COOCH BEHAR PANCHANAN BARMA UNIVERSITY

NCCF SYLLABUS for M.Sc (Two Year – Four Semester Course) in CHEMISTRY

Total Credit : 80 **Credit per Semester : 20**

Total Marks = 1600 **Theory = 750** **Practical = 250**

Cont. Evaluation = 280 **Viva/Seminar = 50** **Attendance = 70** **Research (including attendance) = 200**

Course Structure

(Marks and Credit Distribution)

Sem	Paper Code	Paper Name	Theory					Practical/Project/Seminar/Viva			Total Marks	Total Credit
			ESE	CE	Atten	Total	Credit	Practical	Seminar /Viva	Credit		
I	Core-1	Organic Chemistry-I	50	20	05	75	4	25	-	1	100	5
	Core-2	Inorganic Chemistry-I	50	20	05	75	4	25	-	1	100	5
	Core-3	Physical Chemistry-I	50	20	05	75	4	25	-	1	100	5
	DCE (One Subject is to be Chosen out of Three)	A. Spectroscopy OR B. Soil Chemistry OR C. SWAM Course	75	20	05	100	5	-	-	-	100	5

II	Core-4	Organic Chemistry-II	50	20	05	75	4	25	-	1	100	5
	Core-5	Inorganic Chemistry-II	50	20	05	75	4	25	-	1	100	5
	Core-6	Physical Chemistry-II	50	20	05	75	4	25	-	1	100	5
	GE (One Subject is to be Chosen out of three)	A. Advanced Spectroscopy OR B. Chemistry of Biomolecules OR C. Concepts of Drug Design in Ayurveda (IKS)	75	20	05	100	5	-	-	-	100	5
III	CW-1	Organic Chemistry-III	50	20	05	75	4	25		1	100	5
	CW-2	Inorganic Chemistry-III	50	20	05	75	4	25		1	100	5
	CW-3	Physical Chemistry-III	50	20	05	75	4	25		1	100	5
	RP-1	Research Paper-1	Hands-on Experiment = 20, Project (including Report) = 30, Educational Tour =25, Power Point Presentation = 20, Attendance = 05								100	5
IV	CW-4	Advanced Chemistry – I (Organic & Inorganic)										
	CW-5	Advanced Chemistry– II (Physical Chemistry & Advanced Materials)										

	CW-6 (One Subject is to be chosen out of A, B & C)	Course Work Special Paper (A, B or C) A: Organic Chemistry Special B: Inorganic Chemistry Special C: Physical Chemistry Special										
	RP-2	Research Paper-2	Project (including Report) = 30, Power Point Presentation of Project Work = 20, Attendance = 05, Grand Viva = 15, Seminar Attendance = 10, Review Work (Term Paper) = 20								100	5

COOCH BEHAR PANCHANAN BARMA UNIVERSITY

Syllabus for Two-Year (Four Semester) Post Graduate Course in Chemistry (w.e.f 2026 –2027)

SEMESTER – I

Core-1: Paper Name: Organic Chemistry-I (Theory)

Paper Code: Core-1T

Theory: Credit – 4, Full Marks – 75

A. Nucleophilic and Electrophilic Aromatic substitution:
(15 Lectures)

Aromatic Nucleophilic substitution: SN1(Ar), SN2 (Ar), and benzyne mechanisms; evidence for the structure of benzyne. Von Richter rearrangement. Definition and

types of ambident nucleophiles. 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.

B. Reagents in organic synthesis

(15 Lectures)

Use of following reagents in organic synthesis and functional group transformations – complex metal hydrides, Gilman's reagent, lithium dimethyl cuprate, LDA, DCC, Merrifield resin, Peterson's synthesis, Lawesson's reagent, Wilkinson's catalyst, Baker yeast., hypervalent organoiodines (introduction) and reagents of non-transition metals – Zn, Cd, Sm and In

C. Heterocyclic Chemistry

(20 Lectures)

Nomenclature of bicyclic and tricyclic fused systems; Introduction to the chemistry of azepins, oxepines, thiophenes and their aza analogues; Phosphorus and selenium containing heterocycles, Cyclazines. Synthesis and reactions of Aziridines, azetidines, oxazoles, thiazoles, imidazoles, isoxazoles, isothiazoles, pyrazoles, Pyridine, quinoline, Isoquinoline, Imidazole, Benzofuran, Benzothiophene, Pyrazole, Indoles, pyrimidines, pyridazines, pyrazines, purines, isothiazole, pteridines compounds and higher azoles and corresponding fused systems. Role of heterocyclic compounds in biological systems

D. Multi-component reactions:

(10 Lectures)

Biginelli, Strecker synthesis, Hantszch pyridine synthesis, Multicomponent reactions using alkyl isocyanides: Passerini and Ugi-4-componentsynthesis.

