Course No: CH15301CR
Title: Inorganic Chemistry (03 Credits)

Max. Marks: *75* ***Duration:*** *80 Contact hours (48L)*
End Term Exam: *60 Marks* ***Continuous Assessment****: 15 Marks*

Unit-I Magnetic Properties and Electronic Spectra of Transition Metal Complexes (16 Contact hours)

Magnetic Properties: Types of magnetic behaviour, magnetic susceptibility and magnetic moment. Methods of determining magnetic susceptibility, spin-only formula, L-S coupling, correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moments. Applications of magnetic moment data in investigation of nature of bonding and stereochemistry of first row transition metal complexes. High spin- low spin crossover.

Electronic spectra of Transition metal complexes: General features, types of electronic transitions, theoretical aspects of d-d spectra, selection rules, spectral terms of d^1 - d^{10} metal ions. Selected examples of d-d spectra. Spectra of distorted octahedral and square planar complexes. Charge transfer spectra.

Unit-II Metal-ions in Biological Systems (16 Contact hours)

The role of metal-ions in Metal-Protein systems, in trigger and control mechanisms, in structural context, as Lewis acid and as redox catalysts.

Biodistribution and biochemical role of essential trace and ultra-trace elements: Fe, Zn, Cu, V, Cr, Mn, Ni, P, F and I. Effects of their deficiencies and treatment. Antagonism and Synergism among essential trace elements.

Alkali and Alkaline earth metal ions: Biological role of Na^+, K^+, Ca^{2+} & Mg^{2+}. Mechanism of ion transport (Facilitated transport, Carriers, Channeling and active transport of Cations). Role of Lithium in mental health.

Chlorophyll: Structure and role of magnesium in photosynthesis.

Biological Nitrogen Fixation: Dinitrogen complexes and their reactivity; Nitrogenase enzyme and fixation via nitride formation.

Unit-III NQR & Mossbauer Spectroscopy (16 Contact hours)

NQR Spectroscopy: NQR isotopes, Nuclear quadruple moment; Electric field gradient; nuclear quadruple coupling Constant; Effect of applied magnetic field, Applications.

Mossbauer Spectroscopy: Basic principles, Spectral parameters such as isomer shift, quadrupole splitting and magnetic splitting, spectrum display. Application of the technique to the studies of (i) bonding and structure of Fe^{2+} and Fe^{3+} compounds including those of intermediate spin, (ii) Sn^{2+} and Sn^{4+} compounds, nature of M—L bond, coordination number and structure, (iii) detection of oxidation state and inequivalent MB atoms.

Books Recommended

1. Elements of Magnetochemistry; R. L. Dutta, A. Syamal; Affiliated East-West; 1993.
2. Electronic Spectra of Transition Metal Complexes; D. Sutton; McGraw-Hill; 1968.
3. Bioinorganic Chemistry- An introduction; Ochhai; Allyn and Bacon; 1977.
4. Principles of Bioinorganic Chemistry; S. J. Lippard and J. M. Berg; University Science Books; 1994.
5. The Inorganic Chemistry of Biological Processes; 2nd ed.; M. N. Hughes; John Wiley; 1973.
6. Bioinorganic Chemistry- A Short Course; R. M. Roat Malone; Wiley Interscience; 2003.
7. NMR, NQR, EPR, and Mossbauer Spectroscopy in Inorganic Chemistry; R. V. Parish; Ellis Horwood; 1990.
8. Structural Methods in Inorganic Chemistry; 2nd edn.; E. A. V. Ebsworth & D.W.H. Rankin; ELBS; 1991.
9. Spectroscopy in Inorganic Chemistry; Vol I & II; Rao, Ferraro; Academic Press; 1970.
10. Physical Methods for Chemistry; 2nd edn.; R .S. Drago; Saunders; 1992.
11. Coordination Chemistry; D. Banerjee; Tata McGraw Hill; 1993.

