DEPARTMENT OF CHEMISTRY
SRM UNIVERSITY

M.Sc., CHEMISTRY(GENERAL)*

SYLLABUS

SEMESTER – I

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHET 402	INORGANIC CHEMISTRY - I	CORE	4	1	0	4

***Effective From 2013-2014**

UNIT – I ATOMIC STRUCTURE , PERIODIC TABLE AND BONDING

Atomic Structure and Periodic Table: Atom as nucleus with orbital electrons, concept of wave-functions, quantum numbers and spin, shape of s, p and d orbitals and their radial distribution functions, electronic configuration of atoms, Aufbau principle, Pauli Exclusion Principle, and Hund's rule. Slater's rules for the determination of screening constants; arrangement of elements in Groups in the Periodic Table, s-block, p-block, d-block and f-block elements; periodic properties, ionic radii, ionization potential, electron affinity, electronegativity (Pauling, Mulliken and Aflred-Rochnow scales); atomic states and term symbols.

Bonding and structure: Types of bonds, ionic, covalent, coordinate, double and triple bonds; orbital symmetry and overlaps. Concept of MO and VB theory, concept of hybridization, the extent of d orbital participation in molecular bonding; bond energy and covalent radii. Concept of resonance, bond moment and molecular dipole moment; polarizing power and polarizability AND Fajan's rules.

UNIT – II MAIN GROUP CHEMISTRY

Main Group Chemistry: Chemistry of boron – borane, higher boranes, carboranes, borazines and boron nitrides. Chemistry of silicon – silanes, higher silanes, multiple bonded systems, disilanes, silicon nitrides, siloxanes and silicates. P-N compounds, cyclophosphazenes and cyclophosphazanes. S-N compounds – S4N4, (SN)x.

Ionic Model - Lattice energy – Born-Lande equation - Kapustinski equation - High Tc superconductors – Solid state reactions – Types and examples.

UNIT III COORDINATION CHEMISTRY

Coordination Chemistry: Principles Studies of coordination compounds in solution – detection of complex formation in solution – Stability constants – stepwise and over-all formation constants – simple methods (Potentiometric, pH metric and photometric methods) of determining the formation constants - Factors affecting stability –statistical and chelate effects – Forced configurations.

Theories of Metal - Ligand bond: VB theory and its limitations – Crystal field theory - splitting of d-orbitals under various geometries – Factors affecting splitting – CFSE and evidences for CFSE (Structural and thermodynamic effects) – Spectrochemical series – Jahn-Teller distortion – Spectral and magnetic properties of complexes – Site preferences - Limitations of CFT – Ligand field theory – MO theory – sigma – and pi-bonding in complexes – Nephelauxetic effect – The angular overlap model.

UNIT – IV REACTION MECHANISM OF COMPLEXES

Coordination Chemistry – Reaction Mechanism: Kinetics and mechanism of reactions in solution – labile and inert complexes – Ligand displacement reactions in octahedral and square planar complexes – acid hydrolysis, base hydrolysis and anation reactions – trans effect – theory and applications. Electron transfer reactions – electron exchange reactions – complementary and non-complementary types – inner sphere and outer sphere processes – Application of Electron transfer reactions in inorganic Complexes - isomerisation and racemisation reactions of complexes – Molecular rearrangement – Reactions of four and six-coordinate complexes – Interconversion between stereoisomers. Reactions of coordinated ligands – Template effect and its application for the synthesis of Macrocyclic ligands – Unique properties.

UNIT – V INORGANIC PHOTOCHEMISTRY

Electronic transitions in metal complexes, metal-centered and charge-transfer transitions – Various photophysical and photochemical processes of coordination compounds – Unimolecular charge-transfer photochemistry of cobalt (III) complexes. Mechanism of CTTM photoreduction. Ligand-field photochemistry of chromium(III) complexes, Adamson's rules, photoactive excited states, V-C model – photophysics and photochemistry of rutheniumpolypyridine complexes, emission and redox properties – photochemistry of organometallic compounds, metal carbonyl compounds, compounds with metal-metal bonding and Reinecke's salt chemical actinometer.

REFERENCES

1. M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, Affiliated East West Press Pvt. Ltd. 2nd Edition, 1985.
2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 4th Edition, A Wiley - Interscience Publication, John –Wiley & Sons, USA, 2009.
3. J.E. Huheey, Inorganic Chemistry 3rd. Edition, Harper & Row publisher, Singapore, 1983.
4. A.W.Adamson, Inorganic Photochemistry, John Wiley & Sons, New York, 1975.
5. S.F.A. Kettle, Physical Inorganic Chemistry – A Coordination Chemistry Approach, Spectrum, Academic Publishers, Oxford University Press, 1996.
6. A. W. Adamson and P. D. Fleischauer, Concepts of Inorganic Photochemistry, Wiley, New York, 1975.
7. J. Ferraudi, Elements of Inorganic Photochemistry, Wiley, New York, 1988.
8. F.Basolo and R.G.Pearson, Mechanism of Inorganic Reactions, John Wiley, New York, 1967.

SEMESTER – I

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UNIT-I: STRUCTURE, BONDING AND REACTIVE INTERMEDIATES

Structure and Bonding Localized Chemical Bonding: Electronic Structure of molecules; VB and MO - Inductive and Field Effects, Bond distances, Bond angles and Bond energies. Delocalized Chemical Bonding: Bond energies and Bond distances in compounds containing delocalized bonds - Cross conjucation - Resonance - Hyperconjugation and Keto – Enol tautomerism.

Reactive Intermediates: Generation, Structure, Stability and Reactivity of Carbocations and Carbanions, Free radicals, Carbenes, Nitrenes and Benzynes.

UNIT-II AROMATICITY

Huckel's theory of aromaticity, Concept of homoaromaticity and antiaromaticity. Electron occupancy in MO's. Systems with 2, 4, 8 and 10 electrons, systems of more than 10 electrons,alternant and non-alternant hydrocarbons (azulene type). Bonding properties of systems with$(4n + 2)\pi$ electrons and $4n\pi$ electrons, Aromaticity of benzenoid, heterocyclic and non-benzenoid compounds. Annulenes, Sydnones and Fullerenes. NMR concept of Aromaticity

UNIT-III SUBSTITUTION REACTIONS

Aliphatic Nucleophilic substitutions: The S_N2, S_N1, mixed S_N1 and S_N2 and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by σ and π- bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions and norbornyl system. The S_N^i mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate, attacking nucleophile, leaving group and reaction medium.

Aromatic Nucleophilic Substitution: The S_NAr, S_N1, benzyne and $S_{RN}1$mechanisms. Reactivity - effect of substrate, structure, leaving group and attacking nucleophile.

UNIT-IV STEREOCHEMISTRY

Fundamentals of Organic Stereochemistry: Principles of symmetry-Stereoisomerism-Optical isomerism-Definitions-Conventions used in Stereochemistry: Newmann, Sawhorse and Fischer notations and interconversions and representations. Nomenclature, correlation of configuration, Cahn-Ingold-Prelog rules for simple molecules, Optical activity and chirality-Types of molecules exhibiting optical activity-Fischer projection-Absolue configuration. Molecules with more than one chiral center-molecular chirality-Atropisomerism-Biphenyles, allenes and spiranes. Methods of determining configuration. Prochiral centers-Asymmetric synthesis-Recemisation and resolution.

Geometrical Isomerism: E&Z Nomenclature, Determination of configuration of geometrical isomers. Stereochemistry of addition and elimination reactions. Stereoselective and stereospecific synthesis(Elementary examples)
Conformational Analysis
Basic concepts of conformation analysis-conformation of ethane, substituted ethane, n-butane and cyclohexane

UNIT-IV REAGENTS

Use of the following reagents in organic synthesis:, Diazomethane, Dicyclohexylcarbodiimide, DIBAL, Griganard, Lead tetraacetate, Lithium aluminium hydroxide, Lindlar's catalyst, N-Bromosuccinimide, Osmium tetraoxide, PCC, Raney Nickel, Selenium dioxide, Wittig reagent.

References

1. J. March, Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 5th edition, Wiley, 2000.
2. D. Nasipuri, Stereochemistry of organic compounds-Principles and applications, New Age International, 2nd edition,2002.
3. I.L. Finar, Organic Chemistry, Vol.II, 5th ed., ELBS, 1975.
4. R.K. Bansal, Organic Reaction Mechanisms, Tata McGraw Hill, 1975.
5. R.T. Morrison and R.N. Boyd, Organic Chemistry, 6th edition, Pearson, 1992.
6. J.M. Coxon, B. Halton, Organic Photochemistry, Camb. Uni. Press, 2nd edition, 1987.
7. G.R. Chatwal , Organic Photochemistry, Himalaya Publications house, 1st edition, 1998.
8. P.S. Kalsi, Stereochemistry , Wiley eastern limited, New Delhi, 1990.

SEMESTER – I

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CHET 404*	PHYSICAL CHEMISTRY - I	CORE	4	1	0	4

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UNIT- I IONS IN SOLUTIONS

Conductivity of solutions and their measurement - the Arrhenius ionisation theory - transport numbers and mobilities of ions - measurement of transport numbers - Hittorff method and moving boundary method - ionic activities and activity coefficients and their determination by various methods - Debye-Huckel-Onsager theory - ionic atmosphere - Debye-Huckel limiting law - dissociation constant of acids and bases.

UNIT – II ELECTROCHEMICAL CELLS

Electromotive force - measurement of EMF – the cell EMF and the cell reaction - reversible cells - types of half cells - classification of cells - the standard EMF of a cell - electrochemical potential - standard electrode potentials - calculation of the EMF of a cell - Nernst equation and its limitations - calculation of solubility products - standard free energies and entropies of aqueous ions - electrode concentration cells - electrolyte concentration cells - cells with liquid junctions - oxidation - reduction reactions, measurement of PH, concentration cells - decomposition voltages - concentration polarisation and over voltage - polarography.

