symmetry elements and symmetry operation, definition of group, subgroup, Conjugacy relation and classes. Point symmetry group, Schonfilies symbols, representation of groups by matrices (representation for the $C_{\eta h}$, $C_{\eta v,}$ etc. groups to be worked out explicitly). Characters of a representations, Great orthogonality theorem (without proof) and its importance. Character tables and their use; spectroscopy, Derivation of character table for C_{2v} and C_{3v} point group, symmetry aspects of molecular vibrations of H_2O molecule.

UNIT-II

Unifying Principles: Electromagnetic radiations, Interaction of electromagnetic radiation with matter, Uncertanity relation and natural line width, Factors affecting natural line width, Born oppenheimer approximation.

Photoelectron spectroscopy: Franck Condon principle, types of electron spectroscopy, ESCA-theory, instrumentation and applications, Auger emission spectroscopy-Basic idea.

UNIT III

Rotational spectroscopy: classification of molecules, rigid rotator, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor, stark effect, nuclear and electron spin interaction and effect of external field, applications.

Vibrational Spectroscopy:

Review of linear harmonic oscillator, Vibrational energies of diatomic molecules, Zero Point energy, force constant and bond strength, anharmonicity, Morse Potential energy diagram,

Vibration-rotation spectroscopy, P.Q.R. branches, breakdown of oppenheimer approximation, selection rules, finger print region, Group frequencies and intensities, overtones, hot bands, combination bands and Fermi resonance.

UNIT IV

Raman spectroscopy: Classical and quantum theories of raman effect, Stokes and anti-Stokes lines, Pure rotational, vibrational, rotational- vibrational Raman spectra, Mutual exclusion principle.

IR Spectroscopy (Characterization of functional groups)

Normal modes of vibration, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds), factors affecting the band positions, brief idea of FT-IR.

UNIT V

Ultra-violet and visible spectroscopy:

Various electronic transitions, Beer-lambert law, effect of solvent on electronic transitions, UV spectra of carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, Woodward-Feiser rules for conjugated dienes and carbonyl compounds, UV spectra of benzene and its derivatives, applications of UV spectroscopy.

Books recommended-

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Chemical Applications of Group Theory, F. A. Cotton.
3. Symmetry and Group theory: Some chemical applications, Ramashankar and Suresh Ameta, Himanshu Publications, Udaipur, Delhi.
4. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
5. Basic Principles of Spectroscopy, R. Chang, McGraw Hill.
6. Theory and Applications of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBH- Oxford.

7. Introduction to Photoelectron Spectroscopy, P. K. Ghosh, John Wiley.
8. Introduction to Magnetic Resonance, A Carrington and A.D. Maclachalan, Harper & Row.
9. Physical Methods for Chemistry, R.S. Drago, Saunders Company.
10. Infrared and Raman Spectra: Inorganic and Coordination Compounds, K. Nakamoto, Wiley.
11. Molecular Symmetry in Chemistry Via Group Theory - U.C. Agarwala, Ane books India

SEMESTER-I

M1 CHE 05-CP 01 (Core practical I) **Credits 4; Time 8h**

M.M. 80 marks (External)
20 marks (Internal)

1. **Separation of binary mixture (minimum -8)**

   Purification and identification of compounds in a binary mixture of two solids and preparation of their suitable derivatives

2. **Organic Synthesis (minimum -5)**

   (One experiment to be performed from the following in the examination)

I. **Acetylation-** Acetylation of Salicylic acid using acetyl chloride

II. **Benzoylation-** Benzoylation of phenol/ aniline/ glycine

III. **Oxidation-** Phenanthroquinone from Phenanthrene

IV. **Sandmayer Reaction-** o-Chlorotoluene from o-Toluidine

V. **Acetoacetic ester Condensation-** Synthesis of ethyl-n-butylacetoacetate

VI. **Bromination Reaction-** to prepare dibromoflurorescein from fluorescein.

VII. **Backmann Rearrangement-** Acetanilide from acetophenone

VIII. **Claisen-Schmidt Condensation-** Benzalacetophenone/Bezalacetone/ diBenzalacetone from Benzaldehyde

SEMESTER-I

M 1 CHE 06-CP 02 (Core Practical-2) Credits 4; Time 8 h

M.M. 80 marks (External)
20 marks (Internal)

1. **Qualitative analysis of Inorganic mixture– (minimum -6)**

Qualitative analysis of inorganic mixture containing SIX radicals from the following list: (at least three from Group B)

Group A - Carbonate, Sulphite, Sulphate, Sulphide, Nitrite, Acetate, Oxalate, Nitrate, Chloride, Iodide, Phosphate, Fluoride, Borate, Silver, Lead Mercury, Bismuth, Copper, Cadmium, Tin, Arsenic, Antimony, Aluminium, Chromium, Iron, Nickel, Cobalt, Zinc, Manganese, Calcium, Barium, Strontium, Magnesium, Ammonium.

Group B - Thiosulphate, Cyanate, Thiocyanate, Hypochlorite, Chlorate, Percholrate, Iodate, Persulphate, Silicate, Chromate, Arsenate, Benzoate, Thalium, Tungsten, Molybdenum, Vanadium, Beryllium, Uranium, Thorium, Titanium, Zirconium, Cerium.

2. **Kinetics – (minimum -4)**

I. Determine the specific rate constant for the acid catalyzed hydrolysis of methyl acetate by the Initial Rate Method.

II. Compare the strengths of hydrochloric acid and sulphuric acid by studying rate of hydrolysis of methyl acetate.

III. Determine the specific reaction rate constant of the potassium persulphate-iodide reaction by the Initial Rate Methods.

IV. Study the kinetics of the iodination of acetone in the presence of acid by the Initial rate Method.

3. **Conductometry – (minimum -4)**

I. Determine the equivalent conductance, degree of dissociation and dissociation constant (K_a) *of* acetic acid and verify Ostwald dilution law.

II. Determine the solubility of sparingly soluble salt and its solubility product.

III. Study the conductometric titration of hydrochloric acid with sodium carbonate and determine the concentration of sodium carbonate in a commercial sample of soda ash.

IV. Determine basicity of weak organic acid.

V. Determine the strength of strong and weak acids in a given mixture.

SEMESTER-II
M 2 CHE 01-CC 05
Inorganic chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Metal π – complexes I: Carbonyls,, structure and bonding, use of vibrational spectra of metal carbonyls for bonding and structure elucidation, types of carbonyls, their preparations and important reactions.

UNIT-II

Metal π – complexes II: Preparation, bonding, structure and important reactions of transition metal nitrosyls, dinitrogen and dioxygen complexes.

UNIT-III

Boranes: Preparation and important reactions, electron deficient characters of boranes, structure and bonding in boranes, concept of multicentric bonding and M.O. Description, Lipscomb concept of bonding elements, semitopological description of s,t,y and x nomenclature.

Silicones- Preparation, properties and structure of silicones, their industrial and technical importance.

UNIT-IV

Sulphur-Nitrogen compounds: Preparation, properties of tetrasulphur tetranitride Disulphur, dinitride, polythiozyl and other sulphonitrides, sulphur imides

Phosphorus-Nitrogen compounds: Linear and cyclic polymers, their synthesis and reactions, structure and bonding Alcok's skeletal π-bonding concept.

UNIT-V

Metal Clusters: Higher boranes, carboranes, metalloboranes, Metal carbonyl and halide clusters, compounds with metal-metal multiple bonds.

Books Recommended:

Advanced Inorganic Chemistry, F. A. Cotton and Wilkinson, John Wiley

1. Inorganic Chemistry, J. E. Huhey, Harpes & Row

2. Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon

3. Inorganic Electronic Spectroscopy, ABP Lever, Elseview

4. Magnetochemistry, R.L. Carlin, Springer Verlag

SEMESTER-II
M 2 CHE 02-CC 06
Organic chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Stereochemistry-I:

Elements of symmetry, Chirality, Molecules with more than one chiral center, DL, RS and EZ nomenclature, methods of resolution, Optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereo specific and stereo selective synthesis, optical activity in the absence of chiral carbon (biphenyl, allenes and spiranes), chirality due to helical shape.

UNIT-II

Stereochemistry-II:

Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, Asymmetric synthesis, Cram's and Prelog's rules, CD, ORD, Octant rule, Cotton effect. Stereochemistry of compounds containing nitrogen and sulphur.

UNIT-III

Rearrangements: General mechanistic considerations-nature of migration, migratory aptitude, memory effects.

A detailed study of the following rearrangements - Pinacol-Pinacolone rearrangement, Wagner- Meerwin rearrangement, Demjanov rearrangement, Benzil - Benzilic acid rearrangement, Favorskii rearrangement, Wolff rearrangement, Neber rearrangement, Beckmann rearrangement, Hofmann rearrangement, Curtius rearrangement, Schmidt rearrangement, Lossen rearrangement, Bayer-Villiger rearrangement and Stevens rearrangement.

UNIT-IV

Reagents in organic synthesis: Use of the following reagents in organic synthesis and functional group transformation, Gilman's reagent, lithium dimethyl cuprate LDA, dichlorohexylcarbodiimide, trimethyl silyl iodide, tributyltin hydride, DDQ, Baker yeast, Petersons synthesis, Merrifield resins, 1,3-dithiane, selenium oxide, osmium tetroxide

Reagents containing phosphorous, Silicon and Boron in organic synthesis: Preparation, properties, applications and mechanistic details.