Course No: CH15302CR
Title: Organic Chemistry (03 Credits)

Max. Marks: *75* ***Duration:*** *48 Contact hours*

End Term Exam: *60 Marks* ***Internal Assessment:*** *15 Marks*

Unit-I Photochemistry-I (16 Contact hours)

Photochemical Reactions: Interaction of electromagnetic radiation with matter. Types of excitations. Singlet and triplet states and their lifetimes. The fate of excited molecule. (Physical and chemical processes). Transfer of excitation energy: Sensitization and Quenching. Quantum yield. Types of photochemical reactions.

Photochemistry of alkenes: Geometrical isomerisations, cyclisation and dimerisation reactions. Photochemical reactions of 1,3- butadiene (excluding pericyclic reactions). Rearrangement of 1,4 and 1,5- dienes.

Photochemistry of saturated carbonyl compounds: Intramolecular reactions of saturated acyclic and cyclic carbonyl compounds.(Norrish type-I and Norrish type-II processess).Intermolecular cycloaddition reactions (Paterno-Buchi reaction).

Unit II Photochemistry –II (16 contact hours)

Photochemistry of unsaturated carbonyl compounds: Photochemical reactions of α,β-unsaturated carbonyl compounds.(H-Abstraction and isomerisation to β,γ, -unsaturated carbonyl compounds). Photolysis of cyclic α,β - unsaturated ketones (dimerisation and lumiketone rearrangement) and cyclohexadienones.

Photochemistry of Aromatic compounds: Photoinduced isomerisations of benzene and its alkyl derivatives. 1,2 ; 1,3 and 1,4 photoaddition reactions of benzene. Nucleophilic Photosubstitution reactions in aromatic compounds. Photo Fries-rearrangement of aryl esters and anilides.

Miscellaneous Photochemical reaction :Photolysis of organic nitrites and their synthetic utility (Barton reaction). Photochemistry of vision

Unit III Pericyclic reactions (16 contact hours)

Classes of organic reactions. Definition and classification of pericyclic reactions. Woodward Hoffman rules.Frontier molecular orbital (FMO) concept by Fukui. FMO of π- electron systems: Ethene, 1,3-butadiene,1,3,5-hexatriene, allyl systems and those of conjugated ions and radicals. HOMO, LUMO and SOMO concepts.

Cycloadditions: Thermal and Photochemical 2+2 and 4+2 cycloadditions. Suprafacial and antrafacial cycloaddition.

Electrocylic Reactions: Thermal and Photo-induced Electrocyclic reactions of 4n and 4n + 2 systems and their stereochemistry. Conrotatory and disrotatory motions.

Sigmatropic rearrangements: Classification, [1,3], [1,5] and [3,3] sigmatropic shifts. [1,3]sigma tropic migration of hydrogen and carbon. Cope and Claisen rearrangements. Suprafacial and Antrafacial shifts of hydrogen atom .Biological pericyclic reactions.

Books recommended

1. Introductory Photochemistry; A. Cox and T. Kemp; McGraw Hill; 1971.
2. Organic Photochemistry; 2nd edn.; J. Coxon, and B.Halton; Cambridge University press; 1987.
3. Fundamentals of photochemistry; Rohtagi & Mukherjee; Wiley Eastern; 1992.
4. Advanced Organic Chemistry Reactions, Mechanism and Structure; 5^{th} edn.; Jerry March; Wiley; 1999.

Course No: CH15303CR
Title: Physical Chemistry (03 Credits)

Max. Marks: *75* ***Duration:*** *48 Contact hours*
End Term Exam: *60 Marks* ***Internal Assessment:*** *15 Marks*

Unit-I Quantum Chemistry (16 Contact hours)

Chemical Bonding: Hybridization of orbitals (sp, sp2 &sp3).

Huckel's Pi-MO theory: Application to linear and cyclic polyenes. Pi-electron charge and bond-order. Alternant hydrocarbons, Naphthalene, heteroatomic conjugated systems. Limitations of Huckel theory. Parisar-Parr-Pople method, Extended Huckel Method.

Self consistent field method: Hamiltonian and wave function for multi-electron systems. Electronic Hamiltonian, antisymmetrized wave function, Slater determinant. Hartree and Hartree-Fock self consistent field methods. One and two-electron integrals in the light of minimal basis H_2 system.

Unit-II Electrochemistry (16 Contact hours)

Debye-Huckel-Onsager conductance equation and brief idea of its extension.

