M.SC. CHEMISTRY SECOND SEMESTER

Course Title: ADVANCED INORGANIC CHEMISTRY	**Course Code: HCT21**
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 20 Marks	**Semester End Examination:** 80 Marks

Course objectives:

1.	To acquaint the knowledge in the advanced and applied inorganic chemistry.
2.	To understand the concepts of organometallic chemistry and the properties of inorganic complexes, and their importance.
3.	To gain knowledge on bonding metal complexes and their spectra properties

Unit	Description	Hours
1	**Chemistry of Non-Transition Elements** **Electron deficient compounds**: Classification of boranes, nomenclature of boranes.: Synthesis, structure and properties **of** B_2H_6, B_3H_9, B_4H_{10}, B_5H_9, B_5H_{11} and B_6H_{10}. Polyhedral skeletal electron pair counting using Wade's rules (*styx* numbers): classification of boron clusters using electron pair count. **Carboranes:** Classification, Nomenclature, Synthesis of closocarboranes ($C_2B_{10}H_{12}$). Structural aspect of closo-$C_2B_{10}H_{12}$. **Metalloborane:** Synthesis and structural aspects of $[B_{11}H_{11}AlCH_3]^{2-}$, $[Fe(CO)_3B_4H_8]$ and [2-CpCoB4H8]. **Metallocarboranes**: Synthesis of $[(C_2B_9H_{11})_2Fe]^{2\square}$, $[C_2B_9H_{11}FeCp]^-$ and $[Co(C_2B_9H_{11})_2]^-$, Structure and Bonding in $[Co(C_2B_9H_{11})_2]^{\square}$ **Borazines:** Synthesis, reactivity and, structure and bonding. **Electron Rich Compounds:** Compounds of Noble gases, Preparation and structure and bonding in Xenon compounds (XeF_2, XeF_4, XeF_6, $XeOF_4$, XeO_2F_2, XeO_3, XeO_4) based on VBT and VSEPR.	15hrs
2	**Bonding in Metal Complexes Metal-Ligand Bonding:** Concept of effective atomic number, electronic configuration of metal complexes by VBT, draw backs of VBT. Crystal Field Theory(CFT)-salient features, crystal field splitting of d orbitals in octahedral, tetrahedral, tetragonal and squarer planar fields Magnitude of Δ, factors affecting Δ,	15hrs

	crystal field stabilization energy (CFSE), effects of crystal field splitting, energy of ligation, stabilities of oxidation states Co(III). Spectrochemical series, nephelauxetic series, short comings of CFT, evidences for covalence, John-Teller distortion in metal complexes and metal chelates. M.O treatment of coordination compounds involving σ and π bonding	
3	***ELECTRONIC SPECTRA OF TRANSITION METAL COMPLEXES*** Microstates, R-S coupling, term symbols for d^n ions, spectroscopic ground states, types of electronic spectra, selection rules for the electronic transitions, relaxation of the selection rules, nature of spectral bands, effect of spin-orbit coupling, effect of distortion and reduction in symmetry, Orgel diagrams, limitations of Orgel diagrams, Tanabe-Sugano diagrams, characteristics of the T-S diagrams, Racah parameters, interpretation of spectra of octahedral, tetrahedral, calculation of nephelauxetic parameter. **Charge transfer bands**: origin, types and characteristics, intervalence charge-transfer bands.	15hrs
4	**Organometallic chemistry** Classification & nomenclature of organometallic compounds – 16 & 18 electron rules – electron counting by neutral atom & oxidation state method. Organometallic compounds of main group elements:- General methods of synthesis structure and bonding in alkyls of Li, Mg, & Al. Transition Metal alkyls (synthesis and stability), Synthesis structure and bonding in metal olefins, carbonyls, nitrosyls, carbenes and metallocenes. Isobolality and Fluxionality	15hrs

References:

1. Inorganic Chemistry-Principles of Structure and Reactivity, 4thEdn-J. E. Huheey, E.A. Keiter, R. L. Keiter and O.K. Medhi. Pearson Education (2009).
2. Shriver & Atkins' Inorganic Chemistry, 5th Edn P. Atkins, Tina Overton, J. Rourke, Mark Weller and F.Armstrong.Oxford University Press (2010)
3. Electronic absorption Spectroscopy and Related Techniques D. N. Satyanarayana, OUP, 2001.
4. Concepts and models of Inorganic Chemistry B.Douglas, D. McDaniel & J.Alexander, 3rd Edn. Wiley Student Edn.(2013).

. Elements of Magnetochemistry-R. L. Dutta and A Syamal : Affiliated East-West, 1993.
. Inorganic Chemistry of Biological Processes, (2nd edn.) M. N. Hughes, Wiley, 1988.
. Bioinorganic Chemistry-Asim K. Das, Books and Allied (P) Ltd, (2007).

8. Principles of Bioinorganic Chemistry-S. J. Lippard and J. M. Berga. Panima Publishing Corporation.

Course outcomes:

1. Acquint with non-transition elements and complexes of biological importance.
2. Learn and skilled with Boron and Zeolite chemistry
3. Able to comment on various inorganic bonding theories
4 Gain knowledge on organometallics

Course Title: INORGANIC CHEMISTRY PRACTICALS-II **Course Code: HCP21**

Teaching Hours/Week (L-T-P): 0 - 0 - 4 **No. of Credits:** 02

Internal Assessment: 10 Marks **Semester End Examination:** 40 Marks

Course objectives:

1.	Hands-on training for synthesis and estimation of inorganic complexes.
2.	Understand the analysis of mixtures by volumetry and gravimetry.
3	Acquire skills for industry

List of Experiments: **60 hrs**

1.	I. Separation and determination of two metal ions involving volumetric and gravimetric methods from the following i) Fe + Ni ii)Cu + Fe
2.	II. Preparation and quantitative analysis of inorganic complexes: i)Cis and trans–potassium dioxalatoaquachromium(III) complex [analysis of oxalate and chromium] present in the above complex. ii) Hexaminecobalt(III)chloride [analysis of cobalt] iii) Chloropentammine cobalt(III) chloride iv) Tris (acetylacetonate) copper (II) sulphate v) Mercuric tetrathicynato cobalate (II). vi) Estimation of Ni^{+2} as Ni-DMG.

