SOLAPUR UNIVERSITY, SOLAPUR
Ph. D. Course Work in Chemistry

There shall be FOUR theory papers each of 100 marks. The first three papers i.e Paper- I, Paper- II and Paper- III are compulsory whereas a student shall have to select any one paper from amongst the five elective papers under the paper IV.

Paper I-(compulsory) 100Marks
Research Methodology and Information Communication Technology

Paper II-(compulsory) 100Marks (60 Periods)
PCHEM-02A: Recent trends in Physical Chemistry
OR
PCHEM-02B: Recent trends in Inorganic Chemistry
OR
PCHEM-02C: Recent trends in Organic Chemistry
OR
PCHEM-02D: Recent trends in Polymer Chemistry
OR
PCHEM-02E: Recent trends in Analytical Chemistry

Paper III (compulsory) 100Marks (60 Periods)
PCHEM-03A: Modern Topics in Physical Chemistry
OR
PCHEM-03B: Modern Topics in Inorganic Chemistry
OR
PCHEM-03C: Modern Topics in Organic Chemistry
OR
PCHEM-03D: Modern Topics in Polymer Chemistry
OR
PCHEM-03E: Modern Topics in Analytical Chemistry

Ph.D COURSE WORK IN CHEMISTRY

Paper II
Recent trends in Physical Chemistry

(PCHEM-02A:PHYSICAL CHEMISTRY)

Unit I: NMR, IR and Mass Spectroscopy:

a) IR spectroscopy: Applications of IR in analysis
b) NMR spectroscopy: Chemical shifts and coupling constant, Introduction of NOE, DEPT and 2D NMR, 13CNMR and its applications.
c) Mass spectroscopy: Mass spectral fragmentation of complex molecules and its applications.
d) Combined spectroscopic problems based on IR, NMR and mass spectral data.

Unit II : Thermodynamic properties of solids and liquids:

Thermodynamic properties of solids :

Differences between gases and condensed phases, the influence of crystal symmetry on macroscopic properties. Thermal properties of crystalline solids. The contribution of anhormonicity to the properties of crystal. Some properties of complex solids and imperfect solids. Electronic heat capacity of metals.

a) Thermodynamic properties of liquids:

Bulk properties of liquids, the structure of liquids.

X – Ray scattering from liquids. Determination of structure of a liquid. Molecular theories of liquid state.

Unit III : Preparation of Materials and Applications :

Thin films and Langmuir- Blodgett Films:

Preparation of techniques; sol – gel, spin coating, Langmuir- Blodgett (LB) photolithography, properties and applications of films.

a) Materials of solid state devices: Organic and In-organic materials for rectifiers, transistors, capacitors and their applications in optoelectronic and photovoltaic devices.

Unit IV: Kinetics of Redox Reactions:

Kinetics of catalyzed reactions: Homogeneous and Heterogeneous.Positive, negative and auto catalyzed reactions. Induced reactions, promoters and poisons. Theory of catalysis: intermediate compound formation and adsorption theory, characteristic of catalytic reaction and activation energy of catalyzed reactions.

Micellar catalysis: Models for Micellar catalysis (Menger and Portony, Sepulveda, Berezin, Piszkiewicz and Raghavan and Srinivasan models), phase transfer catalysis, general mechanism, and difference between phase transform and micellar catalysis.

Unit V: Thermodynamic and Dielectric properties of liquids and solutions:

Structure of liquids, relationship between structure and thermodynamic properties, Molecular theory of monatomic and polyatomic liquids, thermodynamics of phase equilibria, statistical molecular description of phase transitions, chemical potential and partial molar quantities, mixing and excess thermodynamic properties of mixtures, statistical mechanical theories of non electrolyte and electrolyte solutions, influence of solute on structure of water, structure of water near a surface.

Static Dielectric constant: Dipolar interactions, dipolar molecules in gases and in dilute solutions.Debye equation and its generalizations.