Core-1: Paper Name: Organic Chemistry-I (Practical) (10 practical classes, each practical class is of 3 hours)

Paper Code: Core-1P

Practical (P): Credit – 1, Full Marks – 25

Isolation of Natural products (Any three)

1. Extraction of curcumin from turmeric.
2. Extraction of caffeine from tea/coffee.
3. Extraction of cinnamaldehyde from cinnamon
4. Extraction of Eugenol from clove
5. Extraction of Lycopene from tomatoes

Reference:

Organic Chemistry, Vol. II - I. L. Finar
Heterocycles in Organic Synthesis - A.I. Meyers, Wiley
Heterocyclic Chemistry - J.A. Joule and K. Mills, Blackwell
Heterocyclic Chemistry - T.L. Gilchrist, Wiley
Name Reactions: A Collection of Detailed Reaction Mechanisms and Synthetic Applications J. J. Li

Core-2: Paper Name: Inorganic Chemistry-I (Theory)

Paper Code: Core-2T

Theory: Credit – 4, Full Marks – 75

A. Structure & Bonding of Inorganic molecule:

(10 Lectures)

Bonding in homonuclear and heteronuclear diatomic molecules of 2nd period. Bonding in triatomic (H_3+, BeH_2, H_2O), tetra-atomic (BH_3, NH_3) and CH_4. MO diagrams, Walsh diagrams. Models of structure prediction

B. Coordination Chemistry-I:

(18 Lectures)

Adjusted CFT, Effect of crystal field stabilization on ionic radii, lattice energy, hydration enthalpy and stabilization of complexes (Irving Williams order). Site preference in mixed metal oxides (Spinel and inverse spinel structures). Tetrahedral distortion and Jahn Teller effect, Static and Dynamic Jahn-Teller effect. Qualitative idea of splitting of d orbitals in various geometries, calculation of energies of d-orbitals in various symmetries using Krishnamurty & Schaap approach, Factors effecting Dq value, spectrochemical series and Nephelauxatic series; spectrochemical series for metal ion, Dq value for $MX_{(6-i)}Y_i$ complexes.

C. Reaction Mechanism-I:

(18 Lectures)

Inert and labile complexes, consideration of octahedral substitution reactions in the light of VBT and CFT. Mechanism of substitution reactions, Classification of reactions of complex compounds, energy profile diagram of ligand substitution reactions-associative (A), dissociative (D), interchange (I) etc. type pathways, relation between intimate and stoichiometric mechanisms of ligand substitution

D. Clusters-I

(15 Lectures)

Higher boranes, carboranes, metalloboranes and metallocarboranes. Metal carbonyls and halide clusters, compounds with metal-metal multiple bonds.

Core-2: Paper Name: Inorganic Chemistry-I (Practical)

(10 practical classes, each practical class is of 3 hours)

Paper Code: Core-2P

Practical (P): Credit – 1, Full Marks – 25

Inorganic qualitative analysis: Less common metals –Mo, W, Ti, Zr, Th, V, U, Ce and all the radicals included in the B. Sc (Honours) Chemistry syllabus.

(30 Classes)

Suggested Books

- Inorganic Chemistry: Purcell and Kotz
- Ligand field theory and its application by B. N. Figgis
- Inorganic chemistry, principal of structure and reactivity by J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi
- Inorganic Chemistry, 4th edition by C. E. Housecroft, A. G. Sharpe
- Inorganic Chemistry by Shriver and Atkins
- Inorganic Chemistry, Vol.- 5 by A. K. Das, M. Das
- Elements of magnetochemistry by R. L. Dutta, A. Shyamal
- Chemistry of elements by N. N. Greenwood and A. Earnshaw
- Inorganic Chemistry: Principles , D. Banerjea
- Hand book of Inorganic analysis, G. N. Mukherjee
- Vogel's Quantitative Inorganic analysis, G. Svehla & B. Shivasankar

Core-3: Paper Name: Physical Chemistry-I (Theory)

Paper Code: Core-3T

Theory: Credit – 4, Full Marks – 75

A. Quantum Chemistry

(30 Lectures)

Wave equation, operator algebra, commutation relations, Basic postulates and general principles of quantum mechanics, Schrödinger equation, physical interpretation of wave function, stationary states, functions and their properties, Fourier transform, theorems, projection operator, ladder operator, parity operator, exact uncertainty and Heisenberg uncertainty relations, Heisenberg's equation of motion, virial theorem; Translational Motion: free particle, particle in a one-, two- and three-dimensional box,

finite barrier problem and tunnelling; Linear Harmonic Oscillator: derivations of wave functions, energy expression, and selection rules; Rotational Motion of single-particle: commutation relations of angular momentum operators, derivations of angular momentum eigenvalues and wavefunctions, Rigid rotor, selection rule. Hydrogen atom problem and its implications.