References:

1.	Chemical Semi micro analysis- V.N.Alexeyev Mir Publishers (Mascow)
2.	Vogel's Qualitative Inorganic analysis, Revised by G.Suchla Longarman group ltd.
3.	Vogel's Text book of Quantitative Inorganic Analysis – J.Basett, R.C.Denney, G.H.Jeffery and J.Mendhaman, Longamans Green and Company Ltd.
4.	Advanced Inorganic Analysis by Agarwal and Keemtilal, A Pragati Edition, Eleventh Revised edition, 2011.

Course Outcomes:

1. Acquinted with synthesis and analysis of complexex
2. Able to carryout separate the mixture and analyse them
3. Able to apply for routine analysis in industries

Course Title: REACTIONS IN ORGANIC CHEMISTRY	**Course Code: HCT22**
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 20 Marks	**Semester End Examination:** 80 Marks

Course objectives:

1.	To acquaint the knowledge in the oxidation and reduction reactions in organic chemistry.
2.	To Understand the concepts and mechanism of rearrangement reactions.
3.	Gain knowledge on reagents used in organic synthesis.

Unit	Description	Hours
1	**Oxidation:** Introduction, **oxidation by potassium permanganate**: alkenes, alcohols, alkynes, aldehydes, ketones and aromatic compounds. **Oxidation by manganese dioxide**: allylic and benzylic alcohols. **Oxidation of alcohols and phenols** by chromic acid and potassium dichromate, Jones reagent, chromium trioxide-pyridine complex, pyridinium chlorochromate (PCC), pyridinium dichromate (PDC), oxidation of alkanes, alkenes, aromatic side chains and aromatic rings. **Oxidation with per acids** – oxidation of alkenes, ketones. **Oxidation with miscellaneous oxidants**: Ozones (O_3), t-butyl hydroperoxide, aluminium lead tetra-acetate (LTA), SeO_2, OsO_4, periodic acid, DMSO, N-Bromosuccinimide.	15hrs
2	**Reduction:** **Reduction:** Catalytic hydrogenation; Classifications, reactions, and their applications, Hydrogenolysis and their applications. **Introduction** to Pt, Pd, Ni, catalysts, reduction of alkenes, alkynes and Nitro compounds. **Reduction with metal hydrides**: $LiAlH_4$, $NaBH_4$, $NaBH_3CN$ and B_2H_6. **Reduction by dissolving metals:** Na-alcohol, Na-liq.ammonia, Mg-Hg and Zn-HCl. **Reduction by miscellaneous reducing agents:** Di-imide, Hydrazine, $SnCl_2$, tin-hydrochloric acid, Zn-acetic acid, Zn-NaOH, sodium metabisulphite, Mg-alcohol and sodium hydrogen sulphide.	15hrs
3	**Molecular Rearrangements:** General mechanistic treatment of nucleophilic, electrophilic and free-radical rearrangements. **Rearrangements reactions involving migration to electron deficient Carbon:** Wagner-Meerwein rearrangement, pinacol-pinacolone rearrangement, acid catalyzed isomerization of aromatic hydrocarbons: Dienone phenol rearrangemet, Fries rearrangement, benzidine rearrangement, benzil-benzilic rearrangement, rearrangements involving	15hrs

	diazomethane: and alkanes, Wolf rearrangement and Bamberger rearrangement. **Rearrangements reactions involving migration to electron deficient Nitrogen:** Hoffmann, Curtius, Schmidt, Lossen and Beckmann rearrangement. **Rearrangements reactions involving migration to electron deficient Oxygen:** Baeyer-Villiger oxidation and Dakin rearrangement. **Rearrangements reactions involving migration to electron rich Carbon:** Favorskii, Sommlet-Hauser, Neber, Stevens and Wittig rearrangements	
4	**Reagents in Organic Synthesis:** **Reagents and reactions in organic synthesis:** Use of following reagents in organic synthesis and functional group transformations: Lithium diisopropylamide (LDA), Gilmann reagent, dicyclohexyl carbodimide (DCC), dichlorodicyanoquinone (DDQ), Silane reagentstrialkylsilyl halides, trimethylsilyl cyanide, trimethyl silane, phase transfer catalyst, crown ethers, cyclodextrins, Ziegler-Natta catalyst, diazomethane, Woodward and Prevost hydroxylation, Stark enamine reaction, phosphorous ylides - Wittig and related reactions, sulphur ylides – reactions with aldehydes and ketones, 1,3-dithiane anions – Umpolung reaction, Peterson reaction.	15hrs

References:

1. Organic Chemistry, J. Clayden, S. Warren, N. Greeves, P. Wothers, 1st Edition, Oxford University Press, UK, 2001.
2. Organic Chemistry – Solution Mannual, S. Warren, Oxford University Press, UK, 2009.
3. Advanced Organic Chemistry, Part-A:Structure and Mechanisms, 5th Edition, Francis A. Carey, Richard J. Sundberg, Springer, New York, 2007.
4. Principles of Organic Synthesis, R.O.C. Norman, J.M. Coxon, 3rd Edition (First Indian Reprint), Nelson Thrones, UK, 2003.
5. Advance Organic Chemistry – Reactions, mechanisms and structure, Jerry March, 4th Edition, Wiley India Pvt. Ltd., New Delhi, 2008.
6. Organic Reaction Mechanisms, V.K. Ahluwalia, R.K. Parashar, 3rd Edition, Narosa Publishing House, New Delhi, 2009.
7. Organic Chemistry, Solomons, Fryhle, 8th Edition (Wiley Student Edition), Brijbasi Art Press Ltd., Noida, India 2004.
8. Organic Chemistry, G. Marc Loudon, 4th Edition, Oxford University Press, UK, 2000.
9. Organic Chemistry, R.T. Morrison, R.N. Boyd, 6th Edition, Pearson Education (Singapore Pvt. Ltd.), Delhi, Indian, 2005.
10. Organic Chemistry, L.G. Wade, JR., 5th Edition, Pearson Education (Singapore Pvt. Ltd.), Delhi, Indian, 2004.
11. Organic Chemistry, M.A. Fox, J.K. Whitesell, 2nd Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts, London, 1997.
12. Organic Chemistry, Francis A. Carey, 5th Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.