UNIT – III ELECTRICAL DOUBLE LAYER AND ELECTRODE KINETICS

Evidences for electrical double layer. Electrocapillary phenomena-Electro capillary curves, Electro-osmosis, electrophoreses. Streaming and Sedimentation potentials. Zeta potentials and its determination by electrophoresis, influence of ions on Zeta potential. Helmholtz-Perrin, Guoy-Chapmann and Stern models of electrical double layer-Applications and limitations.

Kinetics of electrode process. Energy barrier at electrode surface- electrolyte interface, overpotential, Butler – Volmer equation, Tafel equation

UNIT – IV CHEMICAL KINETICS

Simple collision theory, absolute reaction rate theory(ARRT),thermodynamic treatment, potential energy surfaces, application of ARRT to simple bimolecular process; chain reactions – general characteristics, study of kinetics of chain reaction like H_2-Br_2 reaction, decomposition of acetaldehyde and N_2O_5 ,study of H_2- O_2 explosives reactions. Theory of unimolecular reactions-Linedemann, Hinshelwood, RRKM and Slater treatment; steady state approximation, principle of microscopic irreversibility and detailed balancing kinetic isotope effect.

UNIT - V REACTION IN SOLUTION AND FAST REACTIONS TECHNIQUES

Comparison between gas phase and solution reactions. Cage effect. The influence of the solvent on the reactions between ions and reaction between ions and neutral molecules. Influence of ionic strength on rates of reactions in solution. ARRT to reaction in solution, Significance of volume and entropy of activation. Primary and secondary salt effect.

Introduction, flow methods (continuous and stopped flow methods) - Relaxation methods (T and P jump methods) – Pulse techniques (pulse radiolysis, flash photolysis, Shock tube method) - molecular beam method – lifetime method.

REFERENCES

1. K.J. Laidler, Chemical Kinetics, Tata McGraw Hill
2. Gurdeep Raj, Chemical Kinetics, Goel Publishing House.
3. P.W.Atkins, Physical Chemistry
4. W.J.Moore, Physical Chemistry, Longmans
5. A.A.Frost and R.G.Pearson, Kinetics and Mechanism, Wiley Eastern, Pvt. Ltd.
6. Agarwal, Basic chemical kinetics, Tata McGraw- Hill, 1990.
7. Bockris J.O.M and A.K.N. Reddy, Electrochemistry, volumes 1 and 2,Plenum,New york, 1977.
8. Glasstone.S, An introduction to Electrochemistry Affiliated East West press, New Delhi ,1977.

SEMESTER – I

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			L	T	P	C
CHET 401*	ANALYTICAL CHEMISTRY - I	CORE	4	1	0	4

***Effective From 2013-2014**

UNIT - I

Colorimetry

Standard series method, duplication method, photo-electric calorimeter, spectro-photo meter, single beam, double beam, determination of pKa value of an indicator, simultaneous spectrophotometric determination.

Ultraviolet and visible spectrophotometry (UV-VIS)

Introduction, Beer Lambert's law, instrumentation, calculation of absorption maxima of dienes, dienones and polyenes, applications.

UNIT - II

Infrared Spectroscopy (IR)

Introduction, instrumentation, sampling technique, selection rules, types of bonds, absorption of common functional groups. Factors affecting frequencies, applications.

Flame Spectrometry:

Instrumentation, combustion flames, nebulise burner system, resonance line sources, monochromator, detector, types of interferences, non-flame techniques.

UNIT - III

Electroanalytical Techniques:

Polarography: Introduction, Instrumentation, Ilkovic equation and its verification. Derivation of wave equation, Determination of half wave potential, qualitative and quantitative applications. Amperometry: Basic principals, instrumentation, nature of titration curves, and analytical applications.

Theory of Electrogravimetric analysis, electrode reactions, overpotential, completeness of deposition, electrolytic separation of metals with controlled cathode potential.

UNIT - IV

Redox titration- Redox potentials, theory and feasibility of redox titration, calculation of potentials at different stages of titrations, redox indicators, their choice and applications.

Pecipitation titrations- theory and types, Mohr, Volhard and Fajan's methods. Adsorption indicators-theory, choice and applications.

Complexometric titrations- Theory, Stepwise and overall formation constants, Titrations involving chelates (EDTA). Metalochromic indicators-Theory and Choice. Masking and demasking and extractive methods. Direct, indirect (including substitution) titration and applications.

UNIT – V Nephlometry and Turbidometry

Introduction, Theory, Instruments, working and Applications

Radiochemical Analysis, NAA: Scintillation counter and G.M. Counter

REFERENCES

1. Fundamentals of Analytical Chemistry-Skoog, West and Holler, Saunders College Publising VI Edition 1991, and VII Edition, 1996.
2. Text Book of Quantitative Inorganic Analysis – A.I. vogel, ELBS, III Edition, 1976, and IV Edition, 1985.
3. Vogel's Text Book of Quantitative Chemical Analysis- A.I.Vogel, VI Edition, Pearson Eduction Ltd, 2001.
4. Analytical Chemistry –Gary D. Christian, Jhon Wilys & Sons, INC, V Edition, 2001.
5. Statistics for Analystical Chemistry – J.C. Miller and J.N. Miller, Ellis Harwood. Chichester, 1984.
6. Instrumental Analysis – Gary D. Christian & James, E. O'Reilly, Allyn & Bacon Ino, II Edition, 1986.
7. Analytical Chemisstry – J.G. Diok, McGraw Hill Publishers, 1975.
8. Analytical Chemistry- An Indtroduction – Skoog, West &Holler, McGraw Hill Publishers, 1975.
9. Instrumental Methods of Chemical Analysis- G. W. Ewing, McGraw Hill Publishers, 1975.
10. Statistics for Analytical Chemists- R. Caulcutt and R. Boddy, Champmann and Hall Publications, London, 1982.

SEMESTER – I

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHEP 405*	INORGANIC CHEMISTRY PRACTICAL – I	CORE	0	0	6	3

***Effective From 2013-2014**

OBJECTIVES

To enable the learners, to apply the principle in the semi-micro analysis of an inorganic salt mixture.

Semi – micro qualitative analysis: Analysis of mixtures containing two familiar and two less familiar cations from the following W, Pb, Se, Te, Mo, Cu, Cd, As, Sb, Ce, Be, Th, Zr, Ti, V, Cr, Mn, U, Ni, Co, Zn, Ca, Ba, Sr, Li, Mr (insoluble and interfering anion may be avoided).

REFERENCE:

1. Vogel's Qualitative Inorganic Analysis, Revised by G Svehla, Sixth Edition, Longman, 1987.
2. V.V. Ramanujam, "Inorganic Semi-micro Qualitative Analysis", The National Publishing Co, Chennai 1974.

SEMESTER – I

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHEP 406*	ORGANIC CHEMISTRY PRACTICAL - I	CORE	0	0	6	3

***Effective From 2013-2014**

Qualitative Analysis of an organic mixture containing two components.

Pilot separation, bulk separation, analysis, derivatization.

Preparation of Organic compounds.(Single stage).

(a) methyl –m- nitrobenzoate from methylbenzoate (nitration)
(b) glucose pentaacetate from glucose (acetylation)
(c) resorcetophenone from resorcinol (acetylation)
(d) benzophenone oxime from benzophenone (addition)
(e) o-chlorobenzoic acid from anthranillic acid (Sandmayer reaction)
(f) P-benzoquinone from hydroquinone (oxidation)
(g) Phenyl-azo-2-napthol from aniline (diazotization)

- Detection of elements (N, Cl, S) by Lassaigne's test
- Detection of the following functional groups by systematic chemical analysis: Aromatic amino ($-NH_2$), aromatic nitro ($-NO_2$), Aimdo ($-CONH_2$, including imide), Phenolic –OH, Carboxylic acid (-COOH), Carbonyl (>C=O); only one test for each functional group is to be reported.

REFERENCES

1. A Textbook of Practical Organic Chemistry - A. I. Vogel.
2. Practical Organic Chemistry - Mann & Saunders.
3. A Handbook of Quantitative & Qualitative Analysis- H. T. Clarke.
4. Organic Synthesis Collective Volumes by Blat.
5. Reagents in Organic Synthesis by Fieser and Fieser.

SEMESTER – II

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHET 408*	INORGANIC CHEMISTRY - II	CORE	4	1	0	4

***Effective From 2013-2014**

UNIT I

Acids and Bases: Acids and Bases : Bronsted and Lewis acids and bases, pH, pKa, acid – base concept in non-aqueous media, buffer solution, Protonic acids – Proton Affinities – Differentiation and Leveling solvents – Hammet Ho scale – Acidic behaviour of the binary Hydrides – Cosolvating agents - Oxyacids – Organic acids – Acetic acid and the Inductive Effect, Aromatic Acids and Resonance Effects – Hydrolysis and Aquoacids – Basic precipitations – Amphoteric oxides – Nonprotonic concepts of Acid – Base Reactions – Lux Concept – Solvent Ion theory of Acids and Bases – Liquid Ammonia, Acetic acid as a solvent, Bromine trifloride, Binitrogen teroxide, Liquid hydrogen chrloride – Hard and Soft Acids and Bases – Classification – Acid – Base strength and Hardness and Softness – Symbiosis – Theoretical basis of Hardness and Softness – Electronegativity and Hardness and Softness.

Inorganic Chains, Rings and Clusters, Cages: Chains – Catenation, heterocatenation – silicate minerals (names and structures only) Intercalation chemistry – talc, muscovite (structure only). Isopoly anions: - basic building units of vanadate, molybdate and tungstate ions – apek sharing (structure only) – Heteropoly anions – structure only. Rings – Phosphazenes – structure – Craig and Paddock model – Dewar model. Cages: synthesis, structure and bonding of cage like structures of phosphorous. Boron cage compounds-Wade MingosLauher rules, MNO rule, boranes, carboranes, metallacarboranes.