UNIT-V

Pericyclic reactions

Introduction, classification of pericyclic reactions, molecular orbital symmetry, frontier orbitals of ethylene, 1,3 –butadiene, 1,3,5-hexatriene and allyl system. Woodward Hoffmann Correlation diagram, F.M.O. and PMO approach to cycloaddition and electrocyclic reactions. Electrocyclic reactions- Conrotatory and disrotatory motions, 4n and 4n+2. Cycloadditions- antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3-dipolar cycloaddition and cheleotropic reactions.

Sigmatropic rearrangement-suprafacial and antrafacial shifts of H, Sigmatropic shifts involving carbon moieties, Claisen, Cope and aza-Cope rearrangement. Fluxional tautomerism. Ene reaction.

Books Recommended :

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum
3. Modern Organic Reactions, H.O. House, Benjamin
4. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
6. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.

7. Stereochemistry of Organic Compounds, P.S Kalsi, New age International.
8. Organic Reaction and Their Mechanisms, P.S. Kalsi, New Age International.
9. Organic Reaction Mechanism, V.K. Ahluwalia and R.K. Parshar, New Age International.
10. Stereochemistry of Organic Compounds, E.L. Eliel.

SEMESTER-II
M 2 CHE 03-CC 07
Physical Chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT -I

Classical thermodynamics: Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies, partial molar properties, partial molar free energy, partial molar volume and partial molar heat content and their significance, determinations of these quantities.

Non-ideal systems: Excess function for non-ideal solutions, activity, activity coefficient. Debye-Huckel theory for activity coefficient of electrolyte solutions, determination of activity and activity coefficients, ionic strength.

UNIT-II

Statistical thermodynamics - Concept of distribution, thermodynamic probability and most probable distribution, ensemble averaging, postulates of ensemble averaging, canonical, grand canonical, and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers)Partition function, translational, rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions, applications of partition functions. Chemical equilibrium and equilibrium constant in terms of partition functions, Fermi-Dirac statistics, Bose-Einstein statistics, distribution law.

UNIT-III

Non-equilibrium thermodynamics –Meaning of Irreversible(Non-equilibrium) thermodynamics, Thermodynamic criteria for non-equilibrium states, phenomenological laws-linear laws, Gibbs equation, Onsager reciprocal relations, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g. heat flow, chemical reaction

etc.) Prigogines principal of maximum entropy production, transformations of the generalized fluxes and forces. Applications of non-equilibrium thermodynamics.

UNIT-IV

Surface chemistry - Surface tension, Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electrokinetic phenomenon), catalytic activity at surfaces. Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization, solubilization, micro-emulsion, reverse micelles.

UNIT-V

Electrochemistry: Debye-Huckel-Onsager treatment and its extension, ion-solvent interactions, Debye-Huckel-Jerum mode, derivation of electro-capillarity, Lippmann equations (surface excess), methods of determination, structure of electrified interfaces, Guoy-Chapman, Stern, Graham-Devanathan-Mottwatts, Tobin, Bockris, Devanathan models, over potentials, exchange current density, derivation of Butler-Volmer equation, Tafel plot, semiconductor interfaces, theory of double layer at semiconductor, electrolyte - solution interfaces, structure of soluble layer interfaces, effect of light at semiconductor solution interface.

Book Recommended:

1. Modem Electrochemistry Vol. I and Vol.II, J.O.M. Bockris and A.K.N. Reddy, Plenum

2. Silbey, R. J., Alberty, R. A. & Bawendi, M. G. Physical Chemistry 4th Ed. Wiley

3. McQuarrie, D. A. Statistical Mechanics Viva Books Pvt. Ltd.: New Delhi (2003).

4. Nash, L. K. Elements of Statistical Thermodynamics 2nd Ed., Addison Wesley (1974).

5. Physical Chemistry, P.W Atkins, ELBS

6. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum

SEMESTER-II
M 2 CHE 04-CC 08
Environmental and Green Chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT I

Principle and concepts of Green Chemistry:-Introduction, definition, principles, atom economy, atom economic and atom uneconomic reaction, reducing toxicity.

Waste- Production, Problems and Preventions: Introduction, problem caused by waste, source of waste, cost of waste, waste minimization techniques, on-site waste treatment, design for degradation, polymer recycling. Introduction to catalysis, biocatalyst and phase transfer catalysis.

UNIT-II

Green Solvents: Organic solvents, solvent-free systems, controlling of solvent-free reactions, supercritical fluids (H_2O and CO_2), fluorous biphase solvents.

Green Reagents: Introduction, methods of designing safer chemicals, avoidance of toxic functional groups, examples of greener reagents including replacement of phosgene, methylations using dimethyl carbonates and other polymer supported reagents, solid state polymerization, alternative nitrile synthesis.

UNIT-III

Green Synthesis: Design for energy efficiency, classification and applications of Green Synthesis including Microwave Assisted Synthesis green synthesis of polycarbonates, paracetamol, ibuprofen, citral, urethane, adipic acid, styrene, α, β-unsaturated nitroalkenes.

UNIT-IV

Environmental chemistry: Atmosphere –chemical and photochemical reactions in the atmosphere, oxygen and ozone Chemistry, greenhouse gases and effect, hydrosphere- physical

chemistry of sea water, eutrophication, sewage treatment, lithosphere and chemistry involved, smoke formation acid rains. A brief idea of toxicological effects of arsenic, lead, cadmium mercury, ozone PAN, cyanide and pesticides. Oxide of nitrogen, sulphur and carbon, carcinogens.

UNIT-V

Analysis of pollution: Sampling and monitoring of air and water, determination of total dissolved solids, conductivity , acidity, alkalinity, harmness, chloride, sulphate, fluoride phosphate and different forms of nitrogen phenols, pesticides, surfactants DO, BOD, COD and microorganism. Catalysts of aquatic chemical reactions water pollution laws and standards.

Books Recommended:

1. Green Chemistry: An Introductory Text, Mike Lancaster, Royal Society of Chemicals, Cambridge,

2. Green Chemistry: Frontiers in Benign Chemical Synthesis and Processes, Edited by Paul T. Anastas & Tracy C. Williamson, Oxford University Press.

3. Green Chemical Syntheses and Processes: Edited by Paul T. Anastas, Lauren G. Heine & Tracy C. Williamson, ACS Symposium Series.

4. Green Chemistry: Environment Friendly Alternatives, Edited by Rashmi Sanghi, M. M. Srivastava, Narosa Publishing House, New Delhi.

5. Green Chemistry: Microwave Synthesis, K. R. Desai, Himalaya Publishing House.

6. Green Chemistry: A Teaching Resource, Dorothy Warren, Royal Society of Chemicals, 2001.

7. Green Chemistry: Williams, Charlotte.

8. Environmental Chemistry, S. E. Manahan, Lewis Publishers.

9. Environmental Chemistry, Sharma & Kaur, Krishna Publishers.

10. Environmental Chemistry, A. K. De, Wiley Eastern.

11. Environmental Pollution Analysis, S.M. Khopkar, Wiley Eastern

12. Standard Method of Chemical Analysis, F.J. Welcher Vol. Ill, Van Nostrand Reinhold Co.

13. Environmental Toxicology, Ed. J. Rose, Gordon and Breach Science Publication.

14. Elemental Analysis of Airborne Particles, Ed. S. Landsberger and M. Creatchman, Gordon and Breach Science Publication.

15. Environmental Chemistry, C. Baird, W. H. Freeman.

SEMESTER-II
M 2 CHE 05-CP 03 (Core Practical-3) Credits 4; Time 8h

M.M. 80 marks (External)
20 marks (Internal)

1. Water Analysis - (minimum -5)

Water analysis for hardness, BOD, COD, DO, available Chlorine, Fluoride and Iron.

Note: Some exercise to be added

SEMESTER-II
M 2 CHE 06-CP 04 (Core practical-4) Credits 4; Time 8h

M.M. 80 marks (External)
20 marks (Internal)

1. Distribution law

I. Complex formation between copper sulphate and ammonia

II. Equilibrium constant of the reaction between iodine and potassium iodide

2. Conductometry – (minimum -4)

I. Determine the equivalent conductance at infinite dilution for acetic acid by applying Kohlrausch's law of independent migration of ions.

II. Determination of velocity constant and order of the reaction for saponification of ethyl acetate by sodium hydroxide conductometrically.

III. Study the stepwise neutralization of a polybasic acid e.g. oxalic acid, citric acid, succinic acid by conductometric titration and explain the variation in the plots.

IV. Study the estimation of potassium sulphate solution by conductometric titration. Titrate a mixture of copper sulphate, acetic acid and sulphuric acid with Sodium hydroxide.

1. Quantitative Analysis (minimum -2)

I. Determination of equivalent weight of an acid by silver salt method

II. Estimation of phenol/ aniline using Bromate-Bromide solution or by acetylation method

III. Estimation of glucose by titration using Fehling's solution/ Benedict solution

IV. Estimation of carbonyl group by using 2, 4-dinitrophenylhydrazine.

2. Analysis of oils and fats (minimum -2)

I. Determination of saponification value of oil.

II. Determination of iodine value of oil.

III. Determination of acid value of oil.

3. Chromatography of amino acids and carbohydrates:

I. Separation of components by TLC

II. Separation of components by adsorption paper chromatography

SEMESTER-III
M 3 CHE 01-CT 09
Advanced Spectroscopic Techniques

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Mass Spectrometry: Introduction, ion production - El, Cl, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement. Retro Diel-Alder reaction, Nitrogen rule. High resolution mass spectrometery. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

UNIT II

Nuclear Magnetic Resonance Spectroscopy: General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (second order spectra), virtual coupling. Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with dihedral angle. Simplification of complex spectra-nuclear magnetic double resonance, contact shift reagents, solvent effects. Fourier transform technique, nuclear Overhauser effect (NOE). Resonance of other nuclei-^{19}F, ^{31}P.