13. Stereochemistry – Conformation and Mechanism, P.S. Kalsi, 7th Edition, New Age International Publishers, New Delhi, India, 2008.
14. Heterocyclic Chemistry, Thomas L. Gilchrist, 3rd Edition, Pearson Education, New Delhi, India, 2007.
15. Heterocyclic Chemistry, Raj K, Bansal, 4th Edition, New Age International Publishers, New Delhi, India, 2009.
16. Organic Chemistry, I.L. Finar, 5th Edition (Volume-2), Pearson Education, New Delhi, India, 2009.
17. Organic Chemistry, I.L. Finar, 6th Edition (Volume-1), Pearson Education, New Delhi, India, 2007.

Course outcomes:

1. Acquint and able to carry out oxidation and reduction reaction of industrial importance.
2. Learn to apply various regents in organic synthesis
3. Able to comment on various rearrangement reactions along with mechanism
4. Gain knowledge for industrial application along with mechanism

Course Title: ORGANIC CHEMISTRY PRACTICALS-II **Course Code: HCP22**

Teaching Hours/Week (L-T-P): 0 - 0 - 4 **No. of Credits:** 02

Internal Assessment: 10 Marks **Semester End Examination:** 40 Marks

Course objectives:

1.	Hands-on training for synthesis of organic compounds.
2.	Understand the mechanism of synthetic reaction.
3.	Estimation of organic compounds using titrimetry

List of Experiments: **60 hrs**

Two step preparations:	
At least six preparations have to be carried out involving following types of reactions.	
1.	Preparation of acetanilide from acetophenone.
2.	Preparation of para nitroaniline from acetanilide.
3.	Preparation of para bromoaniline from acetanilide.
4.	Preparation of azlactone from hippuric acid
5.	Preparation of benzilic acid from benzil
6.	Preparation of anthranilic acid from phthalimide
7.	Preparation of 2-Phenyl indole from Phenyl hydrazine and acetophenone

8.	Preparation of 2,5 Dihydroxy acetophenone from Hydroquinone.
9.	Preparation of Acridone from 2- Chloro benzoic acid.
10.	Preparation of benzoic acid (Cannizarro reaction)
11.	Preparation of Chalcone **II. Estimations:** 1. Estimation of glucose by titration 2. Estimation of ascorbic acid by titration 3. Estimation of hydroxyl group by titration 4. Estimation of amino group by titration 5. Saponification value of oils by titration Estimation of ester group by titration

References:

1.	Advanced Practical Organic Chemistry, N K Vishnoi , Second edition, Vikas Publishing House Pvt. Ltd, 1996
2.	Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis Renu Aggarwal, V. K. Ahluwalia, Universities press (India), 2001
3.	Systematic Laboratory Experiments in Organic Chemistry, Arun Sethi, New Age International, 2003.
4.	Comprehensive Practical Organic Chemistry: Qualitative Analysis, Ahluwalia V.K. Sunitha Dhingra, First edition, Orient Longman, 2004
5.	Practical Organic Chemistry: Qualitative Analysis, Bhutani S.P. Chhikara A, First edition, ANE books-new Delhi, 2009
6.	Vogel's Textbook of Practical Organic Chemistry, Brian S. Furniss, 5th Edition, Pearson India, 2005.
7.	Practical Organic Chemistry , F.G. Mann, B.C Saunders, Fourth edition , Pearson India,2009.

Course Outcomes:

1. Able to synthesise organic compounds
2. Can comment on the mechanism involved in the reaction
3. Skilled to determine the organic compounds

Course Title: APPLIED ANALYTICAL METHODS	**Course Code: HCT23**
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 20 Marks	**Semester End Examination:** 80 Marks

Course objectives:

1.	To acquaint the knowledge in the basic methods of spectroscopic analysis.
2.	To Understand the concepts and mechanism of thermal methods of analysis.
3.	Gain knowledge on radiochemical methods.
4.	To train with advanced methods of separation techniques

Unit	Description	Hours
1	**Flame photometry and Atomic absorption spectrometry:** Energy level diagram –atomic absorption spectra. Flame characteristics, flame atomizers and electrothermal atomization. Comparison of spectral interferences, chemical and physical interferences in Flame Photometry and AAS. Use of organic solvents. Quantitative techniques –calibration curve procedure and the standard addition technique. Typical commercial instruments for Flame Photometry and AAS, Applications. Qualitative analysis and quantitative evaluations. Relative detectability of atomic absorption and flame emission spectrometry. **Inductively coupled plasma**: Atomic emission spectroscopy, Limitations of flame emission spectroscopy, principles of plasma spectroscopy, process of atomisation and excitation, plasma as an excitation source, inductively coupled plasma source, ICP-AES instrumentation, applications of plasma spectroscopy, comparison of ICP-AES with AES, comparison of AFS, AAS and ICP-AES.	15hrs
2	**Radioactive Tracers: Principles and Applications** **Radioanalytical Methods:** Radioactive decay and half-life. Calculation of decay rate and its relevance in tracer studies. Radioactive tracers, principles and applications. Isotopic dilution analysis – direct and inverse; special analytical applications and radiometric titrations. **Neutron activation analysis:** Principle, instrumentation, applications and limitations. Radiochromatography and radio immunoassay-principle, trace element analysis in various materials.	15hrs
3	**Thermogravimetric Analysis (TGA)**: Introduction, principles theory and instrumentation. Factors affecting the results – heating rate, thermobalance, and furnace, instrument control/data handling. Applications-purity and thermal stability, evaluation of correct drying temperature, analysis of complex mixture and determination of kinetic parameters of thermal degradation.	15hrs