Reference Books -

1. V.M. Parikh - Absorption spectroscopy of organic compounds (C.J. Wiley)
2. D.W. Williams and Flemming spectroscopy methods of organic compounds
3. Fundamentals of moleculor spectroscopy C.N. Banwell.
4. Physical chemistry, R.S. Berry ,S.A. Rice and J. Ross Oxford University Press 2000
5. Theory of Defect in solid A.M. Stoneham Oxford University press 1975
6. Thermodynamics of crystals D.C. Wallace Wiley 1972
7. Solid state physics N.W. Ashcrott and N,D. Mermin Sauders College
8. Material science and Engineering AN introduction W.D. Callister Willey
9. Principals of Solid state H.V. Keer Willey Eastrn
10. aterials Science J.C. Anderson k.D. Leaver J.M. Alexander and R.D. Rawlings ELBS
11. Chemical Kinetics by K.J. Laidler
12. Kinetics and mechamism by A.A. Frost and R.G. Pearson
13. Micellar effect on the kinetics and mechanism of chromium (VI) oxidation of organic substrates By Asim K. Das, Coordination Chemistry Reviews, Vol. 248, p 81-89 (2004).
14. Some aspect of electron transfer reactions involving organic molecules by B.Seturam, Allied Publishers, 2003.
15. Surfactant and polymers in aqueous solution by Bo. Johnson Bjorn Lindman, Krister Holmberg and Bengt Kronberg, John-Wiley and Sons, 1998.
16. Trends in Chemistry of materials, C.N.R. Rao.
17. R.S. Berry, S. A. Rice and J. Ross, Physical Chemistry, 2nd Ed., Oxford University Press, New York, 2000.
18. A. Ben-Naim, Water and Aqueous Solutions, Plenum Press, New York, 1974.
19. D. A. McQuarrie, Statistical Mechanis, Harper and Row Ltd., New Work, 1976.
20. Y. Marcus, Introduction to Liquid State Chemistry, Wiley, New Work, 1977.

21. K. S. Pitzer, Theromodyanmics, 3 rd Ed., McGraw Hill, New Work, 1955.
22. H. Frohlich, Theory of Dielectrics: Constant and Dielectric Loss, 2nd Ed. Oxford University Press, New York, 1958.
23. V. I. Gaiduk, Dielectric Relaxation and Dynamics of Polar Molecules, World Scientific Publishing Co., Singapore, 1999.
24. J. B. Hasted in Water: A Comprehensive Treatise, edited by F. Franks (Plenum Press, New York, 1973), Vol. II.
25. Chemical Kinetics by Keith J. Laidler, third edition, Person (2004).
26. Chemical Kinetics and Reaction Dynamics by Santosh K. Upadhyay, Anamaya (2008).
27. Some Aspects of Electron Transfer reaction Involving Organic Molecules by B. Sethuram, Allied Publishers (2003).
28. Mechanism of Inorganic Reactions by F. Basolo and R.G. Person, John Wiley (1967).

Paper – II

Recent Trends in Inorganic chemistry

(PCHEM-02B:INORGANIC CHEMISTRY)

1. Mossbauer Spectroscopy of Iron and Tin compounds :
   Basic Principles, Instrumentations, spectral parameters and spectrum display. Application of the technique to the studies of

i) Bonding and structure of Fe^{+2} and Fe^{+3} compounds including those of intermediate.

ii) Sn+2 and Sn+4 compounds, nature of M-L bond, co-ordination numbers, structure

iii) Detection of oxidation state and inequivalent MB atoms and Numerical problems

2. Structural Tin Chemistry - Introduction, Inorganic systems, Tin metal, Intermetallic compounds monomolecular Solids, Inorganic cluster compounds, Tin halides, chalcogenides, Tin(IV) chalcogenides And related Compounds, Inorganic complexes of Tin(II) and Tin(IV) with nitrogen Donar ligands, Bonding in Tin compounds, organo tin compounds.

