GONDWANA UNIVERSITY, GADCHIROLI

Syllabus

for

Master of Science (M.Sc.III & IV)

Chemistry

Based on NEP – 2020

(with effect from 2024-25)

Board of Studies in Chemistry

Faculty: Science and Technology

Gondwana University, Gadchiroli

NEP 2020 P.G. PROGRAMME SESSION 2024-25
Faculty of Science and Technology
Program Name - M.Sc. Sem-III (CHEMISTRY) GUG ST PG CHE 03

Sr. No.	Course Category	Subject name	Tot. Credit	Teaching Scheme (Hrs)			Examination Scheme									Tot Marks
							Theory					Practical				
				Th.	Pract	Tot. Hrs.	UA	CA	Total Mark	Min. Pas	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min. Pas	
1	Major	STPG03CHE01 (Special - I Org./ Inorg. / Phy. / Anal. Chemistry)	04	04	--	04	80	20	100	40	03	--	--	--	--	100
2		STPG03CHE02 (Special - II Org./ Inorg./ Phy./ Anal. Chemistry)	04	04	--	04	80	20	100	40	03	--	--	--	--	100
3		STPG03CHE03 Paper III (Spectroscopy - I)	04	04	--	04	80	20	100	40	03	--	--	--	--	100
4		STPG03CHE08 Practical (Based on Major)	02	-	04	04	-	-	-	-	-	30	20	50	25	50
5	Major (Elective)	STPG03CHE04 Paper IV (Polymer Chemistry - I) or	02	02	--	02	40	10	50	20	02	--	--	--	--	50
		STPG03CHE05 Paper IV (Medicinal Chemistry - I) or														
		STPG03CHE06 Paper IV (Nuclear Chemistry – I) or														
		STPG03CHE07 Paper IV (Appl. Analytical – I)														
6		STPG03CHE09 Practical	02	-	04	04	-	-	-	-	-	30	20	50	25	50
7		**STPG03CHE10** Paper V (Research Project phase – I)	04	--	08	08	--	--	--	--	--	60	40	100	50	100
Total			22	14	16	26	280	70	350	-	-	120	80	200	100	550

Gondwana University, Gadchiroli

NEP 2020 P.G. PROGRAMME SESSION 2024-25
Faculty of Science and Technology
Program Name - M.Sc. Sem-IV (CHEMISTRY) GUG ST PG CHE IV

Sr. No.	Course Category	Subject name	Tot. Credit	Teaching Scheme (Hrs)			Examination Scheme									Tot Marks
							Theory					Practical				
				Th.	Pract	Tot. Hrs.	UA	CA	Total Mark	Min. Pas	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min. Pas	
1	Major	**STPG04CHE01** Paper I (Special - III Org./ Inorg. / Phy. / Anal. Chemistry)	04	04	--	04	80	20	100	40	03	--	--	--	--	100
2		**STPG04CHE02** Paper II (Special - IV Org./ Inorg. / Phy. / Anal. Chemistry)	04	04	--	04	80	20	100	40	03	--	--	--	--	100
3		**STPG03CHE07 Practical III**	02		04	04	--	--	--	--	--	30	20	50	25	50
4		**STPG03CHE08 Practical IV**	02	-	04	04	-	-	-	-	-	30	20	50	25	50
5	Major (Elective)	**STPG03CHE03 Paper IV (Polymer Chemistry - II) or**	04	04	--	04	80	20	100	20	02	--	--	--	--	100
		STPG03CHE04 Paper IV (Medicinal Chemistry - II) or														
		STPG03CHE05 Paper IV (Nuclear Chemistry –II) or														
		STPG03CHE06 Paper IV (Appl. Analytical – II)														
7		**STPG03CHE08** Paper IV (Research Project phase – II)	06	--	12	12	--	--	--	--	--	90	60	150	75	100
Total			22	12	20	32	240	60	300	-	-	150	100	250	120	550

General scheme for distribution of marks in practical examination

Time : 6-8 h (One day Examination) Total Marks : 50)

1) Any two experiments of 10 marks each	**20**
2) Viva Voce of 5 marks	**05**
3) Record Completion 5 marks	**05**
Total	**30**
Practical Internal 20 marks	
1) practical attendance	**15**
2) Practical writing regularity and Check	**05**
Total	**20**

Question Paper Pattern: paper comprising of Max marks 80 of 3 hours duration

Que.-1 (From Unit I) – (A-8 Marks + B-8 Marks) = 16 Marks or (a-4 + b-4 + c-4 + d-4) = 16 Marks
Que.-2 (From Unit II) – (A-8 Marks + B-8 Marks) = 16 Marks or (a-4 + b-4 + c-4 + d-4) = 16Marks
Que.-3 (From Unit III) – (A-8 Marks + B-8 Marks) = 16 Marks or (a-4 + b-4 + c-4 + d-4) = 16Marks
Que.-4 (From Unit IV) – (A-8 Marks + B-8 Marks) = 16 Marks or (a-4 + b-4 + c-4 + d-4) = 16Marks
Que.-5 Short answer question each carry two marks (10 short ques.s from 04 units) = 16 marks
(Out of 10 any 08) Total: 80 marks

Question Paper Pattern: paper comprising of Max marks 40 of 2 hours duration

Que.-1 (From Unit I) – (A-4 Marks + B-4 Marks) = 08 Marks **or** (a-2 + b-2 + c-2 + d-2) = 08 Marks
Que.-2 (From Unit II) – (A-4 Marks + B-4 Marks) = 08 Marks or (a-2 + b-2 + c-2 + d-2) = 08Marks
Que.-3 (From Unit III) – (A-4 Marks + B-4 Marks) = 08 Marks or (a-2 + b-2 + c-2 + d-2) = 08Marks
Que.-4 (From Unit IV) – (A-4 Marks + B-4 Marks) = 08 Marks or (a-2 + b-2 + c-2 + d-2) = 08Marks
Que.-5 Short answer question each carry 01 marks (10 short questions from 04 units)= 08 marks
(Out of 10 any 08) Total: 40 marks

Syllabus – NEP, M.Sc. Semester – III

STPG03CHE01 Major DSC – Paper – I, (Special – I Organic Chemistry)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60 h (4 h per week): 15 h per unit

Unit – 1 15 h

Photochemistry

Interaction of radiation with matter, types of excitation, rate of excited molecules, quenching, Quantum efficiency, quantum yield, transfer of excitation energy, actinometry, singlet and triplet states, experimental methods in photochemistry of carbonyl compounds, and transition, Norrish type I and Norrish type II reactions Paterno–Buchi reaction, Photoreduction, Photochemistry of enones, Hydrogen abstraction rearrangement of unsaturated ketones and cyclohexadienones, Photochemistry of parabenzoquinones, Photochemistry of Aromatic compounds with reference to isomerisation addition and substitution Photochemical isomerization of cis and trans alkenes, Photochemical cyclization of reaction, Photo-Fries rearrangement, Photo theory reaction of anilides Barton reaction, Hoffmann-Loefler-Freytag reaction, photochemistry of vision, Applications of photochemical methods in synthesis: Isocumene, Cedrene, Hirsutene.

Unit – 2 15 h

A) Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1, 3, 5-hexatriene, allyl system, classification of pericyclic reaction. FMO approach, Woodward-Hoffman correlation diagram method and Peturbation of molecular orbital (PMO) approach of pericyclic reaction under thermal and photochemical conditions Electrocyclic reactions, conrotatary and disrotatary motion 4n and (4n+2) systems, with more emphasis on [2+2] and [4+2] Cycloaddition of ketones Secondary effects in [4+2] cycloaddition. Stereochemical effects and effect of substituents on rate of cycloaddition reaction, Diels-Alder reaction, 1,3-dipolarcycloaddition and chelotropic reaction. Sigmotropic rearrangement, suprafacial, and antarafacial shift involving carbon moieties, retention and inversion of configuration, [3,3] and [3,5] sigmotropic rearrangements, Claisen, Cope, Sommelet-Hauser rearrangements, Ene reaction.

Unit 3 15 h

A] Oxidation

a) Oxidation of alkanes, aromatic hydrocarbons and alkenes, Dehydrogenation with S, Se, Fremy's salt, DDQ, chloranil and $PhI(OAc)_2$, Oxidation with SeO_2, Epoxidation of olefins, Synthetic application of epoxides, Sharpless asymmetric epoxidation, Dihydroxylation of olefins using $KMnO_4$, OsO_4, Woodward and Prevost dihydroxylation, Oxidative cleavage of olefins, Ozonolysis.

b) Oxidation of alcohols: Chromium reagents, pyridinium chlorochromate (PCC), pyridinium dichromate (PDC), Collin and Jones reagent, Combination of DMSO with DCC, $(COCl)_2$, NCS and $(CH_3CO)_2O$ for oxidation of alcohols, Oxidation with MnO_2, Oppenauer oxidation.

c) Oxidation of aldehydes and ketones, Conversion of ketones to α, β-unsaturated ketones and α-hydroxy ketones, Baeyer-Villiger oxidation, Chemistry and synthetic applications of $Pb(OAc)_4$, Dess-Martin periiodinane, IBX.

B] Reduction

a) Catalytic heterogeneous and homogeneous hydrogenation, Hydrogenation of alkenes, alkynes and arenes, Selectivity of reduction, Mechanism and stereochemistry of reduction, Raney Ni-catalyst, Adam catalyst, Lindlar catalyst, Wilkinson catalyst.

b) Reduction by dissolving metals, Reduction of carbonyl compounds, conjugated systems, aromatic compounds and alkynes. Birch reduction, Hydrogenolysis.

c) Reduction by hydride transfer reagents, Meerwein-Pondorff-Verley reduction, Reduction with $LiAlH_4$ and NaBH4, stereochemical aspects of hydride addition, Derivatives of $LiAlH_4$ and $NaBH_4$, Selectivity issues, Diisobutylaluminium hydride (DIBAL-H), Sodium cyanoborohydride,

Reduction with boranes and derivatives Reduction with Bu3SnH., Enzyme catalyzed reduction,

Reduction of carbonyl group to methylene, Reduction with diimide and trialkylsilanes.

Unit – IV 15 h

Chemistry of P, S, Si, B, and Ti compounds 15 h

a) Phosphorus and sulphur ylide: Preparation and their synthetic application along with stereochemistry b) Umpolung concept: Dipole inversion, generation of acyl anion, use of 1,3-dithiane, ethylmethylthiomethylsulphoxide, bis-phenylthiomethane, metallated enol ethers, alkylidene dithiane, ketone thioacetals, 2-propenethiobismethyl thioallyl anion, thiamine hydrochloride based generation of acyl anion c) Organoboranes- preparation and properties of organoborane reagents e.g. RBH_2, R_2BH, R_3B, 9-BBN, catechol borane. Thexyl borane, cyclohexyl borane, ICPBH2, IPC2BH, Hydrboration-mechanism, stereo and regeoselectivity, uses in synthesis of primary, secondary tertiary alcohols, aldehydes, ketones, alkenes, Synthesis of EE, EZ, ZZ dienes and alkyenes. Mechanism of addition of IPC_2BH. Allyl boranes-synthesis, mechanism and uses d) Organo silicon compounds in organic synthesis, Me_3SiCl, Me_3SiH and Paterson synthesis e) Synthetic methodologies based on titanium compounds.

List of books

1] Books as suggested in Semester I for organic chemistry
2] Organic Synthesis, The disconnection approach-S. Warren
3] Designing Organic Synthesis-S. Warren
4] Some Modern Methods of Organic Synthesis-W. Carruthers
5] Advance Organic Chemistry Part-B-F. A. Caray and R. J. Sundberg Plenum Press
6] Protective Group in Organic Synthesis-T. W. Greene and PGM
7] The Chemistry of Organo Phosphorous-A. J. Kirbi and S.G. Warren
8] Organo Silicon Compound-C. Eabon
9] Organic Synthesis via Boranes-H. C. Brown
10] Organo Borane Chemistry-T. P. Onak
11] Organic Chemistry of Boron-W. Gerrard
12] Fundamentals of Photochemistry-K. K. Rohatgi-Mukharji, Wiley Eastern Limited
13] Photochemistry-Cundau and Gilbert
14] Aspects of Organic Photochemistry-W. M. Horspoot
15] Photochemistry-J. D. Calvert
16] Photochemistry-R. P. Wayne

STPG03CHE02 Major DSC – Paper – II, (Special – II Organic Chemistry)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60 h (4 h per week): 15 h per unit

Unit-I: 15 h

A] Terpenoids

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-terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-carotene, Vitamin A and H.

B] Porphyrins: Structure and synthesis of Haemoglobin and Chlorophyll.

Unit-II: 15 h

A] 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 the following: Ephedrine, (+)-coniine, Nicotine, Atropine, Quinine, Reserpine and Morphine.

B] Prostaglandins: Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE2 and PGF2α.

Unit-III: 15 h

A] Steroids Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone and Aldosterone. Biosynthesis of steroids

B] Plant Pigments

Occurrence, nomenclature and general methods of structure determination, isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Cyanidin-7-arabinoside, Cyanidin, Hirsutidin. Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway.

Unit IV: 15h

A] Carbohydrate: Types of naturally occurring sugars, deoxy sugars, amino sugars, branched chain sugars, methyl ethers and acid derivatives of sugars, general methods of structure and ring size determination with reference to maltose, lactose, sucrose, starch and cellulose.

B] Amino acids, protein and peptides: Amino acids, structural characteristics, acid base property, stereochemistry of amino acids, optical resolution, Stecker synthesis, peptide and proteins structure of peptide and protein, primary, secondary, tertiary and quaternary structure. Reaction of polypeptide, structure determination of polypeptide, Solid phase peptide synthesis, end group analysis.