Carbon-13 NMR Spectroscopy: General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants.

Two dimension NMR Spectroscopy - COSY, NOESY, DEPT, INEPT, APT and INADEQUATE techniques.

UNIT III

Electron Spin Resonance Spectroscopy: Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron) including biological systems and inorganic free radicals such as PH_4, F_2 and $[BH_3]$.

UNIT IV

X-ray Diffraction: Bragg condition, -Miller indices, Laue method, Bragg method, Debye-Scherer method of X-ray structural analysis of crystals, index reflections identification of unit cells from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem. Description of the procedure for an X-ray structure analysis, absolute configuration of molecules, Ramchandran diagram.

Electron Diffraction: Scattering intensity vs. scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules. Low energy electron diffraction and structure of surfaces. Neutron Diffraction: Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cell.

UNIT V

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

Books Recommended:

1. Physical Methods for Chemistry, R.S. Drago, Saunders Company.

2. Structural Methods in Inorganic Chemistry, E. A. V. Ebsworth, D.W.H. Rankin and S. Cradock, ELBS

3. Infrared and Raman Spectra: Inorganic and Coordination Compounds, K. Nakamoto, Wiley.

4. Progress in Inorganic Chemistry vol., 8, ed., F.A. Cotton, vol., 15, ed. S.J. Lippard, Wiley.

5. Transition Metal Chemistry edi R.L. Carlin vol. 3, Dekker

6. Inorganic Electronic Spectroscopy, A.P.B. Lever, Elsevier.

7. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Norwood.

8. Practical NMR Spectroscopy, M.L. Martin, J.J. Delpeuch and G.J. Martin, Heyden.

9. Spectrometric Identification of Organic Compounds, R. M. Silverstein, G. C. Bassler and T. C. Morrill, John Wiley

10. Introduction to NMR Spectroscopy, R. J. Abraham, J. Fisher and P. Loftus, Wiley.

11. Application of Spectroscopy of Organic Compounds, J. R. Dyer, Prentice Hall.

12. Spectroscopic Methods in Organic Chemistry, D. H. Williams, I. Fleming, Tata McGraw-Hill.

13. Modern Spectroscopy, J.M. Hollas, John Wiley.

14. Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windawi and F.L. Ho, Wiley Interscience.

15. NMR, NQR, EPR and Msssbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.

16. Physical Methods in Chemistry, R.S. Drago, Saunders College.

17. Chemical Applications of Group Theory, F. A. Cotton.

18. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.

19. Basic Principles of Spectroscopy, R. Chang, McGraw Hill.

20. Theory and Applications of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBH-Oxford.

21. Introduction to Photoelectron Spectroscopy, P. K. Ghosh, John Wiley.

22. Introduction to Magnetic Resonance, A Carrington and A.D. Maclachalan, Harper & Row.

SEMESTER-III
M 3 CHE 02-CT 10
Bioinorganic, Bioorganic and Biophysical Chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT I

Metal Ions in Biological Systems

Essential and trace metals. Na/K^+ Pump, Role of metals ions in biological processes.

Electron transfer in biology: Structure and functions of electron transfer proteins, Cytochromes and respiratory chain, iron sulphur proteins rubredoxin and ferridoxins.

Photosynthetic pigments: Photosynthesis, Chlorophyll molecule, Photosystem-I and Photosystem-II.

UNIT II

Transport and Storage of Dioxygen: Heme proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, hemocyanins and hemerythrin, model synthetic complexes of iron, cobalt and copper.

UNIT III

Enzyme and Mechanism of Enzyme Action: Introduction of enzymes, enzyme action, Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chymotrypsin, ribonuclease, lysozyme and carboxypeptidase A.

UNIT IV

Co -Enzyme Chemistry: Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate,

pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipoic acid, vitamin B12. Mechanisms of reactions catalyzed by the above cofactors

UNIT V

Bioenergetics: Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP, muscular contraction and energy generation in mechanochemical system.

Cell Membrane and Transport of Ions: Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport. Nerve conduction.

Books recommended:

1. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-Verlag.

2. Understanding Enzymes, Trevor Palmer, Prentice Hall.

3. Enzyme Chemistry: Impact and Applications, Ed. Collin J Suckling, Chapman and Hall.

4. Enzyme Mechanisms Ed, M. I. Page and A. Williams, Royal Society of Chemistry.

5. Fundamentals of Enzymology, N.C. Price and L. Stevens, Oxford University Press.

6. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael D. Trevan, John Wiley.

7. Enzymatic Reaction Mechanisms, C. Walsh, W. H. Freeman.

8. Enzyme Structure and Mechanism, A Fersht, W.H. Freeman.

9. Biochemistry: The Chemical Reactions of Living Cells, D. E. Metzler, Academic Press. Principles of Biochemistry, A. L. Lehninger, Worth Publishers.

10. Biochemistry, L.Stryer, W.H.Freeman.

11. Biochemistry, J. David Rawn, Neil Patterson.

12. Biochemistry, Voet and Voet, John Wiley.

13. Supramolecular and Bioinorganic Chemistry, Rekha Dashora and A. K. Goswami, Pragati Prakashan.

14. Outlines of Biochemistry, E. E. Conn and P. K. Stumpf, John Wiley.

15. Macromolecules: Structure and Function, F. Wold, Prentice Hall.

16. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.

17. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.

18. Inorganic Biochemistry volume I and II. ed. G.L. Eichhorn, Elsevier.

19 .Progress in Inorganic Chemistry, Volume 18 and 38 ed. J.J. Lippard, Wiley.

SEMESTE R-III
M 3 CHE 03 DT 11 A
Coordination Chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Isomerism of Coordination Compounds: Isomerism's and stereochemistry, Classification of isomers. Study of constitutional and configurational isomerism.

UNIT-II

Optical activity of coordination compounds, symmetry requirements for optical activity, study of ORD, circular dichroism, cotton effect with special reference to complexes of Cr, Co, Ni and Pt.

UNIT-III

Magnetic properties of coordination compounds, paramagnetism, ferromagnetism and anti-ferromagnetism, effect of temperature, measurements of magnetic susceptibility.

UNIT-IV

Inorganic Photochemistry- Ligand field excited state, charge transfer excited state, ligand to metal, metal to ligand, charge transfer to solvent, tetra ligand state, metal to metal state, the xi state and DOSENCO state.

Photochemical reactions of coordination compounds- Chromium (III) complex, Cobalt (III) complexes, Radium (III) complexes, complex of transition elements.

UNIT-V

Mixed ligand complexes: Stabilities of ternary complexes, Dyna—of formation of terneryu complexes Reaction of coordinationed ligand in ternary complexes.

Books Recommended :

1. Principle and Applications of Organotransition Metal Chemsitry, J.P. Coliman, L.S Hegsdus, J.R. Norton and R.G. Finke, University Science Books.

2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree, John Wiley.

3. Metallo-Organic Chemistry, A.J. Pearson, Wiley

4. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books

5. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lipparad and J.S Valentine, University, Science Books

6. Inorganic Biochemistry Volume I and II. Ed G.L. Eichhorn, Elsevier

7. Progress in Inorganic Chemistry, Volume 18 and 38 Ed. J.J. Lipparad, Wiley

SEMESTER
M 3 CHE 04 DT 12 A
Advanced Bio-inorganic chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Fundamentals of inorganic biochemistry, geo-chemical effects on life systems essential and non-essential elements in bio-systems, Role of alkali/alkaline earth metals in bio-systems. Role of 3d block elements and non-metals in bio-systems.

UNIT –II

Role of metal ions in oxygen carriers and synthetic oxygen carriers. Designing of chelating agents and metal chelates as medicines. Fixation of dinitrogen biologically and abiologically, biotransformation of nonmetallic inorganic compounds.

UNIT-III

Environmental bioinorganic chemistry: Metal ions as probes for locating active sites. Anti-oxidants. Metal ions as antioxidants, metal ion enhancing catalytic activity of enzymes (Biocatalysts). Inhibitions as competitive and non-competitive metals and metalloproteins. Metal complexes of polynucleotides, nucleosides and nucleic acids (DNA & RNA) Template temperature, stability of DNA.

UNIT-IV

Role of metal ions in replication and transcription process of nucleic acids, Biochemistry of dioxygen, bioinorganic chips and biosensors. Biochemistry of calcium as hormonal messenger, muscle contraction blood clotting neurotransmitter, calcification reclaiming of barren land.

UNIT-V

Metals in the regulation of biochemical events. transport and storage of metal ions in vivo. Metal complexes as probes of structure and reactivity with metal substitution. Fundamentals of Toxicity and Detoxification, Nuclear medicines.

Books Recommended:

1. Supramolecular and Bioinorganic chemistry, Rekha Dashora and A. K. Goswami, Pragati Prakashan.

SEMESTER-III
M 3 CHE 03 DT 11 B
Modern Interfaces of Organic Chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Selective organic name reactions: Hoffmann-Loffer-Fretag reaction, chichibabin reaction, Sharpless, asymmetric epoxidation, Barton reaction, ene reactions, Stork enamine reaction, Aldol, Perkin, Stobbe, Dieckmann, Condensation, Michael addition, Mannich reaction.

UNIT-II

Disconnection approach: Elementary idea of disconnection, an introduction to synthons, synthetic equivalents, functional group one and two group C-x & C-C disconnection). Interconversions, Chemoselectivity, Diels-Alder reaction, 1,3-and 1,5 difunctionalised compounds, α, β-unsaturated carbonyl compounds, Michael reaction, Robinson annelation.

