University of Pune

Syllabus Structure of M.Sc.(II) Physical Chemistry for Colleges

Course no.	Course name	Credits
Semester III	**Compulsory Theory Courses**	
CHP-310	Quantum and Solid State Chemistry	4 Credits
CHP-311	Nuclear, Radiation and Photo-Chemistry	4 Credits
CHP-312	Physicochemical Methods of Analysis	4 Credits
	Optional Theory Courses : Any one of the following	
CHP-313	Polymer Chemistry	4 Credits
CHP-314	Modern Trends in Physical Chemistry	4 Credits
	Compulsory Practical Courses	
CHP-315	Physical Chemistry Practical : I	6 Credits
CHP -316	Physical Chemistry Practical : II	6 Credits
Semester IV	**Compulsory Theory Courses**	
CHP-410	Molecular Structure and Spectroscopy	4 Credits
CHP-411	Surface Chemistry and Electrochemistry	4 Credits
CHP-412	Materials Chemistry and Catalysis	4 Credits
	Optional Theory Courses : Any one of the following	
CHP-413	Biophysical Chemistry	4 Credits
CHP-414	Special Topics in Nuclear and Radiation Chemistry	4 Credits
	Compulsory Practical Course	
CHP-415	Physical Chemistry Practical III / Project	6 Credits

CHP-310 Quantum and Solid State Chemistry (4 Credits) (48 lectures)

Quantum Chemistry

1. Postulates of quantum mechanics, properties of quantum mechanical operators, Eigen functions and Eigen values, Hermitian, linear, ladder, and angular momentum operators. term symbols and selection rules, spin –orbit coupling, regular and inverted multiples (8L)
2. The variation method, theorem and applications, non-degenerate perturbation method (8L)
3. Application of LCAO-MO theory on the basis of Huckel approximation to conjugated aliphatic molecules and monocyclic conjugated polyenes. Huckel (4n+2) rule, alculation of resonance stabilization energy from Schaad and Hess model, antiaromatic molecules. (8L)

Solid State Chemistry

1. Properties of metals and semiconductors: band theory, types of solids, intrinsic and extrinsic semiconductors, p-n junctions, optical properties, photoconductivity of crystals (6L)
2. Imperfections and related phenomenon: Defects in solids: point defects line defects, diffusion in solids- mechanism, elastic and plastic deformations (4L)
3. Crystal growth techniques: General principles, growth from solution, growth from melts , growth from vapour (3L)
4. Imperfections and physical properties crystals: Electrical properties, Optical properties : Colour centers in ionic crystals: types, creation, Magnetic properties , Thermal properties and Mechanical properties. (6L)
5. Solid state reactions: reactions of single solids and their kinetic characteristics, gas - solid, solid -solid, addition and double decomposition reactions, photographic process (5L)

Reference Books

1. Quantum chemistry (4th edition), Ira N.Levine, Prentice Hall, Englewood Cliffs, N. J.
2. Quantum Chemistry A.K. Chandra
3. Quantum Chemistry D. A. McQuarrie,, Viva Books, New Delhi (2003)
4. Introduction of Solids L.V Azaroff , Tata McGraw Hill
5. Principles of the solid state H. V. Keer, Wiley Eastern (1993)
6. Selected topics in solid state physics Vol. 12, The growth of crystals from liquids –J. C. Brice, North Holland/American Elsevier (1973)
7. Defects and diffusion in solids. S. Mrowec Elseivier publ.(1960)
8. Treatise on solid state chemistry, ED-N.B. Hannay, Plenum press Vol –2 (1975)

CHP-311 Nuclear, Radiation and Photochemistry (4 Credits) (48 lectures)

Nuclear and Radiation Chemistry

Nuclear fission -: The discovery, conformation of nuclear fission, types of fission reaction, mass distribution of fission product, emission of neutron in fission, fissile and fissionable nuclides, theory of nuclear fission, critical energy for fission, products of nuclear fission (4L)

Nuclear reactors :- General aspects of reactor design, thermal, fast and intermediate reactors, reactor fuel materials, reactor moderators and reflects, coolants, control materials, shield, regeneration and breeding of fissile matter, types of research reactors. (4L)

Nuclear structure-: The liquid drop model, calculation of nuclear binding energies, properties of isobars, missing elements, the nuclear shell model, magic numbers, filling of nucleon shells, the collective and unified models. (4L)

Ion beam analysis techniques: Particle induced X-ray emissions- projectile accelerator and target preparation, ionization and X-ray emission detection,analysis and applications.