B. Classical Thermodynamics:

(10 Lectures)

Brief review of 1st, 2nd and 3rd laws of thermodynamics, Nernst heat theorem and the third law of thermodynamics, calculation of entropy changes in chemical reactions. Mathematical and thermodynamic probability, Entropy and probability, the free energy of a mixture, Partial molal quantities, Analytical form of the chemical potential in ideal solutions, Chemical potential of a solute in a binary solution, Application of Gibbs Duhem equation, Nonideal solutions, concept of activity: experimental determination of activity coefficients of non-electrolytes, Application of thermodynamics to micelles and microemulsion.

C. Chemical Kinetics – I

(15 Lectures)

Potential energy surface: reaction coordinates and reaction paths, Transition state theory and thermodynamics, Reactions in solutions: enzyme catalysis and enzyme inhibition reactions, ionic reactions, oscillating reaction. Fast reactions: Flow and stop-flow technique, Flash photolysis, Relaxation and Nuclear magnetic resonance techniques

D. Macromolecules

(10 Lectures)

Polymer definition, various types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics and mechanism of polymerization. Molecular mass, number and mass average molecular mass, molecular mass determination by various methods (osmometry, viscometry, diffusion and light scattering), sedimentation, chain configuration of macromolecules, and calculation of average dimensions of various chain structures, visco-elasticity

Core-3: Paper Name: Physical Chemistry-I (Practical)

(10 practical classes, each practical class is of 3 hours)

Paper Code: Core-3P

Practical (P): Credit – 1, Full Marks – 25

1. Studies on the kinetics of iodination of acetone.
2. Determination of solubility product of PbI2 by titrimetric method.
3. Verification of Beer's law and studies on the kinetics of alkaline hydrolysis of crystal violet.
4. Conductometric titration of a mixture of acids.
5. Estimation of acid potentiometrically.
6. Estimation of acid pH metrically.
7. Ion exchange capacity of resin.
8. Determination of coordination number of Cu++ (partition method).

Suggested Text Books:

1. Quantum Chemistry -- A B Sannigrahi
2. Quantum Chemistry – I.N. Levine
3. Quantum Chemistry – Donald A McQuarrie
4. Chemical Kinetics (3rd edition) Pearson Publisher by K. J. Laidler
5. Polymer Science (3rd Edition) by V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar
6. Thermodynamics for Chemists – S. Glasstone
7. Thermodynamics – P.C.Rakshit
8. A Text Book of Physical Chemistry Vol.II – K.L. Kapoor
9. A Textbook of Physical Chemistry, Vol 5, by K. L. Kapoor, McGraw Hill Publisher
10. Introductory polymer chemistry, by G. S. Misra
11. Text Book of Polymer Science, F.W. Billmeyer
12. Chemical Thermodynamics (Classical, Statistical & Irreversible) by Hrishikesh Chatterjee
13. Practical Physical Chemistry by Renu Gupta (New Age International Pubisher)
14. An Advanced Course in Practical Chemistry by A.K. Nad, B. Mahapatra, A. Ghoshal

DCE: A. Paper Name: Spectroscopy

Paper Code: DCE-A

Credit – 5, Full Marks – 100

A. Basic Concepts, Electronic Spectroscopy and LASER

(15 Lectures)

a. Introduction to basic principles, Widths and Intensities of spectral transitions, Fourier transform, computer averaging techniques.

b. Electronic spectroscopy: Born-Oppenheimer approximation, vibrational coarse structure, Franck-Condon principle, dissociation energy and dissociation products, rotational fine structure, predissociation.

c. Basic principle of LASER.

B. Microwave Spectroscopy

(10 Lectures)

Classifications of molecules based on moments of inertia, Rotational spectra, Rigid and non-rigid rotor model, Selection rules, Spectral intensity, degeneracy and relative population of energy levels, Isotopic substitution. Symmetric top molecules.

C. Infra-red Spectroscopy:

(10 Lectures)

Vibrational and rotation-vibrational spectra, Simple harmonic oscillator model, Selection rules, Fundamentals and overtones, Hot bands, Q, P, and R branches, Chemical analysis by IR techniques.

D. CD, ORD; Mössbaur & EXAFS:

(15 Lectures)

Overview of Advanced Spectroscopic Methods, Optical Activity and Circularly Polarized Light, Optical Rotatory Dispersion (ORD), Circular Dichroism (CD): CD Spectra and Electronic Transitions and applications to coordination compounds. Mössbauer Effect: Fundamental Principles, Isomer Shift and Quadrupole Splitting, Applications to Fe(II) vs Fe(III), effect of spin and coordination environment.

Fundamentals of X-ray Absorption Spectroscopy, EXAFS Data Analysis and Structural Information.

