UNIVERSITY OF RAJASTHAN
JAIPUR

SYLLABUS

M.SC. CHEMISTRY

Semester Scheme

I/II Semester Examination 2018-19
III/IV Semester Examination 2019-20
Credit-based Semester System with continuous assessment.

To acquire a Master degree in Chemistry, a candidate is required to earn minimum of 120 credits with grade E or higher.

Credit registration at least once in all Compulsory Credit Course (CCC) and earning all credits for accumulation of the prescribed minimum credit with grade E or higher grade in all CCC will be binding.

SCHEME OF EXAMINATION:

- Each Semester shall have continuous assessment which shall include internal assessment in theory and practical by internal examination/seminar/oral examination/viva-voce etc, besides assessment of candidate’s regularity and performance in the class.
- A candidate has to pass in the continuous assessment as well as EoSE (End of Semester Examination) paper separately.
- Each EoSE of theory paper shall carry 100 marks and will be of 3 hours duration. Candidate has to attempt five (05) questions in all. All questions carrying equal marks.
- Part ‘A’ of the theory paper shall contain 10 Short Answer Questions of total 20 marks, based on knowledge, understanding and applications of the topics/texts covered in the whole syllabus. Each question will carry two (02) marks for correct answer.
- Part ‘B’ of the theory paper will have total four questions of 20 marks each, framed by taking one question from each unit with internal choice. The limit of answer will be five pages.
- Each Laboratory EoSE will be of six hours durations and involve laboratory experiments/exercises, record and viva-voce examination with weightage in ratio of 75:25.
- The Practical examination will be conducted by board of examiners consisting of one internal (to be appointed by the Head of Department) and one external examiner (to be appointed by the University).
- The medium of instruction and examination shall be English only.

COURSE STRUCTURE

The Credit Courses of the programme have been classified as below:

- CCC: Compulsory Core Course
- BCC: Elective Core Course
- SSC: Self Study Course
- PRJ: Project Work

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## FIRST SEMESTER

<table>
<thead>
<tr>
<th>S. No</th>
<th>Subject Code</th>
<th>Course Title</th>
<th>Course Category</th>
<th>Credit</th>
<th>Contact Hours/week</th>
<th>EoSE (hrs)</th>
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<tr>
<td>1.</td>
<td>CHE 701</td>
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<td>Quantum, Surface and Electrochemistry</td>
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<td>7.</td>
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Elective Core Courses (ECC) groups
A: Integrated / Allied Chemistry
B: Inorganic Chemistry group
C: Physical Chemistry group
D: Organic Chemistry group
E: Pharmaceutical Chemistry group

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Elective Paper Title</th>
<th>Prerequisite</th>
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* Department will inform the students about the minimum/maximum number of Elective courses offered to students at the beginning of each semester based on the courses opted by students and availability of faculty.
* In Semesters III and IV, Theory elective papers 1-3 to be opted out of one of four elective groups offered (B,C,D,E). Pharmacy group students may opt D04 and D07 as third elective in III and IV semester, respectively. Elective Laboratory – 3 will be according to the opted Elective Theory group.

[Signature]

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CHE 701: ADVANCED INORGANIC CHEMISTRY - I
(Theories of Bonding, Spectroscopic methods and Nuclear Chemistry)

UNIT - I
Stereochemistry and Bonding in Main Group Compounds:
Limitations of VSEPR Theory, $\sigma$-$\pi$-$\pi$ bond, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules
Metal Ligand Bonding:
Limitation of crystal field theory, molecular orbital theory, and introduction to ligand field theory: $\sigma$-bonding in octahedral and tetrahedral complexes, $\pi$-bonding and molecular orbital theory.

UNIT - II
Electronic Spectra of Transition Metal Complexes
Spectroscopic ground states, correlation diagrams, Orgel and Tanabe-Sugano diagrams for transition metal complexes ($d^1$-$d^9$ states), calculations of $Dq$, Racah parameters (B) and nephelauxetic ratio ($\beta$) parameters, charge transfer spectra.

UNIT - III
Optical Rotatory Dispersion (ORD), Circular Dichroism (CD) and Magnetic Properties of Transition Metal Complexes
Spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical conformation, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

UNIT - IV
Nuclear and Radiochemistry:
Laws of radioactive decay; Detection of radiations; Geiger-Nuttal rule; GM tubes and their characteristics; Ionization chamber, Proportional counters, Scintillation counters; Solid state detectors; Calibration of counting equipments; Determination of absolute disintegration rates.
Activation analysis: Principles; Various methods of activation; Methodology; Advantages, limitations and applications.

SUGGESTED BOOKS AND REFERENCES
3. Theoretical Inorganic Chemistry; Day and Selbin.
UNIT - I

Reaction Mechanism: Structure and Reactivity
A review of types of mechanisms and reactions, methods of determining reaction mechanism, thermodynamic and kinetic requirements for reaction, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett Principle, Isotope effects. Effects of structure on reactivity, resonance and field effects, steric effects. Quantitative treatment of the effect of structure on reactivity. The Hammett equation and linear free energy relationship, substituent and reaction constants, Taft equation.
Aromaticity: Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons. Huckel's rule, energy level of π-molecular orbitals, annulenes, anti-aromaticity, homoaromaticity, PMO approach, energetic and magnetic concept.

UNIT - II

Aliphatic Nucleophilic Substitution
The S_N1, S_N2, mixed S_N1-S_N2 and SET mechanisms. The S_N2 mechanism. The neighbouring group mechanism - participation by π and σ bonds, anionic assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl system. Application of NMR spectroscopy in the detection of carbocations. Nucleophilic substitution at the allylic, aliphatic trigonal and a vinyl group.
Reactivity - effect of substrate structure, attacking nucleophile, leaving group and reaction medium.
Ambident nucleophile, regioselectivity.

Aromatic Nucleophilic Substitution
The S_NAr, S_N1, benzyne and S_RN1 mechanisms. Reactivity - effect of substrate structure, leaving group and attacking nucleophile. The von Richte, Sommelet-Hauser and Smiles rearrangements.

UNIT - III

Aliphatic Electrophilic Substitution
Bimolecular mechanisms - S_E2 and S_E1. The S_E1 mechanism - electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and solvent polarity on reactivity.

Aromatic Electrophilic Substitution
The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeir reaction, Gattermann-Koch reaction.

Free Radical Reactions

UNIT - IV

Addition to Carbon-Carbon Multiple Bonds
Addition to Carbon-Heteroatom Multiple Bonds

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagent, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Introduction to condensation reactions involving enolates - Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.

Elimination Reactions

The E2, E1 and E1cB mechanisms. Steric orientation of the double bond. Reactivity, effect of substrate structure, the attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic eliminations.

SUGGESTED BOOKS AND REFERENCES

CHE 703: QUANTUM, SURFACE AND ELECTROCHEMISTRY
4 Credit (4 hrs/week)

UNIT - I
Introduction: Historical background – Black body Radiation, de-Broglie concept, Heisenberg’s Uncertainty Principle. Postulates of Quantum Mechanics, Operators - Linear, Commutator, Hamiltonian, Hermitian and Angular Momentum Operators. Eigen Value and Eigen Functions, Schrodinger’s equation, wave function, physical significance of \( \psi \).

Application of Schrodinger’s Equation to (i) particle in one dimensional box, (ii) particle in three dimensional box, (iii) Simple Harmonic Oscillator, (iv) Rigid Rotor and (v) Hydrogen atom; Radial and angular wave functions, quantum numbers and their significance.

UNIT - II
Angular Momentum: Ordinary angular momentum, Eigen functions and Eigen values of angular momentum, Ladder Operator, Addition of Angular Momentum, Spin, antisymmetry and Pauli’s exclusion principle.

Approximation Method: The Variation theorem, linear variation principle, perturbation method (First order and nondegenerate). Application of variation method and perturbation method to Helium atom.

Molecular Orbital Theory: Basic ideas, criteria of forming MOs, LCAO Concept. Huckel’s Molecular Orbital (HMO) theory for conjugated organic systems. Application of HMO to ethylene, allylic, cyclopropanyl, butadiene and cyclobutadiene system.

UNIT - III
Surface Chemistry
Adsorption: Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electro-kinetic phenomenon).

Micelles: Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization -phase separation and mass action models, solubilization, micro emulsion, reverse micelles.

UNIT - IV
Electrochemistry

SUGGESTED BOOKS AND REFERENCES
1. Physical Chemistry by P.W. Atkins, ELBS.
4. Quantum Chemistry; R.K. Prasad, New Age International
7. Physical Chemistry by Puri, Sharma and Pathania Vishal Publications.
A. Qualitative analysis of mixture consisting of eight cationic / anionic radicals including:
   a. Interfering anionic radical
   b. Insolubles: oxides, sulphates and halides
   c. Less common metal ions: Tl, W, Mo, Se, Te, V, Th, Ti, Zr, Ce, Li

B. Purification techniques and Qualitative analysis
   a. Demonstrations of purification, drying and storage of solvents using various techniques – distillation, steam distillation, vacuum distillation, etc.
   b. Separation of Organic binary mixtures [(one liquid and one solid) or (two solids)] using H₂O, HCl, NaOH, NaHCO₃, Ether or other reagent and identification of components using chemical tests, IR spectra for functional group identification and preparation of derivatives.

C. Experiments based on
   Surface tension
     i. To study surface tension concentration relationship for solution (Gibbs equation).
     ii. To determine the critical micelle concentration (CMC) of SDS and CTAB by surface tension techniques.

Adsorption
   i. Adsorption of Oxalic acid
   ii. Acetic acid on charcoal

Viscosity, Solubility and Molecular weight determination
   i. Experiments based on determination of viscosity of given liquid using Ostwald’s viscometer.
   ii. Study the variation of viscosity of pure liquid with temperature and determination of temperature coefficient of viscosity of the liquid.
   iii. Determination of Solubility of various salts like NaCl, KCl, KNO₃ and NaNO₃ at different temperature and draw the solubility Curve.
   iv. Determination of molecular weight of given polymer (Polyvinyl alcohol, polystyrene, methyl acrylate, etc.) using viscometer
   v. Determination of molecular weight of non-volatile and non-electrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte
UNIT - I


Microwave Spectroscopy: Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor; stark effect, nuclear and electron spin interaction and effect of external field applications.