Rutherford back scattering – scattering reaction,surface analysis,depth profiling, chanelling effects and applications (4L)

Radiation detectors: Scintillators and their properties inorganic and organic, solid state semiconductor detectors-theory, surface barrier, Li drifted and intrinsic detectors (4L)

Radiolysis of aqueous solutions : Radiolysis of water,ferric sulphate,ceric sulphate, cupric sulphate solutions , Radiolysis Kinetics: Pulse Radiolysis and competition kinetics, non-homogeneous kinetics, flash photolysis (4L)

Photochemistry

Introduction: Laws of photochemistry, interaction of light with matter, theory of photoluminescence, general features of photochemical and photophysical processes (4L)

Mechanism of absorption and emission of radiation: Einstein’s treatment, selection rules, Life times of excited electronic states of atoms and molecules Types of electronic

transitions in organic molecules photochemical pathways, Jablonski diagram, Fluorescence, Phosphorescence (5L)

Photophysical kinetics of uni and bimolecular processes, delayed fluorescence mechanisms, kinetics of collisional quenching, Stern-Volmer equation, quenching by added substances charge transfer mechanism, energy transfer mechanism (6L)

Photolysis, Laser-general principles, types of lasers: two, three and four level lasers, solid state Ruby and Nd/YAG laser, self phase modulation, single photon counting, experimental techniques, flash photolysis: conventional microsecond flash photolysis, Nanosecond laser flash photolysis, Actinometry (5L)

Frontiers of photochemistry Picosecond, Femtosecond flash photolysis, applications: Solar energy conversion and storage, photosynthesis (4L)

Reference Books

1. Essentials of Nuclear Chemistry, H. J Arnikar, Wiley Eastern Limited, 4th Edition.(1995)
2. Nuclear and Radiochemistry, G. Friedlander, J. W. Kennedy and J. M. Miller, John Wiley (1981)
3. Introduction to Radiation Chemistry, J. W. T. Spinks and R. J. Woods, John Wiley (1990)
4. Introduction to Nuclear Physics and Chemistry, B.G. Harvey, Prentice hall (1963).
5. Sourcebook on Atomic Energy-S. Glasstone, Van Nostrand Company (1967)
6. Radiochemistry and Nuclear methods of analysis-W.D.Ehman and D.E. Vance, John Wiley (1991)
7. Fundamentals of photochemistry by K.K.Rohatgi-Mukherjee New Age International Publishers Revised Edition (Reprint 2003)
8. Chemistry and light by Paul Suppan, The Royal Society of Chemistry
9. Introduction to Instrumentation Analysis by R.D. Braun Pharma Med Press

CHP-312 Physicochemical Methods of Analysis (4 Credits) (48 lectures)

1. X-ray methods
Generation and properties of X-rays, X-ray absorption, Concept of absorptive edge, applications, X-ray absorptive apparatus, radiography and radiotherapy, applications X ray fluorescence, fundamental principles, instrumentation, wavelength dispersive and energy dispersive, qualitative and quantitative analysis, X-ray emission, fundamental principles, electron microprobe.

(10 L)

2. Luminescence, chemiluminescence, electrochemiluminescence, apparatus, fluorescence, phosphorescence, theory, factors affecting intensity, apparatus, analytical applications.

(8L)

3. Inductively coupled plasma atomic emission spectroscopy: principle, instrumentation, analysis and applications

(4L)

4. Thermal methods of analysis: TGA, DTA, DSC and thermometric titrations – principle, instrumentation, factors affecting TGA curve, applications.

(6L)

5. Electron spectroscopy for chemical analysis : Theory, spectral splitting and chemical shift. Apparatus used for ESCA, applications.

(6L)

6. Coulometry: Current-voltage relationship, coulometric methods, controlled potential coulometry.

(6L)

7. Voltammetry: Excitation signals, instrumentation, hydrodynamic voltammetry, cyclic voltammetry, pulse voltametry, applications.

