Subject wise Programme outcomes and course outcomes

Chemistry

BSc I Semester Chemistry

Course outcomes

Inorganic Chemstry

Atomic structure and Periodic trends : Review of Bohr's atomic model, calculation of radius and energy of nth orbital,
extension of bohr's theory-Sommerfield model, deBroglie hypothesis, deBroglie equation,(Derivation),
experimental verification-Davisson-Germer experiment, Quantum numbers and their significance,
electronic configuration of the elements up to atomic number 60,
Aufbau principle, Hund's rule, (n+l) rule, Pauli's exclusion
principle.

Chemical bonding- I : Ionic bonding: factors affecting the formation of ionic bonding, Lattice energy and its
determination by Born-Haber cycle.
Covalent bond: Types, factors favouring covalent bond, properties of covalent compounds.
Valence bond theory with respect to H2, F2, HCl molecules and its limitations.

Methods of analysis : Errors in quantitative analysis, classification and minimization, accuracy, precision,
standard deviation, t-test,

significant figure and rules for computations.

Principles of volumetric analysis : Concentration terms, normality, molarity, mole fraction, percentage, primary standard solution, titration-acid-base,
precipitation, iodometric, redox and
complexometric(with reference to EDTA) titrations, choice of indicators in the above titrations

ORGANIC CHEMISTRY

Purification of organic compounds : **Methods of purification of solids:** Crystallization, fractional crystallization and sublimation.
Method of purification of liquids: Distillation, fractional distillation, distillation under reduced pressure, steam distillation.

Chromatography: General principles, types, brief outline of thin layer chromatography, paper chromatography and column chromatography, solvent extraction.
Criteria of purity: Melting point and boiling point.

Stereochemistry of organic molecules : **Cycloalkanes:** Baeyer's strain theory, calculation of angle strain, Sachse Mohr theory
of strainless rings. Chair and boat forms of cyclohexane. Axial and equatorial bonds.
Conformational isomerism: Basic concept of conformational analysis with reference to ethane and butane.
Geometrical isomerism: definition, E and Z notation for 2-butene and butenedioic acid, rules for assigning notations.
Determination of configuration of butenedioic acid by anhydride formation, dipole moment measurement, melting point and
stability.
Optical isomerism: Chirality, van't Hoff-Lebel hypothesis, optical activity, D and Lconfigurations,
R and S notations, sequence and priority rules, enantiomers,
distereoisomers, epimers, anomers, racemic and meso (with suitable examples like lactic and tartaric acids.), racemisation, resolution of racemic mixture by chemical method, asymmetric synthesis, Walden inversion.

Spectroscopy : Introduction to conventional methods of elucidation of structure of organic
compounds (chemical degradation) and comparison with spectroscopic methods, electromagnetic spectrum.
UV spectroscopy: Principle, types of transitions, chromophores, concept of auxochromes and their effect on λmax,
bathochromic shift, hypsochromic shift, hypochromic and hyperchromic shift.
Woodward and Fieser rules and illustration of calculation of λmax taking myrcene and B-phelladrene as examples.

PHYSICAL CHEMISTRY

Gaseous State : Real gas isotherms, Andrew's experiment of CO2, PV-relationship, Critical phenomenon of gases. Critical constants(Pc, Vc, Tc) – Definition, of critical temperature, critical pressure & critical volume.
Relationship between critical constants and Vanderwaals constants,
experimental determination of critical constants, reduced equation of state and statement of law of corresponding states.
Liquification of gases(Linde's method only),
Maxwell's law of distribution of molecular velocities(No derivation), effect temperature on distribution of molecular
velocities.

Solutions : Solution of gas in liquid – Henry's law and limitations.

Completely miscible liquid pairs.
azeotropes, theory of azeotropic mixtures, partially
miscible liquid systems, critical solution temperature with respect to phenol water, triethyl amine-water and nicotine- water system.

Salt-hydrolysis : Types of salts, definition of degree of hydrolysis and hydrolysis constant derive the
relation between Kh, Ka & Kw and expression for pH in case of hydrolysis of the following - salts of weak base and strong acid, weak acid and strong base.
Numerical problems.

Nernst distribution law : Statement and limitations,
applications of Nernst distribution law in solvent extraction.

Practical outcome :

Preparation of standard solution and Volumetric estimations

Course specific outcome :

CSO1: Able to understand different theories of atomic models
CSO2:Able to learn significance of quantum numbers
Cso3:Have understood types of bandings present in different compounds
CSO:4: errors involved i qualitative and quantitative analysis and how to minimise it.
CSO 5 : How to compute the results.
CSO6 : Will understand concentration terms used to indicate strength of the solution.
CSO7 : Different types of titrations.
CSO8 : will be introduced to different types of purification techniques followed in the laboratories.
CSO9 : will be able to judge sample is pure or not.
CSO10 : Different types of confirmations and configurations will be introduced.
CSO11: Techniques to resolve and check optically active compounds.
CSO 12: Students are introduced to spectroscopic techniques and their applications.
CSO13 : Able to understand how structure is correlated with the type of absorption shown.
CSO14 : Able to understand critical constants and their applications.
CSO15 : Able to understand how the liquefaction of gases is brought about.
CSO16 : Henrys law and its applications.
CSO17: Different types of azeotropic mixtures.
CSO18: Will understand types of salts and their hydrolysis.
CSO19: Application of Nernst law in solvent extraction.

BSc II Semester Chemistry

Course outcomes

Inorganic Chemistry

- **Chemical bonding-II**

Hybridization: Salient features of hybridization, geometry of molecules with respect to sp, sp2, sp3, dsp3, sp3d2 hybridization.

VSEPR theory- Postulates, regular and irregular geometry (BF3, CH4, NH3 and H2O). Molecular orbital theory: L C A O c o n c e p t , elementary account with respect to H2, He2, Li2, B2, N2, O2, O2+, O2- and O2-2 molecules, calculation of bond order, stability, magnetic property etc.

Hydrogen bonding: Types, significance of hydrogen bonding, properties explained by hydrogen bonding like a)State of H2O and H2S b) Melting and Boiling point c) Ice has less density than water.

- **Organic reagents in inorganic analysis**

Sensitivity, selectivity and specificity, advantages of organic reagents over inorganic reagents - Dimethyl glyoxime, 8-hydroxyquinoline (oxime).

ORGANIC CHEMISTRY

- **Alkenes, Dienes and Alkynes**

Alkenes: Methods of preparation of alkenes by (i) dehydration of alcohols (ii) dehydro halogenation. Saytezaff's elimination (Formation of highly substituted alkenes, 2-butene), Hofmann orientation (Formation of least substituted alkenes, 1-pentene)
Chemical reactions of alkenes- Peroxide effect and its mechanism, hydroboration, oxidation, oxy-mercuration–reduction and mechanism, ozonolysis with respect to 2-butene and 2-methyl-2-butene, oxidation with KMnO4.
Dienes: Classification and Nomenclature Preparation of 1,3 butadiene; 1,2 and 1,4 addition reactions (addition of halogens and halogen acids), Diel's-Alder reaction, polymerization of 1,3 butadiene.
Alkynes: Acidity of Alkynes, reactions of acetylene –metal ammonia reduction, oxidation and polymerization.

- **Aromatic Hydrocarbons :**

Resonance in benzene, Aromaticity–Huckel's 4n +2 rule with respect to benzene, furan, pyridine and [10]–annulene. Mechanism of electrophilic aromatic substitution–halogenation, nitration, sulphonation and Friedel-Craft's reaction (evidences for two step mechanism and evidences for formation of electrophile).
Poly nuclear hydrocarbons: Classification, examples, constitution of naphthalene, Haworth synthesis, nitration and sulphonation of naphthalene.

- **Conversions**

a) Alkanes to alkyhalides to alcohols and vice versa
b) Alkanes to alkyl cyanides to carboxylic acids

c) Benzene to p-nitrobenzoic acid
d) Benzene to m-bromoaniline
e) Naphthalene to 1,4–naphthaquinone
f) Naphthalene to anthranilic acid

PHYSICAL CHEMISTRY

- **First law of thermodynamics**

Statement, isothermal and adiabatic process, expression for work done in the reversible expansion of adiabatic expansion of an ideal gas (PV^{γ}=Constant) Joule- Thomson effect, Joule-Thomson experiment, derivation of Joule Thomson coefficient for an ideal gas and inversion temperature.

- **Thermochemistry**

Kirchoff's equation, bond energies and bond dissociation energies, calculation of bond energy and bond dissociation energies by taking simple molecules. Numerical problems.

- **Liquid State: Physical Properties of Liquids**

Surface Tension: Effect of temperature on surface tension. Determination of surface tension of liquid by drop numbers method, parachor and its application.
Viscosity: Effect of temperature on viscosity, determination of relative, absolute and intrinsic viscosity of liquids by ostwald's viscometer method.
Refractive index of liquid: Specific and molar refractions, determination of refractive index of liquid by Abbe's refractometer.

- **Liquid Crystals**

Types and applications.

- **Colloids**

Emulsions: Types of emulsions, Preparation and emulsifiers.
Gels: Classification, preparation and properties, general applications of colloids.

- **Solids**

Space lattice, unit cell, crystal systems, calculation of particles per unit cell, laws of crystallography, x-ray diffraction of crystals, derivation of Brag's equation, Miller indices, determination of structure of NaCl by rotating single crystal method.

Practical Outcome

Spotting of Organic Compound by Qualitative Analysis.

Course specific outcome

CSO1: Able to understand different types of Hybridisation and geometry of compound.
CSO2:Able to learn different theories in chemical bonding.
Cso3: Have understood types of Hydrogen bonding present in molecules.
CSO: 4: Able to understand advantages of organic reagents over inorganic reagents

CSO 5: Understand methods of preparation of alkenes and Saytezaff's elimination
CSO6: Able to understand different Chemical reactions of alkenes.
CSO7: Able to Classify and understand nomenclature of alkenes
CSO8: Able to identify Aromatic compound by Huckel's Rule.

CSO9: Can able to understand mechanism of Electrophilic aromatic substitution.
CSO10: Learnt about poly nuclear hydrocarbon.
CSO11: Can able to learn convertions of different organic compounds.

BSc III Semester Chemistry

Programme Outcome

PO 3. 1: Metallurgical process and reducing agents used in the extraction of metals.
PO 3.2: Types and properties of solvents, water as solvent.
PO 3.3: Different theories of acids and bases.
PO 3.4: Types of electronics effects and orientation of substituents
PO 3.5: Alcohols, preparation of alcohols and its reactions.
PO 3.6: Phenols, classification distinguishing properties of phenols and its reactions
PO 3.7: Synthesis and applications of organo-metallic compounds.
PO 3.8: Principal and application of infra-red spectroscopy.
PO 3.9: Raults law and colligative properties with respect to solution.
PO 3.10: Review of second law of thermodynamics.

Course Outcome

CO 3.1: Students will be able to tell about various metallurgical process and reducing agents used in the extraction of metals.
CO 3.2: Students will learn about types of solvents and its properties, water as solvents.
CO 3.3: Students is going to about different theories of acids and bases
CO 3.4: Students will able to distinguish types of electronic effects and orientation of substituents
CO 3.5: Students will learn about alcohols, preparation of alcohols and its reaction
CO 3.6: Students will learn what are phenols, its classification, distinguishing properties of phenols and its reactions.
CO 3.7: Students will learn synthesis and applications of organo-metallic compounds.
CO 3.8 : Students will learn the principle and applications of infrared spectroscopy.
CO 3.9 : Students will able to tell colligative properties and Rault's law with respect to solutions.
CO 3.10 : Students will learn second law of thermodynamics, applicative study of second law of thermodynamics

BSc IV Semester Chemistry

Programme Outcome

PO 4.1 : General properties of d and f block elements.
PO 4.2 : Trace elements in biological process, its structure and functions.
PO 4.3 : Types of air pollutants, sources and its consequences.
PO 4.4 : Types of water pollutants, sources and its consequences.

PO 4.5 : Structure and bonding of aldehydes and ketone, reactions involving C=O bond.
PO 4.6 : Introduction of carboxylic acids, comparative strength of different types of acids and its reactions.
PO 4.7 : Classification of aromatic amines, comparison of basic strength of different amines.
PO 4.8 : Preparation and chemical reactions of ether, brief introduction to crown ethers, synthesis of epoxides and its reactions.
PO 4.9 : Study of strong and weak electrolytes, application of conductance measurements.
Po 4.10 : Kinetics of chemical reactions.

Course Outcome

CO 4.1 : Students will learn the general properties of f and d block elements and lanthanide contraction.
CO 4.2 : Students should be able to understand about trace elements in biological process,its structure and function.
CO 4.3 : Students will learn the types of air pollutants, sources and its consequences.
CO 4. 4 : Students should be able to understand what is water pollution and treatment methods of sewage and industrial effluents.
CO 4.5 : Students are able to tell about structure and bonding of aldehyde and ketones, mechanism of nucleophilic addition involving C=O bond.
CO 4.6 : Students will learn about carboxylic acids its nomenclature and comparative strength of different types of acids and its reactions.
CO 4.7 : Students will learn the classification of aromatic amines and comparison of basic strength of different amines.
CO 4.8 : Students will learn preparation and chemical reactions of ethers, introduction to crown ethers, synthesis of epoxide and its reactions, application of crown ether.
CO 4.9 : Students will learn what are strong and weak electrolytes, Debye- Huckel theory,applications of conductance measurements.
CO 4.10 : Students will learn the kinetics of chemical reactions, determination of order of reactions, theories of reaction rates

BSc V Semester Chemistry Paper -I

Programme Outcome

Inorganic chemistry

Co-ordination chemistry

PO 1 : Review of terms double salts, complex salt, central metal ion, ligands,types of ligandscomplex
ion and co-ordination number.
PO 2 : IUPAC nominclature of co- ordination compounds.

PO 3 : Valence bond theory of co- ordination compounds with reference to $[Fe(CN)_6]^{3-}$, [Fe(CN)6]4-,$[FeF_6]$3-,$[Zn(NH_3)_4]^{2+}$,$[Ni(CN)_4]^{2-}$ and its limitations.

PO 4 : Isomerism – Ionisation, hydrate, linkage, geometricaland optical in co-ordination compounds.

Theory of gravimetric analysis

PO 5 : Principes of gravimetric analysis.
PO 6 : supersaturation.
PO 7 : von Weimar equation.
PO 8 : Conditions of precipitation, co-precipitation and post-precipitation.
PO 9 : Separation of precipitate from mother liquor, washing,
PO 10 : Properties of washed liquids
PO 11: Drying and ignition of precipitates, weighing form.

Inorganic polymers

PO 12 : Types of inorganic polymers and its comparison with organic polymers.
PO 13 : Silicones, phosphonitrilic halides formation, structure and applications.

Green chemistry

PO 14 : The need for green chemistry and eco-efficiency , green methods, green products, recycling of waste.
PO 15 : 12 principles of green chemistry.

Organic Chemistry

Heterocyclic compounds

PO 16 : Classification, molecular orbital picture and aromatic character of furan, thiophene, pyrrole and pyridine.
PO 17 : Synthesis of furan pyrrole and thiophene from 1,4-diketones.
PO 18 ; Hantzch pyridine synthesis.
PO 19 : Electrophyllic substitution reactions of furan pyrrole and pyridine.
PO 20 : Comparison of basicities of pyridine, piperidine and pyrrole.

Organic synthesis via enolates

PO 21 : Acidity of α- hydrogens.
PO 22 : Synthesis of ethyl aceto acetate by claisen condensation and its mechanism.
PO 23 : synthesis of diethyle malonate.
PO 24 : Keto-enol tautomerism of EAA.
PO 25 : Synthesis of ketones, carboxylic acids, heterocyclic componds and dicarboxylic acids byusing EAA and diethyl malonate.

Alkaoids

PO 26 : Definition , source, classification and general characteristics of alkaloids.

PO 27 : Hoffmann's exhaustive methylation with pyridine as an example.
PO 28 : Isolation, constitution and conformation by synthesis of conine, hygrine and nicotin

Physical Chemistry

Microwave spectroscopy

PO 29 : Classification of molecules, rotation spectra of rigid diatomic molecules
PO 30 : Criteria for showing the spectra.
PO 31 : Energy levels of rigid rotator, selectin rule.
PO 32 : Determination of bond length and moment of inertia of HCL molecule.

Phase rule

PO 33 : Terminology and explanation of the terms involved .
Po 34 : Application of phase rule
One component system- water system and sulphur system
Two component systems- Bi- Cd system and KI- water system.
PO 35 : Eutectic and freezing mixture.

Vibrational spectrum

PO 36 : Simple harmonic oscillator, Hooke's law.
PO 37 : Energy level of simple harmonic oscillator, model of diatomic Molecule, Selection rule.
PO 38 : Zero point energy, determination of force constant and qualitative relation between force constant and bond dissociation energy.
PO 39 : Vibrational degrees of freedom of linear and non-linear molecules.

BSc V Semester Chemistry Paper –I

Course Outcome

Inorganic Chemistry

Co-ordination chemistry

CO 1 :Students will understand the terms -double salts, complex salt, central metal ion,ligands,types of ligands,complex ion and co-ordination number.
CO 2 : Students will learn IUPAC nominclature of co- ordination compounds.
CO 3 : Students will understand the Valence bond theory of co- ordination compounds with reference to $[Fe(CN)_6]^{3-}$, [Fe(CN)6]4-,$[FeF_6]$3- $[Zn(NH_3)_4]^{2+}$,$[Ni(CN)_4]^{2-}$ and its limitations.
CO 4 : students will come to know isomerism – Ionisation, hydrate, linkage, geometricaland optical in co-ordination compounds.

Theory of gravimetric analysis

CO 5 : Students will understand Principes of gravimetric analysis.
CO 6 : Students will understand supersaturation.
CO 7 : Students will understand von Weimar equation.
CO 8 : Students will understand Conditions of precipitation, co-precipitation

and post-precipitation.
CO 9 : Students will understand Separation of precipitate from mother liquor, washing,
CO 10 : Students will understand Properties of washed liquids
CO 11: Students will understand Drying and ignition of precipitates, weighing form.

Inorganic polymers

CO 12 : Students will understand Types of inorganic polymers and its comparison with organic polymers.

Green chemistry

CO 14 : Students will understand The need for green chemistry and eco-efficiency , green methods, green products, recycling of waste.
CO 15 : Students will understand 12 principles of green chemistry.

Organic Chemistry

Heterocyclic compounds

CO 16 : Students will understand Classification, molecular o
rbital picture and aromatic character of furan, thiophene, pyrrole and pyridine.
CO 17 : Students will understand Synthesis of furan pyrrole and thiophene from 1,4-diketones.
CO 18 ; Students will understand Hantzch pyridine synthesis.
CO 19 : Students will understand Electrophyllic substitution reactions of furan pyrrole and pyridine.
CO 20 : Students will understand Comparison of basicities of pyridine, piperidine and pyrrole.

Organic synthesis via enolates

CO 21 : Students will understand Acidity of α- hydrogens.
CO 22 : Students will understand Synthesis of ethyl aceto acetate by claisen condensation and its mechanism.
CO 23 : Students will understand synthesis of diethyle malonate.
CO 24 : Students will understand Keto-enol tautomerism of EAA.
CO 25 : Students will understand Synthesis of ketones, carboxylic acids, heterocyclic componds and dicarboxylic acids byusing EAA and diethyl malonate.

Alkaoids

CO 26 : Students will understand Definition , source, classification and general characteristics of alkaloids.
CO 27 : Students will understand Hoffmann’s exhaustive methylation with pyridine as an example.
CO 28 : Students will understand Isolation, constitution and conformation by synthesis of conine, hygrine and nicotin

Physical Chemistry

Microwave spectroscopy

CO 29 :Students will understand the classification of molecules, rotation spectra of rigid diatomic molecules
CO 30 : Students will understand the criteria for showing the spectra.
Students will understand
CO 32 : Students will understand the determination of bond length and moment of inertia of HCL molecule.

Phase rule

CO 33 : Students will come to know the terminology and explanation of the terms involved .
CO 34 : Students will understand the application of phase rule
One component system- water system and sulphur system
Two component systems- Bi- Cd system and KI- water system.

Vibrational Spectrum

CO 36 : Students will understand the Simple harmonic oscillator, Hooke's law.
CO 37 : Students will understand the energy level of simple harmonic oscillator, model of diatomic molecule, Selection rule.
CO 38 : Students will understand Zero point energy, determination of force constant and qualitative relation between force constant and bond dissociation energy.
CO 39 : Students will understand Vibrational degrees of freedom of linear and non-linear molecules.

BSc V Semester Chemistry -Paper II

Course Outcome

Inorganic Chemistry

UNIT –I

Industrial Chemistry-I

CO 1: Alloy

- Significance and types of alloys werw taught.
- Student learnt about preparation of alloyand their application.

CO 2: Abrasives-

- Students are able to classify Abrassives.
- Students have understood Mohrs scale of hardness.

Students have learned about manufacture and application of Carborundum,Alundum and Tungstun carbide etc.

CO 3:Glass-

- Students were able to study about chemical and physical properties of glass and raw materials.
- Students learnt about manufacturing using tank furnace.

Students have learnt annealing of glass,types ,composition and uses of glasses.

UNIT-II

Industrial Chemistry-II

CO 4-Cement-

- Students learnt about raw materials,composition of Portland cement.
- Students understood manufacturing of cement by rotary keen method and mechnism of setting.

CO 5- Pigments

- Students understood manufacturing and relative merits of White lead,Lothopone,Titanium White and constituent of paints and varnishes.

CO 6:Fuels-

- Students are able to identify characteristics and calorific values of fuels,advantages gaseous fuels
- Students learnt about manufacture of water,gas and biogas.

Organic Chemistry

UNIT I

CO 7: Reagents and Reactions

- Students learned about preparation ,mechanism of action and application of the following reagents:
  DCC(Amide formation)
  LiAlH4
  DDQ
  Lead Tetra Acetate
  NBS
  OsO4
  PCC(Pyridinium Chlorochromate)

UNIT-II

CO 8: Mass Spectroscopy

- Principle and instrumentation of mass spectroscopy was taught
- Students are able to define parent peak and base peak.
- Students are able to write Mc Lafferty rearrangement with respect to butyraldehyde.

UNIT- III

CO 9:Dyes

- Students are able to classify dyes.
- Students have understood requirements ,colours and constituents of dyes.
- Students learnt about the synthesis of following class of dyes:

  Azo dyes-Congo red
  Vat dyes-Indigo
  Anthriquinone dyes-Alizarin

Triphenyl methane dyes-Malachie green
Crystal violet
Pthalein dyes-Fluoroscine and Eosin.

Physical Chemistry

UNIT- I

CO 10: Surface Chemistry

- Students are able to derive Friendlich and Langmuir's adsorption isotherm
- Students have understood BET equation
- Students are able to determine surface area using BET equation.
- Students learnt about theories of catalysis –interediate and adsorption theory,enzyme catalysis Micheali's Menten Equation and industrial application of catalysis.
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UNIT –II

CO 11: Chemical Equillibrium

- Students have understood thermodyanamic treatment of law of mass action,Van't Hoff reaction isotherm.
- Students are able to derive relationship between Kp,Kc and Kx,variation of Kp and Kc with temperature and pressure.

UNIT –III

CO 12: Kinetics of chain reaction

- Examples of chain reaction were taught
- Students have understood general aspects of chain reaction,chain length,chain transfer reaction, chain inhibition and kinetics of branching chain reaction.

BSc VI Semester Chemistry Paper II

Course outcomes

Inorganic Chemistry

UNIT-I
CO 1:Chromatography
• Principle and types were taught.
• Students understood the difference between stationary and mobile phases and physical factors of separation.
• Students learnt paper chromatography, calculation of Rf value, column chromatography and its applications.

CO 2:Flame photometry

- The students were taught the Principle and Limitations.
- Students were able to understand Instrumentation, Flame photometric determination of Na and K.

CO 3:Thermogravimetry

- Students were able to learn Principle and applications of thermogravimetric methods (TG and DTA).

CO 4:Electrogravimetry

- Students learnt Principle, Instrumentation, Electrogravimetric determination of Copper.

UNIT-II

CO 5:Soil Analysis

- Students have understood Macro nutrients, trace metals and organic matter in soil.
- Students were able to understand Determination of pH, Determination of nitrogen by alkaline permanganate method and phosphorus by Bray's and Olsen's method present in the soil.

UNIT-III

CO 6: Electronic spectra of transition metal complexes

- Students were able to study Russel-Sandar's coupling in defining ground states of spectrochemical series.
- Students were able to derive spectroscopic ground terms(d1 to d10 without J values.
- Students learnt types of electronic transitions(d-d transitions, charge transfer transitions-MLCT and LMCT), selection rule for d-d transitions.
- Students were able to draw Orgel- energy level diagram-d1 and d2 states and the electronic spectrum of [Ti(H2O)6]3+ complex ion.

Organic Chemistry

UNIT-I

CO 7:Chemotherapy

- Students were taught Introduction, requirement of an ideal synthetic drug and classification.
- Students were able to write the mechanism for synthesis and also write the uses of the Antipyretics–antipyrine, paracetamol Anaesthetics-novacaine(local) and pentothal sodium(general)Antihistamines–chlorpheniramine maleate(CPM)Antimalarials–paludrine, chloroquineAntibiotics-chloromycetin, penicillin, tetracyclinPara pharmaceutical reagents–Benedict's reagent, sodium citrate, Barfoed reagent.

UNIT-II

CO 8:Soaps and Detergents

- Soaps –
- Students understood Introduction, manufacture by modern process, cleaning action of soap.
- Detergents –

• Students learnt anionic, cationic, nonionic, with suitable examples, distinction between soaps and detergents, emulsifiers, stabilisers and builders.