Metal-electrolyte electrified interface, concept of surface excess, thermodynamics of electrified interface, Lippman equation, electrocapillary curves. Methods for determination of surface excess.

Structural models of metal-electrolyte interface: Helmholtz-Perrin, Gouy-Chapman and Stern models, recent advances. Semiconductor electrodes: Structure of seminconductor/electrolyte interface

Theories of Heterogeneous Electron Transfer: Electron transfer at electrified interface at and away from equilibrium. Butller-Volmer equation, low and high field approximations, significance of transfer coefficient.

Unit-III Surface Chemistry (16 Contact hours)

Liquid Surface: Surface tension, pressure difference across curved surfaces (Laplace equation), vapor pressure of droplets (Kelvin equation), Capillary condensation.

Solid liquid interface: Contact angle, young's equation, wetting, Wetting as contact angle phenomena.

Thermodynamics of Interfaces: surface excess, surface tension and thermodynamic parameters, Gibbs adsorption isotherm.

Solid surfaces: Adsorption at solid surfaces, adsorption models; Langmuir adsorption isotherm, BET adsorption isotherm and its use in estimation of surface area. Fumkin and Temkin adsorption equations. Adsorption on porous solids.

Books Recommended

1. Physical Chemistry; P. W. Atkins; ELBS; Oxford; 1997.
2. Physical Chemistry- A Molecular Approach; D. A. McQuarie & J. D. Simon; University Science Books; 1997.
3. Introduction to Quantum chemistry; A. K. Chandra; Tata McGraw Hill; 1997.
4. Quantum Chemistry - Ira. N. Levine, Prentice Hall, 2000.
5. Quantum Chemistry, Prasad, New Age Publishers, 2000.
6. Physics and Chemistry of Interfaces, H-J, Butt, K. Graf and M. Kappl, 2nd Edition, Wiley-VCH Verlag Gmbh and Co. KGaA, 2006.
7. Physical Chemistry of Surfaces, A. W. Adamson and A. P. Gast, 6th Edition, John Wiley and Sons, Inc. 1997.
8. Molecular Thermodynamics of Electrolyte Solutions, Lioyd L Lee, World Scientific, 2008.
9. An Introduction to Aqueous Electrolyte Solutions, Margaret Robson Wright, Wiley, 2007.
10. Modern Electrochemistry 1, 2A, 2nd Edition, J. O`M. Bokris and A. K. Reddy, Kluwer Academic/Plenum Publishers, New York.

Course No: CH15304CR

Title: Laboratory Course in Chemistry (03 Credits)

Max. Marks: *75* ***Duration:*** *96 Lab hours*

End Term Exam: *60 Marks* ***Internal Assessment:*** *15 Marks*

Unit-I Laboratory Course in Inorganic Chemistry (32 Lab hours)

A. Preparation of Coordination compounds of Transition metals

Theoretical appraise of first row Transition metal Coordination Chemistry. Synthesis as a Laboratory Technique (Concepts, Calculations and Design of Synthetic procedures).

B. Selected preparations of the following coordination compounds with specific objectives:

i) Mercurytetrathiocyanatocobaltate(II)	:	To visualize the complexation process.
ii) Tris-thioureacopper(I)sulphate monohydrate	:	Insitu generation and Stabilization of unusual oxidation state and re-crystallization /crystal growing
iii) Hexaamminecobalt(III) chloride	:	Multistep synthetic procedure
iv) Tris-ethylenediaminecobalt(III) chloride	:	Two stage synthesis and aerial oxidation/Resolution of a racemic mixture
v) Ammonium dodeca molbedophosphate	:	Synthesis of a heteroploymetallate/ Bonding and structure.

C. Chromatography

***Paper/Thin Layer Chromatography*:**

(i) Principle, Separation process, Technique and design of mobile phase.

(ii) Methods of paper chromatography (Ascending, Descending and Radial)

(iii) Comparative mobile phase study of separating mixtures. Chromatogram analysis and Interpretation.