(8L)

Reference Books

1) Introduction to instrumental analysis-R. D. Braun, McGraw Hill (1987).
2) Principles of instrumental analysis – Skoog, Holler, Nieman, 5th edition.
3) Principles of activation analysis - P. Kruger , John Wiley (1971)
4) Nuclear analytical chemistry- J. Tolgyessy and S. Verga Vol. 2 , University park press (1972)

CHP-313 Polymer Chemistry (4 Credits) (48 lectures)

1. Basic concepts of polymer science, classification of polymers as biological - nonbiological, linear branched network, condensation, addition homo- and heterochain, thermoplastic - thermosetting, History of Macromolecular Science, molecular forces and chemical bonding in polymers. (5L)

2. Thermodynamics of polymer solutions - Entropy and heat of mixing of polymer solutions - ideal behaviour and deviations. Experimental results, flory - Krigbaum theory - Thermochemistry of chain polymerization. (8L)

3. Copolymerization - Kinetics of copolymerization, the copolymer equation, monomer reactivity ratios, instantaneous composition of polymer. (4L)

4. Morphology and rheology of polymers - configuration of polymer chains crystal structure, crystallization processes, viscous flow, rubber elasticity, viscoelasticity, the glassy state and glass transition, mechanical properties of crystalline polymers.

(8L)

5. Polymer structure and physical properties - The crystalline melting point Tm- the glass transition temperature (Tg) - properties involving small and large deformations- polymer requirements and polymer utilization.

(4L)

6. Measurements of molecular weights - characterization of polymers, Molecular weight averages, fractionation and molecular weight distribution - methods for determination of average molecular weight (end group analysis) colligative property measurements, osmometry, diffusion light scattering, viscosity, ultracentrifugation.

(8L)

7. Polymer processing - Plastic technology - molding, other processing techniques fibre technology - textile and fabric properties, spinning fibre after treatments, elastomer technology- natural rubber, vulcanization, reinforcement, carbon blocks.

(4L)

8. Radiation induced polymerization - kinetics and mechanism of polymerization in the liquid and solid phases, effect of irradiation on polymers - degradation and cross-linking, block copolymerization.

(4L)

9. Conducting polymers - Basics, synthesis, conduction mechanism, applications.

(3L)

Reference Books

1) Textbook of Polymer Science - F. W. Billmeyer Jr., John Wiley & Sons Inc. (1971)
2) Principles of Polymer Systems - F. Rodrigues, Tata McGraw Hill Publishing Company, New Delhi
3) Principles of Polymer Chemistry - P. J. Flory, Cornell University Press, Ithaca New York (1953)
4) Polymer Chemistry - An introduction, Seymour-Carraher, Marcel Dekker Inc, New York
5) Polymer Science - Gowarikar, Vishwanathan & Sreedhar, Wiley Eastern Ltd. New York (1988)
6) Handbook on Conducting Polymers - T. A. Skotheim, Ed., Marcel Dekker Inc, New York, 1&2 (1986)

CHP-314 Modern Trends in Physical Chemistry (4 Credits) (48 lectures)

1. Nanoscience and Nanotechnology

Introduction to Nanoworld, Metas, Semiconductor, Nanocrystals, Ceramics, Metal nanoparticles:Double layers, Optical properties & Elelctrochemistry, Magnetism, Chemical and catalytic aspects of Nanocrystals, Applications of nanoparticles (12 L)

2. Phase Studies :

Temperature – Composition diagrams, lever rule, phase rule, counting components, experimental procedures, liquid – liquid, liquid-solid diagrams, eutectics, technologically important eutectics, ultra-purity, controlled purity, role of added salt, supercritical liquids and applications. (12 L)

3. Ionic equilibria and pH calculations

Solution of an equilibrium problem, numericals, mass balance, proton condition, charge balance, exact solution, approximations on the equations, Graphical representations – the distribution diagram, the logarithmic concentration diagram. numericals, pH concept of polyprotic acids, pH calculations.