Vibrational Spectroscopy: Vibrational energies of diatomic molecules, zero point energy, force constant and bond strengths; anharmonicity, Morse potential energy diagram, vibration-rotation spectroscopy, P.Q.R. branches, breakdown of Oppenheimer approximation; vibrations of polyatomic molecules; selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region, metal ligand vibrations.


UNIT - II

Electronic Spectroscopy

Atomic Spectroscopy: Energies of atomic orbitals, vector representation of momenta and vector coupling, spectra of hydrogen atom and alkali metal atoms.

Molecular Spectroscopy: Energy levels, molecular orbitals, vibronic transitions, vibrational progressions and geometry of the excited states, Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; radiative and non-radiative decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra.

Photoelectron Spectroscopy: Photo-electric effect, ionization process, Koopman's theorem, photoelectron spectra of simple molecules, ESCA, chemical information from ESCA; Auger electron spectroscopy-basic idea.

UNIT-III

Magnetic Resonance Spectroscopy

Nuclear Magnetic Resonance: Basic Principle, Spin quantum number, interaction between Spin and a Magnetic Field, Larmor Precession, Relaxation Times; Continuous Wave NMR Spectroscopy, Fourier Transform NMR Spectroscopy; Introduction to Chemical Shift, Spin-spin coupling, Coupling constant. Nuclei other than hydrogen: Nuclei with spin ½ (13C, 19F, 31P, 117Sn, 199Sn, etc.), Nuclei with spin greater than ½ (14N, 11B). Quadrupole effects; factors effecting chemical shift in inorganic compounds - geometry, electronegativity, charge, oxidation state, coordination number. Coupling between two or more than two types of NMR active nucleus in a compound (e.g. CHFCl2, HPF6, OP(O)F3, HP(O)F2, BH3).

Electron Spin Resonance: Basic principles, zero field splitting and Kramer’s degeneracy, Isotropic and anisotropic Hyperfine coupling, spin-orbit coupling and significance of g-tensors, factors affecting g value, its applications to the study of free radicals & fast reactions and applications to transition metal complexes; spin Hamiltonian, spin densities and McConnell relationship - spin polarization for atoms and transition metal ions.

UNIT-IV

Infrared Spectroscopy: Basic principles, spectral parameters and spectrum display, applications of techniques to the studies of (i) bonding and structures of Fe²⁺ and Fe³⁺ compounds including those
of intermediate spin; (ii) Sn\textsuperscript{2+} and Sn\textsuperscript{4+} compounds, nature of M-L bond, coordination number, structure; and (iii) detection of oxidation state and in equivalent MB atoms.

**Electron Microscopy:** Basic principles of Electron Microscopy: SEM, TEM, APM; and their applications in structural analysis.

**SUGGESTED BOOKS AND REFERENCES**

1. Fundamentals of Molecular Spectroscopy, Banewell and McCash
7. Electronic Absorption Spectroscopy and related Techniques, D N Sathyanarayana
UNIT I

Statistics – Introduction to Chemometrics
Limitations of analytical methods, Errors and classification, Determinant, constant and indeterminate, accuracy, precision, minimization of errors, significant figures and computation rules, mean and standard deviation, distribution of random errors, variance and confidence interval, paired t-test, least square method, correlation and regression, linear regression.

UNIT II

Sampling in analysis
Definition, theory, basis and techniques of sampling, sampling statistics, sampling and physical state, crushing and grinding, hazards in sampling, techniques of sampling of gases, fluid, solids, and particulates, minimization of variables, transmission and storage of samples, high pressure ashing techniques (HPAT), particulate matter, its separation in gas stream, filtering and gravity separation, analysis of particulate matter like asbestos, mica, dust and aerosols etc.

Solvent extraction method in analysis
Principle, classification, theory, instrumentation and applications.

UNIT III

Conductometry:
Important laws, definitions, relations, effect of dilution on conductivity, measurement of conductivity, types of conductometric titrations, its applications and limitations.

Potentiometry:
Principle, instrumentation, types of potentiometric titrations and its applications, pH measurements, determination of pH, ion selective electrodes, instrumentation and applications.

UNIT IV

Coulometry:
Introduction, principle, experimental details of coulometry at constant current and constant potential, titration applications.

Atomic Absorption Spectroscopy:
Introduction, principle, Grotrian diagram, instrumentation, applications, detection limit, sensitivity and disadvantages.

SUGGESTED BOOKS AND REFERENCES
7. Sivan JAD Butter Worth, Photoelectron spectroscopy.

[Dy. Registrar
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University of Rajasthan
JAIPUR]
CHE A03: GREEN AND SUSTAINABLE CHEMISTRY

UNIT – I
Introduction, principle and concepts of Green Chemistry
Need for green chemistry; Inception and evolution of green chemistry; Twelve principles of green chemistry with their explanations and examples; Designing a green synthesis using these principles; Green chemistry in day to day life.

UNIT – II
Non-traditional greener alternative approaches
Different approaches to green synthesis: (a) Uses of green reagents in organic synthesis - Dimethyl carbonate, polymer supported reagents - per acids and chromic acid; (b) Green catalysts, role of catalysis in sustainable development, homogeneous and heterogeneous catalysts; Introduction, advantages and applications of - (i) Nanocatalysts, (ii) Phase transfer catalysts, (iii) Biocatalysts, (iv) Organocatalysts, in organic synthesis.

UNIT – III
Applications of non-conventional energy sources
Introduction of microwave induced synthesis: Microwave activation, equipment, time and energy benefits, limitations; Organic transformations under microwaves - Fries rearrangement, Diels-Alder reaction, decarboxylation, saponification of ester, alkylation of reactive methylene compounds; Heterocyclic synthesis -α-Lactams, pyrrole, quinoline.
Introduction of ultrasound assisted green synthesis: Instrumentation, physical aspects, applications in organic transformations.
Electrochemical synthesis: Introduction, synthesis of sebacic acid and adiponitrile.

UNIT – IV
Environmentally Benign Solutions to Organic Solvents
Ionic liquids as green solvents: Introduction, properties and types of ionic liquids. Synthetic applications - Diels-Alder reaction, epoxidation and Heck reaction.
Fluorous solvents in green chemistry: Scope, definition and their synthetic applicability.
Role of supercritical carbon dioxide in green chemistry.
Ethyl lactate as a renewable green solvent: Properties and applications.

SUGGESTED BOOKS AND REFERENCES:
CHE A11: CHEMISTRY ELECTIVE LAB-1

A. Laboratory Estimations
   i. Estimation of an acid using another standard acid
   ii. Estimation of a base using another standard base
   iii. Estimation of boric acid
   iv. Determination of percentage purity of commercial soda
   v. Determination of percentage of CaCO₃ in precipitated chalk sample
   vi. Determination of percentage purity of caustic soda
   vii. Determination of alkali content-antacid tablet using HCl

B. Organic Preparations (single step)
   i. Preparation of p-bromoacetanilide from acetanilide.
   ii. Preparation of p-bromoaniline from p-bromoacetanilide.
   iii. Preparation of m-dinitrobenzene from nitrobenzene.
   iv. Preparation of m-nitroaniline from m-dinitrobenzene.
   v. Synthesis of adipic acid from cyclohexanol.
   vi. Preparation of 1,1-bis-2-naphthol (BINOL) from β-naphthol.
   vii. Green synthesis of 7-hydroxy-4-methylcoumarin (Pechmann condensation).
   viii. More one step preparations may be carried out according to requirement of curriculum

C. Experiments based on-
   Phase Equilibrium:
   i. Determination of congruent composition and temperature of a binary system (e.g., diphenylamine-benzophenone system).
   ii. To construct the phase diagram for three component system (e.g., chloroform-acetic acid water).
   iii. Study of distribution of benzoic acid in benzene and water to show that benzoic acid dimerise in benzene.
   iv. Determine the equilibrium constant for the reaction KI + I₂ → KI₃ by distribution method.

Conductometry
   v. Verification of Onsager's equation for strong electrolytes (NaCl, HCl, KNO₃, KCl) and determination of constant A and B.
   vi. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
   vii. Determination of the strength of strong and weak acids in a given mixture conductometrically.

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CHE 801: ADVANCED INORGANIC CHEMISTRY—II
(Group Theory, Molecular rearrangement processes & Inorganic reaction mechanisms)
4 Credit (4 hrs/week)

UNIT-I
Symmetry and Group Theory in Chemistry
Symmetry elements and symmetry operation, definition of group, subgroup, conjugacy relation and classes. Point symmetry group. Schonflies symbols, representations of groups by matrices (representation for the C_3v, C_4v, etc., group to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use; spectroscopy. Derivation of character table for C_3v and C_4v point group. Symmetry aspects of molecular vibrations of H_2O molecule.

UNIT-II
Molecular Rearrangement Processes
Electron transfer reactions (outer and inner sphere), HOMO and LUMO of oxidant and reductant, chemical activation. Precursor complex formation and rearrangement, nature of bridge ligands, fission of successor complexes, Two-electron transfers, Synthesis of coordination compounds using electron transfer reactions, mixed valence complexes and internal electron transfer.

UNIT-III
Inorganic Reaction Mechanism- I
Basic principles; lability, inertness, stability and instability of coordination compounds; general principles and mechanisms of substitution reactions of tetrahedral, square planar, trigonal bipyramidal, square pyramidal and octahedral complexes; potential energy diagrams, transition states and intermediates, isotope effects, Berry's pseudo rotation mechanism, Swain-Scott equation.