UNIT-III

CO 9:Reaction Mechanism

Students were able to write the following mechnaisms

a) Beckmann rearrangement

b) Favorskii rearrangement

c) Benzidine rearrangement

d) Benzillic acid rearrangement

UNIT-IV

CO 10:NMR Spectroscopy

• Students understood the Principle of Proton Magnetic Resonance(1H NMR) spectroscopy, nmr spectrum, chemical shift, nuclear shielding and deshielding.

• Students learnt spin-spin coupling(n+1) rule, intensity(height) of the signal, TMS as internal standard-advantages.

• Students were able to interpret PMR spectra of simple organic molecules such as ethyl bromide, n-propyl bromide, iso propyl bromide, ethanol, acetaldehyde and benzene.

Physical Chemistry

UNIT-I

CO 11:Electromotive force

• Students understood the basic concepts of Reversible and irreversible cells.

• Students understood the meaning of EMF of a chemical cell and its measurement by potentiometer and working of standard cell (Weston standard cell).

• Students were able to learn Types of electrodes - Reference electrode, calomel electrod.

• Students were able to derive Nernst equation for emf of a cell and concentration cells– with and without transference.

• Students learnt liquid junction potential and its derivation, salt bridge.

• Students learnt Applications of emf measurements to the

1) Determination of pH: Using hydrogen electrode, quinhydrone electrode and glass electrode.

2) Potentiometric titrations: Acid-base and redox titration.

UNIT-II

CO 12:Photochemistry

• Students studied Photochemical reactions and laws of photochemistry – Beer's law, Lambart's Law, Beer- Lambart's Law, Grothus-Draper Law and Einstein's Law of photochemical equivalence.

• Students were able to calculate quantum efficiency or yield.

• Students realized the reasons for high and low quantum efficiencies with examples.

• Students successfully learnt fluorescence, phosphorescence, photosensitization and chemiluminescence.

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Geology

BSc I Semester Geology

COURSE OUTCOME

DYNAMIC GEOLOGY, CRYSTALLOGRAPHY AND FIELD GEOLOGY

CO 1: An understanding of the physical and chemical structure of the earth's interior, geological agents and its origin.
CO 2: Theory of plate tectonics and development of all Earth's surface features including mountain ranges, ocean basins, etc.
CO 3: A detailed understanding of actions of river, glacier, ocean and wind in formation of various geological landforms and weathering processes.
CO 4: The description of a crystal structure in terms of atom positions, unit cells, and crystal symmetry; and to relate the crystal symmetry in the minerals.
CO 5: Course completes with an ability to observe and interpret the formation of landforms in the field.

BSc II Semester Geology

MINERALOGY

CO 1: The first part of the course covers the fundamentals of mineralogy, including physical properties depending upon light and state of aggregation.
CO 2: Important mineralogical principles such as Isomorphism, Polymorphism, Pseudomorphism. In addition, properties depending upon cohesion and elasticity explain the Cleavage, Fracture, Tenacity and Hardness which includes Moh's scale of hardness.
CO 3: In this part of the course, this fundamental knowledge is used to systematically discuss the different groups of rock-forming minerals, including the different types of silicates and silicate structure. It also includes Gemology where it covers specification of gemstone, types of gemstones and uses.
CO 4: Optical mineralogy begins with fundamentals of light behavior such as reflection, refraction and double refraction phenomenon. It covers behavior and various parts of the microscope and procedure to prepare thin sections.
CO 5: It covers systematic way to construct a Nicol prism and Behavior of light in the microscope with isotropic mineral, with anisotropic mineral and without mineral. Accessories required to study mineral under microscope includes Mica plate, Gypsum Plate and Quartz Wedge. Course ends with complete study of optical properties of mineral.

BSc III Semester Geology

PETROLOGY

CO 1: This part of course provides an introduction to petrology and classification of rocks.The course provides an introduction to origin, age and development of various

types of magma. It also covers an introduction to igneous rock, their forms and structures.

CO 2: A thorough understanding of Textures in igneous rocks, Various types of Classification of igneous rocks based on Mineralogy, silica content ,CIPW and Shand and Holmes. Bowen's reaction serious covers the crystallization sequence of typical magma.

CO 3: This part of the course covers an introduction to sedimentary petrology, several sedimentary rock formation processes such as transportations, deposition environments and diagenesis. Further it gives complete outcome of structures, textures and classification of sedimentary rocks.

CO 4: An understanding and be able interpret mineral reactions and metamorphic PT conditions in the earth. It also covers various types of metamorphism in brief.

CO 5: It includes not only the formation of new mineral assemblages but also changes in mineral chemistry by studying facies concepts. It also includes standard texture and structure of metamorphic rock.

BSc IV Semester Geology

PALEONTOLOGY, STRATIGRAPHY & INDIAN STRATIGRAPHY

CO 1: This course gives introduction to the paleontology which has mode of fossilization, identification of fossils and its significance. It includes General morphological characters, description, and geological distribution of Phylum Ceolenterata and Phylum Protozoa- Foraminifera.

CO 2: Further General morphological characters, description, and geological distribution of Phylum Brachiopoda,Echinoderma, Arthropoda and Phylum Mollusca which includes classes of Lamellibranch, Gastropoda and Cephalopoda.

CO 3: Basic concepts, principles and correlation methods cover this course. Geological Time Scale which includes important geological events such as climate, glaciations and fauna- flora.

CO 4 and CO 5: In these units have detailed information of Indian stratigraphy, where it covers brief account of physiographic divisions of India followed by Petrology, classification and economic importance of Indian stratigraphic units.

B.Sc V Semester Geology

I. STRUCTURAL GEOLOGY, GEOPHYSICS & MINING GEOLOGY

CO 1: Gives an overview of two important concepts within structural geology; stress and strain with basics of attitude of beds, use of brunton compass. It also includes types of unconformities and recognition of unconformity in the field.

CO 2: This particular course focuses on geometry and classification of major structure such as joints and folds and also how to recognize these structures in the field.

CO 3: Gives detailed information about Faults, followed by Nature of movement- translation and rotational and relative movements. Further, details of genetic and geometric classification of faults and also covers how to recognize faults in the field.

CO 4: It covers the basis for geophysical observation and measurement. It includes geophysical prospecting methods such as magnetic methods, gravity method, electrical methods and interpretation of geophysical data.
CO 5: It covers role of geology in the mining industry, mining terminologies followed by various mining methods such as underground and open cast with their advantages and limitations.

II. ORE PROCESSES, INDIAN MINERAL DEPOSITS & GEOCHEMISTRY

CO 1: It includes various ore processes with introduction to syngenetic and epigenetic deposits. Also, processes like Magmatic concentration, Metamorphisam and Contact metsomatism deposits.
CO 2: This chapter focuses on Hydrothermal processes and ore deposits such as, cavity filling, crustification, fissure veins and replacement deposits. It also covers Sedimentation Deposits such as Precipitation from carbonate solution; precipitation in oxidizing environment.
CO 3: Gives detail knowledge of Residual deposits through the processes of lateritisation and bauxitisation. And overview on Oxidation and supergene enrichment processes.CO 4: This is an overview of metallic and non-metallic ore minerals. It covers major occurring ores in India with their distribution and uses across the country.
CO 5: The course aims to give an introduction in how chemical principles are used to explain the mechanisms that control the large geological systems such as the Earth´s mantle, crust, ocean and atmosphere.

B.Sc VI Semester Geology

I. HYDROGEOLOGY & ENVIRONMENTAL GEOLOGY

CO 1: The teaching focuses on Hydrological Cycle and processes involved. It also gives sources of water on the earth and teaches sustainiable water management.
CO 2: it includes Hydrological properties of water bearing materials: Specific yield, specific retention, porosity, and permeability. It covers Subsurface distribution of water where water occurs in different zones.
CO 3: this unit specifically covers occurrences of groundwater unconfined and confined conditions. it gives information regarding Seepage and Springs and their types.
CO 4: this chapter normally focuses on occurrences of groundwater in different terrain and different types of rocks. Further it includes water harvesting techniques and its importance followed by major water quality parameters.
CO 5: The Environmental Geology encompasses natural hazards, man made hazards and pollutoin. It also gives serious threats of global warming. Course ends with risk assessment and mitigation.

B.Sc VI Semester Geology

II. REMOTE SENSING & ENGINEERING GEOLOGY

CO 1: Fundamentals of Remote Sensing which contains Electromagnetic spectrum and properties of various parts of spectrum. It contains Brief history and types of Indian Remote Sensing Satellites. It also involves importance of aerial photographs and satellite imageries in geoscience & geomorphological studies.

CO 2: this part comprises of sensors used in satellite with their resolutions. Its consist of types of images: panchromatic image, true color & false color composite, thematic images.
CO 3: A detail study of aerial photograph has been covered with their elements which helps in the identification of features.
CO 4: Specifically this unit focuses on interpretation of Geotechnical elements- landforms, vegetations, drainage patterns and density, erosional pattern and land use. It also covers uses of GPS and general principal
CO 5: This course is an introduction to the basic concepts of geology and engineering geology such as engineering properties of rocks. It also introduces students to the main tools and methods of Engineering Geology and the problems) that can create the geological conditions in the construction of civil works. It gives thorough knowledge of building materials - sand, building and dimension stones, aggregates, lime and cement, clays and clay products.

Programme Outcome (PO)

. B.Sc I Semester Geology

DYNAMIC GEOLOGY, CRYSTALLOGRAPHY & FIELD GEOLOGY

- Develop skills and insight into critical thinking and situational awareness of surrounding environment.
- Develop skills which are needed in the field work and can handle field equipments
- Gain an understanding of the physical processes that operate in and on earth.
- Understand the outcrops on the field and can explain the reasons behind the formations of landforms.
- Understand past, present, and future environmental issues and how they affect the earth and our society.
- Develop greater self-awareness of personal role regarding environmental issues.

B.Sc II Semester Geology

MINERALOGY & OPTICAL MINERALOGY

- Develop ability to identify different minerals and occurance.
- Develop skill in identification of minerals under the microscope.

B.Sc III Semester Geology

PETROLOGY

- Develops ability to identify verities of rocks on field as well as under microscope.
- Understand the outcrops on the field and can explain the reasons behind the formations of landforms.

B.Sc IV Semester Geology

PALEONTOLOGY; PRINCIPLES OF STRATIGRAPHY & INDIAN STRATIGRAPHY

- Understand and determine the evolutionary identity of living and past organisms.
- Gaining predictive power with regards to rare events that have been experienced in the past, and may be experienced again in the future.
- It provides a basis for historical geology, and its principles and methods have found application in such fields as petroleum geology and archaeology.
- Show an understanding of the principles of facies analysis and be able to apply these principles to specific regional examples in order to reconstruct palaeoenvironments.
- Show an understanding of the current theories on the origin of the earth and the origin and evolution of life on the earth.
- Show an understanding of the biostratigraphical techniques and be able to apply these techniques to specific examples.
- Describe the methods used to reconstruct palaeoclimates.
- Show an understanding of the stratigraphy of selected regions of India.

B.Sc V Semester Geology

I. STRUCTURAL GEOLOGY, GEOPHYSICS & MINING GEOLOGY

- Develop essential skills for understanding crustal structures in three spatial dimensions, and how those structures change with time.
- Learn how to describe and explain geologic structures.
- Build upon and forge links between geology, mathematics, and physics.
- Develop the ability to integrate theory, laboratory results, and field observations.
- Be introduced to how the earth's crust can be treated as a predictable mechanical system.

II. ORE PROCESSES, INDIAN MINERAL DEPOSITS & GEOCHEMISTRY

- Describe the composition of the Earth´s main geochemical reservoirs
- Explain element fractionation and how this can be used to understand endogenous and exogenous geochemical and geobiological processes
- Explain fractionation of stable isotopes and how such data can be used to understand various geochemical and geobiological processes
- Describe how radiogenic isotope signatures can be used to trace the source of minerals, rocks and fluids

B.Sc VI Semester Geology

HYDROGEOLOGY & ENVIRONMENTAL GEOLOGY

- Understand the role of hydrology, water resources management and the legal and economic frameworks associated with addressing these challenges.

- Comprehend the chemistry of water and biological phenomena as related to water quality and contaminant transport in surface water and groundwater that provide for drinking water, agriculture, ecosystems, and industry.

REMOTE SENSING & ENGINEERING GEOLOGY

- Students will be able to recognize and explain basic computational properties of remote sensing data acquisition, storage, and processing.
- Students will demonstrate proficiency and conceptual understanding in using software or manual techniques to carry out remote sensing image processing and analysis through a series of laboratory exercises and reports.
- Students will be able to identify key applications of land, marine, aquatic, and atmospheric remote sensing and relate them to the properties of historical, current, and planned remote sensing instruments, approaches, and datasets.

Physics

B.Sc I Semester Physics

COURSE OUTCOME

- CO1-Understand SHM and study differential equation of linear SHM, Energy of a particle, potential energy and kinetic energy.
- CO2-Study of Lissajous figures, Composition of two rectangular SHM's having same periods.
- CO3-Concept of frame of reference and Laws of conservation of linear momentum for a system of particles.Elastic collision between two particles in laboratory and centre of mass frames of references.
- CO4-Study of Angular Momentum and torque, conservation of angular momentum, central force, Kepler's second law. Spin, orbital and total angular momentum.
- CO5-Study of orbital velocity and escape velocity in closed and open orbit in a central field, escape velocity of a satellite, stationary satellite, weightlessness.
- CO6-Study of Moduli of elasticity of isotropic materials and relation between three moduli of elasticity. Poisson's ratio. Bending of beams, expression for bending ratio and bending moment. Theory of light cantilever and loaded at the free end and at the center.
- CO7-Surface Tension, determination of surface tension by Quinke's method with relevant theory. Effect of temperature and impurity on surface tension. Viscosity, motion of body in viscous medium, Stoke's law with derivation and expression
- for terminal velocity.

Programme Outcome (PO)

- PSO1-Understand the basic concepts of Mechanics and Properties of Matter.
- PSO2-Study of SHM, Linear and Angular Momentum, Elasticity.

- PSO3-Study of surface tension and viscosity with the applications.
- PSO4-Perform experimental procedures as per laboratory standards in Elasticity, Moment of Inertia, Surface Tension, Viscosity.
- PSO5-Understand the laws of Physics and their role in the development of Technology.

B.Sc II Semester Physics

COURSE OUTCOME

- CO1-Understanding Forced free, damped vibrations and sustained vibrations, their applications. Theory of Helmholtz resonator and determination of unknown frequency.
- CO2- Postulates of kinetic theory of gases, Maxwell's law of distribution of velocities. Average, rms and most probable velocity. Einstein's theory of Brownian motion with derivation of mean free path.
- CO3-Working of Otto and Diesel Engine, efficiency. Carnot's theorem, concept of entropy. Entropy temperature diagram. Maxwell's relations. Application of Clausius-Clapeyron's equation.
- CO4-Study characteristics of exhaust pump. Diffusion pump and ionization gauge. Joule Thomson effect.
- CO5-Study of low pressure Physics. Stefan's law and its derivation using radiation pressure. Determination of Stefan's constant. Energy distribution in the black body spectrum. Wein's displacement law and its derivation.
- CO6-Study of Black Body Radiation with the derivation of Planck's radiation law, Weins law and Rayleigh Jean's law.

Programme Outcome (PO)

- PSO1-Understand the basic concepts of matter and energy.
- PSO2-Study of properties of matter.
- PSO3-Study of Sound and Thermal Physics.
- PSO4-Perform procedure as per laboratory standards in the areas of Resonance, Thermal conductivity.
- PSO5-Understand the characteristics of loudspeaker and microphone in laboratory.
- PSO6-Understand the applications of Physics Law in the development of technology.

BSc III Semester Physics

COURSE OUTCOME

- CO1-Understand Fermat's principle, derivation of laws of reflection and refraction. Abbe's sine rule. Lagrange and Helmoltz's relation.

- CO2-Cardinal points, principal points and nodal points. Equivalent focal length of a lens system separated by a distance and location of cardinal points.
- CO3-Study of Aberrations, spherical and chromatic aberrations and methods to remove them.
- CO4-Study of Dielectric Polarization, Gauss law in dielectrics and electric displacement. Boundary condition at a surface separating two dielectric media. Relation between electric displacement, electric field and polarization.
- CO5-Understand laws of current electricity, statement of Biot-Savart's law, derivation of expression for magnetic field due to a straight conductor carrying current.
- CO6-Study of Electrical instruments and measurements, theory of ballistic galvanometer and dead beat. Charge sensitivity, current sensitivity and their relationship. Use of CRO in the measurement of voltage, frequency and phase.

Programme Outcome (PO)

- PSO1- Understand the basic concepts of Geometrical Optics and Electricity.
- PSO2-Study of Geometrical Optics, Aberrations, Electrostatics, Current Electricity.
- PSO3-Perform experimental procedures as per the laboratory standards in the areas of Cardinal points and equivalent focal length of a lens system. Constants of Ballistic Galvanometer.
- PSO4- Study of CRO and AFO.
- PSO5- Understand the applications of Physics in the field of optics and electricity.

BSc IV Semester Physics

COURSE OUTCOME

- CO1-Study of Interferance of Light. Thin films, condition for maxima and minima in case of reflected light. Theory of Newton's Rings. Michelson's interferometer: construction and working, formation of circular and straight fringes. Determination of wavelength of monochromatic light.
- CO2-Study of Diffraction of Light. Zone plates: construction, theory, expression for focal length.
- CO3-Analytical treatment of circularly and elliptically polarized light. Huygens theory of double refraction, positive and negative crystals. Retardation plates.
- CO4-Optical activity, specific rotation, Laurent's half shade polarimeter. Fresnel's theory of rotatory polarization.

- CO5-Understand the working of LCR series and parallel resonance circuit, condition for resonance frequency, band width, quality factor and their relations. Expression for admittance and condition for resonance.
- CO6-Discuss Laws of Thermo-electric effects, Seebeck effect and its explaination, variation of emf with temperature, neutral temperature and temperature of inversion. Peltier effect, Peltier coefficients. Thomson coefficient.

Programme Outcome (PO)

- PSO1- Understand the basic concepts of Optics, Electricity and Magnetism.
- PSO2-Study of Physical optics, Electricity and Magnetism.
- PSO3-Perform procedure as per laboratory standards in the areas of variation of Magnetic field, Measurements of wavelength, Dispersive power and Resolving power.
- PSO4-Study of Interference and Diffraction patterns.
- PSO5-Understand the applications of Physics in Optics, Electricity and Magnetism.

B.Sc V Semester Physics-I

COURSE OUTCOME

- CO1-Study and understand the types of constraints, degrees of freedom, configuration space, principal of virtual work, generalized co-ordinates, virtual displacement.
- CO2-D'Alembert's Principle. Study application of Lagrange's equation to
  I. Motion of a single particle in Cartesian Co-ordinates and
  II. Harmonic Oscillator.

  Reduction of two body problem to equivalent one body problem.Kepler's laws of planetary motion and their derivation from Lagranges equation of motion.
- CO3-Study of Nanophysics, size effect, surface volume ratio, quantization, quantum computing, single elctron transistor.
- CO4-Understand postulates of special theory of Relativity. Relativity of length and time. Law of addition of velocities. Variation of mass with velocity. Mass energy relation.
- CO5-Derive Lorentz transformation equations.
- CO6-Study of Analog Electronics, network theorems, current and voltage sources, superposition theorem, Thevenin's and Norton's theorem.
- CO7-Understand the working of Power Supply, unregulated bridge rectifier, filters. Zener diodes: characteristics parameters, explaination of zener breakdown, zener diode used as voltage regulator using unregulated DC voltage bridge rectifier.
- CO8-Transistors, h-parameters, transistor as CE amplifier with frequency response. Oscillators: Hartley and phase shift oscillators and their applications.

Programme Outcome (PO)

- PSO1-Understand the basic concepts of Classical Mechanics, Relativity and Electronics.
- PSO2-Understand basic electronic circuit.
- PSO3-Perform experiments in the areas of Transistors, FET and Zener diodes.
- PSO4-To set up Amplifier and Oscillator circuits.
- PSO5-To design bridge rectifier circuit and regulated power circuits.
- PSO6-Understand the applications of Physics in the development of technology.

B.Sc V Semester Physics-II

COURSE OUTCOME

- CO1-Study of Quantum Mechanics, Compton effect, Devission and Germer experiment, de-Broglie Hypothesis. G.P.Thomson experiment, uncertainity principle statement.
- CO2-Study of LASERs, stimulated absorption and emission, Einstein A and B coefficients. Condition for LASER action, application of laser.
- CO3-Understand wave mechanics, time independent Schrodinger's wave equation, physical significance of wave function. Derivation of expression for energy of a particle in a box. Eigen function and eigen values.
- CO4-Study Vector Atom Model, electron spin and quantization and quantum numbers. Couling scheme for single valence and two valence systems.
- CO5-Understand the concepts of Molecular Spectra, nature of molecular spectrum, different types of energies of a molecule, diatomic molecule as a rigid rotator. Application of molecular spectra, energy of a diatomic molecule as a non-rigid rotator. LASERs.
- CO6-Study of Raman effect, Raman scattering, explaination of Raman effect on the basis of quantum theory and its applications.
- CO7-Study of Mathematical Physics, Legendre polynomials, Rodrigue's formula, generating function and recursion relations, orthogonality and normalization. Bessel functions, Hermite functions, recursion relations, orthogonality.
- CO8-Understand Legendre and Bessel's functions and their applications.

Programme Outcome (PO)

- PSO1-Understand the basic concepts of Quantum mechanics, Atomic and Molecular Spectra and Mathematical Physics.
- PSO2-Set up and design the circuits for Filters and Multivibrators.
- PSO3-Construction of multirange voltmeter and ammeter.
- PSO4-Study the characteristics of Photoconductive and Photovoltaic cells.
- PSO5-Characteristics of G.M.Counter.
- PSO6-Understand the practical applications of Physics Laws through the lab experiments.

B.Sc VI Semester Physics-I

COURSE OUTCOME

- CO1-Understand Crystal structures, lattice, types of unit cells, coordination numbers, Bravais lattices, seven crystal systems, Miller indices, crystal structure of NaCl and KCl.
- CO2-Study of Crystal Diffraction with the help of Bragg's X-ray spectrometer. X-ray diffraction.
- CO3-Study of Free electron theory. Classical free electron model, expression for electrical and thermal conductivity. Weidman-Franz law, failure of classical free electron theory.
- CO4-Expression for electrical conductivity in case of intrinsic semiconductor, experimental determination of energy gap, Semiconductors with study of Hall effect, Hall co-efficient and applications.
- CO5-Introduction of superconductors, Properties and Applications of superconductors.
- CO6-Understand Nuclear models with their merits and de-merits, Liquid drop model and Shell model. Magic numbers.
- CO7-Study the Principles, Construction and Working of Nuclear Instruments: GM Counter, linear accelerator and cyclotron.
- CO8-Conventional and Non-conventional Energy Sources. Advantages of olar energy, solar radiation at Earth's surface, Zenith angle.
- CO9-Number system: Decimal, binary and hexadecimal and their inter conversion, Boolean algebra, truth tables, De Morgan's theorems. Designing logic gates using NAND and NOR gates.
- CO10-Introdution and classification of liquid crystals, display system, introduction to conducting polymers and applications.

Programme Outcome (PO)

- PSO1-Understand the basic concepts of Solid State Physics, Nuclear Physics and Digital Electronics.
- PSO2-Study of Energy sources and Special materials.
- PSO3-Perform procedure as per laboratory standards to set up Astable multivibrator, Amplifiers, Oscillators.
- PSO4- PSO5-Study of Digital electronics, LOGIC Gates and their applications.
- PSO5-Study of Solar Cell Characteristics.
- PSO6-Study Attenuation of β-rays using G.M.Counter.
- PSO7-Determination of dead time of G.M.tube.
- PSO8-Understand the scope of Modern Physics in the development of technology.

B.Sc VI Semester Physics-II

COURSE OUTCOME

- CO1-Study of Fourier transform, definition, Fourier integral, inverse transform, Fourier transform of derivatives. Laplace transform, definition, transform of elementary functions. Difference betwwen Fourier and Laplace transform.
- CO2-Introduction of LED, Photodiodes and optocouplers.
- CO3-Understanding concepts of transmission through optical fibres, gradind, numerical aperture, coherent bundle, transmission loss, attenuation and distortion, fibre optical communication system.
- CO4-Study of modulation, need of modulation, types of modulation, comparison of FM with AM. Demodulation types, necessity, transmitters and detectros.
- CO5-Writing of algorithm and flowchart to write a programme.
- CO6-Writing and execution of programme using C-language.
- CO7-Understanding Sinusoidal and non-sinusoidal oscillators, explaination of astable, monostable and bistable multivibrator. Integrated circuits, IC555 and IC7400.
- CO8-Operational amplifiers: Symbol, Op-amp as inverter and non-inverter, its application as Phase shift and Wien bridge oscillator.

Programme Outcome (PO)

- PSO1-Understand the basic concepts of Integral Transforms.
- PSO2-Study of Optoelectronics and Integrated Electronics.
- PSO3-Understand C-Programming.
- PSO4- Study of IC circuits.
- PSO5-Set up and design Op-Amp circuits. (Phase shift Oscillator and Wein bridge Oscillator).
- PSO6-Design, develop and execute C-programming.

Mathematics

B.Sc I Semester Mathematics-I

COURSE OUTCOMES (Cos)

Course Name –"Differential Calculus"

CO1:Real numbers, Postulates and their consequence
CO2: Inequalities and absolute values.
CO3: Archimedean property, LUBand GLB properties
CO4: Recapitulation of limits and continuity. Algebra of limits (with proofs).properties of continuous functions

CO5: Boundedness of continuous functions, Intermediate value theorem.
CO6: Borel covering theorem. Uniform continuity.
CO7: The nth derivative of $(ax+b)^n, \frac{1}{ax+b}, \sin(ax+b)$
CO8: The nth derivative of $\cos(ax+b), e^{ax} \sin(ax+b)$
CO9:The nth derivative of , $e^{ax}\cos(bx+c)$
CO10:.Leibntz's Rule for nth derivative of a product
CO11: Rolle's Theorem
CO12: Lagrange's Mean Value Theorem.
CO13:Taylor's Theorem (with Sclomilch and Rouche's form of reminder
CO14: L-Hospital's rule (statement only), Indeterminate forms of 0/0, ∞/∞ **CO15**:0×∞, ∞ - ∞
CO16: 0^0, $1^{\infty}$and∞^0

Programme Specific Outcomes (PSOs)

PSO1:Understand the different types of real numbers and properties.
PSO2:Understand the types of limits and continuity .Analyse the theorem.
PSO3:Understand the details of different types of nth derivative.
PSO4:Understand the types of Mean value theorem.
PSO5:Understand the types Indeterminate forms and analyse the examples.