(8 L)

4. Smart Materials

Definition of smart materials (SM), Design of intelligent materials, actively smart and passively smart materials and their characteristics. e.g. - smart ceramics, oxides, smart polymers and gels, shape memory alloys, electorheological fluids, ferrofluides, smart windows, smart sensors, smart electroceramics. Magnetostrictive materials, biomineralisation and biosensing. Integration to smart clothes, smart rooms.

(6 L)

5. SEM:

Operating principals, penetration of electron in solids, secondary electron images, backscattered electron images, operating condition, specimen preparation, electron beam lithography (10 L)

Reference Books

1. Ionic Equilibirium: A Mathematical Approach, J.N.Butler, Addison-Wesley Publishing Co. Inc.
2. Intelligent materials – Craig A. Rogers,Scientific American,1995,p.122
3. Smart structures and materials by B.Culshaw (Artech House,Norwood,MA1998)
4. Intelligent Gels Y.Osada and S.B. Ross – Murphy-Scientific American May1993
5. Introduction to Nanoscale science & technology Massimiliano Di Ventra, Stephane Evoye & James Heflin, Springer Publication

6. Thermodynamics, statististical thermodynamics and kinetics
7. Thomas Engel, Philip Reid 1st Edn.
8. Physical Chemistry- Ira Levin 1st Edn
9. Physical Chemistry- P.W. Atkins, 8th Edn.

CHP-315 - Physical Chemistry Practical I (Compulsory Course) (6 Credits)

1) Thermodynamic data of electrochemical cell by e.m.f.measurements.
2) Simultaneous determination of two ions by polarography.
3) Determination of the equilibrium constant of triiodide ion formation
4) Magnetic susceptibility measurement by Gouy technique.
5) Determination of dipole moment of liquid at various temperatures.
6) Kinetics of iodination of aniline: pH effect and base catalysis.
7) Dissociation constant of an acid- base indicator by spectrophotometry.
8) Actinometry – photolysis of uranyl oxalate
9) Absorption coefficient and half thickness of lead for gamma radiation.
10) Radiation dose measurement by Fricke dosimeter/ceric sulphate dosimeter.
11). Flame Photometric determination of Na, K, Li and Ca (Working curve method, standard addition method and Internal standard method)
12) A photometric titration of a mixture of Bi and Cu with EDTA (-745nm)
13)Determination of lead in petrol by atomic absorption technique.
14) The reaction between potassium persulphate and potassium iodide by colorimetry.
15) Determination of the chain linkage in poly (vinyl alcohol) from viscosity measurements.
16) Calibration of Gamma ray spectrometer and determination of energy of given Radioisotope

CHP-316 Physical Chemistry Practical II (Compulsory Course) (6 Credits)

1. Hydrolysis constant of aniline hydrochloride by distribution coefficient method.
2. Determination of the dimerization constant of an organic acid in benzene.
3. Differential potentiometric titration.
4. Amperometric titration with platinum microelectrode.
5. Determination of the stability constant of a complex by spectrophotometry.
6. Studies on a clock reaction: determination of the energy of activation
a. Reactions such as bromate-bromide reaction, iodate –iodide reaction,
b. Formaldehyde - bisulphite reaction etc.
7. Magnetic susceptibility measurements by the Faraday technique.
8. Analysis of fruit juice for vitamin C by HPLC technique.
9. Determination of half-life of two isotopes in a mixture.
10. Study of characteristics of GM counter.
11. Effect of salt on the distribution of acetic acid between water ethyl acetate.
12. To study the effect of addition of a salt on the solubility of an acid in water.

13. Determination of concentration of sulfuric acid, acetic acid and copper sulphate by conductometric titration with sodium hydroxide.
14. Determine the formula and stability constant of a metal ion complex (Lead Oxalate) by polarography.

CHP-410 Molecular Structure and Spectroscopy (4 Credits) (48 lectures)

1. Nuclear Magnetic Resonance Spectroscopy

Nuclear spin, nuclear resonance saturation. Shielding of magnetic nuclei, chemical shift and its measurements. Factors influencing chemical shift, deshielding, spin-spin interactions, factors influencing coupling constant "J" Classification (ABX,AMX,ABC. A2 B2) spin decoupling, basic ideas about Instrument, NMR studies of nuclei other than proton 13C, 19 Fand31 P, FT NMR, advantages of FT NMR, use of NMR in medical diagnostics.