UNIT-IV
Inorganic Reaction Mechanism- II
Substitution reactions of octahedral complexes; nature of substitution reactions; Theoretical approach to substitution mechanisms; mechanism of substitution reaction of complexes of cobalt; acid hydrolysis and base hydrolysis of Co (III) complexes. Substitution reactions of square planar complexes; reaction of Pt (II) complexes; trans effect and its applications to synthesis of complexes; theories of trans effect; mechanism of substitution kinetics of substitution of Pt(II) complexes; factors affecting the reactivity of square planar complexes.

SUGGESTED BOOKS AND REFERENCES

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CHE 802: STEREOCHEMISTRY AND ORGANIC REACTION MECHANISM II

UNIT I

Stereochemistry
Optical activity and chirality, elements of symmetry, specification of configuration - molecules with more than one chiral center. D/L, R/S and Threo/Erythro nomenclature.
Prochirality, Homotopic and Heterotopic ligands and faces, Enantiotopic groups and faces, Re/Si Nomenclature. Stereospecific and stereoselective reactions.
Optical activity in the absence of chiral carbon (biphenyls, acenes, spiranes, anza compounds).
Chirality due to helicity. Chirality in the compounds containing N, S and P.
Geometrical isomerism in cyclic and condensed systems, Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity.
Cram's, Prelog's and Horeau's rules. Circular birefringence, CD, ORD, Octant rule, Cotton effect. The axial haloketone rule. Determination of configuration (absolute and relative) and conformation.

UNIT II

Organic Photochemistry
Photochemical reactions of ketones - Norrish type I cleavage, Norrish type II cleavage; photo reductions; Paterno-Buchi reactions; photochemistry of α,β-unsaturated ketones, β,γ-unsaturated ketones.
Photochemistry of alkenes: intramolecular reactions of the olefinic bond – cis-trans isomerisation (stilbene), cyclization reactions.
Photochemistry of aromatic compounds: photochemical rearrangement, photostationary state, isomerizations.

UNIT III

Pericyclic Reactions
Characteristics and Classification of pericyclic reactions, thermal and photochemical reactions.
Electrocyclic reactions: conrotatory and disrotatory motions, 4n, 4n+2 π electron and allyl systems.
Valence Tautomerism.
Cycloadditions: antarafacial and suprafacial additions, 4n and 4n+2 π electron systems. Diels-Alder reaction – stereoselectivity (endo, exo), and regioselectivity; normal and inverse electron demand.
Diels-Alder reactions; asymmetric Diels-Alder reactions; retro-Diels-Alder reactions; 2+2 addition.
Ketenes, 1,3-dipolar cycloadditions. Cheletropic reactions.

UNIT IV

Molecular Rearrangements
Mechanistic aspects, nature of the migration, migratory aptitudes, memory effects. A detailed study of the following rearrangements: Benzil-benzilic acid rearrangement, Favorovii rearrangement, Nef rearrangement, Beckmann rearrangement, Hoffmann rearrangement, Curtius rearrangement, Loss.
rearrangement, Wolff rearrangement, Wittig rearrangement, Fritsch-Buttenberg-Wiechell rearrangement, Stevens rearrangement, Chapman rearrangement, Wallach rearrangement. Photochemical rearrangements: rearrangement of 1,4- and 1,5-diienes, di-π methane rearrangement, rearrangement of cyclohexadienone (conjugate and cross conjugate), Dienone-Phenol rearrangement.

SUGGESTED BOOKS AND REFERENCES
15. Ian Fleming, Pericyclic Reactions, Oxford Chemistry.
20. Fleming I., Molecular orbitals and photochemical reactions.
22. Albright T., Burdet J and Whango M, Orbital interaction in chemistry, Wiley VCH
CHE 803: THERMODYNAMICS AND CHEMICAL KINETICS

UNIT-I

Classical Thermodynamics

UNIT-II

Statistical Thermodynamics

UNIT-III

Chemical Kinetics - I
Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects; steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions.
Dynamic chain reactions (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical reactions (hydrogen-bromine and hydrogen-chlorine).

UNIT-IV

Chemical Kinetics - II
General features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method.
Collision theory of reaction rates, Arrhenius equation and the effect of temperature on reaction rate.
Rotated complex theory, Modified collision theory (steric effect)
Lindemann-Hinshelwood and Rice-Ramsperger-Kassel-Marcus (KKM) theories of unimolecular reactions.

SUGGESTED BOOKS AND REFERENCES
1. P. W. Atkins, Physical Chemistry, ELBS.

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A. Inorganic Preparations: Following selected inorganic compounds and their studies by IR spectra, Mössbauer, ESR and Magnetic susceptibility measurements. Handling of air and moisture sensitive compounds under vacuum.
   i. Sodium thiosulphate, Na₂S₂O₃.5H₂O
   ii. CuCl₂.2DMSO
   iii. Tetraamine cupric sulphate [Cu(NH₃)₄SO₄].H₂O
   iv. N,N-bis(salicylaldehyde)ethylenediamine, Salen H₂, Co(Salen)
   v. Copper glycine complex – cis- and trans-bis(glycinato)Copper(II)
   vi. Cis- and trans-dichlorobis(ethylenediammine)cobalt(III) chloride, [Co(en)₂Cl₂]Cl
   vii. Na[Cr(NH₃)₆(SCN)₄]
   viii. [Ni(NH₃)₆]Cl₂

B. Two Step Organic Synthesis
   i. Aniline → 2,4,6-Tribromoaniline → 1,3,5-Tribromobenzene
   ii. Aniline → Diazoaminobenzene → p-Aminoazobenzene
   iii. Phthalic anhydride → Fluorescein → Eosin
   iv. Phthalic anhydride → Phthalimide → Anthranilic acid
   v. Acetanilide → p-Nitroacetanilide → p-Nitroaniline
   vi. More two step organic preparations involving general organic reactions may be carried out.

The products to be characterized by m.pt / spectral techniques.

C Experiments based on -

   Chemical Kinetics
   i. Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship (iodide ion is oxidized by persulphate ion).
   ii. Determination of the effect of (a) Change of temperature (b) Change of concentration of reactant and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions.
   iii. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
   iv. Determination of the rate constant for the oxidation of iodide ions by peroxide studying the kinetics as an iodine clock reaction

   Thermochemistry
   Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture.
   Determination of the temperature dependence of the solubility of a compound in two solvents having similar intramolecular interactions (benzoic acid in water and in DMSO mixture) and calculate the partial molar heat of solution.
CHE A04: SPECTROSCOPY-II

UNIT I

Ultraviolet and Visible Spectroscopy
Various electronic transitions (185-800 nm) Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Woodward-Fieser rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls.

Infrared Spectroscopy
Characteristic vibrational frequencies of 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 II

Mass spectrometry
Introduction, ion production - 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. McLafferty rearrangement. Ring rule, Nitrogen rule. High resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

UNIT III

Proton Magnetic Resonance Spectroscopy
Chemically nonequivalent protons, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydeic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides and mercapto). Chemical exchange, effect of deuteration. Complex spin-spin interaction between two, three, four and five nuclei (first order spectra). Stereochemistry, hindered rotation. Karplus curve-variation of coupling constant with dihedral angle. Simplification of complex spectra - nuclear magnetic double resonance, NMR shift reagents, solvent effects. Fourier transform technique, nuclear overhauser effect (NOE).

UNIT IV

Carbon-13 NMR Spectroscopy
General consideration, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Two dimension NMR spectroscopy - COSY, NOESY, DEPT, INEPT, APT and INADEQUATE techniques.
Applications of Spectroscopy - Problems based on UV, IR, NMR spectroscopy and Mass spectrometry for structural elucidation of organic compounds.

SUGGESTED BOOKS AND REFERENCES
2. Fundamentals of Spectroscopy by Banwell and McCash

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CHE A05: ENVIRONMENTAL CHEMISTRY

UNIT-I

Atmospheric Chemistry

Tropospheric Photochemistry

UNIT-II

Air Pollution: Air pollutants and their classifications. Aerosols-sources, size distribution and effect on visibility, climate and health.
Acid Rain: Definition, Acid rain precursors and their aqueous and gas phase atmospheric oxidation reactions, damaging effects on aquatic life, plants, buildings and health. Monitoring of SO₂ and NOₓ, acid rain control strategies.
Stratospheric Ozone Depletion: Mechanism of ozone formation, Mechanism of catalytic ozone depletion, discovery of Antarctic ozone hole and role of chemistry and meteorology, control Strategies.
Green House Effect: Terrestrial and solar radiation spectra, major green house gases and their sources and global warming potentials. Climate change and consequences.
Urban Air Pollution: Exhaust emissions, damaging effects of carbon monoxide, monitoring of CO, control strategies.

UNIT-III

Aquatic Chemistry and Water Pollution
Redox chemistry in natural waters. Dissolved oxygen, biological oxygen demand, chemical oxygen demand, determination of DO, BOD and COD. Aerobic and anaerobic reactions of organic sulphur and nitrogen compounds in water, acid-base chemistry of fresh water and sea water. Aluminium, nitrate and fluoride in water, petrification, sources of water pollution, treatment of waste and sewage, purification of drinking water, techniques of purification and disinfection.

UNIT-IV

Environmental Toxicology
Toxic Heavy Metals: Mercury, lead, arsenic and cadmium, causes of toxicity, bioaccumulation, sources of heavy metals, chemical speciation of Hg, Pb, As, and Cd, biochemical and damaging effects.
Toxic Organic Compounds: Pesticides, classification, properties and uses of organochlorine and atmospheres pesticides, detection and damaging effects.
Polychlorinated Biphenyls: Properties, use and environmental continuation and effects.
Polynuclear Aromatic Hydrocarbons: Source, structures and as pollutants.
Soil and Environmental Disasters: Soil composition, micro and macronutrients, soil pollution by fertilizers, plastic and metals. Methods of re-mediation of soil. Bhopal gas tragedy, Chernobyl, three mile island, Minamata disease, Sevoso (Italy), London smog.