List of books

1] Chemistry of Alkloids-S. W. Pelletier
2] Chemistry of Steroids-L. F. Fisher and M. Fisher
3] The Molecules of Nature-J. B. Hendricsion
4] Biogenesis of Natural Compound - Benfield
5] Natural Product Chemistry and Biological Significance- J. Mann, R. S Devison, J. B. Hobbs, D. V. Banthripde and J. B. Horborne
6] Introduction to Flavonoids-B. A. Bohm, Harwood
7] Chemistry of Naturally Occurring Quinines-R. H. Thomson
8] The Systematic Identification of Flavonoids- Marby, Markham, and Thomos
9] Text Book of Organic Medicinal Chemistry-Wilson, Geswold
10] Medicinal Chemistry Vol I and II-Burger
11] Synthetic Organic Chemistry -Gurudeep Chatwal.
12] Organic Chemistry of Natural Products Vol I and II-O. P. Agrawal
13] Organic Chemistry of Natural Products -Gurudeep Chatwal
14] A Textbook of Pharmaceutical Chemistry-Jayshree Ghosh
15] Synthetic Dyes Series -Venkatraman
16] Chemistry Process Industries-Shreve and Brink
17] Principal of Modern Heterocyclic Chemistry-L. A. Paquelte
18] Heterocyclic Chemistry-J. Joule and G. Smith
19] Heterocyclic Chemistry-Morton
20] An Introduction to Chemistry of Heterocyclic Compound-J. B. Acheson
21] Introduction to Medicinal Chemistry-A. Gringuadge
22] Wilson and Gisvold Text Book of Organic Medicinal and Pharmaceutical Chemistry-Ed. Robert F Dorge
23] An Introduction to Drug Design-S. S. Pandey and J. R. Demmock
24] Polymer Science-V. Govarikar
25] Principle of Polymer Chemistry-P. J. Flory
26] An Outline of Polymer Chemistry-James Q. Allen
27] Organic Polymer Chemistry-K. J. Saunders.

STPG03CHE08 - Laboratory – V (Major) (Organic Special)

Credit = 2, Total Marks – 50 (30+20)

[A] Quantitative Analysis

Student is expected to carry out following estimations (minimum 5 estimations.)

1. Estimation of Vitamin C by Iodometry.
2. Estimation of Phenol by KBrO3-KBr.
3. Estimation of Amine by Bromate/ Bromide solution.
4. Estimation of Formaldehyde by Iodometry.
5. Estimation of Glucose by Benedict's solution.
6. Estimation of given carbonyl compound by hydrazone formation.
7. Estimation of Aldehyde by Oxidation method.
8. Determination of percentage of number of hydroxyl group in an organic compound by acetylation method.

[B] Isolation of Organic Compounds from Natural Source (Any five)

a) Isolation of caffeine from tea leaves.
b) Isolation of casein from milk (the students are required to try some typical colour reactions of proteins)
c) Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf value reported.)
d) Isolation of nicotine dipicrate from tobacco
e) Isolation of cinchonine from cinchona bark
f) Isolation of piperine from black pepper
g) Isolation of lycopene from tomatoes
h) Isolation of β-carotene from carrots
i) Isolation of cysteine from hair
j) Isolation of oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid
k) Isolation of eugenol from cloves
l) Isolation of (+) limonine from citrus rinds

[C] QUALITATIVE ANALYSIS

Separation of the components of a mixture of three organic compounds (three solids, two solids and one liquid, two liquids and one solid, all three liquids and identification of any two components using chemical methods or physical techniques. Minimum 10-12 mixtures to be analysed.

STPG03CHE01 Major DSC – (Special – I Inorganic Chemistry)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60 h (4 h per week): 15 h per unit

Unit -I 15h

A) Essential and trace metals in biological systems: Biological functions of inorganic elements, biological ligands for metal ions. Coordination by proteins, Tetrapyrrole ligands and other macrocycle. Influence of excess and deficiency of V, Cr, Mn, Fe, Co, Cu, & Zn. Genetic defects in the absorption of trace elements. Regulation and storage of trace elements. Role of minerals. Toxic effects of metals.

B) Metal storage, transport and biomineralization with respect to Ferritin, Transferrin and Siderophores, Na+ /K+ pump. Role of Ca in transport and regulation in living cells.

C) Medicinal use of metal complexes as antibacterial, anticancer, use of cis-platin as antitumor drug, antibiotics & related compounds. Metal used for diagnosis and chemotherapy with particular reference to anti-cancer drugs.

Unit-II 15h

A) Bio-energetics and ATP cycle: DNA polymerization, metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem II in cleavage of water, Model systems.

B) Electron transfer in Biology: Structure and functions of metalloproteins in electron transfer proteins, cytochromes & Fe-S proteins, Non-heme iron proteins; Rubredoxins, Synthetic models. Biological Nitrogen fixation (in vitro and in vivo)

Unit-III 15h

Transport & Storage of Dioxygen: Heme proteins & oxygen uptake, structure and functions of haemoglobin, myoglobin, hemocyanins & hemerythrin. Perutz mechanism showing structural changes in porphyrin ring system. Oxygenation and deoxygenation. Model compounds. Cyanide poisoning
and treatment. Vanadium storage and transport.

Unit-IV 15h

Metallo enzymes: Apoenzymes, Haloenzyme & Coenzyme. The principle involved and role of various metals ini) Zn-enzyme:- Carboxyl peptidase & Carbonic anhydrase. ii) Fe-enzyme:- Catalase Peroxidase & Cytochrome P-450 iii) Cu-enzyme:-Super Oxide dismutase iv) Molybdenum:-Oxatransferase enzymes, Xanthine oxidase,Co-enzyme Vit.B12, Structure of 6 vitamin B12 Co-C bond cleavage, Mutase activity of co- Enzyme B-12, Alkylation reactions of Methyl Cobalamin. Synthetc model of enzyme action, stability and ageing of enzyme.

List of books

1. Akhmetov, N.: General and Inorganic Chemistry.
2. Aylett, B. and Smith, B.: Problems in Inorganic Chemistry, (English University Press)
3. Bertini, et al: Bioinorganic Chemistry (Viva)
4. Charlot, G and Bezier, D.: Quantitative Inorganic Analysis (johnWiley).
5. Douglas, B. E. McDanirl, D. H. et al: Concept and Models of Inorganic Chemistry (4th edt.) J. Wiley
6. Dutt P. K.: General and Inorganic Chemistry.(Sarat Books House)
7. Fenton, David E.: Biocoordination chemistry, Oxford
8. Jolly, W. L. : Inorganic Chemistry (4th edn.) Addison-Wesley.
9. Katakis, D. and Gordon, G.: Mechanism of Inorganic Reactions.(J.Wiley).

STPG03CHE02 Major DSC, (Special – II Inorganic Chemistry)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

Unit-I 15 h

Crystal Structure of Some Simple Compounds:

i) Ionic Crystals &Their structures, radius ratio rule, effect of polarization on crystals.

ii) Covalent structure type- Sphalerite & Wurtzite.

iii) Geometry of simple crystal AB type: NaCl, CsCl & NiAs, reasons for preference for a particular structure in above AB type of compounds.

iv) AB2 type: Fluorite, antifluorites, Rutile structures. Li2O, Na_2O, $CdCl_2$, CdI_2 structures.

v) Ternary Compounds ABO3 type: Perovskite, Barium titanate, lead titanate, $CaTiO_3$, Tolerance factor, charge neutrality & deviation structures. $FeTiO_3$.

Unit-II 15h

A) AB_2O_4 type- compounds: Normal & inverse,2-3 and 4-2 spinel, packing of oxygen in tetrahedral & octahedral sites, sites occupancy number of site surrounding each oxygen, application of charge neutrality principles, site preferences in spinel, distorted spinel. Hausmannite (Jahn-Teller distortions), Factors causing distortion in spinel.

B) Lattice Defects: Perfect & Imperfect crystals, point defects**,** Interstitial, Schottky defect, Frenkel defect, line defect & other entities, thermodynamics of Schottky & Frankel defects.

Dissociation, theory of dislocation, plane defects- Lineage boundary, grain boundary, stacking fault, 3D defects, Defects & their concentrations, ionic conductivity in solids, Non stoichiometric compounds. Electronic properties of Non-stoichiometric oxides.

Unit-III 15h

Glasses, Ceramics and composite:

Glasses, Ceramics Composites and Nano-materials: Glassy state, glass formers and Glass Modifiers. Glasses, Ceramics, Clay products, Refractories with reference to: preparation, Properties and applications. Microscopic composites, dispersion, strengtheried and particle reinforced, fibre reinforced Composites, microscopic composites, nanocrystaline phase, preparation procedure, special properties and applications.

Unit-IV 15 h

A) Liquid Crystals: Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematics & smectic mesophases; smectic-Nematic transition clearing temperature-homeotropic, planer & schlieren textures twisted nematics, chiral nematics, molecular arrangement in smectic A & smectic C phases, optical properties of liquid crystals. Dielectric susceptibility & dielectric constants. Lyotropic phases & their description of ordering in liquid crystals.

STPG03CHE08 - Laboratory – V (Major) (Inorganic Special)
Credits =2, Total Marks – 50 (30+20).

Instrumental methods and Analytical Techniques:

A) Exercise based on experimental technique-

i) Colorimetry and Spectrophotometry: a) Simultaneous determination of manganese ($KMnO_4$), and Chromium ($K_2Cr_2O_7$) and b) Cobalt and Nickel.

ii) Determination of composition and stability constant of complexes by Job's/continuous variation and mole ratio methods

1. Iron-phenanthroline complex: By Job's method of continuous variation
2. Zirconium-Alizarin Red-S complex: By mole ratio method
3. Copper-Ethylene diamine complex: By slope-ratio method.

iii) PH-metry: stepwise proton-ligand and Metal-ligand stability constant of complexes by Irving Rossotti method.

iv) Polarography: Composition and stability constant of complexes.

v) Flame photometric determination: Na, K and Ca. (Individual or together)

B) Separation and quantitative estimation of binary ant ternary mixture by the use of following separation techniques:

i) Paper and thin layer chromatography
ii) Ion exchange
iii) Solvent extraction
iv) Electrophoretic separation

List of Books

1. Day and Underwood: Quantitative Analysis
2. Vogel A.I: A textbook of quantitative Inorganic analysis, Longman.
3. Flaschka: EDTA Titration
4. Meites and Thomas: Advanced Analytical Chemistry.
5. Ewing,G.W.: Instrumental Methods of Chemical Analysis, McGraw-Hill
6. Drago,R.S: Physical Methods in Inorganic Chemistry
7. Christian G.D.: Analytical Chemistry
8. Khopkar S.M.: Basic Concept of Analytical Chemistry.
9. Kolltath and Ligane: Polarography
10. Braun: Instrumental methods of chemical Analysis
11. Willard, Merritt and Dean: Instrumental methods of Chemical Analysis, Van Nostrand

12. Strouts, Crifillan and Wison: Analytical Chemistry.
13. Skoog S.A.and West D.W.: Fundamental of Analytical Chemistry
14. Dilts R.V.: Analytical Chemistry
15. Jahagirdar D.V.- Experiments in Chemistry
16. Chondhekar T.K.- Systematic Experiments in Physical Chemistry, Rajbog S.W., Anjali Pubn.
17. Wlehov G.J.- Standard methods of Chemical analysis, 6th Ed.
18. Ramesh RandAnbu M,Chemical Methods for Environmenta Analyss: Water and Sedient, Macmillion India.
19. Akhmetov, N.: General and Inorganic Chemistry.
20. Aylett, B. and Smith, B.: Problems in Inorganic Chemistry, (English University Press)
21. Bertini, et al: Bioinorganic Chemistry (Viva)
22. Charlot, G and Bezier, D.: Quantitative Inorganic Analysis (johnWiley).
23. Douglas, B. E. McDanirl, D. H. et al: Concept and Models of Inorganic Chemistry (4th edt.) J. Wiley
24. Dutt P. K.: General and Inorganic Chemistry.(Sarat Books House)
25. Fenton, David E.: Biocoordination chemistry, Oxford
26. Jolly, W. L. : Inorganic Chemistry (4th edn.) Addison-Wesley.
27. Katakis, D. and Gordon, G.: Mechanism of Inorganic Reactions.(J.Wiley).

STPG03CHE01 Major DSC – (Special – I Physical Chemistry)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60h (4h/week) 15h/unit

UNIT I 15h

A] Statistical thermodynamics: Concepts of distribution, thermodynamic probability and most probable distribution, ensemble averaging, postulates of ensemble averaging, canonical grand canonical and micro canonical ensembles, corresponding distribution laws using lagranges method of undetermined *multipliers,* ortho and para hydrogen, principle of equipartition of energy, calculation of average energy

B] Partition function, Translational partition function, rotational partition function, vibrational partition function, electronic partition function, applications of partition functions.

UNIT II 15h

A] Electrode Interfaces: Quantum aspects of charge transfer at electrode-solution interfaces, quantization of charge transfer, tunneling. Semiconductor interfaces: Theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces, effect of light at semiconductor solution interface.

B] Electro catalysis: Comparison of electro catalytic activity, importance of oxygen reduction and hydrogen evolution reactions, and their mechanism, volcanoes.

C] Bio-electrochemistry: Threshold membrane phenomena, Nernst Plank equation, Hodges Huxley equations, core conductor models, electrocardiography.

UNIT III 15h

A] CHEMICAL KINETICS**:** Introduction, complex reactions: reversible, consecutive, concurrent, and branching reactions, free radical and chain reactions, steady state treatment, reaction between H2-Br2(thermal and photochemical),H2-Cl2, decomposition of ethane, acetaldehyde, N2O5, Rice Herzfeld mechanism

B] Fast Reactions: relaxation methods, stopped flow methods, flash photolysis, magnetic resonance method, jump method, relaxation time and numericals.