(12 L)

2. Electron Spin Resonance Spectroscopy

Basic principles, Zero field splitting and Kramers degeneracy,factors affecting the "g" value . Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and Mc Connell relationship, measurement techniques, applications.

(8 L)

3. Nuclear quadrupole resonance spectroscopy

Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant, splitting, and applications.

(4 L)

4. X- Ray diffraction

Index reflections, Identifications of unit cell from systematic absences in diffraction pattern. Structure of simple lattices and X-Ray intensities Structure factor and its relation to intensity and electron density , phase problems in XRD

(8 L)

5. Electron Diffraction

Scattering intensity Vs Scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules, low energy electron diffraction and structure of surfaces.

(4 L)

6. Neutron Diffraction analysis

Scattering of neutron by solids and liquids, Magnetic scattering, Measurement techniques, Elucidation of structure of magnetically ordered unit cell.

(4 L)

7. Magnetic susceptibility

Pacal constant, Diamagnetic susceptibility, paramagnetic susceptibility , Langevin Equation ,Van Vlecks formula, Ferro, Ferri and Antiferromagnetism, Measurement of Magnetic susceptibility by Faraday and Gouy Techniques.

(8 L)

Reference Books

1, Modern Spectroscopy J.M. Hollas, (John Wiley)
2. Spectroscopy (Atomic and Molecular) Gurdeep Chatwal,Sham Anand
(Himalaya Publishing house)
3. Applied Electron spectroscopy for Chemical analysis Ed. H. Windawi & F.L. Ho
(Wiley interscience)
4. Introduction to Magnetic resonance A. Carrington and A.D Maclachalan ,
Harper & Row
5. Spectroscopy B.K. Sharma
6. NMR, NQR, & Mossbauer spectroscopy in Inorganic chemistry R.V.Parish, Ellis Harr wood
7. Physical methods in Chemistry R.S Drago, Saunders college
8. Introduction to Molecular Spectroscopy G.M. Barro, Mc Graw Hill
9. Basic principles of spectroscopy R.Chang, Mc Graw Hill
10. A text book of Spectroscopy .O.D.Tyagi & m.Yadhav Anmol Publications
11. Introduction to Magento chemistry Alen Earnshaw, Acad Press (1968)
12. Magneto chemistry Sanyl and Dutta
13. Chemist's guide to NMR spectroscopy – Mc Comber (Wiley) 2000.

CHP-411 Surface Chemistry and Electrochemistry (4 Credits) (48 lectures)

Surface Chemistry

1. Adsorption at liquid surfaces, Gibbs equation and its verification, Gibbs Monolayers, insoluble films on liquid substrates, states of monomolecular Films, Wetting, flotation, detergency.

(8 L)

Ref. 1,6

2. Adsorption forces, thermodynamics of physical adsorption, heat of adsorption and its determination, measurement of adsorption by different methods, chemisorption and its mechanism.

(8 L)

Ref. 1,2,5,6

3. Multilayer adsorption – critical comparison of various multilayer models- BET, Potential and Polanyi models (no derivation). Measurement of surface area of solids by different methods. Harkins and Jura equation.

(6 L)

Ref. 1, 6

4. Porous solids – Defination, pore size distribution, methods to determine pore size, hysteresis of adsorption, theories of hysteresis, Adsorption behaviors of porous

materials,

(2L)

Ref. 3,4,6

Reference Books

1. Physical chemistry of surfaces – A. W. Adamson, Interscience publishers Inc New York, 1967.
2. Surface chemistry – Theory and applications, J. J. Bikerman, Academic press, New York 1972.
3. Adsorption, surface area and porosity – S. J. Gregg and K. S. W. Sing, Academic Press Ltd., London 1967.

4. Zeolities and clay minerals as Adsorbents and molecular sieves, R. M. Barrar, Academic Press London.
5. Physical adsorption of gases, D. M. Young and A. D. Crowell, Butterworths, London, 1962.
6. Adsorption, J. Oscik, John Wiley and Sons. New York.