SUGGESTED BOOKS AND REFERENCES
5. Introduction to Atmospheric Chemistry, P.V. Hobbs, Cambridge.
CHE D01: BIOMOLECULES I

UNIT-I

Carbohydrates
Structure and biological functions of derivatives of monosaccharides like, Amino sugars - Glucosamine and N-Acetylglucosamine; Carboxylic acid sugars- Gluconic acid and Gluconic acid; Sugar phosphates- Adenosine triphosphate (ATP); Sugar alcohols- Maltitol and Lactitol. Structure, nomenclature, properties and reactions of oligosaccharides. Structure and biological functions of derivatives of polysaccharides - chondroitin sulphate, heparin and hyaluronan.

Unit-II

Lipids
Introduction, nomenclature, classification, and physical properties of fatty acids. Chemical properties of fatty acids - methylation of carboxyl groups, halogen addition reactions, transformation of isonene-type fatty acids to conjugated fatty acids and hydrogenation. Nomenclature, classification, structure, and function of triacylglycerols, Phospho- and Glycolipids, Definition and classification of lipoproteins. Involvement of lipids in the formation of biological membranes, Introduction of dioleic lipids, higher alcohols (Waxes and alkoxy lipids) and Cutin.

UNIT -III

Amino-acids, Peptides and Protein
Peptide bond, Chemical and enzymatic hydrolysis of proteins to peptides. Synthetic Amino Acids Utilized for Increasing the Biological Value of Food (Food Fortification) - Glutamic Acid, Aspartic Acid, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan. General Remarks, Nomenclature, physical properties and sensory properties of Peptides. Structure and use of peptides of interest to food chemists - Glutathione, Carnosine, Anserine and Balenine, Nisin and Lysine Peptides. Secondary structure of proteins-α-helix, β-sheet, forces responsible for holding the secondary structures of proteins.

UNIT-IV

Transmission of Genetic Information from the Gene to the Protein
Nucleic acid structure and function - DNA, double helix, DNA replication, Mutation and DNA repair, RNA, types of RNA, transcription, RNA modification, Genetic code, Translation, Transfer RNA, Steps of translation-initiation, elongation and termination, Chromosome organization, Repetitive DNA sequences.
Prokaryotic regulation of gene expression, Eukaryotic control of gene expression, transcriptional regulations.

SUGGESTED:
- Biochemistry, J. David Rawn, Neil Patterson.
- Biochemistry, Voet and Voet, John Wiley.
- Food Chemistry, H.D. Bellitz et.al., Springer.
CHE A12: CHEMISTRY ELECTIVE LAB-2

A. Laboratory Estimations
   i. Estimation of ferric ions in ferric alum.
   ii. Estimation of Cr³⁺ ions in tannery waste.
   iii. Estimation of available chlorine in bleaching powder.
   iv. Analysis of bauxite with respect to Aluminium (gravimetrically).

Synthesis of inorganic compounds and their characterization by IR spectroscopy
   i. Sodium hexanitritocobaltate(III), Na₃[Co(NO₂)₆]
   ii. Sodium tetraethionate Na₂S₄O₆
   iii. Prussian blue, Fe₆[Fe(CN)₆]₃
   iv. Pentaamminechlorocobalt(III)chloride, [CoCl(NH₃)₅]Cl₂
   v. Hexaamminecobalt(III)chloride, [Co(NH₃)₆]Cl₃
   vi. Cis- and trans-K[Cr(C₂O₄)₂(H₂O)₂].2H₂O

B. Organic Quantitative Analysis
   i. Estimation of amines using bromate-bromide solution or acetylation method.
   ii. Estimation of phenols using bromate-bromide solution or acetylation method.
   iii. Determination of number of hydroxyl groups in an organic compound by acetylation method.
   v. Determination of Neutralization Equivalent of given carboxylic acid.
   vi. Determination of Iodine number and saponification value of an oil sample.
   vii. Estimation of sulphur by Messenger or Fusion method.

C. Potentiometry:
   i. Determination of strengths of halides in a mixture potentiometrically.
   ii. Determination of the valency of given ions potentiometrically.
   iii. Determination of activity and activity coefficient of the given electrolytes.

Conductometric Experiments
   iv. Double displacement & acid base titration
      a. NH₄Cl – NaOH – Mixture of CH₃COOH & HCl
      b. NH₄Cl – NaOH – Mixture of NH₄Cl & HCl

v. Precipitation titration
   a. KCl – AgNO₃ – KCl
   b. K₂SO₄ – BaCl₂ – K₂SO₄

vi. Determination of dissociation constant of weak acids
UNIT-I
Synthesis, Properties, Structure and Bonding of:
(Giving some specific examples)
(i) $\eta^1$- bonded alkyl complexes
(ii) $\eta^1$- carbene and carbyne complexes
(iii) $\eta^2$- alkene and alkynyl complexes
(iv) $\eta^3$- allyl complexes
(v) $\eta^4$- dienyl complexes
(vi) $\eta^4$- dienyl complexes

UNIT-II
Metal nitrosyls, cyanides and isocyanides:

UNIT-III
Synthetic and Catalytic Aspects of Organotransition Metal Chemistry:
(i) Transition metal organometallics in organic synthesis
(ii) Homogenous catalysis by transition metal organometallics
(a) Hydrogenation of alkenes
(b) Hydrosilylation of alkenes
(c) Metathesis of alkenes
(d) Oligomerization and polymerization of alkenes and alkynes
(e) Hydroformylation of alkenes
(f) Acetic acid synthesis and other carbonylation reactions
(g) Oxidation of alkenes

UNIT-IV
Catalysis
(a) Heterogenous catalysis by organotransition metal compounds
(b) Fisher-Tropsch synthesis: Methanation reactions, Synthesis of methanol, gasoline production, function of ZSM-5 Zeolite in stabilization of carbone molecule, application of reaction to industry.
(c) Water gas shift reaction: Role of ZnO/Cr$_2$O$_3$ in the reaction, Acetic acid synthesis from water gas shift, Role of Co catalyst.
(d) Functional organometallic compounds: Rate of rearrangement, Simple examples of non-metal molecules in different coordination geometries, classification, future developments.

REFERENCES
5. J.P. Candel and K. Aayler and D.T. Thomson, Reaction of Transition Metal Complexes, Elsevier
UNIT - I
Enolate Chemistry

UNIT - II
Metal and non-metal mediated oxidation
Mechanism, selectivity, stereochemistry and applications of Oppenauer oxidations, aromatization, dehydrogenation, cleavage of C=C bond, ozonolysis, epoxidation using peracids, Baeyer-Villeger oxidation. Oxidations using FeCl₃, DDQ, NBS, lead tetraacetate, selenium dioxide, Ag, Cr and Mn reagents, periodic acid and osmium tetroxide. DMSO-based oxidations. Oxidation of S, Se and N containing compounds.

UNIT - III
Metal and non-metal mediated reduction

UNIT - IV
New Synthetic Reactions
b. C=C Formation Reactions: Shapiro, Bamford-Stevens, McMurry reactions, Julia-Lythgoe olefination and Peterson’s stereoselective olefination.
d. Ring Formation Reactions: Pauson-Khand reaction, Bergman cyclisation, Nazarov cyclisation.
e. Click Chemistry: Criteria for Click reaction, Sharpless azide cycloadditions.
g. olefin cross metathesis (OCM), ring closing metathesis (RCM), ring opening metathesis (ROM) and applications.

Suggested Books and References
UNIT I

Biological Cell and its Constituents:
Biological Cell, Structure and functions of proteins, DNA and RNA in living system, Helix Coil Transition.

Cell Membrane and transport of Ions:

UNIT II

Bioenergetics:
Standard free energy change in biological reactions, Exergonic and endergonic processes, Hydrolysis of ATP, Synthesis of ATP from ADP.

Biopolymer Interactions:
Forces involved in biopolymers interactions, Electrostatic charges and molecular expansions, hydrophobic forces, dispersion forces, Multiple Equilibria and various binding process in biological systems. Hydrogen ion titration curve.

UNIT III

Statistical Methods in Biopolymer:
Chain Configuration of macromolecules, statistical distribution end to end dimensions, calculations of average dimension of various chain structure. Polypeptide and protein structure. Introduction to protein folding problems.

Molecular weights of biopolymers:
Evaluations of size, shape and extent of hydration of biopolymers by various experiments, determination of molecular weight of biopolymers by light scattering, sedimentation, viscosity and osmotic pressure methods. Bio-degradable polymers.

UNIT IV

Biosensors
Definition, Biosensor system, Bio receptors, surface attachment of biological elements. Electrochemical transducers, placement of biosensors.

Applications:
Glucose monitoring, food analysis, DNA biosensors, microbial biosensors, commercialized biosensors, identification of blood glucose (diabetes) and pregnancy test by colorimetric and electrochemical strip.

SUGGESTED BOOKS AND REFERENCES
A. Laboratory Estimations
   i. Spectrophotometric determination of Iron-phenanthroline complex: Job’s method of continuous variations.
   ii. Spectrophotometric determination of nickel as nickel dimethyl glyoximate complex.
   iii. Find out the stability constant of metal complexes by Bjerrum’s Method.
   iv. Analyse the given sample of Copper Ferrite (CuFe₂O₄) & determine the amount and percentage of Copper and Iron volumetrically.
   v. Determination of ferrous (Fe²⁺) and ferric (Fe³⁺) ions in the given solution.
   vi. Determination of Ca²⁺ and Mg²⁺ ions in a given solution and estimation of total hardness of water.
   vii. Estimation of H₂O₂ by iodometric method.
   viii. Estimation of Zinc involving Potassium ferrocyanide.
   ix. Estimation of sulphate as barium sulphate gravimetrically.
   x. Estimate Ni in a given sample complexometrically using mureoxide as an indicator.
   xi. Analysis of the given sample of iron ore & determination of Silica – Gravimetrically, Iron Volumetrically to find out their percentages in the given sample.

B. Separation & Purification Techniques:
   i. Extraction of organic compound using separating funnel, Soxhlet extraction method
   ii. Purification of organic compounds using Chromatographic methods
   iii. Isolation of caffeine, casein, chlorophyll.