Protecting group: Principle of protection of hydroxy, amine and carbonyl groups

UNIT-III

Oxidation: Introduction, different oxidative processes, hydrocarbons (alkenes aromatic rings, activated and inactivated saturated C - H groups), alcohols, diols aldehydes, ketones, ketals and carboxylic acids, singlet oxygen, ruthenium tetroxide and Tl (III) nitrate as oxidizing agent, Provost reaction, Wacker's process Barbier-Wieland degradation

UNIT-IV

Reduction: Introduction, different reductive processes, hydrocarbons (cyclo alkanes, alkenes, conjugated system, alkynes and aromatic rings), carbonyl compounds, nitro, azo and oxime compounds, hydrogenolysis, reductions using Wilkinson's catalyst, Meerwein –Pondrof - Verley reduction.

UNIT-V

Applications of the following in the organic synthesis: Phase transfer catalysts, polymer supported reagents, Biocatalysts, microwave and ultrasound induced reactions.

Chemistry of fullerenes: Structure bonding physical and chemical properties, compounds of fullerenes.

Books Recommended:

1. Modern Synthetic Reactions, H.O. House, W.A Benjamin

2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.

3. Principles of Organic Synthesis, R.O.C Norman and J.M. Coxon, Blackie Academic & Professional

4. Advanced Organic Chemistry, F.A Carey and R.J. Sundberg.

5. The Disconnection Approach- An art of organic synthesis, Suresh Ameta and P. B. Punjabi, Sadguru Publications, Udaipur.

6. Organic Synthesis-Concept, Methods and Starting Materials, J. Fuhmop and G. Penzillin

7. Guide Book to Organic Synthesis, R.K. Mackie & D.M. Smith, ELBS.

8. Organic Synthesis, V.K. Ahuwalia and Renu Agarwal, Narosa

9. Synthesis, Approaches in Organic Chemistry, R.K. Bansal, Narosa

10. Advanced Organic Chemistry -Reactions, Mechanism and Structure, Jerry March, John Wiley.

SEMESTER III
M 3 CHE 04 DT 12 B
Chemistry of Heterocyclic Compounds

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Nomenclature of heterocycles: Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic, fused and bridged heterocyclic.

Aromatic heterocycles: General Chemical behaviour of aromatic heterocyclic, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in 1H-NMR spectra. Empirical resonance energy, delocalization energy, Dewar resonance energy and diamagnetic susceptibility exaltations).

UNIT-II

Small ring heterocycles: Three membered heterocycles with one and two heteroatoms synthetic methods, physical, spectroscopic and chemical properties of aziridines, oxiranes, Thiiranes, diaziridines, diazirines, oxaziridines. Four membered heterocyclic compounds synthetic methods, physical, spectroscopic and chemical properties of azetines, azetidines, oxetanes, thietanes and their carbonyl derivatives.

UNIT-III

Benzo-fused five membered heterocycles: Synthetic methods, physical and chemical properties of benzopyrroles, benzofuranes and benzothiophenes.

Six-membered heterocycles: Synthetic methods, physical and chemical properties of pyrilium salts, pyrones, quinolizinium salts, pyridazines, pyrimidines, pyrazines, acridines and phenanthridines, diazines and triazines

UNIT-IV

Seven and large membered heterocycles: Synthetic methods, physical and chemical properties of azepines, oxepines, thiepines and diazepins.

UNIT-V

Meso-ionic heterocycles: Synthetic methods, properties of 1,3-oxazolium-4-olates, 1,3-oxathiolium-4-olates, 1,3-diazolium-4-olates, 1, 2, 3,-oxadiazolium-5-olates and 1, 2-diathiolium-4-olates.

Books Recommended-

1. Heterocyclic Chemistry, R.R Gupta, M. Kumar and V. Gupta, Springer Verlag.

2. The Chemsitry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.

3. Heterocyclic Chemistry, R. K. Bansal, New Age International Publishers.

4. Heterocyclic Chemistry, J.A Joule, K. Mills and G.F. Smith Chapman and Hall

5. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Technical

6. An Introduction to the Hetrocyclic Compounds, R. M. Acheson, John Wiley.

7. Comprehensive Heterocyclic Chemistry, A.R Kartritzky and C.W Rees.

8. Stereoselective Synthesis: A Practical Approach, M. Nogradi

SEMESTER-III
M 3 CHE 03 DT 11 C
Chemical Kinetics

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Methods for determining rate of reaction, reaction mechanism and rate law.

Principles of reactivity: Significance of entropy, enthalpy and Gibb's free energy, Arrhenius equation, uses of activation parameters, nature of activation barrier in chemical reaction

UNIT II

Structure effect on rate: Linear free energy relationship, Hammett equation, substitution constants, theories of substituent effect, interpretation of σ values and reaction constant ρ, deviation from Hammett equation, the Taft model, σ_I and σ_R scales, steric acceleration, molecular measurements of steric effect upon rates.

UNIT-III

Solvation and solvent effect on rate: Factors affecting reaction rate in solution, effect of solvation on reaction rate, solvent effect on ion - ion, ion – dipole and dipole – dipole reactions, and preliminary idea about diffusion - controlled reactions.

UNIT-IV

Electron transfer processes in solution: Inner-sphere, outer sphere, bridged transition states, Marcus theory and its modifications, one equivalents and two equivalent exchange reactions, reactions of solvated electron with metal ions.

Kinetic isotope effect: Theory of isotope effects, primary and secondary kinetic effect, heavy atom isotope effect, tunneling effect, solvent isotope effect.

UNIT-V

Reaction on surfaces: Adsorption isotherm, structure of solid surface and adsorbed layers, mechanism of surface reactions, unimolecular and bimolecular surface reactions, transition state theory of surface reactions, surface chemistry in industrial processes.

Gas phase reaction: Hydrogen-oxygen reaction, combustion of hydrocarbons decomposition of N_2O_5 and acetaldehyde, Gold, Finger- Lettort –Niclause rule and inhibition mechanism.

Books Recommended:

1. Surface activity and Detergency, K. Durham, Ed. Mc Millan.

2. Emulsion and Foams, S. Berkman and G. Egloff, Reinhold.

3. Surface Chemistry, J. B. Bikeman, Academic

4. Chemical Kinetics, K. J. Laidler

5. Chemical Kinetics and Mechanism, A. A Frost and R.G. Pearson

SEMESTER-III
M 3 CHE 04 DT 12 C
Nuclear and Radiochemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT I

Stability of the nucleus, Mass Energy relationship for nuclear reactions, Properties of nucleus, Nuclear Models (The shell model, the liquid drop model, the Fermi gas model, the collective model and the optical model)

UNIT II

Nuclear reactions: Specific nuclear reactions, photonuclear reactions and thermonuclear reactions, Interaction of radiation with matter; passage of neutrons through matter;

UNIT III

Measurement of Radiation: Counting techniques, Radiation Detectors

Gas ionization detectors- Principle, ion chamber- proportional counter, G M counter Scintillation Detector- Principle, features, Inorganic and organic Scintillators, Solid state detectors,

UNIT IV

Radiochemical principles and uses of tracers: Reaction mechanism, structure determination, Surface area of a powder

UNIT V

Neutron activation analysis, Isotope dilution analysis, radiometric titration,

Applications in chemical investigations and synthesis in physiochemical analysis, in age determination and in prospecting of natural resources

Books Suggested:

1. Source Book of atomic Energy, Glasstone, East West Edition

2. Essentials of Nuclear chemistry, H. J. Arniker

3. Introduction to Nuclear Science, M. W. Sarton, West East Edition

4. Theory of Nuclear Structure, M. K. Pal, East West Edition

SEMESTER-III
M 3 CHE 03 DT 11 D
Fundamentals of Analytical Chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Basic tools and operations of analytical chemistry- Role of analytical chemistry, types of analysis, analysis methods, classical and instrumental, selecting an analytical method, laboratory operations and practices , Analytical balance, volumetric glass wares, calibration of glassware, sample dissolution and decomposition , selecting and handling of reagents, preparation of solution of analytic. Laboratory safety measurements.

UNIT-II

Data Handling in analytical chemistry: Accuracy and precision, central value and its measurement, errors, determinant and indeterminant errors. Standard derivation. Reporting analytical data, Statistical evaluation of data significant figure and its rounding off. Test of significance, rejecting of a result Q-test.

UNIT-III

Use of spreadsheets in analytical chemistry: Spreadsheets and their use, control charts, Statistics for small data sets, linear least square method, plotting right standard straight line, correction coefficient and coefficient of determination. Use of spreadsheet for plotting calibration, --- slops and intercepts and coefficient of determination LINSET for additional statics

UNIT-IV

Environmental sampling and qualitative analysis: Getting a meaningful sample, air sample collection and qualitative analysis, water sample collection and qualitative analysis, soil sample sediment sample. Sample preparation for trace organic contaminated land sites, EPA (Environmental protection agencies)- methods and performance based analysis.

UNIT-V

Thermal methods of analysis- Thermometric titration, thermogravimatric analysis, Activation analysis.

SEMESTER-III
M 3 CHE 04 DT 12 D
Modern analytical methods

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Electrochemical methods of analysis: Electrochemical reduction and oxidation, electrode materials, cathode materials, Polarisable and non Polarisable electrodes. Theory of electrochemical oxidations and reductions possible path for electroreduction reactions, Conductometry and high frequency titrations

UNIT- II

Refractometric and interferometric: Principle of refractometric, perameters influencing refrection, significance of critical angle during measurement, refractometer, Qualitative and quantitative analysis

Interferometer: Principle and application

UNIT- III

Chemiluminiscence, Atomic fluorescence and ionization spectroscopy- luminescence, Chemiluminiscence, measurement of Chemiluminiscence quantitative analysis thermoluminescence titrations, chemiluminiscence of liquids, electro Chemiluminiscence,

Atomic fluorescence principle and applications instruments for Atomic fluorescence, ionization spectroscopy, laser enhanced ionization spectroscopy.