3. Thermal Analysis of Inorganic compounds :
   Principle, Instrumentation and morphology of TGA, DTA and DSC, Investigation of Decomposition products by NIR, IR and Mass Spectroscopy. Application and Numerical problems.

4. Instrumentation for Characterization of Inorganic solid state material:

a) Microscopy & Compositional and Tech. :
   TEM,SEM,HREM,AFM,XRD & EDAX

b) Spectroscopic Techniques: AAS, ESCA, UV-VIS-NIR

c) Interference (SQUID) Magnetometry

5. X-ray Photoelectron Spectroscopy and X-ray absorption Spectroscopy XRP, experimental aspects, chemical shift, shake up, multiplate splitting and valance Orbital spectra,

Sulphur containing ligands and their complexes, spectra of metal halides. X-ray monochromators, X-ay absorption spectra of transition metal complexes.

6. Metal Oxides:
   TiO_2, $SrTiO_3$, Fe_2O_3, other oxides & synthesis, Applicators of metal oxide – sensors Catalysis, photodegradation, PEC etc.

Reference books :

i) H.H. Willard L.L. Merritt, J.A.Dean and Settle : Instrumental methods of chemical analysis, CDVN/AEWP.

ii) Ashcrft : Thermochemistry of metal complexes Academic press

iii) Goldanski V.1. and Harber R.H. Chemical application of Massbaur Spectroscopy, (Academic press, 1968)

iv) Greenwood N.N.Gibbs T.C. : Mossbaur Spectrocopy, Chapmann Hall, 1971

v) Wendland W.W. Thermal method, John Wiley, 1986

vi) X-ray absorption Spectroscopy in Inorganic Chemistry by B. D. Culity

vii) Principals of solid state H,V Keer wiley Eastern (1999)

viii) Solid state physics S.O. Pillai Wiley Eastern.

ix) Emelius and Sharpe: Advances in inorg.chem. Vol. 1,2,16

Paper II- Recent trends in Organic Chemistry
(PCHEM-02C:ORGANIC CHEMISTRY)
(Reaction Mechanism and Spectroscopy)

Reaction Mechanism:

Topic 1. Advanced Stereochemistry and Asymmetric Synthesis, Stereochemistry of fused ring systems, conformations of cholestane, olenane, yohimbine

Topic 2. Writing a reasonable reaction mechanism, Reactive Intermediates, Reactions and Rearrangements Spectroscopy

Topic 3. Introduction to IR, UV, NMR, & MS techniques, applications in analysis

Topic 4. NMR Spectroscopy- Introduction, COSY, NOESY, NOE, DEPT, 2D-NMR, Structural assignments of organic compounds employing the above 2D-NMR methods, C13 NMR and its applications

Topic 5. Mass Spectroscopy- Mass spectral fragmentation of complex molecules and its applications

Topic 6. Structural assignment by employing above techniques

Reference Books –

1. Tereochemistry of carbon compounds – E.L. Eliel
2. Introduction to stereochemistry – K. Mislow
3. Conformational analysis – E.L. Eliel, N.L. Allinger, S. J. Ayngal
4. Spectroscopic methods in organic chemistry – D.H. Williams, I fleming
5. Spectroscopic identification of compounds – Silverstein and Bassler
6. Absorption spectroscopy of organic compounds – V.M. Parikh
7. Spectroscopy of organic compounds – P.S. Kalsi
8. Applications of absorption spectroscopy to organic compounds – J.R.Dyer
9. Organic reaction mechanism – R. bresslow
10. Mechanism and structure in organic chemistry – B.S. Gould
11. Reactive intermediates in organic chemistry – (John Wiley) N.S. Issacs
12. Organic reaction mechanism (Tata McGraw Hill) R.K. Bansal
13. Basic principles in organic chemistry (Bonjamin) – J.D. Roberts and M.C.Caserio
14. Organic chemistry (MeGraw Hill) – Hendrickson, Cram and Hammond
15. A Gaide book to mechanism in organic chemistry – Peter Sykes
16. Advanced organic chemistry – (McGraw Hill) – J. march.