UNIT II

Ionic Bond and Crystal structure: Radius Ratio rules – Calculation of some limiting radius ration values for C.N.3 (planar triangle), C.N. 4 (tetrahedral), C.N. 6 (octahedral). Classification of Ionic structures – AX (ZnS, NaCL, CsCL), AX2 (fluorite, rutile, beta-cristobalite) and AX3 types (Structures only), Layer structure – CdI^2, Nickel arsenide structures – Lattice energy – Born-Lande equation derivation – Important points arising from Born-Lande equation – Schottky defect and Frenkel defect – explanation and calculation of number of defects form per cm^3 – Metal excess defect – F centers and interstitial ions – Metal deficiency defect – positive ions absent – extra interstitial negative ions – Semiconductors and transistors – Rectifiers – Photovoltaic cell – Transistors – steps in the manufacture of memory chips for computers.

UNIT III

Nuclear Chemistry:

Radioactive decay – Theories of decay processes – Laws of radioactivity – Detection and measurement of radiations – Nuclear structure – Composition of nuclei – properties of nuclei – nuclear radii, nuclear spin etc, - nuclear forces – its characteristics – Meson field theory – nuclear stability – characteristics – Meson field theory – nuclear stability – nuclear models – liquid drop, shell and collective models. Artificial radioactivity – Nuclear reactions – transmutations, stripping and pick up, fission, fusion, spallation and fragmentation reactions –

scattering reactions – nuclear cross section. Nuclear reactors – charged particle accelerators – neutron sources – gamma ray and X-ray sources. Applications of nuclear science in agriculture and biology – neutron activation and isotopic dilution analysis.

UNIT IV

INORGANIC SPECTROSCOPIC METHODS:

Infrared and Raman Spectroscopy: Structural elucidation of coordination compounds containing the following molecules/ions as ligands-NH_3, H_2O, CO, NO, OH^-, $SO4^{2-}$, CN^-, SCN^-, NO^{2-} and X^- (X=halogen).

Electron Paramagnetic Resonance Spectroscopy: EPR of d^1 and d^9 transition metal ions in cubic and tetragonal ligand fields, evaluation of g values and metal hyperfine coupling constants. **Mössbauer Spectroscopy:** Applications of Mössbauer spectroscopy in the study of Fe(III) complexes.

UNIT V

STABILITY AND MAGNETISMS

Stability of complexes – Factors affecting stability of complexes, thermodynamic aspects of complex formation, Stepwise and overall formation constants, stability correlations, statistical and chelate effects; Determination of stability constant – Polarographic, photometric and potentiometric methods.

Magnetism: dia, para, ferro and antiferro magnetism, quenching of orbital angular moment, spin orbit coupling; Chemistry of lanthanides and actinides: lanthanide contraction, oxidation states, spectral and magnetic properties, use of lanthanide compounds as shift reagents.

REFERENCE:

1. Bodie E.Douglas and Darl H.McDaniel, Concepts and Models in Inorganic Chemistry, Indian Edition, 1970, Oxford & IBH Publishing Co, New Delhi.
2. J.D. Lee, A New concise Inorganic Chemistry, 4th edition, ELBS, 1995.
3. G.Friedlander, J.W. Kennady and J.M. Miller, Nuclear and Radiochemistry, 3rd Edition, 1981.
4. Keith F.Purchell and John c.Kotz, Inorganic Chemistry, Saunders goldern Sunburst Series, W.B. Saunders Company, Philadelphia.
5. Cotton and Wilkinson, Advanced Inorganic Chemistry, 5th ed., John Wiley & Sons, New York, 1988.
6. W.Kain and B.Schwederski, Bioinorganic Chemistry, Inorganic elements in the Chemistry of Life, John Wiley & Sons, New York, 1994.
7. James E.Huheey, Ellen A Keiter and Richard L.Keiter, Inorganic Chemistry Principles of Structures and Reactivity, 4th ed., Addison-Wesley, New York, 2006.
8. C.N. Banwell, E.M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edn., Tata McGraw Hill, 1994.
9. A. K. Bridson, Inorganic Spectroscopic Methods, Oxford University Press, 1998.
10. D.M. Roundhill, Photochemistry and Photophysics of Metal Complexes, Plenum Press, 1994.
11. A.W. Adamson, P.D. Fleischauer, Concepts of Inorganic Photochemistry, Wiley, 1975.
12. V. Balzani, V. Carassiti, Photochemistry of Coordination Compounds, Academic Press, 1970.
13. S.F.A. Kettle, Coordination compounds, ELBS, 1973.
14. K.F. Purcell and J.C. Kotz, Inorganic Chemistry, WB. Sanders Co. USA. 1977.
15. J. E. Huheey, Inorganic Chemistry, 3rd Edn., Harper International, 1983.

SEMESTER - II

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CHET 409*	ORGANIC CHEMISTRY - II	CORE	4	1	0	4

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UNIT-I: ADDITION REACTIONS

Addition to Carbon - Carbon Multiple Bonds: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals - regio and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds - Hydrogenation of aromatic rings and Hydroboration. Sharpless asymmetric epoxidation.

Addition to Carbon - Hetero Multiple Bonds: Steric course of addition reactions to C=O and C=N, Cram's rule, Aldol condensation, Cannizzaro, Perkin, Knoevenagel condensations, Claisen - Schmidt, Claisen, Dieckman, Benzoin and Stobbe condensations, Wittig, Grignard, Mannich, Michael reaction. Hydrolysis of Carbon-Nitrogen bond, Isocyanates and isothiocyanates.

UNIT-II: ELIMINATION REACTIONS, ESTERIFICATION AND HYDROLYSIS

Elimination Reactions: Types of elimination reactions, Mechanisms, Stereochemistry and Orientation. Hofmann and Saytzeff rules. Syn elimination versus anti- elimination, competition between elimination and substitution, factors influencing elimination and substitution reaction, dehydration, dehydrogenation, dehalogenations, decarboxylative eliminations, pyrolytic eliminations, molecular rearrangement during elimination and Fragmentation reactions.

Esterification and hydrolysis: Mechanism of hydrolysis of Esters, amides and acyl halides, Esterification of acids and trans esterification.

UNIT-III: REARRANGEMENTS

Rearrangement involving migration to electron-deficient carbon
Wagner-Merwein, Pinacol-Pinacalone, Benzil-Benzilic, Wolf rearrangements.
Rearrangement involving migration to electron-deficient nitrogen
Beckmann, Hofmann, Curtius, Lossen, Schmidt rearrangements
Rearrangement involving migration to electron-deficient oxygen
Haeyer-Villiger oxidation, Hydroperoxide rearrangement.
Rearrangement involving migration to electron-rich carbon
Favorskii, Stevens, Neber rearrangements

UNIT-IV: PHOTOCHEMISTRY

Organic Photochemistry – Fundamental concepts – Jablonski diagram – Energy transfer, characteristics of photoreactions, photoreduction and photoxidation, photoreactions of ketones and enones, Norrish Type I and II reactions. Photochemistry of alkenes, dienes and aromatic compounds, reactions of unactivated centres – Photolytic cycloadditions and photolytic rearrangements –Photosenstitisation –Photoadditions – Barton reaction – Parterno Buchi reaction.

UNIT-V: PERICYCILC REACTIONS

Concerted reactions – stereochemistry-orbital symmetry and concerted symmetry and correlation diagram –Frontier molecular orbital approach – Woodward and Hoffmann rules – Electrocyclic reactions – cycloaddition reactions – sigmatropic rearrangements – selection rules and examples with simple molecules – 1,3 and 1,5 hydrogen shifts –Cope and Claisen rearrangements.

REFERENCES

1. J. March, Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 5th edition, Wiley, 2000.
2. I.L. Finar, Organic Chemistry, Vol.II, 5th edition, ELBS 1975.
3. R.K. Bansal, Organic Reaction Mechanisms, Tata McGraw Hill, 1975.
4. R.T. Morrison and R.N. Boyd, Organic Chemistry, 6th edition, Pearson, 1992.
5. J.D. Coyle, Organic Photochemistry - Wiley, 1985.
6. J.M. Coxon, B. Halton, Organic Photochemistry, Camb. Uni. Press, 2nd edition, 1987.
7. G.R. Chatwal , Organic Photochemistry, Himalaya Publications house, 1st edition, 1998.
8. P.S. Kalsi, Stereochemistry , Wiley eastern limited, New Delhi, 1990.
9. S.H. Pine, J.B. Hendrickson, D.J. Cram and G.S. Hammond, Organic chemistry, McGraw Hill, 4th edition, 1980.
10. T.H. Lowry and K.S. Richardson, Mechanism and Theory in Organic Chemistry, Harper and Row, 1976.
11. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry, Parts A & B, Plenum, 2002.

SEMESTER – II

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CHET 410*	PHYSICAL CHEMISTRY - II	CORE	4	1	0	4

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UNIT - I BASICS OF QUANTUM MECHANICS

de-Broglie's concept of matter waves, experimental verification of matter waves, Compton effect. Heisenberg's uncertainty principle – derivation of Schrodinger wave equation - requirements of the acceptable wave function. Operators, linear operators, method of getting the following quantum mechanical operators: Position, Momentum, kinetic energy, potential energy, total energy, angular momentum. Hermicity and proving the quantum mechanical operators are hermitian operation- commutator algebra-evaluation of commutators - eigen functions and eigen values - postulates of quantum mechanics.

UNIT – II APPLICATION OF QUANTUM MECHANICS-I

Particle in a one dimensional box - quantisation of energy - normalisation of wave function - orthogonality of the particle in a one-dimensional box wave functions - average position and average momentum of a particle in a one-dimensional box - illustration of the uncertainty principle and correspondence principle with reference to the particle in a one-dimensional box -

Schrodinger wave equation for a particle in a three dimensional box and the concept of degeneracy of energy levels. Schrodinger wave equation for linear harmonic oscillator, solution by polynomial method, zero point energy and its consequence.