	Differential Thermal Analysis (DTA): Introduction, principles theory and instrumentation. Variables affecting the DTA curve. Applications – analysis of the physical mixtures and thermal behavior study,determination of decomposition point. **Differential Scanning Calorimetry (DSC):**Introduction, principles theory and instrumentation. Differences between DTA and DSC,power compensated DSC, heat Flux DSC, applications – studies of thermal transistors and isothermal crystallization, pharmaceuticalindustry for testing the purity of the samples. **Thermometric Titrations:** Applications, Enzyme Kinetics Studies, Applications in biochemistry and pharmaceuticals, Calorimetric Acid-Base Titrations,	
4	**Electromagnetic radiation:** Characterization, quantization of energy levels, regions of electromagnetic radiation spectrum, interaction electromagnetic radiation with matter, representation of spectra-intensity and width of spectral lines. **UV-Visible Spectroscopy:** Quantitative aspects of absorption, Beer-Lambert's law. Terminology associated with absorption measurements. Criteria for spectrophotometric determinations with examples (Fe, Mo and Ni). Limitations of the law, Types of absorption bands, modes of electronic transitions, simple chromophoric –auxochrome theory, Solvent effect and choice of solvent. Prediction of λ-max value by using Wood-Ward and Fieser rules for conjugated diens, trienes and cyclic, α, β-unsaturated aldehydes and ketones, Instrumentation (single beam and double beam spectrophotometers). Quantitative applications of UV-Visible spectroscopy in structural determination. **Applications:** Applications of UV Visible spectroscopy in Pharmacokinetic Studies, Clinical Toxicology, Nucleic Acid Quantification.	15hrs

References:

1. Fundamental of Analytical Chemistry (8th edition, 2005) by D.A. Skoog, D.M. West, Holler, and Crouch, published by Saunders College Publishing, New York.
2. Analytical Chemistry (5th edition, 2001) by G.D. Christian, published by John Wiley & Sons, Inc., India.
3. Quantitative Analysis (6th edition, 1993) by R. A. Day and A. L. Underwood, published by Prentice Hall, Inc., New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis (6th edition, 2003) by J. Mendham, R.C. Denney, J.D. Barnes, and M.J.K. Thomas, published by Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles (2nd edition, 1990) by John H. Kennedy, published by Saunders College Publishing, California.
6. Analytical Chemistry (Pragati edition) by Alka L. Gupta.
7. Introduction to Chromatography: Theory and Practice by V. K. Srivastava and K. K. Srivastava, published by S. Chand and Co. Ltd.
8. Chromatography by B. K. Sharma, published by Goel Publishing House, Meerut.
9. An Introduction to Practical Biochemistry (3rd edition) by David T. Plummer, published

by Tata McGraw-Hill Publishing Company Limited.
10. Principles of Instrumental Analysis (5th edition) by Skoog, Holler, and Nieman, published by Harcourt Asia PTE. LTD.
11. Modern Analytical Chemistry by David Harvey, published by McGraw-Hill Publishing Company Limited.
12. Modern Methods of Chemical Analysis (II edn) by P. L. Descok, L. D. Shields, T. Carins, and F. G. Milliam.
13. Industrial Methods of Chemical Analysis by F. D. Sneel (Encyclopedia).
14. Instrumental Methods of Analysis (6th Edn.) by L.L. Merutt, J.A. Dean, F.A. Settle, published by Van Nostrand.
15. Principles of Instrumental Analysis by D.S. Kooj (Sander Colley).
16. Fundamentals of Analytical Chemistry (7th Edn.) by Skoog, West, Holler, published by Harcourt Agra, Publication Harcourt College Publishers.
17. Principles of Instrumental Analysis (5th Edn.) by Skoog, Haller, Nieman, published by Harcourt Agra, Publication Harcourt College Publishers.
18. Text Book of Quantitative Chemical Analysis by A.I. Vogel (ELBS).
19. Standard Methods of Chemical Analysis by Wekin E. J.
20. Instrumental Methods of Chemical Analysis by Gurudeep R. Chatwal and Sham. K. Anand, published by Himalaya Publishing House.
21. Separation Chemistry by R.P. Budhiraj, published by New Age International (P) Limited, Publisher.
22. Basic Concepts of Analytical Chemistry by S.M. Khopkar, published by New Age International (P) Limited, Publisher.

Course outcomes:

1. A able to carry out simple flame and atomic absorption spectrophotometric analysis.
2. Learn to apply various analytical methods in daily life and industries
3. Able to handle advanced chromatographic methods
4. Skilled with thermal methods to characterise the materials for their thermal stability
5. Able to apply radioanalytical methods

Course Title: APPLIED ANALYTICAL METHODS-II **Course Code: HCP23**

Teaching Hours/Week (L-T-P): 0 - 0 - 4 **No. of Credits:** 02

Internal Assessment: 10 Marks **Semester End Examination:** 40 Marks

Course objectives:

1.	Hands-on training on Flame photometry.

2.	Understand the concept of Atomic Absorption Spectroscopy
3.	Estimation of organic compounds using titrimetry

List of Experiments: **60 hrs**

Two step preparations:	
At least six preparations have to be carried out involving following types of reactions.	
1.	Flame photometric determination of Na^+ & K^+ concentration in tap water.
2.	Flame photometric determination of Ca & Mg
3.	Estimation of Calcium by Flame photometry
4.	Estimation of Sodium and Potassium Mixture by Flame photometry
5.	Analysis of metal ions (any one from -Na, Mg, Ca, Fe) by Atomic Absorption Spectroscopy
6.	Spectrophotometric determination of NO_2^- in water sample
7.	Determine the amount of Molybdenum by solvent extraction using KSCN as reagent using spectrophotometry
8.	Determine the amount of Iron by solvent extraction using 8-hydroxy quinoline as reagent using spectrophotometry
9.	Interpretation of Spectral data (TGA, DTA and DSC) for $CuSO_4$, $CaSO_4$, $CaCO_3$, CaO (Any One molecule)

References:

1.	Instrumental Methods of Chemical Analysis, Chatwal and Anand, 5 th Edn
2.	Analytical Chemistry by Alka L. Guptha, A, Pragathi edition. Fourth edition.
3.	Separation Methods by M. N. Sastri, Himalaya Publisher.
4.	Instrumental Methods of Chemical Analysis, Gurudeep R Chatwal, Sharma K Anand. Himalaya publishers.
5.	Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
6.	Chromatography by B. K. Sharma, GOEL publishers.