B.Sc.I Semester Mathematics-II

COURSE OUTCOMES (Cos)

Course Name –"Algebra and Trigonometry"

CO1:Determinant of fourth order.
CO2: Symmetric and Skew-Symmetric determinants.

CO3: Reciprocal determinants.
CO4: Recapitulation of Matrices of Symmetric matrices and Skew symmetric matrices,
CO5: Elementary transformations.
CO6: Rank of a Matrix, Reduction to Normal forms.
CO7: Inverse of matrix, Solution system of Linear equations.
CO8:Arbitrary unions and intersections. De Morgan's laws.
CO9:. Countable and Uncountable sets.
CO10:Polynomial equation of nth degree in one variable, Euclidean algorithm, Reminder Theorem
CO11: Factor Theorem, Fundamental Theorem of Algebra

CO12:Relation between the roots andcoefficient of general polynomial equation in one variable, Synthetic division.
CO13: If one of theroot of an equation a0xn+a1xn-1+-------+an has one of its rational root is p|q, then p is an exact divisor of an and q is an exact divisor of a0.Solution of cubic and Bi- quadratic equations.

CO14: Expansions of Sine and Cosine functions,
CO15: Series of Sines and Cosines.Hyperbolic functions
CO16: Hyperbolic functions
CO17: Logarithm of a Complex number,
CO18:Summations of Trigonometricseries.

Programme Specific Outcomes (PSOs)

PSO1:Understand the Fourth order of Determinants.
PSO2:Understand the types Matrices.
PSO3:Understand the types of set theory and
PSO4:Understand the Polynomial equation of nth degree in one variable.
PSO5:Understand the Trigonometry expansions .

B.Sc.II Semester Mathematics-I

COURSE OUTCOMES (Cos)

Course Name –"DIFFERENTIAL AND INTEGRAL CALCULUS"

CO1: Polar coordinates of a point and polar curve.
CO2: Angle between the radius vector and the tangent at a point on the curve.
CO3: Angle of the intersection of two curves.
CO4:Polar and pedal equation of the curves.
CO5**:** Polar sub-tangent and polar sub - normal.
CO6:Dreivative of arc length, Curvature
CO7: Radius of curvature in Cartesian. Parametric, polar and pedal forms.
CO8: Centre of curvature, Evolutes and Involutes.
CO9: Limits, continuity of functions of two variables.

CO10: Partial derivatives, higher order partial derivatives
CO11: total derivatives and total differentials, Homogeneous functions,
CO12: Euler's theorem on homogeneous functions.

CO13: Concavity and Convexity of curves, Points of inflexion of curves,
CO14: Envelops, and asymptotes.
CO15: Reduction formulae for integration of $\sin^n x$, $\mathrm{Cos}^n x$,
CO16: Reduction formulae for integration of $\tan^n x$, $\cot^n x$, $\sec^n x$,
CO17: Reduction formulae for integration of $\mathrm{cosec}^n x$, $\sin^m x \cos^n x$, $x^n e^{ax}$, $x^m (\log x)^n$.

Programme Specific Outcomes (PSOs)

PSO1: Understand the Polar coordinates of a point and polar curve. Angle between the radius vector andthe tangent at a point on the curve. Angle of the intersection of two curves. Polar andpedal equation of the curves. Polar sub-tangent and polar sub - normal.

PSO2: Understand the Derivative of arc length, Curvature, Radius of curvature in Cartesian. Parametric, polar and pedal forms. Centre of curvature, Evolutes and Involutes.
PSO3: Understand the Limits, continuity of functions of two variables. Partial derivatives, higher order partial derivatives, total derivatives and total differentials, Homogeneous functions, Euler's theorem on homogeneous functions.
PSO4: Understand the Concavity and Convexity of curves, Points of inflexion of curves, Envelops, and asymptotes.
PSO5: Understand the Reduction formulae for integration of $\sin^n x$, $\cos^n x$, $\tan^n x$, $\cot^n x$, $\sec^n x$, $\text{cosec}^n x$, $\sin^m x \cos^n x$, $x^n e^{ax}$, $x^m (\log x)^n$.

B.Sc.II Semester Mathematics-II

COURSE OUTCOMES (Cos)

Course Name –"ALGEBRA AND GEOMETRY"

CO1:Lattices and algebraic structures. Principle of duality.
CO2: Distributive and complemented lattices. Boolean lattices and Boolean algebra.
CO3:Boolean functions and expressions.
CO4:Recap of division algorithm, properties of prime and composite numbers
CO5:Congruence'sand its properties, Fundamental theorem of arithmetic, Bracket function,
CO6:Euler's function, Fermat, Euler and Wilson's theorems.
CO7: Equation of a sphere, section of a sphere by a plane
CO8:Equation of a sphere through a circle,
CO9:Equation of a sphere through two given points as ends of a diameter.
CO10: Equation to a tangent plane of a sphere. Condition for tangency.
CO11: Radical planes. Orthogonality of two spheres.
CO12:Equation of a cone, enveloping cone of a sphere
CO13: Right circular cone.
CO14: Equation of a cylinder, enveloping cylinder of a sphere,
CO15: Right circular cylinder.

Programme Specific Outcomes (PSOs)

PSO1: Understand the Lattices and algebraic structures.Principle of duality.Distributive and complemented lattices.Boolean lattices and Boolean algebra.Boolean functions andexpressions.
PSO2: Understand the Recap of division algorithm, properties of prime and composite numbers.Congruencesand its properties, Fundamental theorem of arithmetic, Bracket function, Euler's function, Fermat, Euler and Wilson's theorems.
PSO3: Understand the Equation of a sphere, section of a sphere by a plane, Equation of a sphere through a circle, Equation of a sphere through two given points as ends of a

diameter. , Equation to a tangent plane of a sphere. Condition for tangency. Radical planes. Orthogonality of two spheres.
PSO4: Understand the Equation of a cone, enveloping cone of a sphere, Right circular cone.
PSO5: Understand the Equation of a cylinder, enveloping cylinder of a sphere, Right circular cylinder.

B.Sc.III Semester Mathematics-I

COURSE OUTCOMES (Cos)

Course Name –"Mathematical Logic and Real Analysis"

CO1:TautologyandContradiction
CO2: logical equivalence
CO3: Converse, inverse and Contra-positive of an implication
CO4: Mathematical structures, Existential & universal quantifiers, methods of proofs
CO5: Jacobians and Properties,
CO6: Lagrange's mean value theorem for functions of two variables.
CO7:Taylor's and Mac Laurian's theorems for two variables.
CO8:Maxima and Minima of two and three variables
CO9:.Necessary and sufficient condition for extreme values of two variables
CO10:Lagrange's method undetermined multipliers.
CO11: Sequences. Limit of a sequences
CO12: Bounded and unbounded sequences,
CO13:Convergent, Divergent, and Oscillatory sequences.
CO14: Algebra of convergent sequences.
CO15: Monotonic sequences. Theorems on monotonic sequences.
CO16: Cauchy's sequences
CO17: Cauchy's first and second theorems on limits.and examples
CO18: Cauchy's criterion for convergence of sequences. Subsequences.

Programme Specific Outcomes (PSOs)

PSO1:Understand the TautologyandContradiction, Converse, inverse and Contra-positive of an implication, Mathematical structures, Existential & universal quantifiers, methods of proofs and examples and analyse

PSO2:Understand Jacobians, Lagrange's mean value theorem for functions of two variables. Taylor's (only statement) and Maclaurian's theorems for two variables.
PSO3:Understand the Maxima and Minima of two and three variables, Necessary and sufficient condition for extreme values of two variables, Lagrange's method undetermined multipliers.

PSO4: Understand the Sequences. Limit of a sequences, Bounded and unbounded sequences, Convergent, Divergent, and Oscillatory sequences. Algebra of convergent sequences. Monotonic sequences. Theorems on monotonic sequences.
PSO5: Understand the Cauchy's sequences, Cauchy's first and second theorems on limits. Cauchy's criterion for convergence of sequences. Subsequences. (definition& example)

B.Sc.III Semester Mathematics-II

COURSE OUTCOMES (Cos)

Course Name –"Group Theory,Integral Calculus & Differential Equations"

CO1: Groups, Abelian group, Standard examples of groups, Properties of Groups.
CO2: Properties of groups, Semi groups, Subgroups and its properties.
CO3: Permutation group.
CO4: Cyclic groups & its properties
CO5:Cosets. Lagrange's theorem.
CO6: Euler's theorem and Fermat's theorem.
CO7:Application of integration for finding the lengths of arc, polar and parametric forms and examples,
CO8: Surface areas and volume of solids of revolution for standard curves whose equations are given in Cartesian.
CO9:.polar and parametric forms
CO10:First order and first degree differential equations
CO11: linear differential equation
CO12: Homogeneous forms
CO13:Reducible to homogeneousform
CO14: Bernoulli's form, Exact equations
CO15: Necessary and sufficient condition for the equation to be exact
CO16: solution of differential equation by finding suitable integrating factor
CO17:Differential equations of the first order higher degree
CO18: Solvable for p
CO19:Solvable for x
CO20: Solvable for y
CO21: Clairaut's equations and equations reducible to Clairaut's form.

Programme Specific Outcomes (PSOs)

PSO1:Understand the Groups, Abelian group, Properties of groups, Semi groups, Subgroups and its properties, Permutation group, Cyclic groups & its properties and examples Cosets. Lagrange's theorem, and examples,
PSO2:Understand Application of integration for finding the lengths of arc, Surface areas and volume of solids of revolution for standard curves whose equations are given in Cartesian, polar and parametric forms.

PSO3:Understand the First order first degree equations: linear differential equation, Homogeneous and reducible to homogeneous forms, Bernoulli's form, Exact equations, Necessary and sufficient condition for the equation to be exact, solution of differential equation by finding a suitable integrating factor.

PSO4: Understand the Differential equations of the first order higher degree, Solvable for p, Solvable for x, Solvable for y, Clairaut's equations reducible to Clairaut's form.

B.Sc.IV Semester Mathematics-I

COURSE OUTCOMES (Cos)

Course Name –"MATHEMATICAL LOGIC & REAL ANALYSIS"

CO1: Dot and cross product of vectors, Ordinary derivatives of vectors.
CO2: Continuity and differentiability of a vector function. Derivatives of sum.

CO3: Continuity and differentiability of a vector function.
CO4:Dot product, Cross product and Triple product of vectors.
CO5: Constant vector functions, Partial differentiation of vector functions.
CO6: The vector differential operator del. The gradient of a scalar point function,

CO7:The directional derivative of function. Properties of gradient of vector function.
CO8: Divergence and Curl of a vector point function.
CO9: Properties of divergence and curl. Solenoidal and irrotational vectors.
CO10: Properties of divergence and curl. Solenoidal and irrotational vectors.
CO11: Partial sum of series. Series of non-negative terms,
CO12:Necessary and sufficient condition for convergence,
CO13: Cauchy's general principle of convergence. Geometric series.
CO14: The P-series(Harmonic), Comparison tests (different forms).
CO15:D'Alembert's ratio test, Raabe's test,
CO16: Cauchy's integral test and Root test.
CO17: Absolute convergence and conditional convergence of series.
CO18: Alternating series, Leibnitz theorem, Uniform convergence.

Programme Specific Outcomes (PSOs)

PSO1: Understand the Dot and cross product of vectors, Ordinary derivatives of vectors. Continuity and differentiability of a vector function. Derivatives of sum. Dot product, Cross product and Triple product of vectors. Constant vector functions, Partial differentiation of vector functions.

PSO3: Understand the The vector differential operator del. The gradient of a scalar point function, The directional derivative of function. Properties of gradient of vector function. Divergence and Curl of a vector point function. Properties of divergence and curl. Solenoidal and irrotational vectors.

PSO4: Understand the Infinite series and examples. Convergent, Divergent and Oscillatory series. Partial sum of series. Series of non-negative terms, Necessary and sufficient condition for convergence, Cauchy's general principle of convergence. Geometric series. The P-series(Harmonic), Comparison tests (different forms).

PSO5: Understand theD'Alembert's ratio test, Raabe's test, Cauchy's integral test and Root test.
PSO6:Understand the Absolute convergence and conditional convergence of series. Alternating series, Leibnitz theorem, Uniform convergence.

B.Sc.IV Semester Mathematics-II

COURSE OUTCOMES (Cos)

Course Name –"Group Theory, Fourier series and Differential Equations"

CO1:Normal sub-groups, Quotient groups.
CO2: Homomorphism and Isomorphism of groups
CO3:Kernel of Homomorphism. Fundamental theorem of Homomorphism.
CO4: Periodic functions,Fourier series of functions of period 2π and 2l.
CO5: Fourier series of odd and even functions,
CO6:half range sine and cosine series.
CO7:Finite sine and Cosine transforms.
CO8:Linear differential equation of n^{th} order with constant co-efficient.
CO9: Particular integral when RHS is of the form e^{ax}, sinax, where v is function of x.
CO10: Particular integral when RHS is of the form cosax, x^n, e^{ax}v and xv
CO11:Homogeneous linear differential equation of n^{th} order
CO12: Equation reducible to the homogeneous linear form,
CO13: higher order exact differential equations.

B.Sc.V Semester Mathematics-I

COURSE OUTCOMES (Cos)

Course Name –"Real Analysis"

CO1:Partition of a set. The upper and lower sums.
CO2: Necessary and sufficient conditions for integrability
CO3:Algebra of integrable functions
CO4: Integrability of continuous functions, monotonic functions.
CO5: Fundamental theorem of integral calculus, Change of variables
CO6: Integration by parts. The first and second mean value theorem
CO7:second mean value theorem (Bonnet & Weirstrass form) of integral calculus.
CO8: Improper integrals of first and second kind.
CO9: Comparison tests. Duplication formula.
CO10: Abel's test

CO11: Dirichlet's test.
CO12: Beta and Gamma functions:Properties
CO13: Relation between Beta & Gamma functions and their convergence

CO14: Duplication formula.
CO15:Differentiation under integral sign
CO16: Double and triple integrals
CO17: Areas and volumes (Cartesian coordinates).of Double and triple integrals

Programme Specific Outcomes (PSOs)

PSO1: Understand thePartition of a set. The upper and lower sums. Necessary and sufficient conditions for integrability. Algebra of integrable functions (constant, sum, difference, product, quotient, and modulus)

PSO2: UnderstandIntegrability of continuous functions, monotonic functions. Fundamental theorem of integral calculus, Change of variables, Integration by parts. The first and second mean value theorem (Bonnet & Weirstrass form) of integral calculus.

PSO3: Understand the Improper integrals of first and second kind. Comparison tests. Abel's test and Dirichlet's test.

PSO4: Understand the Properties, Relation between Beta & Gamma functions and their convergence and Duplication formula.

PSO5: Understand the Differentiation under integral sign. Double and triple integrals, areas and volumes (Cartesian coordinates).

B.Sc.V Semester Mathematics-II

COURSE OUTCOMES (Cos)

Course Name –"Numerical Analysis"

CO1: **Solutions of Algebraic and transcendental equations:** Bisection method
CO2: Iteration method
CO3:Newton-Raphson method
CO4:Numerical Solutions of non-homogeneous systems of Gauss Siedal method.
CO5:Numerical Solutions of non-homogeneous systems of Jacobi Iteration Method**.**
CO6: **Finite Differences:** Operators Δ (Delta), ∇ (Del) &***E*** (Shift), Definitions and their properties
CO7:n^{th} order difference of a polynomial
CO8: **Interpolation:** Newton Gregory forward difference interpolation formula CO9: Newton Gregory backward difference interpolation formula
CO10: Lagrange's interpolation formula
CO11: **Numerical differentiation:** Forward and backward difference formulaCO12: Computation of first and second ordered derivatives.

CO13: **Numerical integration of:** General Quadrature formula
CO14:Trapezoidal rule
CO15:Simpsons rules ($1/3^{rd}$ and $3/8^{th}$
CO16: **Solution of initial value problems:** by ordinary linear first order differential equations by Taylor's series method.
CO17: **Solution of initial value problems:** by ordinary linear first order differential equations by Euler's method
CO18: **Solution of initial value problems:** by ordinary linear first order differential equations by Picard method
CO19: **Solution of initial value problems:** by ordinary linear first order differential equations by Runge- Kutta method of order two. CO20:
Difference equations: Basic definitions**,** order and degree, solution
CO21:Formation of first linear difference equations with constant coefficients
CO22: Formation of second linear difference equations with constant coefficients.

Programme Specific Outcomes (PSOs)

PSO1: Understand the Solutions of Algebraic and transcendental equations: of Bisection method, Iteration method, Newton-Raphson method.
PSO2: Understand the Numerical Solutions of non-homogeneous systems : of Gauss Siedal method. Jacobi Iteration Method.
PSO3: UnderstandFinite Differences of Operators Δ (Delta), ∇ (Del) &*E* (Shift), Definitions and their properties, n^{th} order difference of a polynomial,
PSO4:Interpolation: Newton Gregory forward and backward difference interpolation formula and examples. Lagrange's interpolation formula and examples. PSO5: Understand the Numerical differentiation of Forward and backward difference formulae.Computation of first and second ordered derivatives.
PSO6:Numerical integration of General Quadrature formula, Trapezoidal rule, Simpsons rules ($1/3^{rd}$ and $3/8^{th}$).
PSO7: Understand the Solution of initial value problems of by ordinary linear first order differential equations by Taylor's series, Euler's, Picard and Runge- Kutta method of order two.
PSO8: Understand theDifference equations ofBasic definitions, order and degree, solution, formation of first and second linear difference equations with constant coefficients (simple examples).

B.Sc.V Semester Mathematics-III

COURSE OUTCOMES (Cos)

Course Name –"Dynamics and Calculus of Variations"

CO1:**Kinematics:** Velocity and acceleration of a particle along a plane curve
CO2: Radial and Transverse components of velocity and acceleration
CO3: Tangential and normal components of velocity and acceleration
CO4:Central Orbits: Motion of a particle under a central force
CO5: Use of Polar and Pedal co-ordinates
CO6: Apse, Apsidal distance and Apsidal angle
CO7:**Motion of a projectile**: in a non resting medium under gravity
CO8: **Elastic Impact:** Direct impact of elastic bodies
CO9: Oblique impact of elastic bodies

CO10: **Calculus Of Variations:** Variation of a function f = f(x,y,z),and functional.Variational problems .
CO11: Fundamental theorem of calculus of variation,
CO12: Euler's equation.
CO13: Geodesic on plane , on sphere
CO14:Brachistochrome problem
CO15:Minimum surface of revoluation.
CO16: Isoperimetric problems.

Programme Specific Outcomes (PSOs)

PSO1: Understand the Kinematics of Velocity and acceleration of a particle along a plane curve, Radial and Transverse components of velocity and acceleration, Tangential and normal components of velocity and acceleration.
PSO2: Understand the Central Orbits of Motion of a particle under a central force. Use of Polar and Pedal co-ordinates. Apse, Apsidal distance and Apsidal angle
PSO3: Understand Motion of a projectile of in a non resting medium under gravity. **Elastic Impact:** Direct and Oblique impact of elastic bodies.
PSO4: Understand Calculus Of Variations of Variation of a function f = f(x,y,z),and functional. Variational problems . Fundamental theorem of calculus of variation, Euler's equation.
PSO5: Understand the Geodesic on plane , on sphere, Brachistochrome problem , minimum surface of revolution, Isoperimetric problems.

B.Sc.VI Semester Mathematics-I

COURSE OUTCOMES (Cos)

Course Name –" DIFFERENTIAL EQUATIONS"

CO1: **Differential Equations :** Simultaneous differential equations with two and three variables
CO2: Total differential equation
CO3: Condition of Integrability and its solutions
CO4:.Series Solutions of Ordinary Differential Equations: Basic definitions, Power series, ordinary and singular points
CO5: Ordinary and singular points
CO6: Power series solutions of ODEs
CO7:. Frobenius method.
CO8: Solutions of Legendre's equations in series,
CO9:Legendre's functions- first and second kind,
CO10: Rodrigue's formula,
CO11:.Orthogonal properties
CO12: Legendre's polynomial, recurrence formulae
CO13: Formation of partial differential equation by eliminating arbitrary constants and functions

CO14: Lagrange's linear partial differential equation Pp+Qq = R and its solution.
CO15:Non-linear differential equations of standard forms I, II, III and IV CO16: Non-linear differential equations of standard forms III and IV
CO17: **Non-linear partial differential equations:** Charpit's method.
CO18: **Linear partial differential equations with constant**

Programme Specific Outcomes (PSOs)

PSO1: Understand the Differential Equations of Simultaneous differential equations with two and three variables, Total differential equation, Condition of Integrability and its solutions.
PSO2: Understand the Series Solutions of Ordinary Differential Equations: Basic definitions, Power series, ordinary and singular points, Power series solutions of ODEs. Frobenius method.
PSO3: UnderstandtheLegendre equation and functionsof Solutions of Legendre's equations in seriesLegendre's functions- first and second kind, Rodrigue's formula, Orthogonal properties. Legendre's polynomial, recurrence formulae
PSO4: UnderstandPartial differential equations of 1st order: formation of partial differential equation by eliminating arbitrary constants and functions. Lagrange's linear partial differential equation Pp+Qq = R and its solution.Non-linear differential equations of standard forms I,II,III and IV
PSO5: Understand the Non-**linear partial differential equations:** Charpit's method. Linear partial differential equations with constant coefficients

B.Sc.VI Semester Mathematics-II

COURSE OUTCOMES (Cos)

Course Name –"Complex Analysis and Ring Theory"

CO1: **Complex Analysis:** Analytic function. Cauchy-Riemann equations
CO2: Harmonic function, Harmonic conjugate.
CO3: Construction of analytic function using Milne-Thomson's method
CO4:Complex Integration of Cauchy'sTheorem
CO5: Morera's Theorem
CO6:Cauchy's Integral formula,
CO7:Cauchy's Integral formula for derivatives, Cauchy's inequalities
CO8:Lioville's Theorem
CO9: Taylor's and Laurent's series, zeros and singularities of analytic functions.
CO10:Calculus of Residues
CO11: Residue Theorem,
CO12: Jordan's lemma
CO13:Contour Integration
CO14: Rings, Properties of rings, sub rings,
CO15:Ideals, principle and maximal ideals in a commutative ring, CO16: Quotient rings, homomorphism and isomorphism,

CO17:Integral domains

Programme Specific Outcomes (PSOs)

PSO1: Understand the Analytic function. Cauchy-Riemann equations, Harmonic function, Harmonic conjugate. Construction of analytic function using Milne-Thomson's method.

PSO2: Understand the Cauchy's Theorem , Morera's Theorem , Cauchy's Integral formula, Cauchy's Integral formula for derivatives, Cauchy's inequality , Lioville's Theorem .

PSO3: Understand the Taylor's and Laurent's series, zeros and singularities of analyticfunctions.Calculus of Residues.

PSO4: Understand the Residue Theorem, Jordan's lemma and Contour Integration.

PSO5: Understand the Rings, Properties of rings, sub rings, ideals, principle and maximal ideals in a commutative ring, quotient rings, homomorphism and isomorphism, and integral domains

B.Sc.VI Semester Mathematics-III

COURSE OUTCOMES (Cos)

Course Name –"Topology and Laplace Transformations"

CO1:**Topology-:** Open set, closed set, closure of a set.
CO2: Neighbourhood, limit points.
CO3: Derived sets, interior, exterior and boundary points of a set
CO4: Base & sub-base, subspace
CO5: Separation axioms
CO6:T_1& T_2 spaces properties
CO7:**Laplace transforms-of** Definition**,** basic properties. Laplace transforms of some common functions
CO8: First shifting theorem, change of scale property
CO9: Laplace transforms of periodic functions
CO10: Laplace transforms of derivatives and integrals
CO11: Inverse Laplace transforms
CO12:Heaviside function, Dirac-delta function, unit step function
CO13: Convolution theorem and Laplace transforms method of solving differential equation of first order with constant coefficient
CO14: Convolution theorem
CO15: Laplace transforms method of solving differential equation second order with constant coefficient

Programme Specific Outcomes (PSOs)

PSO1: Understand the Open set, closed set, closure of a set, neighbourhood, limit points and derived sets, interior, exterior and boundary points of a set

PSO2: Understand the. Base & sub-base, subspace, separation axioms. T_1& T_2 spaces (properties and examples).

PSO3: Understand the Definition**,** basic properties. Laplace transforms of some common functions. First shifting theorem, change of scale property.

PSO4: Understand the Laplace transforms of periodic functions, Laplace transforms of derivatives and integrals, inverse Laplace transforms

PSO5: Understand the Heaviside function, Dirac-delta function, unit step function, convolution theorem and Laplace transforms method of solving differential equation of first and second order with constant coefficients

Botany

BSc-I SEMESTER BOTANY
Plant anatomy and Embryology

CO-Course out come

CO-1 Tissues-Meristems, types, characters Histological organisation of root and shoot, Apices theories

CO-2 Permanent tissues- Simple & complex tissues, Types of vascular bundles

CO-3 Tissue systems- Dermal tissue system, Mechanical tissue system, secretory, nectary, laticiferous & Oil glands.

CO-4 Internal structure of primary plant body-root,stem, & leaf (dicot& monocot).

CO-5 Secondary growth- root &stem.