UNIT - III APPLICATION OF QUANTUM MECHANICS-II AND NEED FOR APPROXIMATION

Solving of Schrodinger wave equation for Rigid rotator, energy of rigid rotator, space quantization; Schrodinger wave equation for hydrogen atom, separation of variable in polar spherical coordinates and its solution, principle, azimuthal and magnetic quantum numbers and the magnitude of their values, probability distribution function, radial distribution function and shape of atomic orbitals (s, p & d).

Approximation methods applied to many electron atoms and diatomic molecules- Need for approximation methods, Schrodinger equation for He atom and other many electron atoms, the perturbation theory (first order only), the variation method, secular equation and secular determinants. Hatree-Fock self- consistent method of many electron system and its application to He atom, electron spin and pauli principle.

UNIT – IV GROUP THEORY

Symmetry elements and symmetry operation, group and its properties, Multiplication table, point symmetry groups. Schonflies symbol, representations of groups by matrices (representation for the C n, Cnv,Cnh, Dnh etc. groups to be worked out explicitly) Irreducible representation of groups, the Great Orthogonality theorem, construction of character table (C_{2V}, C_{3v} only)

UNIT – V APPLICATION OF GROUP THEORY

Symmetry of normal modes of vibrations, applications of group theory to normal modes analysis, symmetry properties of integrals, Selection rules for fundamental vibrational transition – IR and Raman activity of fundamentals in H_2O,BF_3,NH_3,N_2F_2,HCN – The rule of

mutual exclusion and Fermi resonance. Application to bonding theory – hybridization (AB_3, AB_4)

REFERENCES

1. N. Levine - Quantum chemistry, Prentice Hall of India Pvt Ltd, 1994.
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3. A. K. Chandra - Introductory quantum chemistry.
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7. K. V. Raman K V, group Theory and its application to chemistry, Tata McGraw-Hill,1994.
8. R. L. Carter, "Molecular Symmetry and Group Theory", Wiley and Sons Inc (New York), 1998.
9. G. Davidson, "Group theory for chemists", MacMillan Education Ltd (London), 1991.
10. A. Vincent, "Molecular Symmetry and Group Theory", Wiley and Sons (New York), 1977.
11. S. F. A. Kettle, "Symmetry and Structure - Readable Group Theory for Chemists", Wiley and Sons Ltd, England, 1995.

SEMESTER – II

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHET 424	NANOCHEMISTRY	CORE	4	1	0	4

UNIT – I

Nanochemistry – An Introduction: Definition of nanodimensional materials - Some historical milestones in the saga of nano forms - Size effects - Importance of Nanomaterials - Classification of Nanomaterials - Simple examples of unique properties of nanosized materials -Elementary aspects of bionanotechnology - Some important recent discoveries in nanoscience and technology.

UNIT – II

Techniques in Nanochemistry: Techniques for Characterisation of nanoscale materials (Basic aspects): Atomic force microscopy (AFM)-Transmission electron microscopy (TEM)-Resolution and scanning transmission electron microscopy (STEM) Scanning Tunneling Microscopy (STM) Scanning nearfield optical microscopy (SNOM) and surface plasmon spectroscopy.

UNIT III

Synthesis of nanomaterials: Chemical methods in preparation of nanomaterials: Sol – gel technique – co-precipitation hydrolysis –sonochemical method – combustion technique – colloidal precipitation – template process.

Inorganic Nanoparticles and Nanoporous Materials: Oxide nano particles – Oxomolybdates – Nano catalysis – Porous silicon – Transition and Non transition metal phosphates.

UNIT – IV

Carbon Clusters and Nanostructures: Nature of carbon bond − New carbon structures − Carbon clusters: Discovery of C60 − Alkali doped C60 − Superconductivity in C60 − Larger and smaller fullerenes. Carbon nanotubes: Synthesis − Single walled carbon nanotubes − Structure and characterization − Mechanism of formation − Chemically modified carbon nanotubes − Doping − Functionalizing nanotubes − Application of carbon nanotubes. Nanowires − Synthetic strategies − Gas phase and solution phase growth − Growth control − Properties.

UNIT V

Organic Films and Supramolecular Assembly: Organic films - Insulating and passivating layers – Electron transfer – Organic nanostructures – Optical properties – Organic semiconductors – Active organic devices. Polymerization – Sizes of polymers – Nanocrystals – Conductive polymers – Block co-polymers. Supramolecular structures – Transition-metal mediated types - Dendritic molecules – Supramolecular dendrimers – Micelles –Biological nanostructures – Examples of proteins.

Applications of nanomaterials: Applications of Nanoparticle in various fundamental research, industries, medical field and environmental issue; toxicity, biosafety and ethical issue in application of Nanoparticles.

REFERENCES

1. C. N. R. Rao, A. Muller, A.K. Cheetam (Eds), The Chemistry of Nanomaterials, Vol.1, and 2, Wiley – VCH, Weinheim, 2004.
2. C. P. Poole, Jr: F. J. Owens, Introduction to Nanotechnology Wiley Interscience, New Jersey, 2003.
3. Kenneth J. Klabunde (Ed), Nanoscale materials in Chemistry, Wiley- Interscience, New York, 2001.
4. T. Pradeep, Nano: The Essentials in understanding nanoscience and nanotechnology, Tata McGraw Hill, New Delhi, 2007.
5. H. Fujita (Ed.), Micromachines as tools in nanotechnology, Springer- Verlag, Berlin, 2003.
6. Bengt Nolting, Methods in modern biophysics, Springer-Verlarg, Berlin, First Indian Reprint, 2004.
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8. W. Kain and B. Schwederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, John- Wiley R Sons, New York.
9. T. Tang and P. Sheng (Eds), Nano Science and Technology – Novel Structures and Phenomena, Taylor & Francis, New York, 2004.
10. A. Nabok, Organic and Inorganic Nanostructures, Artech House, Boston, 2005.
11. J. M. Lehn, Supramolecular Chemistry – Concepts and Perspectives, V. C. H, 1995.
12. G.B. Sergeyev, Nanochemistry, Elsevier, 2007.

SEMESTER – II

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHEP 411*	PHYSICAL CHEMISTRY PRACTICAL - 1	CORE	0	0	6	3

***Effective From 2013-2014**

PURPOSE

This practical consists of experiments in chemical kinectics, conductivity, phase transition and potentiometric titrations which illustrate the underlying principles of measurement techniques, dynamics and chemical transformation.

INSTRUCTIONAL OBJECTIVES

To motivate the students to understand the principles of chemical kinectics, potentiometric and conductometric titrations.

To impart knowledge with respect to the phase transformation of different systems.

LIST OF EXPERIMENTS

1. Determination of rate constant of Acid hydrolysis of an ester.
2. Determination of energy of activation (Ea) of Acid hydrolysis of an ester.
3. Determination of Ea of saponification of Ester by conductometry method.
4. Determination of order, effective of ionic strength on rate constant of Persulphate- Iodine reaction.
5. Determination of molecular weight of substance by Transition Temperature method.
6. Determination of molecular weight of substances by Rast method.
7. Determination of Critical Solution Temperature (CST) of phenol- water system and effect of impurity on CST.
8. Study of phase diagram of two components forming a simple eutectic.
9. Study of phase diagram of two components forming a compound.
10. Study of phase diagram of three components system.
11. Determination of molecular weight of substances by cryoscopy.
12. Determination of integral and differential heat of solutions by colorimetry.
13. Determination of rate of polymerization of acrylamide.

REFERENCES

1. J. B. Yadav, " Advanced Practical Physical Chemistry". 20th edn. GOEL publishing House, Krishna Pakashan Media Ltd., (2001)
2. Findlay's "Practical Physical Chemistry" Revised and edited by B.P. Levitt 9th ed., Longman, London, 1985.
3. J. N. Gurtur and R. Kapoor, "Advanced Experimental Chemistry", Vol. I Chand & Co., Ltd, New Delhi

SEMESTER – II

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHEP415*	ORGANICCHEMISTRY PRACTICAL-II	CORE	0	0	6	3

***Effective From 2013-2014**

Quantitative analysis of organic compounds

Estimation of phenol, aniline, ketone, glucose, nitrobenzene, saponification value of an oil and Iodine value of an oil.

Preparation of organic compounds (Double stage)

a. p-bromo acetanilide from aniline (acetylation and bromination).
b. acetyl salicylic acid from methyl salicylate (hydrolysis and acetylation).
c. 1,3,5-tribromobenzene from aniline (bromination, diazotization and hydrolysation).
d. p-nitroaniline from acetanilide (nitration and hydrolysis).
e. benzillic acid from benzoin (rearrangement).
f. p-amino benzoic acid from p-nitro toluene (oxidation and reduction).
g. benzanilide from benzophenone (rearrangement).
h. p-bromoaniline from acetanilide (bromination and hydrolysis).
i. m-nitroaniline from nitrobenzene (nitration and reduction).
j. 1,2,4-triacetoxy benzene from hydroquinone (oxidation and acylation).

REFERENCES

1. A Textbook of Practical Organic Chemistry - A. I. Vogel.
2. Practical Organic Chemistry - Mann & Saunders.
3. A Handbook of Quantitative & Qualitative Analysis- H. T. Clarke.
4. Organic Synthesis Collective Volumes by Blat.
5. Reagents in Organic Synthesis by Fieser and Fieser.

SEMESTER – III

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHEP 425	INORGANIC CHEMISTRY CHEMISTRY - III	CORE	4	1	0	4

UNIT – I

General Principles of Bioinorganic Chemistry: Occurrence and availability of Inorganic elements in biological systems.
Biomineralisation: Control and assembly of advanced materials in Biology - Nucleation and crystal growth – various biominerals – calcium phosphate – calcium carbonate – Amorphous silica, Iron biominerals – strontium and barium sulphate.

Function and Transport of Alkali and Alkaline Earth Metal Ions: Characterization of K^+, Na^+, Ca^{2+} and Mg^{2+} - complexes of alkali and alkaline earth metal ions with macrocycles - Ion channels – ion pumps. Catalysis and regulation of bioenergetic processes by the Alkaline Earth Metal ions Mg^{2+} and Ca^{2+}.