Course Outcomes:

1. Able handle Flame photometry .
2. Able handle Atomic Absorption Spectroscopy

Course Title: APPLIED PHYSICAL CHEMISTRY	Course Code: SCT 21
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 20 Marks	**Semester End Examination:** 80 Marks

Course objectives:

1.	Understand the concepts of kinetics and catalysis
2.	Acquire knowledge on nanomaterials and their applications
3.	Gain information on catalysis

Unit	Description	Hours
01	**Chemical Kinetics:** Complex reactions: Kinetics of parallel, consecutive and reversible reactions. Chain reactions: Branched chain reactions, general rate expression, Auto catalytic reactions (Hydrogen-Oxygen reaction), oscillatory reactions and explosion limits. Theories of reaction rates: Collision theory and its limitations, Activated complex theory (postulates -derivation) and its applications to reactions in solution. Energy of activation, other activation parameters - determinations and their significance. Lindemann theory, Hinshelwood's theory of unimolecular reactions. Potential energy surfaces: Features and construction, theoretical calculations of Ea. **Reactions in solution:** Ionic reactions - salt effects, effect of dielectric constant (single and double sphere models). Effect of pressure, volume and entropy change on the rates of reactions. Cage effect with an example. Fast reactions-Introduction, study of fast reactions by continuous and stopped flow techniques.	15hrs
02	**Catalysis and Molecular Group Theory:** Adsorption, adsorption isotherms- Langmuir, Freundlich, BET and Gibb's adsorption isotherms, adsorption with dissociation, competitive adsorption, mechanism of Unimolecular and bimolecular surface reactions. **Homogenous catalysis:** Principle of general and specific acid-base catalysis, linear free energy relation and acidity function and Hamet equation, salt effect and base catalysis. Heterogeneous catalysis: Study of solid surface, employing surface techniques viz. BET and N_2 adsorption. **Enzyme catalysis:** single substrate mechanism, Michaelis-Menten equation, effect of pH,temperature and inhibitors on kinetics of enzyme catalyzed reaction. **Group Theory:** Symmetry operators and symmetry elements, products of symmetry operations C_{2V}, C_{3V}, groups, point groups, group multiplication table, character table, Application of group theory to IR and Raman spectra of typical molecules (NH_3, H_2O and CO_2).	15hrs

03	**Material and Nano systems:** **Preparative methods:** Solid state reaction, role of Chemistry in Materials design, chemical precursor method, co-Precipitation, sol-gel, metathesis, self-propagating high temperature synthesis intercalation / deintercalation reactions; hydrothermal and template synthesis; High pressure synthesis **Organic Materials** : Conducting organics - Metals from molecules, charge transfer materials and Organic superconductors. Fullerenes. and optical data storage materials. Light emitting diodes (organic and polymer light emitting diodes). **Materials possessing** high strain and energy: simple preparation techniques and properties (velocity of detonation) of organic molecules possessing cage structures. Understanding the energetics and properties of these molecules. Examples of the molecules to be studied include; nitramines (1,3,5-Trinitroperhydro-1,3,5-triazine, **1,3,5,7-Tetranitro-[1,3,5,7]tetrazocane,** Hexanitrohexaazaisowurtzitane, cubanes**).** **Nanochemistry**: classification of nanomaterials as zero, one and two dimensional materials. Synthesis of nanomaterials: chemical (sol gel, low temperature combustion, hydro and solvo thermal methods) and bio (microbial and plant extracts) routes. Synthesis of nanowires and nanorods with reference to carbon nanorods and nanowires (single- walled).	15hrs
04	**Atomic spectra and atomic structure:** Review of hydrogen spectrum, hydrogen like spectra. Terms, Term Symbols and multiplicities and couplings. Atomic spectra of alkali and alkali like elements (any one example) . Atomic spectra of helium, atomic spectra of alkaline earth and alkaline earth like elements (any one example), prohibition of inter combination, Mosely lines, Multiplet structure, simple and compound doublets and triplets. Space quantization, Stern-Gerlach experiment, Normal Zeeman effect, Anomalous Zeeman effect, Paschen Back effect, Stark effect. Comparison between Stark and Zeeman effect	15hrs

References:

1. Physical Chemistry by P. W. Atkins.
2.Introduction to kinetics of chemical chain reactions by
3.Gimblett (TMH).3.Chemical kinetics by Laidler.
4.X-ray diffraction by Clug and Alexander.

Course outcomes:

1. Capable to predict the kinetics of reaatcion
2. Able to synthesise and predict the properties of nanomaterials
3. Apply the catalytic reactions and interpret the physical processes

Course Title: PHYSICAL CHEMISTRY PRACTICALS-II **Course Code: SCP21**

Teaching Hours/Week (L-T-P): 0 - 0 - 4 **No. of Credits:** 02

Internal Assessment: 10 Marks **Semester End Examination:** 40 Marks

Course objectives:

1.	Hands-on training for the physical properties characterization.
2.	Understand the physical properties like equivalent conductance, rate constant, electrode potential, dissociation constant, etc
3.	Acquire knowledge on characterization

List of Experiments: **60 hrs**

1.	Determination of limiting equivalent conductance of a weak electrolyte.
2.	Determination of Concentration of given solution by spectrophotometer(Cu^{2+} and NH_3).
3.	Determination of optical rotation and rate constant by polarimeter.
4.	Determination of standard electrode potential by potentiometry
5.	Determination of dissociation of constant of dibasic acid potentiometrically
6.	Determination of rate constant and order of reaction between $K_2S_2O_8$ and KI.
7.	Determination of distribution coefficient for benzene, benzoic acid and water system.
8.	Construction of phase diagram for three component system.
9.	Determine the equilibrium constant for the reaction $KI + I_2 = KI_3$ by distribution method.
10.	Determination of molecular weight of a given solute by Beckmann thermometer.