Unit II Laboratory Course in Organic Chemistry (32 Lab hours)

A. Separation of organic compounds from three component mixture and their identification using physico-chemical methods.

B. Identification of simple functional groups using IR/NMR spectra.

Unit-III Laboratory Course in Physical Chemistry (32 Lab hours)

A. ***pH metery***

1. Titration of with a tribasic acid alkali to find its pKa values.
2. Determination of degree of hydrolysis of aniline hydrochloride.

B. ***Polarimetry***

1. Determination of the specific rotation of an optically active compound and determination of unknown concentration from the calibration curve.
2. Determination of the rate constant of inversion of cane sugar catalysed be HCl.

C. ***Potentiometry***

1. Titration of Fe (II) vs K_2Cr_2O7 and determination of standard redox potential of Fe^{2+}/Fe^{3+}.
2. Determination of formation constant of Ag-NH_3 complex.

Books Recommended

1. Vogel's Textbook of Quantitative chemical Analysis; 5th edn; Jeffery, Bassett; ELBS; 1989.
2. Analytical Chemistry; 6th edn; D. Christian; Wiley; 2008.
3. Essence of Chromatography; Colin. F. Poole; Elsevier.Inc;
4. Chromatographic methods; A. Braithwaite and F. J. Smith; 5th edn.; Kluwer Academic Publishers; 1999.
5. Chromatographic Methods; 3rd edn.; Stock & Rice; Chapman & Hall; 1980.
6. Experiments and Techniques in Organic Chemistry; D. Pasto, C. Johnson and M. Miller; Prentice-hall; 1992.
7. Microscale and Macroscale Organic Experiments; K .L. Williamson; D.C. Heath and Co.; 1989.
8. Advanced Practical Organic Chemistry; 2nd edn.; N. K. Vishnoi; Vikas; 1999.
9. Vogel's Textbook of Practical Organic Chemistry; 5th edn.; A. R. Tatchell; ELBS; 1996.
10. Comprehensive Practical Organic Chemistry; V. K. Ahluwalia and Renu Aggarwal; University Press; 2000.
11. Electrochemical methods, Fundamentals and Methods; A.J. Bard, L.R. Faulkner; Wiley; 1980.
12. Physical Electrochemistry- Fundamentals, Techniques and Applications; Eliezer Gileadi; Wiley-VCH; 2011.
13. Electrochemistry; 2nd Edition; Carl H. Hamann, Andrew Hammett, Wolf Vielstich; Wiley-VCH.

Course No: CH15304DC
Title: Symmetry and Group Theory (02 Credits)

Max. Marks: *50* ***Duration:*** *32 Contact hours*
End Term Exam: *40 Marks.* ***Internal Assessment****: 10 Marks*

Unit I Symmetry -I (08 Contact hours)

Symmetry elements and operations. Combination of symmetry operations.
Groups, subgroups, Classes. Group multiplication tables.

Unit II Symmetry-II (08 Contact hours)

Symmetry point groups. Schoenflies notations of point groups. Identification of point groups. Systematic procedure for assignment of point groups to molecules. Symmetry classes and their geometrical significance.

Unit III Symmetry -III (08 Contact hours)

Matrices and their combinations, block factored matrices; matrix representation of symmetry operation and point groups. Reducible and irreducible representation, character of a representation, properties of irreducible representations, Mulliken Symbols for IRS. Character table, construction of character tables for C_{2v}, C_{3v} and C_{4v} point groups.

Unit IV Symmetry -IV (08 Contact hours)

Applications of group theory to IR and Raman spectroscopy**,** Symmetry of IR and Raman active normal vibrational modes of AB_2, AB_3, AB_4, AB_5, andAB_6 type molecules.
Normal Coordinate Analysis of H_2O molecule (introductory idea).
Applications of symmetry to Molecular chirality, Polarity and Fluxionality,

Books Recommended

1. Chemical Applications of Group Theory; 2nd edn.; F.A.Cotton; Wiley Eastern; 1994)
2. Molecular Symmetry and Group Theory; L. Carter; Wiley; 1998.
3. Symmetry and Spectroscopy of Molecules; K. Veera Reddy; New Age 1998.
4. Inorganic Chemistry, Principles of structure and reactivity; 4^{th} edition; James E. Huheey, Ellen A. Keiter and Richard L. Keiter. Pearson Education Inc.