CO-6 Abnormal secondary growth- general account with the examples Bignonia, Boerhaavia. Dracaena &Beet root.

CO-7 Wood anatomy- General account, ring porous, diffused porous, Distribution & types of Wood parenchyma, Tracheary elements, fibre types.

CO-8 Anther-development, microsporogenesis& male gametophyte, MGU

CO-9 Palynology applications of palynology in taxonomy, coal, oil exploration& forensic sciences.

CO-10 Ovule- development, types, structure of anatropus ovule.

CO-11 Megasporogenesis, development of gametophyte- monosporic, bisporic &tetrasporic types (Peperomia, Drusa,Fritillaria &Adoxa) & FGU

CO-12 Fertilization- Pollen–Pistil interaction, entry of pollen tube into the stigma, style & embryosac Double fertilization

CO-13 Endosperm-Types, Embryogeny-dicots (Crucifer) Monocots (grass)

CO-14 A brief account of polyembryony, Amphimixis & their significance

B.Sc. II Semester Botany

Course Outcomes (Cos)

Course Name-Plant Physiology and Biochemistry

CO1: Plant water relations: Solutions, Suspensions, colloids, true solutions, percentage, molarity, molar, buffer, molal solution, pH, colloids, emulsion and gels.

CO2: Permeability, Diffusion, imbibitions, osmosis, endosmosis, exosmosis, osmotic pressure, turgour pressure, wall pressure, relation between OP. TP, DPD, Plasmolysis, deplasmolysis and imbibition.

CO3: Active, passive water absorption, ascent of sap and Transpiration.

CO4: Mineral Nutrition: macro and micronutrients role and deficiency symptoms in plants.
CO5: Photosynthesis: Photosynthetic pigments, photo system 1 and 2, Calvin cycle, C4, CAM pathway, photorespiration and factors affecting photosynthesis.
CO6: Respiration: Aerobic and Anaerobic fermentation, glycolysis, Krebs cycle, ETS, RQ, oxidative phosphorylation, pentose phosphate pathway and factor affecting photosynthesis.
CO7: Nitrogen fixation its importance and ammonium assimilation.
CO8: Growth: Photomorphogenesis, biological clock, seed dormancy, plant stress physiology and growth regulators.
CO9: Thermodynamics laws and its principles.
CO10: Enzymes classification, nomenclature, properties, mechanism of enzyme action, inhibition and enzyme kinetics.
CO11: Protein structure and classification.
CO12: Study the structure of Carbohydrates.
CO13: Study the structure of Lipids.
CO14: Pharmacognacy and its importance, Crude drugs, drug evaluation, secondary metabolites, its biosynthesis, types and action against pathogen. Study of steroids, Tannins and alkaloids (uses and Plant Source).

Programme specific Outcomes (PSOs)

PSO1: Understand the process of water and mineral absorption, Transpiration, water translocation, Movement of water to various parts of plants.
PSO2: Understand the process of Photosynthesis and Respiration taking place in plants.
PSO3: Understand the external environmental factors and internal plant factors affecting growth of Plants.
PSO4: Understand the role of enzyme in plant metabolism and the biomolecules structure and role.
PSO5: Understand Crude drug uses and its application.

B.Sc III Semester Botany

Paper- Diversity of Cryptogams (Algae, Fungi, Bryophytes, Pteredophytes Gymnosperms)-52 hrs.

CO-Course out come

CO-01 General characters, Pigmentation, Classification by Fritsch (up to class level)
CO-2 Distribution, thallus, structure, reproduction and life cycle of Nostoc Volvox Oedogonium
Sargassum Batrachospermum.
CO-3 Economic importance of algae, General characters, Classification(Alexopoulus system)
CO-4 Distribution, structure, reproduction and life cycle of Albugo, Rhizopus, Pencillium, Puccinia

CO-5 Economic importance of fungi
CO-6 General account of Lichens
CO-7 General account of Bacteria,
CO-8 General account of Viruses
CO-9 Introduction and general symptoms of plant deseases, Symptoms, Pathogen, Control measures
of Late blight of Potato, White rust of Crucifers, Tikka disease of Ground nut
CO-10 General characters, classification (Smith)
CO-11 Structure, reproduction and schematic life cycle of Riccia, Anthoceros, Funaria
CO-12 Evolution of sporophytes.
CO-13 General characters and classification
CO-14 Distribution, structure (External and internal) and reproduction of Psilotum, Selaginella,
Equisetum, Nephrolepis.
CO-15 Stelar evolution.
CO-16 Heterospory and seed habit
CO-17 General characters and classification
CO-18 Destribution, structure, (External and Internal) Reproduction of Cycas, Pinus, Gnetum.
CO-19 Geological time scale, Fossilization, molds, impression, petrification and cast.
CO-20 Study of fossils- Calamitis, Study of fossils- Lepidodendron, Lygenopteris

B.Sc. IV SEMESTER BOTANY

Course Outcomes (COS)

Course Name:DIVERSITY OF ANGIOSPERMS AND THEIR SYSTEMATICS

Section – I Morphology and Taxonomy
COs 1:Study of stems and its modification, leaf types,stipules,phyllotaxy and their modifications.
Cos 2: Study of Inflorescence, flower and fruits.
Section –II Angiosperm taxonomy:
COs 3:Study of principles and rules,taxonomic ranks, type concept and principle of priority of botanical nomenclature.
Cos 4: Study of system of classification of angiosperms proposed by Bentham and Hooker and Engler prantl. Their salient features, merits and demerits. APG system.
Cos -5: Study of major contributions of cytology (cytotaxonomy), phytochemistry (chemotaxonomy) and taximetrics (numerical taxonomy) to taxonomy.
Cos - 6: Diversity of flowering plants as illustrated by members of the following families: Annonaceae, Brassicaceae, Malvaceae, Rutaceae, Rhamnaceae,Fabaceae, Myrtaceae, Combretaceae, Cucurbitaceae.
Cos -7: Diversity of flowering plants as illustrated by members of the following families: Apiceae, Rubiaceae, Asteraceae,

Sapotaceae, Apocyanaceae Asclepiadaceae, Convolvulaceae, Solanaceae, Acanthaceae.
Cos -8: Diversity of flowering plants as illustrated by members of the following families: Verbenaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Orchidaceae, Amaryllidaceae, Liliaceae, Arecaceae and Poaceae.

Section – III Economic Botany
Cos 8: Study of Origin& Distribution,Family,Botanical name and utility of food plants(Rice, Wheat, Maize, Pulses, Potato and Sugarcane)
Cos 9: Study of Origin& Distribution,Family,Botanical name and utility of Fibre yielding plants(Cotton,Jute,Agave and Deccan hemp)
Cos 10: Study of Origin& Distribution,Family,Botanical name and utility of Vegetable oil yielding plants(Ground nut,Sunflower, Palm oil, sandal wood and Citronella oil)
Cos 11: Study of Origin& Distribution,Family,Botanical name and utility of Paper & pulp yielding plants (Bamboo & Eucalyptus), Spices: Ginger,Clove, Cinnamom,Asafoetida and Cardamom, Beverages: Tea & Coffee, Rubber: Hevea sp.

Section IV- **Medicinal botany:**
Cos 12: Study of common medicinal plants in primary health care:
Tippateega (Tinospora cordifolia), Tulsi (Oscimum sanctum)
Kalabanda (Aloe-vera) Turrmeric (Curcuma longa)
Ashwagandha (Withania somnifera) and Sarpagandha
(Rauwolfia serpentina)

Program Specific Outcome

PSO 1: Students will understand the morphology of/external features of whole plant including their parts.
PSO 2: Students will learn various aspect of botanical nomenclature.
PSO 3: Students will learn how to identify the plants of different families.
POS 4: Students will learn to identify the plants of different families.
PSO 5: Understand the utilization of different plants and their parts by human beings.
PSO6: Understand the use of herbal plants for health disease.

BSc V semester Botany Paper I

Course outcomes (Cos)

Course Name – Plant Breeding, Tissue Culture and Horticulture Practices.
CO1: History, objectives, Introduction of plant breeding, pure line and, mass selection.
CO2: Inter specific and inter generic hybridization, Mutational and Polyploidy breeding.
CO3: Germ plasm conservation and its maintenance. Pollen bank maintenance and study of quarantine method.

CO4: Basic aspects ,Scope and significance of plant tissue culture.
CO5: Study of cellular totipotency, different cultural techniques and study of differentiation and morphogenesis.
CO6: Methods of artificial Propagation in plants : Grafting, layering, cutting, budding and their importance.
CO7: Different types of nurseries and their cultural practice.
CO8. Study of Collection of seeds, storage and treatment; Use of manure, fertilizers, pesticides, and Methods of irrigation in nursery.
CO9. Introduction, advantages, limitations, types, structure and principle of green house technology. Green house technology applied to ornamental, vegetables and fruit plants
CO10. Flower and fruit plants management, Artificial ripening, maturity indices, methods of picking. Post harvesting technology and management of fruits: grading, processing, storage and packing.
CO11. Introduction and Significance of weed management :concepts ,causes and dominance of invasive weeds .Physical, Chemical, Biological methods of weed control.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Understands plant breeding techniques and its applications.
PSO2: Study of basic aspects of plant tissue culture and applications.
PSO3: Understand types of artificial vegetative propagation in plants.
PSO4: Understand nursery types and its management.
PSO5: Understand green house technology, its advantages and green house technology applied to vegetables fruits and ornamental plants.
PSO6: Understands fruit, flower and weed management.

BSc V semester Botany Paper II

Course outcomes (Cos)

Course Name –Ecology, Environmental Biology and Phytogeography

CO1: study of atmosphere, water, light, temperature, soil and biota.
CO2: Morphological anatomical and physiological responses of plant to water, temperature, light, and salinity.
CO3: Study of growth curves, ecotypes, ecads and ecological succession.
CO4: Study of structure of ecosystem, Biotic and Abiotic components, food chain, food web, ecological pyramids and energy flow.
CO5: Botanical regions of world, vegetation types of Karnataka and India.
CO6: Different types of natural resources and their conservation.
CO7: Study of forest type and its ecological significance, deforestation and social forestry. Natural depletion of vegetation endangered and threatened economic plants of India and red data book. Wild life management in India. Indian board of wild life, national park and sanctuary.
CO8: study of conventional and nonconventional sources of energy.
CO9: Study of biodiversity its significance, types, depletion conservation of biodiversity.

CO10: Introduction causes, effects and control measures of water pollution, Air pollution, Soil pollution, Acid rain, Global warming and ozone depletion.
CO11: Sewage water and waste water types. Methods of effluent treatment of industrial waste water, sludge disposal and its care related to environment.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Understand response of plants to environmental factors.
PSO2: Understand growth curves and structure of ecosystem.
PSO3: Understand botanical regions of world and vegetation types of Karnataka and India.
PSO4: Understand forest type, wild life management, conservation biodiversity and natural resources.
PSO5: Understand causes, effects and control measures of pollutions.

B.Sc. VI semester Botany Paper I

Course Outcomes (COS)
Course Name: Cell Biology, Genetics and Evolution

Section I- Cell Biology:
Cos1: The cell- General organization of prokaryotic and eukaryotic cells.
Cos2: Ultra-structure and functions of Nucleus, Plastids, Mitochondria, Golgi complex, Endoplasmic reticulum, Lysosomes, Peroxisomes and Vacuoles.
Cos3: Ultra structure and functions of plasma membrane and cell wall.

Section II- Morphology of Chromosomes:
Cos4: Number, size, shape, types, centromere.
Cos5: SAT- chromosome, Ultra structure of gaint chromosomes, Ploidy and Chromosomal aberrations.

Section III- Cell Division:
Cos6: Mitosis and Meiosis
Cos7: Cell cycle- regulation of cell cycle.

Section IV- Genetics:
Cos8: Mendelism- Laws of inheritance, Monohybrid, Dihybrid Experiments.
Cos9: Gene Interaction- Allelic-incomplete dominance, Co-dominance, Non-allelic-Complementary, Supplementary, Epistasis.
Cos10: Linkage and crossing over, Alleles and Multiple alleles.
Cos11: Sex determination, sex linked inheritance, Mutations, Problems related to the above topics.

Section V- Evolution:
Cos12: Origin of life Lamarckism, Darwinism.

Cos13: Mutational and Modern concepts of evolution.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1: Students understand ultra structure of prokaryotic and eukaryotic cells with cell organelle.
PSO2: Students should learn structure of chromosome, type and its aberrations.
PSO3: Students should understand process of cell division with details of cell cycle.
PSO4: Students should understand Mendel's laws of inheritance.
PSO5: Students should learn examples for gene interactions, Linkage and Multiple alleles.
PSO6: Students should understand mechanism of crossing over and sex determination.
PSO7: Students should solve genetic problems to know types of inheritance.

B.Sc. VI semester Botany Paper II

Course Outcomes (COS)
Course Name: Molecular Biology, Biotechnology and Immunology

Section I- Nucleic Acids:
COS1: DNA and RNA, occurrence, types and chemical compositions.
COS2: Experimental evidences for DNA as genetic material. Structure of DNA, Replication, semi conservative method , RNA and types, post transcription changes.

Section II- Gene Expression:
COS3: Gene concepts, Genetic code and protein synthesis.
COS4: Regulations of gene expression in prokaryotes and eukaryotes.

Section III- Recombinant DNA Technology and Bioinformatics
COS5: Enzyme vector (plasmid PBR 322), marker gene, steps of cloning technique, PCR and its application.
COS6: Genomic DNA and cDNA library. Brief concept on Genomics and Proteomics.

Section IV- Biotechnology and Genetic Engineering of plants
COS7: Basic concepts, principles and scope, Aims, Structures for development of transgenic plants with suitable example.
COS8: Agrobacterium- the natural genetic engineer. T- DNA and transposon mediated. Gene tagging, intellectual.
COS9: Property rights, possible ecological risks and ethical concerns.

Section V: Microbial genetic manipulation and Immunology
COS10: Microbial genetic manipulation: Bacterial transformation, selection of recombinant and transformants.
COS11: Genetic improvement of industrial microbes, nitrogen fixers and fermentation technology.

COS12: Immunology: Immuno systems, Immunotechniques in agriculture, ELISA method to detect plant diseases and monoclonal antibodies.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1: Students should learn genetic material with experimental evidences.
PSO2: Students should understand process of protein synthesis along with gene regulation.
PSO3: Students should learn techniques involved in recombinant DNA and Bioinformatics.
PSO4: Students should understand the process of genetic engineering in terms of research aspects.
PSO5: Details of property rights, merits and demerits concerning ecological and ethical aspects.
PSO6: Students should learn details of microbial genetics and immunology with application.

Zoology

B. SC. I Semester Zoology

Course Outcomes (COs)

Course Name – 'Biology of Non-chordates'

CO1: Binomial nomenclature, Concept of Species
CO2: General characters of phylum Protozoa and classification up to classes with examples.
CO3: Locomotion and nutrition in Protozoa
CO4: General characters of phylum Porifera and classification up to classes with examples.
CO5: Type study Sycon - Structure & Life history, Canal system, Spicules, Spongin-fibres and Gemmule.
CO6: General characters of phylum Coelenterata and classification up to classes with examples.
CO7: Type Study Obelia - Structure & life history, Polymorphism.
CO8: General characters of phylum Platyhelminthes and classification up to classes with examples.
CO9: Type Study - *Fasciola hepatica* - External characters, Reproductive system & Life history.
CO10: Parasitic adaptation in Platyhelminthes.
CO11: General characters of phylum Aschelminthes and classification up to classes with examples. Parasitic adaptations in Aschelminthes.
CO12: General characters of phylum Annelida and classification up to classes with examples.
CO13: Type study *Pheretima posthuma* – External characters, Digestive system.

CO14: Excretory system, Nervous system, Circulatory system and Reproductive system.
CO15: General characters of phylum Arthropoda and classification up to classes with examples.
CO16: Type study Prawn - Externals characters, Digestive system. Nervous system & Reproductive system.
CO17: Appendages of prawn.
CO18: Mouth parts of Cockroach, House fly, Butter fly & Mosquito.
CO19: General characters of phylum Mollusca and classification up to classes with examples.
CO20: Type study *Pila globosa* – External characters, Digestive system, Respiratory System, Nervous system & Reproductive system.
CO21: General characters of phylum Echinodermata and classification up to classes with examples.
CO22: Type study-Starfish-External characters, Digestive system, Water vascular system and Echinoderm larvae.
CO23: *Plasmodium vivax* - External structure, Life Cycle, mode of transmission, pathogenecity and control measures.
CO24: *Entamoeba histolytica* - External structure, Life Cycle, mode of transmission, pathogenecity and control measures.
CO25: *Taenia solium* - External structure, Life Cycle, mode of transmission, pathogenecity and control measures.
CO26: Ascaris - External structure, Life Cycle, mode of transmission, pathogenecity and control measures.
CO27: *Wucheria bancrofti* - External structure, Life Cycle, mode of transmission, pathogenecity and control measures.
CO28: Ectoparasites – Ticks & mites.

Programme Specific Outcomes (PSOs)

PSO1: Understand different phyla and the classification of Non-chordates.
PSO2: To understand the life-history and adaptations in different species of non-chordates.
PSO3: To understand digestive, excretory, circulatory, nervous and reproductive system in various species of non-chordates.
PSO4: To understand the life-cycle, pathogenecity and control measures in different parasites.

B. Sc. II Semester Zoology

Course Outcomes (COs)

Course Name – 'Biology of Chordates'

Describe general taxonomic rules (classification) and characters

CO1: General characters of Hemichordata, Externals & Digestive system of Balanoglossus**.**
CO2: General characters of Urochordata, External Characters & Retrogressive metamorphosis in Herdmania.
CO3: General characters of Cephalochordata, External Characters & feeding mechanism in Branchiostoma.
CO4: Cyclostomata: External Characters & general organisation of Petromyzon & Myxine.
CO5: General characters of Pisces & Classification up to orders with examples. General characters of Chondrichthyes and Osteichthyes.
CO6: Type study Scoliodon **-** External Characters, Digestive system, Reproductive system and Fish migration.
CO7: General characters of Amphibia & classification up to orders with examples.
CO8: Type study Frog **-** External characters, Digestive system, Circulatory & Reproductive system. Axolotl larva & its significance.
CO9: General characters of Reptilia & classification up to orders with examples.
CO10: Type study Calotes - External characters, Digestive, Circulatory & Reproductive system.
CO11: Indian poisonous & non-poisonous snakes**.**
CO12: General characters of Aves & Classification up to orders with examples.
CO13: Type study Pigeon - External characters, Digestive, Respiratory & Reproductive system.
CO14: Bird migration, Flight adaptations, Beak & Feet modification.
CO15: Flightless birds.
CO16: General characters of Mammalia & classification up to orders with examples.
CO17: Type study Rat - Externals characters, Digestive, Circulatory, Nervous, Excretory & Reproductive system.
CO18: Comparative Anatomy: Origin, development & structure of Heart, Brain and integument in Fishes, Amphibians, Reptiles, Aves and Mammals.

Programme Specific Outcomes (PSOs)

PSO1: Understand the classification of Protochordates and Chordates. PSO2: Analyse and understand the advancements or adaptations in the general anatomy of various classes of Protochordates and Chordates.
PSO3: Understand the comparative anatomy of the members of various classes in vertebrates.
PSO4: Determine the evolutionary aspects in various classes of vertebrates.

B. Sc. III Semester Zoology

Course Outcomes (COs)

Course Name – 'Developmental Biology, Animal Physiology and Biochemistry'

CO1: Gametogenesis and the process of fertilization. Types of Eggs, Cleavage

patterns.

CO2: Development of Frog – Egg, cleavage, morula, blastula, gastrula. Concept of Organizer phenomenon.

CO3: Development of chick: Egg, cleavage, gastrula, 18hrs, 24hrs, 36hrs & 48hrs chick embryo.

CO4: Types of placenta, Structure and functions. Extra embryonic membranes in mammals.

CO5: Human Development up to Implantation.

CO6: Definition, Classification and Biological Significance of Proteins, Carbohydrates and Lipids.

CO7: Enzymes - IUB, Mechanism of enzyme action, specificity of enzymes, reversibility of enzyme action and enzyme inhibitors. Brief account of coenzymes and cofactors. Clinical importance of enzymes.

CO8: Vitamins - Water soluble vitamins (B complex and C). Fat soluble vitamins (A, D, E and K).

CO9: Bioenergetics - Concepts of bio-energetics, Glycolysis, Kreb's Cycle & Electron Transport System.

CO10: Physiology of Digestion, Respiration, Circulation, Excretion, Muscle contraction and Nervous co-ordination. Understand method of digestion of proteins, carbohydrates & fats. Balanced diet.

CO11: Transport of Oxygen & Carbon-di-oxide, myogenic and neurogenic heart, double circulation. Concept of blood pressure.

CO12: Ammonotelism, Ureotelism & Uricotelism. Ornithine cycle. Formation of Urine

CO13: Ultra structure of striated muscles. Sliding filament theory for muscle contraction.

CO14: Structure of neuron, understand the propagation of nerve impulse along the medullated and non-medullated nerve fibres. Neuro-muscular junction. Neuro-transmitters and their importance.

CO15: Study of structure of organs related to Vision, Olfaction & Audition in human beings.

CO16: Immunology - Bone marrow, thymus, spleen, Payer's patches. T and B cells. Antigens and Antibodies. Structure of Immunoglobins G (IgG) & Immunization.

Programme Specific Outcomes (PSOs)

PSO1: Understand and analyse the early development of frog, chick and human beings, starting from types of eggs, cleavage pattern, morula, blastula, gastrula etc.

PSO2: Understand the process of gametogenesis.

PSO3: To understand the similarities of developmental stages of various vertebrates and how later it diverges into Organizer phenomenon and an embryo.

PSO4: Analyse the structure, types and functions of placenta along with extra embryonic membranes.

PSO5: Understand the structure, functions and mechanism of working of biological molecules like carbohydrates, proteins, fats, enzymes & vitamins.

PSO6: Understand the process of how we derive energy by burning glucose by a process called Glycolysis, Kreb's cycle & Electron Transport System (ETS).

PSO7: Understand the details of different physiological activities occurring in human body like digestion, respiration, circulation, excretion, contraction of muscles and nervous system.
PSO8: Analyse the structure and functioning of sense organs like eyes, nose and ear in human beings.
PSO9: In general to know about the immune system in man with the help of antigens, antibodies, immunoglobulin G, T & B cells, analysing the structure of bone marrow, thymus, spleen, Payer's patches etc.

B. SC. IV Semester Zoology

Course Outcomes (COs)

Course Name – 'Cell biology, Histology and Animal Behaviour'

CO1: Ultra structure of animal cell.
CO2: Cell theory and cell cycle.
CO3: Ultra Structure & function of cell organelles: Plasma membrane, Endoplasmic reticulum, Lysosome.
CO4: Ultra Structure & function of cell organelles: Golgi-complex, Ribosome, Mitochondria and Nucleus.
CO5: Ultra structure of chromosome, types of chromosomes.

CO6: Histochemical Techniques - Cytoplasmic & Nuclear stains.
CO7: Preparation of histological slides.
CO8: Cell division – Mitosis.
CO9: Cell division – Meiosis.
CO10: Concept of Aging theories.
CO11: Cell death – Apoptosis, Necrosis.
CO12: Theories/ Hypothesis regarding causes of cancer.
CO13: Factors for ageing and cancer. Ageing related phenomenon.
CO14: Histological structure and functions of Tongue, Salivary glands, Stomach, Intestine.
CO15: Histological structure and functions of Liver, Pancreas, Kidney.
CO16: Histological structure and functions of functions of Adrenal, Pituitary, Ovary.
CO17: Histological structure and functions of Testes, Thyroid, Parathyroid, Thymus.
CO18: Introduction to Ethology and scope of Ethology.
CO19: Contributions of Konard Lorenz, NikoTinbergen and Karl Von Frisch.
CO20: Social behaviour - Types of animal society & Colony in Honey Bees and Monkey troops. Parental care in Fishes, Amphibians and Birds.
CO21: Animal Communication - Chemical, visual and Audio. Function of signals odours, sounds and light.
Territoriality & Courtship Behaviour in Scorpion, Stickle Back Fish & Peacock.
CO22: Innate Behaviour - Taxes, Reflexes, Instincts & Motivation.
Learned Behaviour - Habituation, Imprinting, Conditioned reflexes,

Insight learning.
CO23: Study of nesting behaviour and mimicry in animal.
CO24: Biological clock, Circadian rhythm and Chronobiology.

Programme Specific Outcomes (PSOs)

PSO1: Understand structure of animal cell and ultra structure of chromosome.
PSO2: Analyse the cell division in plant and animals.
PSO3: Understand concept of cellular ageing and cell death.
PSO4: Study the characteristics of cancer cell and understand causes of cancer.
PSO5: Understand the Histochemical techniques and histological structure and functions of mammalian organs.
PSO6: Study Animal Behaviour.
PSO7: Understand Animal Communication.
PSO8: Understand parental care in different groups of animals.

B. Sc. V Semester Zoology (Paper I)

Course Outcomes (COs)

Course Name – 'Ecology, Evolution, Palaeontology, Zoogeography, Wild life Conservation)'

CO1: Earth as Living Planet. Sub divisions of ecology, Scope of ecology, BiosphereCO2: Abiotic factors – Effect of Light on Animals and Plants,Effect of temperature on animals and plants.
CO3: Biotic Factor - Mutualism, Commensalism, Amensialism.
CO4: Parasitism, Predation, Competition, Parasitism.
CO5: Freshwater habitat - Lotic and Lentic systems. Zonation of Sea, Marine Biota, Estuarine ecology & Mangroves.
CO6: Terrestrial habitat - A brief account of Biomes.
CO7: Ecological Adaptations - Freshwater, Marine and Terrestrial.
CO8: Biogeochemical Cycles - Principles and concepts of Water, Nitrogen, Carbon and Oxygen cycles.
CO9: Community Ecology - Community structure, Ecological niches, Edge effect, Stratification, Ecoton.
CO10: Population Ecology - Density, Natality, Mortality. Age distribution.
CO11: Population growth - Types and curves.
CO12: The Solar System - Origin of Earth, Origin of Life and its theories.
CO13: The geological time scale.
CO14: Fossils - Definition and Kinds of fossils, How fossils are formed, Methods of Preservation.
CO15: Connecting links and Living fossils. The importance of fossils.
CO16: Theories of Organic Evolution - Lamarckism, Darwinism, Mutation Theory and Modern Synthesis Theory.
CO17: Variations - Gene mutation, Chromosomal mutation, Isolation and recombination.
CO18: Genetic drift, Hardy-Weinberg equilibrium.
CO19: Modes of Evolution - Microevolution, Macroevolution and Mega-evolution.