Quantitative estimations
   iv. Estimation of number of Functional groups (phenol, amino, methoxy groups) in given organic compounds
   v. Estimation of amino acids and sugar in given samples.
   vi. Estimation of citric acid / vitamin C in citrus juice.

C. Chemical Analysis
   i. Determine the dissolved oxygen (DO) of the given water sample.
   ii. Determine the biological oxygen demand (BOD) of the given water sample.
   iii. Determine the Chemical Oxygen Demand (COD) of the given water sample
   iv. Determine the Nitrate (NO₃⁻) in drinking water sample.
   v. Determine the phenolic substance in the waste water sample.
   vi. Determine the amount of free Chlorine in given water sample.
   vii. Determine the amount of Fluoride in given water sample.
   viii. Determine the dissolved CO₂ in the given water sample.
UNIT - I

Metals in Life Processes:
Role of metal ions in biological systems; essential and non-essential elements - macro minerals and essential trace elements - synergism and antagonism among essential trace elements; active transport of Na, K, Mg and Ca ions across the biological membrane; elements of bioenergetics with special reference to elements of high energy phosphate bond.

UNIT - II

Electron Carriers and Photosynthesis:
(a) Electron transfer in biology: Structure and functions of electron transfer proteins. Cytochromes and respiratory chain, iron-sulphur proteins rubredoxin and ferridoxins. Synthetic models for Fe₄S₄ cluster only.
(b) Photosynthetic pigments: Photochemistry of chlorophyll molecules, mechanism of photosynthesis, Calvin cycle and Quantum efficiency. Function of photosystem- I and photosystem-II. Cyclic and noncyclic photophosphorylation.

UNIT - III

Transport and Storage of Dioxgen:
Haem proteins and oxygen uptake. Structure and function of haemoglobin, myoglobin. Structural model for dioxgen binding-co-operativity, Perutz mechanism and Bohr effect; non-haem oxygen carriers in some lower animals, haemocyanin and haemerythrin. Model synthetic complexes of iron, cobalt and copper.

UNIT - IV

Nitrogen Fixation:
Nitrogen in biosphere, nitrogen cycle, role of microorganisms in nitrification, nitrogen fixation in soils. Biological nitrogen fixation and its mechanism, nitrogenase, Chemical nitrogen fixation and other nitrogenase model systems.

SUGGESTED BOOKS AND REFERENCES
UNIT-I

Introduction
Definition and development of supramolecular chemistry, classification of supramolecular host-guest compounds. Nature of supramolecular interactions: ion-ion interactions, ion-dipole interactions, dipole-dipole interactions. Cation binding hosts, binding of anions, binding of neutral molecules, binding of organic molecules.

UNIT-II

Molecular Recognition and Crystal Engineering
Receptors, design and synthesis of co-receptors and multiple recognition. Hydrogen bonds, strong, weak and very weak H-bonds, utilization of H-bonds to create supramolecular structures, use of H-bonds in crystal engineering and molecular recognition.

UNIT-III

Supramolecular Reactivity and Catalysis
Supramolecular metallo-catalysis, biomolecular and abiotic catalysis. Transport processes and carrier design, cation carriers, anion carriers, coupled transport processes.

UNIT-IV

Devices and Chemistry
Supramolecular devices, supramolecular photochemistry, molecular and supramolecular photonic devices, photosensitive molecular receptors. Supramolecular chemistry of Fullerene, Fullerene as guests, Fullerene as hosts, Fullerene as superconducting intercalation compounds.

SUGGESTED BOOKS AND REFERENCES
CHE B03: INORGANIC POLYMERS

UNIT-I
Basic Concepts
Classification by connectivity, and classification by dimensionality, metal/backbone classification of metal-containing polymers, linear inorganic polymer.

UNIT-II
Synthesis and Characterization
Step-growth synthesis, chain polymerization, ring-opening polymerization, reductive coupling and other redox polymerization reactions, Inorganic polymer characterization: average molecular masses, and characterizing methods using Gel permeation chromatography and viscosity, degree of polymerization

UNIT-III
Applications
Polysiloxane and polyphosphazene elastomers, inorganic medical polymers: polysiloxanes and polyphosphazene as bio polymers, Inorganic polymer conductivity: main group inorganic polymers, metal-containing polymers, Luminescent inorganic polymers: Ruthenium polymers for solar energy conversion.

UNIT-IV
Polymetallocenes

SUGGESTED BOOKS AND REFERENCES
1. Ronald D. Archer, Inorganic and Organometallic Polymers, Wiley-VCH
UNIT-I

Fuel Cells

Electro-chemical Energy Storage
Properties of Electrochemical energy storages: measure of battery performance, Charging and discharging of batteries, Storage density, Energy density.


UNIT-II

Corrosion and Passivity
Electrochemical mechanism of corrosion of metals, thermodynamics and stability of metals, potential - pH (or Pourbaix) Diaphragms, uses and abuses, corrosion current and corrosion potential - Evans diagrams.

Measurement of corrosion rate: weight loss method and Electrochemical method. Inhibition of Corrosion (i) by addition of substrates to the electrolyte environment (ii) By charging corroding method from external source, anodic protection, organic inhibitors. The Fuller theory, Green inhibitors.


UNIT-III

Bio-electrochemistry and Bioelectrocatalysis
Membrane potential, simplistic and modern theory, Electrical conductance in biological organisms, electrochemical mechanism of nervous systems, enzymes as electrodes, Biosensors, Bio-electrocatalysis. Enzymes as biological catalysts, immobilization, methods of immobilization.

UNIT-IV

Kinetics of Electrode Process
Essentials of electrode reaction, significance of current density and overpotential in electrode processes, Standard rate constant ($k^0$) and Electron Transfer coefficient ($\alpha$) and its significance, exchange current density. Criteria of irreversibility information from irreversible wave. Koutecky method, Meits Israel and Gelling's method for determining kinetic parameters for quasireversible and irreversible waves.

SUGGESTED BOOKS AND REFERENCES


Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR
CHE C02: ADVANCED CHEMICAL KINETICS-I

UNIT I

Kinetics of Atmospheric Reactions

UNIT - II

Radiation Chemistry

UNIT - III

Dynamics of Gas-Surface Reactions

Transition State:
A brief aspect of statistical mechanics and transition state theory, application in calculation of the second order rate constant for reactions with collision for (i) atom + atom (2) atom + molecule (3) molecule (for both linear and non-linear molecules) + molecule reactions. Static solvent effects and thermodynamic formulations. Adiabatic electron transfer reactions, energy surfaces.

UNIT - IV

Enzymes and Inhibitors
Enzyme catalyzed models of 1:2 type enzyme-substrate systems. Kinetics of one enzyme-Two substrate systems and their experimental characteristics. Enzyme inhibitors and their experimental characteristics. Kinetics of enzyme inhibited reactions.

Micelles Catalysis and Inhibition
(b) Kinetics and Mechanism of Substitution Reaction: Classification of ligand substitution mechanism, anation and base catalysed Kinetics of anation reactions. Auration and acid catalysed Kinetics of aquation reactions (octahedral complexes).

SUGGESTED BOOKS AND REFERENCES
CHE C03: CHEMICAL ANALYSIS

UNIT-I

Water Analysis

UNIT-II

Food Analysis

UNIT-III

Soil and Fuel Analysis
(a) Analysis of soil, moisture, pH, total nitrogen, phosphorus, silica, lime, magnesia, manganese, sulphur and alkali salts.

UNIT-IV

Body Fluids and Drug Analysis
Composition of blood collection and preservation of samples. Serum electrolytes, blood glucose, blood urea nitrogen, uric acid albumin, globulins acid and alkaline phosphatases, Immunoassay: Principle of radio immunoassay (RIA) and applications. The blood gas analysis trace elements in the body. Narcotics and dangerous drugs classification of drugs. Screening by gas and thin layer chromatography and spectrophotometric measurements.

SUGGESTED BOOKS AND REFERENCES
UNIT-I

Nomenclature of Heterocycles
Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic, fused, spiro and bridged heterocycles.

Aromatic Heterocycles
General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in $^1$H NMR-spectra, empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity.

UNIT-II

Non-aromatic Heterocycles
Strain - bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interactions. Stereo-electronic effects; anomeric and related effects. Attractive interactions - hydrogen bonding and intermolecular nucleophilic electrophilic interactions.

UNIT-III

Small Ring Heterocycles
Three-membered and Four-membered Heterocycles: Synthesis and reactions of aziridines, oxiranes, thiranes, oxaziridines, azetidines, oxetanes, thietanes and azetidinones.

UNIT-IV

Five-membered Heterocycles with Two Heteroatoms
Synthesis and reactions of 1,2- & 1,3-diazoles, oxazoles, thiazoles and azaphospholes.

Benzo-fused five-membered Heterocycles
Synthesis, reactions and medicinal applications of benzopyrroles, benzofurans, benzothiophenes and benzimidazoles.

SUGGESTED BOOKS AND REFERENCES

UNIT I

Terpenoids and Carotenoids

UNIT II

Alkaloids
Introduction, occurrence, nomenclature, classification based on structure, isolation, general methods of structure elucidation of alkaloids, stereochemistry and synthesis of the following: Narcotine, Quinine, Reserpine and Morphine.

UNIT III

Steroids

Plant Hormones
Introduction, occurrence, isolation and physiological effects of Auxins, Gibberellins (Synthesis of GA₃), Cytokinins and Abscisic acid.

Naturaceuticals and Natural Products
Occurrence, isolation, biological function and structure elucidation (by spectroscopic methods) of Curcumin, Silymarin, 5-hydroxytryptophan, Chlorogenic acid and Vinpocetine.

UNIT IV

Natural Pigments
Occurrence, nomenclature and general methods of structure determination. Isolation, structure determination and synthesis of Luteolin, Quercetin, Luteolin, Diadzein, Genistein, and Cyanidin chloride.