Course No: CH15305DC
Title: Applications of Spectroscopic Techniques (02 Credits)

Max. Marks: **50** ***Duration:*** **32** *Contact hours*
End Term Exam: *40 Marks* ***Internal Assessment:*** *10 Marks*

Unit I Application of UV and IR Spectroscopy (08 Contact hours)

Ultraviolet spectroscopy: Ultraviolet absorption spectra of enones, dienes (homo and heteroannular) carbonyl compounds, aromatic and heteroaromatic compounds. Effect of conjugation on ultraviolet spectra, Woodward-Fieser rules, application and limitation. Kuhn's rule, application to conjugated polyenes.

Infrared Spectroscopy: Introduction, instrumentation and sample handling, characteristic vibrational frequencies of hydrocarbons, alcohols, ethers , phenols,amines, aldehydes, ketones, acids, anhydrides, esters, lactones, amides and conjugated carbonyl compounds. Effect of hydrogen bonding on vibrational frequencies in IR spectra.Overtones, combination bands and Fermi resonance. FT-IR

Unit II Mass Spectrometry (08 Contact hours)

Introduction, instrumentation, Ionization methods like EI, CI, SIMS, FAB, MALDI, ESI, MS/MS. Mass Analyzers like Magnetic Sector Mass Analyzer, Double Focusing Mass Analyzer, Quadrupole Mass Analyzer, Time-of-Flight. Mass Analyzer Determination of Molecular Formula, Role of Isotopes, Nitrogen Rule, Metastable Peak. Fragmentation pattern like Stevenson rule , initial ionization event, α-cleavage, inductive cleavage, two bond cleavage, Retro-Diels. Alder cleavage, McLaffertey Rearrangements. Fragmentation pattern of alkanes, alkenes, alcohols, phenols, aldehydes, ketones, Carboxylic acids, Amines, Problems based on Mass Spectroscopy. Some specific examples from natural products like flavanoids terpenes, steroids, alkaloids.

Unit-III ^{1}H Nuclear Magnetic Resonance Spectroscopy (08 Contact hours)

Basic concepts, Mechanism of Measurements, Chemical shift values for various classes of compounds. Fourier Transform (FT) , Techniques and advantages, Nuclear Overhauser Effect (NOE). One bond coupling, two bond coupling, three bond coupling, second order spectra A_2, AB, AX, AB_2, AX_2, A_2B_2. Proton exchange, deuterium exchange, Peak broadening exchange

Unit IV ^{13}C Nuclear Magnetic Resonance Spectroscopy (08 Contact hours)

Carbon 13-chemical shifts , proton coupled and decoupled spectra. Nuclear Overhouser Effect, Off-Resonance De-coupling, Basic concepts of DEPT-45 , DEPT-90, DEPT-135.

Introduction to two-dimensional spectroscopy methods, COSY techniques, HETCOR technique, NOSY,

Structure determination of organic compounds based on their spectral data (UV, IR, NMR and Mass Spectrometry). Problem based exercises.

Books recommended

1. Spectroscopy of Organic Compounds; 6th edn.; P. S. Kalsi; New Age Publishers; 2006.
2. Spectrometric identification of Organic Compounds; 5th edn.; R. M. Silverstein, G.C.Bassler and T.C.Morill; John Wiley; 1991.
3. Introduction to NMR Spectroscopy; R. J. Abraham. J. Fisher and P. Loftus; Wiley; 1991.
4. Applications of absorption spectroscopy of Organic Compounds, J.R.Dyer (Prentice Hall-1991).
5. Spectroscopic Methods in organic Chemistry; D. H. Williams, I. Fleming; Tata McGraw Hill; 1988.

Course No: CH15306DC
Title: Non-Equilibrium Thermodynamics (02 Credits)

Max. Marks: *50* ***Duration:*** *32 Contact hours*
End Term Exam: *40 Marks* ***Internal Assessment****: 10 Marks*

Unit-I Introduction to Irreversible Thermodynamics (08 Contact hours)

Basic principles of non-equilibrium thermodynamics: rate laws, second law of thermodynamics for open system, law of conservation of mass, charge and energy.