UNIT-IV

Chemical sensor/biosensor: Classification of sensors, sensitivity and limits of detection, signal and noise, significance of sensors. Electrochemical sensors, Gas sensor, voltametric sensor, solid

state electrode sensor, optical sensor, thermal sensor, bio sensor, bio catalytic bio sensor, mass sensitive sensor, efficiency of sensor

UNIT – V

Flow Injection analysis: Characteristics of physical parameters of a flow injection analysis system, Single line FIA spectrometric determination of chloride, three line FIA spectrometric determination of phosphate.

Books recommended:

1. Vogels textbook of quantitative analysis, sixth edition, Pearson education.

2. Analytical chemistry, 7^{th} edition by Skoog, West and Holler, Harcourt college publishers

3. Quantitative chemical Analysis, Eighth edition by Daniel C. Harris, Publish by Clany Marshall

SEMESTER-III

M 3 CHE 05 CP 05 (Core practical-5) Credits 4; Time 8h

M.M. 80 marks (External)
20 marks (Internal)

1. Inorganic preparation (minimum -10)

I. $Na[Cr(NH_3)_2(SCN)_4]$

II. $Mn(acac)_3$

III. $K_3[Fe(C_2O_4)_3]$

IV. Prussian Blue, Turnbull's Blue.

V. $Co[(NH_3)_6][NO_2]_6$

VI. Cis-$[Co(trien)(NO_2)_2]Cl.H_2O$

VII. $Hg[Co(SCN)_4]$

VIII. $[Co(Py)_2Cl_2]$

IX. $[Ni(NH_3)_6]Cl_2$

X. $Ni\ (dmg)_2$

XI. $[Cu(NH_3)_4]SO_4.H_2O$

XII. $VO(acac)_2$ $TiO(C_9H_8NO)_2.{}_2H_2O$

XIII. Cis-$K[Cr(C_2O_4)_2(H_2O)_2]$

2. Spectral problems- (Minimum -15)

Identification of organic and inorganic compounds by the analysis of their spectral data (UV, NMR, IR and Mass)

3. Titrimetric estimation of drugs: (minimum 3)

Paracetamol, Ascorbic acid, Aspirin, Sulpha drugs, Benzocaine etc.

SEMESTER-III

M 3 CHE 06 EP 06 A Credits 4; Time 8 h

DSE-1 (Inorganic Chemistry)

M.M. 80 marks (External)
20 marks (Internal)

1. Quantitative analysis I (Minimum-5)

Volumetric determination of two components (binary) mixture containing any two of the following;

I. Copper and Zinc

II. Tin and Lead

III. Lead and Cadmium

IV. Tin and Cadmium

V. Chromium and Iron

VI. Calcium and Magnesium, etc.

2. Quantitative analysis II (minimum-4)

Volumetric determination of ores and alloys such as dolomite, pyrolusite, marble solder, brass, Zinc Sludge etc.

3. Spectrophotometry II (minimum-4)

I. Study of Complex formation by Jobs, Mole ratio and slope ratio method

II. Stability constant by Bjerrum's method.

III. Stability constant by Turner-Anderson method

4. Chromatographic separations

I. Cadmium and zinc

II. Zinc and magnesium

III. Thin layer chromatography; Separation of nickel, manganese, cobalt and zinc,

a. Determinations of R_f values.

IV. Separation and identification of the sugars present in the given mixture of

a. glucose, fructose and sucrose by the paper chromatography and determination of R_f values

5. Magnetochemistry (one exercise) -

I. Determination of magnetic susceptibility and moment by Gouy's method.

SEMESTER-III

M 3 CHE 06 EP 06 B **Credits 4; Time 8h**

DSE-2 (Organic Chemistry)

M.M. 80 marks (External)
20 marks (Internal)

1. Qualitative Analysis (Minimum-5)

Separation, Purification and identification of compounds in a ternary mixture of three organic compounds (three solids or two solids one liquid), Separation by ether, $NaHCO_3$, dil NaOH, Preparation of their suitable derivatives wherever possible

2. Organic Synthesis (Minimum-3)

The exercise should illustrate the use of organic reagents and may involve purification of the products by Chromatoghraphic technique

I. Photochemical Reaction

II. Benzophenone- Benzpinacol- Benzpinacolone

III. Beckmann Rearrangement-

Benzopheone- Benzophenone Oxime- Benzanilide- Benzoic Acid Acetophenone- Acetophenone Oxime- Acetanilide- p- Nitroacetanilide, p-Bromoacetanilide

IV. Hoffmann and Sandmeyer Reaction

Phthalic anhydride- Phthalimide- Anthranilic acid- o-Chlorobenzoic acid Benzillic Acid Rearrangement Benzoin- Benzil- Benzilic Acid

3. Spectrophotometric Estimation (Minimum-4)

I. Amino Acids

II. Proteins

III. Carbohydrates

IV. Cholesterol

V. Ascorbic Acid

VI. Aspirin

VII. Caffeine

SEMESTER-III
M 3 CHE 06 EP 06 C **Credits 4; Time 8 h**
DSE-3 (Physical Chemistry)

M.M. 80 marks (External)
20 marks (Internal)

1. Chemical Kinetics

I. Study the reaction between potassium persulphate and potassium iodide and find out the order of reaction also effect of Temperature and Concentration of salt.

II. Study the kinetics of reaction between glycolic acid and cerric ammonium sulphate and find out the order of reaction with respect to cerric ammonium sulphate and glycolic acid and find out effect of Temperature and Concentration of salt.

III. Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide (the kinetics of an iodine clock reaction.)

2. Potentiometry

I. Determination of the valency of mercurous ions potentiometrically

II. Determine the strength of strong and weak acids in a given mixture using a potentiometer/pH meter

III. Determination of the dissociation constant of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH.

IV. Determination of the dissociation constant of monobasic or dibasic acid.

V. Determine the dissociation constant of acetic acid potentiometrically.

VI. Titrate a mixture of strong acid (hydrochloric acid) and dibasic acid (oxalic acid) versus sodium hydroxide.

VII. Titrate a solution of Mohr's salt against potassium permanganate/potassium dichromate potentiometrically.

VIII. Titrate potentiometrically solutions of mixture of KCl + KBr + KI and determine the composition of each component

IX. Determination of the formation constant of copper - ammonia complex and stoichiometry of the complex potentiometrically

X. Determination of activity and activity coefficient of electrolytes

Semester III

M 3 CHE 06 EP 06 D **Credits 4; Time 8h**

DSE-4 (Analytical chemistry)

M.M. 80 marks (External)
20 marks (Internal)

1. Estimation of Ca, Na and K by Flame photometry

2. Separation of amino acids by ion exchange and chromatographic method

3. Analysis of oils and fats and determine saponification value and iodine values

4. Determination of fats, protein and solid in milk

5. Polarimetric estimation of sugar

6. Analysis of HCl extract of fusion with Na_2CO_3 for Al, Fe, Ca, Mg, P and K

7. Analysis of fertilizers

8. Estimation of lead and tin in solder or bismuth, cadmium and lead in low melting alloys such as Woods metal using EDTA (Volumetrically)

9. Analysis of German silver (copper, zinc and nickel).

Books recommended:

1. Experiments in chemistry by D.V. Jahagirdar, Himalaya Publishing House

2. Instrumental Methods of Chemical Analysis B. K. Sharma

Semester IV
M 4 CHE 01 CT 11
Special Methods of Analysis

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

(a)**Thermo Gravimetry Analysis (TGA) and Derivative.** Thermogravimetry (DTG): Principle, instrumentation and application, factor affecting TG curves,

(b) **Differential Thermal Analysis (DTA):** Principle, instrumentation and application, factor affecting TA curves

(c) **Differential Scanning Calorimeter (DSC):** Principle, instrumentation and application, factor affecting DC curves, comparison with DTA.

UNIT-II

(a) **D.C.Polarography:** Basic principle, types of currents, experimental technique, Illovic equation (no derivation) and application of polarography

(b) Principle, technique and application of

(i) Voltametric and cyclic voltametery

(ii) Amperometry

(iii) Anodic stripping voltametery

UNIT-III

(a) **High Performance Liquid Chromatography (HPLC):** Introductory knowledge of adsorption basic principle, instrumentation and applications of HPLC, comparison with gas liquid chromatography

(b) **Gas Liquid Chromatography:** Principle, instrumentation and applications

(c) **Gel Permeation or Size Exclusion Chromatography:** Introduction, theory and application

UNIT-IV

(a) **Ion Exchange:** Introduction, types-cationic, anionic, chelating and liquid ion exchangers, preparation, action and properties of exchangers and applications of ion exchangers

(b) Solvent Extraction, ion association complexes

(c) **Gel Electrophoresis:** Introduction, Factors affecting ionic migration, detection of separated components and applications of Gel electrophoresis.

UNIT-V

(a) **Radioactive Technique:** Tracer technique, neutron activation analysis, counting technique such Geiger-Muller, ionization and proportional counters

(b) **Light Scattering Techniques:** Principle, instrumentation and applications of nephelometery and Raman spectroscopy.

Books recommended:

1. Ion exchange separations in Analytical Chemistry. O.Samuelson, John Wiley

2. Exchangers amd Solvent Extractions, J.A.Marinsky and Y.Parcus, Marcel Dekker

3. Polagraphic Techniques, I.Metes, Interscience

4. Gel Chromatography, Tibor Kremmer and Laszol Boross, Wiley.

Semester IV
M 4 CHE 02-CT 12
Photochemistry and Supramolecules

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Basic of Photochemistry: Photochemical laws, quantum yield, electronic excitation and molecular orbital view of excitation, excited states and fate of excited molecules (modified Jablonski diagram).

