M.Sc. CHEMISTRY

SYLLABUS

2021 – 2023

Department of Chemistry and Research Centre

POPE'S COLLEGE (AUTONOMOUS)

SAWYERPURAM-628 251

Pope's College (Autonomous), Sawyerpuram

Accredited by NAAC – II Cycle with 'A'
Grade (CGPA:3.28) Choice Based Credit System
Course Structure for **M.Sc Chemistry**

(with effect from the Academic Year 2021 – 2022 onwards)

Sem	S. No.	Subject Status	Subject Code	Subject Title	Hrs Per Week	Credits
I - Semester	1	Core-1	21PCHM11	Organic Chemistry-1	04	04
	2	Core-2	21PCHM12	Inorganic Chemistry-1	05	04
	3	Core-3	21PCHM13	Physical Chemistry-1	05	04
	4	**DSE** Elective-1	21PCHE11 21PCHE12 21PCHE 13	Chemistry and industry Pharmaceutical Chemistry Nano Science and Technology	04	04
	5	Practical	21PCHMP1	Organic Chemistry Practical- continuing in II Sem	04	
	6	Practical	21PCHMP2	Inorganic Chemistry Practical- continuing in II Sem	04	
	7	Practical	21PCHMP3	Physical Chemistry Practical- continuing in II Sem	04	
	8	**MOOC certificate course self-Study**			-	**2**
	Subtotal				**30**	**16+2**
II - Semester	1	Core-4	21PCHM21	Reaction Intermediates and Stereochemistry	05	04
	2	Core-5	21PCHM22	Inorganic Chemistry-II	04	04
	3	Core-6	21PCHM23	Physical Chemistry-II	05	04
	4	**DSE** Elective- II	21PCHE21 21PCHE22 21PCHE23	Environmental and Green Chemistry Agricultural Chemistry Forensic Science	04	04
	5	Practical	21PCHMP1	Organic Chemistry Practical-1	04	04
	6	Practical	21PCHMP2	Inorganic Chemistry Practical-1	04	04
	7	Practical	21PCHMP3	Physical Chemistry Practical-1	04	04
	Summer Training Programme				-	**2**
	Subtotal				**30**	**28+2**

III - Semester	1	Core-7	21PCHM31	Organic Reagents and Natural Products	05	04
	2	Core-8	21PCHM32	Inorganic Chemistry-III	04	04
	3	Core-09	21PCHM33	Quantum Chemistry and Polymer Chemistry	05	04
	4	**DSE** Elective-III	21PCHE31 21PCHE32 21PCHE33	Scientific- Research Methodology Analytical Chemistry Chemical Instrumentation	04	04
	5	Practical	21PCHMP4	Organic Chemistry Practical- continuing in IV semester	04	
	6	Practical	21PCHMP5	Inorganic Chemistry Practical- continuing in IV semester	04	
		Practical	21PCHMP6	Physical Chemistry Practical- continuing in IV semester	04	
	Life Skill Training				**-**	**2**
	Subtotal				**30**	**16+2**
IV - Semester	1	Core-10	21PCHM41	Spectroscopy and Substitution Reactions	04	04
	2	Core-11	21PCHM42	Inorganic Chemistry-IV	04	04
	3	Core-12	21PCHM43	Spectroscopy and Surface Chemistry	04	04
	4	Practical	21PCHMP4	Organic Chemistry Practical-II	04	04
		Practical	21PCHMP5	Inorganic Chemistry Practical-II	04	04
		Practical	21PCHMP6	Physical Chemistry Practical-II	04	04
	5	Project	21PCHM4P	Major Project	06	06
	Subtotal				**30**	**30**
	Total				120	90+6

PC/ 2021-23 / PG / Chemistry / Semester – I				
Core	**Sub Code**	**ORGANIC CHEMISTRY-I**	**Hrs./ Week**	**Credits:**
1	**21PCHM11**		**4**	**4**

COURSE OBJECTIVES	• To know the difference between aromatic and non-aromatic compounds. • To know the retrosynthetic analysis with some examples. • To know the Norrish Type – I and Norrish type-II cleavage. • To know about Classification of supramolecular host-guest compounds. • To study about Synthesis and reactions of heterocyclic and biomolecules.
COURSE OUTCOME	• Classify the aromaticity, anti aromaticity and homoaromaticy of organic compounds and the novel ring system. • Discuss the outline of retrosynthetic analysis with some examples. • Differentiate chemical reaction and photochemical reaction. • Illustrate the supramolecular chemistry. • Identify the reaction mechanism for the preparation of heterocyclic compounds and biomolecules.
UNIT – I	**AROMATICITY AND NOVEL RING SYSTEM** **Aromaticity:** Criteria - Huckel's rule – Benzenoid and non-benzenoid aromatic compounds –Molecular orbital description for aromaticity –Anti and homo aromaticity. **Novel ring system:** Nomenclature of bicyclic and tricyclic system- Structure and synthesis of Adamantane- Congressane- Alternant and non–alternant- Azulene and sydnones.
UNIT – II	**RETROSYNTHETIC ANALYSIS** Synthon-synthetic equivalent-functional group interconversion-use of protecting groups for alcohols, amines, acids, carbonyl compounds-use of activating and blocking groups –Robinson annulations - Role of key intermediate in organic synthesis. Reterosynthetic analysis of the following compounds: Twistane, Cis-jasmone, Baclofen, Cascarllic acid, Camphor.
UNIT – III	**ORGANIC PHOTOCHEMISTRY AND PERICYCLIC REACTIONS** **Organic photochemistry :** Theories of light absorption- Grotthuss-Draper law-Beer lambert law -Jablonski diagram - electronic excitation - photosensitization –Norrish Type – I and Norrish type-II cleavage - Paterno-Buchi reaction – Cis-trans isomerization – Di-π methane rearrangement. **Pericyclic reactions:** Classification- Theories (Molecular orbital theory) – FMO method and correlation diagram approaches –Woodward-Hoffmann rule: Electrocyclic reaction: con and dis rotatory motions for 4n and 4n+2 system (butadiene and 1, 3, 5-hexatrienes). Cyclo addition: Suprafacial and antrafacial , [2+2] and [4+2] cycloaddtion reactions (ethylene and butadiene). Sigmatropic rearrangements: [i, j] shift of C-H and C-C bonds (1 ,3) and (1, 5)carbon migration.

UNIT – IV	**SUPRAMOLECULAR CHEMISTRY** Definition –host guest chemistry – Classification of supramolecular host-guest compounds- Coordination and the lock and key analysis- The chelate, macrocyclic and template effect – nature of supramolecular interaction – Spherands, lariat ethers, podants, cryptands – molecular recognition, chiral recognition, molecular sieves, molecular wires, molecular switches.
UNIT – V	**HETEROCYCLIC AND BIOMOLECULES** Synthesis and reactions of imidazole, oxazole, thiazole, coumarins, pyrimidine, pyrazine, and pyridazine. Synthesis of flavones, isoflavones, flavonol and quercertin. Pyranose and furanose forms of aldohexose and ketohexose – methods used for the determination of ring size – structure and synthesis of maltose, sucrose and lactose. A study on the structure of starch.
REFERENCES	1. Charles H.Depuy, molecular reactions and photochemistry, Orville L.Chapman. Prentice Hall of India Pvt Ltd. New Delhi. 2. Jerry March, Advanced Organic Chemistry-Reactions'. John Wiley & Sons. 3. R.T. Morrison and R.N. Boyd, Organic Chemistry, Prentice-Hall. 4. R.O.C. Norman, Principles of Organic Synthesis, Chapman and Hall. 5. Bansal, K. "Heterocyclic Chemistry", new age international, New Delhi. 6. P.Sykes, A guide book Mechanism in organic Chemistry, Orient Longman. 7. Ahluwalia, V. K and Rajender S. Varma, Green Solvents for Organic synthesis, Narosa Publishing House Pvt. Ltd. 8. Finar I L, Organic Chemistry Volume I and II, ELBS with Longmann, Singapore. 9. Gurdeep Chatwal, Organic Chemistry of Natural Products, Vol II, Himalaya Publishing House, Bombay. 10. S.Warren,A Programmed Synthon approach-John Wiley & Sons 11. Carrutherus W. 'Some Modern methodsin Organic Synthesis'. Cambridge University Press, New York. 12. Depuy, E.C.H. and Chapman, O.S., "Molecular reactions and photochemistry", Prentice Hall, New York.

PC/ 2021-23 / PG / Chemistry / Semester – I				
Core	**Sub Code**	**INORGANIC CHEMISTRY-I**	**Hrs./ Week**	**Credits:**
2	**21PCHM12**		**5**	**4**

COURSE OBJECTIVES	• To know the arrangement of elements in the periodic table and the periodic properties. • To understand the different kinds of chemical forces in molecules. • To study about the nucleus models, nuclear fusion and nuclear fission. • To know about classification and components of nuclear reactors. • To know the difference between lanthanides and actinides.
COURSE OUTCOME	• List about the periodic properties like electronegativity, ionization energy and atomic properties. • Describe the ionic bond, covalent bond and the types of interactions present between the molecules. • Analyze the nuclear fission, nuclear fusion and fission products. • Construct the nuclear reactors and their components. • Explain the properties and uses of lanthanides and actinides.
UNIT – I	**CHEMICAL PERIODICITY** Periodic table and atomic properties – Causes of periodicity- division of elements into s,p,d and f blocks-Atomic properties–covalent radius-Vander Waals radius –ionic radius—ionization energy–factors determining ionization energies-electron affinity- variation of electron affinity in the periodic table- electronegativity –factors determining electronegativity. Determination of electronegativity by Pauling's method. Diagonal relationship between beryllium and aluminium. Comparative study of elements of alkali and alkaline earth metals, chalcogens and halogens with respect to electronic configuration.
UNIT – II	**CHEMICAL BONDING** **Ionic bond:** Lattice energy, Born-Haber cycle, Born-Lande equation (derivation not required, problems on Born-Lande expression to be worked out). Calculation of lattice energies of NaCl and MgO effect of lattice energy on solubility of ionic compounds. **Covalent bond:** Valence bond approach: hybridization and directional characteristics of sp,sp^2,sp^3,sp^2d,sp^3d^2. VSEPR theory, Walsh diagram, Bent's rule. Molecular orbital theory: Symmetry and overlap in molecular orbital. MO diagram of hetero nuclear diatomic molecules (HF, CO and NO) and triatomic molecule (BeH_2, CO_2). Polarization concept, Fajan's rule. **Weak interactions:** i)Hydrogen bond: Intra molecular and Intermolecular types, anomalous properties of HF, H_2O, NH_3, alcohols, carboxylic acids, nitro phenols.
UNIT – III	**NUCLEAR CHEMISTRY-I** Atomic nuclei: Classification, Composition and stability- nuclear shell structure- nuclear reactions: types, Q- value, threshold energy cross section and excitation functions- Nuclear reaction models: Optical and compound nucleus models. Direct nuclear reactions- transmutation reactions: Stripping and pick-up- high energy reactions: neutron evaporation and spallation-

	Photonuclear reaction. Nuclear fusion and stellar energy- nuclear fission: mass and charge distribution of fission products- fission energy- fission neutrons- theory of nuclear fission- spontaneous fission.
UNIT – IV	**NUCLEAR CHEMISTRY-II** Nuclear reactors: Classification, components, reproduction factor. Breeder reactor: fast breeder test reactor- reprocessing of spent fuels: aqueous and non- aqueous processes- disposal of gaseous, liquid and solid radioactive wastes. Radio isotopes; preparation, application of radio isotopes in elucidating reaction mechanism and structural determinations; Analytical applications: Radio chromatography, neutron activation analysis, neutron absorptiometry and radiometric titrations- synthesis of transuraniens.
UNIT – V	**LANTHANIDE AND ACTINIDE** Occurrence ,extraction from ores and separation methods ion exchange and solvent extraction methods and properties of the elements – chemistry of separation of Pu from U and fission product- common and uncommon oxidation states – comparison with transition element- lanthanide and actinide contraction – magnetic characteristics of lanthanide and actinide- similarities between actinide and lanthanide – coordination compounds of lanthanide and actinides – use of lanthanide complexes as shift reagents.
REFERENCES	1. James E. Huheey, Ellen A. Keiter and Richard L. Inorganic Chemistry: Principles and structure and Reactivity, Harper College Publishers. 2. F. Albert Cotton, Geoffery Wilkinson Carlos A. Marilo and Manfred Bochman, Advanced Inorganic Chemisrty, Wiley Inter science Publication. 3. H.J. Arnikar, Essentials of Nuclear Chemistry, Wiley Eastern Ltd. 4. G. Friendlander, J.W.Kennedy, E.S. Macies and Julian Malcolm, Nuclear and Radiation Chemistry, A. Wiley Inter science, Publication. 5. J.D. Lee, Concise Inorganic Chemistry, Blackwell Science Ltd., Reprint. 6. B.E. Douglas, D.H. McDaniel and J.J. Alexander, Concepts and Models of Inorganic Chemistry, John Wiley and Sons Ltd. 7. G.S. Manku, Theoretical Principles of of Inorganic Chemistry, Tata McGraw Publishers. 8. D.F. Shriver, P.W. Atkins and C.H. Langford, Inorganic Chemistry, ELBS, Oxford University press. 9. W.L. Jolly, Modern Inorganic Chemistry, McGraw Hill Company. 10. Shriver D.F., Atkins P.W. and Langford C.H., inorganic chemistry, ELBS, Oxford University Press. 11. Emeleus .H.J,Sharpe. A.G., Modern Aspects of Inorganic chemistry. 12. Wood. C.W and Holliday. A.K, Inorganic chemistry, An intermediate Text. 13. Purcell K.F. and Kotz J.C, Advanced Inorganic Chemistry, Saunders Golden Publishers.