Irreversible processes and uncompensated heat, degree of advancement, reaction rate & affinity. Gibb's equation, entropy production, entropy production due to matter flow, heat flow, charge flow & chemical reactions.

Unit-II Phenomenological laws (08 Contact hours)

Concept of forces & fluxes, Onsagers theory of irreversible processes- phenomenological laws, their domain of validity. Chemical reactions near equilibrium. Transformation properties of forces and fluxes. Theorm of minimum entropy production. Curie – Prigogine principle. Applications of non – equilibrium thermodynamics: thermoelectricity, electrokinetic phenomena and expressions for streaming potential, electro- osmotic pressure difference, streaming potential using the linear phenomenological equations.

Unit-III Stationary non-equlibrium states (08 Contact hours)

Fluctuation theory, principle of microscopic reversibility, Derivation of reciprocity relation. Stationary non-equilibrium states, thermodynamic significance. States of minimum entropy production, stability of stationary states, entropy flow in stationary systems. Stationary state coupling in irreversible processes. Variation of entropy production in stationery states, Glansdroff- Prigogine inequality

Unit-IV Self-Organization in Non-equilibrium Systems (08 Contact hours)

Self-Organizationin physico-chemical systems, Dissipative structures, thermal convection, Symmetry breaking, chiral symmetry breaking & life, biomolecular asymmetry, structural instability & biochemical evolution. Chemical oscillations: Belousov-Zhabotinsky reaction (elementary treatment).

Books Recommended

1. Thermodynamics of Irreversible Processes; De Groot, Mazur; Dover; 1986.
2. Introduction to Thermodynamics of Irreversible Processes; I. Prigogine; Wiley-Interscience; 1967.
3. Thermodynamics for students of Chemsitry, Kuriacose, Rajaram, (S. Chand and Co., 1996).
4. Exploring Complexity, I. Prigogine, G. Nicolis, (Freeman, 1998).
5. Molecular Thermodynamics, D. A. McQuarrie, J. D. Simon, USB, 1998.
6. Understanding non-equilibrium thermodynamics. G. Lebon, D. Jon, J. Casas-Vasques. Springer, 2008.
7. Non-equlibrium thermodynamics, 2nd ed. Yasar Demirel. Elsevier, 2007.

Course No: CH15307GE
Title: Industrial Pollution and Green Chemistry (02 Credits)

Max. Marks: *50* ***Duration: 32*** *Contact hours*
End Term Exam: *40 Marks* ***Internal Assessment:*** *10 Marks*

Unit-I Industrial Pollution (08 Contact hours)

Industrial Pollution: Cement, Sugar, Drug, Paper and pulp. Thermal power plants, Nuclear power plants and Polymers.

Radio nuclide analysis: Disposal of wastes and their management.

Unit-II Environmental Toxicology (08 Contact hours)

Principles of Toxicology, Dose Response Relationship, risk assessment and management.

Organochlorine Compounds: Accumulation and fate in biological systems. Toxicology of PCBs. Dioxins and Furans, health effects in humans.

Environmental Estrogens.

Unit-III Green Chemistry-I (08 Contact hours)

Introduction, Need for Green Chemistry and the role of chemists. Principles of Green Chemistry.

Tools of Green Chemistry: Selection of starting materials, Catalysts, Alternative Solvents, Appropriate reagents, Percentage atom utilization. Microwaves and Sonication.

Unit-IV Green Chemistry-II (08 Contact hours)

Green Solvents and Reaction conditions: Supracritical fluids, aqueous reaction conditions, immobilized Solvents and irradiative reaction conditions.

Examples of Green materials, reagents and some specific reactions.

Books Recommended

1. Environmental Chemistry; 8th edn.; S. E. Manahan; CRC Press; 2005.
2. Chemistry of the Environment; IInd edn.; T. G. Spiro and W. M. Stigliani; Prentice Hall; 2002.
3. Environmental Chemistry; IInd edn.; Colin Baird; Freeman & Co.; 1991.
4. Chemistry of the Environment; IInd Edn. R. A. Bailey; H. M. Clark; J. P. Ferris; S. Krause & R. L. Strong; Elsevier; 2005.
5. Environmental Chemistry; IInd edn.; Samir K. Banergi; Prentice- Hall; 2001.
6. Green Chemistry- Environment Friendly Alternatives; Rashmi Sangh & M. M Srivastava; Narosa; 2007.
7. Green Chemistry- An Introductory Text; IInd Edn.; Mike Lancaster; RSC; 2010.
8. Green Chemistry- Theory and Practice; P. T. Anastas and J. C. Warner; oxford; 2000.
9. Green Chemistry; Ist Edn.; Samuel Delvin; IVY Publishing House; 2008.
10. Green Chemistry- Environmentally Benign Reactions; V. K. Ahluwalia; Ane Books; 2006.