SUGGESTED BOOKS AND REFERENCES
CHE D04: MEDICINAL CHEMISTRY - I

UNIT-I

Drug Design

UNIT-II

Pharmacodynamics: Definition, Receptors and specificity, agonists and antagonists, Site(s) of drug action, Mechanism of Drug action: therapeutic and side effects, elementary treatment of enzyme stimulation, enzyme inhibition, membrane active drugs, Drug metabolism, xenobiotics, biotransformation significance of drug metabolism in medicinal chemistry.


UNIT-III

Pharmacology: Definition, dose-response relationship, potency and effective dose 50 (ED 50), minimal effective concentration, efficacy: time-response graph, onset, duration and termination of action.

Drug Toxicity and Poisoning: Types of therapeutic drug toxicity, Mechanism of Toxicity, Dose response complexities, Therapeutic Index, Lethal Dose 50 (LD 50), Adverse drug effects, Principles of treatment of poisoning, Mechanism of Detoxification and testing.

UNIT-IV

Biostatistics: Introduction its role and use, Collection, Organization: Graphics and pictorial representation of data, Sampling: Random and non random sampling methods, standard deviation and coefficient of variation, Probability, student t-test, F-Test, chi square test, correlation and regression.

SUGGESTED BOOKS AND REFERENCES

UNIT- I
Chemistry of acids and bases
Dissociation of weak acids and bases, Hydrolysis of salts, Amphiprotic salts, Buffer solutions, Buffer capacity, Biological buffers, Ionization of drugs, pKa values of drug molecules, pH indicators.
Partition coefficient and biopharmacy

UNIT- II
Drug metabolism

UNIT III
Stability of drugs and medicines
Oxidation, Stability of free radicals, Prevention of oxidative deterioration, Autoxidation of fats and oils, Ageing, Hydrolysis, Examples of drugs susceptible to hydrolysis, Other mechanisms of degradation.

UNIT IV
Kinetics of drug stability
Rate, order and molecularity, Rate equations and first-order reactions, Half-life, Shelf-life, Second-order reactions, Zero-order reactions, Reaction rates and temperature.

BOOKS AND REFERENCES
1. Essentials of Pharmaceutical Chemistry (third edition) by Donald Cairns, Pharmaceutical Press
UNIT-I
Fuel Molecule Metabolism
Glycogenesis and glycogenolysis. Aerobic Respiration, glycolysis and regulation of glycolysis, citric acid cycle, regulation of the citric acid cycle, Electron transport chain Oxidative Phosphorylation, Regulation of Oxidative Phosphorylation, oxidative stress, anaerobic pathways, Lactic acid fermentation, pentose phosphate pathway.

UNIT-II
Enzymes
General Remarks, Isolation and Nomenclature of enzymes Enzyme structure and function, Factors that affects enzyme function- enzyme kinetics, Michaelis–Menten kinetics, Cooperativity, Control of enzyme activity- feedback regulation, enzyme inhibition, covalent modification. Enzyme Cofactors Theory of Enzyme Catalysis and Enzymatic Analysis.

UNIT-III
Marine Biomolecules and Application
Introduction and history of marine biomolecules, Discovery and development of marine pharmaceuticals, Isolation and screening of marine biomolecules, Occurrence, Structure and function of furanone, kainic acid, tyrian purple, ziconotide and dolastatin,

UNIT-IV
Fungal Biomolecules and Biomolecules of Mushrooms

BOOKS AND REFERENCES
1. www.mhpracticeplus.com/BBFLS_MCAT/mca88351_V1
2. Biomolecules and Nanotechnology, David S. Goodsell, American Scientist
3. Food Chemistry, H.D. Belitz et.al., Springer
1. Chromatographic separation and identification by paper chromatography and determination of Rf values:
   a. Cadmium and Copper.
   b. Zinc and Manganese.
   c. Arsenic, Antimony and Tin.
   d. Lithium, Sodium and Potassium.
   e. Fe$^{3+}$, Al$^{3+}$ and Cr$^{3+}$
   f. Ca$^{2+}$, Sr$^{2+}$ and Ba$^{2+}$
   g. Ni$^{2+}$, Co$^{2+}$, Mn$^{2+}$ and Zn$^{2+}$
   h. Cu$^{2+}$, Fe$^{3+}$, Ni$^{2+}$ and Ti$^{4+}$

2. Cerimetric titration:
   a. Standardization of ceric sulphate solution using ferrous ammonium sulphate as intermediate solution
   b. Determination of the percentage of H$_2$C$_2$O$_2$ in oxalic acid crystals.
   c. Determination of percentage purity of a sample of sodium nitrite.

2. Quantitative analysis:
   Separation and determination of two metal ions involving Volumetric and Gravimetric methods:
   b. Copper – Nickel
   c. Copper – Zinc
   d. Iron – Nickel
A. Chemical Kinetics
   i. Determining the energy of activation and entropy of activation in KMnO₄-benzyl alcohol reaction measuring the rate constant at least at three temperatures.
   ii. Determining the Formation Constant for the [Ce⁴⁺-H₃PO₂] intermediate complex and also the rate constant of its decomposition.
   iii. Determine the rate constant in bleaching of malachite green in the basic medium.
   iv. Determine the order with respect to Ag (I) in the oxidation of Mn (II) by S₂O₅²⁻ and the rate constant for the unanalyzed reaction.
   v. Investigate the autocatalysed reaction between KMnO₄ and Oxalic Acid.
   vi. Kinetics of enzyme catalyzed reactions.
   vii. Flowing clock reaction (Ref. Experiments in physical Chemistry by Snowmaker).

B. Spectrophotometry / Colorimetry
   i. Verify Beer’s Law for the solution of potassium permanganate (KMnO₄) and determine the concentration of the given aqueous solution of unknown concentration of this salt.
   ii. Determine the pH of the solution employing methyl red indicator spectrophotometrically.
   iii. Determine indicator constant (pKa) of methyl red, spectrophotometrically.
   iv. Determine stability constant of FeSCN⁺²⁺ complex ion spectrophotometrically keeping strength constant.

C. Electrochemistry
   i. Identification and Estimation of metal ions such as Cu⁺²⁺, Cd⁺²⁺, Ni⁺²⁺ Voltammetrically.
   ii. To plot a cyclic voltammogram of a reversible system and calculate the number of electron in the redox process.
   iii. To plot a voltammogram of a organic compound (such as nitroaniline, picric acid, m-dinitrobenzene) and verification of RandleSevcik equation (current vs scan rate and current vs concentration)
   iv. Determination of the strength of strong and weak acids in a given mixture using a potentiometer/pH meter.
   v. Determination of the formation constant of silver-ammonia complex and stoichiometry of the complex potentiometrically.
CHE D11: CHEMISTRY ELECTIVE LAB-3

Organic Chemistry group

A. Multi-step Organic synthesis based on Name Reactions
The exercise should illustrate the use of organic reagents and mechanism. Purification of products by chromatographic techniques.
   i. Photochemical reaction:
      (Benzophenone $\rightarrow$ Benzpinacol $\rightarrow$ Benzpinacolone)
   ii. Beckman Rearrangement: Benzanilide from benzene
        (Benzene $\rightarrow$ Benzophenone $\rightarrow$ Benzophenone oxime $\rightarrow$ Benzanilide)
   iii. Benzilic acid rearrangement: Benzilic acid from benzoin
        (Benzoin $\rightarrow$ Benzil $\rightarrow$ Benzilic acid).
   iv. Synthesis of heterocyclic compounds
       a. Skraup synthesis: Preparation of quinoline from aniline
   v. Diazocoupling: Phthalic anhydride $\rightarrow$ Phthalamide $\rightarrow$ anthranilic acid $\rightarrow$ methyl red.
   vi. More Name reaction based organic synthesis based on curricula may also be carried out.

B. Qualitative analysis: Separation of three component organic mixture and identification of its components, Preparation of their derivatives and verification with the help of IR and NMR spectral data provided.
CHE E11: CHEMISTRY ELECTIVE LAB-3

Pharmaceutical Chemistry group

i. Identification reactions of ions such as aluminium, ammonium salts, arsenic, calcium and sodium chloride.

ii. Identification reactions of functional groups such as Alkaloids, Barbiturates (non nitrogen substituted, Lactates, Tartrates).

iii. Assay of Hydrogen Peroxide Solution and Isolation of Bismuth from Pepto-Bismol

iv. The Isolation of Lactose from Milk

v. Assay for Galacturonic Acid

vi. Separation of Fatty Acids and Glycerol and Extraction of Glycerol

vii. Color Reactions of Proteins-Biuret Reaction, Ninhydrin Reaction, Xanthoproteic, Ehrlich Diazot Reaction

viii. Pharmacopeial qualifications of active pharmaceutical ingredients such as chloral hydrate, hexobarbital, caffeine, acetyl salicylic acid, atropine sulphate and quinine hydrochloride

ix. Preparations of Benzocaine and Acetaminophen

x. Assay of Sulfadiazine Tablets and Assay of Amitriptyline HCl

xi. Thiamine Assay of Vitamin B Complex Tablets

xii. Determination of Vitamin C content of Commercial Tablets

Books suggested


2. Pharmaceutical Chemistry I- laboratory Experiments and Commentary, Attila Almansi et.al, EU Social Fund Project

Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR
CHE X01: SOLID STATES AND NANOMATERIALS
4 Credit (4 hrs/week)

UNIT-I

Solid State Chemistry
Introduction to the solid state, defects of solids, classification of imperfections, Electronic defects, atomic defects, Lattice imperfections, thermodynamics of Schottky defect and Frenkel defect. Electrical, optical, magnetic and thermal properties of inorganic materials.

Solid State Reactions: general principles, types; sintering; nucleation; Factors influencing the reactivity of solids; co-precipitation as a precursor to solid state reactions, kinetics of solid state reactions.