Electrochemistry

1. Ionics - Ion-solvent interactions, ion –dipole theory of solvation, ion-ion interaction, Debye-Huckel limiting law, extended law, activity coefficients, electrochemical potential. Ion transport in solution. - Fick's laws of diffusion, Einstein relation between diffusion coefficient and ionic mobilities.

(8L)

Ref.1,2

2. Electrodics – Standard electrode potentials, different chemical and physical processes at the electrode surfaces, electrode-electrolyte interface, double layer and phase boundaries, Butler-Volmer equation, Tafel equation.

(8L)

Ref 1,2

3. Applications -
a. Fuel cells and batteries – primary and secondary power cells, fuel cells, Li ion battery, evaluation of performance of electrochemical systems, energy density, shelf life, and Faradic efficiency.
b. Corrosion and corrosion prevention- Thermodynamics and kinetics of corrosion, methods of prevention to corrosion.
c. Electrosynthesis – use of electrodes in synthesis of organic compounds

(8L)

Reference Books

1.Physical chemistry - Peter Atkins, Julio de Paula , 7th Edition
Oxford University Press.
2. Modern Electrochemistry - Vol I & II J. O'M Bockris and AKN Reddy,
Plenum Press,N.Y.
3. Fuel cells - Their Electrochemistry, J.O'M Bockris and S Srinivasan,
McGraw Hill, NY (1969)
4. Fuel cell systems L.I. M Blomen and M.N. Mugerwa, Plenum Press NY
(1993)
5.Electrochemical techniques in corrosion science and engineering
R.G.Kelly, J.R.Scully D.W.Shoesmith and R.G. Buchheit Dekker NY 2003
6.Lectures on electrochemical corrosion M.Pourbaix, Plenum NY (1973)

CHP-412 Materials Chemistry and Catalysis (4 Credits) (48 lectures)

Materials Chemistry

1. Hitech materials

Defect perovskites, super conductivity in cuprates, preparation & characterization of 1-2-3 & 2-1-4, Normal state properties, anyzotropy, temperature dependents of electrical resistance, otpical photon modes, coherent length, elastic constants posion life times, heat capacity, micro wave absorption, - pairing & multigap structure in hi tech materials. Application of Hitech materials. (12 L)

2. Thin films Langmuir – Blodgett films

Preparation techniques, sputtering, chemical process, MOCVED, sol gel, Langmuir – Blodgett films, Photolithography, Applications of LB films. (8 L)

3. Materials of solid devices

Rectifiers, transistors, capacitors, IV-V compounds low dimensional quantum structures, optical properties. (4 L)

Catalysis

Fundamentals of adsorption and catalysis: Physical and Chemical adsorption – adsorption isotherms: evaluation, chemisorption on metals and metal oxides. Catalysis: concept of activity, selectivity, poisoning, promotion and deactivation. Types of catalysis: homogeneous, heterogeneous. Heterogeneous catalysis and catalytic kinetics: concept of Langmuir-Hinshelwood

(8L)

Preparation and Characterization of Catalysts: General methods for preparation of catalysts: precipitation, sol-gel, hydrothermal, impregnation, hydrolysis, vapour deposition. Activation of catalysts: calcinations, reduction. Catalyst characterization:

surface area, pore size distribution, particle size determination, XPS, AES, UV-Vis, FT-IR and thermal methods

(8L)

Catalysis in green chemistry and environmental applications: Purification of exhaust gases from different sources: auto-exhaust catalysts (petrol vehicles, diesel vehicles), VOC removal; ozone decomposition; photocatalysis in effluent treatment.

(4L)

Photo-catalysis: Photoprocesses at metals, oxides and semiconductors: concepts and mechanism. Photocatalysis application in organic pollutant degradation present in water and air.