CO20: Evolution of Man.
CO21: Evolution of Horse.
CO22: Palaeontology - Mesozoic reptiles with a note on Dinosaurs.
CO23: Zoogeography: Zoogeographical realms of world, A brief account of Wallace's line.
CO24: Wildlife Conservation - Wildlife conservation methods, Wildlife in India, Causes for the depletion of wildlife. Wildlife Conservation Techniques, Methods and measures.
CO25: Brief account of IUCN, WWF, Bombay Natural History Society, Indian Board for Wildlife, Red Data Book. Wild Life Act 1972 and its amendments in India, CITES. Project Tiger and Biosphere Reserve.

Programme Specific Outcomes (PSOs)

PSO1: Study of ecology, abiotic factors, biotic factors, ecological adaptations, biogeochemical cycles.
PSO2: Understand the evolutionary aspects of evolution of man and horse, modes of evolution.
PSO3: Study Paleontology.
PSO4: Understand zoogeography.
PSO5: Study Wildlife conservation.

B. Sc. V Semester Zoology (Paper II)

Course Outcomes (COs)

Course Name – 'Genetics, Biotechnology and Biostatistics'

CO1: Definition of genetical terminologies, Mendel and his contribution.
CO2: Monohybrid and Dihybrid cross.
CO3: Supplementary Factors – Comb pattern in fowls.
Complimentary Factors – Flower colour in sweet peas.
CO4: Dominant Epistasis - Plumage colour in Leghorn and Wyandotte.
Recessive Epistasis - Coat colour in sweet peas.
Lethal gene - Coat colour in mice.
CO5: Multiple alleles - ABO blood group and Rh factor in human.
CO6: Linkage in Drosophila, Significance of Crossing over.
CO7: Chromosomal mechanism of sex determination, Genic balance theory, Gynandromorphs, Intersexes.
CO8: Syndromes in human - Klinefelter and Turner's syndrome.
CO9: Environmental and hormonal effects on determination of sex.
CO10: Sex-linked inheritance in Drosophila and Man.
CO11: Haemophilia and colour blindness in Man. Sex linkage in poultry. Y - linked genes in man.
CO12: Chromosomal aberrations, Molecular basis of gene mutation & types.
CO13: Inborn errors of metabolism - Albinism, Phenyl ketonuria, Alkaptonuria.
CO14: Sickle cell anaemia, Thalassemia, Huntington's chorea.

CO15: Properties of genetic code.
CO16: Mechanism of biosynthesis. Wobble hypothesis.
CO17: Introduction, Sub-fields of biotechnology, history of biotechnology, Biotechnology Scenario in India.
CO18: Types of Biotechnology: Animal Biotechnology, Plant Biotechnology, Microbial Biotechnology, Environmental Biotechnology, Medical Biotechnology.
CO19: Genetic engineering, isolation of DNA, Gene cloning.
CO20: Vectors, Restriction enzymes.
CO21: Polymerase Chain Reaction (PCR), DNA finger printing.
CO22: Agricultural applications of biotechnology - Improvements in crop yield. Industrial application - Ethanol production, Food processing, Food fermentors and Industrial enzymes.
CO23: Environmental Applications - Cleaning up of environmental pollutants, Bioremediation.
CO24: Medical Applications - Gene testing, Gene therapy, Drug discovery, Diagnosis of inherited Disorders.
CO25: Fundamentals of Biostatistics, preliminary concepts, frequency distribution, graphical presentation of data.
CO26: Measures of Central Tendency - Mean, Median and Mode. Measures of Variation.

CO27: Probability, Chi-Square Test.

Programme Specific Outcomes (PSOs)

PSO1: Understanding terminologies used in the field of genetics.
PSO2: Understanding the process of interaction of genes by taking examples of structures in fowls and sweet peas plant.
PSO3: Study of multiple alleles and their role in the formation of ABO blood groups and 'Rh' factor in human.
PSO4: Study of linkage in drosophila, significance in crossing over.
PSO5: Understanding the mechanism of sex determination, different theories, factors affecting it.
PSO6: Study the characters of Klinefelter and Turner's syndrome.
PSO7: Studying sex-linked inheritance in drosophila and man.
PSO8: Studying about chromosomal aberrations, gene mutation & types.
PSO9: Studying about inborn errors of metabolism.
PSO10: Studying the properties of genetic code & understanding the mechanism of biosynthesis.
PSO11: Studying history, sub-fields and types of biotechnology.
PSO12: Understanding the principles and details of process of various biotechnological techniques.
PSO13: Understanding the agricultural, industrial, environmental and medical applications of biotechnology.
PSO14: Studying fundamentals and preliminary concepts of biostatistics.
PSO15: Studying measures of central tendency, measures of variation.

Representing any given data in the form of graph.
PSO16: Studying probability and Chi-square test.

B. Sc. VI Semester Zoology (Paper I)

Course Outcomes (COs)

Course Name – 'Applied Zoology'

CO1: Apiculture - Species of Honey Bees, their Social organization, Life-History, Methods of Bee Keeping, products of Bees, & their Economic importance.
CO2: Sericulture - Mulberry Silkworm and Life History of *Bombyx mori*.
Rearing of Silkworm: Grainage management, Emergence of moth, fertilization, egg laying, hatching and moulting of-silkworm, spinning of cocoons. Cocoon processing, stifling and spinning silk. Filature.
CO3: Non-mulberry silkworm, types in brief.
Silkworm diseases - Muscardine, Grasserie, Flacherie & Pebrine.
CO4: Poultry - Breeds of fowl, Diseases of poultry, Poultry maintenance and by-products, Composition and Nutritive value of Egg.

CO5: Vermiculture - Earthworm species used in vermiculture, vermiculture techniques and Importance.
CO6: Insect Pest Management - Natural control and Applied control of pests.
Applied Control - Mechanical, Physical, Cultural, Legal, Chemical control.
CO7: Aquaculture - Prawn Fisheries, Species of Prawns, Culture of freshwater and marine prawns.
CO8: Preservation and processing of Prawns.
Pearl Culture - Pearl producing molluscans, pearl formation, pearl producing sites in India.
CO9: Quality and composition of pearl, artificial Insertion of nucleus.
CO10: Brief technique of Fish culture, Preservation of fishes and their byproducts.
CO11: Maintenance of breeds of Sheeps.
CO12: Maintenance of breeds of Goats.
CO13: Maintenance of breeds of Cows.
CO14: Maintenance of breeds of Buffaloes.
CO15: Diseases in sheeps, goats, cows and buffaloes.
CO16: Composition and nutritive value of milk.
CO17: Lac culture - Classification of Lac insect (*Techardia lacca*), Life history of Lac Insect. Host plants, Cultivation of Lac, Composition, properties & Economic importance.

Programme Specific Outcomes (PSOs)

PSO1: Understanding rearing of silkworms, spinning of cocoons, processing of silk.
PSO2: Studying about non-mulberry silk, silkworm diseases.
PSO3: Study of Apiculture and economic importance.
PSO4: Applied study of Insect-Pest Management.

PSO5: Study of vermiculture.
PSO6: Understand aquaculture.
PSO7: Study of pearl culture.
PSO8: Study of rearing of poultry birds.
PSO9: Understand animal husbandry.
PSO10: Study of Lac culture.

B. SC. VI Semester Zoology (Paper II)

Course Outcomes (COs)

Course Name – '(Microbiology, Nanotechnology, Bioinformatics and Methods in Biology)'

CO1: Compound Microscope and its functions.
CO2: Dark field Microscope, Fluorescent Microscope, Phase Contrast Microscope, Electron Microscope and their uses.
CO3: Sterilization Techniques - Physical and Chemical methods.
CO4: Bacteria - Classification based on shapes, structure (anatomy), bacterial reproduction and growth.
CO5: Virus - Morphology, chemical properties, classification, nomenclature, DNA and RNA viruses.
CO6: Fungi - Structure, classification and reproduction (Yeast).
CO7: Fermentation - Types of Fermentor and basic functions.
CO8: Methods of preservation and criteria for the selection of microorganisms.
CO9: Production of antibodies - Penicillin, Streptomycin.
Production of enzymes - Protease, Riboflavin.
CO10: Normal microbial flora of the human body.
CO11: Role of microbes in environment.
CO12: Nanotechnology - Introduction : History, Name, Tools and Techniques in Nanotechnology.
CO13: Application of Nano in biology - Nano drug Administration. Diagnostic & Therapeutic applications.
CO14: Lotus effect, Gold & Silver Nanotechnology. Curcumin phytochemicals, Cinnamon in green nanotechnology.
CO15: Bioinformatics - Definition, Goal of Bioinformatics, Sequences analysis and Structure analysis. Applications of Bioinformatics.
CO16: Classification of Biological Data Bases. Characteristics of FASTA (Fast Alignment), BLAST (Basic Local Alignment Search Tool).
CO17: Aims and goals of Human Genome Project: Main findings of human genome project. Prediction and tools for gene prediction, Comparative genomics.
CO18: Proteomics: Two dimensional Gel Electrophoresis, Mass spectrometry, SDS-PAGE. Structure of protein: Primary, Secondary, Tertiary and Quaternary.
CO19: Protein structure prediction, Application of Proteome analysis, The future of Proteomics.
CO20: Techniques of Cell fraction and Centrifugation - Homogenization and cell

tissue disruption, Centrifugation, Ultra centrifugation.
CO21: DNA Sequencing - *In situ* Hybridization, DNA microchips.
CO22: Genetic Engineering in animals - Transgenic Mouse, Transgenic sheep, Genetically altered Fish, Mosquito and Drosophila.
CO23: Gene therapy in Humans.
CO24: Histochemical and Immunization Techniques - ELISA, RIA, Flow Cytometry.
CO25: Nucleic Acid Blotting and their applications - Southern Blotting, Northern Blotting, Western Blotting.
CO26: Biophysical Methods - Brief note of NMR, ESR, Spectroscope and their uses.
CO27: Radioisotopes Techniques in Biochemistry - Types of radioactive decay- Alpha, Beta emission & Gamma rays.
CO28: Geigar-Mullar counter, Liquid Scintillator.
CO29: Biological applications of Radioisotopes.
CO30: A brief note on the use of ECG, PET, MRI, CAT. Single Neuron recorder in Electro-Physiological methods.

Programme Specific Outcomes (PSOs)

PSO1: Understand Compound, Dark field, Fluorescent, Phase Contrast, Electron Microscope and their uses.
PSO2: Studying sterilization techniques.
PSO3: Study morphology of bacteria and virus.
PSO4: Understand structure, classification and reproduction in yeast.
PSO5: Understand the process of biological fermentation.
PSO6: Study the production of antibiotics.
PSO7: Study microbial flora in human body & Role of microbes in environment.
PSO8: Understand nanotechnology and its applications.
PSO9: Understand bioinformatics and its applications.
PSO10: Understand classification of Biological Data Bases.
PSO11: Study aims and goals of Human Genome Project.
PSO12: Understand proteomics.
PSO13: Study techniques of cell fraction & centrifugation, DNA sequencing.
PSO14: Genetic engineering in animals, gene therapy in humans.
PSO15: Study Histochemical and Immunization Techniques.
PSO16: Studying Nucleic Acid Blotting techniques and their applications.
PSO17: Understanding about NMR, ESR, Spectroscope and their uses.
PSO18: Studying radioisotopes Techniques in Biochemistry & Biological applications of radioisotopes.
PSO19: Understanding the use of ECG, PET, MRI, CAT etc.
PSO20: Studying working of Geigar-Mullar counter & Liquid Scintillator.

Bachelor of Computer Applications

BCA-I Semester

Course Learning Outcomes(CO): **Mathematics I**

Course Outcomes: On completion of this course, students are able to:

CO1: Apply the knowledge of complex numbers to solve problems related to polar curves and its applications.
CO2: Learn the notion sequence and series and apply in day to day examples.
CO3: Apply the concept of binomial theorem and quadratic equations their usage in computing the area and volumes.
CO4 : Illustrate the applications of trigonometry and its applications to find the height of a tower or a cliff.
CO5 : Make use coordinate geometry and straight line concepts for diagonalization process.

Computer Fundamentals

After completion of course students will able to:

1. Explain how data is represented and processed in computers.
2. Evaluate advancement in computers through generations.
3. Explain the functions of various units in a computer system.
4. Explain the various arithmetic operation performed by computer using binary numbers.
5. Explain the internal structure of processor.
6. Explain the memory structure and working of various memories used in a computer.
7. Explain the commonly used IO devices.
8. Define software and types of software.
9. Explain steps involved in software development.
10. Write documents using application software like MS-word.
11. Define operating system.
12. Explain the functions of operating system.
13. Work with windows based computer system.
14. Install and remove software.
15. Manage files, folders in a computer system.

C Programming

At the end of the course student should be able to :

C01 – Compare different types of languages.
C02 – Explain the process of problem solving using computer.
C03 - Design an algorithm for a given problem.

C04 – Design a Pseudocode for a given problem.
C05 - Design a flowchart for a given problem.
C06 – Implement all basic concepts of C program
C07 - Write a maintainable program for a given algorithm or flow chart.
C08.- Implement the program
C09 - Interpret a given C program.
C10 - Debug a given C program
C11 - Test a given program for the Test cases written.
C12 - Develop conditional and iterative statements to write C programs.
C13 - Write C programs using arrays and strings.
C14. Write C programs using library functions and user defined functions.
C15. Develop C programs using structures and unions.

Financial Accounting

Course: Learning Outcomes (CO)

UNIT I Introduction and pattern of question paper

- **CO1: Meaning of basic terms of Accounting and types of accounts Rules for Personal account Real accounts and Nominal accounts Accounting equation and system of English method and American method**
- **CO2: Problems on accounting equation and Preparation of Journal entry and different types of problems**
- **CO3: Preparation of personal account of Debtors and Creditors**
- **CO4; Passing compound entry from different problems**

UNIT II

- **CO1: Meaning of Ledger, preparation of ledger balancing and preparing Trial balance**
- **CO2; Need and objective of accounting Merits and demerits of accounting**
- **CO3; Basic concept of Accountancy and Subsidiary books namely Purchase book Sales book Cash Book and so on**
- **CO4; Difference types of errors and rectification of errors and problems on the same**

UNIT III

- **CO1: Final accounts i.e. trading account Profit and loss account and Balance sheet importanant provision for Joint stock Company inrespect of preparation of final account.**
- **CO2: Understanding of adjustments and Preparation of different types of cash book**
- **CO3: Problems on company final accounts of company**

- **CO4: Final accounts without adjustments**

UNIT *IV*

- ***CO1:*** ***Meaning of Bank Reconciliation statement.***
- **CO2: Preparation of simple Bank reconciliation statement.**
- **CO3: Need for preparation of Bank reconciliation statement**
- **CO4: Meaning of Depreciation methods of depreciation Types of depreciation i.e. Fixed method and Reducing method …….. Different types of probels.**

UNIT V

- **CO1: Computerized accounting Computer and financial application**
- **CO2: Accounting software packages**
- **CO3: Salient features and significance, concept of grouping accounts**
- **CO4: Generating accounting reports etc**

BCA-IInd Semester

Course Learning Outcomes(CO): **Mathematics II**

CourseOutcomes: On completion of this course, students are able to:

CO1: Apply the concept of straight line and conic section in computer engineering field.
CO2: Learn the notion infinite series and apply in day to day examples.
CO3: Determine derivatives of functions involving two variables.
CO4 : Evaluate the integrals of functions of two variables.

Data Structures using C

Course Objective for Data Structures using C -

At the end of the course student should be able to :

C01 – Explain the need of Data Structures.

C02 – Discuss the applications of Data Structures.

C03 - Implement pointers and design different programs.

C04 – Compare between Static Memory Allocation and Dynamic Memory Allocation

C05 – Implement DMA functions for writing C programs.

C06 – Implement file as a data structure .

C07 - Write a maintainable program for searching and sorting techniques.

C08.- Compare different sorting and searching techniques.

C09 –Implement recursive functions.

C10 –Define stack and write programs using stack.

C11 –Define queue and develop programs using queue.

C12 - Define linked list and write programs using it.

C13 - Discuss the advantages and disadvantages of different data structures.

C14.- Write advanced C programs using different data structures.

C15. –Choose appropriate data structure to implement C programs.

Digital Logic and Computer Design

1. Convert different types of codes and number systems which are used in digital computer systems.
2. Write truth table and logic symbols of various logic gates.
3. Minimize Boolean expressions using laws and rules of Boolean algebra.
4. Minimize Boolean expressions using K-map methods.
5. Implement Boolean expressions using logic gates and using only universal gates.
6. Define the design procedure for combinational circuits.
7. Explain the working of circuits that perform arithmetic operations.
8. Explain the working of various flip flops, registers and counters.
9. Explain internal structure and working of various data storage devices used in computer system.

Financial Accounting

Course: Learning Outcomes (CO)

UNIT I Role of Management Accounting

- **CO1: Functions of Management, Purpose of Management**
  Nature of management
  Definition of Management
- **CO2: Comparison between Financial accounting and Management account**
  Comparison between cost accounting and Management accounting
- **CO3: Merits and Demerits of Management accounting**
  How the limitations can be eliminated?
  What are the techniques of the Management?
- **CO4; Steps involved in Management accounting**
  Overcoming of resistance of changes

UNIT II Financial Analysis and Interpretation

- **CO1: Meaning of financial statement**
  Delimitation and SWOT analysis
  Objectives of financial statement
  Types of financial statement
- **CO2: Meaning of interpretation and definition of interpretation**
  What are the three Ps……Position……Progress……Prospects of concern
- **CO3: Steps in financial analysis and problems of financial analysis**
  Absolute data in terms of percentage
  Types of comparative financial statement

UNIT III

- **CO1: Cash flow statement**
  Introduction need for cash flow statement
  Negative and net cash flow

- **CO2: Objective of cash flow**
  Types of cash flow ….. Actual cash flow and Notional cash flow.
  Advantages of cash flow statement. Limitation of cash statement

- **CO3: Comparison between Fund flow and cash flow statement**
  Distinguish between cash book and cash flow statement
  Steps for preparation cash statement
- **CO4: New method or Modern method**
  Direct method and indirect method
  Traditional method…….An account form and Report form

UNIT IV

- **CO1: Meaning of Marginal costing and Break even analysis**
  Definition of Marginal costing
  Concept of Marginal costing
  What is formula for marginal costing…..Total cost less fixed cost.
- **CO2: Absorption costing**
  Definition
  Difference between Absorption costing and Marginal costing
  Contribution……Meaning merits and limitation
- **CO3: Profit volume ratio P/V Ratio Improvement of P/V Ratio**
  - **Uses of Profit volume ratio…..**
  - **Application of marginal costing**
  - **Accepting additional order and exploring foreign market**
  -
- **CO4: Margin of Safety Impertinence of margin of safety**
  Make or buy decision

Choice of profitable sales mix or selection of a profitable sle mix

UNIT *V*

- ***CO1: Joint stock company….Meaning definition and objective***
  Special features of joint stok company
  Comparison between Joint stock company and partnership
  Different types of company…..Chartered company Statutory company Registered company
  .
- **CO2:Formation of Joint stock company**
  Commencement of business by company
  Registered Capital Issued capital Subscribed capital Called up capital
- **CO3: Need for preparation of Bank reconciliation statement**
- **CO4: Meaning of Depreciation methods of depreciation**
  Types of depreciation i.e. Fixed method and Reducing method …….. Different types of problems.

BCA-III Semester

Operating System Concepts

Course Learning Objectives (CO):

UNIT – I: Introduction

At the end of the course, the students will be able to:

CO1: Elaborate the concepts, principles and services of operating system and types of operating systems.

CO2: Analyze and discuss the various operating system structures like layered, monolithic and microkernel.

CO3: Identify and understand the concept of virtual machine and its applications in our day to day life.

UNIT – II: Process Management

At the end of the course, the students will be able to:

CO1: Identify and describe the processes, process states, transitions, process control block (PCB) of operating system and context switching.

CO2: Understand the concepts of threads, multithreading and also recognize the benefits of threads and classifications of threads.

CO3: Interpret the multitasking concept and implement the various scheduling algorithms in programming.
CO4: Incorporate the various CPU scheduling algorithms to understand the importance of these problems in the system.

UNIT –III: Inter-process Communication

At the end of the course, the students will be able to:

CO1: Express the concepts of race conditions, critical section problem & discuss the mutual exclusion principles and concurrent programming.
CO2: Acquire the knowledge of produces-consumer problem, principles if semaphores and understand the event counter concept.
CO3: Discuss and interpret the concepts of monitors and classical IPC problems in the system programming.
CO4: Express and incorporate the concept of deadlocks, its characteristics and study the deadlock avoidance and prevention technique.

UNIT – IV: Memory Management

At the end of the course, the students will be able to:

CO1: Define the knowledge of memory, its physical & logical address, also to understand the memory allocation problem.
CO2: Analyze and apply the internal and external fragmentation problems in the memory and compaction theory.
CO3: Study the paging, demand paging & virtual memory concepts and implement the different page-replacement algorithms to solve the various memory problems.
CO4: Identify and incorporate the allocation of frames and thrashing concepts.

UNIT –V: I/O Management

At the end of the course, the students will be able to:

CO1: Analyze the knowledge of I/O storage and file management concepts.
CO2: Understand the concepts of disk structure and discuss the various types of disk scheduling algorithms.
CO3: Express and recognize the file management concepts, the access methods of files, file types and various file operations.
CO4: Study and compare the directory structure & file system structure in the operating system.
CO5: Implement the allocation methods of file, its free space management and directory implementation.

Object Oriented Programming using Java

Course Learning Outcomes (CO):

UNIT – I: Fundamentals of object oriented programming

At the end of the course, the students will be able to:

CO1: Define the basic concepts of object oriented programming.
CO2: Understand the key features of java, JDK, JVM, JRE and java coding conventions.
CO3: Write debug and compile programs using basic java concepts
CO4: Understand the concepts of Arrays and command line arguments.

UNIT – II: Java classes, objects and methods

At the end of the course, the students will be able to:

CO1: Understand and express the fundamental concepts of classes, objects and methods.
CO2: Writing java programs using concepts like constructor and method overloading.
CO3: Provide the practical hands on experience with java concepts.
CO4: Explain the concept of Wrapper classes and Strings.

UNIT –III: Inheritance

At the end of the course, the students will be able to:

CO1: Understand the concept of Inheritance and types of Inheritance
CO2: Defining the concept of packages.
CO3: Implementing and defining the interfaces in java.
CO4: Exploring the Utility package like vector, scanner, date and calendar

UNIT – IV: Exception Handling

At the end of the course, the students will be able to:

CO1: Define the types of exceptions in java
CO2: Managing input output files in java
CO3: Learn the concept of multithreading and synchronization.
CO4: Explain and understand the life cycle of the thread.
CO5: Develop the java programs using try, catch finally and throw keyword.

UNIT –V: Applets

At the end of the course, the students will be able to:

CO1: Learn the basic concepts of building applet code and creating executable applet.
CO2: Understand the applet life cycle and learn applet tags.
CO3: Analyze the graphics class, lines and rectangle
CO4: Implement the small applet programs.

Course Learning Outcomes(CO):

Discrete Mathematical Structures

- Simplify and evaluate basic logic statements including compound statements, implications, inverses, converses, and contrapositives using truth tables and the properties of logic.
- Express a logic sentence in terms of predicates, quantifiers, and logical connectives
- Apply the operations of sets and use Venn diagrams to solve applied problems; solve problems using the principle of inclusion-exclusion.
- Determine the domain and range of a discrete or non-discrete function, graph functions, identify one-to-one functions, perform the composition of functions, find and/or graph the inverse of a function, and apply the properties of functions to application problems.
- List the terms in a sequence, write a sequence in closed form, compute the sum of a finite sequence, compute the product of a finite sequence, and express sequences in terms of recursive or non-recursive forms.
- Use elementary number theory including the divisibility properties of numbers to determine prime numbers and composites, the greatest common divisor, and the least common multiple; perform modulo arithmetic and computer arithmetic.
- Perform basic matrix operations including sums, products, and transpose and perform 0-1 matrix operations.
- Apply rules of inference, tests for validity, and methods of proof including direct and indirect proof forms, proof by contradiction, proof by cases, and mathematical induction and write proofs using symbolic logic and Boolean Algebra.
- Identify the base step and the recursive or inductive step in applied problems and give a recursive and a non-recursive definition for an iterative algorithm.
- Verify that a simple program segment with given initial and final assertions is correct using the rule of inference for verification of partial correctness and loop invariants.
- Solve counting problems by applying elementary counting techniques using the product and sum rules, permutations, combinations, the pigeon-hole principle, and binomial expansion.
- Solve discrete probability problems and use sets to solve problems in combinatorics and probability theory.

- Describe binary relations between two sets; determine if a binary relation is reflexive, symmetric, or transitive or is an equivalence relation; combine relations using set operations and composition.
- Determine if a given graph is simple or a multigraph, directed or undirected, cyclic or acyclic, and determine the connectivity of a graph.
- Represent a graph using an adjacency list and an adjacency matrix and apply graph theory to application problems such as computer networks.
- Determine if a graph is a binary tree, N-ary tree, or not a tree; use the properties of trees to classify trees.