PC/ 2021-23 / PG / Chemistry / Semester – I				
Core	**Sub Code**	**PHYSICAL CHEMISTRY-I**	**Hrs./ Week**	**Credits:**
3	**21PCHM13**		**5**	**4**

COURSE OBJECTIVES	• To know the Symmetry elements and symmetry operations. • To understand the symmetry of hybrid orbitals in linear and non-linear molecules. • To study about Debye-Huckel-Onsager equation. • To know the Butler Volmer equation– Tafel equation. • To understand the calculation of reaction free energy by electrochemical, thermochemical and equilibrium data.
COURSE OUTCOME	• Describe point group to various molecules. • Illustrate the Raman active and IR active molecules using group theory. • Identify the deviation of ions in solution. • Evaluate the structure of the electrode surface and the applications of electrode process. • Design phase diagrams for single and multi-component system.
UNIT – I	**GROUP THEORY-I** Symmetry elements and symmetry operations – Point groups – abelian and non abelian group-Cyclic and inverse rule-Classes and sub group-identification and representation of groups – Matrix representation of symmetry operations- Reducible and irreducible representation – Direct product representation – Great orthogonality theorem and its consequences – Construction of Character tables for C_{2V}, C_{3V}, C_{2h}, C_{4V}, D_2.
UNIT – II	**GROUP THEORY-II** Symmetry selection rules for vibrational, Electronic and Raman Spectra – standard reduction formula – Mutual exclusion Principle - determination of vibrational modes in non-linear molecules such as H_2O, NH_3, CH_4 ,XeF_4, – symmetry of hybrid orbitals in linear and non-linear molecules (H_2O, NH_3, CH_4, XeF_4,PCl_5, CO_2, HCN, C_2H_2) Electronic spectra of formaldehyde.
UNIT – III	**ELECTROCHEMISTRY-I** Ions in solution – Deviation from ideal behavior- Debye-Huckel-Onsager equation – derivation and experimental verification – Debye-Falkenhagen and Wien effect– Debye-Huckel limiting law – Debye Huckel Bronsted equation– Electrochemical cells - Lippmann capillary equation. Determination of solubility product and dissociation constant.
UNIT – IV	**ELECTROCHEMISTRY-II** Kinetics of electrode processes – theory of electrical double layer-Electrochemical cell- Butler Volmer equation– Tafel equation-Polarization – polarizable and non-polarizable electrode – Hydrogen and oxyen evolution reactions and mechanism. Corrosion – theories, methods of preventing corrosion; electrochemical processes as sources of energy –fuel cells principle, types and application- electrodeposition principle and application – Evans diagram.
UNIT – V	**CHEMICAL AND PHASE EQUILIBRIA** Reaction free energy/ Reaction potential- reaction isotherm and direction of

	spontaneity- Standard reaction free energy – Calculation of reaction free energy by electrochemical, thermochemical and equilibrium data – Temperature coefficient of reaction free energy and equilibrium constant. Gibbs phase rule- thermodynamic derivation- application of phase rule to three component system and formation of one pair, two pairs and three pairs for partially miscible liquids- System composed of two solids and a liquid.
REFERENCES	1. Robert L. Carter, Molecular Symmetry and Group Theory, John Wiley and Sons, Inc., New York. 2. R. L. Flurry, Jr, Symmetry Groups- Prentice Hall, New Jersy 3. Cotton. F.A - Chemical applications of group theory. Wiley. 4. Raman K V, Group Theory and its Applications to Chemistry,Tata McGraw HillCo. 5. S.Glasstone, An Introduction to Electrochemistry, New Delhi, East West Press Pvt.Ltd. 6. J.O.M. Bockris and A.K.N. Reddy, Modern Electrochemistry Vol-1&2, Plenum press, Newyork. 7. Antorpov L, Theoritical Electrochemistry, Mirpublishers, Moscow. 8. J.O.M. Bockris and A.K.N.Reddy, "Modern Electrochemistry" vol.1& Pilenum Press, New York. 9. S.Glasstone, "Electrochemistry" Affiliated East – West Press, Pvt., Ltd., New Delhi. 10. A. J. Bard, L.R. Faulkner, Electrochemical Methods: Fundamentals and Applications, 11. John Wiley and Sons, New York,.R. Crow, Principles and Applications of Electrochemistry, Chapman and Hall, London. 12. Physical Chemistry, R.S.Berry, S.A.Rice and J.Ross, Oxford. 13. M. Ladd, Introduction to Physical Chemistry, Cambridge. 14. D. A. McQuarrie and J. D. Simon, Physical Chemistry, A molecular Approach, Viva.

PC/ 2021-23 / PG / Chemistry / Semester – I				
DSE Elective	**Sub Code**	**CHEMISTRY AND INDUSTRY**	**Hrs./ Week**	**Credits:**
1	**21PCHE11**		**4**	**4**

COURSE OBJECTIVES	• To know the composition and classification; distillation of crude petroleum. • To understand the synthesis of important plastics. • To know the manufacture of soap and detergents. • To know about Fertilizers. • To study the types of cement.
COURSE OUTCOME	• List out the occurrence and preparation of petroleum products. • Explain the types of plastics and its application. • Describe the different types of soaps and detergents. • Assess the preparation of fertilizers. • Explain the types of cements and its uses.
UNIT – I	**PETROLEUM PRODUCTS** Petroleum – its occurrence, mining, composition and classification; distillation of crude petroleum; gasoline for motor and aeroplanes, diesel and kerosene, knocking and anti-knocking; octane and cetane number; pyrolysis of heavy oil and production of gasoline.
UNIT – II	**PLASTICS** Natural and Synthetic polymers, plastics – thermosetting and thermoplastic and their general methods of preparation; synthesis of important plastics and their applications polythene, polypropylene, nylon, polyester, PVC and Bakelite
UNIT – III	**SOAPS AND DETERGENTS** Soap – hard & soft – manufacture; toilet, laundry, shaving and other types of soaps; cleaning action of soap. Detergents – different types and manufacture.
UNIT – IV	**FERTILIZERS** Fertilizers – different types and their requirement; manufacture of urea, ammonium phosphate, superphosphate and potassium sulphate and their utilization; complex fertilizers; micronutrients.
UNIT – V	**CEMENT** Portland and other types of cement; manufacture of Portland cement-wet and dry processes; settling of cement; cement industries in India.
REFERENCES	1. B.K. Sharma, Industrial Chemistry, Goel publication, Ist revised Edn. 2. M.G. Arora, M. Singh, Industrial Chemistry Vol. 1 & 2 Anmol publication, Ist Edn. 3. B.N. Chakrabarthy, Industrial Chemistry, Oxford & IBH, 5th reprint. 4. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK. 5. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.

PC/ 2021-23 / PG / Chemistry / Semester – I				
DSE Elective	**Sub Code**	**PHARMACEUTICAL CHEMISTRY**	**Hrs./ Week**	**Credits:**
2	**21PCHE12**		**4**	**4**

COURSE OBJECTIVES	• To know the Drug delivery systems and sustained release of drugs. • To understand the pharmaceutical aids. • To know the different type of diseases and treatment using drugs • To know about pathogenicidal drugs and its applications. • To study about bioregulatory drugs.
COURSE OUTCOME	• Acquire the knowledge on chemistry of drugs. • Discuss the role of pharmaceutical aids in day-to-day life. • Determine the cause of various diseases and their treatment. • Manipulate the idea about pathogenicidal drugs. • Point out the thorough applications of Bio-regulatory drugs.
UNIT – I	**INTRODUCTION TO CHEMISTRY OF DRUGS** Drugs-Sources-Classification (Biological, chemical, commercial and utility)- Nomenclature of drugs-Biotransformation-Drug design-Factors affecting the stability of drugs-Encapsulation-Drug delivery systems and sustained release of drugs
UNIT – II	**PHARMACEUTICAL AIDS** Preservatives - Antioxidants - Sequestering agents – Emulsifiers – Colorants -Flavoring agents- Sweeteners – Stabilizers - Suspending agents - Ointment bases - Solvents
UNIT – III	**COMMON DISEASES AND TREATMENT** Insect borne diseases-Treatment using drugs-Air borne diseases-Treatment using drugs- Water borne diseases-Treatment using drugs-Digestive disorders-Treatment-Diseases of respiratory system-Treatment-Diseases of nervous system-Treatment-Other common diseases (Ulcer, Vomitting, Pellagra, Goiter, Piles and Leprosy)-Treatment
UNIT – IV	**PATHOGENICIDAL DRUGS** Antibiotics – Classification – Chloramphenicol – Penicillin – Streptomycin -Tetracycline – Macrolides – Erythromycin – Rifamycin – Antiseptics and disinfectants-Phenols Halogen compounds- Analgesics-Antipyretics-Anti – inflammatory agents-Sulpha drugs
UNIT – V	**BIOREGULATORY DRUGS** Cardiovascular drugs-Cardiac glycosides-Anti arrhythmic drugs-Antihypertensive agents-Antianginal agents-Diabetes-Hypoglycemic drugs-Types of diabetes-Insipidus- Mellitus-Control of diabetes-Insulin-Hypoglycemic agents-Anticonvulsants-Cancer- Antineoplastic drugs-Common Causes-Antimetabolites-Muscle relaxants
REFERENCES	1. Silverman R B, The Organic Chemistry of Drug Design and Drug Action, Academic Press. 2. Lednicer D, Strategies for Organic Drug Synthesis and Design, John Wiley. 3. William Foye, Principles of Medicinal Chemistry; Lippincott, William and Wilkins.

	4. AKar, Textbook of Medicinal Chemistry, Asian Age Publication. 5. Sriram D and Yogeshwari P, Medicinal Chemistry, Pearson Education. 6. Ahluwalia V K, Chopra Madhu, Medicinal Chemistry, Ane Books India. 7. Jayashree Gosh, Textbook of Pharmaceutical chemistry, S.Chand & Chand publications, New Delhi. 8. Becket A.H. and Stenlake J.B., Practical Pharmaceutical Chemistry Vol. I and II, The Athlone Press of the University of London. 9. Chatten L.G., A Text Book of Pharmaceutical Chemistry, Vol. I and II, Marcel Dekker, New York. 10. Block J.H. and Beale J.M., Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, Lippincott Williams and Wilkins, Philadelphia. 11. Singh H. and Kapoor V.K., Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Delhi. 12. Buncher C.R., Statistics in the Pharmaceutical Industry, Marcel Dekker, New York.

PC/ 2021-23 / PG / Chemistry / Semester – I				
DSE Elective	**Sub Code**	**NANO SCIENCE AND TECHNOLOGY**	**Hrs./ Week**	**Credits:**
3	**21PCHE13**		**4**	**4**

COURSE OBJECTIVES	• To know the introduction about Nanotechnology and Nano structures. • To understand the Structural Characterisation of X- ray diffraction, STM, AFM. • To know the different types of Carbon nanotubes. • To study about quantum well, quantum wire and quantum dots. • To know the applications of Nanotechnology.
COURSE OUTCOME	• Define the background on Nanoscience. • Categorize the synthesized nanomaterials by various techniques. • Explain the preparation, characterization and properties of carbon nanotubes. • Analyze the types and properties of Quantum dot. • Apply their learned knowledge to develop Nanomaterials.
UNIT – I	**INTRODUCTION** History of Nanotechnology- Nano structures- importance of nano materials- Synthesis of nanomaterilas- physical methods(Laser Ablation, Evaporation,Sputtering and solvated metal Dispersion)- Chemical methods- Thermolysis, Sonochemical approach, reduction of metal ions by hydrogen and Methanol- Biosynthesis (Elementary idea only)
UNIT – II	**PREPARATION AND CHARACTERISATION** Structural Characterisation (X- ray diffraction, Scanning Tunneling Microscopy, Atomic force microscopy) - Properties of nanomaterials(Optical,Electrical and magnetic properties) – Synthesis of semiconductor nanomaterials (Precipitation methods, Thermal decomposition of complex precursors) -Synthesis of Ceramic nanomaterials - Physical methods (Gas condensation & Laser methods)- Chemical method(Sol-gel synthesis)
UNIT – III	**CARBON NANOTUBE** Carbon nanotube - Carbon allotropes (Diamond, Graphite, Carbon nanotubes) - Types of Carbon nanotubes – Graphene sheet to single walled nanotube - Synthesis of carbon nanotubes (Electric arc -Discharge method, Laser method, Fluidised bed CVD method, Solar production of Carbon nanotubes) - Purification and properties of Carbon nanotubes – Fullerenes - Purification and properties of Fullerenes.
UNIT – IV	**QUANTUM WELL, QUANTUM WIRE AND QUANTUM DOTS** Introduction - preparation of Quantum nanostructures - Fermi gas and Density of states – Calculation of the density of states in 1,2 and 3 dimension- Infrared detector -Quantum wire(Production ,Structure, Use), Quantum dot - Application of Quantum dots – Quantum dot information storage, Infrared photodetectors, Lasers.
UNIT – V	**APPLICATIONS OF NANOTECHNOLOGY** Chemistry and Environment - Energy applications of Nanotechnology -

	Information and Communication- Heavy industry - Consumer goods - Nano medicine - medical applications of molecular nanotechnology (Nanorobots, Cell repair machines, nanonephrology)
REFERENCES	1. Shanmugam.S, Nanotechnology, MJP Publishers, Chennai. 2. Parthasarathy. B.K, Nanostructure and Nanomaterials, Isha Books, Delhi. 3. Fahrner.W.R (Ed), Nanotechnology and Nanoelectronics- materials, Devices, measurement techniques, Spinger . 4. Charles.P. Poole Jr Frank J. Owens;John Wiley & Sons inc. Publication. 5. Massimiliano Di ventra, Stephane Evoy, James R. Heflin Jr(Editors) , Introduction to Nanoscale science and Technology Springer. 6. Guozhong Cao, Nanostructures and Nanomaterials – Synthesis, Properties and Applications, Imperial College Press, London.