Course No: CH15308GE

Title: Bio-organic Chemistry (02 Credits)

Max. Marks: *50* ***Duration: 32*** *Contact hours*
End Term Exam: *40 Marks* ***Internal Assessment:*** *10 Marks*

Unit-I Chemical Origins of Biology (08 Contact hours)

Bio organic chemistry: Introduction ,Basic consideration , Proximity effects in Organic Chemistry , Molecular rearrangments.

Pre-Biotic Chemistry: Role of HCN and HCHO in biosynthesis , Nucleophiles and Electrophiles in solution of HCN , Formation of Purines and Pyrimidines from HCN under prebiotic conditions .

Carbohydrates from Aldol reaction with HCHO , Formation of Amino acids under prebiotic conditions.

Unit-II Enzymes (08 Contact hours)

Introduction Nomeclature and Classification of enzymes.

Specificity of enzyme action: Types of specificity , The active sites; The Fischer 'lock and key' hypothesis, The Koshland 'induced fit' hypothesis, Hypothesis involving strain or transition state stabilization.

Enzyme Inhibition: Introduction, Competitive inhibition, UnCompetitive inhibition, Non competitive, Allosteric inhibition.

Unit-III Coenzymes (08 contact hours)

Introduction, Types of coenzymes, Involvement of coenzymes in enzyme catalysed reactions: Introduction , Nicotinamide Nucleotides (NAD+ and NADP+), Flavin Nucleotides (FMN and FAD), Adenosine phosphate (ATP, ADP, AMP) .

Coenzyme A (CoA -SH) ,Thiamine Phosphate, Biotin, Tetrahydrofolate, Coenzyme B_{12} .

Unit-IV Biosynthesis of Natural Molecules (08 contact hours)

Biosynthesis of Fatty Acids and Triglycerides, Biosynthetic Pathway of Terpenoids and Steroids, Inhibitors of Terpene biosynthesis, Biosynthesis of Flavanoids.

Books recommended

1. Introduction to bioorganic chemistry and chemical biology. D. V. Vranket and Gregary Weiss; Taylor and francis. 2013.
2. Bio-organicchemistry : Harman Dugas 3rd ed.Springer (2010) .
3. Bio-organic chemistry J.Rohr ,Springer (2000).
4. Enzymes 2nd ed. T. Palmer and P. Bonner (2008).
5. Biochemistry :Donald Voet, Judith.G. Voet 2nd ed.Willey (1995)

Course No: CH15309GE

Title: Bio-Physical Chemistry (02 Credits)

Max. Marks: *50* ***Duration:*** *32 Contact hours*

End Term Exam: *40 Marks* ***Internal Assessment****: 10 Marks*

Unit-I Bioenergetics (08 Contact hours)

Relevence of thermodynamics to Biological systems, Biochemists standard state,
standard energy changes in biochemical reactions, ATP as energy currency of cell (synthesis & hydrolysis). Principles of coupled reactions and their importance for living systems.

Unit- II Equilibrium in biological Systems (08 Contact hours)

.Acid–base Equilibria: pH, pK_a & pK_b values. Dissociation of Amino-acids, isoelectric point. Buffer solutions, effect of ionic strength & temperature, buffer capacity, maintaining pH of blood.

Biological Membranes, Transport of ions across biological membranes, active and passive transport. Theory of membrane potential, Nernst, Plank, Goldman equation,

Electrochemical equilibria: Standard redox potential, half- cell potentials of biological reaction, Nernst Equation.

Unit- III Bio-electrochemistry& Kinetics (08 Contact hours)

Enzymes as electrodes- problems and future application.