Data communication and Computer networks

CO1: To build an understanding of fundamental concepts and terminologies of networking and its services. List the key factors in communication networks evolution.
CO2: To Enumerate the layers of OSI reference model and TCP/IP model. To explain the functionality of each layer in detail.
CO3: To understand the basic properties of digital transmission system. Discuss the different Line Coding schemes and modulation techniques.
CO4: To enumerate various Guided and unguided media and study their characteristics and applications. Study the different error detection and correction techniques and solving its examples.
CO5: To get familiarized with different multiplexing techniques. And understand the concept of Circuit switches and its types.
CO6: To discuss the different ARQ protocols, Sliding window flow control and timing recovering in synchronous services and the protocols like HDLC frame format and PPP.
CO7: To Enumerate the transmission medium sharing techniques in wireless and wired communication. Discuss in detail the LAN structure and protocols like Aloha and Slotted Aloha.
CO8: Briefly discuss the CSMA and CSMA – CD, Different scheduling techniques and Channelization techniques, the IEEE 802.3 Ethernet LAN standard format and list its topologies, the IEEE 802.11 wireless LAN standard. Briefly discuss the Bridges and its types.

BCA-IV Semester

Course Learning Outcomes (CO):

DATABASE MANAGEMENT SYSTEM

After learning this course the students will be able to:

UNIT I

1. Students can describe data models and schemas in DBMS
2. Students can identify the basic concepts and various data models used in database design.
3. Students get familiar with database system environment.

UNIT II

1. Students are able to describe the fundamental elements of relational database management system
2. Students can design ER models to represent simple database application scenarios.
3. Students are able to use ER modeling concept and design queries using SQL.
4. Students are able to compare and contrast SQL databases with each other and relational database system.
5. Studentsconvert the ER model to relational tables populate relational database and formulate SQL queries on data.

UNIT III

1. Students canexplain the basic concepts of relational algebra.
2. Students can apply relational database theory and describe relational algebra expression, type and domain relation expression for queries.
3. Students can implement ER to relational mapping.

UNIT IV

1. Students can improve the database design by normalization.
2. Students recognize and identify the use of normalization.
3. Students recognize and identify the use of functional dependency indexing.

UNIT V

1. Students can identify the purpose of query processing and also demonstrate the basic of query evaluation.
2. Students study the basics of SQL and construct queries using PL/SQL efficiently and apply object oriented features for developing database applications.
3. Students analyze and evaluate variety of SQL databases.
4. Demonstrate the knowledge of key-value databases, column based databases.
5. Students are able to create different procedures.

1. Have basic understanding knowledge of test planning and have an ability to use various skills to communicate with their teammates.
2. Students can identify the needs of software test automation and define test tool to support automation.

Design and Analysis of Algorithms

Course Learning Outcomes (CO):

UNIT – I: Introduction

At the end of the course, the students will be able to:

CO1: Elaborate the concepts, principles and services of operating system and types of operating systems.

CO2: Analyze and discuss the various operating system structures like layered, monolithic and microkernel.

CO3: Identify and understand the concept of virtual machine and its applications in our day to day life.

UNIT – II: Process Management

At the end of the course, the students will be able to:

CO1: Identify and describe the processes, process states, transitions, process control block (PCB) of operating system and context switching.

CO2: Understand the concepts of threads, multithreading and also recognize the benefits of threads and classifications of threads.

CO3: Interpret the multitasking concept and **implement** the various scheduling algorithms in programming.

CO4: Incorporate the various CPU scheduling algorithms to understand the importance of these problems in the system.

UNIT –III: Inter-process Communication

At the end of the course, the students will be able to:

CO1: Express the concepts of race conditions, critical section problem & discuss the mutual exclusion principles and concurrent programming.

CO2: Acquire the knowledge of produces-consumer problem, principles if semaphores and understand the event counter concept.

CO3: Discuss and interpret the concepts of monitors and classical IPC problems in the system programming.

CO4: Iincorporate the concept of deadlocks, its characteristics and study the deadlock avoidance and prevention technique.

UNIT – IV: Memory Management

At the end of the course, the students will be able to:

CO1: Define the knowledge of memory, its physical & logical address, also to understand the memory allocation problem.

CO2: Analyze and apply the internal and external fragmentation problems in the memory and compaction theory.

CO3: Study the paging, demand paging & virtual memory concepts and implement the different page-replacement algorithms to solve the various memory problems.

CO4: Identify and incorporate the allocation of frames and thrashing concepts.

UNIT –V: I/O Management

At the end of the course, the students will be able to:

CO1: Analyze the knowledge of I/O storage and file management concepts.

CO2: Understand the concepts of disk structure and discuss the various types of disk scheduling algorithms.

CO3: Express and recognize the file management concepts, the access methods of files, file types and various file operations.

CO4: Study and compare the directory structure & file system structure in the operating system.

CO5: Implement the allocation methods of file, its free space management and directory implementation.

Advanced Java Programming

After completion of course students will able to:

1. Develop java programs to handle various events.
2. Explain features of swings.
3. Develop programs using java swing components.
4. Develop java programs that communicate with DBMS.
5. Write java programs that manage transaction processing.
6. Develop dynamic web pages using servlets and jsp.
7. Develop web pages that handle session using session object.
8. Write network programs using TCP/IP.
9. Explain EJB and its types.

Advanced Computer Networks and Security

CO1: To get familiarized with data communication components and data flow. To understand the different network topologies and the protocol standards.

CO2: To discuss the OSI model theoretical framework and the TCP/IP model which is the actual model used in today's data communication.

CO3: To build an understanding of Cellular Telephony & its generations and different aspects of Satellite networks and discuss its different categories.

CO4: Understand the SONET architecture and different SONET layers. To understand the SONET frame format.
CO5: Discuss in detail virtual circuit approach used in WAN technologies using Frame relay and ATM and Frame Relay network protocol ,the ATM architecture and its switching technique.
CO6: To discuss the various static and dynamic routing algorithms. And to be able to solve certain problems based on these routing algorithms. To discuss the IPv4 and IPv6 protocol header format in detail.
CO7: Understand in detail the transport layer services , design, protocols and its primitives. Discuss in detail the TCP protocol segment header format, Congestion control and timer management.
CO8: To get introduced to application layer concepts DNS , namespace , name servers, E-mail architecture and services, user agents, MIME, SMTP, IMAP and working of the WWW.
CO9: Briefly discuss the functions of network management system. Discuss in detail the SNMP framework, its PDU format and message format.
CO10: To elaborate on the security services in a network and show how it can be achieved using cryptography. To discuss the concept of Digital Signature, Entity authentication, firewalls and VPN technology.

BCA-V Semester

Operating System Concepts

CO1: To get introduced to the history, fundamental concepts and terminologies of Internet and the world wide web, HTTP protocol request and response and their methods.
CO2: Discuss the different versions of HTML and XHTML and the standard document structure of XHTML. Also enumerate and implement the various XHTML tags and be able to create static web pages using XHTML.
CO3: To Introduce different types of stylesheets and different CSS properties .Understanding the Box model and be able to apply CSS to the web pages.
CO4: Understand the basic syntactic characteristics and screen output and keyboard input functions in javascript. Study Pattern matching using regular expressions and be able to validate XHTML code using javascript.
C**O5:** To get familiarized with different Event and event handling functions in Javascript and be able to apply events and methods in javascript code.
CO6: List different File types, Page Directives in ASP.Net. Explore ASP.NET Web Pages and Understand Discuss the Compilation process in ASP.NET.
CO7: Familiarize with the Structure of an Application, The Global.asax application File and different States. Discuss the Http Handlers and Postback.

CO8: Introduce the control class, the web control class and how to use CSS in Web Application. Enumerate and understand the different web server controls, user controls, custom controls and validation controls.
CO9: To Understand the ADO.NET architecture, creation of Connection Strings and Connection to Databases, Data Adapters. Be able to create ASP.Net pages and connect to database and perform different database operations.
CO10: Understand the different Database Controls like Data Grid View Control, Data List Controls and Details View Controls. To use these controls to display data stored in database.

Software Engineering

CO1: Build an understanding of what is software engineering and know the answers to keyquestions that provide an introduction to software engineering. Also be aware of the ethical and professional responsibilities important to software engineers.

CO2: Develop an understanding of software process, software process models and theability to select the suitable model to use in software development.

CO3: Develop an understanding of requirements engineering process and distinguishbetween different types of requirements. Apply several techniques of requirementselicitation and analysis and to be able to prepare the software requirementsspecification document for a software project.

CO4: Ability to analyze, design and develop the system models using object orientedmethodology (UML) for software development.

CO5: Develop an understanding of how the system to be organized and the decisions thathas to be made while designing the architecture of a software system. Ability toselect an architectural pattern for design reuse.

CO6: Understand the important activities in object oriented design process and differentdesign patterns. Consider the key issues while implementing the software.

CO7: Understand how dependability is achieved by using redundant and diversecomponents and applying different architectural styles. To be aware of goodprogramming practices in dependable systems engineering.

CO8: Understand the security issues that affect the system design; be aware of the designguidelines for system security. Also understand the notion of system survivability.

CO9: Understand the principal tasks of project managers and notion of risks that can ariseduring software projects. Identify the issues that influence team organization andcommunication.

CO10: Understand what sections to include in a project plan, create and represent a projectschedule using bar/Gantt charts. Ability to use Basic COCOMO model to estimateproject effort, cost and duration.

Operating System

After completion of course students will able to:

1. Define operating system.
2. Explain Multiprogramming, time sharing, distributed and real time system.
3. Analyze CPU scheduling algorithms.
4. Explain Critical section problem of process synchronization.
5. Apply solution to critical section problems.
6. Explain the classical problem of synchronization.
7. Explain deadlock.
8. Explain how to prevent, avoid and detect a deadlock.
9. Explain how to recover from a deadlock.
10. Explain Logical and Physical address in memory management.
11. Apply various page replacement algorithms for implementing virtual memory.
12. Explain File concepts, access methods, directory structure.
13. Explain disk structure and various scheduling methods.
14. Apply access matrix method for security problem.

Explain authentication process in an operating system

Computer Networks

Course Learning Outcomes (CO):

UNIT – I: Introduction

At the end of the course, the students will be able to:

CO1: Define and analyze the fundamental concepts of computer networks and its various applications areas.

CO2: Understand the basic networking structure and network architecture to build the communication between different networks.

CO3: Recognize and implement the various network topologies to build different kinds of networks.

CO4: Explain how communication takes place in computer networks and understand the types of networks.

CO5: Aware about various types of cables used in guided media like twisted pair, coaxial, optical fiber cables and its categories and also analyze the different switching techniques used in the computer networks.

UNIT – II: The Data Link Layer

At the end of the course, the students will be able to:

CO1: Understand the various data link layer design issues while building any computer networks.

CO2: Express and apply the various error handling mechanisms like single bit error, polynomial codes and CRC techniques.
CO3: Discuss the various error detection & error correction mechanisms used in the computer networks.
CO4: Implement the different protocols used in the data link layer like sliding window protocols and examples of DLL.

UNIT –III: The Medium Access Control

At the end of the course, the students will be able to:

CO1: Define and analyze the medium access control protocols.
CO2: Study the channel allocation problem while designing a computer network.
CO3: Explain and design the various multiple access protocols like ALOHA, Slotted ALOHA, while designing any computer networks.
CO4: Design and build the CSMA protocols and collusion free protocols while implementing real time computer networks and also to build the wireless LAN and Bluetooth architecture.

UNIT – IV: The Network Layer

At the end of the course, the students will be able to:

CO1: Analyze and study the functions of network layers and various design issues while implementing computer networks.
CO2: Understand the different routing algorithms used in building real time computer networks like distance vector routing, flooding, hierarchical routing.
CO3: Incorporate the type's congestion control algorithms to avoid the heavy traffic in the networks like leaky bucket, token bucket algorithms.
CO4: Study the basic concepts of quality of service of transmission of packets on the networks.

UNIT –V: The Transport Layer and Application layer

At the end of the course, the students will be able to:

CO1: Define the basic functions being performed by the transport layer and application layer.
CO2: Plan and analyze the various elements of transport protocols.
CO3: Compare and implement the TCP and UDP protocols while designing real time networks.
CO4: Study the basic concepts of DNS, E-mailing and WWW server on the Internet.

.NET using C#

Course Learning Outcomes (CO):

UNIT – I: Swings

At the end of the course, the students will be able to:

CO1: Study the basic concepts of swings and the architecture of MVC connection.

CO2: Design and develop platform independent applications using a variety of component based swing applications.

CO3: Understand the fundamental concepts of swing applets and ***generate*** the simple swing based applets.

CO4: Create and implement an event based programs using swing applets & also can develop a small project independently.

UNIT – II: J2EE & Database Access

At the end of the course, the students will be able to:

CO1: Understand and express the fundamental concepts of JDBC process and various JDBC driver types.

CO2: Provide the necessary knowledge to design and develop dynamic, database driven applications using J2EE.

CO3: Write, debug and compile the database programs using advanced java concepts.

CO4: Provide the practical hands on experience with J2EE concepts.

CO5: Learn how to connect to any jdbc complaint database and perform hands on practice with a database to create database driven-connectivity.

UNIT –III: Servlets and JSP

At the end of the course, the students will be able to:

CO1: Express and recognize the basic concepts of Servlets server-side technology & identify the life cycle of a servlet technology using Tomcat for building servlet development.

CO2: Generate and develop the simple applications based on the HttpServletRequest, HttpServletResponse methods of servlet technology.

CO3: Understand the fundamental concepts of Java Server Pages (JSP) and various JSP tags.

CO4: Implement the programs based on JSP technology to build the dynamic web pages.

UNIT – IV: Networking and RMI

At the end of the course, the students will be able to:

CO1: Define *and study* the basic concepts of networking in advanced java.

CO2: Design and develop the platform independent applications of simple client/server socket programming.

CO3: Build the cookies related programs to keep track of the user's activity and generate the datagram programs for building networking concepts.

CO4: Express the necessary knowledge to design and develop or build Remote method invocation applications for the server-side and client-side applications.

UNIT –V: Enterprise Java Beans

At the end of the course, the students will be able to:

CO1: Learn the basic concepts of enterprise java beans and their various applications.

CO2: Define the development descriptors concept in EJB technology.

CO3: Analyze and incorporate the types of bean applications like Session java bean, Message-driven bean and entity java bean

CO4: Implement the small enterprise based applications by using EJB concepts.

BCA-VI Semester

SOFTWARE TESTING AND PRACTICES

Course Learning Outcomes (CO):

After learning this course….

UNIT I

1. Students can describe the principles of software testing.
2. Students analyze the principles in software testing to prevent and remove bugs.
3. Students can describe different software development life cycle models.
4. Students are able to express quality assurance and quality control.
5. Have an ability to understand and identify various software testing problems by selecting software test models, criteria, strategies and methods.

UNIT II

1. Students can make the differences between white box testing and black box testing.
2. Students can have ability to apply software testing knowledge and methods.
3. Have ability to describe various types and levels of software testing for a software project.

UNIT III

1. Students can evaluate different types of testing.
2. Students can make out the differences between usability and accessibility testing.
3. Students have ability to use software testing methods and modern software testing tools for their testing programs

UNIT IV

1. Students get aware of misconceptions about testing field.
2. Students Have basic understanding knowledge of issues in software testing and test planning.
3. Students get ideas of responsibilities of different roles in software companies and coordination with their teams.
4. Students get ideas about single product organization and multi product organization. And they can implement their ideas for business.

UNIT V

3. Students are able to design test plan.

Java 2 Enterprise Edition (J2EE)

Course Learning Outcomes (CO):

UNIT – I: Swings

At the end of the course, the students will be able to:

CO1: Study the basic concepts of swings and the architecture of MVC connection.

CO2: Design and develop platform independent applications using a variety of component based swing applications.

CO3: Understand the fundamental concepts of swing applets and ***generate*** the simple swing based applets.

CO4: Create and implement an event based programs using swing applets & also can develop a small project independently.

UNIT – II: J2EE & Database Access

At the end of the course, the students will be able to:

CO1: Understand and express the fundamental concepts of JDBC process and various JDBC driver types.

CO2: Provide the necessary knowledge to design and develop dynamic, database driven applications using J2EE.

CO3: Write, debug and compile the database programs using advanced java concepts.

CO4: Provide the practical hands on experience with J2EE concepts.

CO5: Learn how to connect to any JDBC complaint database and perform hands on practice with a database to create database driven-connectivity.

UNIT –III: Servlets and JSP

At the end of the course, the students will be able to:

CO1: Express and recognize the basic concepts of Servlets server-side technology & identify the life cycle of a servlet technology using Tomcat for building servlet development.

CO2: Generate and develop the simple applications based on the HttpServletRequest, HttpServletResponse methods of servlet technology.

CO3: Understand the fundamental concepts of Java Server Pages (JSP) and various JSP tags.

CO4: Implement the programs based on JSP technology to build the dynamic web pages.

UNIT – IV: Networking and RMI

At the end of the course, the students will be able to:

***CO1: Define** and analyze* the basic concepts of networking in advanced java.

CO2: Analyze and develop the platform independent applications of simple client/server socket programming.

CO3: Design and build the cookies related programs to keep track of the user's activity and generate the datagram programs for building networking concepts.

CO4: Express the necessary knowledge to design and develop or build Remote method invocation applications for the server-side and client-side applications.

UNIT –V: Enterprise Java Beans

At the end of the course, the students will be able to:

CO1: Define the basic concepts of enterprise java beans and their various applications.

CO2: Analyze the development descriptors concept in EJB technology.

CO3: Incorporate the types of bean applications like Session java bean, Message-driven bean and entity java bean

CO4: Implement the small enterprise based applications by using EJB concepts.

Business Intelligence

CO1: To get familiarized with the context of typical business enterprise which leverages IT and its core business processes. Identify the information users and their requirements.

CO2: List and understand different types of digital data (structured, semi-structured and unstructured) and their storage mechanisms, data access methods and challenges.

CO3: Build an understanding of OLTP and OLAP systems and operations. and ERP in brief.

CO4: To define Business Intelligence technology domain into its current state. To be able to compare and contrast business analytics with business intelligence.

CO5: Understand the BI component framework and get familiarized with BI users & roles and BI applications.

CO6: Describe the concepts, approaches of data integration wrt data warehousing goals. Realize the importance of data profiling and data quality.

CO7: To be able to analyze and design an ER data model and dimensional data models. Understand and identify different types of facts and dimensions. Describe the dimensional modeling life cycle.

CO8: To realize the need for a system of measurement ,measurement terminology and SMART test. List the attributes of a good metric considering examples.

CO9: Demonstrate the impact of business reporting, information visualization, scorecards and dashboards into business enterprise.

PG Department of Botany

M.Sc. I Semester Botany

TEACHING HRS: 04 hrs/ week

Course No-1.1 Outcomes (Cos)

Course Name- Microbial Diversity

UNIT-1

CO-1 Diversity in structure and organization of Eubacteria, Spirochetes, Rickettsias,Chlamydias, Actinomycetes, Archaebacteria, mycoplasmas and Cyanobacteria.

CO-2 Metabolic diversity in relation to phototrophic, chemolithotrophic, symbiotic,saprophytic and parasitic mode of life.

CO-3 Diversity in relation to photosynthetic pigments and energy conversion.

CO-4 Diversity in carbon utilization by microorganisms.

UNIT-2

CO-5 Microbial diversity in the degradation of natural substances- such as cellulose,xylene starch and other glucans, fructose, pectans, chitin, lignin, methane, aromatic hydrocarbons etc and its ecological significance.

CO-6 Methods of studying microbial biodiversity.

CO-7 Various culture methods- biodiversity of culturable bacteria.

CO-8 Isolation strategies recovering microbial biodiversity- using environmental DNA,environmental genomics, screening environmental libraries preservation of microbial biodiversity,

CO-9 Polyphasic taxonomy of microorganisms.

UNIT-3

CO-10 Toxin producing microorganisms and cyanobacterial blooms-their ecological significance.

CO-11 Viruses, Viroids and Prions bacterial animal and plant viruses their diversity in structure and organization.

CO-12 Genetic diversity, **vertical and horizontal gene transfer in microbial diversification and speciation.**

UNIT-4

CO-13 Structural diversity distribution and the ecological significance of lichens.

CO-14 Fungal biodiversity- taxonomic diversity, general structural features and the latest Classification

M.Sc. I Semester Botany

Programme specific Outcomes (PSOs)

PSO1: Understand the Diversity in structure and organization.

PSO2: Understand the process of Metabolic diversity Diversity in relation to photosynthetic
pigments and energy conversion.

PSO3: Understand the Diversity in carbon utilization by microorganisms.

PSO4: Understand the Isolation strategies recovering microbial biodiversity.

PSO6:.Understand the Toxin producing microorganisms and cyanobacterial blooms.

PSO7: Understand the Structural diversity distribution and the ecological significance of lichens, Fungal biodiversity.

M.Sc. I Semester Botany

Subject-: Botany

TEACHING HRS: 04 hrs/week

Course No-1.2 Outcomes (Cos)

Course Name- Biodiversity and Conservation Biology

UNIT-1

CO-01 Biodiversity: Definition, levels of diversity - genetic, species and ecosystem
diversity.

CO-2 Endemism- concept, types, endemism in Western Ghats.

CO-3 Biodiversity hotspots - general and with special reference to India.

CO-4 Mega- diversity regions.

UNIT-2

CO-5 Threats to biodiversity.

CO-6 IUCN threatened plant categories.

CO-7 Methods of conservation:

In-situ methods - National parks, Biosphere reserves, sacred grooves.

Ex-situ methods: Botanical gardens, Germplasm collection seed bank, pollen bank.

UNIT-3

CO-8 Environmental movements:

a. Global and regional Environmental laws

b. Forest Conservation Act
c. Biodiversity bill (2002)
d. Community Biodiversity Register (PBR)
e. Convention on International Trade in Endangered Species (CITES)
f. Ramsar Convention
g. Intellectual Property Rights (IPR)

UNIT-4

CO-16 Biodiversity Management: Sustainable development Environmental Impact Assessment (EIA) Ecological restoration, Afforestation, Green belt, Social forestry,Agroforestry.

CO-17 Remote sensing and biodiversity management.

M.Sc. I Semester Botany

Programme specific Outcomes (PSOs)

PSO1: Understand the Biodiversity.
PSO2: Understand the process of Endemism.
PSO3: Understand the Mega-diversity regions.
PSO4: Understand the Threats to biodiversity.
PSO6:.Understand the Methods of conservation.
PSO7: Understand the Environmental movements.
PSO8: Understand the Biodiversity Management.

M.Sc. I Semester Botany

Subject-: Botany
TEACHING HRS: 04 hrs/week
Course No-1.3 Outcomes (Cos)
Course Name- Systematic Botany of Angiosperms

UNIT-1

CO-01 Brief history and development of plant classification.
CO-02 Types of classification- sexual system of Linnaeus, Artificial system, Natural system
and phytogenetic systems.
CO-03 Detailed study of Benthan & Hooker's system.
CO-04 Outlines of Hutchinson, Cronquist and APG systems.

UNIT-2

CO-05 Botanical Nomenclature: Need for scientific names, history of botanical

nomenclature.

CO-06 Principles of ICBN- typification, rule of priority, ranks of taxa and nomenclature of

taxa,effective and valid publication, citation, retention, choice and rejection of names and epithets, conservation of names, names of hybrids, names of cultivated plants.

UNIT-3

CO-07 Botanical Survey of India - organization and contributions of BSI.

CO-08 Herbarium methodology, significance of herbaria; floras.

CO-09 Taxonomic evidence: Chemotaxonomy, Cytotaxonomy, Embryology as taxonomic evidence.

CO-10 Brief account of numerical taxonomy.

UNIT-4

CO-11 Study of the following families with economic important, systematics and

phylogeny: Magnoliaceae, Menispermaceae, Capparidaceae, Polygalaceae, Caryophyllaceae, Meliaceae, Oxalidaceae, Balsaminaceae, Meliaceae, Droseraceae,

Combretaceae, Melastomataceae, Cactaceae, Sopotaceae, Oleaceae, Loganiaceae,

Gentianaceae, Lentibulariaceae, Podostemaceae, Piperaceae, Myristicaceae, Lauraceae,

Loranthaceae, Moraceae, Orchidaceae, Zingiberaceae, Commelinaceae, Araceae, Cyperaceae, Poaceae etc.

M.Sc. I Semester Botany

Programme specific Outcomes (PSOs)

PSO1: Understand the Brief history and development of plant classification.

PSO2: Understand the Types of classification.

PSO3: Understand the Botanical Nomenclature.

PSO4: Understand the Botanical Survey of India.

PSO6:.Understand the Taxonomic evidence.

PSO7: Understand the Study of the families with economic important, systematics andphylogeny.

M.Sc. I Semester Botany

Subject-: Botany

TEACHING HRS: 04 hrs/week

Course No-1.4 Outcomes (Cos)

Course Name- Evolutionary Biology and Plant Geography

UNIT-1

CO-01 Origin of Life – A biogenesis

CO-02 Hypothesis of panspermia.

CO-03 Theory of Chemical of evolution.

CO-04 Origin of life at molecular level process.

CO-05 **Structure of *Cosmos* primitive earth.**

CO-06 Prebiotic synthesis

CO-07 Origin and evolution of RNA world, Ribonucleoprotein,

CO-08 Adaptive radiation in progenote.

CO-09 Evolution of Eukaryotes – Endosymbiotic hypothesis.

CO-10 Theories of evolution- Lamarckism Neolamarkism, Darwinism, Neo-Darwinism,
Germplasm theory, Mutatiuon theory and Synthetic theory.

UNIT-2

CO-11 Population genetic and Evolution – Madeline population.

CO-12 Gene pool, gene frequency, genetic drift, founder effect, genetic polymorphism.

CO-13 HardyWeinberg's Law- Genetics equilibrium and mechanism of speciation.