Paper-II Recent trends in Polymer Chemistry
(PCHEM-02D:POLYMER CHEMISTRY)

(Polymer Chemistry & Physics)
POLYMER CHEMSITRY

Unit-I: General introduction to polymers (chemistry perspective):
Definitions, types of polymers, random, homo, block copolymers, architectures (linear, branched, cross-linked, grafted); classification (by reaction products-condensation/addition; by mechanism- step growth/chain growth; by application – plastics/elastics/ fibers); Number and weight average MW, MWD, Methods of MW and MWD determination; Polymer Crystallization, Glass transition and thermal properties, isothermal and non-isothermal crystallization.

Unit-II: Step Polymerization:
Reactivity of Functional Groups, Kinetics of Step Polymerization, Molecular Weight Control, Need for stoichiometric control A-A+B-B condensation, Melt polycondensation, Solid state Polymerization, Solution/Melt properties of linear versus branched condensation polymers, Specific examples: polyesters, polyethers, polyamides, polyurethanes, polyurea and polycarbonate.

Unit-III: Addition Polymers:
Radical chain polymerization, rate of radical chain polymerization, initiation, propagation, termination, chain transfer, auto acceleration (Trommsdorf effect), kinetics of initiation and propagation, ATRP, RAPT, Nitroxide mediated polymerization.

Unit-IV: Conducting Polymers:
Concepts, discovery, polyaniline, polythiophene, polypyrrole, poly(phenylnevinylenes), polyphenylvene, low band gap polymers, Application of conducting polymers in opto-

electronic devices, one and three dimensional conducting nano-materials and their futuristic aspects. Polymer LEDs, FETs and PVs.

POLYMER PHYSICS

Unit-V:

Polymer blends and composites: Physical and Reactive blends, phase separation, nano composites and synthetic natural fiber composites.

Unit-VI:

Polymer processing: Extrusion, Molding, Injection/Blow molding, Structure development during processing.

Processing thermoplastics material, polyolefins, injection moulding, thermo forming, extrusion, General Features of single screw extrusion, mechanism of flow, Analysis of flow in Extruder, general features of twin-screw extruder, pultrusion, blow moulding and casting : introduction, details of process. Rotational moulding, calendering and its analysis, structural foaming. Moudling: sandwitch moulding, RIM. Moulding of thermoset: preparation of material for moulding, compression moulding, transfer moulding. Effect of processing, microstructural changes, Shrinkage and distortion, residual Stress. Processing of fibers and fabrics, spinning and post-spinning Processes.

PAPER II

Recent Trends In Analytical Chemistry

(PCHEM-02E:ANALYTICAL CHEMISTRY)

(Advanced Instrumental Methods for chemical characterization and analysis)

Unit – I - Atomic Emission Spectroscopy -

Introduction, Emission Spectra, Flame emission spectroscopy, Evaluation methods, Evaluating Flame emission spectroscopy, Direct current plasma, Inductively coupled plasma, sample introduction, ICP instrumentation, Applications, Determining alkali metals by Flame photometry.

Unit – II - Polarography and Amperometry -

Introduction, DME, Paleographic wave, half wave potential, maxima suppressors, Qualitative and quantitative analysis. Organic and inorganic applications. Oscillographic polarography, cathode ray polarography, Anodic stripping paleography Alternating current polarography, Amperometric titrations

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Unit – III - Electron spin Resonance Spectroscopy.

Introduction, Instrumentation, qualitative analysis, study of free radicals, structure determination, Analytical applications.

Unit –IV - Gel Permeation and Ion-pair chromatography

a) Gel permeation choromatography -

Introduction techniques in gel chromatography, theory of gel chromatography, applications of gel chromatography, salting out chromatography

b) Ion-pair chromatography -

Introduction, principles of ion pair extractrion, bonded phase chromatography, Applications of ion-pair chromatography.