References:

1.	Fridley's Practical physical chemistry by B. P. Levitt
2.	Advanced practical physical chemistry by G. B. Yadhav
3.	Experiments in practical physical chemistry by Shomaker
4.	Systematic experimental physical chemistry by S.W. Rajbhoj and T K Chondeker.
5.	Senior physical chemistry practical's by Khosla et. al

Course Outcomes:

1. Able to understand the physical properties
2. Can comment on the equivalent conductance, ate constant, 3 phase system, etc
3. Skilled to determine the physical properties

Course Title: SELECTED TOPICS IN PHYSICAL CHEMISTRY	**Course Code: SCT 22**
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 20 Marks	**Semester End Examination:** 80 Marks

Course objectives:

1.	To understand foundation in the fundamentals and application of Polymer Chemistry.
2.	To understand the basics of biopolymers.
3.	To explore new areas of research in both chemistry and allied fields such as, Biochemistry, Material chemistry, Pharmaceutical chemistry and chemical biology and technology.
4.	To understand the central role of photonic devices

Unit	Description	Hours
01	**Natural polymers**: Classification, bio-polymers - introduction – functions – Cellulose, cotton, wool, silk, paper, rubber, collagen, hyaluroran- melanin, lignin – applications. Polymer fromrenewable resource: Introduction – Monomers and polymers from renewable resource materials: castor oil, natural gums, oleo chemicals, cashew nut shell liquid, carbohydrate derived monomers, furfural as a raw material for monomers and polymers. 14h	15hrs
02	**Structure of bio-polymers**: Proteins, nucleic acids and polysaccharides – the Macromolecular structure and biological functions of polymers- primary, secondary, tertiaryandquaternary structures – structure maintenance and transmission of the biological informations- structure and enzymatic activity – mechano structural function of bio-polymers-viruses andphages–living macromolecules.	15hrs
03	**Biological Sources and applications of Nanomaterials:** Carbon nanotubes, Nanomagnets and sensors, High density data storage materials, Nanofillers, spintronics devices, nanotechnology for biological systems and sensor applications Biological sources of nanomaterials: Microorgaism, plants and animals. Mechanism of bolilgical synthesis of functionalized nanomaterials for gold, silver and iron oxides, Diffraction, bonding and morphological (SEM/TEM) study biofunctionalised nanoparticles	15hrs
04	**Photonic devices** **LED and semiconductor lasers**: radiative transitions: Light emitting diodes, Theory, characteristics and applications of Semiconductor lasers. Photodetectors, Photoconducotors and Photo transistors **Solar Cells**: Solar radiation and ideal conversion efficience; p-n junction solar cells, hetereojunction cells, thin film solar cells, optical concentration	15hrs

References:

1. Physics of Semiconductor devices : S.M. Sze (Wiley Eastern)
2. Introduction to Solid State Physics : C Kittel
3. Solid State Physics : A.J. Dekker

4.Introduction to NanoScience –Gabor L Hornyak,JoydeepDutta,Harry F Tibbbals and Anil K Rao-CRC Press
5.Nanomaterials: Synthesis, properties and application, A.S Edelstein, R Cammarada(IOP Pub.)
6.Optical properties of metal clusters, UweKribig and Michael Vollmer, Springer.
7.Nanostructured Materials: Processing, Properties and Applications, Carl C Koch, Noyes Pub
8.Nano: The Essentials, T.Pradeep. Tata McGraw Hill, New Delhi (2007)
9.Introduction to Nanotechnology, Charles P Poole Jr and Frank J Ownes, John Wiley Sons, Inc(2003)
10. Nanocomposite Science and Technology, Pulickel M. Ajayan, Linda S.Schadler, Paul V.Braun,Wiley – VCH Verlag, Weiheim (2003)
11. Nanotechnology: Basic sciences and emerging technologies, Mick Wilson, KamaliKannangara,Geoff Smith, Michelle Simmons, BurkarRaguse, Overseas Press (2005).
12. Semiconductor Quantum Dots, L.Banyai and S.W.Koch (World Scientific) 1993
13. An introduction to the physics of low dimensional semiconductors, J.H. Davies, Cambridge Press,1998.

Course outcomes:

1. Enormous job opportunities at all level of polymer chemistry.
2. Specific placements in R & D and synthetic division of polymer industries & Allied Division.
3. Facile development for the synthesis of biologically significant organic molecules using the green route for chemical reactions for sustainable properties.
4. To inculcate the scientific temperament in the students and outside the scientific community.

Course Title: SELECTED TOPICS IN PHYSICAL CHEMISTRY PRACTICALS - II **Course Code: SCP22**

Teaching Hours/Week (L-T-P): 0- 0 – 4 **No. of Credits:** 02

Internal Assessment: 10 Marks **Semester End Examination:** 40 Marks

Course objectives:

1.	Study of biophysical Techniques.
3.	To understand of some biological and physical techniques

List of Experiments: **60 hrs**

1.	Synthesis of Nano-cellulose from Bagasse
2.	Synthesis of Chitin and chitosan from mushroom
3.	Synthesis of cellulose diacetate polymers
4.	Green synthesis of metal oxide-nano practicals
5.	Determination of anti-oxidant activity for synthesized nano material
6.	Anti bacterial activity for synthesized nano material
7.	Anti fungal activity for synthesized nano material
8.	Invitro analgesic activity synthesized nano material

References:

1. Physics of Semiconductor devices : S.M. Sze (Wiley Eastern)
2. Introduction to Solid State Physics : C Kittel
3. Solid State Physics : A.J. Dekker
4. Introduction to NanoScience –Gabor L Hornyak,JoydeepDutta,Harry F Tibbbals and Anil K Rao-CRC Press
5. Nanomaterials: Synthesis, properties and application, A.S Edelstein, R Cammarada(IOPPub.)