UNIT IV: 15h

A] Photophysical phenomenon: Introduction, prompt fluorescence, delayed fluorescence, and phosphorescence, fluorescence quenching: concentration quenching, quenching by excimer and exciplex emission, fluorescence resonance energy transfer between photoexcited donor and acceptor systems. Stern-Volmer relation, critical energy transfer distances, energy transfer

efficiency, examples and analytical significance, bimolecular collisions, quenching and Stern-Volmer equation.
B] Photochemical reactions: photoreduction, photooxidation, photodimerization, photochemical substitution, photoisomerization, photosenitisation, chemiluminescence, photochemistry of environment: Green house effect.

List of books:

1. G.M.Panchenkov and V.P.Labadev, — Chemical Kinetics and catalysis‖, MIR Publishing
2. E.A. Moelwyn- Hughes, — Chemical Kinetics and Kinetics of Solutions‖, Academic
3. K.J.Laidler, Chemical Kinetics, Third Edition (1987), Harper and Row, New York
4. J.Raja Ram and J.C.Kuriacose, Kinetics and Mechanism of Chemical Transformations MacMilllan Indian Ltd., New Delhi (1993)
5. 1. J.G. Calvert and J.N. Pitts, Jr., *Photochemistry,* John Wiley and Sons, New York (1966).
6. 2. K. K. Rohtagi-Mukherjee, *Fundamentals of Photochemistry,* New Age International, New Delhi(1986).
7. R. P. Wayne, *Principles and Applications of Photochemistry,* Oxford University Press, Oxford(1988).
8. N. J. Turro, *Modern Molecular Photochemistry,* Univ. Science Books, Sansalito (1991).
9. J. F. L. Lakowicz, *Principles of Fluorescence Spectroscopy,* 2nd Edition (1999), Plenum Publishers, New York.
10. F.W.Sears, — Introduction to Thermodynamics, Kinetic Theory of Gases and statistical mechanics ‖. Addison Wesley
11. M.C.Gupta, Statistical Mechanics
12. Andrew Maczek, *Statistical Thermodynamics,* Oxford University Press Inc., New York (1998).
13. Andrew Maczek, *Statistical Thermodynamics,* Oxford University Press Inc., New York (1998).
14. B.K. Agarwal and M. Eisner, *Statistical Mechanics*, Wiley Eastern, New Delhi (1988).
15. D.A. McQuarrie, *Statistical mechanics*, Harper and Row Publishers, New York (1976).
16. J.O.M.Bokris and A.K.N.Reddy, — Modern Elcrtrochemistry‖. Wiley
17. S. Glasstone, — Introduction to Electrochemistry‖ Affilisated East West.
18. D.R.Crow, — The Principle of electrochemistry‖, Chapman Hall

STPG03CHE02 Major DSC (Special - II Physical Chemistry)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60h (4h/week) 15h/unit

UNIT-I: 15h

A] Radioactive Decay Processes: Alpha decay- penetration of potential barriers, hindered alpha decay, alpha decay energies. Beta Decay- Fermi theory, energy, Curie plots, comparative half-lives, electron capture, selection rules, forbidden transitions, non-conservation of parity, neutrinos. Gamma decay- life-time of excited states.
B] Nuclear Energy: Basic principles of chain-reacting systems, the 4-factor formula, Classification of reactors, Breeder reactor, Reactor associated problems, Reactor safety, Fuel cycle, Re-processing of spent fuel, Nuclear waste management

Unit II: 15h

A] Solid State Reactions: General principle, types of reactions: Additive, structure sensitive, decomposition and phase transition reactions, tarnish reactions, kinetics of solid state reactions, factors affecting the reactivity of solid state reactions. photographic process.
B] Nanoparticles and Nano-structural materials: Introduction, methods of preparation, physical properties, and chemical properties, sol-gel chemistry of metal alkoxide, application of nanoparticles. Nano-porous Materials: Introduction, Zeolites and molecular sieves,

determination of surface acidity, porous lamellar solids, composition-structure, preparation and applications.

UNIT-III: Electrochemistry of Solution 15h

A] Metal/Electrolyte interface : OHP and IHP, potential profile across double layer region, potential difference across electrified interface; Structure of the double layer **:** Helmholtz-Perrin, Gouy Chapman model, Stern, Graham Devanathan- Mottwatts, Tobin, Bockris, Devnathan Models.

B] Over potentials, exchange current density, derivation of Butler Volmer equation under near equilibrium and non-equilibrium conditions, Tafel plot

C] Electrical double lever, theories of double layer, electro-capillary phenomena, electro-capillary curve. Electro-osmosis, electrophoreses. Streaming and Sedimentation potentials. Zeta potentials and its determination by electrophoresis, influence of ions on Zeta potential.

UNIT IV: Irreversible Thermodynamics 15h

Local equilibria, Thermodynamic criteria for non-equilibrium states, generalized flux, forces, phenomenological laws, matter flow and current flow, entropy production and entropy flow for different irreversible reactions (e.g. heat flow, chemical reaction and electrochemical reactions), saxen relations, reciprocity relations, coupled reactions- Onsager theorem of microscopic reversibility, irreversible thermodynamics of biological systems.

List of books:

1. C.N.Rao. Nuclear Chemistry.
2. B. G. Harvey, *Introduction to Nuclear Physics and Chemistry,* Prentice Hall, Inc. (1969).
3. H.J. Arnikar, *Essentials of Nuclear Chemistry*, 4th Edition (1995), Wiely-Eastern Ltd., New Delhi
4. L.V.Azaroff, — Introduction to solids‖, McGraw Hill
5. C.Kittel, —Introduction to solid state Physics‖,Wiley
6. J.O.M.Bokris and A.K.N.Reddy, — Modern Elcrtrochemistry‖. Wiley
7. S. Glasstone, — Introduction to Electrochemistry‖ Affilisated East West.
8. D.R.Crow, — The Principle of electrochemistry‖, Chapman Hall
9. I.Prigoggine, — An Introduction to Thermodynamics of Irreversible Processes,‖ Interscience
10. G. Fridlander, J.W. Kennedy, E.S. Macias and J.M. Miller, Nuclear & Radiochemistry, 3rd Edition (1981) John-Wiley & Sons, New York.

STPG03CHE08 - Laboratory – V (Major) (Physical Special)

Credits =2, Total Marks – 50 (30+20)

9 h /week MarksSolutions:

1. Study the variation of solubility of potassium hydrogen tartarate with ionic strength using a salt having a common ion and hence determine the mean ionic activity coefficients.
2. Determination of partial molar volume of solute and solvent (ethanol-water, methanol-water, KCl-water mixture)
3. Determination of temp. dependence of the solubility of a compound in two solvents having similar intermolecular interactions (benzoic acid in water and DMSO –water mixture) and calculation of the partial molar heat of solution.

Phase equilibrium:

4. To study the effect of addition of an electrolyte such as NaCl, KCl, Na_2SO_4, K_2SO_4 etc. on the solubility of an organic acid (benzoic acid or salicylic acid).
5. To determine the heat of crystallization of CuSO4,5H2O
6. To determine the heat of reaction involving precipitation of a salt BaSO4
7. To determine transition temperature of $CaCl_2$ by thermometric method and to determine transition temperature of $CaCl_2$, sodium bromide by solubility method.

Kinetics:

8. To determine the activation energy of hydrolysis of an ester by acid.

9. Kinetics of reaction between sodium thiosulphate and KI. Determination of rate constant; study of influence of ionic strength
10. Kinetics of decomposition of H2O2 catalysed by iodide ion. Also determination of activation energy of reaction.

Electrochemistry:

11. Estimate the concentration of H2SO4, CH3COOH, CuSO4.5H2O in a given solution by carrying out conductometric titration against NaOH solution.
12. Determine the eq. conductance of strong electrolyte (KCl, NaCl, HCl, KNO3) at several concentration and hence verify Onsager's equation.
13. Carry out the following precipitation titration conductometrically-

a.50 ml.0.02N AgNO3 with 1N HCl
b.50 ml.0.02N AgNO3 with 1N KCl
c. 50 ml 0.004 N MgSO4 with 0.1 N Ba(OH)2
d. 50 ml 0.002 N BaCl2 with 1 N Li2SO4
e. 50 ml.0.02 N BaCl2 with 1N K2SO4

Potentiometry:

14. Determination of redox potential of the couples (Fe2+/Fe3+, Co3+/Co2+, Cr3+/Cr2+, MnO4-/Mn2+) (any two) and equilibrium constant.
15. Study of complex formation by potentiometry e.g. Ag^{+}-$S_2O_3^{2+}$, -, Fe^{3+}-SCN-, Ag^{+} -NH_3(any two) and calculation of stability constant.

STPG03CHE01 Major DSC (Special – I Analytical Chemistry)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20) 60h (4h/week) 15h/unit

Unit-I: Radioanalytical Chemistry-I 15h

Radioactivity-Radiation-Units-Curie, Becquerel, Gray, Rad, Sievert, RBE, REM, Half life, mixed half life, branching decay, different types of radiations and their interactions with matter, radioactive equilibrium, Elementary principles of GM and proportional counters, Gamma Ray Spectrometer, calibration using standard sources, resolution, numericals.

Unit-II: Optical methods of analysis-III 15h

***Atomic absorption spectroscopy*:** Principle. Atomic energy levels. Grotrian diagrams. Population of energy levels. Instrumentation. Sources: Hollow cathode lamp and electrodeless discharge lamp, factors affecting spectral width. Atomizers: Flame atomizers, graphite rod and graphite furnace. Cold vapour and hydride generation techniques. Factors affecting atomization efficiency, flame profile. Monochromators and detectors. Beam modulation. Detection limit and sensitivity. Interferences and their removal. Comparison of AAS and flame emission spectrometry. Applications of AAS.

Unit-III: Electrochemical methods of analysis-II 15h

***Stripping Voltammetry*:** Principle and technique in anodic and cathodic stripping voltammetry, applications to metal ion analysis, limitations.

Adsorptive stripping voltammetry: Principle, technique, applications to metal ions and organic analysis. Advantages over anodic stripping voltammetry. Catalytic effects in voltammetry.

Working electrodes: Mercury electrodes, carbon electrodes, film electrodes.

***Cyclic voltammetry*:** Principle and technique. Randles-Sevcik equation. Interpretation of voltammogram- reversible, irreversible and quasi-reversible systems. Applications of cyclic voltammetry in study of reaction mechanism and adsorption processes.

Electrochemical sensors *(Chemically modified electrodes):* Biosensors, catalytic sensors and gas sensors. Comparison of voltammetry with AAS and ICP-AES.

Unit-IV: Miscellaneous techniques-I 15h

Photoacoustic spectroscopy: Theory. Instrumentation. Advantages over absorption spectroscopy. Chemical and surface applications of PAS.

***Electrochromatography*:** Principles of electrophoresis. Instrumentation. Zone electrophoresis. Curtain electrophoresis. Applications of electrochromatography. Reverse osmosis. Electrodialysis. Capillary electrophoresis. Applications of capillary electrophoresis. Micellar electrokinetic capillary chromatography.
Electrogravimetry: Theory of electrolysis. Electrode reactions. Decomposition potential. Overvoltage. Characteristics of deposits and completion of deposition. Instrumentation. Application in separation of metals.

STPG03CHE02 Major DSC (Special – II Analytical Chemistry)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60h (4h/week) 15h/unit

Unit-I: Organoanalytical Chemistry 15h

Elemental analysis: Outline of macro, semi-micro, micro and ultra-micro analysis, semi-micro determination of carbon, hydrogen, halogen, sulphur, nitrogen, phosphorous, arsenic, boron and metals in organic compounds.
Functional group analysis: Semi-micro determination of the following functional groups in organic compounds- hydroxyl, amino, nitro, nitroso, azo, N-acetyl, O-acetyl, methyl, aldehydes, ketones, thio, disulphide, sulphonamide, unsaturation and active hydrogen.
KF reagent: Karl Fischer reagent and its use in analysis of water in organic compounds.

Unit-II: Analysis of ores and cement 15h

Ores: Composition and analysis of the followings ores- Bauxite, Pyrolusite, Dolomite, Chromite.
Portland cement: Composition, raw material, manufacturing processes, characteristics, analysis.

Unit III: Water pollution and analysis

Sources of water pollution, composition of potable water, importance of water analysis, sampling and sample preservation, physico-chemical analysis of water. Mineral analysis (temperature, pH, conductivity, turbidity, solids, alkalinity, chloride, fluoride, sulphates, hardness), Demand analysis (DO, BOD, COD, TOC), nutrients (nitrogen-total, nitrate, nitrite, phosphate) and heavy metals (As, Cd, Cr, Hg and Pb). A brief idea of coagulation and flocculation.

Unit-IV: Air pollution and analysis 15h

Air pollution and analysis-classification of air pollutants, sources of air pollution and methods of control, sampling of aerosols and gaseous pollutants and their effects, SO2, NO2, CO, CO2, particulates-SPM, RSPM, High Volume Sampler, Fabric Filters, Cyclones (direct and Reverse), ESP, ozone layer, Green house effect, Heat Islands, Acid Rain.

List of books:

1. Essentials of Nuclear Chemistry: H. J. Arnikar (Willey Eastern Ltd)
2. Substoichiometry in Radioanalytical Chemistry: J. Ruzicka and J Stary (Pergamon Press)
3. Introduction to Radiation Chemistry: J. W. T. Spinks and R. J. Woods
4. Radiochemistry: A. N. Nesmeyanov (Mir Publications)
5. Instrumental Methods of Analysis: Willard, Meriit and Dean(Van Nostrand)
6. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
7. Vogel's Text Book of Quantitative Inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)
8. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
9. Atomic Absorption Spectroscopy: Robinson (Marcol Dekker)
10. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
11. Analysis of Water: Rodier
12. Laboratory manual of water analysis: Moghe and Ramteke (NEERI)
13. Electroanalytical chemistry: Joseph Wang

14. Electroanalytical stripping methods: Brainina and Neyman (Wiley-Interscience)
15. Trace analysis: S. Lahiri (Narosa Publishing House)
16. Electroanalytical Chemistry: Bard (Marcel-Dekker)
17. Chemistry in Engineering and Technology- Vol I and II: J.C. Kuriacose and J. Rajaram (Tata-McGraw Hill).