(4L)

Reference books

1. Physical Chemistry of Surfaces , W. Adamson, Wiley Intersciences,(5th edition) 1990.
2. Heterogeneous Catalysis: Principles and Applications. Bond, G C, Oxford University Press 1987
3. Heterogeneous Catalysis, D.K. Chakrabarty and B. Viswanathan, New Age Publishers
4. Catalytic Chemistry, B.C. Gates, John Wiley and Sons Inc. (1992)

5. Solid state physics – N.W. Aschocruts & N.D. Mermin, Saunders College.
6. Material science & Engineering, An Introduction - W.D. Callister, Willey.
7. Principles of solid state – H.V. Keer, Willey.
8. Materials Science – Anderson, Leaver, Alexander, & Rawlings, ELBS
9. Theromotropic liquid crystals Gray, Willey
10. Text Book of liquid crystals – Kelkar & Halz, Chemie Verlag

CHP-413 Biophysical Chemistry (4 Credits)(48 lectures)

Introduction : The cell and its constituents, proteins, nucleic acids, RNA and DNA, enzymes etc., molecular basis of life, human genome and beyond. Transcription and Translation

(5L)

Bioenergetics and Thermodynamics: Molecular interpretation of Energy and Enthalpy, Non-covalent reactions, hydrophobic interactions, Protein and Nucleic Acids. Biochemical Applications of Thermodynamics, Thermodynamics of Metabolism, Role of ATP in biological Systems (hydrolysis of ATP). Biological Reactions, Double Stranded Formation in Nucleic Acids, Ionic Effect on Protein–Nucleic Acid Interactions

(8L)

Physical Equilibria: Lipid Molecules and Bilayer Phase Transitions in Lipids, Bilayers and Membranes, Biological Membranes, Membrane Equilibrium, Transport through cell membrane, Active and Passive Transport, Osmosis and Diffusion, Muscle Contraction, Energy Generation. Nerve Cells, Neutron: Structure and Functions, Nerve Impulse and its conduction

(8L)

Biopolymers: Basics, Size of biopolymers, Methods of determining particle shape and molecular weight, Interactions with water

(3L)

Electrophoresis: Gel electrophoresis, DNA Sequencing, Double Stranded DNA, DNA, Finger Printing, Conformations of Nucleic Acids, Pulsed-Field Gel Electrophoresis, Protein Molecular Weight, Protein Charge, Macromolecular Interactions.

(6L)

Kinetics: Basic Concepts, Enzyme kinetics, catalytic antibodies and RNA enzymes-Ribozymes, Michaelis Menten Kinetics, Competition and Inhibition, Monod-Whyman Changeux Mechanism. Photochemistry and Photobiology, Photosynthesis

(6L)

Spectroscopy of Biomolecules : Spectra of Proteins and Nucleic Acids, Amino acid, Polypeptides, Secondary structure, Rhodopsin :A Chromophoric Protein, Principles of Circular Dichorism and optical rotator dispersion, applications to biomolecules

(7L)

Macromolecular structure and X-ray diffraction: Chain configuration and conformations of macromolecules, proteins and polypeptides, problems of protein folding, Fundamentals of X-rays, Braggs Law, Determination of molecular structure, calculation of diffracted intensities from atomic co-ordinates

(5L)

Reference Books

1.Biophysical Chemistry ,Gurtu and Gurtu, Pragati Edition, 2007.
2.Physical Chemistry, Principles and Applications in Biological Sciences I. Tinico, K. Sauer, J. Wang and J. D. Puglisi, 4th Edition, Pearson Edition, 2007.
3.Biophysical Chemistry , A. Upadhyay, K Upadhyay and N. Nath, Himalaya Publishing House, 2005.
4.Biophysical Chemistry , James P. Allen,

5.Biophysical Chemistry , C. R.Cantor and P.R. Schimmel, WH Freeman & Company, New York, 2004.

CHP-414 Special Topics in Nuclear and Radiation Chemistry
(4 Credits) (48 lectures)

Nuclear reactions: Bethe's notation, types of nuclear reactions, conservation in nuclear reactions, compound nucleus theory, experimental evidence, specific nuclear reactions, photonuclear and thermonuclear reactions.

(3L)

Accelerators: Basic components,Cockroft-Walton acceleratorVan de Graaff accelerator, Linear accelerators,cyclotrons, synchrotrons,

(3L)

Radiation hazards and safety ; Natural and manmade sources of radiations, internal and external radiation hazards, safe handling methods, personal dosimetry, reactor safety, the effects of Three miles and Chernobyl accidents, radiation protecting materials.