Photochemistry of alkenes: Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1, 4-and1, 5-dienes.

UNIT-II

Photochemistry of carbonyl compounds: Intramolecular reactions of carbonyl compounds - saturated, cyclic and acyclic, β, γ- unsaturated and α,β-unsaturated compounds, cyclohexadienones, intermolecular cycloaddition reactions- dimerisations and oxetane formation.

Photochemistry of aromatic compounds: Isomerisations, additions and substitutions.

Unit III

Miscellaneous Photochemical Reactions: Photo-Fries reactions of anilides. Photo Fries rearrangement, Barton reaction, Hoffmann-Loeffler-Freytag reaction, Singlet molecular oxygen reactions, Photochemical formation of smog, Photo degradation of polymers, Photochemistry of vision.

UNIT-IV

Supramolecular Chemistry: Concepts: Definition and development, nature of supramolecular interactions, Cation binding hosts: Crown ethers, cryptands and spherands - synthesis and properties, binding of anions: biological anion receptors and organometallic receptors, Templates

and selfassembly-tennis balls and soft balls, catenanes and rotaxanes, Supramolecular chemistry of Fullerene, fullerene as guests, fullerene as hosts and fullerene as superconducting intercalation compounds, supramolecular photochemistry.

UNIT-V

Nanochemistry

Introduction, Synthesis of nanomaterials: Chemical methods. Dendrimers. Nanostructured materials: Carbon Nanotubes (CNTs) : Single walled carbon nanotubes (SWNTs), Multiwalled carbon nanotubes (MWNTs), Graphenes. Characterization techniques for Nanomaterials: Optical Microscopy: Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Scanning tunnel microscopy (STM).

Books Recommended:

1. Photochemistry, J.G.Cavert and J.N.Pitts, Wiley

2. Molecular Photochemistry, N.J.Turro, Benjamin

3. Fundamentals of Photochemistry, K.K. Rohatgi Mukherji, New Age

4. Photochemistry, R.P. Wayne, Butterworth

5. Analytical Chemistry of Macrocyclic and Supramolecular compounds, S.M. Khopkar

6. Supramolecular Chemistry, J.M. Lehn VCH

7. Supramolecular Chemistry, J.W Stead and J.I. Atwood, John Wiley. G. Timp, Ed. Nanotechnology: Springer-Verlag: N.Y. (1999)

8. Nanochemistry, G.B. Sergeev, Elsevier (2006)

9. Supramolecular and Bioinorganic Chemistry, Rekha Dashora and A. K. Goswami, Pragati Prakashan.

SEMESTER IV
M 4 CHE 03 DT 13 A
Organometallic Chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Introduction

Classification and Nomenclature and general Characteristics of Organometallic Compounds

UNIT-II

Organometallic Compounds of transition metals- Introduction and nature of bonding, α bonded Organometallics, π bonded Organometallics

UNIT-III

Fluxional organometallic compounds: Classification of fluxional organometallic Compounds, Some simple example of non-rigid molecule in different coordination geometries.

UNIT-IV

Synthetic and catalytic aspects of Organometallic Chemistry: General Introduction, Transition metal organometallics as catalytic and synthetic reagents

UNIT-V

Biological application and environmental aspect of organometallic compounds: Organometallics in medicine, Organometallics in Industry, Environmental aspects of Organometallic Compounds.

Books Recommended:

1. Principle and Applications of Organotransition Metal Chemsitry, J.P. Coliman, L.S Hegsdus, J.R. Norton and R.G. Finke, University Science Books.

2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree, John Wiley.

3. Metallo-Organic Chemistry, A.J. Pearson, Wiley

4. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books

5. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lipparad and J.S Valentine, University, Science Books

6. Inorganic Biochemistry Volume I and II. Ed G.L. Eichhorn, Elsevier

7. Progress in Inorganic Chemistry, Volume 18 and 38 Ed. J.J. Lipparad, Wiley

SEMESTER-IV
M 4 CHE 04 DT 14 A
Inorganic polymers

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Inorganic polymers: Introduction, Classification, Preparation, General Characteristics of Inorganic Polymers.

UNIT II

Silicon Polymers: General preparation, properties and application of silazanes, polysilazanes, organo-siloxy and poly-carbosilanes

UNIT III

Phosphorus nitrogen polymers: Synthesis and important properties of organometallic polyphosphazenes, Liquid crystalline high refractive index polyphosphazenes, poly carbophosphazenes, polynitrophosphazenes

UNIT IV

Metal chelate polymers and Ferrocenes: Synthetic methods, linking of ligands with metal ions, Reactions with chelates containing fluxional groups, Synthesis of Ferrocenes containing polyamides and polyurea polymers

UNIT V

Applications of Phosphorous, Nitrogen, Silicon and Ferrocene as well as other metal chelate polymers in industry such as advanced elastomers and biomedical materials.

SEMESTER-IV
M 4 CHE 03 DT 13 B
Medicinal Chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT I

Drug Design: Development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, structure-activity relationship (SAR), factors affecting bioactivity, resonance, inductive effect, isosterism, bio-isosterism, spatial considerations. Theories of drug activity- occupancy theory, rate theory, induced fit theory. Elementary idea of Quantitative structure activity relationship, Concepts of drug receptors. Elementary treatment of drug receptor interactions. Physico-chemical parameters: lipophilicity, partition coefficient, electronic ionization constants, steric, Free-Wilson analysis, Hansch analysis, LD-50, ED-50 (Mathematical derivations of equations excluded).

UNIT II

Pharmacokinetics: Introduction to drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetic parameters in defining drug disposition and in therapeutics. Mention of uses of pharmacokinetics in drug development process.

Pharmacodynamics: Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, sulphonamides, membrane active drugs, drug metabolism, xenobiotics, biotransformation, significance of drug metabolism in medicinal chemistry.

UNIT III

Antineoplastic Agents: Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors.

Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards, and 6-mercaptopurine. Recent development in cancer chemotherapy. Hormone and natural products.

Cardiovascular Drugs: Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function, central intervention of cardiovascular output. Direct acting arteriolar dilators. Synthesis of amyl nitrate, sorbitrate, diltiazem, quinidine, verapamil, methyldopa, atenolol, oxyprenolol.

UNIT IV

Local Antiinfective Drugs: Introduction and general mode of action. Synthesis of sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, norfloxacin, dapsone, amino salicylic acid, isoniazid, ethionamide, ethambutal, flucanazole, econozole, griseofulvin, chloroquin and primaquin. Antibiotics Cell wall biosynthesis, inhibitors, (3-lactam rings, antibiotics inhibiting protein synthesis. Synthesis of penicillin G, penicillin V, ampicillin, amoxycillin, chloramphenicol, cephalosporin, tetracyclin and streptomycin.

UNIT V

Psychoactive Drugs (The Chemotherapy of Mind): Introduction, neurotransmitters, CNS depressants, general anaesthetics, mode of action of hypnotics, sedatives, anti-anxiety drugs, benzodiazipines, buspirone, neurochemistry of mental diseases. Antipsychotic drugs - the neuroleptics, antidepressants, butyrophenones, serendipity and drug development, stereochemical aspects of psychotropic drugs. Synthesis of diazepam, oxazepam, chlorazepam, alprazolam, phenytoin, ethosuximde, trimethadione, barbiturates, thiopental sodium, glutethimide

Books Recommended:

1. Introduction to Medicinal Chemistry, A Gringuage, Wiley-VCH.

2. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed Robert F. Dorge.

3. An Introduction to Drug Design, S. S. Pandeya and J. R. Dimmock, New Age International.

4. Burger's Medicinal Chemistry and Drug Discovery, Vol-1 (Chapter-9 and Ch-14), Ed. M. E. Wolff, John Wiley.

5. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.

6. The Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press.

7. Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley.

SEMESTER
M 4 CHE 04 DT 14 B
Chemistry of Natural Products

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Terpenoids and carotenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule, structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules - Citral, Geraniol, α-Terpineol, Menthol, Farnesol, Zingiberene,Santonin, Phytol, Abietic acid and β-Carotene

UNIT-II

Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants, structure, stereochemistry, synthesis and biosynthesis of following - Ephedrine, (+) - Coniine, Nicotine, Atropine, Quinine and Morphine.

UNIT-III

Plant pigments: Occurrence, nomenclature and general methods of structure determination, isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7, arabinoside, Cyanidin and Hirsutidin.

Biosynthesis of flavonoids: acetate pathway and shikimic acid pathway.

Porphyrins: Structure and synthesis of hemoglobin and chlorophyll.

UNIT-IV

Steroids: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry, isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone, biosynthesis of steroids.

UNIT-V

Prostaglandins: Occurrence, nomenclature, classification, biogenesis and physiological effects, synthesis of PGE_2 and $PGF_{2\alpha}$

Pyrethroids and Rotenones: Synthesis and reactions of pyrethrodis and rotenones.

Books Recommended-

1. New Trends in Natural Products Chemistry, Atta-ur-Rahman and M.I. Choudhary.

2. Chemistry of Natural Products, S.N. Bhat

3. Organic Chemistry Vol.-II, I.L. Finar

SEMESTER-IV
M 4 CHE 03 DT 13 C
Advanced Photochemistry and Radiation Chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT-I

Photochemistry: Molecular photochemistry: An overview: Transitions between states (Chemical, classical and quantum dynamics, vibronic states). Potential energy surfaces; transitions between potential energy surfaces, The Franck-Condon Principle and radiative transitions. A classical model of radiative transitions. The absorption and emission of light - state mixing, spin-orbit coupling and spin forbidden radiative transitions, absorption complexes, delayed fluorescence and phosphorescence.