STPG03CHE08 - Laboratory – V (Major) (Analytical Special)

Credits =2, Total Marks – 50 (30+20)

9 h /week Marks

pH-metry

1. Determination of percent Na2CO3 in soda ash by pH-metric titration.
2. Determination of isoelectric point of amino acid.

Conductometry

1. Displacement titration of CH3COONa with HCl.
2. Precipitation titration of MgSO4 and BaCl2.

Potentiometry

1. Estimation of Cl-, Br- and I- in a mixture.
2. Determination of percent purity of phenol by potentiometric titration with NaOH.

Coulometry

1. Estimation of nickel and cobalt by coulometric analysis at controlled potential.
2. Analysis of antimony (III) with I3- .

Polarography

1. Determination of E1/2 of Cd2+ and Zn2+ at DME.
2. Estimation of Cd2+ and Zn2+ in respective solutions by calibration curve and standard addition methods.
3. Determination of composition /stability constant of complex.

Cyclic voltammetry

Study of cyclic voltammograms of K3[Fe(CN)6].

Electrogravimetry

Estimation of nickel and copper individually as well as in mixture.

Polarimetry

1. Inversion of cane sugar in the presence of HCl.
2. Determination of percentage of two optically active substances (d-glucose and d-tartaric acid) in a mixture.

Colorimetry/spectrophotometry

1. Simultaneous determination of chromium and manganese in given mixture.
2. Simultaneous determination of two dyes in a mixture.
3. Estimation of Mn in steel.
4. Estimation of Cu/Ni in alloys.
5. Estimation of iron in water sample using 1,10-phenanthroline.
6. Estimation of Fe(III) in given solution by photometric titration with EDTA (salicylic acid method).

Flame photometry

Estimation of Li, Na, K, Ca in rock/ soil / water samples.

Turbidimetry and nephelometry

1. To determine molecular weight of polymer.
2. Estimation of sulphate in water sample by turbidimetry.
3. Estimation of phosphate by nephelometry.

Radioanalytical techniques

1. *GM-counter*: Plateau, nuclear statistics, half thickness of aluminium absorbers, dead time.
2. *Gamma ray spectrometer*: Calibration using standard sources, determination of half life (Mn-56, I-128, In-116)
3. Experiments based on radiation chemistry: G-value, radiolysis of organic solvents.

Demonstrations

UV-spectrophotometry.

STPG03CHE03 Major DSC Paper – III Spectroscopy - I

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60 h (4 h per week): 15 h per unit

Unit - I: Symmetry properties of molecules and group theory:**15h**

Symmetry elements and symmetry operations. Properties of group. Point groups and Schoenflies symbols. Symmetry operations as a group. Matrix representations of groups. Multiplication table for C2v, C3v and C2h. Reducible and irreducible representations. Similarity transformation. Classes of symmetry operations. Great Orthogonality Theorem. Derivation of character tables for H2O and NH3 using Great Orthogonality Theorem. Application of character tables in selection rules of IR, Raman and Electronic spectroscopy.

Unit - II: 15h

A] Mass spectrometry: Theory, ion production (EI, CI, FD, FAB), ion analysis, ion abundance, isotopic contribution, N-rule, types of fission processes, high resolution mass spectrometry, metastable peak, molecular ion peak, Mclaffferty rearrangement, mass spectral fragmentation of organic compounds alkanes, alkenes, alkynes, alcohols, amines, amides, acids, aldehydes, ketones, halides, Structure determination of organic molecules by mass spectrometry

B] Mossbauer spectroscopy: Basic principle, experimental techniques, recoil emission and absorption, source, absorber, isomer shift, quadrupole interaction, magnetic hyperfine interaction, applications in determining electronic structure, molecular structure, crystal symmetry, magnetic structure, surface studies, biological applications.

Unit - III: 15h

A] Microwave spectroscopy: Classification of molecules on the basis of M.I., rigid and non rigid rotor, effect of isotopic substitution on transition frequencies, stark effect, microwave spectrometer, application in deriving: molecular structure, dipole moment, atomic mass and nuclear quadrupole moment.

B] ESR spectroscopy: Introduction, principle of ESR, ESR spectrometer, hyperfine coupling, zero field splitting, factors affecting g values, Kramer's degeneracy, application of ESR spectra to study free radicals like hydrogen, methyl radical, 1,4 semibenzoquinone, naphthalene, transition metal complexes, biological systems.

Unit IV: 15h

A] Infrared spectroscopy: Diatomic molecules: 1) Molecules as harmonic oscillator, Morse potential energy function, vibrational spectrum, fundamental vibrational frequencies. Force zero pointenergy, isotope effect. The Anharmonic oscillator, the interactions of rotations and vibrations. P,Q,R branches, vibration of polyatomic molecules, selection rules, normal modes of vibration, group frequencies, overtone and combination frequencies. Structure determination of organic molecules by IR spectroscopy.

B] Raman Spectroscopy: Rayleigh scattering. Raman Scattering, classical and quantum theories of Raman effect. Rotational Raman Spectra for linear and symmetric top molecules. Vibrational Raman Spectra, rotational fine structure. Selection rules, coherent antiStokes Raman spectroscopy, Structure determination from Raman and Infra-red spectroscopy.

List of books

1] Spectroscopic identification of organic compound- **RM Silverstein,** GC Bassler and TC Morril, John Wally
2] Introduction to NMR spectroscopy-R. J. Abraham, J. Fisher and P Loftus Wiely
3] Application of Spectroscopy to Organic Compound-J. R. Dyer, Printice Hall
4] Organic Spectroscopy-William Kemp, ELBS with McMillan
5] Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi
6] Organic Spectroscopy-RT Morrison and RN Boyd
7] Practical NMR Spectroscopy-ML Martin, JJ Delpench, and DJ Martyin
8] Spectroscopic Methods in Organic Chemistry-DH Willson, I Fleming
9] Fundamentals of Molecular Spectroscopy-CN Banwell
10] Spectroscopy in Organic Chemistry-CNR Rao and JR Ferraro
11] Photoelectron Spectroscopy-Baber and Betteridge
12] Electron Spin Resonance Spectroscopy-J Wertz and JR Bolten
13] NMR –Basic Principle and Application-H Guntur

14] Interpretation of NMR spectra-Roy H Bible
15] Interpretation of IR spectra-NB Coulthop
16] Electron Spin Resonance Theory and Applications-W gordy
17] Mass Spectrometry Organic Chemical Applications, JH Banyon

STPG03CHE04 Major Elective IV – Paper - IV Polymer Chemistry - I,
Credits : - Theory = 02 Marks : - Theory = 50 (40 + 10)

60 h (4 h per week): 15 h per unit

Unit-I: Introduction to polymers 15h

Nomenclature and classification of polymers. Types of polymers- linear, branched, crosslinked, ladder, thermoplastic, thermosetting, fibres, elastomers, natural polymers, addition and condensation polymers.

Stereoregular polymers- atactic, syndiotactic and isotactic.

Unit-II: Molar mass and its determination 15h

Molecular mass and molar distribution. Number average, mass average, viscosity, average molecular mass and relation between them. Molecular mass distribution. Determination of molecular mass- Osmometry (membrane and vapour phase), light scattering, gel permeation chromatography, sedimentation and ultracentrifuge, viscosity method and end-group analysis.

Unit III: Physical characteristics of polymers 15h

Morphology and order in crystalline polymers. Configuration of polymer chains, crystal structure of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. The glass transition temperature (Tg), relationship between Tg and TT, Effect of molecular weight, dilments, chemical structure, chain topology, branching and cross linking. Methods of determination of glass transition and crystallinity of polymers.

Unit IV: Commercial polymers 15h

A) Organic polymers: Commercial polymers, synthesis and application of polyethylene, polyvinyl chlorides, polyamides, polyesters, phenolic resins and epoxy resins.

B) Functional polymers: Fire retarding polymers and conducting polymers.

STPG03CHE09 - Practical – II (Elective) (Polymer Chemistry - I)
Credits =2, Total Marks – 50 (30+20)

9 h per week

1. Synthesis of polymers:

a) Synthesis of Thiokol rubber (condensation)
b) Urea-formaldehyde (condensation)
c) Glyptal resin: glycerine phthalic acid (crosslinked Polymer Chemistry)
d) Polyacryonitril (bulk polymerization)
e) Polyacryonitril (emulsion polymerization)
f) Polymethylomethacrylate (emulsion of suspension Polymer Chemistry)
g) Nylon-66 (interfacial polycondensation)
h) Coordination polymers
i) Conducting polymer (electro- or peroxodisulphate oxidation)

2. Characterization of polymers:

a) End-group analysis
b) Viscosity and molecular mass
c) Density of polymer by flotation methods
d) IR spectra.

3. Purification and fractionation of polymer, polystyrene, Nylon 66, PMMA.

4. Magnetic and electrical properties of polymers, magnetic susceptibility and electrical conductivity of coordination and conducting polymers.

5. Thermal analysis and degradation of polymers

TGA: Isothermal and non-isothermal DTA: Glass transition temperature and melting point

6. Crystallinity of polymers by density measurement.
7. Swelling and solubility parameters of polymers.
8. Synthesis of Graft-Polymers and its characterization by density and IR spectra.
9. Dielectric behaviour of polymers.
10. Kinetics of polymerization:
a) Polycondensation
b) Peroxide initiation polymerization.

List of books:
1. Textbook of polymer science: F.W. Billmayer Jr. Wiley.
2. Polymer science: V.R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern.
3. Fractional monomers and polymers: K Takemoto, Y. Inaki, and R.M. Ottam Brite.
4. Contemporary polymer chemistry: H.R. Alcock and F. W. Lambe, Prentice Hall.
5. Principles of polymer Chemistry: Flory, Cornell Univ. press.
6. Introduction to polymer chemistry: R. B. Seymour, McGraw Hill.
7. Principles of polymerization: Odian.
8. A first course in polymer chemistry: A. Strepikheyew, V. Derevistkay and G. Slonimasky, Mir Publishers, Moscow.
9. Laboratory preparation of macro chemistry: EMM effery, McGraw Hill Co.
10. A practical course in polymer chemistry: S.J. Punea, Pergamon Press.

STPG03CHE05 Major Elective IV – Paper - IV Medicinal Chemistry - I,

Credits : - Theory = 02 Marks : - Theory = 50 (40 + 10)

60 h (4 h per week): 15 h per unit

UNIT-I: 15 h

A] Biological response to drug, significance of drug metabolism in medicinal chemistry, Prodrugs, computer aided drugs, molecular modelling and drug design, Clinical studies, medical formulations, Stereochemistry and drug development

B] Cardiovascular Drugs: Introduction, cardiovascular diseases, Synthesis of nitrate, verapami, methyldopa, atenolol.

UNIT-II: 15 h

A] Antineoplastic Agent: Introduction, classification, cancer chemotherapy, cancer causing chemicals, role of alkylating agents and antimetabolites in treatment of cancer, hormone and natural products. Synthesis of melphalan, thiotepa, lomustine.

B] Antidiabetic Agents- Type-I and Type-II diabetes, Insulin, thiazolidinediones, Synthesis of ciglitazone.

UNIT-III: 15h

A] Local Anti-infective drug: Introduction and general mode of action. Synthesis of sulphonamides, ciprofloxacin, norfloxacin, dapsone ,amino salicylic acid, isoniazid, ethionamide, ethambutal, econozole, griseofulvin.

B] Diuretics: Introduction, mode of action, loop diuretics. Synthesis of Bumetanide, Frusemide, Ethacrynic acid, clorexolone Quinethazone.

C] Analgesics and Antipyretics: Introduction, mode of action, evaluation of analgetic agents. Synthesis of: Aspirin, salsalate, phenacetin, phenylbutazone, Indomethacin, Analgin.

UNIT-IV: 15 h

A] Psychoactive drugs: Introduction, CNS depressants, Introduction and mode of action of Barbiturates, Benzodiazepines, hydantoins, butyrophenones, buspirone, CNS Stimulants, Synthesis of Phenobarbital, thiopental sodium ,diazepam, lorazepam, bromazepam, ethosuximide **B]Coagulant and Anticoagulants:** Introduction, factors affecting coagulant and anti-coagulant. Mechanism of Blood coagulation and Anticoagulation. Structure of Vitamin K1, Vitamin K2 and heparin. Synthesis of Coumarins and indanediones.

STPG03CHE09 - Practical – II (Elective) (Medicinal Chemistry - I)
Credits =2, Total Marks – 50 (30+20)

9 h per week

1. Volumetric estimation of Ibuprofen.
2. Estimation of aspirin by volumetric and instrumental methods.
3. Analysis of ascorbic acid in biological/tablet sample.
4. Determination of paracetamol by colorimetry.
5. Analysis of ampicillin trihydrate.
6. Determination of vitamin B12 in commercial sample by spectrophotometry.
7. Determination of phenobarbitone in given cough syrup.
8. Determination of tetracycline in given capsule.
9. Determination of iron, calcium and phosphorus from milk or drug sample.
10. Determination of glucose by glucometer.
11. To perform I.P. monograph of tablet.
12. Estimation of uric acid in serum and urine.
13. Estimation of chloride in serum and Urine.
14. Estimation of liver glycogen.
15. Determination of blood cholesterol.
16. Determination of creatinine and creatine in blood/Urine.
17. Separation and determination of sulpha drugs in tablets or ointments.

Preparation of Drugs: Synthesis, purification and identification of (8-10) of the following drugs.