CO-14 Patterns of evolution in plants- Evolution of vegetative, reproductive structure in
Algae, Fungi, Bryophytes, Pteridophytes and spermatophytes (Evolution of sporophytes in Bryophytes).

CO-15 Steelar evolution in Pteridophytes.

CO-16 Heterospory and seed habit.

CO-17 Fossil forms- *Lepidodendron, Lepidocarpon, Stigmaria.*

UNIT-3

CO-18 Principles of Plant Geography- Origin of islands and Continents- Pangea, Panthalasa, Laurisia, Gondwana land.

CO-19 Plant tectonics and Continental drifts.

CO-20 Center of origin of cultivated plants.

CO-21 Vavilo centers and Zhukosky centers with plants in each region.

UNIT-4

CO-22 Plant distribution and Plant migration- Floristic regions of the world.

CO-23 Phytogeographical regions of India

CO-24 Hansen's classifications- distribution of plants based on altitude and

latitude,

contisin, tricontisin and endemic distribution.

CO-25 Age and area hypothesis- Wills theory.

CO-26 Plant migration and barriers for plant migration.

M.Sc. I Semester Botany

Programme specific Outcomes (PSOs)

PSO1: Understand the Origin of life at molecular level process.

PSO2: Understand the Theory of Chemical of evolution.

PSO3: Understand the Population genetic and Evolution.

PSO4: Understand the Patterns of evolution in plants.

PSO6:.Understand the Principles of Plant Geography.

PSO7: Understand the Plant tectonics and Continental drifts.

PSO8: Understand the Plant distribution and Plant migration.

M.Sc. II Semester Botany

Subject-BOTANY

COURSE NUMBER: 2.1

COURSE NAME: BIOCHEMISTRY AND BIOPHYSICS

CO:- Course Outcome

UNIT: 01

CO:01 - Physical and chemical properties, structure: of water, nucleic acids, nucleotides, and poly nucleotides .

CO:02 - Amino acids: General Properties; peptide bonds, classification and characteristics of amino acids.

CO:03 - Proteins: primary structure, solubility of protein, protein sequencing, protein conformation, protein folding alpha-helix and beta sheets, Rammachandra Plot, Hydropathic index, solid phase synthesis of polypeptides and protein denaturation.

UNIT: 02

CO:04 - Carbohydrates : A brief account of monosaccharide's and disaccharides, structure of starch, cellulose, pectin and chitin.

CO:05 - lipids : classification, chemical and physical structure and properties of saturated and unsaturated fatty acids.

CO:06 - Enzymes- nature and classification of enzymes, enzyme specificity, reaction rates and activation energy, enzyme kinetics. Micheaelis-Menten equation, Line weavers Burk plot. Kinetics of bisubstrate reactions. Kinetic tests for determining inhibition mechanisms.

UNIT: 03-

CO:07 - Atoms, bonds and molecules. Basic principles of diffusion, osmosis and viscosity, and their application in biology.

CO:08 - Electromagnetic radiation: Electromagnetic spectrum and light scattering absorption and emission of electromagnetic radiations by biomolecules.

CO:09 - Fluorescence and phosphorescence. Theory of fluorescence-instrumentation,

polarization and anisotropy of fluorescence. Fluorescence spectroscopy applied to protein, nucleic acids and
membranes.

UNIT:04 –

CO:10 - Nuclear Magnetic Resonance: The phenomenon of energy absorption and relaxation, chemical shifts.
Instrumental; techniques –Proton NMR,C-13 NMR,P-31 NMR, two
dimensional NMR-FINMR, solid state NMR, Magnetic resonance imaging. Application of NMR in the study of proteins. Nucleic acids ,membranes and metabolism.

CO:11 - Mass spectrometry- basic theory and instrumentation, general modes of fragmentation Gas Chromatography and Mass Spectroscopy (GCMS), FTIR spectroscopy and LASERS - its applications in biology and medicine.

M.Sc. II

Semester Botany

Subject-BOTANY
COURSE NUMBER: 2.1
COURSE NAME: BIOCHEMISTRY AND BIOPHYSICS
PROGRAMME SPECIFIC OUTCOME (POS)

POS:01 - Understand the definition, Physical and Chemical properties, structure of water, nucleic acid, nucleotide, polynucleotides and amino acid
POS:02 - Understand the different structure and conformation of proteins
POS:03 - Understand the definition, physical and chemical properties, structure and classification of carbohydrates, lipids and enzyme
POS:04 - Understand the enzyme specificity, reaction rates and activation energy, Michaelis – Menten Equation and kinetic test for determining inhibition mechanisms.
POS:05 – Understand the Basic account on Atoms, bonds and molecules
POS:06 – Understand the Basic principles and application of diffusion, osmosis and viscosity.
POS:07- Understand the Basic principle, Theory, Instrumentation and Application of Electromagnetic radiation, Fluorescence and phosphorescence, Nuclear Magnetic Resonance, Mass spectrometry, Gas Chromatography and Mass Spectroscopy (GCMS), FTIR spectroscopy and LASERS

M.Sc. II Semester Botany

Subject-BOTANY
COURSE NUMBER: 2.2
COURSE NAME: Developmental Biology of Plants.
CO: Course Outcome

UNIT:01 -

CO:01 - Differentiation and cell polarity in acellular (Dictyostelium) unicellular (Acetabularia, ficus egg, equisetum spore) and multicellular (root hair and stomata formation)systems.
CO:02 - Shoot apical meristems (SAM): origin, structure and function, organogenesis, formation

of auxiliary buds. Cytohistological zonation and biochemical activity in the shoot apex and ultra structure of meristems, shoot apical meristem organization, SAM mutants, mechanism of leaf primordium initiation.
CO:03 - Phyllotaxy and Vernalization: Phyllotaxis positioning, transition to reproductive phase, vernalization – changes in the biochemical activity.
UNIT:02 –

CO:04 - ABC model, specification floral organs, molecular aspects of MADS box genes during flower development. Cellular differences
in between floral organs
CO:05 - Senescence : a general account
CO:06 - Root Apical Meristem(RAM):structure and function of RAM quiescent centre, origin of lateral roots, genetics of root
development.
UNIT:03
CO:07 - Androgenesis: Histochemical , ultra structural, genetical and fictional aspects, concept and significance of male germ unit.
CO:08 – Gynogenesis: Histochemical, ultra structural, genetical and fictional aspects, concept and significance of female germ unit.
CO:09 - Pollination and fertilization: structural and functional aspects of pollen, stigma and styles in the current aspects of fertilization.
CO:10 - Male sterility : concept, causes and mechanism in present
status.
UNIT:04
CO:11 – Embryogenesis: Cellular and biochemical aspects, composition and function of endosperm in relation to embryo development. Regulation of gene activity during zygotic embryogenesis, embryo suspensor- composition and function
CO:12 - Seed development and germination: Physiology and biochemistry expression of genes during seed germination.
Seed dormancy and role of hormones, Photomorphogenesis: photoreceptors, structure and function.

M.Sc. II Semester Botany

Subject-BOTANY
COURSE NUMBER: 2.2
COURSE NAME: Developmental Biology of Plants.
PROGRAMME SPECIFIC OUTCOME (POS)

POS:01 – Understand the Differentiation and cell polarity in acellular, unicellular and multicellular systems.
POS:02 – Understand the origin, structure and function, Cytohistological zonation and biochemical activity of SAM and RAM
POS:03 – Understand the concept of Phyllotaxy and Vernalization
POS:04 – Understand the concept in detail on developmental pattern at the flowering apex

POS:05 – Understand in detail the Androgenesis, Gynogenesis, Male sterility, Pollination and fertilization, Embryogenesis, Photomorphogenesis, Seed development and germination.

M.Sc. II Semester Botany

Subject-BOTANY
COURSE NUMBER: 2.3
COURSE NAME: Genetics and Plant Breeding
CO:- Course Outcome

UNIT:01

CO:01 - Transmission Genetics: An over view of Mendelian Genetics, extension of Mendelian's principles: Quantitative inheritance, multiple alleles, lethal allele
CO:02 - Extra nuclear inheritance: Inheritance of mitochondrial and chloroplast genes, male sterility in plant.
CO:03 - Sex determination: Role of chromosomes and hormones in sex determination, molecular basis of sex determination and dosage compensation in man and Drosophila
CO:04 - Genetic disorders in man and their managements, Genetic testing and counselling, sex determination in plants.
UNIT:02
CO:05 - Population Genetics: Population and gene pools , Hardy-Weinberg's Law, Factors effecting allelic frequencies in population- Mutation, Migration, Nonrandom mating, selection, genetic drift, genetic equilibrium.
CO:06 - Linkage and crossing over, Cytological and molecular basis of crossing over, recombination and gene mapping.
UNIT:03
CO:07 - DNA as genetic material, Gene concept, Mechanism of DNA replication in prokaryotes and eukaryotes, Enzymes in DNA replication.
CO:08 - RNA: Types and role of RNA
CO:09 - Genetic code-Contribution of Nirenberg and Khorana.
CO:10 - Transposable genetic elements: AC-DS elements in Maize, mechanism of transpositions, Human genome project.
UNIT:04
CO:11 - Plant Breeding: Mode of reproduction, methods of hybridization in self and cross pollinated plants, Plant Introduction, Domestication and acclimatization, patterns of evolution in crop plants.
CO:12 - Heterosis-genetic basis of heterosis and Breeding plants for resistance to abiotic and biotic stresses.

M.Sc. II Semester Botany

Subject-BOTANY
COURSE NUMBER: 2.3
COURSE NAME: Genetics and Plant Breeding
PROGRAMME SPECIFIC OUTCOME (POS)
POS:01- Understand in detail the concept of Mendelian genetics including extra nuclear inheritance
POS:02 – Understand in detail the concept of sex determination and genetic disorders
POS:03 - Understand the concept of population genetics**,** DNA as genetic material**,** Genetic code**,** Transposable genetic elements
POS:04 – Understand the concept of Plant Breeding and Heterosis

M.Sc. II Semester Botany

COURSE NUMBER: 2.4
COURSE NAME: OEC – Personality Development
CO: Course Outcome
UNIT:01
CO:01 - Self Analysis: SWOT Analysis, who am I Attitudes, Importance of Self Confidence, Self Esteem: Creativity
UNIT:02
CO:02 - Attitude: Factors Influencing Attitude, Challenges and Lessons from Attitude, Etiquettes.
UNIT:03
CO:03 - Time Management: Value of Time, Priority Work, Time Wasters, Techniques of Time Mangement.
UNIT:04
CO:04 - Stress Management: Causes of Stress and its Impact, Techniques of Stress Mangement, Circle of Control, Stress Busters
UNIT:05
CO:05 – Resolution and Decision Making: Importance and Necessity of Decision Making, Process and Practical Way of Decision Making, Weighing Positives and Negatives, Conflicts in Human Relations, Approach to Conflict Resolution.

M.Sc. II Semester Botany

Subject-BOTANY
COURSE NUMBER: 2.4
COURSE NAME: OEC – Personality Development
PROGRAMME SPECIFIC OUTCOME (PSO)
POS:01 – Understand in detail the concept of Self Analysis, Attitude, Time Management,

Stress Management, and Conflict Resolution and Decision Making.
POS:02 -Understand the concept of time management and stress management.

M.Sc. III Semester Botany

TEACHING HRS: 04 hrs/week

Course No-3.1 Outcomes (Cos)

Course Name-PLANT PHYSIOLOGY

UNIT-I. Bioenergetics

CO1: Bioenergetics - First and second law of thermodynamics. Relation between Free energy change and equilibrium constant. Reduction potential. Relation between Reduction potential and free energy change.

CO2: Hexose catabolism – Study of Glycolysis and citric acid cycle.

UNIT-II. **Photosynthesis**

CO3: Photosynthetic pigments, photo system 1 and 2, Calvin cycle, C4, CAM pathway, photorespiration and factors affecting photosynthesis

CO4: Biosynthesis of sucrose, starch and cellulose.

UNIT -III. Lipid metabolism

CO5: Fatty acid biosynthesis and oxidation. Biosynthesis and catabolism of storage lipids. Biosynthesis and functions of membrane lipids.

CO6: Membrane transport-organization of transport at plasma membrane and Tonoplast pumps, carriers and ion channels.

CO7: Transporters- P-type and V- type, ATPases, ABC transporters.
Regulation of membrane transport in guard cells

UNIT-IV- Nitrogen metabolism and Phytohormones

CO8: Nitrogen metabolism -uptake of nitrate and its reduction; catalytic and genetic regulation of nitrate reductase. Symbiotic nitrogen fixation, mechanism of action of nitrogenase.

CO9: Plant growth regulators- Mechanism of action of auxins, gibberlins, cytokinins, ethylene, abscisic acid.

M.Sc. III Semester Botany

3.1 Programme specific Outcomes (PSOs)

PSO1: Understand the laws of thermodynamics and its applications in various processes plant.

PSO2: Understand the process of Photosynthesis and Respiration taking place in plants.

PSO3: Understand the catabolism of sugars through different pathways.

PSO4: Understand the different modes of transport systems and their working in plant body.

PSO5:.Understand the nitrogen metabolism.

PSO6: Understand the role and mechanism of action of Phytohormones.

M.Sc. III Semester Botany

TEACHING HRS: 04 hrs/week

Course No-3.2 Outcomes (Cos)

Course Name- CELL AND MOLECULAR BIOLOGY

UNIT-I. Microscopy

CO1: Microscopy and applications of Light- Phase contrast, Fluorescent and Electron microscopy. Autoradiography, Cell fractination and Centrifugation Technology.

CO2: Organization of chromatin – Euchromatin and heterochromatin, constitutive and facultative heterochromatin, rearrangement.

CO3: Repetitive and non repetitive DNA- C-value paradox, nucleosome model, structure and organization of telomere, centromere and kinetochore.

CO4: Structural and numerical abnormalities - Deltions,Duplications,Inversions,Traslocations,Aneuploidy Euploidy .

CO5: Central dogma of molecular biology- Fine structure of gene, Concept of split gene, introns. Gene families, Overlapping gene, Pseudo gene and cryptic gene.

UNIT-II. **Cell cycle regulation and Mutations**

CO6: Regulation of cell cycle -CDK- Cyclin activities, cellular check points at G1,S, G2 &M

CO7: DNA Repair mechanism-Base excision repair, nucleotide excision repair, Post replication repair, transcription coupled repair, SOS response.

CO8: Mutation- Chemical and radiation mutagenes, molecular basis of mutations and their role in evolution.

CO9:Cancer Biology - Oncogenes, Proto-oncogenes, P53 gene, Tumor suppressor genes, RB gene, E2F gene, RAS genes

UNIT -III. Transposable elements

CO10: Retro-elements -Transposable elements in man, Prokaryotic transposons: Insertion and composite sequences, Applications of transposons in research and health care system.

UNIT-IV- Expression of Genome

CO11:Trascription - RNA polymerase-types, structure and Function, mechanism of transcription in prokaryotes and eukaryotes.

CO12: Post transcriptional modifications, capping, polyadenylation, splicing, alternate splicing, exon, shuffling.

CO13: Types of RNA- organization of m-RNA, t-RNA and r-RNA, m-RNA transport;.

CO14: Translation: t-RNA identity, amino acylation of t-RNA, amino acyl synthetase, mechanism of translation-initiation, elongation and termination, proof reading, translational inhibitors, post translational modifications of proteins.

CO15: Regulation In Prokaryotes: Concept -Lac operon-positive and negative control, tryp – operon ; A detailed study of Gene regulation in eukaryotes**.**

M.Sc. III Semester Botany

3.2 Programme specific Outcomes (PSOs)

PSO1: Understand the Principle, working & application different microscopes
PSO2: Understand the organization of chromatin and chromosome.
PSO3: Understand the genome Organization in prokaryotes and eukaryotes.
PSO4: Understand the process of mutation, types and its role in evolution.
PSO5: Understand the mechanism of cell cycle regulation.
PSO6: Understand the causes, types and genes involved in cancer.
PSO7: Understand the types and mechanism of transport of transposable elements.
PSO8: Understand the transcription, RNA processing, translation, post translation modifications of proteins.
PSO9: Understand the lactose and tryptophan operon.

M.Sc. III Semester Botany

TEACHING HRS: 04 hrs/week

Course No-3.3 Outcomes (Cos)

Course Name- MEDICINAL PLANTS AND HERBAL DRUG TECHNOLOGY

UNIT-I

CO1: History of medicinal plants - A brief account of Indigenous medicinal sciences- Ayurveda, Siddha and Unani. Brief account of herbal formulations and preparations.

UNIT-II

CO2: Plant identification – Authentication and deposition in recognised herbaria, Ethnic communities of India

CO3: Ethnobotany -Folk medicine, Applications of Ethnobotany.

CO4: Study of selected medicinal plants - *Solanum trilobatum, Cardiospermum halicacabum, Vitex negundo, Adathoda vasica, Azadirachta indica, Gloriosa superba, Eclipta alba, Aristolochia indica, Phyllanthus amarus, Boerhaavia diffusa, Curcuma longa, Ocimum sanctum,Centella asiatica, Aloe vera, Coleus forskohlii and Costus speciosus.*

UNIT- III

CO5: Database of medicinal plants - Methods of preparation of herbal extracts and phytochemical analysis. Antibacterial and antifungal activity assay of herbal Extracts.

CO6: Medicinal plants - plant products used in the treatment of Jaundice, Cardiac problems,infertility, cancer and diabetes.

CO7: Conservation of medicinal plants-In situ and ex situ.

CO8: IPR and Patenting- Patenting and study of threatened medicinal plants.

UNIT-IV

CO9: Herbal drug technology - Identification and authentication of phytoconstituents, Alkaloids, Coumarins,LignIns, phenols, terpenes, sterols,.

CO10: Method of isolation and estimation- Forskolina *from Coleus forskaoli*
L-Dopa from Mucuna pruriens Alicin- *alliun sativa* Piperine *from piper nigram*
Catechines *from camellia sinensis (green tea).*
CO11: Organization and institutes- National medicinal plant board (NMPB) foundation for Revitalization of local health tradition (FRLHT) national botanical research institute (NBRI) central institute for medicinal [and aromatic plants (CIMAP) AYUSH**.**

M.Sc. III Semester Botany

3.3 Programme specific Outcomes (PSOs)

PSO1: Understand the History and principles of different medicinal systems.
PSO2: Understand the herbal formulations and preparations.
PSO3: Understand the process of plant identification and authentification.
PSO4: Understand the preparation of herbal extracts and Phytochemicals analysis.
PSO5: Understand the medicinal uses of selected plants and their bioactive compounds.
PSO6: Understand the importance of conversation and methods of conservation.
PSO7: Understand the IPR and Patenting and data analysis.
PSO8: Understand the working of different institutes.

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M.Sc. III Semester Botany

TEACHING HRS: 04 hrs/week
Course No-3.4 Outcomes (Cos)
Course Name- OPEN ELECTIVE: ENVIRONMENTAL CHEMISTRY
UNIT-I. Environmental segments, evolution of earth's atmosphere
CO1: Air pollution: Air pollutants, prevention and control, green house gases and acid rain, carbon monoxide, industrial sources and transportation sources.
CO2: SOx- sources, ambient concentration, test methods, control techniques - scrubbing, , limestone injection process. Ozone hole and CFC's, photochemical smog and PAN.
CO3: NOx- sources, ambient concentration, test methods, thermodynamics and NOx, control techniques..
CO4: Particulates: Size distribution, particulate collection - settling chambers, centrifugal separators, wet scrubbers, electrostatic precipitators & fabric filters, catalytic converters for mobile sources, Bhopal gas tragedy.
UNIT-II
CO5: Hydrologic cycle- sources, chemistry of sea water, criteria and standards of water quality- safe drinking water.
CO6: contamination levels – inorganic and organic chemicals, radiological contaminants, turbidity, microbial contaminants.
CO7: Public health significance -measurement of colour, turbidity, total solids, acidity, alkalinity, hardness, chloride, residual chlorine, sulphate, fluoride, phosphate and different forms of nitrogen in natural and polluted water sampling and monitoring techniques.
UNIT -III.

CO8: Water parameters- Determination and significance of DO, BOD, COD and TOC
CO9: water purification- disinfection techniques, demineralization, desalination processes and reverse osmosis.
CO10: Radioactive waste management- radionuclides in soil, effects of ionizing radiationseffect on ecosystem, accidents at atomic power plants-Chernobyl disaster, disposal of radioactive liquid wastes, methods of radiation protection.
UNIT-IV
CO11: Detergents- pollution aspects, eutrophication.
CO12: Pesticides-pollution of surface water. Sewage and industrial effluent treatment, heavy metal pollution.
CO13: Chemical speciation- biochemical effects of pesticides, insecticides, particulates, heavy metals (Hg, As, Pb, Se), carbon monoxide, nitrogen oxides, sulphur oxides, hydrocarbon, particulates, ozone, cyanide and PAN. Solid pollutants and its treatment and disposal.
CO14 : Composition of soil - Inorganic and organic components in soil, micro and macro nutrients, nitrogen and sulphur pathways, soil pollution: classification of pollutants and their characteristics, sources, prevention and control, sampling and monitoring techniques.

M.Sc. III Semester Botany

3.3 Programme specific Outcomes (PSOs)

PSO1: Understand the Environmental segments, evolution of earth's atmosphere.
PSO2: Understand the nature and effect of air pollutants.
PSO3: Understand the effect of Particulate matter and Bhopal gas tragedy.
PSO4: Understand the Public health significance.
PSO5: Understand the water pollution and radioactive waste and effect on public health.
PSO6: Understand the effect of pesticides and detergents on fauna and flora.
PSO7: Understand the composition of soil and control of soil pollution.

M.Sc. III Semester Botany

Course No-3.1 Outcomes (Cos)

Course Name-PLANT PHYSIOLOGY
UNIT-I. Bioenergetics
CO1: Bioenergetics - First and second law of thermodynamics. Relation between Free energy change and equilibrium constant. Reduction potential. Relation between Reduction potential and free energy change.
CO2: Hexose catabolism – Study of Glycolysis and citric acid cycle.
UNIT-II. **Photosynthesis**
CO3: Photosynthetic pigments, photo system 1 and 2, Calvin cycle, C4, CAM pathway, photorespiration and factors affecting photosynthesis

CO4: Biosynthesis of sucrose, starch and cellulose.

UNIT -III. Lipid metabolism

CO5: Fatty acid biosynthesis and oxidation. Biosynthesis and catabolism of storage lipids. Biosynthesis and functions of membrane lipids.

CO6: Membrane transport-organization of transport at plasma membrane and Tonoplast pumps, carriers and ion channels.

CO7: Transporters- P-type and V- type, ATPases, ABC transporters.
Regulation of membrane transport in guard cells

UNIT-IV- Nitrogen metabolism and Phytohormones

CO8: Nitrogen metabolism -uptake of nitrate and its reduction; catalytic and genetic regulation of nitrate reductase. Symbiotic nitrogen fixation, mechanism of action of nitrogenase.

CO9: Plant growth regulators- Mechanism of action of auxins, gibberlins, cytokinins, ethylene, abscisic acid.

M.Sc. III Semester Botany

3.1 Programme specific Outcomes (PSOs)

PSO1: Understand the laws of thermodynamics and its applications in various processes plant.

PSO2: Understand the process of Photosynthesis and Respiration taking place in plants.

PSO3: Understand the catabolism of sugars through different pathways.

PSO4: Understand the different modes of transport systems and their working in plant body.

PSO5:.Understand the nitrogen metabolism.

PSO6: Understand the role and mechanism of action of Phytohormones.

M.Sc. III Semester Botany

TEACHING HRS: 04 hrs/week

Course No-3.2 Outcomes (Cos)

Course Name- CELL AND MOLECULAR BIOLOGY

UNIT-I. Microscopy

CO1: Microscopy and applications of Light- Phase contrast, Fluorescent and Electron microscopy. Autoradiography, Cell fractination and Centrifugation Technology.

CO2: Organization of chromatin – Euchromatin and heterochromatin, constitutive and facultative heterochromatin, rearrangement.

CO3: Repetitive and non repetitive DNA- C-value paradox, nucleosome model, structure and organization of telomere, centromere and kinetochore.

CO4: Structural and numerical abnormalities -
Deltions,Duplications,Inversions,Traslocations,Aneuploidy Euploidy .

CO5: Central dogma of molecular biology- Fine structure of gene, Concept of split gene, introns. Gene families, Overlapping gene, Pseudo gene and cryptic gene.

UNIT-II. Cell cycle regulation and Mutations

CO6: Regulation of cell cycle -CDK- Cyclin activities, cellular check points at G1,S, G2 &M

CO7: DNA Repair mechanism-Base excision repair, nucleotide excision repair, Post replication repair, transcription coupled repair, SOS response.

CO8: Mutation- Chemical and radiation mutagenes, molecular basis of mutations and their role in evolution.

CO9:Cancer Biology - Oncogenes, Proto-oncogenes, P53 gene, Tumor suppressor genes, RB gene, E2F gene, RAS genes

UNIT -III. Transposable elements

CO10: Retro-elements -Transposable elements in man, Prokaryotic transposons: Insertion and composite sequences, Applications of transposons in research and health care system.

UNIT-IV- Expression of Genome

CO11:Trascription - RNA polymerase-types, structure and Function, mechanism of transcription in prokaryotes and eukaryotes.

CO12: Post transcriptional modifications, capping, polyadenylation, splicing, alternate splicing, exon, shuffling.

CO13: Types of RNA- organization of m-RNA, t-RNA and r-RNA, m-RNA transport;

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CO14: Translation: t-RNA identity, amino acylation of t-RNA, amino acyl synthetase, mechanism of translation-initiation, elongation and termination, proof reading, translational inhibitors, post translational modifications of proteins.

CO15: Regulation In Prokaryotes: Concept -Lac operon-positive and negative control, tryp – operon ; A detailed study of Gene regulation in eukaryotes**.**

M.Sc. III Semester Botany

3.2 Programme specific Outcomes (PSOs)

PSO1: Understand the Principle, working & application different microscopes

PSO2: Understand the organization of chromatin and chromosome.