PC/ 2021-23 / PG / Chemistry / Semester – II				
Core	**Sub Code**	**REACTION INTERMEDIATES AND STEREOCHEMISTRY**	**Hrs./ Week**	**Credits:**
4	**21PCHM21**		**5**	**4**

COURSE OBJECTIVES	• To study about Carbenes, Nitrenes, Carbanion and Arynes. • To know the different type of naming reactions. • To understand the organic reaction mechanism. • To know the optical activity and chirality of compounds. • To understand the conformational analysis of mono substituted disubstituted cyclohexnes.
COURSE OUTCOME	• Classify the types of reaction intermediates like carbenes, nitrenes, carbanion, arynes and the rearrangement involves in it. • Summarize the different types of reaction intermediate. • Differentitate Kinetic and thermodynamic rates of organic reaction. • Determine the R/S notation of spiranes, allenes and biphenyl compounds and E/Z nomenclature of double bonded system. • Discuss the Conformational analysis of cyclic molecules and the factors governing the reactivity of axial and equatorial substituents in cyclohexanes.
UNIT – I	**REACTION INTERMEDIATES AND REARRANGEMENTS** **Carbenes:** Generation, Stability, Structure and reactivity of carbenes – Wolff rearrangement of acyl carbene and its synthetic applications. **Nitrenes:** Generation, Stability and reaction of nitrenes. Mechanism of rearrangements through nitrene intermediate. Schmidt, Hoffmann, curtius and Beckmann Rearrangements. **Carbanion:** Generation, Structure, Stability and reaction of carbanion- Mechanism of rearrangements involving carbanion as intermediate: Steven, Sommelet- Hauser and Favorski rearrangements. **Arynes:** Generation, Stability, Structure and trapping of arynes- cine substitution.
UNIT – II	**REACTION INTERMEDIATE CHEMISTRY** **Reaction under carbanion intermediate:** Clasien, Knovenegal, Stobbe, Darzen, acyloincondensation, Shapiro reaction and Julia olefination. **Reaction through carbocation intermediate:** Oxymercuration, halolactonisation, Bayer villiger oxidation. **Reaction following radical intermediate:** Mc Murray coupling, Gomberg – Pechmann and Pschorr reactions. **Reaction Involving ylide intermediate:** Wittig and Peterson olefination
UNIT – III	**STUDY OF ORGANIC REACTION MECHANISM** Types of reactions- Types of mechanism-Kinetic and thermodynamic requirements of reactions- Hammond postulate-Microscopic reversibility-Kinetic and thermodynamic control of product formation. Kinetic method of determination: Primary and secondary isotopic effect. Non-Kinetic method of determination: Testing and trapping of intermediates, Isotopic labeling, Cross over experiment and stereochemical evidence. Hammett equation-Physical significance of σ and ρ constants –Taftequation.

UNIT – IV	**STEREOCHEMISTRY** Optical activity and chirality-optical activity in the absence of chiral atom-axial and planar chirality – enantiotopic, diasterotopichydrogens and prochiralcentres-stereochemistry of compound containing two dissimilar asymmetric carbons –ansa compounds. R/S notation of spiranes, allenes and biphenyl compounds - E/Z isomerism of olefins containing one and two double bond – Stereoselective and stereospecific syntnesis - Assymmetric synthesis – Cram's rule and Prelog's rule .
UNIT – V	**CONFORMATIONAL ANALYSIS** Conformation and configuration-conformational analysis of monosubstituted (alkyl, halogen) and 1,1 disubstituted (alkyl) and 1,2, 1,3-and 1,4-dimethyl substituted cyclohexnes –compounds existing in boat form-conformation-cyclohexanone, decalin and perhydrophenanthrene – Curtius Hammett principle.
REFERENCES	1. Ahluwalia V.K and Parshar R.K, Organic Reaction Mechanism Kalsi P S, Stereochemistry: Conformation and Mechanism, New-Age International Publishers, New Delhi. 2. Morrision R.T. and Boyd R.N., Organic Chemistry, Allyn& Bacon Ltd., New York. 3. March J, Advanced Organic Chemistry, John-Wiley and Sons, New York. 4. Eliel E L, Stereochemistry of Carbon Compounds, Tata-McGraw Hill Publishing Company, New Delhi. 5. Nasipuri D, Stereochemistry of Carbon Compounds, New-Age International Publishers, New Delhi. 6. Sykes P, Guide Book to Mechanism in Organic Chemistry, ELBS with Longmann. 7. Finar I L, Organic Chemistry Volume I and II, Pearson Education Ltd. 8. Michael B. Smith, Organic Synthesis, McGraw Hill Publishing Company. 9. Francia. A. Carey, Organic Chemistry, Tata-McGraw Hill Publishing Company, New Delhi. 10. Clayden, Greeves,Warren and Wothers, Organic Chemistry, Oxford University Press, New York. 11. P.S. Kalsi, Organic Reactions and Mechanisms, New Age International Publishers. 12. S.M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan. 13. Norman, Principles of Organic Synthesis, Chapman and Hall.

PC/ 2021-23 / PG / Chemistry / Semester – II				
Core	**Sub Code**	**INORGANIC CHEMISTRY-II**	**Hrs./ Week**	**Credits:**
5	**21PCHM22**		**5**	**4**

COURSE OBJECTIVES	• To know the Classification of solvents and Characteristic properties of solvents. • To understand the VB theory and Crystal field theory. • To know the Thermodynamic and kinetic stabilities. • To know about Structure of metallic crystals and their characteristics. • To study about inorganic chains, rings, cages and clusters.
COURSE OUTCOME	• Summarize the classification of solvents and the different types of acid-base theory. • Know the valence bond theory and molecular orbital theory. • Identify the types of isomerism present in the coordination compounds. • Detect the different types of solids and the different types of crystal defects. • Determine the different types of chains, rings, cages and clusters in inorganic compound.
UNIT – I	**REACTIONS IN NON-AQUEOUS SOLVENTS** Classification of solvents – Characteristic properties of solvents- a general study of the typical reactions in liquid ammonia, sulphur dioxide, anhydrous hydrogen fluoride, HCN and H_2SO_4. Disadvantages. Acids and Bases: Lowry-Bronsted theory-Lewis concept– Lux Flood-Hardness and softness of acids and bases. Bonding in hard-hard, soft-soft combination, HSAB principle and application.
UNIT – II	**COORDINATION CHEMISTRY –I** The valence bond theory –limitation of VB theory- Crystal field theory, crystal field splitting of d-orbital under various geometries. Factors affecting splitting. Crystal field stabilization energy – Calculation of CFSE. Weak and strong field effects–Spectrochemical series-Jahn-Tellar distortion. Application of CFT- magnetic properties, Spectral properties- Limitation. Molecular Orbital Theory-based on group theoretical approach, MO diagrams of O_h, T_d and Square planar symmetries with and without π bonding.
UNIT – III	**COORDINATION CHEMISTRY –II** Thermodynamic and kinetic stabilities- stepwise stability constants of the metal complexes- Factors affecting stability- Chelate and template effect. Determination of stability constant and composition of the complexes: Bjerrum's method, spectrophotometric method, polarography method, continuous variation (Job's method). Isomerism in coordination compounds: structural isomerism- Stereo isomerism. Electron transfer reactions- outer and inner sphere processes, the bridging ligand. Substitution reaction- Acid hydrolysis, base hydrolysis and anation reaction. Labile and inert complexes. Ligand substitution in square planar complexes- Trans effect- theories of trans effect and application.

UNIT – IV	**SOLID STATE CHEMISTRY** Classification of solids, Types of crystals-structure of diamond and graphite-polymorphism, allotropy, transition temperature, enantiotropy and monotropy. Structure of metallic crystals and their characteristics- hcp,bcc and fccstrcture- structure of ionic crystals of AB type- NaCl and CsCl, AB_2 type- CaF_2 , TiO_2. Crystal defects: point, line and plane defects - intrinsic point defects: Schottky and Frenkel defects. Non-stoichiometric defect – metal excess defect and deficiency defect. Band theory: Conductor, semi-conductor, insulator. Optical and electrical properties of semiconductors. Photovoltaic effect- Hall effect. Super conductivity- high temperature Super conductors, properties and application- BCS theory- Cooper electrons-Meissener effect and levitation.
UNIT – V	**INORGANIC CHAINS, RINGS, CAGES AND CLUSTERS** Chains–catenation-Heterocatenation- Silicate Minerals- Intercalation Chemistry- One dimensional conductors-Poly acids-Isopoly anions-Heteropoly anions-Rings- Borazines- Phosphazenes-Phosphazene polymers-Cages- Boron cage compounds-Boranes-Carboranes- Metallacarboranes-Metal clusters-Wad's rule- styx numbers. Carbonyl cluster-anionic and hydrido cluster. Non carbonyl cluster- octahedral and triangular cluster.
REFERENCES	1. James E. Huheey, Ellen A. Keiter and Richard L. Inorganic Chemistry: Principles and structure and Reactivity, Harper College Publishers. 2. F.Albert Cotton, Geoffery Wilkinson Carlos A. Marilo and Manfred Bochman, Advanced Inorganic 3. J.D. Lee, Concise Inorganic Chemisrty,ELBS. 4. B.E.Douglas, D.H. McDaniel and J.J. Alexander, Concepts and Models of Inorganic Chemistry, John Wiley and Sons Ltd. 5. G.S. Manku, Theoretical Principles of of Inorganic Chemistry, Tata McGraw Publishers. 6. D.F. Shriver, P.W.Atkins and C.H. Langford, Inorganic Chemistry, ELBS, Oxford University press. 7. W.L. Jolly, Modern Inorganic Chemistry, McGraw Hill Company. 8. T.Kutty, J. Tareen, Fundamentals of crystal Chemistry, University Press, 1st Ed. 9. L.V.Azaroff, Introduction to solids, Tata McGraw Hill Publishing Ltd., India. 10. H.V. Keer, Principles of the Solid state, Wiley Eastern Ltd. 11. D. Bannerje, Coordination Chemistry, Tata McGraw Hill. 12. P.K.Puecell and J.c.Kotz, Advanced Inorganic Chemistry, Saunders Golden Publishers. 13. Kazup Nakamoto, Infrared and Raman Spectra of Inorganic and Coordination Compounds, Part B: Applications in Coordination, Organometallic and Bioinorganic Chemistry, John Wiley and sons, Inc. 14. MC. Day and J. Selbin, Theoretical Inorganic chemistry, East West Press.

PC/ 2021-23 / PG / Chemistry / Semester – II				
Core	**Sub Code**	**PHYSICAL CHEMISTRY-II**	**Hrs./ Week**	**Credits:**
6	**21PCHM23**		**5**	**4**

COURSE OBJECTIVES	• To know about the collision theory and absolute reaction rate theory. • To understand the Gibbs-Duhem and Gibbs-Duhem Margulus equation. • To distinguish the Translational, Vibrational, Rotational and Electronic partition Function. • To know about Thermodynamics of irreversible process with simple examples. • To understand the difference between Fluorescence and Phosphorescence.
COURSE OUTCOME	• Identify different theory to determine the rates of the reaction. • Compare the concept of partial molar properties, fugacity and activity. • Conclude the partition function and concept of statistical thermodynamics. • Outline the irreversible thermodynamics. • Differentiate different types of photochemical reactions.
UNIT – I	**CHEMICAL KINETICS** Theories of reaction rate- collision theory- Absolute reaction rate theory (ARRT) including thermodynamic treatment – application of ARRT to simple bimolecular processes -intermolecular reactions; theory of unimolecular reactions – Lindemann's theory, Hindshelwood theory, RRK theory, RRKM theory.–kinetic isotope effect- secondary salt effect. Chain reactions – general characteristics – kinetic – reaction between H_2 and Br_2, pyrolysis of acetaldehyde, thermal decomposition of N_2O_5, explosive reactions – H_2-O_2 reaction. Study of fast reactions:- reactions in flow system-chemical Relaxation methods-temperature and pressure jump methods – Shock tube technique- Stopped flow technique, flash photolysis – Pulse radiolysis.
UNIT – II	**THERMODYNAMICS** Concepts of partial molar properties – Partial molar free energy, chemical potential, partial molar volume and its significance. Gibbs-Duhem and Gibbs- Duhem Margulus equation. Determination of partial molar properties: Graphical method, intercept method and apparent molar volume method. Concept of fugacity- Determination of activity coefficient by EMF and solubility method
UNIT – III	**STATISTICAL THERMODYNAMICS** Objectives of Statistical thermodynamics – concept of thermodynamically and mathematical probabilities – Distribution of distinguishable and non – distinguishable particles. Maxwell – Boltzmann, Bose – Einstein and Fermi – Dirac statistics – comparison and application. Partition Functions – evaluation of Translational, Vibrational, Rotational and Electronic partition Function – Thermodynamic Functions in terms of partition Function.

UNIT – IV	**IRREVERSIBLE THERMODYNAMICS** Thermodynamics of irreversible process with simple examples – Thermoelectric phenomena– Entropy Production in Heat flow and matter flow- entropy production in chemical reactions – Forces and Fluxes – Linear force – flux relation –microscopic reversibility and Onsager's reciprocal relations validity and verification. Electro kinetic phenomena – diffusion – Application of irreversible thermodynamics to biological systems
UNIT – V	**PHOTOCHEMISTRY** Introduction- Laws of photochemistry- Quantum efficiency and quantum yield-Absorption of radiation – decay of electronically excited states – radiative and non –radiative processes – Jablonski diagram- Fluorescence and Phosphorescence – Prompt and delayed fluorescence – quenching of fluorescence – Stern – Volmer equation – Excimers and exciplexes - Kinetics of Photochemical reactions – Photosensitized reactions- Chemiluminescence- Physical properties of electronically excited state- photoelectrochemical cells – solar cells- solar energy conversion.
REFERENCES	1. Laidler K.J, "Chemical Kinetics", Benjamin-Cummings. Indian reprint – Pearson. 2. R.G. Frost and Pearson, Kinetics and Mechanism, Wiley, New York. 3. W.J.Moore and R.G.Pearson, Kinetics and mechanism. 4. C.Capellos and B.J.J.Bielski, Kinetics systems, Wisely Inter Science, New York. 5. P.W.Atkins, Physical Chemistry, ELBS Ed. 6. J.Rajaram and J.C. Kuriacose, Kinetics and Mechanisms or Chemical transformations, Macmillan India Ltd., 1st reprint. 7. P.W.Atkins, Physical Chemistry, Oxford. 8. Y.V.C.Rao, An Introduction to thermo-dynamics, Wiley Eastern, 9. R.S.Berry, S.A.Rice&J.Ross, Physical Chemistry, Oxford. 10. Gupta M.C –Statistical Thermodynamics, Wiley Easter Ltd. 11. Lee.J.F, Sears.F.W and Turcottee.D.L- statistical Thermodynamics. 12. F.W.Sears & G.L.Salinger, Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Narosa. 13. Fundamentals of Photochemistry, K.K. Rohatgi Mukhergee, Wiley Eastern Limited. 14. Photochemistry, Carol E Wayne and Richard P Wayne, Oxford University Press. 15. Molecular Reactions and Photochemistry, C H Deputy and D S Chapman, Prentice Hall India, New Delhi. 16. R.P.Wayne, Photochemistry, Butterworths,London, 35. G.Hughes, Radiation Chemistry, Oxford University Press. 17. J.W.T Spinks and R.J. Woods, Introduction to Radiation Chemistry, 2nd edn., John Wiley & Sons .