UNIT-II

Photophysical radiation less transitions: Wave mechanical interpretation of radiationless transitions between state factors that influence the rate of vibrational relaxation. Energy transfer: Theory of radiation less energy transfer, energy transfer by electron exchange: An overlap or collision mechanism. The role of energetic in energy transfer mechanism. Diffusion controlled quenching. The Perrin formulation. Triplet- triplet, triplet-singlet, singlet-triplet energy transfer. Multiphoton energy transfer processes, reversible energy transfer.

UNIT-III

Radiation Chemistry: An overview, G-value. The mechanism of interaction of high energy radiation with matter, Photoelectric effect, Compton effect, Pair production, total absorption co-efficient, excitation and ionization, Stopping power and linear energy transfer.

UNIT-IV

Radiation dosimetry: Radiation dose and its measurement, standard free air chamber method, chemical dosimeter (Frick's Dosimeter). Short lived intermediates (ions, excited molecules, free radicals: Various mechanisms of their formation and energy transfer processes).

UNIT-V

Flash photolysis: Principle and its applications. Radiolysis of water and aqueous solutions. Radiolysis of molecules of biological interest (carbohydrates, amino acids, peptides, and nucleic acids).

Books Recommended:

1. Turro, N. J. Modern Molecular Photochemistry Univ. Science Books (1991).

2. Gilbert, A. & Baggot, J. Essentials of Molecular Photochemistry Blackwell Scientific (1990)

3. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press (2006).

4. McQuarrie, D. A. & Simon, J. D. Physical Chemistry: A Molecular Approach 3rd Ed., Univ. Science Books (2001).

SEMESTER-IV
M 4 CHE 04 DT 14 C
Solid State Chemistry

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT I

General principles and experimental procedures to study solid state reactions

Difference between reactions in solution, gaseous and solid state phase

UNIT II

Crystal Defects-perfect and imperfect crystals, intrinsic and extrinsic defect, point defects, line and plane defects, Thermodynamics of Schottky and Frenkel defect formation, color centers.

UNIT III

Electronic Properties and Band Theory of metals, insulators and semiconductors, band theory of solids (qualitative treatments), band structure of metals, insulators and semiconductors, p-n junctions

UNIT IV

Superconductors, magnetic properties, persistent current and BCS theory of Superconductors,

Optical properties- photoconduction

UNIT V

Magnetic Properties: Classification of materials, Magnetic domains, hysteresius loop.

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

Books Recommended:

1. Solid State Chemistry and its Applications, A. R. West, Plenum.

2. Principles of the Solid State, H. V. Keer, Wiley Eastern.

3. Solid State Chemistry, N. B. Hannay.

4. Solid State Chemistry, D. K. Chakrabarty, New Age International

SEMESTER-IV
M 4 CHE 03 DT 13 D
Analytical Techniques

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT- I

Food analysis: Reason for analysis of food, analysis of moisture in food materials, analysis of ash, crude fibers, fats, proteins and carbohydrates in food. analysis of calcium and sodium, adult erants and contaminants in food, microscopic examination of food, extraction, purification and estimation of pesticides samples in food by HPLC, TLC for chlorinated pesticides in food products, gel chromatic analysis of food products for orgnophosforos

UNIT-II

Cement: Introduction raw material for cement, Portland cement, weathering of cement and concrete, other types of cement, chemical admixture of concrete, analysis of constituents of cement by various methodology

UNIT-III

Analysis of polymers: Introduction, types of polymers and their uses, chemical analysis of polymers spectroscopic methods for polymer analysis X-ray diffraction analysis, microscopy, thermal analysis of polymers, physical testing of polymers

UNIT-IV

Electrogravimetric analysis: Principles involving electrogravimetric analysis, current voltage relationship during electrolysis, effect of experimental variables, anodic deposition, instrumentations electrolysis at constant current principle and instrumentation, estimation of copper and cobalt by constant current electrolysis, electrolysis at constant potential, principle instruments and application determination copper lead and tin in brass sample by control potential method, electrolysis using mercury electrode principle and application.

UNIT-V

Voltametry: Principle and application of voltametric analysis, Amperometric analysis

SEMESTER-IV
M 4 CHE 04 DT 14 D
Applied Analytical Methods

Time: 3 Hrs. **M.M. 80 marks (External)**
20 marks (Internal)
Credits = 4

UNIT- I

Soil analysis: Introduction, type of soils, analysis of moisture, determination of pH, total nitrogen, phosphorous, silica, magnesium, manganese, lime, sulphur and salts in soil. Quantitative estimation

UNIT-II

Analysis of water pollutants: Water pollution, water pollutants, origin and source of water pollutions effect of water pollutants, Analysis of water, colour turbidity, TDS, total solids, conductivity, acidity/ alkalinity and hardness, Chloride, sulphate and fluoride in water, analysis of silica phosphate and heavy metals pollutants in water. Determination of DO, BOD, COD

Separation and estimation of herbicides as water pollutants, water quality standards, drinking water standards

UNIT-III

Fuel analysis

Fuels types and classifications, solid, liquid and gaseous fuels, producer gas, natural gas, calorific value of fuel, analysis of coal, proximate analysis, ultimate analysis, grading of coal, aniline point, flash point and free point, octane number and its significance

UNIT-IV

Clinical analysis:

Composition of blood, collection and preservation of samples immunoassay principal of radioimmunoassay (RIA) and its applications serum electrolytes, test for carbohydrates, blood glucose blood urea uric acid blood urea nitrogen total serum proteins, serum albumin, non-protein nitrogen (serum creatinine), serum phosphate, alkaline phosphatase, bilirubin, serum cholesterol, trace elements in body

UNIT-V

Drug analysis: Introduction, sources of drugs, dangerous drug, narcotics, classification of drugs, assay of drugs, drug screening by gas chromatography, thin layer chromatography of drugs, analysis of drugs by spectrophotometric methods

Books recommended:

1. Analytical Chemistry by Gurdeep R. Chatwal, Himalaya Publishing House

2. Analytical chemistry, 6^{th} edition by Gary D. Christian, Wiley student Edition.

3. Analytical Chemistry by S.M. Khopkar, New Age International.

SEMESTER-IV

M 4 CHE 05 CP 06 Credits 4; Time 8h

(Polymer synthesis, Extraction of natural products and coal analysis)

(Core Practical -6)

M.M. 80 marks (External)
20 marks (Internal)

1. Extraction of organic compounds from natural sources (Minimum-5)

I. Isolation of caffeine from tea leaves.

II. Isolation of casein from milk (the students are required to try some typical colour reactions of proteins).

III. Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and R_f value reported).

IV. Isolation of nicotine dipicrate from tobacco.

V. Isolation of piperine from black pepper.

VI. Isolation of lycopene from tomato.

2. Polymer synthesis (Minimum-5*)*

I. Preparation of Urea formaldehyde

II. Preparation of Phenol formaldehyde resins

III. Preparation of Thiol rubber

IV. Preparation of Condensation polymer

V. Preparation of Epoxy resin

VI. Preparation of Polymerisation of acrylonitrile

VII. Preparation of Solution polymerization of vinyl acetate

VIII. Preparation of free radical polymer

3. Coal Analysis

I. Moisture contents/Volatile matter-C-Coal Analysis

II. Ash contents

III. Fixed carbon

SEMESTER-IV
M 4 CHE 06 EP 06 A Credits 4; Time 8h

DSE-5 (Inorganic Chemistry)

M.M. 80 marks (External)
20 marks (Internal)

1. Quantitative analysis by Spectrophotometry (minimum-4)

I. Iron/Manganese/Chromium/Vanadium in steel sample by spectrophotometric method

II. Nickel/Molybdenum/Tungsten/Vanadium/Uranium by extractive spectrophotometric method.

III. Fluoride/Nitrite/Phosphate.

IV. Barium/Sulphate by turbidimetric method

2. Quantitative analysis I (one)

I. Volumetric determination of three components (ternary) mixture from synthetic mixture, Ores and minerals, Alloys like German Silver, Cement etc.

II. Simultaneous estimation of Cr(III) and Fe(III) by EDTA titration, Ca^{+2} and Zn^{+2} , Pb^{+2} and Mg^{+2}

3. Solvent extraction (any one)

I. Uranyl nitrate from thorium nitrates with the help of tributyl phosphate

II. Separation of metal from a mixture

III. Study of the solvent extraction of Hg and Al with 8-hydroxyquinoline.

4. Atomic absorption Spectroscopy (any one)

I. Determination of components of Soil, Cement and industrial wastes etc.

5. Study of thermal properties (two)

I. Interpretation of TGA,DTA,DSC etc curves

SEMESTER-IV

M 4 CHE 06 EP 06 B Credits 4; Time 8 h

DSE-6 (Organic Chemistry)

M.M. 80 marks (External)
20 marks (Internal)

1. **Quantitative Analysis**

I. To estimate the percentage of Nitrogen in the given organic sample by Kjeldahl's method.

II. To estimate Halogen in the given sample by Alkaline Reduction method (Modified Stepenow method).

III. To estimate the percentage of Sulfur in the given organic sample by Messenger's method.

2. Synthesis of Organic Compounds

I. Fisher- Indole Synthesis-

Preparation of 2-phenylindole or 2-methylindole or 1, 2, 3, 4-tetrahydro carbazole

II. Enzymatic Reduction-

Reduction of ethyl acetoacetate using Baker's yeast to yield enantiomeric excess of S(+) ethyl-3-hydroxy butanoate and to determine its optical purity.