E. 1H NMR:

(16 Lectures)

Principle, instrumentation and different techniques (CW & FT) of NMR spectroscopy, factors influencing chemical shift, spin-spin interactions, coupling constant (J), spin decoupling, spin tickling, classification of ABX, AMX, ABC, A2B2 in proton NMR.

Suggested Text Books:

1. Organic Spectroscopy -- Dyer & Silverstein
2. Fundamentals of Molecular Spectroscopy -- C. N. Banwell
3. Fundamentals of photochemistry -- K. K. Rohatgi-Mukherjee
4. Introduction to Molecular spectroscopy -- G M Barrow
5. Introduction to Molecular spectroscopy -- G M Barrow

DCE: B. Paper Name: Soil fertility & fertilizer use

Paper Code: DCE-B

Credit – 5, Full Marks – 100

A. Soil fertility and soil productivity; nutrient sources:

Fertilizers and manures; essential plant nutrients - functions and deficiency symptoms. Law of soil fertility soil and fertilizer nitrogen – sources, forms, immobilization and mineralization, nitrification, denitrification; biological nitrogen fixation; nitrogenous fertilizers and their fate in soils; management of nitrogenous fertilizers.

B. Soil and fertilizer phosphorus:

Forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting on availability in soils; phosphatic fertilizers - behavior in soils and management under field conditions. Potassium - forms, equilibrium in soils and its significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions.

C. Sulphur, Calcium and Magnesium:

Source, forms, fertilizers and their behavior in soils; factors affecting their availability in soils; management of fertilizers. Micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability.

D. Fertilizer use efficiency:
Blanket fertilizer recommendations and limitations; site-specific nutrient management; plant need based nutrient management; integrated nutrient management. Common soil test methods for fertilizer recommendations; quantity– intensity relationships; DRIS, soil test crop response. Soil fertility evaluation, tests; soil quality in relation to sustainable agriculture.

DCE: C. SWAM Course

Paper Code: DCE-C (SWAM)

Credit – 5, Full Marks – 100

Topics will be chosen from the relevant courses offered by SWAM during the concerned Session/Semester.

SEMESTER - II

Core-4: Paper Name: Organic Chemistry-II (Theory)

Paper Code: Core-4T

Theory: Credit – 4, Full Marks – 75

A. Click chemistry:

(8 Lectures)

Criterion for click reaction, Sharpless azides cycloadditions, Domino/cascade reactions.

B. Selective Name Reactions: (20 Lectures)

Barton, Baylis Hillman reaction, Benzoin condensation, Chichibabin Reaction, Darzens reaction, Dieckman condensations, Grignard reactions. Henry reaction, Knovengeal reaction, Mannich, McMurry, Perkin, Peterson olefination, Reformatsky and Reimer-Tiemann, Robinson Annulation. Stobbe, Stork enamine reaction and

selective mono and di alkylation via enamines. Wittig and its modifications and other reactions, Oppenauer oxidation, Mitsonobu Reaction.

C. Organometallic Reagents:

(20 Lectures)

Principle, preparations, properties and application of organometallic compounds of transition elements – Cu, Pd, Ni, Fe, Co, Rh, Ru, Cr and Ti in organic synthesis and in homogeneous catalytic reactions (hydrogenation, hydroformylation, isomerization and polymerization), structure and mechanistic aspects, Davies rule, catalytic nucleophilic addition and substitution reaction, coupling reaction – Heck, Stille, Suzuki coupling, Sonogashira, Buchwald-Hartwig , Hiyama, Glazer-Eglington coupling, Ziegler Natta reaction, Walker Process, Olefin metathesis, Tebbe's reagent, Pauson-Khand reaction, functional organometallic compounds, pi-acid metal complexes, activation of small molecules by coordination.

D. Saccharides, polysaccharides and their importance:

(12 Lectures)

Classification, structure, general properties and functions of polysaccharides and complex carbohydrates; amino sugars, proteoglycans and glycoproteins.

Core-4: Paper Name: Organic Chemistry-II (Practical)

(10 practical classes, each practical class is of 3 hours)

Paper Code: Core-4P

Practical (P): Credit – 1, Full Marks – 25

One stage preparations and Recrystallisation (any Ten)

1. Benzilic acid rearrangement: Benzilic acid from benzil
2. Sandmeyer reaction: p-Nitroiodobenzene from p-nitroaniline
3. Heterocyclic compound: 7-Hydroxy-4-methylcoumarin from resorcinol
4. Acetylation: Mannitol hexaacetate from mannitol
   Acetanilide from Aniline.
   Glucose pentacetate from glucose
5. Claisen-Schmidt reaction Dibenzalacetone from benzaldehyde
6. Oxidation: Fluorenone from fluorine
   Benzoic acid from Benzaldehyde
7. Acetylation: Acetylferrocene from ferrocene
8. Hydrolysis: Benzoic acid from Benzamide.
9. Bromination: p-Bromoacetanilide from Acetanilide.
10. Nitration: m-dinitrobenzene from Nitrobenzene.
    p-nitroacetanilide from acetanilide
11. Benzoylation: Benzanilide from Aniline.