(4L)

Biological effects of radiations : The interaction of radiations with biological cells,various stages, somatic and genetic effects, maximum permissible dose-ICRP recommendations

(3L)

Hot atom chemistry : Szilard Chalmers process, chemistry of recoil atoms, recoil techniques, models for retention, annealing reactions, annealing mechanis

(3L)

Applications of radioisotopes in nuclear medicine and pharmaceuticals: general applications of radiopharmaceuticals, use of nuclear properties of indicator nuclides. In vivo diagnostic procedures, in vitro diagnostic testing therapeutic use of radiations, Use of radiation for food preservation and sterilization

(8L)

The origin of chemical elements, cosmology, premordial nucleosynthesis, stellar evolution and stellar nucleosynthesis, solar nutrino problem, Synthesis of Be, B, Li in the cosmos

(4L)

Radioactive wastemanagement: Introduction,Classification of radioactive waste,22.3 Origin of Radioactive waste, Treatmentof Radioactive waste: ,Radioactive waste disposal

(4L)

Radiolysis of organic systems : Alkanes, aromatic hydrocarbons, alcohols

(4L)

Radiolysis kinetics : Emperical rate studies, molecular kinetics, non-homogeneous kinetics, effect of solute concentrations on the molecular yields from water,radical scavenging,chain reactions, pulse radiolysis

(6L)

Radiometric titrations : Principle techniques and titrations based on precipitate formation, complex formation and neutralization reactions

(6L)

Reference Books

1.Radiation Chemistry: Principles and Applications, Farhataziz and M. A. J. Rodgers (Eds.), VCH Publishers, New York (1987).

2.Radiation Chemistry: Present Status and Future Trends, C. D. Jonah and B. S. M. Rao (Eds.) Elsevier, Amsterdam (2001).

3.Essentials of Nuclear Chemistry: H. J. Arnikar. New Age Publication Ltd. (1995).

4.Radiation chemistry and Nuclear Methods of Analysis W. D. Ehmann, D. E. Vance. John Wiley (1991).

5.Nuclear and Radiochemistry G. Friedelarder, J. W. Kennedy, E.. S. Macias, J. M. Miller John Wiley (1981).

6.Source Book of Atomic Energy, S. Glasstone, D. Van Nostrand (1967)

7.Nuclear analytical chemistry- J. Tolgyessy and S. Verga Vol. 2 , University park press (1972)

8.Fundamental of Radiochemistry, D.D.Sood, A.V.R.Reddy, N.Ramamoorthy, IANCAs , Mumbai, 4th Edition

CHP- 413 – Project / Additional Practicals (Compulsory) (4 Credits)(48 lectures)

1. Solubility of a sparingly soluble salt by conductometry.
2. Coulometric estimation of arsenite by bromine.
3. Dead stop end point titration.
4. Activity coefficient of electrolyte by emf measurements.
5. Titration of polybasic acid with sodium hydroxide by pH- metry.
6. Formation constant of a complex by pH- metry
7. Kinetics of the reaction between 2,4-dinitrochlorobenzene and piperidine.

8.Determination of solubility diagram for a three component liquid system.
9. Radiolysis of aqueous iodate solution and determination of G values.
10. Molecular weight of a polymer by end group estimation.
11. Determination of the formula of complexes such as silver –ammonia complex by titration, cuprammonium ion complex by distribution coefficient measurement,
12.Determine the transport number of silver and nitrate ions in aqueous solution from the cell potential of the concentration cell with junction potential.
13.Recording of TGA curve of CuSO4 and NaCl and hence to find the percentage composition of the mixture.
14 Determination of the heat of ionization of phenol/weak acid.
15.Analysis of tertiary mixture by Gas chromatography**.**

References

1. Findlay's Practical Chemistry, S.P.Levitt (Editor), Longman Group Ltd.
2. Experimental Physical Chemistry, Farrington Daniels and others, McGraw-Hill Book Company.
3. Experiments in Physical Chemistry, J.M.Wilson and others, Pergamon Press
4. Practical Physical Chemistry, A.M.James and P.E.Pritchard, Longman Group Ltd.
5. Experimental Physical Chemistry, V.Dathavale, Parul Mathur, New Age International Publishers.
6. Experimental Physical Chemistry, Das and Behera, Tata McGraw-Hill.
7. Practical Physical Chemistry, D.V.Jahagirdar