PC/ 2021-23 / PG / Chemistry / Semester – II				
DSE Elective	**Sub Code**	**ENVIRONMENTAL AND GREEN CHEMISTRY**	**Hrs./ Week**	**Credits:**
4	**21PCHE21**		**4**	**4**

COURSE OBJECTIVES	• To know the Types of environment. • To understand the types of pollutants. • To know the Basic principles of green chemistry. • To study about green reactions**.** • To Organic synthesis using Polymer supported Catalyst.
COURSE OUTCOME	• Describe the environment and the ecosystem. • Identify the types of pollution present in the environment. • Summarize the concept of green chemistry. • Outline the uses of microwave assisted chemical reaction. • Integrate the green catalyst and biocatalyst for the chemical reaction.
UNIT – I	**ENVIRONMENT AND ECOSYSTEM** Introduction – Types of environment – risks and hazards in environment. Ecosystem: Ecology – ecosystem types and structure of ecosystem – function of an ecosystem– oxygen cycle and nitrogen cycle – grass land ecosystem – desert ecosystem – aquatic ecosystem – fresh water ecosystem- pond ecosystem – lake ecosystem – river ecosystem. Biodiversity: Definition – importance –classification – value of biodiversity– biodiversity at national and local level – factors affecting biodiversity- advantages of biodiversity.
UNIT – II	**ENVIRONMENTAL, WATER AND THERMAL POLLUTION** Introduction – types of pollutants – air pollution – classification of air pollution – common air pollutants – sources and their effects – acid rain – ozone layer depletion. Water Pollution: Types – effects and sources of water pollution – waste water treatment. Thermal Pollution: Sources of thermal pollution- effect of thermal pollution-control measurement of thermal pollution-role of an individual prevention of pollutions.
UNIT – III	**CONCEPT OF GREEN CHEMISTRY** Introduction – Basic principles of green chemistry – atom Economy – atom economic reactions – addition reactions – atom un-economic reactions, substitution reactions, elimination reactions.
UNIT – IV	**GREEN REACTIONS** Microwave assisted reactions in water: Hoffmann elimination – hydrolysis of benzyl chloride, benzamide and n-phenyl benzamide – oxidation of toluene – Microwave assisted reactions in organic solvents: Esterification, diel's alder reaction-fries rearrangement –claisen rearrangement, cyclo addition reaction. Ultra sound assisted organic synthesis: Types of sono chemical reaction-homogeneous sono chemical reactions. curtius rearrangement-isomerisation of maleic acid to fumaric acid. Microwave assisted reactions in solid state: Oxidation of alcohols, oxidation of enamines – solid state reactions using solid support: protection and deprotonation reactions: formation of acetals and diaxolanes- n-alkylation reactions.

UNIT – V	**ORGANIC SYNTHESIS USING GREEN CATALYST** Organic synthesis using Polymer supported Catalyst: Polymer pound anhydrous aluminium chloride – polymer supported crown ether – polymer supported phase transfer catalyst – displacement reactions- alkylation. Biocatalyst: Introduction – biochemical oxidation – reduction- organic synthesis using crown ethers – synthetic application – esterification – saponification- aromatic substitution reaction – elimination reaction. Organic synthesis using Phase Transfer Catalyst: Mechanism and types of PTC, advantages of PTC in organic synthesis – nitryles from alkyl halides – benzoyl cyanides from benzoyl chloride – radioactive halides – alcohols from alkyl halides.
REFERENCES	1. V.K Ahluwalia, A text book of Green chemistry, Narosa publishing house pvt Ltd, reprinted. 2. B.K Sharma, H.Kaur, Environmental Chemistry, Goel publishing house, Meerut Pvt Ltd. 3. V.K Ahluwalia, Green Environmentally Benign reactions, Ane book Pvt Ltd. 4. V.K Ahluwalia, Environmental Chemist, Ane book Pvt Ltd. 5. B.Viswanathan, S.Sivasanker, A.V.Ramaswamy, Catalysis-Principles and Applications, Narosa Publishing House, Delhi. 6. Harish Kumar Chopra, Anupama Parmar, A textbook of Engineering Chemistry, Narosa Publishing House, New Delhi. 7. Dr.A.Ravikrishnan, Environmental Science & Engineering, Sri Krishna High tech Publishing Company Pvt. Ltd, Eleventh A.K.DE, Environmental Chemistry, New age international publishers. 8. Ahluwalia V.K & Varma R.S, Alternate Energy Process in Chemical Synthesis, Narosa Publishing House, Delhi. 9. Jain P.C and Monika Jain, Engineering Chemistry, Dhanpat Rai Publishing company Pvt. Ltd, New Delhi.

PC/ 2021-23 / PG / Chemistry / Semester – II				
DSE Elective	**Sub Code**	**AGRICULTURAL CHEMISTRY**	**Hrs./ Week**	**Credits:**
5	**21PCHE22**		**4**	**4**

COURSE OBJECTIVES	• To know the chemistry in agriculture. • To understand the water management and micro irrigation. • To know the Importance and scope of the vegetable cultivation. • To know about plant growth regulators. • To study about soil chemistry.
COURSE OUTCOME	• Examine the scientific approach to farming. • List out the details of pests. • Show pest and weed management. • Develop new methods to improve yield. • Determine the need of the hour and of the society.
UNIT – I	**CHEMISTRY AND AGRICULTURE** Fertilizers: Discussion on ammonium nitrate, urea, superphosphate, triple superphosphate, diammonium phosphate, potassium nitrate, uses of mixed fertilizers, micronutrients and their role- Pesticides: Classification of pesticides with examples-Insecticides: stomach poisons, contact insecticides, fumigants, manufacture and uses of insecticides. DDT, BHC(gammexane: conformation of gamma isomer) pyrethrin mention of aldrin, dieldrin, endrin and penta chlorophenel (and its Na salt) (structures excluded)-Herbicides: 2,4-D and 2,4,5-T - Fungicides: Bordeaux mixture, mention of lime sulphur, creosote oil and formula. NPK fertilizers, triple superphosphate, different types of pesticides, insecticides- Art, Science and business of crop production-Factors affecting crop production-Brief history of agricultural development:- Chronological Agricultural Technology development in India. Indian Agriculture and Dry land agriculture.
UNIT – II	**FERTILIZERS, WATER MANAGEMENT AND MICRO IRRIGATION** Peat and organic manures (composts). Role of humus. Effluent form gobar gas plants- Use of fertilizers : urea, DAP, Super phosphate, Gypsum, NPK-mixed fertilizers, Optimal addition of Fertilizers to obtain estimated yields-Irrigation: Definition and objectives, water resources and irrigation development in India - Soil plant water relationships; Methods of soil moisture estimation, soil water movement, evapo transpiration and crop water requirement; effective rainfall, scheduling of irrigation;- Methods of irrigation: surface and subsurface, Micro irrigation, sprinkler and drip irrigation; Irrigation efficiency and water use efficiency, conjunctive use of water, irrigation water quality and its management-Water management of different crops (rice, wheat, maize, groundnut, sun flower, mustard, pulses, sugarcane, cotton, potato, mango, banana and tomato); Agricultural drainage, On farm water management.
UNIT – III	**PESTICIDES AND VEGETABLE CULTIVATION** Insecticides: stomach and contact poisons-Plant derivatives: pyrethrine, Nicotine and rotenone- Synthetic organic: carbophos, carbaryl, p-DCB,

	dimethoate, butachlor, Endrin, Aldrin (Chemical name and uses)- Rodenticdes. Fungicides: Inorganic (Bordeaux Mixture) and organic (dithiocarbamate). Industrial fungicides: creosote fractions- Herbicides and weedicides: Selective and non-selective, 2, 4-D and 2, 4, 5-t (structure and function) Intenerated pest management. Sex attractants for insect control. Sustainable agriculture-Importance and scope of the vegetable cultivation, classification of vegetables, types of vegetable farming-Study of vegetable crops with respect to their origin, distribution, climate and soil requirement, sowing and planting ,varieties, nutrient requirement, irrigation, intercultural operations, harvesting , important insect pests diseases and disorders crop improvement-seed production techniques of vegetables (tomato, Brinjal, chilli, cauliflower and Pumpkin)
UNIT – IV	**PLANT GROWTH REGULATORS** Indole acetic acid: NAPHTHALENE ACETIC ACID-Ethepon (2-chloroethyl phosphoricacid- Alar (succinin acid-2, 2-dimethyhydrzine :) their function- Plant hormones: Gibberlin, Cyclocel, Phosphon, dwarfing compound (CCC: 2-Chlorethyltrimethyl ammonium chloride) –Defoliants.
UNIT – V	**SOIL CHEMISTRY** Origin of the earth, Earth's crust: Composition: Rocks and minerals, Weathering, soil formation factors and processes-Components of soils and Soil profile, soil physical properties, soil texture, textural classes, particle size analysis and soil structure- soil colour, elementary knowledge of soil classification and soils of India- soil water, Retention and potentials and movement of soil water-Methods of determination of soil moisture. Thermal properties of soil and soil temperature-Soil air, Gaseous exchange, influence of soil temperature and air on plant growth;- Soil analysis. Composition of soil: Organic and Inorganic constituents. Soil acidity: buffering capacity of soils. Limiting of soil. Absorption of cations and anions: availability of soil nutrients to plants.
REFERENCES	1. History of Agriculture in India, Vol.I-IV–(Ed.) M.S.Randhawa 2. Concise History of Science in India, Agriculture - S.P. Rayachaudhury, D.M. Bose, S.N.Sen and B.V.A.Subbarayappa 3. Irrigation Principles and Practices - O.W. Israelsen and V.E. Hansen 4. Agricultural Drainage : Principles and Practices –U.S.Kadam 5. Micro-irrigation for cash crops – M.L.Choudhary 6. Vegetable Crops -T.K.Bose and M.G.Som 7. Vegetable for the tropical region -PremNath, S.Velayadhan and D.P.Singh 8. Text book of Vegetable Tuber Crops and spices -S.Thamburaj and N.Singh 9. G.T. Austin: shreve's Chemical Process Industries, Mc-Graw-Hill. 10. Yagodin (Ed). Agricultural Chemistry, 2 Volumes, Mir Publishers (Moscow). 11. A text book of Soil Science – T.D. Biswas& S.K.Mukherjee 12. Fundamentals of Soil Science – Indian Society of Soil Science

PC/ 2021-23 / PG / Chemistry / Semester – II				
DSE Elective	**Sub Code**	**FORENSIC SCIENCE**	**Hrs./ Week**	**Credits:**
6	**21PCHE23**		**4**	**4**

COURSE OBJECTIVES	• To know the definition and scope of forensic science. • To understand the General methods of chemical analysis. • To know the History and development, biological basis of fingerprints • To know about Forensic photography. • To study about modern developments in forensic science.
COURSE OUTCOME	• Describe the fundamental principles and functions of forensic science. • Identify the significance of chemistry in forensic science. • Measure the method of Identification and detection. • Summarize the questioned documents used in forensic science. • Point out modern development in forensic science.
UNIT – I	**INTRODUCTION AND HISTORY** Definition and Scope of Forensic Science. Divisions of Forensic Science and Laboratory Set up. Basic Principles, theory and application of spectroscopy (U.V., I.R., Atomic Absorption Emission and Mass) and its forensic applications. Electrophoresis (Immuno and Iso-electrofocusing) theory, principle and techniques. X-ray (Hard and Soft) techniques and their forensic applications.
UNIT – II	**FORENSIC CHEMISTRY** Introduction, Conventional methods of chemical analysis, presumptive tests (colour & spot); Drugs of Abuse: Introduction and classification; Forensic Toxicology: Introduction and General methods of chemical analysis for alcohol, Classification of poisons.
UNIT – III	**IDENTIFICATION AND DETECTION** History and development, biological basis of fingerprints, pattern types, scene of crime prints, methods of processing latent/fingerprints, ridge characteristics, comparison of fingerprints for establishing complete identity. Tool marks their identification and importance in forensic science; Trace evidence: Definition, identification and their importance in forensic science. Identification and detection of biological fluids (Blood, Semen, Saliva and Urine) and their Medico-logical importance. Personal Identification through somatometry and Somatoscopy; Study and hair and fibers.
UNIT – IV	**QUESTIONED DOCUMENTS** Definition, handwriting, characteristic, natural variation, comparison and forgery; Forensic photography – techniques and important of photography.
UNIT – V	**MODERN DEVELOPMENTS** Examination of skeletal remains-identification of bones, differentiation between human and non-human, determination of age, sex and height from skeletal remains. Nacre analysis, Brain fingerprinting, DNA Profiling, voice identification, Cybercrime, Forensic Odontology and Bitemarks.