III. Synthesis using microwaves- Benzoic acid, Chalcones, Coumarin, synthesis of simple heterocyclic compound

IV. Synthesis using phase transfer catalyst-Alkylation of diethyl malonate or ethyl acetoacetate with alky halides.

V. Diels Alder reaction

VI. Ultrasound assisted reaction- Esterification, saponification

3. Miscellanous experiments

I. Estimation of glycine (Sorensons method)

II. Estimation of formaldehyde

III. Estimation of cane sugar

SEMESTER-IV

M 4 CHE 06 EP 06 C **Credits 4; Time 8h**

DSE-7 (Physical Chemistry)

M.M. 80 marks (External)
20 marks (Internal)

1. Surface Tension

I. Determination of atomic Parachor value of Hydrogen, Carbon and Oxygen

II. To study surface tension-concentration relationship for solutions (Gibb's equation)

III. Compare different commercial available detergents by surface tension study.

2. Spectrophotometry

I. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture by the MLRA method.

II. Determine the dissociation constant of an indicator spectrophotometrically.

III. Study the kinetics of reaction between acetone and iodine in presence of acid.

IV. Record the U.V. spectrum of a given compound (acetone) in cyclohexane

A. Assign the transitions by recording spectra in solvents of different polarities (H_2O, CH_3OH, $CHCl_3$, CH_3CN and 1, 4-dioxane). Comment on the energy of hydrogen bonding.

B. Calculate the energy involved in the electronic transition in different units, i.e.cm^{-1}, Joules/mol, cal/mol. & eV.

C. Calculate the oscillator strength/ transition probability.

3. Phase equilibrium

I. Determination of congruent composition and temperature of a binary system (e.g. diphenylamine-benzophenone system).

II. Determination of glass transition temperature of a given salt (e.g $CaCl_2$) conductometrically.

SEMESTER-IV

M 4 CHE 06 EP 06 D Credits 4; Time 8h

DSE-8 (Analytical Chemistry)

M.M. 80 marks (External)
20 marks (Internal)

1. Determination of Ca, Mo, Zn, Cu, phosphate and silica contents of soil samples

2. Analysis of sludge obtained from Zinc Smelter

3. Analysis of cement

4. Determination of water in mixture by Karl-Fisher method

5. Colorimetric estimation of fluoride, Fe in drinking waters

6. Analysis of aspirin, sulpha drugs and vitamin C

7. Potentiometric estimation of Ni, Zn, etc.

8. Analysis of Lime, Brass and gun metal

9. Estimation of soluble salts in soils by conductometric method

10. Separation and identification of most common acidic and basic drugs by TLC

Books recommended:

1. Instrumental Methods of analysis, 7^{th} edition, CBS Publishers and distributors

2. Instrumental Methods of chemical analysis, 3^{rd} edition by Galen W. Ewing, International student edition.

3. Principles and practice of Analytical chemistry by F.W. Fifield and D. kealey, Blackwell Publishing.

Skill Based Course- 1

Title of the course - Green methods in chemistry

Tools of Green chemistry, twelve principles of Green chemistry, with examples.

The following Real world Cases in Green Chemistry should be discussed:

1. A green synthesis of ibuprofen which creates less waste and fewer byproducts (Atom economy)

2. Surfactants for Carbon Dioxide – replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments.

3. Environmentally safe antifoulant

4. CO_2 as an environmentally friendly blowing agent for the polystyrene foam sheet packaging market.

5. Using a catalyst to improve the delignifying (bleaching) activity of hydrogen peroxide.

6. A new generation of environmentally advanced preservative: getting the chromium and arsenic out of pressure treated wood.

7. Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments.

8. Development of a fully recyclable carpet: cradle to cradle carpeting.

List of experiments (minimum 10)

1. Preparation of acetanilide

2. Synthesis of dibenzalpropanone

3. Bromination of *trans*-stilbene

4. Diels-Alder reaction between furan and maleic acid

5. Benzil-Benzilic acid rearrangement

6. Thiamine hydrochloride catalyzed synthesis of benzoin

7. Clay catalyzed solid state synthesis of 7-hydroxy-4-methylcoumarin

8. Nitration of phenol

9. Bromination of acetanilide

10. Photoreduction of benzophenone to benzopinacol

11. Preparation of benzopinacolone

12. Rearrangement of diazoaminobenzene to *p*-aminoazobenzene

13. Preparation of 1, 1-bis-2-naphthol

14. Synthesis of adipic acid

15. Synthesis of dihydropyrimidinone

16. Microwave-assisted ammonium formate-mediated Knoevenagel reaction

17. Preparation of Manganese (III) acetylacetonate, $Mn(acac)_3$ or $Mn(C_5H_7O_2)_3$

18. Preparation of Iron (III) acetylacetonate, $Fe(acac)_3$ or $Fe\ (C_5H_7O_2)_3$

19. Synthesis of tetrabutylammonium tribromide (TBATB)

20. Preparation of ionic liquid, [pmlm]Br

21. Preparation of 2- phenylbenzothiazoles catalyzed by ionic liquid, [pmlm]Br

Reference Books:

1. Green Chemistry Experiments A Monograph, R. K. Sharma, Indu Tucker and Mihir K. Chaudhuri, Tucker Prakashan, New Delhi.

2. Manahan S.E. (2005) Environmental Chemistry, CRC Press

3. Miller, G.T. (2006) Environmental Science 11^{th} edition. Brooks/cole

4. Mishra A. (2005) Environmental Studies. Selective and Scientific Books, New

5. Green chemistry: Fundamentals and Applications, Suresh C. Ameta and Rakshit Ameta, Apple Academic Press

Skill Based Course- 2

Title of the course - Basic analytical chemistry

Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Concepts of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

List of experiments (minimum 10):

Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titration, Chelation, Chelating agents, use of indicators.

a. Determination of pH of soil samples.

b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

a. Determination of pH, acidity and alkalinity of a water sample.

b. Determination of dissolved oygen (DO) of a water sample.

Analysis of food products: Nutritional value of foods, idea about food processing and food preservation and adulteration.

a. Identification of adulterants in some common food items like coffee powder, asafetida, chilli powder, turmeric powder, coriander powder and pulses, etc.

b. Analysis of preservatives and colouring matter.

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

a. Paper chromatographic separation of mixture of metal ion(Fe^{+3} and Al^{+3})

b. To compare paint samples by TLC method.

Ion exchange: Column, ion-exchange chromatography etc.

Determination of ion exchange capacity of anion/cation resin (using batch procedure if use of column is not feasible)

Analysis of cosmetics: Major and minor constituents and their function

a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.

b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

Suggested Applications (Any one):

a. To study the use of phenolphthalein in trap cases.

b. To analyze arson accelerants

c. To carry out analysis of gasoline.

Suggested Instrumental demonstrations:

a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.

b. Spectrophotometric determination of Iron in Vitamin/Dietary Tablets

c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in soft Drink.

References books:

1. Willard, H.H. *Instrumental Methods of Analysis*, CBS publishers.
2. Skoog & Leery. *Instrumental Methods of Analysis*, Sanders College publications, New York.

3. Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry* 6th *Ed.* Saunders College Publishing, Fort worth (1992).

4. Harris, D.C. *Quantitative Chemicals* Analysis, W.H. Freeman.

5. Dean, J.A. *Analytical Chemistry*, Notebook, McGraw Hill

6. Day, R. A. & Underwood, A.L. *Quantitative Analysis*, Prentice Hall of India.

7. Freifelder, D. Physical Biochemistry 2nd *Ed*., W.H. Freeman and Co., N.Y. USA (1982).

8. Cooper, T.G. *The Tools of Biochemistry*, John Wiley and Sons, N.Y. USA. 16 (19770.

9. Vogel, A.I. Vogel's *Qualitative Inorganic Analysis* 7th *Ed*., Prentice Hall.

10. Vogel A.I. Vogel's *Quantitative Chemical Analysis* 6th *Ed*., Prentice Hall.

11. Robinson, J.W. *Undergraduate Instrumental Analysis* 5th *ED*. Marcel Dekker, Inc., New York (1995).

Skill Based Course- 3

Title of the course - Basics in pharmaceutical chemistry

Drugs and Pharmaceuticals:

Drug discovery, Design and development; Basic retrosynthetic approach. Synthesis of the representative drugs of the following classes; analgesic agents, antipyrectic agents, anti-inflammatory agents(aspirin, paracetamol, ibruprofen); antibiotics (chloramphenicol); antibacterial and antifungal agents (sulphonamide; sulphanethoxazol, sulphacetamide, trimethoprin); antiviral agent (acyclovir), central nervous system agent (Phenobarbital, diazepam), cardiovascular (glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT-Zidovudine).

Fermentation

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) antibiotics; penicillin, Cephalosporin, chloromycetin and streptomycin, (iii) Lysin, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

List of experiments (minimum 2 from each group I/II/III/IV, maximum 10):

I. To carry out the identification tests with the following pharamaceutical aids:

1. Ammounium Chloride (expectorant diuretic)
2. Boric acid (anti-infective)
3. Calamine (mild astringent)
4. Magnesium Sulfate (Cathartic)
5. Zinc Oxide (astringent soothing)

6. Potassium Permanganate (protective)

7. Iodine

II. To carry out the quantitative analysis of following agents- (assay)

(as per I.P.)

1. Aspirin

2. Paracetamol

3. Isoniaziol

4. Borax

5. Ascorbic acid

III. To determine the % purity of following drugs through spectroscopy

1. Aspirin (colorimetry)

2. Paracetamol (calibration curve method)

3. Ibuprofen

IV. To synthesize following medicinal compounds:

1. Aspirin

2. Sulphonamides

3. Acetaminophen

Refrences:

Pharmacopoea of India 2007