1. Benzocaine from p-nitrobenzoic acid.
2. Dapsone from diphenyl sulphone.
3. Paracetamol from p-nitro phenol.
4. Uracil from sulphanil amide.
5. Diphenyl hydantion from benzoin.
6. Aluminium asprin from salicylic acid.
7. 4,6-diphenyl-thiazine from chalcone.
8. 6/8 nitro coumarin from resorcinol.
9. Copper aspirin from salicylic acid.
10. N-acetyl parabanic acid.
11. Nerolin from 2-naphthol
12. Phenothiazine from diphenylamine
13. Umbelliferon from resorcinol
14. Benzylidene from benzaldehyde and aniline
15. 1-phenyl-1,2-pentadine-3-one from benzaldehyde
16. 1,5 diphenyl-1,3-pentadiene-2-one from benzaldehyde
17. 1,3-diphenyl-prop-2-ene-1-one
18. 3-methy pyrazol-5-one from ethylacetoacetate
19. 6-methyl uracil
20. Sulphanilamide from acetanilide

List of books:

1. Text book of organic medicinal chemistry-Wilson,Geswold
2. Medicinal chemistry Vil I and II-Burger
3. A textbook of pharmaceutical chemistry-Jayshree Ghosh
4. Introduction to medicinal chemistry-A Gringuadge
5. Wilson and Gisvold text book of organic medicinal and pharmaceutical chemistry-Ed.Robert F Dorge
6. An introduction to drug design-SS Pandey,and JR Demmock
7. Goodman and Gilmans pharmacological basis of therapeutics- Stragies for organic drug sythesis and design-D Lednicer.
8. Textbook of Medicinal Chemistry- A. Kar
9. Medicinal Chemistry – D Sriram and P.Yogeeswari.

STPG03CHE05 Major Elective IV – Paper - IV Nuclear Chemistry - I,

Credits : - Theory = 02 Marks : - Theory = 50 (40 + 10)

60 h (4 h per week): 15 h per unit

Unit-I: Radioactive decay 15h

Various modes of decay, natural radioactivity, successive radioactive decay and growth kinetics, radioactive equilibrium, half-life, half-life of mixed radioisotopes, decay schemes, its determination by experimental methods, statistical nature of nuclear radiation, treatment of nuclear data and calculation of standard deviation, probability.

Unit-II: Nuclear structure 15h

mass-energy relationship, nuclear binding energy, semi-empirical mass formula, nuclear stability rules, nuclear properties, mass size, spin and parity, nature of nuclear forces, liquid drop model, shell model, its evidence and advantages, comparison of the two models, calculations based on above.

Energetics of nuclear reaction, cross reaction, comparison with chemical reactions, various types of nuclear reactions, photonuclear, spallation and thermonuclear reaction.

Unit-III: Interaction of radiations with matter, detectors 15h

Interaction with matter and detection of gamma rays with matter by photoelectric, Compton and pai production, interaction of beta particles, neutrons and heavy charged particles, various methods of detecting nuclear radiations, gas filled counters, ionization chamber, proportional and GM counters, scintillation detector and solid state detector.

Unit-IV: Nuclear fission and Fusion 15h

Probability, mass and charge distribution, release of energy and neutrons, spontaneous fission, nuclear reactors and their uses for power production, brief idea about thermal and fast breeder reactors, reprocessing of nuclear fuel, PUREX process, heavy water- manufacturing and use in reactors. accelerators, nuclear fusion.

Production of isotopes by nuclear reactions, production of new elements, radioactive waste management and disposal.

STPG03CHE09 - Laboratory – VI (Elective) (Nuclear Chemistry - I)

Credits =2, Total Marks – 50 (30+20)

9 h per week

1. Working of GM counter, plateau, statistics, geometry effects, dead time, energy of beta particle, back scattering.
2. Working of gas flow proportional counter, plateau, statistics, geometry effects, dead time, energy of beta particle
3. Working with scintillation counter, gamma ray spectra, energy calibration and resolution, half life determination of single and composite nuclei.
4. Radiochemical separation of 234Th from natural uranium salt and its half life determination
5. Experiment on Neutron Activation Analysis by non-destructive method
6. Dose measurement by Fricke and other chemical dosimeters
7. Radiolysis of potassium nitrate, methyl iodide, carbon tetrachloride-iodine systems
8. Szilard-Chalmers reactions with inorganic and organic systems, potassium permanganate and methyl iodide.
9. Some trace experiments like partition coefficient, solubility product, isotopic exchange, isotope dilution analysis, radio-chromatography, ion exchange.

List of books:

1. H. J. Arnikar - Essentials of Nuclear Chemistry (Willey Eastern Ltd)
2. G. Friendlander, J. W. Kennedy,E. S. Macias and J. M. Miller-Nuclear and Radiochemistry (Wiley Intersciences, New York)

3. G. R. Choppin and J. Rydberg- Nuclear Chemistry-Principles and Applications(Pergamon press, London)
4. B. G. Harvey-Introduction to Nuclear Physics and Chemistry(Prentice Hall of India)
A. N. Nesmeyanov - Radiochemistry- (Mir Publications)
5. M. N. Sastry-Introduction to Nuclear Science, Affiliated East-West Press, New Delhi
6. G. Hughes- Radiation Chemistry- Oxford University Press, London
I. V. Verschinskii and A. K. Pikeav-Introduction to Radiation Chemistry, Israel Publication, Jerusalem- Robinson (Marcol Dekker)
7. Farhat Aziz and M. A. J. Radgers-Radiation Chemistry-Principles and Applications, VCH Publishers FRC.
8. M. Hassinsky-Nuclear Chemistry and its application, Addison Wesley.

STPG03CHE07 Major Elective IV – Paper - IV Applied Analytical Chemistry - I, Credits : - Theory = 02 Marks : - Theory = 50 (40 + 10)

60 h (4 h per week): 15 h per unit

Unit-I: Analysis of Pesticides and Fertilizers 15h

***Pesticides*:** General introduction, analysis of pesticides in general with reference to DDT, Dieldrin, Malathion, Parathion, BHC by different analytical methods such as titrimetric, colorimetric, chromatography and electroanalytical methods.

***Fertilizers*:** Sampling and sample preparation, determination of water, total nitrogen, urea, total phosphates, potassium, acid or base forming quality.

Unit-II: Forensic chemistry 15h

Introduction. Classification of poisons on the basis of physical states, mode of action and chemical properties with examples of each type. Methods of administration. Action of poisons in body. Factors affecting poisoning. Study of some common poisons used for suicide. Signs and symptoms of As, Pb, Hg and cyanide poisoning. Poisonous effects of kerosene and cooking gas.

Unit-III: Analysis of petroleum and petroleum products 15h

Introduction, determination of flash and fire point, Pensky Marten's apparatus, cloud and pour point, aniline point, drop point, viscosity and viscosity index, Redwood and Saybolt viscometer, API specific gravity, water and sulphur in petroleum products, carbon residue, corrosion stability, decomposition stability, emulsification, neutralization and saponification number.

Unit-IV: Analysis of alloys 15h

Definition of alloy. Iron-carbon phase diagram. Types of steel: hypoeutectic, hypereutectic steels, mild steel, and stainless steel. Uses of steel. Composition and uses of brass, bronze and soldering alloy. Analysis of iron, nickel, chromium and manganese in steel. Analysis of copper in brass, zinc in bronze and lead in soldering alloy. Industrial applications of alloys.

STPG03CHE09 - Laboratory – VI (Elective) (Applied Analytical Chemistry - I) Credits =2, Total Marks – 50 (30+20)

9 h per week

1. Analysis of ores: Ca and Mg in Dolomite, Al in Bauxite, Mn in Pyrolusite.
2. Analysis of cement: Silica, alumina, ferric oxide, calcium and magnesium oxide, sodium and potassium oxide.
3. Alloy analysis: Mn in steel-colorimetry, Cu in brass-colorimetry, Ni in alloy- back titration/ extraction- spectrophotometry.
4. Analysis of oils: Carbon residue, Acid value, Saponification value, Iodine value, Viscosity, Flash point, Cloud point, Aniline point.
5. Analysis of soils: pH, alkalinity, conductivity, nitrogen, phosphorous and potassium.
6. Ambient air analysis: SPM, RSPM, SOx and NOx in ambient air.

7. Analysis of drugs: Fe in capsule, ascorbic acid in vitamin-C tablet, sulpha drug by diazotization, Mg in milk of magnesia tablet.
8. Bleaching powder: Available chlorine, break point chlorination.
9. Polymer analysis: Molecular weight, Saponification value, Iodine value.
10. Cosmetics analysis: Talcum powder, tooth paste, shampoo.
11. Food: Moisture content by Karl-Fischer titrator, phosphoric acid in cola beverages by pH titration.

List of books

1. ISI Handbook of Food Analysis: Vol.I to X (Bureau of India Standards Publication, New Delhi)
2. Food Analysis: A. G. Woodman (McGraw-Hill)
3. Milk and Milk Products: Eckless, Comb and Nacy (Tata McGraw-Hill)
4. Hand Book of Analysis and Quality Control for Fruit and Vegetable Products: Ranganna (Tata McGraw-Hill)
5. Insecticides- Action and Metabolism: O. Brian (Academic Press)
6. Chemistry of Insecticides and Fungicides: Sree Ramalu, Oxford, IBH,Pub.
7. Analytical Methods for pesticides and plant growth regulators and food additives-(Vol.I to X)Ed. G. Zweing (Academic press)
8. Practical Pharmacognosy: T. N. Vassudevan
9. Aids of analysis of food and drugs: Wicholls
10. Indian Pharmacopoeia-1985
11. British Pharmacopoeia-1990
12. Handbook of Drugs and cosmetics aids: Mehrotra
13. Lynch's medical laboratory technology: S. S. Raphel
14. Basic Food Chemistry: F. Lee (AVI publishing company)
15. Industrial chemistry: B. K. Sharma
16. Parikh's text book of medical jurisprudence, forensic medicine and toxicology, 6th Edn.: C.K.Parikh (CBS publishers and distributors). 17. Clarke's analysis of drugs and poisons: Anthony C Moffat, M David Osselton, Brian Widdop (Pharmaceutical press)
18. A Practical Course in polymer chemistry: S. J. Punea (Pergamon press).
19. The Text book on Petrochemical by Dr. B. K. Bhaskar Rao (Khanna Publishers).
20. Analytical chemistry: A. Gupta (Pragati Prakashan)
21. Applied Chemistry: Vermani and Narula (New Age International).

STPG03CHE10 Paper – V Research Project – Phase - I

Credit = 04 (08 hrs/week)

A) **Seminar Presentation** of 20 minutes duration will be a part of internal assessment for 10 marks (1 credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The **topic will be related to the syllabus**. Marks will be allotted by a group of teachers.

B) **Student have to prepare and submit the work based on the following criteria**

1) **Selection of Topic (Problem finding)**
2) **Introduction of the topic**
3) **Literature review**
4) **Aim & Objectives**
5) **Plan of work/methodology**
6) **References**

Finally submitting the Synopsis in the form of the project/dissertation to the head of department.

Seminar Presentation	**10 marks**
Synopsis work & Submission	**80 marks**
Synopsis Presentation	**10 marks.**
Total	**100 marks**

Syllabus – NEP M.Sc. Semester – IV

STPG04CHE01 Major DSC – Paper – I (Special – III Organic Chemistry)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60h (4h/week) 15h/ unit

Unit I:15 h

A] Carbanions in organic Chemistry, Ionization of carbon hydrogen bond and prototopy, Base and acid catalysed halogenation of ketones, ketoenol equilibria, structure and rate in enolisation, concerted and carbanion mechanism for tautomerism, carbanion character in phenoxide and pyrrolyl anions, geometry of carbanions, kinetic and thermodynamic control in the generation of enolates, LDA, hydrolysis of haloforms, use of malonic and acetoacetic esters, Aldol, Mannich, Cannizzaro, Darzens, Dieckmann, Claisen Baylis-Hillman reactions, Knoevenagel, benzoin condensation, Favorski reaction, alkylation of enolates and stereochemistry thereof, Conjugate additions.

B] Organometallic reagents -I

Synthesis and applications of organo Li and Mg reagents, nucleophilic addition to aldehyde, ketones, ester, epoxide, CO_2, CS_2, isocyanates, ketenes, imines, amides, lactones, Stereochemistry of Grignard addition to carbonyl compounds, o-metallation of arenes using organolithium compounds.

Unit II: 15 h

A] Organometallic reagents-II

Organozinc reagents: Preparation and applications, Reformatsky reaction, Simon-Smith reaction.

Organocopper reagents: Preparation and applications in C-C bond forming reaction, mixed oragno-cuprates, Gilman's reagent. Organo Hg and Cd reagents in organic synthesis.

B] Transition metals in organic synthesis
Transition metal complexes in organic synthesis-Introduction-oxidation states of transition metals, 16-18 rule, dissociation, association, insertion, oxidative addition, reductive elimination of transition metal. Organopalladium in organic synthesis-Heck reaction, allylic activation, carbonylation, wacker oxidation, isomarization formation N-aryl and N-alkyl bond trans-metalation, allyl deprotection in peptides, coupling reactions: Kumada Reaction, Stille coupling, Sonogashira and Suzuki coupling reactions and their importance. Applications of $Co_2(CO)_8$, $Ni(CO)_4$, $Fe(CO)_5$ in organic synthesis. Wilkinson, Noyori, Knowls catalyst of Rutheniumand Rhodium – synthesis and uses its use in hydrogenation reactions-deallylation, C-C, C-O, C-N bond cleavages. Olefin metathesis by Istand IIndgeneration catalyst, reaction mechanism and application in the synthesis of homo and heterocyclic compounds.