REFERENCES	1. R. Saferstein: Criminalistics, Prentice Hall. 2. B.R. Sharma: Forensic Science in Criminal Investigation and Trials, Central Law Agency, Allahabad. 3. W.G. Eckert: Introduction of Forensic Science, CRE Press, Bock Raton. 4. I.P. Singh and M.K. Bhasin: A Laboratory Manual of Biological Anthropology, K.R. Enterprises, N. Delhi. 5. S. Nath: An Introduction to Forensic Anthropology, Gian Publishing House, N. Delhi. 6. S. Nath: Personal Identification through Fingerprints, Shree Publisher & Distributors, New Delhi. 7. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi. 8. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi. 9. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, Boca Raton. 10. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, W.G. Eckert (ED.), CRC Press, Boca Raton.

PC/ 2021-23 / PG / Chemistry / Semester – II				
Practical	**Sub Code**	**ORGANIC CHEMISTRY PRACTICAL – I**	**Hrs./ Week**	**Credits:**
1	**21PCHMP1**		**4**	**4**

COURSE OBJECTIVES	• To identify the components in the given mixture. • To enable the student to develop analytical skill in organic qualitative analysis • To prepare the derivatives of the component in the mixture. • To determine the boiling and melting point for the components in the mixture. • To enable the students to understand better the concepts of organic analysis and appreciate better the applications of organic chemistry towards chemical, industrial and biological systems.
COURSE OUTCOME	• Identify the components in the two component mixture. • Prepare the derivatives of the component in the mixture. • Determine the boiling and melting point for the components in the mixture. • Asses the ability to separate and characterize compounds. • Produce sound knowledge of the fundamental and advanced concepts of organic analysis.
SYLLABUS	**I. Analysis** Identify the components in the two component mixture. Prepare the derivatives of the component in the mixture. **II. Preparation** • Preparation of 1,2,3,4- Tetra hydro carbazole from Cyclohexanone. • Preparation of Resacetophenone from resorcinol. • Preparation of p-benzoquinone from hydroquinone. • Preparation of Bis-2-napthol. • Preparation of Di Benzylidene acetone. • Preparation of s – Benzyl isothiuronium chloride • Preparation of picric acid.
EVALUATION	**Internal- 50 marks** 25 marks- Regular class work 25Marks – Model test **External – 50 marks** Separation and analysis- 25 marks Preparation- 10 marks Submission of derivative of eight mixture -5 marks Viva-Voce- 5 marks Record-5 marks Duration -6 hour
NOTE	Each student is expected for submit both recrystallized samples of the derivatives and the preparation during their regular for evaluation at the time of practical examinations.

REFERENCES	1. B.S. Furniss, A.J. Hannaford, P.W.G. Smith and A.R. Tatchell, 2. Vogel's Practical Organic Chemistry. 5th edn. ELBS. 3. Raj K. Bansal, Laboratory manual of Organic Chemistry, III Edn., New Age International (P) Ltd.

PC/ 2021-23 / PG / Chemistry / Semester – II				
Practical	**Sub Code**	**INORGANIC CHEMISTRY PRACTICAL – I**	**Hrs./ Week**	**Credits:**
2	**21PCHMP2**		**4**	**4**

COURSE OBJECTIVES	• To study the principle of distribution of common and rare metal ions in different groups. • To know the inter and intra group precipitation and separation of metal ions. • To improve the skill in the qualitative analysis of rare metal ions in different groups. • To identify the methodology to analyse a metal ion in the presence of another metal ion. • To analyse the cations present in the inorganic mixtures.
COURSE OUTCOME	• Analyse the cations present in the inorganic mixtures. • Estimate the ions present in the solution. • Develop to independently carry out the semi micro qualitative analysis of inorganic mixtures. • Apply the concepts of inorganic chemistry analysis to solve complex problems to improve human life. • Graph valid conclusions and support them with examples.
SYLLABUS	Semi micro qualitative analysis of inorganic mixtures containing two familiar cation and two less familiar cations Pb,Cu, Bi, Cd, Sb, Zn, Co,Ni, Mn, Ca, Ba, Sr, W, Tl, Te, Se, Mo, Ce, Th, Zr, V, Ti, Li. **Complexometric Titration**- Estimation of Cu, Zn, and Mg by EDTA titration in presence of either Pb or Ba. **Photo colorimetric Estimation** of Fe, Ni, Cr and NH_4^+ (Course work only)
EVALUATION	**Internal- 50 marks** 25 marks- Regular class work 25Marks – Model test **External – 50 marks** Estimation: 20 marks Analysis of mixture: 20 marks Viva – voce: 5 marks Record: 5 marks Duration: 6 hour
REFERENCES	1. G. Svehla, Vogel's qualitative Inorganic analysis, Orient Longman. 2. V.V. Ramanujam, Inorganic Semimicro Qualitative analysis. National Publishing Co.

PC/ 2021-23 / PG / Chemistry / Semester – II				
Practical	**Sub Code**	**PHYSICAL CHEMISTRY PRACTICAL – I**	**Hrs./ Week**	**Credits:**
3	**21PCHMP3**		**4**	**4**

COURSE OBJECTIVES	• To estimate the acid present in the mixture. • To determine the dissociation constant of weak acid. • To predict the solubility product of the salt. • To know the equilibrium constant of the reaction. • To be able to gain knowledge in classical laboratory techniques.
COURSE OUTCOME	• Separate the acid present in the mixture. • Determine the dissociation constant of weak acid. • Predict the solubility product of the salt. • Detect the equilibrium constant of the reaction. • Transform good working knowledge of instrumentation.
SYLLABUS	Any ten experiments (to be decided by the course teacher) Out of the following experiment. 1. Conductometric Experiments i) Estimation of HCl and acetic acid in a mixture. ii) Estimation of NH4Cl and HCl in a mixture. iii) Estimation of Acetic acid and sodium acetate in Buffer solution. iv) Conductometry- Determination of dissociation constant of weak acid. v) Conductometry- Solubility product of sparingly soluble silver salt. vi) Determination of relative strength of two acids by conductivity measurements. 2. Distribution law i) Distribution of Iodine between two immiscible solvents & Study of the equilibrium constant of the reaction $KI+I_2 \rightleftharpoons KI_3$(Or) ii) Distribution of Benzoic acid between two immiscible solvents 3. Thermometry i) Determination of Solution enthalpy of ii) Oxalic aicd- water iii) Ammonium oxalate-water iv) Potassium dichromate- water v) Benzoic acid- water vi) Naphthalene- Toluene
EVALUATION	**Internal- 50 marks** 25marks- regular class work 25Marks – Model test **External – 50 marks** Experiment- 20 marks Record-5 marks Viva-Voce-5 marks Calculation-10 marks Unknown-10 marks Duration -6 hour

References	1. W. J. Popiel, Laboratory Manual of Physical Chemistry, ELBS, London. 2. S. K. Sinha, Physical Chemistry A Laboratory Manual, Narosa Publishing Pvt, Ltd.

PC/ 2021-23 / PG / Chemistry / Semester – III				
Core	**Sub Code**	**ORGANIC REAGENTS AND NATURAL PRODUCTS**	**Hrs./ Week**	**Credits:**
7	**21PCHM31**		**5**	**4**

COURSE OBJECTIVES	• To know the reagents in organic synthesis. • To know about oxidation and reduction naming reactions. • To study about Reagents in Organic Synthesis. • To know about classification and structural elucidation of cholesterol. • To know the General methods to elucidate the structure of natural products.
COURSE OUTCOME	• Compare the different types of organic reagents and its mechanism. • Classify the reagents which causes oxidation and reduction reactions. • Categorize knowledge about the reagents specificity. • Summarize the isolation and structural determination of Steroids and Vitamins. • Explain the synthesis and Elucidation of structure of steroids and terpenoids.
UNIT – I	**REAGENTS IN ORGANIC SYNTHESIS** Gilman's reagent – LDA –DCC – 1, 3-dithane (umpolung synthesis) – Selenium dioxide Aluminiumisopropoxide. Fetizon's reagent-Lemieux-Von Rudloff reagent – Leminux- Johnson reagent – Woodward and Prevost hydroxylation. Phase transfer catalyst, Vaskas catalysts –Wilkinson's catalyst.
UNIT – II	**OXIDATION & REDUCTION** **a) Oxidation:**Jone's reagent, Pyridinium chlorochromate (PCC), Pyridinium dichromate (PDC), Chromyl chloride, Oppenaur oxidation. **Miscellaneous oxidants**: Singlet oxygen, Lead tetra-acetate, Periodic acid, iodine-silver carboxylates. **b)Reduction:** Birch reduction, Rosenmund reduction, Clemmenson reduction- **Reduction with metal hydride**: $LiAlH_4$, $NaBH_4$ and diborane.**Miscellaneous reductant:** Silanes, stannous chloride, hydrazine.
UNIT – III	**REACTIONS & REAGENTS** **a) Selected name reactions**: Benzoin, Dieckmann, Claisen-Schmidt condensation, Reformatsky, Perkin, Enamine, Nef, Vilsmeier-Haack, Mannich and Polonovski reaction. **b) Reagents in Organic Synthesis:** 2,3 –dichloro -5,6 –dicyano -1,4-benzoquinone(DDQ),super hydrides – K and L selectrides – Dess Martin periodinane.
UNIT – IV	**STEROIDS & VITAMINS** **Steroids:** classification –Structural elucidation of cholesterol, testosterone, androsterone and oestrone. Conversion of cholestrol into testrosterone, andosterone, 5α and 5β-cholanic acid. Conversion of oestrone to oestriol, oestradiol and vice versa. **Vitamins:** Structural determination of Vitamins A_1,B_1,C,D

UNIT – V	**CHEMISTRY OF NATURAL PRODUCTS** **Alkaloids:** Degradation studies- HEM, Emde and Von – Braun method – Structural determination of quinine and morphine. **Terpenoids:** General methods to elucidate the structure of terpene, camphor,zingiberene and squalene. **Antibiotics:** Structural determination of penicillin and chloroamphenicol.
REFERENCES	1. S.M Silverstein, G.V Bassler and T.C Morril, 'Spectroscopic Identification of Organic chemistry, Wiley. 2. I.L Finar, 'Organic Chemistry', Vol2. Pearson Education Inc. 3. GurdeepChatwal, 'Chemistry of Natural Products', Vol I and II, Himalaya Publishing House, Bombay. 4. O.P Agarwal, 'Chemistry of Natural Products,' Vol I and II, Goel Publishing House, Meerut. 5. J.March, 'Advanced Organic Chemistry, John Wiley and sons, New York. 6. P. Sykes, 'A Guide book to mechanism in Organic Chemistry', Pearson. 7. Ahluwalia V.K and Parshar R.K, Organic Reaction Mechanism, Narosa Publishing House. 8. Gurdeep Chatwal, Organic Chemistry of Natural Products, Vol II, Himalaya Publishing House, Bombay. 9. Ahluwalia V.K and Parshar R.K, Organic Reaction Mechanism Kalsi P S, Stereochemistry: Conformation and Mechanism, New-Age International Publishers, New Delhi. 10. Morrision R.T. and Boyd R.N., Organic Chemistry, Allyn& Bacon Ltd., New York. 11. March J, Advanced Organic Chemistry, John-Wiley and Sons, New York. 12. Finar I L, Organic Chemistry Volume I and II, Pearson Education Ltd. 13. Michael B. Smith, Organic Synthesis, McGraw Hill Publishing Company. 14. Francia. A. Carey, Organic Chemistry, Tata-McGraw Hill Publishing Company, New Delhi. 15. Clayden, Greeves,Warren and Wothers, Organic Chemistry, Oxford University Press, New York. 16. P.S. Kalsi, Organic Reactions and Mechanisms, New Age International Publishers. 17. S.M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan.

PC/ 2021-23 / PG / Chemistry / Semester – III				
Core	**Sub Code**	**INORGANIC CHEMISTRY-III**	**Hrs./ Week**	**Credits:**
8	**21PCHM32**		**4**	**4**

COURSE OBJECTIVES	• To know the EAN rule and its correlation to stability of organometallic compounds. • To understand the Reaction of organometallic complexes. • To know the electronic spectroscopy. • To know about chemistry of halogens and the noble gases. • To study mossbauer and nqr spectroscopy.
COURSE OUTCOME	• Define the EAN rule for organometallic compounds. • Summarise the substitution, oxidative addition, reductive elimination, nucleophilic and electrophilic reactions of organometallic complexes. • Determine the Microstates and Term symbols for Transition metal complex. • Compare the properties of Halogens and Nobel gases. • List the applications of NMR and NQR spectroscopy.
UNIT – I	**ORGANOMETALLIC CHEMISTRY I** EAN rule and its correlation to stability of organometallic compounds- Isolobal fragments. Synthesis structure and bonding of metal carbonyls, nitrosyls and dinitrogen complexes. IR spectral characterization of carbonyls and nitrosyls - pi – acceptor complexes with alkene, alkyne– Metal carbine and carbine complexes. Metallocenes; synthesis, properties, structure and bonding of ferrocene. Covalent versus ionic bonding in berryllocene.
UNIT – II	**ORGANOMETALLIC CHEMISTRY II** Reaction of organometallic complexes: oxidative addition and reductive elimination, insertion and elimination reactions; nucleophilic and electrophilic attack of coordinated ligands. Homogeneous catalysis – organometallic compounds functioning as catalysts and the requirements; Wilkinson's catalyst, Tolman's catalytic loop; Hydroformylation (oxo) reaction, Wacker and Monsanto acetic acid processes. Cluster compound. Heterogeneous catalysis – synthesis gas and water gas shift reactions; Fischer Tropsch process and synthetic gasoline, Ziegler-Natta catalyst.
UNIT – III	**ELECTRONIC SPECTROSCOPY** Introduction of electronic spectroscopy- selection rules for electronic transition. L-S coupling and J-J coupling, microstates, term symbols - splitting of terms, hole formalism - Orgel and Tanabe – Sugano diagrams - evaluation of 10 Dq and β for octahedral d^2, d^6,$d^7$and d^8systems - effect of distortion and spin-orbit coupling on the spectra - charge-transfer spectra - electronic spectra of lanthanide complexes. Nephelauxetic effect. **Magnetic Properties:** Magnetic properties of 1st row transition metal complexes. Application of magnetic moment- Oxidation state, structure determination.