Books:

Organic Reactions and Orbital Symmetry by Gilchrist and Storr
Some Modern Methods of Organic Synthesis by W. Carothers.
Modern Organic Synthesis-an introduction by George S.Zweifel and Michael H. Nantz,

Core-5: Paper Name: Inorganic Chemistry-II (Theory)

Paper Code: Core-5T

Theory: Credit – 4, Full Marks – 75

A. Coordination Chemistry II:

(16 Lectures)

Stability of mononuclear, polynuclear and mixed ligand complexes in solution. Stepwise and overall formation constants and their relations. Trends in stepwise formation constants, factors affecting the stability of metal complexes with reference to the nature of the metal ions and ligands. Statistical and non-statistical factors influencing stability of complexes in solution. Stability and reactivity of mixed ligand complexes with reference to chelate effect and thermodynamic considerations. Macrocyclic and template effect. Spectrophotometric and pH metric determination of binary formation constants.

Microstates, Russell-sander's terms, energy ordering of terms and Racah parameters, interelectronic repulsion parameters in complex ion terms-vs-free ion terms, hole formalism, determination of ground and excited state terms of d^n ions, spin-orbit coupling, effect of crystal field on Russell- Sander's terms, concept of correlation diagram.

B. Reaction Mechanism of inorganic complex:

(20 Lectures)

Some important rate laws of ligand substitution reaction, activation parameters ($\Delta S^{\#}$, $\Delta H^{\#}$, $\Delta V^{\#}$), mechanism of isomerization reaction, linkage isomerism, cis-trans isomerism, intramolecular and intermolecular racimization, Ray-Dutta and Bailar twist mechanisms, substitution in octahedral complexes- the Eigen-Wilkins mechanism, the Fuoss-Eigen equation, linear free energy relation (LFER) etc. conjugate base formation, anation reaction and base hydrolysis, reactions without metal-ligand cleavage. Substitution reactions in square planar complexes, Trans effect, mechanism of the substitution process, nucleophilicity parameter.

C. Organometallics:

(16 Lectures)

Alkenes and alkyne as ligands: models of ethylene-metal bonding, models of alkyne-metal bonding, synthesis of metal-alkene complexes, reactions of metal complexes of

alkenes and alkynes. Complexes of metal carbon double and triple bonds: synthesis Fischer carbene and Schrock carbene complexes, synthesis of metal-carbyne complexes.

Cyclic and acyclic polyenyl π bonded ligands, synthesis of Cp based sandwich compounds, bent sandwich compounds, chemistry of arene sandwich compound, 1,3 butadiene and cyclobutadiene complexes.

D. Spectra of Complex:

(18 Lectures)

Orgel diagrams (qualitative approach), Tanabe-Sugano diagrams, selection rules for spectral transitions, relaxation of selection rule and band intensity, band width and shape, d-d spectra of d^n ions and crystal field parameters, measurement of 10 Dq and *B*, nephelauxetic series, effet of Jahn-Teller distortion on spectra. Experimental evidence of metal-ligand overlap. MOT to rationalize σ and π interactions in octahedral, square planar and tetrahedral metal complexes. Symmetry designations of LGOs and MOs. Simplified MO diagrams.

Core-5: Paper Name: Inorganic Chemistry-II (Practical): (10 Practical Classes, Each Class is of 3 Hours)

Paper Code: Core-5P

Practical (P): Credit – 1, Full Marks – 25

Inorganic quantitative analysis:

(15 Lectures)

Separation and estimation of two metal ions from minerals, alloys or solutions.

Suggested Books

- Ligand field theory and its application by B. N. Figgis
- Inorganic chemistry, principal of structure and reactivity by J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi
- Inorganic Chemistry, 4th edition by C. E. Housecroft, A. G. Sharpe
- Inorganic Chemistry by Shriver and Atkins
- Inorganic Chemistry, Vol.- 5 by A. K. Das, M. Das
- Inorganic Chemistry, Vol.- 6 by A. K. Das, M. Das
- Elements of magnetochemistry by R. L. Dutta, A. Shyamal
- Inorganic Chemistry: Principles, D. Banerjea
- Hand book of Inorganic analysis, G. N. Mukherjee

- Vogel's Text Book of Quantitative Inorganic analysis, J. Bassett, R.C Denny, G. H Jefery & J. Mendham
- Basic Organometallic chemistry concepts, synthesis and applications. By B. D. Gupta & A.J. Alias, publisher: university press 2nd edition
- Advance inorganic chemistry & spectroscopy by R. R. Roy, CBS publishers