Metals at the Center of Photosynthesis: Primary Processes in Photosynthesis – Photosystems I and II - Light Absorption (Energy Acquisition) – Exciton transport (Direct Energy Transfer) – Charge separation and electron transport – Manganese catalyzed oxidation of water to O_2.

UNIT – II
Cobalamines: Reactions of the alkyl cobalamins – One-electron Reduction and Oxidation – Co-C Bond Cleavage – coenzyme B12 – Alkylation reactions of methylcobalamin.

Heme and Non-heme Proteins: Hemoglobin and Myoglobin – Oxygen transport and storage – Electron transfer and Oxygen activation.Cytochromes, Ferredoxins and Rubredoxins – Model systems, mononuclear non-heme iron enzymes.

Copper Containing Proteins: Classification and examples - Electron transfer – Oxygen transport - Oxygenation – oxidases and reductases – Cytochrome c oxidase – Superoxide dismutase (Cu, Zn).
Nickel containing Enzyme: Urease.

UNIT – III
Medicinal Bioinorganic Chemistry: Bioinorganic Chemistry of toxic metals - Lead, Cadmium, Mercury, Aluminium, Chromium, Iron, Copper and Plutonium. Detoxification by metal chelation. Drugs that act by binding at the metal sites of Metalloenzymes.

Chemotherapy: Chemotherapy with compounds of certain non-essential elements. Platinum complexes in Cancer therapy – Cisplatin and its mode of action – Cytotoxic compounds of other metals – Gold containing drugs as anti-rheumatic agents and their mode of action - Lithium in Pschycopharmocological drugs. Radiopharmaceuticals – Technetium.

UNIT IV

Organometallic Chemistry: Hapticity, Ligand classification, synthesis and structure – The 18 electron rule – application and limitation- isolobal concept and its usefulness. Uses of typical organomettallics in organic synthesis. Structure and bonding in metal carbonyls (simple and polynuclear) - nitrosyl complexes – bridging and terminal nitrosyls, bent and linear nitrosyls. Dinitrogen complexes. Metallocene and arene complexes.Metal carbenes , carbynes, carboxylate anions.

UNIT – V

Reactions and Catalysis by Organomatallics: Organometallic reactions – Ligand association and dissociation – oxidative addition and reductive elimination – Insertion reactions – Reactions of coordinated ligands in organometallics - Hydrogenation, hydroformylation, epoxidation, metathesis, polymerization of olefins, olefin oxidation (Wacker process) and carbonylation of methanol.

REFERENCES:

1. J. E. Huheey, Inorganic Chemistry, 3rd Edition, Harper & Row Publishers, Singapore.
2. Purcell and Kotz, Inorganic Chemistry, Saunders Golden Sunburst Series, W. B. Saunders Company, Philadelphia.
3. S. J. Lippard and J. M. Berg, Principles of Bioinorganic Chemistry , Panima Publishing Company, New Delhi, 1997.
4. W. Kaim and B. Schewederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life , John Wiley & Sons, New York, USA, 1994.
5. Cotton and Wilkinson, Advanced Inorganic Chemistry, 5th Edition, Wiley Interscience 1. Publication, John Wiley & Sons, New York, USA, 2009.
6. Chem. Education, 62, No. 11, 1985, Bioinorganic Chemistry , State of the Art.
7. G. L. Eichorn, Inorganic Biochemistry, Volumes 1 & 2, 2nd Edition, Elsevier Scientific Publishing Company, New York, 1973.
8. F. A. Cotton and G. Wilkinson, Basic Inorganic Chemistry, John Wiley & Sons, New York, 3rd Edition, 1995.
9. R. H. Crabtree, The Organometallic Chemistry of the Transition Metals, John Wiley & Sons, New York, 4th Edition, 2005.
10. S. E. Kegley and A. R. Pinhas, Problems and Solutions in Organometallic Chemistry, University Science Books, Oxford University Press, 1986.
11. A. J. Pearson, Metalloorganic Chemistry. Wiley, 1985.
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15. B. Douglas, D. H. McDaniel and J. J. Alexander, Concepts and Models of Inorganic Chemistry, 2nd Edition, John Wiley & sons, New York, 1985.
16. Oxford Chemistry Primers Series, No. 12, M. Bochmann Organometallics 1: Complexes with transition metal-carbon σ bonds and No. 13 M. Bochmann Organometallics 2: Complexes with transition metal-carbon π-bonds., 1994.
17. J. P. Collman, L. S. Hegedus, J. R. Nortan and R. G. Finke, Principles and Applications of Organotransition Metal Chemistry, University Science Books. Mill Valley, California, 1980.
18. R. Hoffmann, Angew. Chem. Int. Edition, Engl. 21, 711-800 1982.

SEMISTER - III

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHET 413*	ORGANIC CHEMISTRY - III	CORE	4	1	0	4

***Effective From 2013-2014**

UNIT-I UV-VISIBLE SPECTROSCOPY

Various electronic transitions - Effect of solvent on electronic transitions - Ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes and conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds - Ultraviolet spectra of aromatic and heterocyclic compounds - Steric effect in biphenyls.

UNIT-II: IR SPECTROSCOPY

Charecteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines - Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance.

UNIT-III: H^1 NMR SPECTROSCOPY -I

Nuclear spin - Nuclear resonance - Saturation, shielding of magnetic nuclei - Chemical shifts and its measurements - Factors influencing chemical shift - Deshielding - Spin-spin interactions - Factors influencing coupling constant 'J' - Classification (ABX, AMX, ABC, A_2B_2 etc.) - Spin decoupling - Basic ideas about instrument - FT-NMR - Advantages of FT-NMR.

UNIT –IV H^1 NMR SPECTROSCOPY -II and ^{13}C NMR SPECTROSCOPY

H^1 NMR Spectroscopy: Shielding mechanism - Mechanism of measurement - Chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines and amides) - Chemical exchange - Effect of deuteration - Complex spin-spin interaction between two, three, four and five nuclei (First order spectra) - Virtual coupling. Stereochemistry - Hindered rotation - Karplus curve variation of coupling constant with dihedral angle. Simplification of complex spectra: nuclear magnetic double resonance - Contact shift reagents - Nuclear overhauser effect (NOE).

^{13}C-NMR Spectroscopy: General considerations - Chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon) - Coupling constants.

UNIT – V MASS SPECTROMETRY

Mass Spectrometry

Introduction - Ion production - Types of ionization; EI, CI, FD, and FAB - Factors affecting fragmentation - Ion analysis - Ion abundance. Mass spectral fragmentation of organic compounds - Common functional groups - Molecular-ion peak - Metastable peak - Mc. Lafferty rearrangement. Nitrogen rule - Isotope labeling - High resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

REFERENCES

1. C.N. Banwell, Fundamentals of molecular Spectroscopy, 3rd ed., TMH, New Delhi, 1983.
2. B.P. Straughan and S.Walker, Spectroscopy, Vol.3, Chapman Hall, London, 1976.
3. G.M. Barrow, Introduction to Molecular Spectroscopy, McGraw Hill, New York, 1964.
4. P.K.Ghosh, Introduction to Photoelectron Spectroscopy, John Wiley New York, 1989.
5. P.M. Silverstein, F. X. Wester, Spectroscopic Identification of Organic Compounds, 6th ed., Wiley 1998.
6. W. Kemp, Organic Spectroscopy, 3rd Ed., MacMillon, 1994.
7. J.R. Dyer, Applications of Absorption Spectroscopy of Organic Compounds, Prentice Hall, 1965.
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9. P.S.Kalsi, Spectroscopy of Organic Compounds, 6th Edition, New age international publishers, 2007
10. Clegg,W., Crystal structure determination, Oxford University press , New York,1998.
11. Stout,G.H., Jensen , L.H. X-ray structure determination : A practical guide , John wiley & sons Publication: New York,1989
12. Glusker, J.P., Trueblood,K.N. Crystal structure analysis: A primer., Oxford university press, New York, 1972.

SEMESTER – III

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHET 426	PHYSICAL CHEMISTRY - III	CORE	4	1	0	4

UNIT I CHEMICAL THERMODYNAMICS

Thermodynamics of systems of variable composition-Partial molar quantities, partial molar volume, experimental determination: Chemical potential, Gibbs-Duhem equation. Thermodynamic properties of real gases- fugacity concept, determination of fugacity of real gases. Activity concept for condenses states, choice of standard states, experimental methods to determine activity of non- electrolytes. Thermodynamic equation of state- Derivation and their application to real gases – Calculation of JT, (dH/dP) T and (dE/dV)T for real gases. Third law of thermodynamics- purpose, formulation (Planck, Lewis and Randall)- thermodynamic properties at absolute zero- calculation of absolute entropies- apparent exception to the third law.

UNIT II STATISTICAL THERMODYNAMICS

Aims of statistical thermodynamics, definition of state of a system, ensembles (microcanonical and canonical) Boltzmann distribution law and its derivation. Boltzmann-Planck equation: partition functions, thermodynamic properties from partition functions, partition function and equilibrium constant; Quantum statistics- Fermi Diac and Bose-Einstein statistics, photon gas, electron gas according to such statistics: population inversion, negative Kelvin temperature, einstein's and Debye's theories of heat capacities of solids. Nuclear spin statistics-statistical basis of entropy of H_2 gas- ortho and para nuclear states-Calculation of entropy in terms of ortho- para ratio – residual entropy of H_2 at 0 K.

UNIT III MOLECULAR SPECTROSCOPY – I

Time –Dependent States and Spectroscopy : Absorption and Emission of radiation-Selection rules- Line shapes and widths- Fourier Transform spectroscopy.

Rotation and Vibration of Diatomic Molecules: Rigid Rotor and harmonic oscillator wave functions and energies-Selection rules-A review of MW and IR spectroscopy-Diatomic molecule wave functions- Symmetry properties and nuclear spin effects- Raman effect: Rotational and vibration-rotational transitions-Polarization of Raman lines- Vibration of polyatomic molecules- normal coordinates.