UNIT – IV	**CHEMISTRY OF HALOGENS AND THE NOBLE GASES** The discovery of the noble gases-Fluorides of the noble gases- Bonding in noble gases fluorides- Compounds of xenon with F_2 and O_2 their preparation, properties and structure. Halogen in positive Oxidation states – Interhalogen compounds- Polyhalide ions- Fluorine –Oxygen Chemistry–Oxy acids of heavier halogens- Pseudohalogens.
UNIT – V	**MOSSBAUER AND NQR SPECTROSCOPY** **Mossbauer Spectroscopy:** Principles – Doppler effect-Isomer shift – Quadruple interaction – Nuclear Zeeman Splitting – Quadrupole interactions and magnetic interactions; covalently bonded compounds- oxidation states of metal ion in compounds -simple applications to Iron and Tin compounds. **NQR Spectroscopy:** Principles, conditions for NQR, Quadrupole Nucleus, asymmetric parameter, Quadrupole splitting of energy levels- Comparison of NMR and NQR. Instrumentation, Application of NQR- Substituent effect, Phase transition, Hydrogen Bonding.
REFERENCES	1. James E.Huheey, Ellen A. Keiter and Richard L. Keiter, Inorganic Chemistry, Principles of Structure and Reactivity, Harper Collins College Publishers. 2. F.Albert Cotton, Geoffrey Wilkinson, Carlos A.Manic and Manfred Bochman,Advanced Inorganic Chemistry, Wiley Interscience Publication. 3. D.F. Shriver, P.W. Atkins and C.H. Langford, Inorganic Chemistry, ELBS, Oxford University Press. 4. G.S.Manku, Theoretical Principles of Inorganic Chemistry, Tata McGraw Hill. 5. K.F.Purcell and J.C.Kotz,Advanced Inorganic Chemistry, Saunders Golden Publishers. 6. B.E.Douglas, D.H.McDaniel and J.J.Alexander, Concepts and Models of Inorganic Chemistry, John Wiley and Sons Ltd. 7. J.D.Lee, Concise Inorganic Chemistry, Blackwell Science Ltd., Reprint. 8. M.C.Day and J.Selbin., Theoretical Inorganic Chemistry, East West Press. 9. R.S. Drago, Physical Methods in Inorganic Chemistry, Chapman and Hall Ltd., London. 10. R.S. Drago, Physical Methods in Chemistry, Saunders Golden Sunburst series. 11. E.A.V. Ebsworth David, W.H.Rankin Stephen Credock, Structural Methods in Inorganic Chemistry, ELBS. 12. D.A. Skoog, F.J. Holler and T.A. Nieman, Principles of Instrumental Analysis, Saunders. 13. D.A. Skoog, D. M. West, F.J. Holler, S.R.Grouch, Fundamentals of Analytical Chemistry, Thomson Asia Pvt.Ltd.

PC/ 2020-22 / PG / Chemistry / Semester – III				
Core	**Sub Code**	**QUANTUM CHEMISTRY AND POLYMER CHEMISTRY**	**Hrs./ Week**	**Credits:**
9	**20PCHM33**		**4**	**4**

COURSE OBJECTIVES	• To know the properties of Ψ-operators and commutation relation. • To know about Perturbation variation theory. • To know about Huckel molecular orbital (HMO) theory for conjugated π - systems. • To know about Natural and synthetic polymers. • To study about macromole cules.
COURSE OUTCOME	• Analyze Schrodinger wave equation for different wave function • Describe the approximation methods in quantum chemistry • Interpret the approximation methods to different atoms and find the dissociation energy and bond order for various molecules by applying Huckel molecular orbital theory. • Develop the polymer molecule and determine the molecular weight of polymer. • Solve the structure and testing polymers.
UNIT – I	**QUANTUM CHEMISTRY-I** Wave and particle nature of radiation-Planck's Quantum theory – Wave particle duality – uncertainty principle- Bohr's theory of hydrogen atom-hydrogen spectra- properties of Ψ-operators and commutation relation, Application of quantum mechanism to simple cases. Postulates of quantum mechanics – Particle in one dimensional box, three dimensional box.
UNIT – II	**QUANTUM CHEMISTRY-II** Rigid rotator – harmonic oscillator – hydrogen atom, shapes of atomic orbitals – Time dependent and time independent Schrodinger wave equation. Approximation methods in quantum mechanics- Perturbation variation theory-Application to He atom. Hartreefock self-consistent field method. Slater determinant and its methods.
UNIT – III	**QUANTUM CHEMISTRY – III** Theory of chemical bonding – Born – Oppenheimer approximation – LCAO – MO approximation for hydrogen molecule ion and hydrogen molecule – Valence Bond theory of hydrogen molecule – Concept of hybridisation – sp, sp^2 and sp^3 hybridisation – Huckel molecular orbital (HMO) theory for conjugated π - systems – application to ethylene, butadiene and benzene.
UNIT – IV	**POLYMER CHEMISTRY** Natural and synthetic polymers – general concept – radical, ionic and coordination chain polymerization; stereospecific polymerization and the utility of Ziegler-Natta catalyst; copolymerization – synthesis of graft and block copolymers; polystyrene, acrylic polymers and polyesters, cellulosic polymers, phenol resins, amino resins and epoxy resins – Conducting polymers – chemical structure and electronic behavior of polymers- doping of conducting polymers – polyaniline, polypyrrole and polythiophene.
UNIT – V	**MACROMOLECULES** Addition and condensation polymers, number average and weight average molecular weights of macromolecules – Determination of molecular weights

	– kinetics of polymerization, molecular and free radical mechanism – polymerisation in solution sterocochemistry. Analysis and Testing of polymers: Chemical analysis of polymers, Spectroscopic methods X – ray Diffraction analysis – Microscopy – Thermal analysis – Physical Testing.
REFERENCES	1. Prasad R K, Quantum Chemistry, New Delhi, Wiley Eastern Ltd. 2. Donald A McQuarrie, Quantum Chemistry, Viva Books PrivateLtd. 3. Chandra A K, Introductory Quantum Chemistry, Tata McGraw, Hill. 4. Levine I N, Quantum Chemistry, Prentice Hall of India,Pvt. Ltd. 5. Atkins P W, Molecular Quantum Mechanics, Clarendon. 6. Anatharaman R, Fundamentals of Quantum Chemistry, McMillan, NewDelhi. 7. S.N.Datta : Lecture on chemical bonding and quantum chemistry. 8. Manas Chanda, Advanced Polymer Chemistry, Marcel Dekker, Inc.New York. 9. J. R. Fried, Polymer Science and Technology, Prentice-Hall of India Pvt. Ltd., New Delhi. 10. F. Rodriguez, Principles of Polymer Science, Tata McGraw Hill, New Delhi, 2nd Edn. 11. F.W. Billmeyer Jr., Text Book of Polymer Science, John Wiley and sons, New York. 12. Premamoy Ghosh, Polymer Science and Technology, Tata McGraw Hill, New Delhi, 2nd Edn. 13. V.R.Gowarikar, N.V.Viswanathan and J. Sreedhar, Polymer Science, Wiley Eastern, New Delhi. 14. C.E.H. Bawn, The Chemistry of High Polymers, Butterworth and Co., London. 15. Alexander – Leroy E. Alexander, X – Ray Diffraction methods in polymer sciences, John Wiley & sons, New York. 16. Fred W. Billmeyer, Textbook of Polymer Science

PC/ 2021-23 / PG / Chemistry / Semester – III				
DSE Elective	**Sub Code**	**SCIENTIFIC - RESEARCH METHODOLOGY**	**Hrs./ Week**	**Credits:**
7	**21PCHE31**		**4**	**4**

COURSE OBJECTIVES	• To Review the literature. • To understand the Errors in chemical analysis. • To know the chromatographic technique. • To know about principle, instrumentation and applications of analytical techniques. • To study about computer applications in chemistry.
COURSE OUTCOME	• Select the research topic and able to survey the literature. • Develop the accuracy of data in chemical analysis. • Detect the compound from a mixture using various chromatographic techniques. • Interpret the data using TEM, SEM and XRD techniques. • Explain C++ programming for the determination of some Chemical properties.
UNIT – I	**LITERATURE SURVEY AND SCIENTIFIC WRITING** Reviewing the literature, Primary and secondary literature: Journals, patents, Reviews, Chemical abstracts, treatises and monographs. Indexes and abstracts in science and technology. Preparation and presentation of report; dissertation and thesis writing. Scientific writing-research reports, thesis, journal articles and books. Types of publications-communications, articles, reviews, when to publish, where to publish, specific format required for submission. Documentation- referencing styles-bibliography.
UNIT – II	**ERRORS IN CHEMICAL ANALYSIS** Errors in chemical analysis – classification of errors Precision and accuracy– determination of accuracy of methods – improving accuracy of analysis – significant figures – mean, standard deviation – comparison of results : “t” test, “f” test, Q test and “chi” square test – rejection of results – presentation of data. Correlation, linear regression and analysis of variance.
UNIT – III	**CHROMATOGRAPHIC TECHNIQUE** Gas chromatography-gas-liquid and gas solid chromatography-Sample injection system-carrier gas-Columns-Detectors for GC-thermal conductivity detector-flame ionization detector. Principle and operation of column, thin-layer and paper chromatography. Principle of ion-exchange – preparation and types of ion exchange resins-cation exchanger, anion exchangers- analytical applications.
UNIT – IV	**ANALYTICAL TECHNIQUES** Electrogravimetry: principle, instrumentation and applications. Coulometry: constant current coulometry – coulometric titrations – applications – potentiostatic coulometry – Polarography: principle – experimental assembly – working – advantages and Principles, instrumentation and application of SEM, TEM, AFM and XRD

UNIT – V	**COMPUTER APPLICATIONS IN CHEMISTRY** Introduction – Significant developments in the history of computers – computer generations – Components of a computer –block diagram-CPU, ALU, control units, memory unit, Memory –classification of memory devices, Main memory –semiconductor memory devices (RAM, ROM) – Secondary memory devices – magnetic disks (hard and floppy). Peripheral devices – Input devices – keyboard keys and their uses-mouse; Output devices – VDU-printer and its classification; Hardware and software. Programming – to compute the i) slope, intercept and correlation coefficient for the given set of data of straight line, ii) wavelength, frequency or energy for a wave, iii) lattice energy on the basis of Born Lande's equation.
REFERENCES	1. Research Methodology: Methods and Techniques - C. R. Kothari, 2New Age International Publishers. 2. C. Mahadevan, Research Methatology, Sakuntala Publications, Nagercoil. 3. B.T. Bottle, The use of Chemical literature, Butterworths. 4. A.J. Durston, Thesis and assignment writing. 5. J.D. Dick, Analytical Chemistry 6. R.O Bullet, Preparing thesis and other manuscripts. 7. Instrumental methods of analysis - Willard Merritt,Dean and settle 8. Anderson. J, Durston. B. H, Poole. M, Thesis and Assignment Writing, Wiley Eastern, New Delhi. 9. Sharma. B.K, Instrumental Methods of Chemical Analysis, Goel Publishing House. 10. Willard. H, Merrit Jr. L and Dean. A, Instrumental methods of analysis, CBS Publishers and Distributers. 11. Gurdeep R. Chatwal, Sham K.Anand, Instrumental Methods of ChemicalAnalysis, Himalaya Publishing House, Mumbai. 12. Skoog.D.A, West.D.M F, Holler.J, Crouch.S.R, Fundamentals of Analytical Chemistry, Thomson Asia Pvt. Ltd. Third Reprint. 13. Banwell. C.N, Fundamentals of molecular spectroscopy, McGraw Hill Education, Noida.

PC/ 2021-23 / PG / Chemistry / Semester – III				
DSE Elective	**Sub Code**	**ANALYTICAL CHEMISTRY**	**Hrs./ Week**	**Credits:**
8	**21PCHE32**		**4**	**4**

COURSE OBJECTIVES	• To know the Errors and Data Analysis. • To understand the chromatographic techniques. • To know the Principles and analytical experimentation of electro analytical techniques. • To know about atomic absorption and emission spectroscopy. • To study about Principles and applications of surface techniques.
COURSE OUTCOME	• Identify the Errors and Data Analysis • Predict the Advanced techniques in chromatography • Summarize the electro analytical techniques • Differentiate the surface techniques • Explain the principle and application of various spectroscopy
UNIT – I	**STATISTICS FOR ANALYTICAL EXPERIMENTATION** Probability, Regression analysis, Accuracy and propagation of errors, Data analysis. Mean, standard deviation, least square fit, testing the fit (C_2 test, residual etc.). Signal to noise ratio.
UNIT – II	**ADVANCED CHROMATOGRAPHIC TECHNIQUES** Theory of separation methods: HPLC, GC, GC/MS, LC/MS, GPC, Supercritical fluid chromatography, Detectors in Chromatography, Applications of chromatography.
UNIT – III	**ELECTROANALYTICAL TECHNIQUES** Principles and analytical experimentation of Potentiometry, Electrogravimetry, Voltammetry, Stripping methods, Chronoamperometry, Quantitative applications of potentiometry and voltammetry, amperometric titrations.
UNIT – IV	**ATOMIC ABSORPTION AND EMISSION SPECTROSCOPY** Principles and applications of Fluorimetry, nephelometry, turbidimetry, Dynamic light scattering. Preliminary analyses of a spectrum: Relative populations of species from intensity, relate line widths to lifetime, Introduction to spectroscopy in time domain, Time-correlated single photon counting.
UNIT – V	**SURFACE TECHNIQUES** Principles and applications of Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), X-ray Photoelectron spectroscopy (XPS),electron spectroscopy for chemical analysis (ESCA), and Scanning Probe Microscopy.
REFERENCES	1. D. A. Skoog, F. J. Holler and S. R. Crouch, Principles of Instrumental Analysis, Brooks/Cole Cengage Learning, Belmont, CA. 2. H. H. Willard, L. L. Merrln, Jr., J. A. Dean, and F. A. Senle, Jr., Instrumental Methods of Analysis: Wadsworth, Belmont.