Course outcomes:

1. Skills in biological activity.
2. To understand the concepts nanotechniques

REVISED SYLLABUS

Course Title: BIOPHYSICAL CHEMISTRY	Course Code: SCT 23
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 20 Marks	**Semester End Examination:** 80 Marks

Course objectives:

1.	To understand the physico-chemical principles of biological fluids.
2.	To learn the pharmaco kinetics, pharmaco dynamics, toxico kinetics of biological systems.
3.	To gain the knowledge of bioenergetics and physical chemistry of biomaterials

Unit	Description	Hours
01	**Biophysical Chemistry:** Electrophoresis - Principles of free electrophoresis, zone electrophoresis, gel electrophoresis and its applications in qualitative and quantitative study of proteins. Determination of isoelectric point of a protein. Electro-osmosis and streaming potential and its biological significance. Biological significance of Donnan membrane phenomenon. Micelles and its involvement during digestion and absorption of dietary lipids. Diffusion of solutes across bio-membranes and its application in the mechanism of respiratory exchange. "Salting In" and "Salting Out" of proteins. Osmotic behaviour of cells and osmo-regulation and its application in the evolution of excretory systems of organisms. Effect of temperature and *p*H on the viscosity of bio-molecules (albumin solution). Significance of viscosity in biological systems - mechanism of muscle contraction, polymerization of DNA and nature of blood flow through different vessels. Effect of temperature, solute concentration (amino acids) on surface tension. Biological significance of surface tension - stability of Alveoli in lungs, interfacial tension in living cells (Danielli and Davson model). Application of sedimentation velocity and sedimentation equilibrium method for molecular weight determination of proteins.	15hrs
02	**Pharmacokinetics:** Introduction, biopharmaceutics, pharmacokinetics, clinical pharmacokinetics, pharmacodynamics, toxicokinetics and clinical toxicology. Measurement of drug concentration in blood, plasma or serum. Plasma level-time curve, significance of measuring plasma drug concentrations. **One compartment open model:** Intravenous route of administration of drug, elimination rate constant, apparent volume of distribution and significance. Calculation of elimination rate constant from urinary excretion data, clinical application. **Two compartment model:** Plasma level-time curve, relationship between tissue and plasma drug concentrations, Apparent volumes of distribution. Drug clearance, clinical example. Plasma level-time curve for a three compartment open model. Drug absorption: Factors affecting the rate of drug absorption - nature of the cell membrane, Route of drug administration - Oral drug absorption, Intravenous infusion and intravenous solutions, Effect of food on gastrointestinal drug absorption rate.	15hrs

03	**Bioenergetics:** standard free energy change in biochemical reactions, exergonic, endergonic, hydrolysis of ATP, synthesis of ATP from ADP. **statistical mechanics in biopolymers:** chain configuration of macromolecules, statistical distribution end to end dimension, calculation of average dimensions for various chain structure polypeptide and protein structures introduction to protein folding problem. **Biopolymer interactions:** forces involved in by polymer interactions electrostatics charges and molecular expansion hydrophobic forces desperation force interaction multiple equilibria and various types of binding process in biological systems hydrogen ion titration curves.	15hrs
04	**Thermodynamic of biopolymer solutions:** thermodynamics of bio polymer solutions cosmetic pressure member in equilibrium muscular contraction and energy generation in mechanic chemical system. **Cell membrane and transport of ions:** structure and functions of cell membherance ion transport through cell membrance irreversible thermodynamics treatment of membrane transport nerve conduction. **Biopolymers and their molecular weight:** evaluation of size shape molecular weight and extent of hydration of bio polymers by various experimental techniques sedimentation equilibrium hydrodynamic methods diffusion sedimentation velocity viscosity electrophoresis and rotational motions.	15hrs

References:

1. Introduction to Physical Organic Chemistry, R.D. Gilliom, Madison – Wesley, USA (1970).
2. Physical Organic Chemistry- Reaction Rate and Equilibrium Mechanism – L.P. Hammett, McGraw HillBook, Co., (1970).
3. Biophysical Chemistry- Principle and Technique – A. Upadhyay, K. Upadhyay and N. Nath, Himalaya Publishing House, Bombay, (1998).
4. Essentials of Physical Chemistry and Pharmacy – H. J. Arnikar, S. S. Kadam, K.N. Gujan, Orient Longman, Bombay, (1992).
5. Applied Biopharmacokinetics and Pharmacokinetics - Leon Shargel, Andrew YuPrentice-Hall International, Inc (4^{th} edition).
6. Essentials of Physical Chemistry and Pharmacy – H.J. Arnikar, S.S. Kadam, K.N. Gujan, Orient Longman, Bombay, (1992).

Course outcomes:

1.	After the completion of this course, the students gain the knowledge on theory and principles of biophysical chemistry and pharmacokinetics.
2.	This course helps to understanding the bio-availability and different pharmacokinetic parameters of drugs in the living system.
3.	Students will be able to understand the bioenergetics and biomaterials

Course Title: Biophysical Chemistry -II	Course Code: SCP23
Teaching Hours/Week (L-T-P): 0- 0 – 4	**No. of Credits:** 02
Internal Assessment: 10 Marks	**Semester End Examination:** 40 Marks

Course objectives:

1.	Study of Bio-physical Techniques.
3.	Analysis of samples using gerrn synthesis techniques

List of Experiments: **60 hrs**

1.	Synthesis of Nano-cellulose from Bagasse
2.	Synthesis of Chitin and chitosan from mushroom
3.	Synthesis of cellulose diacetate polymers
4.	Green synthesis of metal oxide-nano practicals
5.	Determination of anti-oxidant activity for synthesized nano material
6.	Anti bacterial activity for synthesized nano material
7.	Anti fungal activity for synthesized nano material
8.	Invitro analgesic activity synthesized nano material

Reference

1. Introduction to Physical Organic Chemistry, R.D. Gilliom, Madison – Wesley, USA (1970).
2. Physical Organic Chemistry- Reaction Rate and Equilibrium Mechanism – L.P. Hammett, McGraw HillBook, Co., (1970).
3. Biophysical Chemistry- Principle and Technique – A. Upadhyay, K. Upadhyay and N. Nath, Himalaya Publishing Housc, Bombay, (1998).