UNIT-IV MOLECULAR SPECTROSCOPY II

Electronic Spectroscopy: Electronic spectroscopy of diatomic molecules- Franck-Condon factor- Dissociation and pre-dissociation-Rotational fine structure-Lasers and Laser spectroscopy- XPS-PES

Magnetic Resonance: Review of angular momentum-commutation relations-Basic principles and relaxation times-Magnetic resonance spectrum of hydrogen-First –order hyperfine energies-NMR in liquids-Chemical shifts and spin-spin couplings.

CW NMR: The spectrometer-Multiscan Principle (CAT)

FT NMR: Rotating frame of reference-Effect of rf pulse- FID- Multipulse operation-Measurement of T_1 **by inversion recovery method** – Spin echo and measurement of T_2

UNIT-V SURFACE PHENOMENON AND CATALYSIS

Specific and general acid-base catalysis. Bronsted catalysis law. Acidity functions. Enzyme catalysis (single substrate reactions only). Michaelis-Menton kinetics. Influence of PH and temperature on enzyme catalysis. Surface Phenomenon and Heterogeneous catalysts Adsorption and free energy relation at interfaces. Gibb's adsorption isotherm. Physisorption and chemisorption. Adsorption isotherms (Langmuir and BET). Measurement of surface area. Kinetics of heterogeneous catalysis (Langmuir Hinshelwood mechanism and Eley-Rideal mechanism). Semi conductor catalysis

REFERENCES

1. Glasstone S, Thermodynamics for chemists, Affiliated East - West press, New Delhi, 1960.
2. Rajaram J and J.C. Kuriacose, Thermodynamics for chemistry, Shoban Lal Nagain Chand, New Delhi, 1986.
3. C.N. Banwell and E.M. Mc Cash, Fundamentals of Molecular Spectroscopy, 4th edition (1994), Tata McGraw Hill, New Delhi.
4. J.M. Hollas, Modern Spectroscopy, 4th edition (2004), John Wiley & Sons, Ltd., Chichester.
5. R.K.Harris, Nuclear Magnetic Resonance Spectroscopy, (1986) Addison Wesley, Longman Ltd, London.
6. Moore.W.J. Basic Physical Chemistry, Prentice Hall, 1986.

SEMESTER – III

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHEP 427	INORGANIC CHEMISTRY PRACTICAL – II	CORE	0	0	6	3

Objectives

To enable the learners to synthesis and characterization of the inorganic complexes.

I. Quantitative analysis:

Separation and estimation of mixtures by volumetric and gravimetric methods: some typical recommended mixtures are:

1. Cu-Ca
2. Cu-Ni
3. Cu- Fe
4. Cu-Zn
5. Ba-Ca
6. Ag-Cu
7. Ni-Zn.

II. Inorganic preparations:

Preparation and characterization of at least 5 inorganic complexes.

1. *tris*-triphenylphosphine copper(I) nitrate
2. tris-acetylacetonato iron (III)
3. *cis* and *trans*-dichloro bis (ethylenediamine) cobalt (III) chloride
4. bispyridine iodide nitrate
5. trans-bis glycinato copper(II)

III. Spectrophotometric estimation of any five out of
Cu, Mn, NO_2, Ni, P, Fe, V, Ti, Cr, Co.

IV. Estimation of metal ion by flame photometry.

References:

1. J. Bassett *et al,* Text Book of Quantitative Chemical Analysis", 5th Edition, ELBS, Longmann, U.K., 1989.
2. Vogels Textbook of Quantitative Chemical Analysis, 6th Edition, 2002.
3. Advanced Practical Inorganic Chemistry, Gurdeepraj, Goel Publishing House, 2001.
4. An Advanced Course in Practical Chemistry, A.K. Nad, B. Mahapatra, A. Ghosal, New Central Book Agency, 2004.

SEMESTER – III

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHEP 428	PHYSICALCHEMISTRY PRACTICAL - II	CORE	0	0	6	3

PURPOSE

This practical consists of experiments in chemical kinectics, conductivity, phase transition and potentiometric titrations which illustrate the underlying principles of measurement techniques, dynamics and chemical transformation.

INSTRUCTIONAL OBJECTIVES

To motivate the students to understand the principles of Thermochemistry, Chemical kinectics and Colligative Properties

To impart knowledge about the composition of mixture using phase equilibria.

LIST OF EXPERIMENTS

1. Determination of the heat of neutralization of HCl with NaOH.
2. Determination of heat of ionisation of a weak acid.
3. Determination of molal depression constant of a salt hydrate.
4. Determination of partition coefficient for the distribution of iodine between carbon tetrachloride and water.
5. Phase diagram of the naphthalene – biphenyl system- composition of the given mixture
6. Determination of coefficient of viscosities of different liquids.
7. Determination of dissociation constant of weak acids by conductometry.
8. Determination of precipitation reaction by conductometry.
9. Determination of dissociation constant of weak acids by potentiometry.
10. Determination of relative strength of two acids by conductance measurements.
11. Determination of pH of a buffer solution using a quinhydrone electrode.
12. Determination of equivalent conductance, degree of dissociation and dissociation constant of weak acid by conductometry.

REFERENCES

1. J. B. Yadav, " Advanced Practical Physical Chemistry". 20th edn. GOEL publishing House, Krishna Pakashan Media Ltd., (2001)
2. Findlay's "Practical Physical Chemistry" Revised and edited by B.P. Levitt 9th ed., Longman, London, 1985.
3. J. N. Gurtur and R. Kapoor, "Advanced Experimental Chemistry", Vol. I Chand & Co., Ltd, New Delhi.

SEMESTER - III

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHEE 429	SYNTHETIC ORGANIC CHEMISTRY AND CHEMISTRY OF NATURAL PRODUCTS	ELECTIVE	4	0	0	4

UNIT I TERPENOIDS AND CAROTENOIDS

Classification, nomenclature, occurrence, isolation, general methods of structure determination and isoprene rule.
Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Geraniol, Terpineol, Farnesol, Zingiberene and Abietic acid

UNIT II ALKALOIDS

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring and role of alkaloids in plants.
Structure, stereochemistry, synthesis and biosynthesis of the following: Ephedrine, Nicotine, Atropine, quinine and morphine.

UNIT III STEROIDS

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of cholesterol, bile acids, androsterone, testosterone, estrone, progesterone, aldosterone. Biosynthesis of steroids.

UNIT IV MODERN SYNTHETIC METHODS:

Baylis-Hillman reaction, Henry reaction, Nef reaction, Kulinkovich reaction, Ritter reaction, Sakurai reaction, Tishchenko reaction and Ugi reaction. Brook rearrangement; Tebbe olefination. Metal mediated C-C and C-X coupling reactions: Heck, Stille, Suzuki, Negishi and Sonogashira, Nozaki-Hiyama, Buchwald-Hartwig, Ullmann coupling reactions, directed ortho metalation.

UNIT V RETROSYNTHETIC ANALYSIS

Basic principles and terminology of retrosynthesis, synthesis of aromatic compounds, one group and two group C-X disconnections, one group C-C and two group C-C disconnections, amine and alkene synthesis, important strategies of retrosynthesis, functional group transposition, important functional group interconversions.
Protecting groups: Protection and deprotection of hydroxy, carboxyl, carbonyl, carboxy amino groups and carbon-carbon multiple bonds; chemo- and regioselective protection and deprotection; illustration of protection and deprotection in synthesis.

REFERENCES

1. F. A. Cary and R. I. Sundberg, Advanced Organic Chemistry, Part A and B, 5th Edition, Springer, 2009.
2. M. B. Smith, Organic Synthesis, 2nd Edition, 2005
3. S. Warren, Organic Synthesis, The disconnection Approach, John Wiley & Sons, 2004.
4. J. Tsuji, Palladium Reagents and Catalysts, New Perspectives for the 21st Century, John Wiley & Sons, 2003.
5. I. Ojima, Catalytic Asymmetric Synthesis, 2nd edition, Wiley−VCH, New York, 2000.
6. W. Carruthers, Modern Methods of Organic Synthesis, Cambridge University Press, 1996.
7. J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, Oxford University Press, 2001.
8. R. Noyori, Asymmetric Catalysis in Organic Synthesis, John Wiley & Sons, 1994.
9. L. Kuerti and B. Czako, Strategic Applications of named Reactions in Organic Synthesis, Elsevier Academic Press, 2005.
10. I.L. Finar, Organic chemistry, Vol-I, 6th Edition, Pearson, 2002.
11. Organic Chemistry -Natural products,O.P.Agarwal, Vol –I,40th ed. and Vol.II, 38th ed.,2010

SEMESTER – III

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHEE 430	PHARMACEUTICAL CHEMISTRY	ELECTIVE	4	0	0	4

UNIT I
DRUGS AFFECTING THE CENTRAL NERVOUS SYSTEM:-

Sedatives and Hypnotics-
Barbiturates (structure-activity-relationship and metabolism);
benzodiazepines (structure-activity-relationship and metabolism); miscellaneous compounds. Synthesis of Phenobarbital, hexobarbital, nitrazepam and oxazepam.

UNIT-II

Anaesthetics:
General anesthetics; local anesthetics- Mode of action, structure-activity relationships. Synthesis of methohexital and chloro-procaine.

Expectorants: Codeine phosphate and Papaverine hydrochloride.