Core-6: Paper Name: Physical Chemistry-II (Theory)

Paper Code: Core-6T

Theory: Credit – 4, Full Marks – 75

A. Quantum Chemistry – II

(30 Lectures)

Hydrogen Atom: Solution of Schrodinger equation: radial equation, radial wave function, electronic energy levels, orbitals, probability distribution functions of orbitals, shapes and size of orbitals; space quantization of angular momentum, electron spin and nuclear spin. The variational method, Eckart's theorem, Linear variational method, Perturbation theory (time independent), Application of variational method and nondegenerate perturbation theory to the helium atom problem. Spectroscopic term symbols, Spin-orbit coupling, Degenerate perturbation theory and its application to Zeeman and anomalous Zeeman effect, Stark effect. Permutation operator, Pauli antisymmetry principle, deduction of Pauli exclusion principle, Slater determinants.

B. Fluorescence Spectroscopy

(5 Lectures)

Principles of fluorescence spectra, Jabonlaski diagram, mirror image rule, intersystem crossing, selection of exciting wavelength, quantum yield, effect of temperature, solvent polarity and viscosity, quenching of fluorescence, inner-filter effect, fluorescence of biomolecules.

C. Computers for Chemists

(15 Lectures)

Fundamentals of Computers, Elements of the computer language (FORTRON, BASIC, C), Constants and variables, Operations and symbols, Expressions,

Arithmetic assignment statement, Input and Output format statement, Termination statements, Branching statements. Branching statements such as IF or GO TO statements of LOGICAL variables, Double precision variables. Subscripted variables and DIMENSION DO statement FUNCTION and SUBROUTINE COMMON and DO Statement.

FUNCTION and SUBROUTINE COMMON and DATA statements (above language features refer to FORTRON; may be changed appropriately for C / BASIC)

Development of small computer codes involving simple formulae in chemistry, such as equations for kinetics, radioactive decay etc, Evaluation of lattice energy and ionic radii from experimental data, Linear simultaneous equations to solve secular equations within the Hückel theory. Elementary structural features such as bond lengths, bond angles, dihedral angles etc. of molecules extracted form a database such as Cambridge database.

D. Electrochemistry

(15 Lectures)

Ion-association, Formation of ion-pairs, triplets etc; Ion-solvent interactions, The Born model, structural treatment of ion-solvent interactions, ion-quadruple theory of solvation, The solvation number, Debye- Hückel theory, Debye-Hückel-Onsagar theory, Electrophoretic and relaxation effects, Wein effects, Debye – Fulkenhegen effect.

Core-6: Paper Name: Physical Chemistry-II (Practical)

(10 Practical Classes, Each Practical Class is of 3 Hours)

Paper Code: Core-6P

Practical (P): Credit – 1, Full Marks – 25

1. Studies on alkalis hydrolysis of ethyl acetate conductometrically.
2. Determination of pK_1 and pK_2 of phosphoric acid potentiometrically.
3. Determination of pK_1 and pK_2 of phosphoric acid pH metrically.
4. Studies on the kinetics of reaction between $K_2S_2O_8$ and KI spectrophotometrically.
5. Potentiometric estimation of Fe (II) using $K_2Cr_2O_7$.
6. Ternary phase diagram of $H_2O/C_6H_6/CH_3COOH$.
7. Studies on the kinetics of reaction between KBr_3 and KBr titrimetrically.
8. Verification of Debye Hückel Onsager-equation.

Suggested Text Books:

1. Quantum Chemistry -- A B Sannigrahi
2. Quantum Chemistry – I.N. Levine
3. Quantum Chemistry – Donald A McQuarrie
4. Modern Electrochemistry-Vol-1 by John OM Bockris, Amulya K. N. Reddy
5. Practical Physical Chemistry by Renu Gupta (New Age International Pubisher)
6. An Advanced Course in Practical Chemistry by A.K. Nad, B. Mahapatra, A. Ghoshal

GE: A. Paper Name: Advanced Spectroscopy

Paper Code: GE-A

Advanced Spectroscopy: Credit = 3, Marks =50; IKS-1: Credit =2, Marks = 25; Total Credit = 5, Total Marks = 100

Advanced Spectroscopy:

A. Molecular Symmetry and Group theory

(25 lectures)

Symmetry elements and symmetry operations, Group theory: definitions and theories; multiple symmetry operations, group multiplication table, molecular point groups, Classification of elements of a group, Symmetry and dipole moments and optical activity, Matrix notation for symmetry operations, Block-factored matrices, group representation, great orthogonality theorem, construction of character tables, reducible representation and their reduction, symmetry adapted linear combination (SALC) functions, direct product representation, conditions for survival of integrals.