Unit III: 15 h
A] Advanced Stereochemistry:
Conformation of sugars, monosaccharides, disaccharides, mutorotation, Recapitulation of Stereochemical concepts- enantiomers, diastereomers, homotopic and heterotopic ligands, Chemo-, regio-, diastereo- and enantio-controlled approaches; Chirality transfer, Stereoselective addition of nucleophiles to carbonyl group: Re-Si face concepts, Cram's rule, Felkin Anh rule, Houk model, Cram's chelate model. Asymmetric synthesis, use of chiral auxiliaries, asymmetric hydrogenation, asymmetric epoxidation and asymmetric dihydroxylation,
B] Protection and Deprotection of functional groups: Protection and deprotection of functional groups like, hydroxyl, amino, carbonyl and carboxylic acids groups, Solid phase peptide synthesis.
Unit IV: Designing the synthesis based on retrosynthetic analysis 15 h
(A) Disconnection Approach: An introduction to synthons and synthetic equivalents, disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-Xand two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reactions, amine synthesis.

(B) One Group C-C Disconnections: Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis
(C)Two Group C-C Disconnections: Diels-Alder reaction, 1,3-difunctionalised compounds, α,β-unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds, Michael addition and Robinson annelation, Methods of ring synthesis.

List of books
1] Principle of Organic Synthesis R. O. C. Norman and J. M. Coxon
2] Modern Synthetic Reaction. H. O. House and W. A. Benjamin
3] Organic Synthesis: The Disconnection Approach-S. Warren
4] Designing Organic Synthesis-S. Warren
5] Some Modern Methods of Organic Synthesis-W. Carruthers
6] Advance Organic Reaction. Mechanism and Structure-Jerry March
7] Advance Organic Chemistry Part-B-F. A. Caray and R. J. Sundberg Plenum Press
8] Organic Reaction and their Mechanism-P. S. Kalsi
9] Protective Groups in Organic Synthesis-T. W. Greene
10] The Chemistry of Organo Phosphorous-A. J. Kirbi and S. G. Warren
11] Organo Silicon Compound-C. Eabon
12] Organic Synthesis via Boranes-H. C. Brown
13] Organo Borane Chemistry-T. P. Onak
14] Organic Chemistry of Boron-W. Gerrard.

STPG04CHE02 Major DSC – Paper – II (Special – IV Organic Chemistry)
Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60h (4h/week) 15h/ unit

Unit I: Enzyme chemistry 15h

A] Enzymes: Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labelling and enzyme modification by site-directed mutagenesis. Baker's yeast catalysed reactions, Applications of enzymes in food and drug chemistry.

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

C] 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 II: Heterocycles 15h

A] Azoles: Structural and chemical properties; Synthesis of pyrazole, isothiazole and isoxazole; Synthesis of imidazoles, thiazoles and oxazoles; Nucleophilic and electrophilic substitutions; Ring cleavages.

B] **Benzofused heterocycles:** Synthesis of indole, benzofuran and benzo-thiophene, quinoline and isoquinoline Nucleophilic, electrophilic and radical substitutions; Addition reactions; Indole rings in biology.

C] Diazines: Structural and chemical properties; Synthesis of pyridazines, pyrimidines, pyrazines; Nucleophilic and electrophilic substitutions.

Unit III: 15h

A] Nucleic Acids: Primary, secondary and tertiary structure of DNA; DNA replication and heredity; Structure and function of mRNA, tRNA and rRNA. Purines and pyrimidine bases of nucleic acids and their preparation.

B] Lipids: Fatty acids, essential fatty acids, structures and functions of triglycerols, glycerol-phospholipids, spingo-lipids, lipoproteins, composition and function, role in atherosclerosis,

C] Properties of lipid aggregates, micells, bilayers, liposomes and their biological functions, biological membranes, fluid mosaic model of membrane structure, Lipid metabolism, β-Oxidation of fatty acids

D] Vitamins: Structure determination, synthesis and biosynthesis of vitamin A, E and H.

Unit IV: 15h

A] Dyes: General Introduction, classification on the basis of structure and methos of application dying mechanism, methods of dying, such as direct dying, vat dying, dispersive dying, formation of dye in fibre, dying with reactive dyes, study of quinoline yellow, cyamine dye, ethyl red, methylene blue, Alizarin, cyamine-green, fluorescein, cosin, erythrosine, Rhodomines and Indigo.

B] Pharmaceutical chemistry: History, medical terms in pharmaceutical chemistry, classification of drugs, antibacterial and antifungal drugs, specific clinical applications, Serendipity and drug development, Synthesis and applications of: Benzocaine, Methyl dopa, dilantin, ciprofloxacin, acyclovir, terfenadine, salbutamol.

C] Polymer chemistry: Importance of polymers, Basic concepts: monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition, radical chain-ionic and co-ordination and co-polymerization and their mechanisms, Polymerization in homogeneous and heterogeneous systems. Ziegler-Natta polymerization with mechanism, Stereo regulated polymers, syndiotactic, isotactic and atactic polymers.

List of books

1] Textbook of Polymer Science, F. W. Billmeyer Jr, Wiley
2] Polymer Science, V. R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern
3] Functional Monomers and Polymers, K. Takemoto, Y. Inaki and R. M. Ottanbrite

4] Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-
Verlag
5] Understanding Enzymes, Trevor Palmer, Prentice Hall
6] Enzyme Chemistry: Impact and Applications, Ed. Collin J. Suckling, Chapman and Hall
7] Enzyme Structure and Mechanism, A. Fersht, W. H. Freeman
8] Introduction to Medicinal Chemistry, A. Gringuage, Wiley-VCH
9] Wilson and Gisvold's Text Book of Organic Medical and Pharmaceutical Chemistry, Ed Robert F. Dorge
10] Burger's Medicinal Chemistry and Drug Discovery, Vol-1, Ed. M. E. Wolff, John Wiley
11] Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley
12] The Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press.

STPG04CHE07 Practical III

Total Marks – 50 (30 + 20)

9 h /week Marks: 80

[A] Quantitative Analysis based on classical and instrumental technique (any 8-10)
1] Estimation of nitrogen.
2] Estimation of halogen.
3] Estimation of sulphur.
Spectrophotometric/calorimetric and other instrumental methods of estimation
4] Estimation of streptomycin sulphate.
5] Estimation of vitamin B-12.
6] Estimation of amino acids.
7] Estimation of proteins.
8] Estimation of carbohydrates.
9] Estimation of Ascorbic acid.
10] Estimation of Aspirin.
11] Solvent extraction of oil from oil seeds and determination of saponification value, iodine value of the same oil.

STPG04CHE08 Practical IV

Total Marks – 50 (30 + 20)

[A] Organic multi-step preparations (Two/Three steps): Minimum 10-12 preparations
[1] Aniline Diaminoazobenzene _ p-aminoazobenzene
[2] Benzoin →Benzyl →Dibenzyl
[3] Aniline → acetanilide → p-bromoacetanilide → p-bromoaniline
[4] Aniline → Acetanilide → p-nitroacetanilide → p-nitroaniline
[5] Benzaldehyde (thiamine hydrochloride) → benzoin → benzil → benzilic acid
[6] p-Nitrotoluene → p-nitrobenzoic acid → PABA → p-iodobenzoic acid
[7] p-Cresol → p-cresylacetate → 2-hydroxy-5-methyl acetophenone → 2-hydroxy chalcone
[8] Benzaldehyde → benzilidene acetophenone → 4,5-dihydro-1,3,5-triphenyl-1H-pyrazole
[9] Aniline → phenylthiocarbamide → 2-aminobenzthiazole (Microwave in step I)
[10] Chlorobenzene → 2,4- Dinitrochlorobenzene → 2,4- Dinitrophenylhydrazine.
[11] Acetophenone → acetophenone phenyl hydrazone → 2-phenylindole
[12] Benzion → benzoin benzoate → 2,4,5-triphenyl oxazole
[13] Benzophenone → benzpinacol → benzopinacolone (Photochemical preparation)
[14] Benzophenone → Benzophenone oxime →Benzanilide →Benzoic acid + aniline.
[15] Aniline → aniline hydrogen sulphate → sulphanilic acid → Orange II
[16] Aniline → N-arylglycine → indoxyl → indigo
[17] Phthalimide →Anthranilic acid →Phenyl glycine-o-carboxylic acid →Indigo
[18] Phalic anhydride →Phthalimide→ Anthranilic acid →o-chlorobenzoic acid

[19] Phalic anhydride →Phthalimide →Anthranilic acid→Diphenic acid
[20] Ethyl acetoacetate →3-methyl-pyrazol-5-one →4,4-dibromo-3-methyl-pyrazol-5-one→ Butanoic acid.
[21] Biosynthesis of ethanol from sucrose
[22] Enzyme catalyzed reactions
[B] SPECTRAL INTERPRETATION
Structure Elucidation of organic compounds on the basis of spectral data (UV, IR, 1H and 13CNMR and Mass)
(Minimum 12 compounds are to be analysed during regular practicals).

STPG04CHE01 Major DSC – Paper – I (Special – III Inorganic Chemistry)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60h (4h/week) 15h/ unitUnit-I 15h

A) Nanoparticles& Nanostructural materials: Introduction, methods of preparation, physical properties, and chemical properties. Molecular Precursor routes to inorganic solids:- Introduction, sol-gel chemistry of metal alkoxide, hybrid organic-inorganic compounds. Nanoporous Materials: Introduction, Zeolites & molecular sieves, determination of surface acidity, porous lamellar solids, composition-structure, preparation &applications.
B) Solid State Reaction: General principles, reaction rates, reaction mechanism, reaction of solids, factors influencing reactivity, photographic process.

Unit-II 15h

A) Coordination Polymers:
Coordination polymers and their classification. Synthesis and applications of coordination polymers. Use of polymeric ligands in synthesis of coordination polymers. Organosilicon polymers. Synthesis and their uses.
B) Characterization of coordination polymers on the basis of:
i) Spectra (UV, Visible, IR and NMR)
ii) Magnetic and thermal (TGA, DTA and DSC) studies

Unit-III 15h

Catalysis: Basic principles, thermodynamic and kinetic aspects, industrial requirements, classification, theories of catalysis, homogeneous and heterogeneous catalysis. Introduction, types & characteristics of substrate-catalyst interactions, kinetics and energetic aspects of catalysis, selectivity, stereochemistry, orbital symmetry and reactivity. Catalytic reactions of coordination and Organometallic compounds including polymerization activation of small molecules, addition to multiple bonds, hydrogenation Zeigler-Natta polymerization of olefins, hydroformylations, oxidations, carboxylations and epoxidation.

.**Unit-IV 15h**

A) Supramolecular chemistry: Molecular recognition: Molecular receptors for different types of molecules including arlsonic substrate, design and synthesis of co receptor molecules and multiple recognition. Supramolecular reactivity and catalysis. Transport processes and carrier design. Some examples of self assembly in supramolecular chemistry.
B) Thin films and languir-Biodgett films: Preparation technique, evaporation/spultering, chemical processes, MOCVD, solgel etc. Languir-Biodgett(LB) film, growth techniques, photolithography properties and applications of thin and LB films.

List of books:

1. Barsoum ,M.W.,Fundamentals of Ceramics,McGraw Hill ,New Delhi
2. Ashcroft ,N.W. and Mermin,N.D.,Solid Stae Physics,Saunders College
3. Callister W.D.,Material Science and Engineering, An Introduction,Wiley
4. Keer,H.H,Principals of Solid State,Wiley Eastern
5. Anderson J.C.,Lever K.D.,Alexander J.M and Rawlings,R.D.,ELBS
6. Gray G.W.Ed.Thermotropic Liquid Crystals,John Wiley
7. Kelkar and Hatz Handbook of Liquid Crystals,Chemie Verlag.

8. Kalbunde K.I.,Nanoscale Materials in Chemistry,John Wiley,NY.
9. Shull R.D.,McMichael R.D. and Swartzendrub L.J.,Studies of Magnetic Properties of Fine particles and their
relevance to Materials Science, Elsevier Pub. Amsterdam.

STPG04CHE02 Major DSC – Paper – II (Special – IV Inorganic Chemistry)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60h (4h/week) 15h/ unit

Unit-I 15 h

A) Basics of Photochemistry: Absorption, excitation, photochemical laws, quantum yield, electronically excited states-life times-measurements of the times. Flash photolysis, stopped flow techniques, Energy dissipation by radiative and no-radiative processes, absorption spectra Frank- photochemical stages-primary & secondary processes.

B) Properties of excited states: Photochemical kinetics, Calculation of rates of radiative processes.

C) Excited States of Metal Complexes: Electronically excited states of metal complexes, charge transfer spectra, charge transfer excitations, methods for obtaining charge transfer spectra.

Unit-II 15h

A) Ligand field Photochemistry: photo-substitution, photo oxidation & photoreduction. Liability and selectivity, zero vibrational levels of ground state and excited state, energy content of excited state, zero-zero spectroscopic energy, development of the equations for redox potentials of the excited states.

B) Redox reactions by Excited Metal Complexes: Energy transfer under conditions of weak interaction &strong interaction – exciplex formation, conditions of excited states to be useful as redox reactants, excited electron transfer, metal complexes as attractive candidates (2,2-bipyridine & 1,10-Phenanthrolinecomplexes.), illustration of reducing and oxidizing character of ruthenium (II); role of spin-orbit coupling, lietime of these processes. Application of redox processes of electronically excited states for catalytic purposes, transformation of low energy reactants in to high energy products, chemical energy in to light.

C) Metal Complex Sensitizers: Metal Complex Sensitizers, electron relay, metal colloid systems, and semiconductor supported metal or oxide systems, water photolysis, nitrogen fixation & carbon dioxide reduction.

Unit-III 15h

Organotransition Metal Chemistry: Alkyls and Aryls of Transition Metals: Types, routes of synthesis, stability& decomposition pathways of alkyls & aryls of transition metals. Organocopper in Organic synthesis.

Compounds of Transition Metal –Carbon Multiple bonds: Alkylidenes, alkylidynes, low valent carbenes &carbynes–synthesis, nature of bond, structural characteristics, nucleophilic &electrophilic reactions on ligands, role inorganic synthesis.