Unit – V Thermoanalytical Methods -

Introduction, thermogravimetric analysis, Automatic thermographic analysis, Differential thermal analysis, thermometric titrations and their applications.

Recommended Books -

1. “Vogel’s textbook and Quantitative chemical analysis”, by J. Mendham, R.C.Denney, J. D. barnes and M.J.K. Thomas, Person Education Pvt. Ltd, New Delhi.
2. Instrumental methods of chemical Analysis B.K Sharma, Goel Publishing House, Meerut.
3. Instrumental Methods of Analysis, Willard, Merrit, Dean, Settle CBS Published, New Delhi.
4. Molecular Spectroscopy – Principles and Application – P.R. Singh, S.K. Dikshit, S. chand and Co. New Delhi.
5. Instrumental Methods of Chemical Analysis by Chatwal and Anand.

Paper III – Modern Topics in Physical Chemistry

(PCHEM-03A:PHYSICALCHEMISTRY)

Unit I : Description of crystal structures :

Packing in crystals; Factors affecting crystal structures; Structure of some most common solids; Compact and micro porous solids like zeolites, AIPO's, etc; Mesoporous structures and their symmetry and space groups; packing structures in different planes, shear planes; Non-stoichoimetry.

Unit II : Synthesis, Characterisation and properties of solids:

Synthetic methods for inorganic solids; general characterization techniques; electrical and magnetic properties of solids; structure – property co relations.

Unit III: Nano materials:

a) General considerations – definations, consequences of size reduction, structural, thermodynamic, optical, electrical and magnetic properties.
b) Methods of Synthesis – Chemical, Biochemical processes.
c) Surface fictionalization – Factors governing the stability and assembly.
d) Characterization of surface probe spectroscopic techniques.
e) Possible Applications - Catalysis, Composites and Bio applications.

Unit IV: X -Ray Crystallography :

Unit cell, crystallographic directions and planes,
X – Ray diffraction, Bragg's law, symmetry and space group, determination of crystal structure, diffraction techniques.

Unit V: Radio-active tracers:

Principles and Applications, Sample preparation for analysis, Isotopic dilution analysis, radiometric titrations, radio chromatography, Non tracer methods – Activation analysis, absorption methods, activities in the atmosphere and dating procedures.

Reference Books -

1. Solid State Chemistry - by N.B. Hanny
2. Solid state Chemistry - by J Kumar
3. Introduction to crystal cmemistry by R.C. Evans
4. An Hand book of nano chemistry by P. Saloman
5. Nanomaterial, B. Viswanathan.
6. Nanotechanology Applications, Daniel Minoli.
7. Nanocrystalline Oxid materials, K.C. Patil, M.S. Hegade, Tanu Rattan, S.T. Aruna.
8. Crystal Growth Theory and techniques Vol. 2 edited by C.H.L. Goodman Plenum press New Work, 1978.
9. Crystal Structure Analysis Martin J Buerger John wiley & Sons New York 1960
10. Elements of X ray crystallography leonid V azarofff Mcgrw hill book camp New York
11. Structure Determination by X ray crystallography M.F. C ladd & R.A. Palmer, Plenum Press, NewYork. 1979.
12. Nuclear and Radiochemistry - G. Friedlander J. Kennedy and J.M. Miller
13. Radioisotope technique - Overman and clark
14. Modern Radiochemical practice - Coole and unkan
15. Essentials of nuclear chemistry - H.J. Aruikar
16. Radioactive isotopes - W.J. Whitte house J.L. putton
17. Nuclear and Radiation Chemistry - B.K. Sharma, Krishna Prakashan Media (P) Ltd, Meerat

Paper – III
Modern topics in Inorganic Chemistry
(PCHEM-03B:INORGANIC CHEMISTRY)

1. Inorganic Photochemistry
   Photophysical process energy levels and spectra, spectra of metalcomplexes, ionic
   Energy levels in cubic symmetry LFT, weak fields Intermediate intensities of
   electronic Transitions, Lower symmetry ligand field emission spectra, excitation
   spectra, stoke shifts. The study of photosubstitutions, experimental aspects,
   photochemistry of Cr(III), Co(III) and Fe(III),

2. Biological Iron Binding
   General significance of iron in biology, Prology known physiological roles of iron Relevant biogeochemical properties of iron, iron compounds in plants and animals of iron Therapy, ferrous vs ferric ion in biological transport, the hydrolysis of ferricion, polynuclear Iron chelates, polynuclear iron in biological systems.