B. Raman Spectroscopy

(10 Lectures)

Rayleigh and Raman scattering, Classical and Quantum theory of Raman effect, Stokes and anti-Stokes lines, rotational and vibrational Raman spectra, Mutual exclusion rule, Applications of Raman spectroscopy.

C. 13C NMR spectroscopy, ESR.

(15 Lectures)

D. NMR Spectroscopy of inorganic compounds

(15 Lectures)

1H NMR spectra of paramagnetic coordination compounds, dipolar and contact shifts, magnetic susceptibility and resonance shifts. 11B, 19F, 31P, 51V – NMR spectra. Contact shifts. Factors contributing the magnitude of chemical shift. NMR shift reagent and MRI reagent. Applications of NMR spectroscopy in inorganic systems.

IKS-1:

A. Raman Spectroscopy

Rayleigh and Raman scattering, Classical and Quantum theory of Raman effect, Stokes and anti-Stokes lines, rotational and vibrational Raman spectra, Mutual exclusion rule, Applications of Raman spectroscopy.

B. Chemical Basis of Indian System of Medicine-1:

Suggested Text Books:

1. Chemical Applications of Group Theory – F.A.Cotton
2. Group Theory and Chemistry – David M. Bishop
3. Fundamentals of Molecular Spectroscopy -- C. N. Banwell
4. Physical methods in inorganic chemistry -- R. S. Drago
5. Organic Spectroscopy -- W. Kemp
6. Fundamentals of photochemistry -- K. K. Rohatgi-Mukherjee
7. Introduction to Molecular spectroscopy -- G M Barrow
8. Fundamental concepts of inorganic chemistry, vol - 7 -- A. D. De

GE: B. Paper Name: Chemistry of Biomolecules

Paper Code: GE-B

Credit – 5, Full Marks – 100

A. Carbohydrate:

(12 Lectures)

Classification, structure, general properties and functions of polysaccharides and complex carbohydrates; amino sugars, proteoglycans and glycoproteins.

B. Lipids:

(12 Lectures)

Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrocides, steroids, bile acids, prostaglandins, lipoamino acids, lipoproteins, proteolipids, phosphatidopeptides, lipopolysaccharides.

C. Proteins:

(15 Lectures)

Peptide synthesis: chemical and Merrifield synthesis. Primary (peptide conformation, N- and C- terminal, peptide cleavage), Secondary (α-helix, sheet, random coil, Ramachandran plot), Tertiary and Quaternary structures of proteins. Cell free protain expression.

D. Enzymes:

(15 Lectures)

Historical perspective, general characteristics, nomenclature, IUB enzyme classification (specific examples), measurement and expression of enzyme activity, enzyme assay. Definitions of IU, Katal, enzyme turnover and specific activity. Methods for isolation, purification and characterization of enzymes, tests for homogeneity of enzyme preparation.

E. Nucleic acids:

(13 Lectures)

Nucleic acids as genetic information carriers, experimental evidence e.g., genetic transformation, Hershey-Chase experiments, action spectrum, etc. Structure and function of nucleotides. Primary, secondary and tertiary structure of nucleic acids, DNA forms and conformations, Denaturation of DNA.

F. Chemistry of toxins:

(3 Lectures)

Classification, structure and mode of action of bacterial protein toxins.

Suggested Books

1. Biochemistry (2011) D. Voet and J.G. Voet, pub. Wiley.
2. Biochemistry" (2015) J.M. Berg, J.L. Tymoczko and L. Stryer, pub. W.H. Freeman
3. Molecular Cell Biology (2012) H. Lodish, et al, pub. W.H. Freeman.
4. Molecular Biology of the Cell" (2014) B. Alberts et al., pub. Garland.
5. Practical Skills in Biomolecular Sciences" (2012) R. Reed, D. Holmes, J. Weyers and A. Jones, pub. Prentice Hall.
6. Principles and problems in physical chemistry for biochemists (2001) N.C. Price, R.A. Dwek, R.G. Ratcliffe and M.R. Wormald, pub. Oxford University Press.