Unit-IV 15h

Transition Metal Pi Complexes-Carbon multiple bonds. Nature of bonding, structural characteristics &synthesis, properties of transition metal pi- Complexes with unsaturated organic molecules, alkenes alkynes, allyl, diene, dienyl, arene & trienyl complexes. Application of transition metal, organometallic intermediates in organic synthesis relating to nucleophilic & electrophilic attack on ligands, role in organic synthesis.

List of books:

1. Elschenbroich Ch.and Salzer A.: Organometallics, VCH,Weinheim, NY.
2. Balzani Vand Cavassiti V.:Photochemistry of Coordination compounds,AP,London
3. Purcell K.F.and KotzJ.C., An Introduction to Inorganic Chemistry,Holt Sounder,Japan.
4. Rohtagi K.K.and Mukharjee,Fundamentals of Photochemistry,Wiley eastern

5. Calverts J.G.and Pits.J.N.,Photochemicals of Photochemistry,John Wiley
6. Wells,Introduction of Photochemistry
7. Paulson,Organometallic Chemistry,Arnold
8. Rochow,Organometallic Chemistry,Reinhold
9. Zeiss,Organometallic Chemistry,Reinhold
10. Gilbert A.and Baggott,J,Essential of Molecular Photochemistry,Blackwell Sci.Pub.
11. Turro N.J.and Benjamin W.A.,Molecular Photochemistry
12. CoxAand Camp,T.P.Introductory Photochemistry,McGraw-Hill
13. KundallR.P.and GilbertA,Photochemistry, Thomson Nelson Coxon J and Halton B.,Organic Photochemistry, Cambridge University Press.

STPG04CHE07 Practical III

Total Marks – 50 (30 + 20)

A) Preparation and characterization of following the following complexes/organometallic compound including their structural elucidation by the available physical methods. (Element analysis, molecular weight determination, conductance and magnetic measurement and special studies) Selection can be made from the following:

i) Cis and trans isomers of bis(glycinato) copper(II) monohydratye.
ii) N,N-bis (salicylaldehyde) ethylene diaminato nickel(II)
iii) Trinitrotriamine cobalt(III)
iv) Cis and trans disubstituted octahedral Cr (III) complexes [CrF2(en)2].
v) Preparation of Grignard reagent
vi) Ferrocene and its acelytion
vii) Sodium amide
viii) Synthesis of trichlorodiphenylantimony(V) hydrate.
ix) Synthesis of metal acetylacetonate: magnetic moment, IR, NMR.
x) Magnetic moment of Cu(acac)2H2O
xi) Determination of Cr (III) complexes: [Cr(H2O)6]NO3.3H2O, [Cr(H2O)4Cl2].Cl.2H2O, [Cr(en)3]Cl3
xii) Preparation of N,N bis (salicylaldehyde) ethylenediamine,(salen), Cobalt and copper complexes.

B) Solid State:

1) Preparation of oxides and mixed oxides (Mn2O3, NiO, Cu2O, Fe3O4, ZnFe2O4, ZnMn2O4, CuMn2O4 and NiFe2O4)
2) Preparation of Silica and Alumina by sol-Gel technique.
3) To study the electrical conductivity of ferrites, Magnetites, doped oxides and pure samples and determine band gap.

STPG04CHE08 Practical IV

Total Marks – 50 (30 + 20)

A) Bioinorganic Chemistry

1) Extraction and absorption spectral study of chlorophylls from green leaves of students choice
2) Separation of Chlorophyll and their electronic spectral studies.
3) Complexation study of Cu(II) with biologically important amino acids

B) Inorganic reaction mechanism:

Kinetics and mechanism of following reactions:

1) Substitution reactions in octahedral complexes (Acid/Base hydrolysis)
2) Redox reactions in octahedral complexes.
3) Isomerization reaction of octahedral complexes.

C) Inorganic Photochemistry:

i) Synthesis of potassium ferrioxalate and determination of intensity of radiation

ii) photoxidation of oxalic acid by UO22+ sensitazation
iii) Photo decomposition of HI and determination of its quantum yield.

List of books:

1. Synthesis and Characterization of Inorganic Compounds, W. L. Jolly, Prentice Hall.
2. Inorganic Experiments, J. Derck Woollins, VCH.
3. Practical Inorganic Chemistry, G. Marrand, B. W. Rockett, Van Nostrand.
4. A Text Book of Quantitative Inorganic Analysis, A. I.Vogel, Longoman.
5. EDTA Titrations. F. Laschka
6. Instrumental Methods of Analysis, Willard, Merit and Dean (CBS, Delhi).
7. Inorganic Synthesis, Jolly
8. Instrumental Methods of Chemical Analysis, Yelri Lalikov
9. Fundamental of Analytical Chemistry, Skoog D.A. and West D.M Holt Rinehart and Winston Inc.
10. Experimental Inorganic Chemistry, W.G.Palmer, Cambridge.
11. Solid state Chemistry, N.B.Hanney
12. Introduction to Thermal Analysis, Techniques and Applications, M.E.Brown, Springer
13. Preparation and Properties of solid state Materials, Wilcox, Vol.IandII, Dekker
14. The Structure and Properties of Materials Vol.IV, JohnWulff, Wiley Eastern.

STPG04CHE01 Major DSC – Paper – I (Special – III Physical Chemistry)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60h (4h/week) 15h/unit

UNIT-I SURFACE CHEMISTRY 15h

A] Macromolecules: Number and average molecular mass, molecular mass determination: Osmometry, Viscometry, sedimentation, diffusion and light scattering method.

B] Chemical adsorption, application of adsorption, factors affecting adsorption, Langmuir theory, BET theory, heat and entropy of adsorption. Surface film on liquids; Electro-kinetic phenomena. types of adsorption isotherm. micelle formation, mass action model and phase separation model, shape and structure of micelles, CMC, factors affecting CMC effect of added electrolyte on the surface excess of ionic surfactants.

C] Modern techniques for investigating surfaces-Low energy electron diffraction(LEED), PES, Scanning tunneling and atomic force microscopy (STM and AFM)

UNIT II CORROSION AND CORROSION ANALYSIS 15h

A] Scope and economics of corrosion, causes (Change in Gibbs free energy) and types of corrosion, electrochemical theories of corrosion, dry and wet corrosion, Different types of corrosion-Pit, Soil, chemical and electrochemical, intergrannular, waterline, microbial corrosion, measurement of corrosion by different methods, factors affecting corrosion, passivity, galvanic series, protection against corrosion, design and material selection.

B] Thermodynamics of corrosion, corrosion measurements (Weight loss, OCP measurements, polarization methods), passivity and its breakdown, corrosion prevention (electrochemical inhibitor and coating methods).

UNIT III: RADIATION CHEMISTRY 15h

Measurement of dose. Dosimetric terms and units (Roentgen, REM, Rad, Gray, Sievert), inter conversions, calculation of absorbed dose-various types of dosimeters, chemical dosimeters (Fricke and Ceric sulphate), experimental methods, TLD badges, Radiolysis-definition, process, Radiolysis of water and aqueous solutions, hydrated electron, Effect of radiation on biological substances, genetic effects, radiation effects on organic compounds (Halides-carboxylic acids), polymers, nitrates and solid thermoluminescence.

UNIT IV: LIQUID STATE 15h

A] Theory of liquids:- Theory of liquids, partition function method or model approach, single cell models, communal energy and entropy, LTD model, significant structure model.

B] Supercooled and ionic liquids: Supercooled and ionic liquids, theories of transport properties, non-Arrhenius behavior of transport properties, Cohen- Turnbull free volume model, configurational entropy model, Macedo- litovitz model, glass transition in supercooled liquids.

List of Books

1. Y. Moroi, Micelles : Theoretical and Applied Aspects, Plenum Press, New York (1992).
2. E.M. Mc Cash, Surface Chemistry, Oxford University Press, Oxford (2001).
3. P.A. Eglestaff,‖ An Introduction to Liquid State‖ Academic Press.
4. J.A.Pryde,‖The Liquid State‖
5. A.F.M.Barton, —The Dynamics of Liquid State‖, Longman.
6. Introduction to Radiation Chemistry: J. W. T. Spinks and R. J. Woods
7. Radiochemistry: A. N. Nesmeyanov (Mir Publications)
8. G. Hughes- Radiation Chemistry- Oxford University Press, London.

STPG04CHE02 Major DSC – Paper – II (Special – IV Physical Chemistry)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60h (4h/week) 15h/unit

UNIT I: ELECTRICAL AND MAGNETIC PROPERTIES OF SOLIDS 15h

A] Metals, insulators and semiconductors, electronic structure of solids-band theory, fermi gas model, electrical conductivity, thermal conductivity, Lorenz number, periodic potential, band structure of metals, insulators and semiconductors, intrinsic and extrinsic semiconductors, doping semiconductors, semiconductor p-n junctions, colors in solids. Semiconductors, meissner effect, LTSC, HTSC.

B] Behaviour of substances in magnetic field, effect of temperature: Curie and Curie-weiss law, calculation of magnetic moments, magnetic materials, their structure and properties, Applications: structure/ property relations, numericals.

UNIT II: ELECTRICAL PROPERTIES OF MOLECULES 15h

Dipole moments of molecules, basic ideas of electrostatic interactions, polarizability, orientation polarization, Debye equations, limitation of the Debye theory, Clausius-Mossotti equation.

electrostatic of dielectric medium, molecular basis of dielectric behaviour, structural information from dipole moment measurements, use of individual bond dipole moments, application to disubstituted benzene derivatives, dipole moment andionic character of a molecule, determination of dipole moment from dielectric measurements in pure liquids
and in solutions. The energies due to dipole-dipole, dipole induced dipole and induced dipole-induced dipole interaction. Dispersion, dielectric loss and refractive index. Lennard-Jones potential.

Unit III: LIQUID CRYSTALS 15h

A] LIQUID CRYSTALS: Mesomorpic behavior, thermotropic liquid crystals, positional order, bond orientational order, nematic and sematic meso phases, sematic and nematic transitions and clearing temperature, homeotropic, planer and schlieren textures twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals.

B] THIN FILMS: Langmuir- Blodgett (LB) Film, growth techniques, photolithography, properties and applications of thin and LB films.

Unit IV: 15h

A] Liquid gas and liquid interfaces: Surface tension, methods of determination of surface tension, surface tension across curved surfaces, vapor pressure of droplet (Kelvin equation), surface spreading, spreading coefficient, cohesion and adhesion energy, contact angle, constant angle hystereis, wetting and detergency.

B] Solid - Solid interfaces: Surface energy of solids, adhesion and adsorption, sintering and sintering mechanism, Tammann temperature and its importance, surface structure and surface composition.

List of books

1. Physical Chemistry - P.W. Atkin, ELBS fourth edition.
2. Physical Chemistry – R.A. Alberty, R.I. Bilby, Johy Wiley – 1995
3. Physical Chemistry – G.M. Barrow, Tata Mc – Graw Hill – 1988.

STPG04CHE07 Practical III

Total Marks – 50 (30 + 20)

4 h /week

Adsorption:

1. To verify Freundlich adsorption isotherm.
2. To verify Langmuir adsorption isotherm.
3. To verify Gibbs adsorption isotherm and to find surface excess concentration of solute.
4. To determine CMC of the given surfactant by surface tension method.
5. Study of variation of surface tension of solution of n-propyl alcohol with concentration and hence determine the limiting cross section area of alcohol molecule.

STPG04CHE08 Practical IV

Total Marks – 50 (30 + 20)

Kinetics:

6. Clock reaction- activation energy of bromide-bromate reaction.
7. Temp dependence of persulfate-iodide reaction by iodine clock method and calculation of thermodynamic and Arrhenius activation parameters. Study of ionic strength effect on persulfate-iodide reaction.
8. Kinetics of B-Z reaction; Kinetics of modified B-Z reaction
9. Investigate the Autocatalytic reaction between potassium permanganate and oxalic acid.
10. Determination of PKa value of a weak acid by chemical kinetic method (formate-iodine reaction)

Potentiometry and Conductometry:

11. Transport number by potentiometry.
12. Hydrolysis constant by aniline-hydrochloride by potentiometry and conductometry
13. pKa of weak acids by potentiometry and conductometry.
14. Complexation between Hg2+and I- conductometrically.

STPG04CHE01 Major DSC – Paper – I (Special – III Analytical Chemistry)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60h (4h/week) 15h/unit

Unit-I: Radioanalytical Chemistry-II 15h

Preparation of some commonly used radioisotopes, Use of radioactive isotopes in analytical and physicochemical problems, Industrial applications, Neutron sources, Neutron Activation Analysis, Isotope Dilution Analysis, Radiometric titrations (Principle, Instrumentation, applications, merits and demerits), Radiochromatography, Carbon dating, Numericals based on above.

Unit-II: Optical methods of analysis-IV 15h

Inductively coupled plasma-atomic emission spectroscopy: Principle, atomization and excitation. Plasma source and sample introduction. Instrumentation. Comparison of ICP-AES with AAS. Applications. X-ray fluorescence spectroscopy: Principle. Instrumentation: wavelength and energy

dispersive devices. Sources and detectors. Comparison between wavelength and energy dispersive techniques. Sample preparation for XRF. Matrix effects in XRF. Applications in qualitative and quantitative analysis. Particle induced X-ray emission (PIXE): Basic principle, Instrumentation and applications. Electron microscopy: Principle, instrumentation and applications of scanning electron microscopy (SEM) and transmission electron microscopy (TEM)

Unit-III: Electrochemical methods of analysis-III 15h

Ion selective electrodes: Theory of membrane potential. Types of ion-selective electrodes. Construction of solid state electrodes, liquid membrane electrodes, glass membrane electrodes and enzyme electrodes, Selectivity coefficients, Glass electrodes with special reference to H+, Na+ and K+ ions. Applications of ISE in analysis of environmentally important anions like F-, Cl, Br-, I-, NO3- and CN-. Advantages of ISE. Coulometry: Principle. Coulometry at constant potential and constant current. Instrumentation. Applications and advantages of coulometric titrations. Electrochemical microscopy: Introduction to scanning probe microscopy (SPM), scanning tunnelling microscopy (STM), atomic force microscopy (AFM) and scanning electrochemical microscopy (SECM).