3. Reactions of complexes
   Ligand substitution reactions, Rates of substitution reaction, classification of mechanism. Ligand substitutra in octahedral and squre planar complexes. Classification of redox Reaction inner & outer sphere mechanism.

4. Ion Setective elements.
   Electrode potential and membrane activity in selective electrode design and Instrumentation of ion selective electrode, important applications in analysis of F,Cl,CN,NH_4^+ NO_3^-, K^+,Na,Mg^{++},Ca^{++},Hg^{++},Pb^{++}

5. Organometallic Chemistry - d-block carbonyls, Metallocenes, metal-metal bonding & metal clustures, Ligand Substitution, oxidative addition and reductive elimination.

6. Recent Advances in Chemistry of Lanthanide Elements.
   Introduction, compounds in lower oxidation states halides oxides and chalcogenides Aqueous systems, hydrides, Dipositive lanthanide compounds, Tetrapositive oxidation states Fluorine oxygen compounds, Interpretation of redox stability, spectroscopic correlation, Electronic spectra and magnetic properties of lanthanides.

References books :

1. A.W. Adanson and P.D. Fleisehaner : concepts of Inorganic Photochemistry -J. wiley.
2. Structure and bonding Vol.6 and 11 Springer Verlag.
3. C.B. Anaphlett, Inorganic Ion Exchange
4. J.E.Huheey, Inorganic chemistry.
5. W.V. Stulik, Analysis with Ion selective electrodes J.Wiley.
6. Progress in Inorganic Chemistry Vol.30 ed. S.j. Lippard. Wiley.
7. Inorganic Photochemistry J.Chem.Educ. Vol.60 Nold 1983.
8. Advances in inorganic Chemistry Ed.A.G. Sykes (1991) Vol.36 Academic press INC-lando
9. Advances in Inorganic Chemistry and Radiochemistry, Ed.H.J.
10. Inorngaic chemistry by shriver & attains 4^{th} edition.

Paper III- Modern Topics in Organic Chemistry

(PCHEM-03C: ORGANIC CHEMISTRY)

[Bond formations, Retro synthetic New synthetic methodologies]

Topic 1. Advances in C – C bond formations: Heck, Suzuki, Stille and Sonogashira reactions, Alkene and Alkyne Metathesis

Topic 2. Recent advances in C – Heteroatom bond formations: Hydroamination, Olefin Oxidation

Topic 3. Retrosynthetic Analysis and Retro synthesis of heterocycles, agrochemicals, natural products, perfumery compounds & Selected Total Syntheses

Topic 4. New synthetic methodologies and applications of reagents: microwave and ultrasonic methods in synthesis, phase transfer catalysts, electro- organic synthesis, ionic liquids, enantio and diastereoselective synthesis use of oxone, hypervalent iodine reagents, complex metal hydrides.

Topic 5. Organometallics; Fundamental Principles of Organometallic Catalysis, organometallic compounds of Cu, Ni, Co, Se, and organoboranes for orgaic synthesis

Topic 6. Synthesis and applications of the followings drugs- Cardiovascular, antidiabetics, Antineoplastics, Antivirals, Anti AIDS, Antibiotics.