Suggested Books for Physical Chemistry

1. Quantum Chemistry ---- A.B. Sannigrahi
2. Quantum Chemistry ---- I.N. Levine
3. Quantum Chemistry ---- R.K. Prasad
4. Quantum Chemistry ---- Donald A McQuarrie
5. Elementary Quantum Chemistry ---- Frank I. Pilar
6. Molecular Quantum Mechanics ---- P. Atkins and R. Friedman
7. Introduction to Quantum Mechanics ---- Linus Pauling and E. Bright Wilson
8. Quantum Mechanics in Chemistry ---- G. C. Schatz and M. A. Ratner
9. Introduction to quantum Chemistry ---- A. K. Chandra
10. Physical Chemistry, Quantum Chemistry and Molecular Interactions ---- Andrew Cooksy
11. Quantum Chemistry and Spectroscopy ---- Thomas Engel
12. Chemical Applications of Group Theory ---- F. A. Cotton
13. Group Theory and Chemistry ---- David M. Bishop
14. Molecular Symmetry and Group Theory ---- Robert L. Carter
15. Symmetry and Spectroscopy ---- B. C. Harris and M. D. Bertolucci
16. Group Theory and Quantum Mechanics ---- Michael Tinkham
17. Fundamentals of Molecular Spectroscopy ---- C.N. Banwell and E.M. McCash
18. Introduction to Molecular Spectroscopy ---- G.M. Barrow
19. Fundamentals of Photochemistry ---- K.K. Rohatgi-Mukherjee
20. Principles of Molecular Photochemistry ---- N.J. Turro, V. Ramamurthy and J.C. Scaiano
21. Unimolecular Reactions, 2nd ed------ K. A. Holbrook, M.J. Pilling, S.H. Robertson.
22. A Textbook of Physical Chemistry, Volume 5 -------K. L. Kapoor
23. Chemical Kinetics-------- Keith J. Laidler
24. Chemistry by Computer------- Stephen Wilson
25. Biophysocal Chemistry-----James P. Allen
26. Principles of Physical Biochemistry ---- K.E. van Holde, C. Johnson, P.S. Ho.
27. Principles of Biochemistry ------A. Lehninger, D. L. Nelson, M. M. Cox
28. Solid State Chemistry-----L. E. Smart, E.A. Moore
29. Principle Of Polymer Chemistry----- P.J. Flory
30. An Introduction to X-ray crystallography--------M. M. Woolfson
31. Thermodynamics For Chemists ------- S. Glasstone
32. Textbook of Polymer Science ------ F. W. Billmeyer Jr.
33. Molecular Thermodynamics -------- D. A. McQuarrie, J.D. Simon
34. Modern Electro Chemistry -------- J. O'M. Bockris, A. K. N. Reddy
35. Introduction to solids ------ L. V. Azaroff
36. Elementary crystallography ------- M. J. Buerger
37. Molecular symmetry and group theory ------ Alan Vincent
38. Physical Chemistry of Polymer Solutions - - - - - K. Kamide, T. Dobashi
39. Theoretical Chemistry----------S. Glasstone
40. Polymer Science ------ V.R. Gowariker, N. V. Viswanathan, J. Sredhar
41. Introductory Polymer Chemistry ------ G.S. Misra
42. Biophysical chemistry - Debajyoti Das

GE: C. Paper Name: CONCEPTS OF DRUG DESIGN IN AYURVEDA (IKS)

Paper Code: GE-C

Credit – 5, Full Marks – 100

Unit 1 **(12 Lectures)**

Introduction to Bhaishajya Kalpana (preparation of herbal drugs) and Rasashastra (preparation of

metallic/mineral drugs). Paribhasha (technical terms) used in the context of Ayurvedic

pharmaceutics. Importance of Compound formulations over Ekamoolika Prayoga (single drug

therapy).

Unit 2 **(15 Lectures)**

Knowledge about Pancha Vidha Kashaya Kalpana (basic pharmaceutical techniques). Swarasa

(fresh juice), Kalka (paste), Kashaya (decoction), Phanta (hot infusion), Hima (cold infusion)-

procedure of preparation, general dosage and 1-2 examples.

Demonstration of Ardraka swarasa, Tulasi Kalka, Guduchi Kashaya, Panchakola phanta,

DhanyakaHima.

Unit 3 **(15 Lectures)**

Knowledge about important compound formulations. Taila/ghrta paka (medicated oils and

ghees), Avaleha (confectioneries), Asava-Arishtas (fermented preparations), Vati-Gutika (pills,

tablets), Bhasmas (calcined metals/minerals) and Rasaushadhis (metallic preparations).

Unit 4 **(15 Lectures)**

Introduction to toxic drugs of Ayurveda and principle of their purification. Purification

procedures of Vatsanabha (Aconitum ferox Wall.), Vishatinduka (Strychnos nux-vomica L.),

Parada (mercury) andGandhaka (sulphur) will be briefed.

Unit 5 **(15 Lectures)**

Concept of Ahara kalpana (nutraceutics) will be explained. Procedure of preparation of Odana

(different rice preparations), Yusha (soups) will be briefed. Demonstration of preparation of

Mudga Yusha (green gram soup)

References:

1. Hindu Rasayan (two volumes) by P. C. Roy

2. Ayurvedic Drugs and Their Plant Sources by V.V. Sivarajan

3. Ayurvedic Drugs : Dravyaguna at tips (Ayurveda at your fingertips Book 1) by Ummer Qadir