Unit-IV: Thermal methods of analysis 15h

Introduction to different thermal methods, Thermogravimetry (TG and DTG), Static thermogravimetry, quasistatic thermogravimetry and dynamic thermogravimetry, Instrumentation-Balances, X-Y recorder, Stanton-Redcroft TG-750, Thermogram, Factors affecting thermogram, Applications of thermogravimetry, Differential Thermal Analysis (DTA)-Theories, DTA curves, Factors affecting DTA curve, Applications of DTA, simultaneous determination in thermal analysis, Differential Scanning Calorimetry (DSC)- Introduction, Instrumentation, DSC curves, factors affecting DSC curves, applications, Thermogravimetric titration-Theory, Instrumentation and applications.

STPG04CHE02 Major DSC – Paper – II (Special – IV Analytical Chemistry)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60h (4h/week) 15h/ unit

Unit-I: Pharmaceutical and clinical analysis 15h

Requirements of a quality control laboratory for pharmaceutical units, a general idea about following classes of drugs and their analysis. a. Antibiotics- Chloroamphenicol, ampicilline, terramycine b. Vitamins-Thymine hydrochloride (Vitamin-B1) Riboflavin (Vitamin-B2), Ascorbic acid (Vitamin-C) c. Sulpha drugs- sulphaguanidine, sulphapyrazine, sulphanilamide d. Narcotics and dangerous drugs- screening by GC and TLC and spectrophotometric measurements. Composition of blood, sample collection for blood and urine, clinical analysis, Immuno Assay-RIA, Setting up of RIA and applications, Fluorescence Immunoassay, Enzyme immunoassay, Blood gas analyzer, Trace elements in the body.

Unit-II: Soil analysis and coal analysis 15h

Soil analysis- Classification and composition, pH and conductivity, analysis of constituents such as nitrogen, phosphorous, potassium and micro-constituents. Coal analysis- Proximate analysis (moisture content, ash content, volatile matter, fixed carbon). Ultimate analysis (carbon, hydrogen, sulphur, nitrogen, oxygen content). Combustion of carbonaceous fuel- Flue gas. Calorific value and its units.

Unit-III: Corrosion and corrosion analysis 15h

Definition, draw backs and theories of corrosion-dry and wet corrosion, Different types of corrosion-Pit, Soil, chemical and electrochemical, intergrannular, waterline, microbial corrosion, measurement of corrosion by different methods, factors affecting corrosion, passivity, galvanic series, protection against corrosion, design and material selection.

Unit-IV: Automation in analytical chemistry 15h

Automation in the laboratory, Principle of automation, automated instruments, classification, continuous analyzer, automatic instruments, semiautomatic instruments GeMSAEC Analyzer, Flow Injection Analysis (FIA), Dispersion coefficient, Factors affecting Peak Height, microprocessor based instruments, Numericals based on above. Hyphenated techniques: Introduction to GC-MS, LC-MS, ICP-MS and MS-MS (Tandem) spectrometry.

STPG04CHE07 Practical III

Total Marks – 50 (30 + 20)

9 h /week

A. Organoanalytical chemistry

1. Estimation of sulphur, nitrogen, phosphorous, chlorine in organic compound.
2. Estimation of phenol.
3. Estimation of aniline.

B. Separation techniques

Ion exchange

1. Separation and estimation of zinc and magnesium/cadmium in a mixture on anion exchanger.
2. Separation and estimation of chloride and iodide in a mixture on anion exchanger.
3. Determination of total cation concentration in water.

Solvent extraction

1. Estimation of Copper using Na-DDC.
2. Estimation of Iron using 8-hydroxyquinoline.
3. Estimation of Nickel using DMG.
4. Estimation of Cobalt using 8-hydroxyquinoline.
5. Estimation of Nickel by synergistic extraction with 1,10-phenanthroline and dithizone.

STPG04CHE08 Practical IV

Total Marks – 50 (30 + 20)

A) Paper chromatography

1. Separation and estimation of copper and nickel in a mixture.
2. Separation and estimation of cobalt and nickel in a mixture.

Thin layer chromatography

Separation and estimation of bromophenol blue, congo red and phenol red in a mixture.

B. Water analysis

Mineral analysis: Temperature, pH, conductivity, turbidity, solids, alkalinity, chloride, fluoride, sulphate, hardness Demand analysis: DO, COD Heavy metals: Fe, Cd and Pb D.
Demonstrations 1. Gas chromatography 2. HPLC.

List of books:

1. Essentials of Nuclear Chemistry: H. J. Arnikar (Willey Eastern Ltd)
2. Substoichiometry in Radioanalytical Chemistry: J. Ruzicka and J Stary (Pergamon Press)
3. Thermal analysis: Blazek (translated by J. F. Tyson, Van Nostrand)
4. Instrumental Methods of Analysis: Willard, Meriit and Dean(Van Nostrand)
5. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
6. Vogel's Text Book of Quantitative inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)
7. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
8. Atomic Absorption Spectroscopy: Robinson (Marcel Dekker)
9. Instrumental Methods of chemical Analysis: Braun (Tata McGraw-Hill)
10. Radiochemistry: A. N. Nesmeyanov (Mir Publications)
11. Analysis of Water: Rodier
12. Ion selective electrods: Koryta (Cambridge University Press)

13. Instrumentation in analytical chemistry: Borman (American Chemical Society)
14. Industrial Chemistry: Arora and Singh (Anmol Publications)
15. Diffraction Methods: John Wormald (Clarendon Press)
16. Electroanalytical Chemistry: Bard (Dekker)
17. Analytical Chemistry by Open Learning (Wiley)
18. An Introduction to Electron Diffraction: Beeston (North Holand Publishing Co.)
19. Material Science and Engineering: V. Raghavan (Printice-Hall of India)
20. Practical Physical Chemistry: J. B. Yadav (Goel Publishing House)

STPG04CHE03 Major Elective – Paper – IV (Polymer Chemistry – II)
Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)
60 h (4 h per week): 15 h per unit

Unit I: Polymerization 15h

Types of polymerization, addition-chain, free radical, ionic polymerization, step polymerization, electro-polymerization, ring-opening polymerization.

Unit II: Techniques of polymerization ` 15h

Techniques of polymerization-suspension, emulsion and bulk polymerization, coordination, polymerization mechanism of Ziegler Natta polymerization, stereospecific polymerization, interfacial polycondensation, mechanism of polymerization.

Unit III: Characterization of polymers ` 15h

Electronic, IR and NMR spectral methods for characterization of polymers (Block and Graft) Thermal methods-TGA, DTA, DSC, thermomechanical and X-ray diffraction study, Block and Graft copolymers, random, block, graft co-polymers, methods of copolymerization.

Unit IV: Specific polymers 15h

A) Biomedical polymers: Contact lens, dental polymers, artificial heart, kidney and skin.
B) Inorganic polymers: Synthesis and application of silicon, phosphorous and sulphur containing polymers.
C) Coordination polymers: Synthesis and applications of coordination polymers.

STPG04CHE04 Major Elective – Paper – IV (Medicinal Chemistry – II)
Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)
60 h (4 h per week): 15 h per unitUNIT-I: 15 h

A] Drug rules and drug acts, Overview of Intellectual property right, Indian and International framework for patent protection.
B] Chromatographic separation techniques for drugs: TLC, Paper chromatography, GC, HPLC, LCMS. Dignostic agents: Radio Pharmaceuticals, Radiology and CT.

UNIT-II: 15 h

A] Statistical method: For sampling and interpretation of results, Statastic in quality control, T-Test, F-Test, Validation of analytical methods as defind proceding USP Radioimmuno analysis, Investigational drugs.
B] Anti-Viral agents: Introduction, viral diseases, viral replication, and transformation of cells, investigation of antiviral agents,. Chemotherapy for HIV. Synthesis of: Idoexuidine, acyclovir, amantadine and cytarabin.
C]Anti-malarial agents: Introduction, malarial parasite, and its life cycle, development of

antimalarials, chemotherapy of malaria. Synthesis of: Chloroquin, primaquin, proguanil, and Quinacrine.

UNIT-III: 15 h

A) Histamines and Antihistamic agents: Introduction, histamine H1-receptor antagonists. Inhibitors of histamine release. Synthesis of: alkyl amines, phenothiazines, piperzines derivatives.

B) Antibiotics: Introduction, β-lactam antibiotics, classification, SAR and chemical degradation of penicillin, cephalosporins-classification, tetracycline antibiotics-SAR, miscellaneous antibiotics. Synthesis of ampicillin, cephradine, methacycline, chloramphenicol.

UNIT-IV: 15 h

A) Anthelminitics and antiamoebic drugs: Introduction to Helminthiasis, Anthelminitics, drugs used incestode infection, drugs used in trematode infection, origin of antiamoebic drug, drugs used in nematode infection. Synthesis of: Clioquinol, Iodoquinol, Haloquinol, Dichlorphen, Niclosamide.

B) Anti-inflammatory drugs: Introduction, etiology of inflammatory diseases. The inflammatory response, biochemical response. Synthesis of: Phenyl butazone and its derivatives, pyrazolone derivatives, pyrole and indole acetic acid derivatives.

STPG04CHE05 Major Elective – Paper – IV (Nuclear Chemistry – II)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60 h (4 h per week): 15 h per unit

Unit-I: Radiation Chemistry, Radiolysis 15h

Measurement of dose. Dosimetric terms and units (Roentgen, REM, Rad, Gray, Sievert), inter conversions, calculation of absorbed dose-various types of dosimeters, chemical dosimeters (Fricke and Ceric sulphate), experimental methods, TLD badges, Radiolysis-definition, process, Radiolysis of water and aqueous solutions, hydrated electron, Effect of radiation on biological substances, genetic effects, radiation effects on organic compounds (Halides carboxylic acids), polymers, nitrates and solid thermoluminescence

Unit-II: Hot Atom Chemistry and Radiochemistry 15h

Recoil energy and calculations, Szilard Chalmers effects, Kinetics, primary and secondary retention-effect ofvarious factors on retention and its uses, Mossbauer effect- principle, instrumentation and chemical applications.

Unit-III: Radioanalytical techniques 15h

Neutron sources, Neutron activation analysis, principle, methodology and application for trace analysis, Isotope dilution analysis-principle and application, Isotopic exchange reaction, mechanism and application inuse of radioisotopes and tracers, radioactive dating based on carbon-14 and lead isotopes.

Unit-IV: Radiopharmaceuticals 15h

Radioimmunoassay (RIA), discovery, principle, set up of RIA, Principle of Immunoradiometric assay (IRMA),principle and set up, Radiopharmaceuticlas, classification of products, preparations, quality control aspects,99Mo-99mTc generator, Cylotron based products, PRT studies, Therapeutic applications , Radiotherapy.

STPG04CHE06 Major Elective – Paper – IV (Applied Analytical Chemistry – II)

Credits : - Theory = 04 Marks : - Theory = 100 (80 + 20)

60 h (4 h per week): 15 h per unitUnit-I: Water treatment 15h

Hardness of water and types of hardness. Problems due to hardness. Removal of hardness by lime-soda process, Zeolite process and synthetic ion-exchange resins. Principle,

instrumentation and comparison ofthese three processes. Numericals based on hardness removal. Desalination of sea-water.

Unit-II: Polymer chemistry and Glass analysis 15h

Polymer chemistry: Definition, classification, co-polymers, conducting polymers, determination of molecular weight, acid value, saponification value, iodine value and hydroxyl groups of polymers., TGA and DTA studies of polymers, LDC polymers. Rubbers, elastomers, silicones. Glasses: Introduction. Physical and chemical properties. Composition of ordinary glass and special glasses. Determination of silicon, calcium, magnesium, aluminium, chloride, sulphur, barium, arsenic, antimony, chromium, cobalt, copper, iron, manganese, nickel, titanium in glasses.

Unit-III: Cosmetic technology and leather analysis 15h

Importance of quality control in cosmetic preparations, stability testing of various cosmetic products, Study of rheological properties of semi-solid preparations, evaluation of active ingredients in finished products like shampoos, hair dyes, toothpaste, talcum powder, lip sticks, sun screen preparations. Analysis of leather: Determination of moisture, acid, free sulphur, total ash, chromic oxide in leather, tensile strength and stretch of leather.

Unit-IV: Explosives and propellants 15h

Classification of explosives, characteristics of TNB, TNT, RDX, dynamite, lead azide, ammonium nitrate, ammonium picrate. Pyrotechniques. Analysis of explosives and propellants: Heat of explosion, moisture determination by Karl-Fisher reagent, vacuum oven drying and non-aqueous titration. Stability by different methods. Total volatiles. Qualitative tests for explosives. Colorimetric methods for nitro-compounds. Mechanical tests for explosives.

STPG04CHE09 Paper V (Research Project - II)

Marks = 100 (80+20) (12 Hrs/week)

A) Seminar Presentation of 20 minutes duration will be a part of internal assessment for 10 marks (1 credit). Seminar should be delivered by the student under the guidance of concerned teacher on the topic allotted by the teacher. The **topic will be related to the syllabus**. Marks will be allotted by a group of teachers.

B) Student had to do actual experimental work on the Synopsis submitted in Research Project Phase – I. After completing the Experimental Work and analysis the students has to submit the detailed Project Work in the form of project thesis to the department for 100 marks.

Presentation of Seminar	**10 marks**
Synopsis work and thesis submission	**80 marks**
Presentation of Thesis	**10 marks.**
Total	**100 marks.**