Reference Books -

1. Reagents in organic synthesis – Fieser and Fieser
2. Modern Synthetic reactions – H.O. House
3. Selected organic synthesis – R.E. Ireland
4. Some modern methods of organic synthesis – W. Carruthers (Cambridge University Press)
5. Organic Chemistry of drug synthesis – D. Lednicer and L.A. Mitschers
6. Designing organic synthesis – S. Warren (John-Wiley)
7. Synthetic reagents vol 5 J.S. Pozoy (Ellis-Hardwood)
8. Advanced organic synthesis, methods and techniques – R.S. Morisson
9. Advanced Organic Chemistry Part – B – Carey and Sundberg
10. Organic synthesis, concept, methods and starting materials – J. Furnhop and G. Perzlin
11. Organic synthesis, strategy and control – Warren and Wyatt
12. Medicinal Chemistry – Burger
13. Medicinal Chemistry (Wiley East) – A. Kar
14. Principles of medicinal chemistry – W.O. Foye
15. Advances in organometallic chemistry – Stone and West
16. Organometallics in organic synthesis – Swan and Black
17. Transition metal intermediates in organic synthesis – C.W. Bird

Paper-III Modern topics in Polymer Chemistry

(PCHEM-03-D:POLYMER CHEMISTRY)

(Fundamental Methods, Morphology, Analysis and Polymer Characterization.)

Unit-I: POLYMERISATION METHODS:

Bulk, solution, suspension, precipitation, emulsion, inverse emulsion, melt, inter facial (phase transfer catalyzed interfacial polymerization) and solid state, (gas phase). Batch and continuous, merits and limitations of each process and comparison of various polymerization processes with suitable commercial examples. (Polymerization in ionic liquids, in super critical media. Approach to combinatorial polymer synthesis).

Unit-II: MORPHOLOGY OF POLYMERS:

Crystalline and amorphous phase, factors affecting polymer crystallinity, XRD analysis for polymer crystallinity, crystallites, amorphous regions, spherulites, single crystal, fibrils, transitions, glass transition temperature (Tg), factors affecting Tg, determination of Tg by dialatometry, TMA and DSC, (Principles of TMA and DSC expected).

Unit-III: NMR AND MASS SPECTROSCOPY OF POLYMERS:

Interpretation of H-1 NMR of organic monomers, introduction to C-13 NMR, chemical shift, C-H spin coupling, FT-NMR, Wide-Band proton decoupled CMR, solid state CMR, high resolution CMR of PET and PPO, copolymer composition. Analysis of stereoregularity by CMR in PP and polybutadienes. Polymer analysis by mass spectrometry, polymer pyrolysis GC-MS, FABMS technique, MALDI-TOF

Unit-IV: X-RAY DIFFRACTION ANALYSIS:

Methods of production of x-rays, properties of x-rays, diffraction of x-rays, Bragg's Law, latice and powder diffraction methods, small angle scattering of x-ray by polymers, Analysis

of molecular structure of simple polymers by XRD, determination of crystallinity, size and orientation of crystallites.

Unit-V: SPECIALITY POLYMERS:
I. Hydrogels and stimuli sensitive hydrogels. II. Polymer adhesives. III. Polymer membranes for fuel cell. IV. Silicone resins. V. Polymer blends and alloys. VI. Click polymerization.

Unit-VI: INORGANIC POLYMERS: Phosphorous nitrogen polymers, introduction and structural chemistry, synthesis and reactions, polymer chemistry.
Boron polymers, boron –nitrogen, boron-phosphorous, boron-oxygen, boron-carbon, boron-hydrogen polymers. Silicon polymers, preparation and properties, coordination polymers, Natural and synthetic coordination polymers, reactions, polyanions and polymeric hydroxides.

PAPER – III
Modern Topics In Analytical Chemistry
(PCHEM-03E:ANALYTICALCHEMISTRY)

Unit – I : IR, NMR and Mass-Spectroscopy -

a) IR- Spectroscopy - Applications and IR in analysis.

b) NMR - Spectroscopy - Chemical Shift, Coupling constant, Introduction to DEPT, 2 D NMR the cosy technique, the HETCOR technique, the NOESY experiment, Inverse detection methods, Magnetic resonance imaging. Chemical shift reagents, chiral resoloving agents, Determination and absolute and relative configuration Via NMR.
^{13}C – NMR - Protoncoupled and proton decoupled
^{13}C – Spectra. Application of 13 C NMR.

c) Mass Spectroscopy :- Structural analysis and fragmentation patterns of Complex molecules.

d) Combined spectroscopic problems based on IR, NMR and Mass spectral data.