UNIT-II

Superconductors
Superconductors, with special emphasis on the synthesis and structure of high temperature superconductors; solid state LASERS (Ruby, YAG and tunable lasers): Inorganic phosphor materials; synthesis and advantages of optical fibers over conducting fibres, diffusion in solids, catalysis and zone refining of metals.

UNIT-III

Diffraction Methods
A. X-ray Diffraction
Bragg condition, Miller indices, Laue Method, Bragg method, Debye Scherrer method of X-ray structural analysis of crystals, index reflections, identification of unit cells from systematic absences in diffraction pattern, Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem; description of the procedure for an X-ray structure analysis, absolute configuration of molecules.

B. Electron Diffraction
Scattering intensity vs. scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules, low energy electron diffraction and structure of surfaces.

UNIT-IV

Nanomaterials
Various preparative approaches and techniques; characteristic differences of nanomaterials over bulk materials; dynamic light scattering, atomic force microscopy and characterization of nanomaterials; imaging techniques: electron microscopy (Scanning Electron Microscopy, Transmittance Electron Microscopy). Applications of nanomaterials.

SUGGESTED BOOKS AND REFERENCES
10. G. Temp, Ed. Nanotechnology; Springer-Verlag; N.Y., 1999
UNIT I

Reterosynthetic Analysis
An introduction to synths and synthetic equivalents. Disconnection approach, good disconnections, functional group inter-conversions, importance of the order of events in organic synthesis. One group C-X disconnections. Chemo selectivity. Two group C-X disconnections.
Reversal of polarity (Umpolung), generation of acyl anion equivalent-1,3-dithiane from carbonyl compounds, use of methylthio-methylsulfoxide via cyanide ion and cyanohydrin ethers, nitro compounds and metalled vinyl ethers.
Protecting Groups: Principle of protection of carbonyl, hydroxyl, amino and carboxyl groups.
Enamines: Preparation and synthetic applications

UNIT II

One Group C-C Disconnections
One group C-C disconnection involving alcohols and carbonyl compounds, regioselectivity. Alkene synthesis, use of acetylenes, aliphatic nitro compounds in organic synthesis.
Two group C-C Disconnections
Diels-Alder reaction. 1,3-Difunctionalised compounds; α,β-unsaturated carbonyl compounds; control in carbonyl condensation; 1,5-difunctionalised compounds, Michael addition and Robinson annulation.
1,2-Difunctionalised compounds. Radical reactions in synthesis. 1,4-Difunctionalised compounds.
Reconnections. 1,6-Difunctionalised compounds.

UNIT III

Ring Synthesis
Introduction to ring synthesis of saturated heterocycles. General strategy and stereoselectivity. 3-Membered rings from cyclisations and insertion reactions. Rerarrangements in synthesis. 4-Membered rings from photocycloadditions and use of ketenes.
Five-membered rings from 1,4- and 1,6-dicarbonyl compounds. Pericyclic rearrangements and special methods. 6-Membered rings from carbonyl condensations, Diels-Alder reactions and reduction of aromatic compounds. Synthesis of aromatic Heterocycles.

UNIT IV

Asymmetric Synthesis

Organic Transformations by C-H functionalization

SUGGESTED BOOKS AND REFERENCES
UNIT-I
Quantum Mechanical aspects of Chemical bonding:

UNIT-II
Non Equilibrium Thermodynamics and Magnetochemistry:
Thermodynamic criteria of non-equilibrium state, Entropy production and entropy flow, Entropy balanced equations for different irreversible states (e.g. Heat flow, chemical reaction etc), transformations of generalized fluxes and forces, non-equilibrium stationary state, phenomenological equation, Microscopic reversibility and Onsager's reciprocity relations, electro-kinesis phenomenon and electrical conduction.

UNIT-III
Macromolecules – I

UNIT-IV
Macromolecules – II

SUGGESTED BOOKS AND REFERENCES
Metalloenzymes:
Structure and functions of the following enzymes: carbonic anhydrase, carboxypeptidase, alchoholdehydrogenase, catalase and peroxidase, cytochrome P-450, super oxide dismutase and xanthin oxidase, coenzyme, vitamin B12.

UNIT-II
Metal Storage and Transport:
Iron storage and transport for mammalia systems, transferrin, ferritin, Transport of iron in microorganism, siderophores, types of siderophores - The catecholate siderophores (eg: enterobactin) and hydroxamate siderophores (eg: ferrichrome), Mechanism involved in binding of Iron(III) siderophores complexes to receptors and the release of Iron into the Cytoplasm. Other storage & transport systems: ceruloplasmin and serum albumin for copper, metallothioneins and phytochepatins.

UNIT-III
Metal/Nucleic Acid Interactions
Metal complexes of polynucleotide, nucleosides and nucleic acids (DNA and RNA), Fundamental interactions with nucleic acids, Fundamental reactions of transition metal complexes with nucleic acids, Applications of different Metal Complexes that bind nucleic acids.

UNIT-IV
Metal Deficiency and Diseases:
Iron, zinc and copper deficiency, metal ion toxicity, copper over load and Wilson's disease, iron toxicity, toxicity of arsenic, cadmium, mercury and lead, metal complexes in medicine – chelation therapy – BAL, penicillamine, polyamino carboxyclic acids and desferroxamine – gold compounds and rheumatoid arthritis – platinum complexes as anticancer, drugs – metal complexes in radio diagnosis and magnetic resonance imaging.

SUGGESTED BOOKS AND REFERENCES
UNIT I

Industrial Chemistry: Ferrous and non-ferrous metal industries - quality control methods, general principles applied in studying an industry; manufacture of iron, steel and alloy steels; introduction to metallurgy; metallurgy of iron, aluminium, copper, gold and silver; contaminants; waste management; recycling and pollution control; deformation in metals; modes of failure analysis; an overview of corrosion & its protection; industrial shaping of metals.

UNIT II

Cement: Classification of cement, manufacture of portland cement, setting and hardening of cement, chemical constitution of portland cement and their characteristics, special cements and their uses, Cement Industries in India.

Ceramics: Classification of ceramics, basic raw materials, manufacture and applications, components imparting colours, comparison of pottery porcelain and china ware. Glass raw materials, manufacture and applications: special glass, optical, borosilicate, flint and coloured glasses.

UNIT III

Chemistry of Selective Materials
Solid electrolytes: AgI, RbAgal, β-Alumina - NASICON - Principles and Applications of solid electrolytes.

Ferroelectric, piezoelectric and pyroelectric materials - principle, properties and applications. LED principle - types, advantages and disadvantages of LED displays.

Liquid crystal display LCD - properties - twisted nematic field display - Advantages and disadvantages of LCD - comparison of LCD & LED.

Shape Memory alloys (SMA) - classification - working principles. Non-linear optical materials - second harmonic generators.

UNIT IV

Chemistry of Inorganic Materials: Refractories - characterization properties and applications.
Microscopic composites; dispersion strengthened and particle reinforced, fibre reinforced composites, macroscopic composites. Nanocrystalline phase, preparation procedures, special properties and applications.

SUGGESTED BOOKS AND REFERENCES

13. Study Material in Vocational subject, Industrial Chemistry (UGC Sponsored).
UNIT-I

Basic Concept
Introduction, Photochemical laws and photochemical kinetics. Physical properties of the electronically excited molecules; Photophysical processes in electronically excited molecules.

UNIT-II

Photophysical Properties
Photophysical kinetics of Biomolecular processes; kinetics of collisinal quenching; Stern-Volmer Equation, Concentration dependence of quenching and excimer formation, charge transfer mechanism and energy transfer mechanism.

UNIT-III

Photochemical Reactions
Photoelectrochemistry of excited state redox reactions. Photosensitization. Types of Photochemical reactions; substitution, decomposition and fragmentation, rearrangement, and redox reactions, photochemistry of metallocenes.

UNIT-IV

Redox Reactions by Excited Metal Complexes
Redox reactions of metal complexes in excited states, excited electron transfer, examples using [Ru(bpy)3]²⁺ complex and [Fe(bpy)₃]³⁺ complex. Role of spin-orbit coupling, life-times of excited states in these complexes.

Metal Complex Sensitizers: Electron relay, semiconductor supported metal oxide systems, water-photolysis, nitrogen fixation and carbon dioxide reduction.

SUGGESTED BOOKS AND REFERENCES:

UNIT - I

Induced Phenomena:
Induced reactions, kinetics of Induced reactions and their characteristics. Induction factor and its
mechanistic significance. Mechanism of –
(i) Fe (II) induced oxidation of iodide by Cr (VI).
(ii) As (III) induced oxidation of Mn (II) by chromate in acid solutions.
(iii) Kinetics and mechanism of induced reactions in metal complexes (octahedral complexes of cobalt
(III) only).

UNIT II

Metal Ion Catalysis: Kinetics and Mechanism of following Reactions
(i) When reaction rate is independent of one of the reactants in presence of metal ion catalyst.
(ii) When reaction rate is retarded by one of the products in presence of metal ion catalyst.
(iii) When metal ion catalysis indicates an intermediate species.
(iv) Cyclodextrines are acting as catalyst mode of catalysis. Analysis of one full case study of B-
cyclodextrine, catalysed reaction, Hydroformylation reaction

UNIT – III

Oscillatory Reactions: Autocatalysis and oscillatory reactions, thermodynamics approach of
oscillatory reactions, Kinetics and mechanism of Belousov-Zhabotinski (B-Z) reaction
Substitution Reaction: Classification of ligand substitution reaction, Kinetics and mechanism of
Anation reaction; base catalyzed reaction and acid catalyzed reaction. Kinetics and mechanism of 1:1,
1:2 and 1:3 metal-substrate complexes as intermediates.

UNIT – IV

Electron Transfer Reactions in Metal Complexes:
Inner-sphere and outer-sphere reactions, Mechanism of inner sphere and outer sphere mode of electron
transfer reactions. Henry Taube’s classical reaction, its kinetics and mechanism, experimental analysis
by chromatographic and spectroscopic techniques. Pattern of reaction via adjacent and remote attacks,
linkage isomerism.