UNIT-III

Antibiotics: Preparation of semi-synthetic penicillin, conversion of penicillin into cephalosporin, general account of tetracycline and macrocyclic antibiotics (no synthesis)

Antimalarials: Trimethoprim

Analgesic and antipyretics: Paracetamol, Meperidine, methadone, aminopyrine

UNIT IV

Anti-inflammatory: Ibuprofen, Oxyphenyl butazone, diclophenac, indomethacin
Antitubercular and antileprotic: Ethambutol, Isoniazide and dapsone
Anaesthetics: Lidocaine, thiopental
Antihistamines: Phenobarbital, diphenylhydramine
Tranquilizers: Diazepam,Trimeprazine
Anti AIDS: General study

UNIT V

Cardiovascular: Synthesis of dilliazem, quinidine, methyldopa, atenolol, oxyprenol

Antineoplastic drugs: Cancer chemotherapy, synthesis of mechlorethamine, cyclophosphamide, mephalan, uracils, mustards. Recent deveoplments in cancer chemotherapy

REFERENCE

1. Robert F.dorge Wilson and Gisvod. Textbook of organic Medicinal and Pharmaceutical Chemistry.
2. Ed. M.E. Wolff, John wiley. Berger's Medicinal Chemistry and drug discovery, Vol-I.
3. J.Faprhop and G.Penzillin. Organic synthesis-concept, method and starting material.
4. Eds.Korolkovas and Burkhattar J.H. John Wiley & sons. Essentials of medicinal Chemistry.
6. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill.
7. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed Robert F. Dorge
8. Trease and Evans, Pharmacognosy, 15 Edition, Elsevier.
9. Chemistry of natural products by S.V.Bhat, B.A.Nagasampegi, Springer publications. New York.
10. Finar, Organic Chemistry, Vol-I
11. Drug Discovery and Evaluation, Pharmacological assays, H.Gerhard Vogel, 2 nd edition, Springer publications,
12. Quality Control of Herbaldrugs, An approach to evaluation of botaniocals, by Pulok Mukherjee, Business Horizon Publications.
13. Pharmacognosy and Pharmacobiotechnology, by Ashutosh Kar, New age International publications.
14. Role of Biotechnology in Medicinal and Aromatic plants, Vol-XIII, Ukaaz Publications, Hyderabad.
15. Supplement to cultivation and utilization of medicinal plants, S.S.Handa and M.K.Kaul, RRL Jammu.
16. Chemistry of Natural Products, by O.P.Agarwal, Vol-I & II.

SEMESTER – IV

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHEE 431	**POLYMER CHEMISTRY**	ELECTIVE	4	0	0	4

UNIT – I

Basic concepts of Polymer Science: Molecular forces and chemical bonding in polymers – Classification of polymers – Chain polymerization – Step polymerization – polymerization techniques.

Molecular weight and size: Average molecular weight – Number – average and weight – average molecular weights – Sedimentation and Viscosity – Degree of polymerization – size of polymer molecular.

UNIT – II

Kinetics of Polymerization: Free radical chain polymerization- Cationic polymerization – Anionic polymerization – Poly condensation. Glass transition temperature: Glassy solids and Glass transition – associated properties – Factors influencing glass transition temperature – molecular weight – Plasticisers – melting point – importance of glass transition temperature.

UNIT - III

Crystalline Nature: Crystalline soils and their behaviour towards X-rays – Polymers and X-ray diffraction – Degree of crystallinity – crystallites –factors affecting crystallinity, Helix structures.

Copolyemerization: Free radical copolymerization – Ionic copolymerization – Copolycondensation – Individual monomers: Polyethylene, polypropylene, polystyrene, poly acrylonitrile, polymethyl methacrylate, polyesters, polycarbonates, polyamides, polyurethanes, polyvinyl acetate, polyvinyl chloride, poly isoprenes, silicone polymers.

UNIT – IV

Polymer degradation: Types of degradation, thermal and mechanical – photo degradation – oxidative and hydrolytic degradation. Polymer reactions – Hydrolysis, acidolysis, aminolysis, hydrogenation, addition and substitution reactions – cyclisation, cross-linking reactions – Graft and Block copolymers.

UNIT - V

Experimental methods: Polymer synthesis, isolation and purification of polymers – Fractional - Molecular weight determination – Molecular weight distribution curve – determination of glass transition temperature. Elastomeric materials – Fibre forming materials – Plastic material Rheology of polymeric materials – compounding and processing techniques.

REFERENCES:

1. 'Polymer Science', V.R.Gowariker et.al., Wiley Eastern,1986.
2. 'Organic Polymer Chemistry', K.J.Saunders, Chapman and Hall, 1976.
3. 'Polymer Chemistry – An Introduction', Raymond B.Seymour, Marcel Dekker Inc., New York and Based, 1981.

4. ‘Text Book of Polymer Science’, Fred W.Billmeyer, Jr.John-Wiley and Sons, 3rd Edn., 1984.
5. ‘Fundamentals of Polymer Science and Engineering’, Kumar Gupta, Tata Mc Graw Hill, 1981.
6. “Polymer Characterization of Processing Technolgy’, Stepak, Academic Press, London.
7. ‘Inorganic Polymers’, Stone, Academic Press, New York.
8. Polymer Chemistry, B.K.Sharma, Krishna Prakashan Mandir, Meerut.

SEMESTER – IV

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHEE 432	NUCLEAR AND RADIATION CHEMISTRY	ELECTIVE	4	0	0	4

UNIT I

Systematic of alpha, beta and gamma decays: Alpha decay, energy curve, spectra of alpha particles, Giger-Nuttal law, theory of alpha decay, penetration of potential barrier, beta decay, range of energy relationship, beta spectrum, sergeants curve, Fermi theory of beta decay, matrix elements, allowed and forbidden transitions, curie plots, gamma decay, Nuclear energy levels, selection rule, isomeric transitions, Internal conversion, Auger effect.

Nuclear Structure and Stability: Binding energy, empirical mass equation, The nuclear models, the liquid drop model, the shell model, the Fermi gas model & collective nuclear model, nuclear spin, parity & magnetic moments of odd mass numbers nuclei.

UNIT II

Nuclear reaction: Introduction, Production of projectiles, nuclear cross section, nuclear dynamics, threshold energy of nuclear reaction, Coulomb scattering, potential barrier, potential well, formation of a compound nucleus, Nuclear reactions, direct Nuclear reactions, heavy ion induced nuclear reactions, photonuclear reactions.

Nuclear fission: Liquid drop model of fission, fission barrier and threshold, fission cross section, mass energy and charge distribution of fission products, symmetric and A symmetric fission, decay chains and delayed neutrons.

Radioactivity: Recapitulation, types of radioactive decay, decay kinetics, radiation detection and measurement (G. M. and Scintillation Counter)

UNIT III

Reactor Theory: Nuclear fission as a source of energy, Nuclear chain reacting systems, critical size of a reaction, research reactors, graphite moderated, heterogeneous, enriched uranium reactors, light water moderated, heterogeneous, enriched uranium reactors, water boilers enriched aq. Homogeneous reactors, Thermonuclear reactors, gamma interactions, shielding and health protection. Reactors in India.

Nuclear Resources in India: Uranium and Thorium resources in India and their extractions, Heavy water manufacturing in India.

UNIT IV

Radio Isotopes: Isotope separation, thermodynamic and kinetic isotope effects, isotope exchange reaction kinetics, determination of exchange rate constant, production of radio isotopes.

Elements of radiation chemistry: Interaction of ionising radiation with matter, units for measuring radiation absorption and radiation energy, radiation dosimetry, radiolysis of water and aqueous solutions.

Biological effects of Radiation: Introduction, genetic and somatic effect on human being, effect of radiation on plants and aquatic Environment.

Radiochemical Separation: The need of radiochemical separation techniques, carrier techniques, isotope and nonisotopic carriers, co precipitation and adsorption, ion exchange, solvent extract, electrolytes behavior of carrier free tracer radionuclide.

UNIT V

Principle of tracer chemistry: Application of tracers in physiochemical studies, diffusion studies, isotopic and exchange reactions, tracer in the study of the mechanism of the inorganic chemical reaction, atom transfer & electron transfer mechanisms. Heterogeneous catalysis and surface area measurements, radio carbon dating, tracer studies with tritium, application in metallurgy and preservation of food, geochemical application and hot atom chemistry.

Radiation detection and measurements: Ionization current measurements, multiplicative ion collector, methods not based on ion collection, auxillary Instrumentation and health physical instruments and counting staticsits.

Applications of radioisotopes: General principles of using radioisotopes, applications of radiotracers in Physicochemical constants - diffusion coefficient, surface area, solubility, stability constant. Chemical pathways - kinetic studies, inorganic reactions, organic reaction, biosynthesis, polymerization. Trace analysis of elements and compounds - neutron activation analysis, isotope.

REFERENCES:

1. Friedlander, Kennedy and Miller, Nuclear and Radio Chemistry: John Wiley
2. B.G. Harvey, Nuclear Chemistry
3. Hassinsky: Translated by D.G. Tuck, Nuclear Chemistry and its application: Addison Wiley.
4. B.G. Harvey, Introduction to Nuclear Physics and Chemistry.
5. Maeclefort: Nuclear Chemistry: D.Van Nostrand.
6. An N.Nesmeyannoy: Radiochemistry: Mir.
7. Jacobs et al: Basic Principles of nuclear Science and Reactors, V.Nost & EWAP
8. N.Jay: Nuclear Power Today Tomorrow: ELBS
9. Kenneth: Nuclear Power Today, Tomorrow: ELBS
10. Essentials of Nuclear Chemistry, W.J. Arnikar, John Wiley
11. Nuclear and Radiation Chemistry: B.K. Sharma, Krishna Publication
12. A Introduction to Nuclear Physics: R. Babber. And Puri Friendlander, Kennedy & Miller, Nuclear and radio Chemistry, ohm Wiley.
13. B.G. Harvey, Nuclear Chemistry.
14. Haissinsky, Translated by D.G. Tuck, Nuclear physics and Chemistry.
15. Mark lefort, Nuclear Chemistry, D.V. Nostrand.
16. An N.Nesmeyanov, Radiochemistry, Mir.
17. Jacobs, et al, Basic Principles of nuclear science and reactors, V.Nost, EWAP.
18. N.Jay, Nuclear power, today tomorrow, ELBS.
19. Kenneth, Nuclear power, today and tomorrow, ELBS.
20. Essentials of Nuclear Chemistry, J.Arnikar, John Wiley.
21. D.C. Dayal, nuclear physics.
22. Essentials of Nuclear Chemistry, H. J. Arnikar, 4th Edition Wiley Eastern (1987).
23. Chemical Applications of Radioisotopes, H. J. M. Bowen. Buttler and Tanner (1969).
24. Introduction of Nuclear and Radiochemistry, G Friedlander, T. W. Kennedy, E. S. Macias and J. M. Miller, 3rd Edition, John Wiley (1981).