Unit – II : X-ray Diffraction, XPS, EDX and TEM -

Principle, instrumentation and applications of X- ray diffraction (XRD), X-ray photoelectron Spectroscopy (XPS), Electron spectroscopy for chemical Analysis (ESCA), transmission electron microscopy (TEM) and Scanning electronon microscopy (SEM).

Unit – III : Fluorescence Spectroscopy :-

Introduction, phenomenon and characteristics of fluorescence, fluorescence lifetime, fluorescence quenching, types of quenching processes, Instrumentations, experiments for florescence quenching, types of quenching processes, Instrumentations, Experiments for fluorescence quenching measurements, Organic, Inorganic and Biological applications.

Unit – IV : Hyphenated Techniques

a) Basic and analytical Method development and Validation study

General approach to method development and validation, study of validation parameters following ICH guidelines, Accuracy, Precision, Linearity, Rang, Limit of detection (LOD), Limit of quantification (LOQ) , System suitability, stability, Ruggedness, Robustness/ Cross-senstivity.

b) High Performance Liquid Chromatography (HPLC) –

Introduction, scope, principle and instrumentation, column type, efficiency, Separation parameters of HPLC, Supercritical Fluid extraction (SFE) Chromatography, ion-pair chromatography, and ion chromatography and their applications.

c) Hyphenated Methods –

Introduction, principle, scope, instrumentation and applications and GC-MS, LC-PDA, LC-MS, LC-FTIR, LC-NMR, LC-NMR-MS, CE-MS, HP-TLC, ICP-MS, IC-MS- Applications such as on-line detection of natural products, chemotaxonomic studies, chemical finger printing, quality control of herbal products, dereplication of natural products and metabolism studies.

References –

1) Analytical method development and validation
– Michael E. Swartz, Iras S. Krull (Marcel Dekker Jhc.)

2) Spectroscopy.
– Donald L.Pavia, Gary M. Lampman, George S. Krize and James R. Vyvyan.

3) Absorption Spectroscopy of organic canpounds.
– V.M. Parikh (J. Wiley).

4) Application of absorption spectroscopy of organic Compounds.– J.R. Dyer

5) Spectroscopic identification of organic compounds
– Silverstein and basallar.

6) Applications of spectroscopy Techniques in organic chemistry – P.S. Kalsi

7) Analytical Chemistry
– G.D. Christain

8) Principles of Instrumental Analysis
– D. Skoog and West.

9) Chemical Instrumentation a Systematic Approach
– H. A. Strobel.

10) Instrumental methods of Analysis.
– Willard, merritt, Dean and settle.

11) Instrumental methods of chemical analysis
– B.K. sharma.

12) Instrumental methods of Analysis.
– Chatwal and Anand.

13) Introduction to chromatography
– Bobbit.

14) A test Book of Qualitative Inorganic Chemistry.
– A. I. Vogel.

Ph.D. (Course Work) Nature of Question Paper Pattern

- Ph.D. कोर्सवर्कसाठी फक्त Long Answer व Short Answer असेच प्रश्न असतील.
- Ph.D. (Course work) प्रश्नपत्रिकेत कोणताही External Option व Objective प्रश्न असणार नाहीत.
- एकूण प्रश्न - ५ x गुण २० = १०० गुण
- प्रश्न क्रमांक १ ते ५
- (A) दिर्घोत्तरी प्रश्न (१० गुण)

  (B) Answer Any two out of three (प्रत्येकी ५ गुण)

  या प्रश्नपत्रिकेच्या स्वरुपामुळे Internal Option हा २५% राहतो.