Marcus -Cross-relation in outer-sphere reactions, (no mathematical derivation) in following reactions-
Fe(CN)₆⁴⁻ + Fe(CN)₆³⁻ = Fe(CN)₆³⁻ + Fe(CN)₆⁴⁻.
Ce(IV) + Fe(CN)₆⁴⁻ = Ce(III) + Fe(CN)₆³⁻.
Bridged outer-sphere electron transfer mechanism.

SUGGESTED BOOKS AND REFEREN
5. S. W. Benson, Jacob Kleinberg, R. Kent Murmana, R. T. M. Fraser, John Bauman, Mechanism of
CHE C05: ADVANCED ELECTROCHEMISTRY – II

UNIT-I

Electrochemical analysis
Introduction to electrochemical methods, electrochemical cells, diffusion controlled limiting current, voltage scanning polarography, shape and interpretation of polarographic wave, current-voltage relationship during electrolysis. General Principle and applications of Linear Sweep Voltammetry (LSV), Cyclic Voltammetry (CV), Square Wave Voltammetry (SWV), and Differential pulse Voltammetry (DPV). Stripping voltammetry: Principle, classification and Applications.

UNIT-II

Electro-catalysis
Chemical catalysis and Electro-catalysis, cathodic and anodic electro catalysis; electrocatalysis of mixed oxides of titanium doped with rare earth oxides (Ebonex); Electrolysis in simple redox reactions. Electro catalysis of bimetallic nanostructured materials.

UNIT-III

Electro-organic Synthesis
Types of electro organic reactions, constant current and constant potential electrolysis, cell design, effect of variable, nature of medium, nature of electrode materials, over-voltage, effect of redox couple, application to sewage waste water treatment, electro-chemical incineration of human waste in combined space. Electro-organic synthesis of novel drugs.

UNIT-IV

Electrochemical Sensors
Electrochemical Sensors for Nitric Oxide (NO), pesticides, glucose and superoxide species, Electrochemical sensors based on carbon nano tubes and their applications.


SUGGESTED BOOKS AND REFERENCES
CHE C06: ADVANCED NANOSCIENCE AND NANOTECHNOLOGY
4 Credit (4 hrs/week)

UNIT I

Nanoscience and Nanotechnology
Basic concepts of Nano science and technology. Quantum wire, Quantum well, Quantum dot. Properties and technological advantages of Nano materials. Material processing by Sol. Gel method, Chemical Vapour deposition and Physical Vapour deposition methods.

UNIT II

Synthesis
Top-down (Nanolithography, CVD), Bottom-up (Sol-get processing, chemical synthesis). Wet Deposition techniques, Self-assembly (Supramolecular approach), Characterization TEM, SEM and SPM technique, Fluorescence Microscopy and Imaging.
Use of bacteria, fungi, Actinomycetes for nanoparticle synthesis, Magnetotactic bacteria for natural synthesis of magnetic nanoparticles; Viruses as components for the formation of nanostructured materials; Synthesis process and application, Role of plants in nanoparticle synthesis.

UNIT III

Nanoscale Carbon
Introduction –Carbon molecules-nature of the carbon bond-new carbon structures-discovery of C60-structure of C60 and its crystal- From a Graphene Sheet to a Nanotube, Single wall and Multi walled Nanotubes, Zigzag and Armchair Nanotubes, Euler's Theorem in Cylindrical and Defective Nanotubes.
History Molecular and Super molecular Structure-Intrinsic properties of individual carbon nano tubes-Synthesis -Arcing in the present and absent of catalyze-laser method-Chemical Vapour Deposition -ball milling.

UNIT IV

Applications
Solar energy conversion and catalysis, Polymers with a special architecture, Liquid crystalline systems, Applications in displays and other devices, Advanced organic materials for data storage, Photonics, Plasmonics, Chemical, electrochemical and biosensors, Nanomedicine, Nanofoods, Nanocosmetics and Nanobiotechnology.

SUGGESTED BOOKS AND REFERENCES
UNIT-I
Extraction Techniques for Natural Products
Supercritical Fluid Extraction – Introduction, Principle of Solvent-Free Extraction Process, Applications to the extraction of natural products.
Microwave Assisted Extraction – Introduction, Principle of the method and heating mechanism Instrumentation, Applications to the extraction of natural products.
Ultrasound Assisted Extraction – Introduction, Principle of the method, Instrumentation, Applications to the extraction of natural products.
Pressurised Solvent Extraction- Introduction, instrumentation, Applications to the extraction of natural products

UNIT –II
Isolation and Separation of Natural Products

UNIT –III
Biosynthesis of Natural Products

UNIT –IV
Structure elucidation of Some Naturally occurring compounds
Structure elucidation of ferulic acid, beta-sitosterol, stigmasterol, curcumine, plumericin. Abietic acid, taxol, lanosterol, lupeol, strychnine, camptothecin, Usnic acid and quercetin by IR, UV, NMR and mass spectral data.

SUGGESTED BOOKS AND REFERENCES
9. https://www2.chemistry.msu.edu/faculty/reusch/virtxtjml/lipids.htm/synth
UNIT-I


UNIT-II

Cardiovascular Drugs: Introduction, Classification and general mode of action, Cardiovascular disease, drug inhibitors of peripheral sympathetic function. Synthesis of Sorbitrate, Diltiazem, Verapamil, Methylldopa, Atinolol.

Diuretics: Introduction, Classification and general mode of action, Synthesis of Acetazolamide, Chlorothiazide, Frusemide, Spironolactone, Triamterene.

Hypoglycaemic Agents: Introduction, General mode of action, Insulin and insulin preparations, Oral hypoglycaemic agents: Classification, Synthesis of Tolbutamide.

UNIT-III

Psychoactive drugs: Introduction, Neurotransmitters, CNS depressants, general anaesthetics, mode of action of hypnotics, sedatives, antianxiety drugs.

Anticonvulsant Drugs: Introduction, Classification and general mode of action, synthesis of Phenytoin sodium, Troxidone, Ethosuximide, Primidone.

Antiviral Drugs: Introduction, Classification and general mode of action, synthesis of Amantadine, Hydrochloride, Idoxuridine, Methisazone.

UNIT-IV


Antihistamines: Introduction, Classification and general mode of action, Synthesis of Pheniramine, Promethazine, Ranitidine, Sodium Cromoglycate.

Analgesics and Antipyretics: Classification, Nonnarcotic analgesic. Synthesis of Mefenamic acid, Diclofenac.

SUGGESTED BOOKS AND REFERENCES


Dy. Registrar
(Academic)
University of Rajasthan
JAIPUR
CHE E03: PHARMACEUTICAL CHEMISTRY II

4 Credit (4 hrs/week)

Unit I

Dosage Form Design
Need for dosage form, General considerations for dosage form design, Definition and types of pharmaceuticals ingredients and excipients, Flavouring, sweetening and colouring pharmaceuticals, Preservatives—sterilization and preservation, preservative selection, general consideration, and mode of action

Unit II

Solid Modified—Release Drug Delivery System
Rationale for extended release pharmaceuticals, Drug candidates for extended-release products, Extended-release technology for oral dosage forms, Delayed-release oral dosage forms.

Transdermal drug delivery systems
Transdermal drug delivery systems—introduction, factors affecting percutaneous absorption, percutaneous absorption enhancers, Advantages and disadvantages of TDDSs

Unit III

Novel Dosage Forms
Novel drug delivery systems—introduction and composition, Iontophoresis (IP) and phonophoresis, Mucoadhesive system, Medicated gums, Intravaginal drug delivery system, Intrauterine progesterone drug delivery system, Bioadhesive vaginal gel, Dinoprostone Vaginal Insert, Estring Long-acting parenteral systems, Liposomes as drug delivery vehicles

Unit IV

Products of Biotechnology
Introduction, Techniques for the production of biotechnologic products, Products of biotechnology such as Anticoagulant Drug: Leprudin (Refludan) Antisense Drugs: Fomiviren Sodium (Vitravene), Erythropoietins, Epoetin Alfa, Growth Factor: Becaplermin, Human Growth Hormone, Systemic Growth Hormone, Interferons and Interleukins

BOOKS AND REFERENCES
3. Drug delivery: principles and applications, Binghe Wang, Teruna Siahaan, Richard Soltero, John Wiley & Sons,

[Signature]
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University of Rajasthan
JAIPUR
Biotechnological Applications of Enzymes
Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-brewing and cheese-making, syrups from crown starch, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA technology.

UNIT II
Prodrugs Approaches to Drug Delivery
Introduction, Basic concepts: definition and applications, Prodrug design considerations, Prodrugs of various functional groups- Ester prodrugs of compounds containing -COOH or -OH, Prodrugs of compounds containing amides, imides, and other acidic NH (Mannich bases and N-a-Acyloxyalkyl derivatives, Prodrugs of amines, Prodrugs for compounds containing carbonyl groups

UNIT III
Radiopharmaceutical:
Introduction, Background information, Therapeutic use of radiopharmaceuticals, Representative radiopharmaceutical drugs and primary uses, Mode of actions of some important radiopharmaceuticals such as Technetium-99 m, Strontium-89 Chloride, Yttrium-90 and Thallous-201 Chloride.

UNIT IV
Non radioactive Pharmaceuticals in Nuclear Medicine
Introduction, Mode of action and use of Acetazolamide, Cimetidine, Dipyridamole Adenosine, Furosemide and Vitamin B12, Practice of nuclear pharmacy, Procurement and storage.

SUGGESTED BOOKS AND REFERENCES
2. Understanding Enzymes, Trevor Palmer, Prentice Hall.
5. Pharmaceutical Dosage Forms and Drug Delivery Systems, Loyd V. Allen junior et al., Wolters Kluwel
CHE A21: PROJECT WORK

Project Work: 12 Credits (180 hrs)
EoSE: Max. Marks: 100

Project report duly signed by the project guide will be submitted at the end of Project work. The EoSE assessment of the Project Work shall be as per University guidelines.

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