Electrochemistry of Nerve conduction, medical applications of electrochemistry.

Renaturation of DNA as a second order reaction, Enzyme kinetics, Michaelis-Menton mechanism, competition & inhibition, multisubstrate systems, effect of substrate, temperature and pH.

Unit-IV Spectroscopy (08 Contact hours)

Fluorescence spectroscopy: simple theory, excited state properties, florescence quenching, molecular rulers (FRET), single molecule florescence, applications in biological systems.

ORD and CD spectroscopy: Polarization of light and optical rotation, Optical rotatory dispersion and Circular dichromism, Circular dichroism of nucleic acids and proteins.

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Books Recommended:

1. Physical Chemistry for life sciences; 2nd edn.; P. W. Atkins and J.D. Paula; Oxford University Press; 2010.
2. Fundamentals of general Biological Chemistry; 4th edn.; John . R. Holum; Wiley; 1990.
3. Principles of biochemistry; 3rd edn.; David. L .Nelson, Michael .M.Cox; Worth Pub.; 2002.
4. Physical Chemistry, Principles and applications in biological systems. 4th edn. Tinoco, Sauer, Wang, Puglisi. Pearson education, 2007.
5. Biophysical Chemistry; 2nd edn.; Alan Cooper; RSC. Publishing; 2011.

Course No: CH15310OE
Title: Philosophy of Science (02 Credits)

Max. Marks: *50* ***Duration:*** *32 Contact hours*
End Term Exam: *40 Marks* ***Internal Assessment****: 10 Marks*

Unit-I Representation (08 contact hours)

Laws of nature**:** Knowledge**, S**ources of knowledge, The rationalists, The empiricists, The Mathematical knowledge, Synthetic Knowledge, Science as knowledge source, Religion and science The Method of science, Induction versus deduction, Representation and reason, Probabilistic laws, Basic and derived laws,

Realism: Realism and its critics, Instrumentalism, Constructive empiricism, Laws and antirealism, Anti-realism and structure of science.

Unit-II Reason (08 contact hours)

Inductive Scepticism: Theory and observation, Dissolving the problem of Induction, Probability
and scientific inference, Kinds of Probability,

Inductive Knowledge: Reliabilist epistemology, reasoning with induction, Innate epistemic capacities and reasoning about induction, Internalism and justification.

Method and Progress: Methodology of scientific research programmes, Clinical trials and the scientific method, The content of discovery and the context of justification, Science without the scientific method, Method and the development of sciences, Paradigms and Progress.

Unit-III Classical Determinism and Probabilistic world (08 contact hours)

The Classical Mechanics: Mechanistic determinism, General principles; Action at a distance, Electric and magnetic forces, Failures of the classical mechanics;
Atomic structure, problem of radiation.

The birth of modern science**:** The photo-electric effect**,** The atomicity of radiation, Particle wave duality, waves of probability, Uncertainty principle, subject versus object, the fundamental laws of radioactivity, The new Quantum theory, wave mechanics, Diracs Quantum mechanics, The new philosophical principles, the probabilistic reasoning.

Unit-IV The Dawn of Modern Thinking (08 contact hours)

The arrow of Time: From Descarts to quantum theory, the relation of quantum theory to other natural sciences. Language and reality in modern science. The role of modern science in the present development of human thinking.

Books Recommended:

5. Philosophy of science; Alexander Bird; McGill-Queen's University Press.
6. Physics and Philosophy; W. Heisenberg; Harper Perennial Modern Classics.
7. Physics and Philosophy; Sir James Jeans; Cambridge University Press.
8. Reconstruction of religious thought in Islam; Muhammad Iqbal; Adam Publishers & Dodo Press.
9. Philosophy of natural science; Carl G. Hempel**;** Pearson.
10. The philosophy of science; David Papineaus; Oxford University Press.
11. Reality and Representation; David Papineaus; Blackwell Publication.
12. Belief, truth and knowledge; D.M. Armstrong; Cambridge University Press.
13. Modern epistemology; Nicholas Everitt and Alec Fisher; McGraw-Hill Higher Education.
14. The structure of scientific revolution; Thomas S. Kuhn; The University of Chicago Press