	3. F. Rousseac and A. Roessac, Chemical Analysis: Modern Instrumentation Methods and Analysis, John Wiley & Sons, Ltd. 4. B. Voigtlaender, Scanning Probe Microscopy: Atomic Force Microscopy and Scanning Tunneling Microscopy:, Springer - Verlag, Berlin.

PC/ 2021-23 / PG / Chemistry / Semester – III				
DSE Elective	**Sub Code**	**CHEMICAL INSTRUMENTATION**	**Hrs./ Week**	**Credits:**
9	**21PCHE33**		**4**	**4**

COURSE OBJECTIVES	• To know the nature of a measurement. • To understand the operational amplifiers. • To differentiate modulation and demodulation. • To predict binary logic concepts, logic gates and multivibrators. • To study about instrumentation for optical absorption spectrometry.
COURSE OUTCOME	• Demonstrate automatic operation and computer control • Asses the control of current and voltage. • Differentiate modulation and demodulation. • Predict binary logic concepts, logic gates and multivibrators. • Interpret the optimal value of adjustable parameters
UNIT – I	**MEASUREMENT AND INSTRUMENTATION** Introduction - The nature of a measurement - Choice of a method of measurement - Control of variables - Basic design patterns - General properties of modules - Propagation of uncertainty - Single channel design - Limit of detection and amplification - Automatic operation and computer control.
UNIT – II	**OPERATIONAL AMPLIFIERS** The operational amplifiers - Limitations on amplifier performance – Mathematical operations - Differentiation - Integration - Measurement of current and voltage - Precise control of current and voltage.
UNIT – III	**SIGNAL-TO-NOISE OPTIMISATION** Sensitivity and detection limits - Noise - Minimising Noise in a system - Signal averaging - Modulation: Chopping - Demodulation: Phase sensitive detection - Other methods of Optimising Signal-to-Noise ratio.
UNIT – IV	**DIGITAL ELECTRONICS** Binary logic concepts - Logic gates - Multivibrators - Counters - Wave shaping – Analog to digital convertors - Instruments and Digital computers.
UNIT – V	**INSTRUMENTATION FOR OPTICAL ABSORPTION SPECTROMETRY** Visual Photometres - Filter Photometers - Spectrophotometer - Double beam Spectrophotometer - Recording Spectrophotometers - Optimal value of adjustable parameters - Multiple internal reflection assembly - Rapid scanning spectrometer - Non dispersive Photometers - Photometric titration equipment - Fourier transform Spectrometers.
REFERENCES	1. Strobel H A, Chemical instrumentation - A systematic approach to Instrumentational analysis, Addison- Wesley Publishing company Inc, Phillipines. 2. Jeffery G H, Bassett J, Mendham J and Denney R C, Vogels Textbook of Qualitative chemical analysis, Longman Scientific and technical, Essex. 3. Skoog D A, Hollar F J, Crouch S R, Principles of Instrumental analysis, Thompson Brooks/ Cole, Belmont CA.

PC/ 2021-23 / PG / Chemistry / Semester – IV				
Core	**Sub Code**	**SPECTROSCOPY AND SUBSTITUTION REACTIONS**	**Hrs./ Week**	**Credits:**
10	**21PCHM41**		**4**	**4**

COURSE OBJECTIVES	• To understand the Characteristics of IR absorptions of different functional groups. • To know the 1D and 2D NMR Spectroscopy. • To understand about the applicability of the Mass spectroscopic techniques. • To study about Nucleophilic substitution reactions. • To know about electrophilic substitution reactions.
COURSE OUTCOME	• Integrate the structure of organic compounds using UV,IR, ORD and CD • Interpret the details of 1D and 2D NMR Spectroscopy. • Gain knowledge about the applicability of the Mass spectroscopic techniques. • Explain neighbouring group participation in aliphatic electrophilic substitution. • Conclude the various factors that operate in organic reactions.
UNIT – I	**UV, IR, ORD AND CD OF ORGANIC COMPOUNDS** **UV:** The absoption laws- Types of electronic transitions-effect of solvent and hydrogen bonding on λ_{max} value. Woodward – fischer rules to calculate λ_{max} values of conjugated dienes and α,β-unsaturated ketones. **IR:** Characteristics of IR absorptions of different functional groups-factors influencing absorption of carbonyl and hydroxyl groups-electronic effect, hydrogen bonding and Fermi resonance and finger print region. **Optical rotatory dispersion (ORD) and CD:** Optical rotatory dispersion (ORD) - Octant rule – α-halo ketone rule and their applications- Circular Dichroism.
UNIT – II	**NMR SPECTROSCOPY** **H^1 NMR Spectroscopy:** Basic principles-chemical shift-Shielding and deshielding – Factors influencing chemical shift-spin-spin splitting – classification of spin system-analysis of ABX and AMX system. Geminal, vicinal and long range coupling-NOE in stereochemistry. **C^{13} NMR Spectroscopy:** Principles of proton decoupled ^{13}C NMR-comparison with H^1NMR- Chemical shift (aliphatic, olefinic, aromatic and carbonyl compounds) **2-D NMR:** ^1H-^1HCOSY, ^{13}C-^1H COSY, NOESY, DEPT and INADEQUATE (^{13}C-^{13}C) coupling spectra.
UNIT – III	**MASS SPECTROSCOPY** Basic principles - Base peak- nitrogen rule - metastable ions - isotopic peak -daughter ions –Mc-lafferty rearrangement - General rules for fragmentation - Fragmentation pattern of simple organic compounds of hydrocarbons, alcohols, amines, aldehydes, ketones, ether, esters, acids and phenols. Techniques for ion production: EI, CI, FAB, ESI-MS and MALDI. Spectral problems involving UV, IR, NMR and Mass spectral data.

UNIT – IV	**NUCLEOPHILIC SUBSTITUTION REACTIONS** **Aliphatic Nucleophilic Substitution:** S_N1, S_N2, S_Ni, S_Ni' mechanisms – effect of substrate, nucleophile, leaving group and solvent on the rate of substitution, Ambident nucleophile – NGP-mechanism of esterification and ester hydrolysis ($B_{AC}2$ and $A_{AC}2$ mechanism only) **Aromatic Nucleophilic Substitution:** Unimolecular, Bimolecular and benzyne mechanisms. Reactivity, effect of substrate, leaving group and attacking nucleophile-typical reaction as oxygen and sulphur as nucleophile-Bucherer and Rosenmund reaction-Smiles rearrangement.
UNIT – V	**ELECTROPHILIC SUBSTITUTION REACTIONS** **a) Aliphatic electrophilic substitution:** S_E^1, S_E^2 and S_E^i mechanisms **b) Aromatic electrophilic substitution reactions:** S_E^1 mechanisms. Orientation and reactivity of monosubstituted benzene rings - ortho/para ratio - Ipso attack. Quantitative treatment - reactivity of the substrate -reactivity of the electrophile, effect of leaving group.
REFERENCES	1. J.March, Advanced organic chemistry, John Wiley and Sons, Newyork. 2. I.L. Finar, Organic Chemistry, volume 2, Pearson Education Inc., Singapore. 3. Michael B.Smith, Organic Synthesis-McGraw Hill International Edition. 4. Paula YurkanisBruice, Organic Chemistry--Pearson Education Asia. 5. SeyhanEge, Organic chemistry-A.I.T.B.S.Publishers& Distributors (Regd.) Delhi. 6. Organic chemistry by Clayden, Greeves, Warren &Wothers. 7. Organic chemistry by John McMurry. 8. Organic chemistry by L.G. Wade. JR. 9. Named Organic reactions by Thomas Laue& Andreas Plagens. 10. Gurdeep R. Chatwal, Reaction mechanism and Reagents in organic chemistry, Himalaya publishing House, Bombay. 11. Organic Spectroscopy, William Kemp. ELBS Publications. 12. Jag Mohan, Organic Spectroscopy, Narosa Publishing House. 13. Spectroscopy, B.K.Sharma, Goel Publishing House. 14. P.S. Kalsi, "Organic Spectroscopy" New Age international publishers Ltd. 15. Jag Mohan, 'Organic Analytical Chemistry Theory and Practice' 'Narosa publishing House. 16. W.Kemp, 'Organic Spectroscopy', Macmilan. 17. P.S Kalsi, 'Spectroscopy of organic compounds', New Age International publishers limited.

PC/ 2021-23 / PG / Chemistry / Semester – IV				
Core	**Sub Code**	**INORGANIC CHEMISTRY-IV**	**Hrs./ Week**	**Credits:**
11	**21PCHM42**		**4**	**4**

COURSE OBJECTIVES	• To know the Non-metals and metals in biological systems. • To understand the Copper proteins and Enzymes. • To know the inorganic spectroscopy**.** • To know about General principles of various thermal analysis techniques. • To study about inorganic photochemistry.
COURSE OUTCOME	• Describe the Iron transport and storage proteins. • Illustrate the inhibition and poisoning of Xanthane oxidase and aldehyde oxidase. • Categorise the principle and applications of NMR,and ESR spectroscopy. • Asses the principle, instrumentation and applications of TGA, DTA and DSC. • Develop semiconductor electrodes and solar cells based on laws of photochemistry.
UNIT – I	**BIO-INORGANIC CHEMISTRY I** Non-metals and metals in biological systems, essential and trace elements; Porphyrin – metal complex systems – chlorophyll and photosynthesis; cytochromes, hemoglobin, myoglobin and dioxygen binding, vitamin B12 and co-enzyme - *in vivo* and *in vitro* nitrogen fixation. Iron storage and transport: ferritin and transferrins- Iron proteins: hemerythrin, cytochrome P450 enzyme. Electron transfer reaction: Iron- sulfur protein.
UNIT – II	**BIO-INORGANIC CHEMISTRY II** **Copper proteins and Enzymes:**Plastocyanin and hemocyanin - different types of Cu present in proteins and enzymes. **Zinc enzymes**: Carboxypeptidase A, carbonic anhydrase and superoxide dismutase. Inhibition and poisoning of enzymes illustrated by xanthine oxidase and aldehyde oxidase. Toxicity of metals and the role of metallothionins - excess and deficient levels of Cu and Fe and the consequent diseases - chelate therapy – metal complexes as drugs, anticancer and antiarthritic agents.
UNIT – III	**INORGANIC SPECTROSCOPY** **NMR spectroscopy:** ^{31}P, ^{19}F and ^{15}N NMR-introduction –application in structural problems –NMR studies on exchange rates and fluxional behavior-berry pseudorotation- NMR of paramagnetic molecules and contact shifts. **ESR Spectroscopy** - Theory – Derivative curves – 'g' shift –hyperfine splitting-methyl, benzene, naphthalene, anthrazene and xylene. Calculation of electron density –Mc-connel equation. Zerofield shifting and Kramer degeneracy. Isotropic and anisotropic systems – Identification of free radicals – Applications.

UNIT – IV	**THERMAL ANALYSIS TECHNIQUES** General principles of various thermal analysis techniques – Thermogravimetry (TGA) Differential scanning colorimetry (DSC) and Differential thermal analysis (DTA)- Typical applications. **Amperometric titrations** – Theory, apparatus, types of titration curves, successive titrations and two indicator electrodes; applications, Principle and applications of Atomic Absorption Spectroscopy (AAS)- Atomic Emission Spectroscopy (AES), Inductive Coupled Plasma Resonance Spectroscopy.
UNIT – V	**INORGANIC PHOTOCHEMISTRY** Properties of excited states, electronically excited states of metal complexes and charge transfer excitations - bimolecular deactivation and energy transfer processes; ligand field photochemistry– photo substitution, photo isomerisation and photo redox reactions; synthesis, properties and charge transfer photochemistry of $[Ru(bpy)_3]^{2+}$- photochemical conversion and storage of solar energy - photochemistry at semiconductor electrodes – Honda cell and water photolysis.
REFERENCES	1. Bioinorganic chemistry: A short course by Rosette M. Roat – Malone. 2. D.F. Shriver, P.W. Atkins and C.H. Longford, Inorganic Chemistry, Oxford. 3. W.L.Jolly, Modern Inorganic Chemistry, McGraw Hill Company. 4. J.E. Huheey, E.A. Keiter and R.L. Keiter, Inorganic Chemistry, Harper and Row/PearsonAsia. 5. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, John Wiley & Sons. 6. J.K. Rohatgi – Mukherjee, Fundamentals of Photochemistry, Wiley Eastern Revised Edn. 7. A.W. Anderson and F.D. Fleischer, Concepts of Inorganic Photochemistry, John Wileyand Sons, New York. 8. R.S. Drago, Physical Methods in Inorganic Chemistry, Chapman and Hall Ltd., London. 9. R.S. Drago, Physical Methods in Chemistry, Saunders Golden Sunburst series. 10. E.A.V. Ebsworth David, W.H.Rankin Stephen Credock, Structural Methods in Inorganic Chemistry, ELBS. 11. D.A. Skoog, F.J. Holler and T.A. Nieman, Principles of Instrumental Analysis, Saunders.