Course outcomes:

1.	Skills in microbial activity.
2.	To ger various research of nanoparticles.

Course Title: CHEMISTRY FOR DAILY LIFE	**Course code**: OET21
Total Contact Hours : 30	**Course Credits**:02
Formative Assessment Marks: 10	**Duration of ESA/Exam**: 2 hrs
Summative Assessment Marks:40	

Course Objectives:

1.	Understanding the importance of Chemistry in daily life
2.	Inform on Drug chemistry and chemistry of soaps
3.	Study the use of some chemical products

UNIT	Description	Hours
01	**Chemistry in Household** Soaps, Detergents, surfactants, Diamond. Chemistry in Jewellary: Electroplating, metals and metal alloys. Chemistry of Batteries: cells, wax candals, mosquito coils and common salt. Chemistry of Cosmetics: Cosmetics formulation, perfumes, and fragrances, deodorants, Colour cosmetics, sun protections, Preservatives and its effects, Food toxicity Chemistry and uses of Paints, pigments, Varnishes and coatings, cleaners, stain removears, pesticides, Fire extinguishers, cement, glasses, fertilizers Fuel Chemistry: Fuels, Introduction, fossil fuels with example, biomass energy, Energy sources: Solar energy, wind energy, tidal energy, hydal energy, nuclear energy. Chemical toxicity	15hrs
02	**Chemistry of drugs** Drugs, classification, uses and side effects of pain relief drugs, antibiotics, antacids, Stimulants, ointments, syrups, tablets and capsules, Anesthetic drugs, energetic drugs. Storage and usage Action of drugs: Effects of narcotics and abuse of drugs **Water Chemistry**: Importance, sources, types, underground and surface water, water contents, water born deceases, Water pollution: Sources and Impacts on aquatic and human life Potable water: Specification and limits: pH, acidity and alkalinity, hardness, chloride, TDS, Conductivity, COD, BOD and DO	15hrs

References:

1) Chemistry in daily life by Kirpal Sing, PHI learning Pvt Ltd., 2012.
2) Engineering Chemistry by Dr. Suba Rameshm and Dr. S. Vairam, Wiley Publication, 2013

3) Drugs and pharmaceutical sciences Series, Marcel Dekkar, Vol.II, INC, New York, 2002.
4) Hand book of Fertilizer Technology By Swaminathan and Goswamy, 6th Edn., 2001.
5) Medicinal Chemistry (VEdition) by Asthoush Kar, New Age International publisher,2010.
6) Food 6 facts and principles by N. Shakuntala Manay and S. Swamy, 4th ED. New Age International, 2008.

Course Outcomes:

1.	Know the role of Chemistry in our daily uses
2.	Understand the applications of Chemistry in household activites
3.	Get information about drugs and its side effects

REVISED SYLLABUS

Course Title: AGRO AND ENVIRONMENTAL CHEMISTRY	Course code: OET22
Total Contact Hours: 30 hrs	**Course Credits:** 02
Formative Assessment Marks: 10	**Duration of ESA/Exam:** 2hrs
Summative Assessment Marks: 40	

Course Objectives:

1.	Understand the importance of safe environment
2.	Study the Sources and consequences of environmental pollution
3.	Gain knowledge on the composition and importance of fertilizers, pesticides for agriculture

Unit	Description	Hours
1	**Agricultural products** Micronutrients and macronutrients in soil, Importance of Nutrients for plants, Different nutrients for different crops **Fertilizers**; Different types, Composition and applications, Effects of excess use of fertilizers, pollution by fertilizers, Bio-based fertilizers and advantages **Insecticides:** Composition and applications, side effects **Pesticides:** Composition and applications, side effects **Weedicides:** Composition and applications, side effects **Preservative chemicals:** Composition and side effects **Chemicals used for Ripening:** Composition, uses and side effects **Food adulteratives and contaminants:** Difference and side effects with examples, Rancidity of oil	15
2	**Environment:** Segments of environment, Ecosystem, Laws to safeguard environment. Duties of state and Central pollution Control boards. Importance of safeguarding the environment; Measures to safeguard the environment; Case studies, Chernobyll accident, Bhopal tragedy, Minamota disease, etc **Soil pollution:** Causes, Soil erosion, loss of fertility and remedies **Air pollution:** Sources, greenhouse effect, causes and consequences, Control and remedies, Acid rain **Water pollution:** Sources, Effects, Control and procedure for purification **Noise pollution**: limits and units; effects	15
References:		

1. Environmental Chemistry – A.K. De, New Age International, 8th Edn., 2016
2. Environmental Chemistry – S.K. Banerji, (Prentice Hall India), 1993.
3. Chemistry of Water Treatment – S. D. Faust and O. M. Aly, (Butterworths), 1983.
4. Environmental Chemistry – I. Williams, John Wiley, 2001.
5. Food Analysis – A. G. Woodman, McGrawHill, 1971.
6. Foods: Facts and Principles – Shadaksharaswamy and Manay, Wiley Eastern, 1987.
7. A Text Book of Soil Chemical Analysis – P. R. Hesse, CBS Publishers, 1994

Course Outcomes:

1.	Capable to introduce and educate people about the environment
2.	Practice and adopt the skills for safe environment
3.	Able to properly use agro-products