SEMESTER – IV

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHEE 433	ENVIRONMENTAL CHEMISTRY	ELECTIVE	4	0	0	4

UNIT I

Energy and Environment: Energy resources and their exploitation, Sun as source of energy-nature of its radiation, Conventional energy sources: coal, oil, biomass and nature gas, non-conventional energy sources: hydroelectric power, tidal, wind, geothermal energy, solar collectors, photovoltaic, solar ponds, nuclear-fission and fusion, magneto-hydrodynamic power (MHD), Energy use pattern in different parts of the world and its impact on the environment. CO_2 emission in atmosphere. Mechanism of radiation action on living systems-Stochastic and Non-stochastic effects; delayed effects, radioactivity from nuclear reactors, fuel processing and radioactive waste, hazards related to power plants, terrestrial and non terrestrial radiation, dose from environment and nuclear radiations, ultraviolet radiations, pathways analysis and dose assessment, radiologic age dating, radioactivity risk assessment, criterion for safe exposure.

UNIT II

Ecosystem, Biodiversity and its Conservation: Biodiversity concepts and patterns, Microbial diversity, Plant diversity, Agrobiodiversity, Soil biodiversity, Economic value of biodiversity, biodiversity losses. Biodiversity hotspots and their characteristic flora and fauna, threatened plants and animals of India, ecosystem people and traditional conservation mechanisms, Biodiversity Convention and Biodiversity Act, IPRs, national and international programmes for biodiversity conservation. Wildlife values and eco-tourism, wildlife distribution in India, problem in wildlife protection, role of WWF, WCU, CITES, TRAFFIC, Wildlife Protection Act 1972. In-situ conservation: sanctuaries, biospheres reserves, national parks, nature reserves, preservation plots. Ex-situ conservation: botanical gardens, zoos, aquaria, homestead garden; herbarium; In-vitro Conservation: germplasm and gene Bank; tissue culture: pollen and spore back, DNA bank.

UNIT III

Energy Resources and maintenance: Renewable and non-renewable energy resources, growing energy need, sun as source of energy, solar radiation and its spectral characteristics, fossil fuels classification, com position. Physico-chemical characteristics and energy content of coal, petroleum and natural gas. Principle of generation and conservation of conventional and non-conventional energy. Energy from biomass and biogas, an aerobic digestion, energy use pattern and future need projection in different parts of the world, energy conservation policies.

UNIT IV

Solid and Hazardous Waste Management: Solid wastes: Definition, types, sources, characteristics, and impact on environmental health. Waste generation rates. Concepts of waste reduction, recycling and reuse. Collection, segregation and transport of solid wastes Handling and segregation of wastes at source. Collection and storage of municipal solid wastes. Solid waste processing technologies. Mechanical and thermal volume reduction. Biological and chemical techniques for energy and other resource recovery. Composting,

Vermicomposting, Incineration of solid wastes. Disposal in landfills: site selection, design, and operation of sanitary landfills; secure landfills and landfill bioreactors; leachate and landfill gas management; landfill closure and post-closure environmental monitoring; landfill remediation. Hazardous wastes: Definition, sources and characteristics: Hazardous waste categorization, generation, collection, transport, treatment and disposal. Legislation on management and handling of municipal solid wastes and hazardous wastes.

UNIT V

Social issues: Urban issues - Energy - water conservation - Environmental Ethics - Global warming -Resettlement and Rehabilitation issues - Environmental legislations - Environmental production Act. 1986 - Air, Water, Wildlife and forest conservation Act - Population growth and Explosion - Human rights and Value Education - Environmental Health - HIV/AIDS - Role of IT in Environment and Human Health - Women and child welfare - Public awareness.

REFERENCES

1.Environmental Chemistry : B.K. Sharma, and H. Kaur.
2.Elements of Environmental Chemistry : H.V. Jadhav.
3.Environmental Chemistry : S. K. Banerjee.
4.Environmental Chemistry : J. W. Moore and E. A. Moore.
5.Destruction of hazards chemicals in the laboratory : G. Lunn and E.B. Sansone.
6. A text book of Environmental Chemistry and Pollution Control : S.S. Dara.
7.Environmental Pollution Analysis : Khopkar.
8.Environment Chemistry : A. K. de
9.Environmental Chemistry : M. Satake, ., Do, S. Seth i, S.A. Eqbal.
10. Environmental and Man : The Chemical Environmental : J. Lenihan and W.W. Fletcher.

SEMESTER – IV

SUBJECT CODE	TITLE OF COURSE	CORE/ELECTIVE	CREDITS			
			L	T	P	C
CHEE 434	INDUSTRIAL CHEMISTRY	ELECTIVE	4	1	0	4

UNIT I

Raw Materials and Energy for Chemical Industry

Raw materials – Characteristics of raw materials and their resources – methods of raw material concentrations – integral utilization of raw materials.

Energy for chemical industry – Fuels – classification of fuels – coal – fuel gases and liquid fuels – petroleum – cracking – Octane number – cetane number – composition and uses of coal gas, water gas, producer gas, oil gas and gobar gas.

UNIT II

Surfactants, Explosives, Pesticides

Surfactants: Classification with examples, Adsorption and micelle formation, Manufacture of anionic, cationic, zwitterionic and nonionic detergents, Applications in industries Applications as Foaming agent, Wetting agent, Dispersant, Solubilizers, Emulsifiers and Rheology modifiers, Detergent formulations, Detergent biodegradation, Biosurfactants.

Explosives: classification, characteristics, preparation of nitrocellulose-T.N.T, Picric acid, Dynamite-cordite and Gunpowder, Dynamite, HMX, PETN, Cyclonite, plastic explosives, gelatin, RDX, cordite and seismic explosives, propellants - manufacture of liquid and solid propellants - hydrazine, incendiaries and smoke screens. Industrial applications.

Pesticides: Introduction, classification, synthesis of few common pesticides of chlorinated (DDT, BHC, Chlordane, Aldrin), organophosphorus and carbamate (parathion, malathion, carbaryl) compounds family, Plant pesticides, Pesticide formulations.

UNIT III

Cement, Ceramics, Polymeric Materials, Glass, paints and Fertilizers: Cement: Manufacture – Wet Process and Dry process. Types, Analysis of major constituents, setting of cement, reinforced concrete. Cement industries in India.

Ceramics: Important clays and feldspar, glazing and verification.

Polymeric Materials: Industrial polymers(Thermoplastics polymers and thermosetting Polymers) and composite materials – their constitutions,chemical and physical properties, Industrial applications.

Glass: Types, Composition, manufacture of Optical glass, colored glasses, lead glass and neutron absorbing glass.

Fertilizers: Fertilizer industries in India, Manufacture of ammonia, ammonium salts, urea, superphosphate, triple superphosphate and nitrate salts.

Paints: Components of paints, pigments, thinner, binder, types of paints, water based paints, drying of paints

UNIT IV

Industrial Chemical Analysis.

1**.** Sampling procedures, sampling of bulk materials, techniques of sampling – solids, liquids and gases. Collection and processing of data.

2. Chromatography: Principles, working and applications of – paper chromatography, TLC, GLC, HPLC.

3. Particle size determination, rheological properties of liquids, plastics and their analysis.
4. Modern Instrumental Methods of analysis –
UV-visible spectroscopy-IR spectroscopy and non-dispersive IR-Raman spectroscopy-NMR Spectroscopy-Electron spin resonance spectroscopy-Atomic absorption spectroscopy-Flame photometry-Neutron diffraction-X-ray fluorescence-Ion chromatography

UNIT V

Industrial Hygiene and Chemical Safety

(a) Industrial hygiene: Concept, air and biological monitoring, occupational disease, operational control measures, personal protective equipments; (b) Industrial hazards and Safety: Process hazards checklists, hazard surveys, safety program, Hazop safety reviews. (c) Industrial pollution: Classification of hazards chemicals, storage, transportation, handling, risk assessments, challenges/solutions (d) Eco-friendly effluents disposal: Water pollutants, health hazards, sampling and analysis of water, water treatment, different industrial and domestic effluents and their treatment and disposal, advanced waste water treatment, effluent quality standards and laws, chemical industries, tannery, dairy, textile effluents, common treatment.

REFERENCES

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2. A.K.De., Environmental Chemistry, Wiley Eastern Ltd., 11 edn., Meerut 1989. Chs 5-7
3. B.K Sharma – Industrial chemistry – Goel publishing house.
4. R.Norris Shreve and J.A.Brink, Jr. Chemical Process Industries. IV edn., McGraw Hill, Tokyo, 1977.
5. B.N.Chakrabarty, Industrial Chemistry, Oxford & IBH Publishing Co., New Delhi, 1981.
6. P.P.Singh, T.M.Joseph, R.G.Dhavale, College Industrial Chemistry, Himalaya Publishing House, Bombay, 4th edn., 1983.
7. Chemical Process Industries by R. N. Shreve.
8. Dryden's outlines of Chemical Technology by M. Gopal Rao and Marshall
9. Spectroscopic identification of organic compounds, R.M. Silverstein, G. Basslar and T.C. Morrill, sixth edition,
10. Organic Spectroscopy, William Kemp, third edition
11. Spectroscopy of organic compounds, P.S. Kalsi,
12. Advanced organic chemistry, Bahl and Arun Bahl, third edition
13. Industrial Chemicals by Faith, Keyes, Clark.
14. Riegel's Hand-Book of Industrial Chemistry, Ed. by James A. Kent
15. Hand book of industrial chemistry Vol I & II K. H. Davis & F.S. Berner Edited by S.C. Bhatia, CBS publishers
16. Industrial Chemistry by B.K.Sharma
17. Industrial Pollution Control and Engineering. Swamy AVN, Galgotia publications