PC/ 2021-23 / PG / Chemistry / Semester – IV				
Core	**Sub Code**	**SPECTROSCOPY AND SURFACE CHEMISTRY**	**Hrs./ Week**	**Credits:**
12	**21PCHM43**		**4**	**4**

COURSE OBJECTIVES	• To know the classification of molecules according to their moment of inertia. • To study about the structure determination from Raman and Infrared spectroscopy. • To know the electronic spectroscopy of diatomic molecules. • To know the difference between Physisorption and chemisorption. • To know the different types of adsorption isotherm.
COURSE OUTCOME	• Illustrate different types of electronic spectroscopy and draw the structures of various molecules. • Identify vibrational course structure and rotational fine structure of electronic band and differentiate the molecules whether they are IR active or Raman active. • Outline X-ray, UV-PES, ESCA, Auger electron spectroscopy • Categorize the chemical adsorption and physical adsorption • Compare the different types of adsorption isotherm and improve the surface area in catalysis.
UNIT – I	**SPECTROSCOPY-I** Electromagnetic radiation – Regions of spectrum- transition probability – width and intensity of spectral transitions. Classification of molecules according to their moment of inertia. Rotational spectra of rigid and non-rigid diatomic molecules. The intensities of spectral lines – Effect of isotopic substitution- Polyatomic and symmetric top molecules- stark effect
UNIT – II	**SPECTROSCOPY-II** Diatomic molecules – harmonic oscillator- Force constant –zero point energy – isotope effect – Anharmonic oscillator – diatomic vibrating rotator-overtone and combination frequencies – concept of group frequencies- Fermi resonance and FTIR. Raman spectroscopy – theory of Raman Effect, Rayleigh scattering – pure rotational Raman spectra - vibrational Raman spectra – Rotational fine structure. Polarization of light and the Raman Effect. Technique and instrumentation- Laser Raman Spectrometer. Structure determination from Raman and Infrared spectroscopy.
UNIT – III	**ELECTRONIC SPECTROSCOPY** Electronic spectroscopy of diatomic molecules. Born- oppenheimer approximation. Sequences and progressions. The Franck- condon principle, dissociation energy and dissociation products. Fortrat diagram, predissocition, Brije sponer extrapolation Photoelectron spectroscopy: principle and application of X-ray, UV-PES, ESCA, Auger electron spectroscopy.
UNIT – IV	**SURFACE CHEMISTRY-I** Adsorption –Physisorption and chemisorption – desorption– adsorption isotherms – Langmuir, Freundlich and B.E.T adsorption isotherms – measurement of surface area from BET – surface films- adsorption from solution- Gibb's adsorption equation- derivation and significance – kinetics

	of unimolecular and bimolecular surface reactions Catalysis-: Homogeneous catalysis – acid-base catalysis–heterogeneous catalysis- Enzyme catalysis – effect of substrate concentration- Michaelis – Menton kinetics - Rate of enzyme catalysed reaction- effect of pH and temperature on enzyme catalyzed reactions.
UNIT – V	**SURFACE CHEMISTRY-II** Liquid interfaces – Gibbs adsorption isotherm – surface films – spreading of one liquid on another – measurement of film pressure;; solid-liquid interfaces – contact angle – wetting as a contact angle phenomenon – wetting as a capillary action phenomenon; detergency – general aspects of soil removal – factors in detergent action; foams and aerosols.
REFERENCES	1. C McGraw Hill, New Delhi, N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, Tata 2. K. V. Raman, R. Gopalan and P. S. Raghavan, Molecular Spectroscopy, Thomson and Vijay Nicole, Singapore. 3. P. Atkins and J. de Paula, Physical Chemistry, Oxford University Press, Oxford. 4. I N. Levine, Molecular Spectroscopy, John Wiley & Sons, New York. 5. C.N. Banwell, Fundamentals of Molecular Spectroscopy, Tata McGr Hill, New Delhi. 6. R. Chang, Basic Principles of Spectroscopy, McGraw-Hill, New Delh. 7. G. M. Barrow, Introduction to Molecular Spectroscopy, Tata McGrav Hill, New Delhi. 8. B.P. Straughan and S. Walker, Spectroscopy, Vol. 1, 2 & 3, Chapm and Hall, London. 9. C. D. Becker, High Resolution NMR – Theory and Applications, Academic Press, New York. 10. D. W. Claridge, High Resolution NMR Techniques in Organic Chemist Pergamon. 11. C McGraw Hill, New Delhi, N. Banwell and E. M. McCash, Fundamentals of Molecular SpectroscopyTata 12. K. V. Raman, R. Gopalan and P. S. Raghavan, Molecular Spectroscopy, Thomson and Vijay Nicole, Singapore. 13. D.K.Chakrabarty and B.Viswanathan, Heterogeneous Catalysis,New Age. 14. M.Ladd, Introduction to Physical Chemistry, Cambridg. 15. J.O.M. Bockris and A.K.N.Reddy, "Modern Electrochemistry" vol.1& 2, Pi\lenum Press, New York. 16. S.Glasstone, "Electrochemistry" Affiliated East – West Press, Pvt., Ltd., New Delhi.

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Practical	**Sub Code**	**ORGANIC CHEMISTRY PRACTICAL – II**	**Hrs./ Week**	**Credits:**
4	**21PCHMP4**		**4**	**4**

COURSE OBJECTIVES	• To identify the components in the given mixture. • To prepare the derivatives of the component in the mixture. • To determine the boiling and melting point for the components in the mixture • To develop preparative skills in organic preparations involving two stages. • To enable to students to understand the mechanism involved in the name reactions and conditions of the react ions involving the preparations.
COURSE OUTCOME	• Estimations, two stage preparations and chromatographic techniques have been included as the practical components. • Micro scale preparations are recommended for the simple reason, they are both economic-friendly and eco-friendly. • Develop the skills like preparation of solutions , crystallization techniques, checking the purity of compounds and collection of pure samples • Define principles, proposing mechanism, problem solving , identification of chemical species and arriving to logical conclusion • Correlate theoretical knowledge in the various steps of compound preparation
SYLLABUS	**A. Organic Estimations** 1. Ethyl methyl ketone 2. Glucose-Lane Eynon and method 3. Glucose-Bertrand's method 4. Saponification value of oil 5. Determination of Percentage purity in an unsaturated acid. 6. Purity of Glucose **B. Organic preparations (Two stage)** 1. Benzaldehyde→ Benzoic acid →m-nitro benzoic acid 2. Acetanilide →p-acetanilide →p-Bromoaniline 3. Methyl benzoate →m-nitro methyl benzoate→ m-nitro benzoic acid 4. Acetanilide→ p-nitro acetanilide→ p - nitroaniline 5. Benzophenone →Benzo phenone oxime →Benzanilide 6. Benzophenone →Benzpinacol→ Benzpinacolone 7. Phthalic acid→ Phthalic anhydride →Phthalimide 8. Thiourea →s-benzyl isothiuronium chloride→ s- Benzyl-isothiuroniumbenzoate 9. Aniline →Tri bromoaniline→ Sym-Tribromobenzene **C. For Class Work Only** **(I) Chromatographic techniques** 1. TLC of Nitroaniline 2. TLC of Analgesic Drug

	3. Column Chromatography-Separation of leaf pigments 4. Paper Chromatography-Analysis of Inks and Dyes **(II) Spectral analysis:** 1. Interpretation of IR spectroscopy some organic molecules
EVALUATION	**Internal- 50 marks** 25marks- regular class work 25Marks – Model test **External – 50 marks** Experiments-40 marks Record-5 marks Viva-Voce-5 marks Duration- 6 hour
NOTE	Students are expected to submit at the time of practical examination at least eight recrystallised samples of the final products, for evaluation by the examiners. Section -C is course work only. It is for the purpose of internal assessment only.
REFERENCES	1. F.C.Mann and B.C.Saunders, Practical organic chemistry, ELBS. 2. A.I. Vogel, A Text book of Practical organic chemistry. 3. A.I. Vogel, A Text book of Quantitative Organic Analysis. 4. Raj K. Bansal, Laboratory Manual of Organic Chemistry, Wiley Eastern Ltd. 5. Moore, Dalrympk and Rodig, Experimental methods in organic chemistry, Saunders College publishing, The Oxford Press. 6. Bassett et.al. A Text Book of Quantitative Inorganic Analysis, ELBS. 7. Roberts, Gilbert, Reidwald-Wingrove an Introduction to Experimental Organic Chemistry. 8. V.K.Srivastava and K.K.Srivastava, Introduction to Chromatography-Theory and Practice, S.Chand & Co.

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Practical	**Sub Code**	**INORGANIC CHEMISTRY PRACTICAL – II**	**Hrs./ Week**	**Credits:**
5	**21PCHMP5**		**4**	**4**

COURSE OBJECTIVES	• To prepare single stage inorganic complexes. • To Estimate the ions present in the solution. • To improve the skill in quantitative estimation of metal ions by gravimetric titration. • To identify the methodology to estimate a metal ion in the presence of another metal ion. • To improve the skill in synthesis of inorganic compounds.
COURSE OUTCOME	• Assess quantitative skills in volumetric analysis. • Able to form experimental design for gravimetric analysis and inorganic complex preparation. • Discuss the ethical standards • Apply the concepts of chemistry and mathematics • Summarize the results obtained through the experiment
SYLLABUS	**I. Quantitative estimation of a mixture containing two metal ions (Volumetric and Gravimetric Estimations).** 1. Estimation of Cu^{2+} and Ni^{2+} ions. 2. Estimation of Cu^{2+} and Zn^{2+} ions. 3. Estimation of Fe^{2+} and Cu^{2+} ions. 4. Estimation of Fe^{2+} and Ni^{2+} ions. 5. Estimation of Ca^{2+} and Mg^{2+} ions. 6. Estimation of Ca^{2+} and Ba^{2+} ions. 7. Analysis of ores and alloys (course work only) Note: For examination a mixture may be given from which one cation is to be estimated volumetrically and the other gravimetrically. **II. Preparation of single stage inorganic complexes (a minimum of 10 complexes).**
EVALUATION	**Internal- 50 marks** 25marks- regular class work 25Marks – Model test **External – 50 marks** Experiments-40 marks Record-5 marks Viva-Voce-5 marks Duration- 6 hour
References	1. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney, Vogel's Textbook of Quantitative Chemical Analysis, ELBS. 2. Mounir A. Malati, Experimental Inorganic/Physical Chemistry - An Investigative, Integrated Approach to Practical Project Work, Woodhead Publishing Limited, Reprint. 3. George Brauer, Handbook of preparative inorganic chemistry, , Academic Press. 4. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney, Vogel's

	Textbook of Quantitative Chemical Analysis, ELBS. 5. Geoffrey Pass, Haydn Sutcliffe, Practical Inorganic Chemistry - Preparations, reactions and instrumental methods, Springer.

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Practical	**Sub Code**	**PHYSICAL CHEMISTRY PRACTICAL – II**	**Hrs./ Week**	**Credits:**
6	**21PCHMP6**		**4**	**4**

COURSE OBJECTIVES	• To estimate the acid present in the mixture. • To determine the dissociation constant of weak acid. • To predict the solubility product of the salt. • To know the equilibrium constant of the reaction. • To study the hydrolysis of ester kinetically
COURSE OUTCOME	• Analyse the metal quantitatively using potentiometric method. • Determine the dissociation constant of dibasic acid • Develop Freundlich adsorption isotherm of oxalic acid • Detect the changes in physical and chemical properties of a reaction • Interpret the data from an experiment, including construction of appropriate graph and evaluating error.
SYLLABUS	**I. Potentiometric titrations-** 1. Acid alkali titrations. 2. Precipitation titrations (a) Mixture of Cl^- and I^- vs Ag^+ 3. Redox titrations (a) Fe^{2+} Vs $Cr_2O_7^{2-}$ (b) Fe^{2+}Vs Ce^{4+} (c)I^- Vs $KMnO_4$ 4. Determination of dissociation constant of weak acids. 5. Determination of solubility product of sparingly soluble silver salts. 6. Determination of activity and activity coefficient of ions. 7. Determination of pH of a buffer solution using a quinhydrone electrode. **II. Titration using pH meter** (a) Determination of dissociation constant of dibasic acid. **III. Freundlich Adsorption isotherm** (a) Adsorption of oxalic acid/acetic acid on charcoal. **IV. Kinetic studies** (a) Kinetics –acid hydrolysis of ester –comparison of strength of acids. (b) Kinetics –Persulfate –Iodide –clock reaction-primary salt effect.
EVALUATION	**Internal- 50 marks** 25marks- regular class work 25Marks – Model test **External – 50 marks** Experiments-40 marks Record-5 marks Viva-Voce-5 marks Duration- 6 hour
REFERENCES	1. J.B.Yadav, "Advanced Practical Physical chemistry", GOEL publishing House, Krishna Pakashan Media Ltd. 2. Findlay"s "Practical Physical Chemistry" Revised and edited by B.P. Levitt 9th Edn. Longman, London.

	3. J.N. Gurtur and R.Kapoor, “Advanced Experimental chemistry”, Vol.I. Chand & Co., Ltd., New Delhi. 4. W. J. Popiel, Laboratory Manual of Physical Chemistry, ELBS, London. 5. D.P.Shoemaker and C.W.Garland, Experiments in Physical c McGraw-Hill, New York.

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Core Project	**Sub Code**	**GROUP PROJECT**	**Hrs./ Week**	**Credits:**
1	**21PCHM4P**		**6**	**6**

COURSE OBJECTIVES	• To reinforce the concepts with analytical techniques • To provide a platform for students to have hands –on experience with instruments • To apply the practical skill and knowledge • To prepare students for pursuing research or careers in industry in concerned subject and allied fields • To develop research skills through dissertation/Project work in different fields of chemistry.
COURSE OUTCOME	• Analyse a research topic • Develop analytical skills • Design a method for analysis/synthesis • Prepare a report of their findings • Capability to use appropriate software to solve various problems and interpretations.
GROUP PROJECT	Project for IV semester shall be a GROUP project. Each group will have maximum 4 students only. Students shall submit the project report (Dissertation) on or before the last working day of IV Semester. Project evaluation will be done by guide and an External Examiner or Guide and an Internal Examiner of the same branch of chemistry at the end of IV semester. Viva voce Examination for the project students will be conducted jointly by all the faculty members present in the Dept. including guide and an External Examiner. The marks awarded by all the Examiners (Guide, Internal and External) will be summed up and the average is calculated and this average mark is awarded to the candidate as the viva voce mark.
EVALUATION	**Internal- 50 marks** **External – 50 marks** Project presentation -20 marks Project Report -30 marks Total -50 marks