PSO3: Understand the genome Organization in prokaryotes and eukaryotes.

PSO4: Understand the process of mutation, types and its role in evolution.

PSO5: Understand the mechanism of cell cycle regulation.

PSO6: Understand the causes, types and genes involved in cancer.

PSO7: Understand the types and mechanism of transport of transposable elements.

PSO8: Understand the transcription, RNA processing, translation, post translation modifications of proteins.

PSO9: Understand the lactose and tryptophan operon.

M.Sc. III Semester Botany

TEACHING HRS: 04 hrs/week

Course No-3.3 Outcomes (Cos)

Course Name- MEDICINAL PLANTS AND HERBAL DRUG TECHNOLOGY

UNIT-I

CO1: History of medicinal plants - A brief account of Indigenous medicinal sciences- Ayurveda, Siddha and Unani. Brief account of herbal formulations and preparations.

UNIT-II

CO2: Plant identification – Authentication and deposition in recognised herbaria, Ethnic communities of India

CO3: Ethnobotany -Folk medicine, Applications of Ethnobotany.

CO4: Study of selected medicinal plants - *Solanum trilobatum, Cardiospermum halicacabum, Vitex negundo, Adathoda vasica, Azadirachta indica, Gloriosa superba, Eclipta alba, Aristolochia indica, Phyllanthus amarus, Boerhaavia diffusa, Curcuma longa, Ocimum sanctum,Centella asiatica, Aloe vera, Coleus forskohlii and Costus speciosus.*

UNIT- III

CO5: Database of medicinal plants - Methods of preparation of herbal extracts and phytochemical analysis. Antibacterial and antifungal activity assay of herbal Extracts.

CO6: Medicinal plants - plant products used in the treatment of Jaundice, Cardiac problems,infertility, cancer and diabetes.

CO7: Conservation of medicinal plants-In situ and ex situ.

CO8: IPR and Patenting- Patenting and study of threatened medicinal plants.

UNIT-IV

CO9: Herbal drug technology - Identification and authentication of phytoconstituents, Alkaloids, Coumarins,LignIns, phenols, terpenes, sterols,.

CO10: Method of isolation and estimation- Forskolina *from Coleus forskaoli* *L-Dopa from Mucuna pruriens* Alicin- *alliun sativa* Piperine *from piper nigram* Catechines *from camellia sinensis (green tea).*

CO11: Organization and institutes- National medicinal plant board (NMPB) foundation for Revitalization of local health tradition (FRLHT) national botanical research institute (NBRI) central institute for medicinal [and aromatic plants (CIMAP) AYUSH**.**

M.Sc. III Semester Botany

3.3 Programme specific Outcomes (PSOs)

PSO1: Understand the History and principles of different medicinal systems.

PSO2: Understand the herbal formulations and preparations.

PSO3: Understand the process of plant identification and authentification.

PSO4: Understand the preparation of herbal extracts and Phytochemicals analysis.

PSO5: Understand the medicinal uses of selected plants and their bioactive compounds.

PSO6: Understand the importance of conversation and methods of conservation.
PSO7: Understand the IPR and Patenting and data analysis.
PSO8: Understand the working of different institutes.

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M.Sc. III Semester Botany

Course No-3.4 Outcomes (Cos)

Course Name- OPEN ELECTIVE: ENVIRONMENTAL CHEMISTRY

UNIT-I. Environmental segments, evolution of earth's atmosphere

CO1: Air pollution: Air pollutants, prevention and control, green house gases and acid rain, carbon monoxide, industrial sources and transportation sources.

CO2: SOx- sources, ambient concentration, test methods, control techniques - scrubbing, , limestone injection process. Ozone hole and CFC's, photochemical smog and PAN.

CO3: NOx- sources, ambient concentration, test methods, thermodynamics and NOx, control techniques..

CO4: Particulates: Size distribution, particulate collection - settling chambers, centrifugal separators, wet scrubbers, electrostatic precipitators & fabric filters, catalytic converters for mobile sources, Bhopal gas tragedy.

UNIT-II

CO5: Hydrologic cycle- sources, chemistry of sea water, criteria and standards of water quality- safe drinking water.

CO6: contamination levels – inorganic and organic chemicals, radiological contaminants, turbidity, microbial contaminants.

CO7: Public health significance -measurement of colour, turbidity, total solids, acidity, alkalinity, hardness, chloride, residual chlorine, sulphate, fluoride, phosphate and different forms of nitrogen in natural and polluted water sampling and monitoring techniques.

UNIT -III.

CO8: Water parameters- Determination and significance of DO, BOD, COD and TOC

CO9: water purification- disinfection techniques, demineralization, desalination processes and reverse osmosis.

CO10: Radioactive waste management- radionuclides in soil, effects of ionizing radiationseffect on ecosystem, accidents at atomic power plants-Chernobyl disaster, disposal of radioactive liquid wastes, methods of radiation protection.

UNIT-IV

CO11: Detergents- pollution aspects, eutrophication.

CO12: Pesticides-pollution of surface water. Sewage and industrial effluent treatment, heavy metal pollution.

CO13: Chemical speciation- biochemical effects of pesticides, insecticides, particulates, heavy metals (Hg, As, Pb, Se), carbon monoxide, nitrogen oxides, sulphur oxides, hydrocarbon, particulates, ozone, cyanide and PAN. Solid pollutants and its treatment and disposal.

CO14 : Composition of soil - Inorganic and organic components in soil, micro and macro

nutrients, nitrogen and sulphur pathways, soil pollution: classification of pollutants and their characteristics, sources, prevention and control, sampling and monitoring techniques.

M.Sc. III Semester Botany

3.3 Programme specific Outcomes (PSOs)

PSO1: Understand the Environmental segments, evolution of earth's atmosphere.
PSO2: Understand the nature and effect of air pollutants.
PSO3: Understand the effect of Particulate matter and Bhopal gas tragedy.
PSO4: Understand the Public health significance.
PSO5: Understand the water pollution and radioactive waste and effect on public health.
PSO6: Understand the effect of pesticides and detergents on fauna and flora.
PSO7: Understand the composition of soil and control of soil pollution.

MSc-IV SEMESTER Botany

Subject-BOTANY
TEACHING HRS: 04 hrs/week
COURSE NUMBER: 4.1
COURSE NAME: MYCOLOGY AND PLANT PATHOLOGY

PROGRAMME SPECIFIC OUTCOME(PSO)

PSO:01 Understand the vegetative and reproductive ultra-structures of Fungi.
PSO:02 Understand the concept of hyphal growth, spore's dispersal mechanism of fungi.
PSO:03 Understand the types of reproduction in fungi and significance.
PSO:04 Understand the biosynthesis and metabolism of carbohydrates, lipids, amino acids in Fungi.
PSO:05 Understand the isolation and selection of Mutants, Tetrad analysis, Somatic incompatibility.
PSO:06 Understand the history, types and causal agents, role of environment in plant pathology.
PSO:07 Understand the disease triangle, diagnosis of plant diseases, effect of plant diseases on the World crop production.
PSO:08 Understand the mechanism of pathogen attack on Plants, and Plants defence mechanism.
PSO:09 Understand the disease epidemiology, disease broadcasting control measures to prevent the spread of the diseases.

MSc-IV SEMESTER
TEACHING HRS: 04 hrs/week
Subject-BOTANY
COURSE NUMBER: 4.2
COURSE NAME: ECOLOGY AND ENVIRONMENTAL BIOLOGY

CO: Course out come

UNIT:01
CO:01 Ecosystem concept: Structure, types, components, functions and dynamics. Energy flow in the ecosystem, tropic levels food chains food web ecological pyramid.
C0:02 Biogeochemical cycle: Hydrological cycle, gases nutrient cycle, and sedimentary nutrient cycle.
CO:03 Major terrestrial ecosystem of the world:Desserts, Grasslands, Savanna, Tundra and Forest Ecosystem.
UNIT:02
CO:04 Characteristics of populations: Natality, mortality, life table , age structure, concept of carrying capacity, concept of density dependent and density independent action in population control.
CO:05 Biotic community: Concept, structure, dominance, fluctuation and succession, ecological niche- intraspecific and inter specific interactions allelopathy predation-prey relationship. System ecology and ecological models.
UNIT:03
CO:05 Major aquatic ecosystems of the world: Fresh water ecosystem, Marine ecosystem.
CO:06 Environmental pollution: Sources, major and impact of air, water and soil pollution radioactive pollution disposal and management oil pollution and management. Plant indicators in pollution.
CO:07 Solid and liquid waste management: Tannery, Fertilizer, Pulp and Paper and Sugar industries.
C0:08 Noise pollution: Assessment, control and management.
C0:09 Global environment problem: Ozone depletion, global warming and climatic change.
UNIT 04:
CO:10 Definition and importance of Biodiversity:Biological hotspots, biodiversity loss, magnitude and distribution of biodiversity.
CO:11 Biodiversity values and Conservation:Timber, ornamental, medicinal values. In-situ and Ex-situ methods.
CO:12 Environmental management: natural resources, principles of conservation, concept and strategies of sustainable development, environmental impact assessment, principles of remote sensing, application of RS and GIs in environmental management, environmental laws forest conservation act, Biological diversity Act.

MSc-IV SEMESTER
Subject-BOTANY
TEACHING HRS: 04 hrs/week
COURSE NUMBER: 4.2
COURSE NAME: ECOLOGY AND ENVIRONMENTAL BIOLOGY

PROGRAMME SPECIFIC OUTCOME(PSO)

PSO:01 Understand the definition, energy flow and types of Pyramid in Ecology.
PSO:02 Understand the types of Ecosystems, and details of Population ecology.
PSO:03 Understand the details of Biotic community and concept of Carrying capacity.
PSO:04 Understand the types, causes and control of different types of pollution.
PSO:05 Understand the management of solid and liquid waste in sugar, paper-pulp industries.
PSO:06 Understand the concept of Biodiversity and its conservation.

MSc-IV SEMESTER
Subject-BOTANY
TEACHING HRS: 04 hrs/week

COURSE NUMBER: 4.3
COURSE NAME: PLANT BIOTECHNOLOGY

CO: Course out come

UNIT:01
CO:01 Introduction and definition of old and new Biotechnology: An interdisciplinary activity, Scoped and importance, commercial potential, Biotechnology centres in India.
CO:02 Biofertilizers: Introduction, types, Blue green algae, Sea weeds, Azolla, Vesicular arbuscular mycorrhizal fungi and Rhizobium.
UNIT:02
CO:03 Industrial microbial products: Alcohol production (Beer), Antibiotics production (penicillin), production of Vitamins (Vitamin B12), production of Single Cell Protein, Algal protein: (Spirulina) Fungal protein: (Mushroom) and economic aspects.
CO:04 Plant Tissue Culture: Introduction. Importance of plant tissue culture, Basic requirements for tissue culture laboratory, composition of tissue culture medium. Culture of plant tissues, Regeneration of plants, Root culture, meristem culture, Anther culture, Pollen culture. Role of tissue culture technology in crop improvements.
UNIT:03
CO:05 Production of biogas: Structure of biogas plant, Biochemistry of methane production, Biogas research in India, Uses of biogas.
CO:06 Plant Biotechnology: Introduction, Somatic hybrids and Cybrids, cytoplasmic gene transfer, gene transfer, Advantage and Limitations.
UNIT:04
CO:06 Genetic Engineering of microorganisms: Vectors of gene cloning direct transformations, Microinjection, Nuclear transplantation, Isolation and cloning plasmid and Mitochondrial genes.
CO:07 Transgenic plants:With nif genes. Improvement of seed proteins, production of disease free and disease resistant plants.

MSc-IV SEMESTER
Subject-BOTANY
TEACHING HRS: 04 hrs/week
COURSE NUMBER: 4.3
COURSE NAME: PLANT BIOTECHNOLOGY

PROGRAMME SPECIFIC OUTCOME(PSO)

PSO: 01 Understand the difference between Old, new biotechnology. And about Biofertilizers.
PSO: 02Understand the production of Beer, Vitamins, Penicilin, Single cell protein and Mushroom cultivation.
PSO: 03 understand the details of Plant tissue culture techniques.
PSO: 04 Understand the details of Biogas production, biogas plant and its advantages.
PSO: 05 Understand the process and types of Gene transfer, Vectors used in Genetic engineering.
PSO: 06 Understand the isolation and cloning of plasmid, plants with nif genes and production of disease free and disease resistant plants.

PG Department of Chemistry
M.Sc. I Semester

CHIT-1.1, INORGANIC CHEMISTRY – I

PROGRAMME OUTCOME

UNIT-I **16 hours**

CHEMICAL BONDING

PO 1 : Review of different types of chemical bonds with suitable examples.
PO 2 : Formation and conditions for the formation of ionic compounds.
PO 3 : lattice energy, Born-Lande's equation, Conclusion and problems of lattice energy from Born-Lande's equation.
PO 4 : Born-Haber cycle and its applications.
PO 5 : Kapustinskii equation and Conclusion and problems of lattice energy from Kapustinskii equation.
PO 6 : Factors affecting the lattice energy, properties of ionic substances.
PO 7 : Covalent character in predominantly ionic bonds, polarizing power.
PO 8 : Factors governing the degree of polarization, Fajan's rules in predicting the melting and boiling points and solubility of some compounds.
PO 9 : Energetics of solubility of ionic salts in polar solvents, solvation energy.
PO 10: Relative effects of ionic radii on lattice energy and ion-solvation energy.
PO 11: Relative solubility of ionic compounds (alkali metal halides and silver halides, sulphates and hydroxides of alkaline earth metals).
PO 12 : Covalent bonding- Valence bond theory: hybridization of atomic orbitals, Examples for compound having different hybridization (*sp*, *sp*2, *sp*3, *dsp*2, *sp*3d, *sp3*d2).
PO 13 :VSEPR theory: Predicting molecular geometries, Bent's rule of hybridization, illustration of
Bent's rule with respect to CH_3F, PCl_3F_2), limitations of VSEPR theory.
PO 14 : Symmetry and overlap, molecular orbital diagrams of diatomic homo nuclear molecules/ions .
PO15 :MOT of hetero-nuclear molecules/ions (HCl, LiF, CO, NO, NO^+ and triatomic molecules – linear (CO_2) and angular (NO_2).
PO 16 : Walsh diagrams for XH_2 species.
PO 17 : Metallic bonding: Characteristics of metallic states, electron sea model, V. B. approach, band theory (MOT).

UNIT-II **16 hours**

CHEMISTRY OF NON-TRANSITION ELEMENTS-I

PO 18 Electron deficient compounds: Classification of boranes, nomenclature of boranes.
PO 19 : Synthesis, structure and properties of B_2H_6, B_3H_9, B_4H_{10}, B_5H_9, B_5H_{11} and B_6H_{10}.
PO 20 : Polyhedral skeletal electron pair counting using Wade's rules (*styx*numbers): Classification of boron clusters using electron pair count.

PO 21 : Carboranes: Classification, Nomenclature, Synthesis of closocarboranes ($C_2B_{10}H_{12}$). Structural aspectof closo-$C_2B_{10}H_{12}$.
PO 22 : Metalloborane: Synthesis and structural aspects of $[B_{11}H_{11}AlCH_3]^{2-}$, $[Fe(CO)_3B_4H_8]$ and $[2\text{-}CpCoB_4H_8]$.
PO 23 : Metallocarboranes: Synthesis of $[(C_2B_9H_{11})_2Fe]^{2-}$, $[C_2B_9H_{11}FeCp]^-$ and $[Co(C_2B_9H_{11})_2]^-$, Structure and Bonding in $[Co(C_2B_9H_{11})_2]^-$.
PO 24 : Borazines: Synthesis, reactivity and, structure and bonding.
PO 25 : Compounds of Noble gases, Preparation and structure and bonding in Xenon compounds (XeF_2, XeF_4, XeF_6, $XeOF_4$, XeO_2F_2, XeO_3, XeO_4) based on VBT and VSEPR.

UNIT-III **16 hours**

COORDINATION CHEMISTRY AND METAL CLUSTERS

PO 26 : Coordination chemistry: Coordination numbers (1 to 7) and their geometries.
PO 27 : Geometrical isomerism in square planar and octahedral complexes.
PO 28 : Optical isomerism in octahedral complexes.
PO 29 : Review of VBT, EAN and their limitations, Spectrochemical series (Irwin-William
series).
PO 30 : Crystal Field Theory, splitting of d-orbitals in octahedral, tetrahedral, square planar, trigonal bipyramidal and square pyramid geometries.
PO 31 : Jahn-Teller distortion in co-ordination compounds.
PO 32 : Factors affecting the CFSE values. Limitations of CFT, evidences for metal ligand orbital overlap.
PO 33 : Molecular Orbital Theory with sigma (s) bonding applied to octahedral, tetrahedral and square plannar complexes.
PO 34 : MO-Theory with π(pi)–bonding applied to octahedral complexes.
PO 35: Metal Clusters Dinuclear compounds: Quadrapole bonding, calculation of M-M bond order and structural aspects and magnetic properties of Re_2Cl_8.

PO 36 : Trinuclear clusters: Bond order, magnetic properties and structural aspects of Re_3Cl_9.

UNIT-IV **16 hours**

Pi (π) ACID METAL COMPLEXES AND ACID-BASE CHEMISTRY

PO 37 :Metal Carbonyls: Different binding modes of CO, pi (π) acidity of CO, back bonding, synergic effect.
PO 38 : Mononuclear carbonyls, low nuclearity carbonyl clusters and high nuclearity carbonyl clusters.
PO 39 : Application of 18 electron rule to metal carbonyls.
PO 40 :Structural features of $[Co_2(CO)_8]$, $[Co_4(CO)_{12}]$ and $[Fe_3(CO)_{12}]$.
PO 41 :Preparation and structural aspects of $Ni(CO)_4$, $Fe(CO)_5$ and $Co_2(CO)_8$ by direct reaction of metals.
PO 42 : Preparation and structural aspects of $V(CO)_6$, and $Mn_2(CO)_{10}$ by reductive carbonylation.
PO 43 : Metal Nitrosyls: Coordinating behavior of NO, NO as a bridging ligand, factors favoring linear and bent M-N-O linkage.

PO 44 : Synthesis of nirosyl complexes (brown ring complex).
PO 45: Dinitrogen Complexes: Reason for poor coordinating behavior of N_2 compared to its isoelectronic species.
PO 46 : Binding modes of N_2, preparation of Ru and Mo dinitrogen complexes.
PO 47: Acid-Base Chemistry: Bronsted-Lowry concept, Lux-Flood theory.
PO 48: Solvent-system definition, Lewis theory.
PO 49 :Usanovich concept, Hammett acidity function (superacids).
PO 50 : HSAB theory.

COURSE SPECIFIC OUTCOME

UNIT-I
CO 1 : Student understood different types of chemical bonds with suitable examples.
CO 2 : Student learn the Formation and conditions for the formation of ionic compounds.

CO 3 : Student get to know lattice energy, Born-Lande's equation, Conclusion and problems of lattice energy from Born-Lande's equation.
CO 4 : Student will understand Born-Haber cycle and its applications.
CO 5 : Student get to know Kapustinskii equation and Conclusion and problems of lattice energy from Kapustinskii equation.
CO 6 : Student come to Factors affecting the lattice energy, properties of ionic substances.
CO 7 : Student understand Covalent character in predominantly ionic bonds, polarizing power.
CO 8 : Student learn Factors governing the degree of polarization, Fajan's rules in predicting the melting and boiling points and solubility of some compounds.
CO 9 : Student understand Energetics of solubility of ionic salts in polar solvents, solvation energy.
CO 10: Student able to compare relative effects of ionic radii on lattice energy and ion-solvation energy.
CO 11: Student able to compare relative solubility of ionic compounds (alkali metal halides and silver halides, sulphates and hydroxides of alkaline earth metals).
CO 12 : Student understand Covalent bonding, Valence bond theory: hybridization of atomic orbitals with different example.
CO 13 : Student able to apply VSEPR theory and Bent's rule to Predicting molecular geometries.
CO 14 : Student understand Symmetry and overlap, molecular orbital diagrams of diatomic homo nuclear molecules/ions .
CO15 : Student able to apply MOT of hetero-nuclear molecules/ions and triatomic molecules – linear (CO_2) and angular (NO_2).
CO 16 : Student get to know Walsh diagrams for XH_2 species.
CO 17 : Student understand Metallic bonding: Characteristics of metallic states, electron sea model, V. B. approach, band theory (MOT).

UNIT-II
CO 18 : Student understand Classification of boranes, nomenclature of boranes.

CO 19 : Student learn Synthesis, structure and properties boranes.

CO 20 : Student get to know Polyhedral skeletal electron pair counting using Wade's rules (*styx*numbers) and Classification of boron clusters using electron pair count.
CO 21 : Student understand Classification, Nomenclature, Synthesis and structure of carboranes.
CO 22 : Student understand Synthesis and structural aspects of Metalloborane.
CO 23 : Student understand Synthesis, Structure and Bonding of Metallocarboranes:
CO 24 : Student get to know Synthesis, reactivity and, structure and bonding in Borazines.

CO 25 : Student learn Preparation and structure and bonding in Xenon compounds.

UNIT-III
CO 26 : Student get to know Geometry of complex with Coordination numbers (1 to 7).
CO 27 : Student understand Geometrical isomerism in square planar and octahedral complexes.
CO 28 : Student learn Optical isomerism in octahedral complexes.

CO 29 : Student Review of VBT, EAN and their limitations.
CO 30 : Student learn Crystal Field Theory in octahedral, tetrahedral, square planar, trigonal bipyramidal and square pyramid geometries.
CO 31 : Student learn Jahn-Teller distortion in co-ordination compounds.
CO 32 : Student get to know Factors affecting the CFSE values. Limitations of CFT.
CO 33 : Student understand Molecular Orbital Theory applied to octahedral, tetrahedral and square planar complexes.
CO 34 : Student able to applied MO-Theory with π(pi)–bonding in octahedral complexes.
CO 35: Student understand Quadrapole bonding, calculation of M-M bond order and structural aspects and magnetic properties of Re_2Cl_8.
CO 36 : Student learn Bond order, magnetic properties and structural aspects of Re_3Cl_9.

UNIT-IV
CO 37 : Student learn Different binding modes of CO, pi (π) acidity of CO, back bonding, synergic effect in metal carbonyls.

CO 38 : Student understand mononuclear carbonyls, low nuclearity carbonyl clusters and high nuclearity carbonyl clusters.
CO 39 : Student able to Apply 18 electron rule to metal carbonyls.
CO 40 : Student learn Structural features of $[Co_2(CO)_8]$, $[Co_4(CO)_{12}]$ and $[Fe_3(CO)_{12}]$.
CO 41 : Student learn Preparation and structural aspects of metal carbonyls by direct reaction of metals.
CO 42 : student learn Preparation and structural aspects of metal carbonyls by reductive carbonylation.
CO 43 : Student learn the Coordinating behavior of NO, NO as a bridging ligand, factors favoring linear and bent M-N-O linkage in Metal Nitrosyls.
CO 44 : Student learn synthesis of nirosyl complexes (brown ring complex).

CO 45: Student get to know Reason for poor coordinating behavior of N_2 compared to its isoelectronic species in Dinitrogen Complexes.
CO 46 : Student understand binding modes of N_2, preparation of Ru and Mo dinitrogen complexes.
CO 47: Student learn Bronsted-Lowry concept, Lux-Flood theory of Acid-Base.
CO 48: Student understand solvent-system definition and Lewis theory.
CO 49 : Student learn Usanovich concept, Hammett acidity function.
CO 50 : Student learn HSAB theory.

PG Department of Chemistry
M.Sc. I Semester

CHOT 1.2, ORGANIC CHEMISTRY

PROGRAMME OUTCOME

UNIT-I **16 hours**

BASIC CONCEPTS AND REACTION MECHANISM

PO1: Concept of hybridization: sp3, sp2, sp – with examples.
PO2: Electronic effects: Inductive, electronic, resonance and hyperconjugation.
PO3: Classification of organic reagents and reactions.Reactive Intermediates: carbocations, carbanions, free radicals, carbenes, nitrenes, and arynes- theirformation, stability, structure and reactions.
PO4 : Organic acid and bases: Effect of substituents with examples
PO5: Reaction Mechanism: Classification, determination of reaction mechanism by kinetic and non-kinetic methods.
PO6: **Kinetic Method:** Mechanistic implications from rate laws, the transition state theory, ambiguities ininterpreting kinetic data, solvent effect, ionic effect, isotopic effect, solvent isotopic effect, substituenteffect, steric effect, linear free energy relationships–Hammett equation and Taft treatment.
PO7: **Non-kinetic methods:** Energy profile diagram, identification of products, testing possibleintermediates, trapping of intermediates, cross over experiments, isotopic labeling, stereochemical studies, limitations.

UNIT-II **16 hours**

ADDITION AND ELIMINATION REACTIONS

PO8: **Addition reactions:** Types of addition reactions, mechanism and stereochemistry of addition, effect of substrates and solvents during addition.
PO9:Addition to Carbon-Carbon double bond-addition of hydrogen halide(Markonikov's rule), bromine. Addition to carbon-hetero multiple bonds (C=O)-
PO10:Introduction, structure and reactivity, HCN, bisulphate, Grignard reagent, hydride, amino compounds, alcohols and thiols.
PO11: **Elimination reactions:** Introduction, types of elimination-E1, E2, E1CB mechanisms, orientation during elimination reactions-Saytzeff and Hoffmann rules,

PO12: Pyrolytic eliminations, Chugave, Cope eliminations, Hoffmann degradation and dehalogenation of vicinal di halides, substitution v/s elimination with suitable example.

UNIT-III **16 hours**

SUBSTITUTION REACTIONS

PO13: **Aromatic electrophilic substitution reactions:** General mechanism of electrophilic substitution in aromatic systems using examples of nitration, halogenations, sulphonation and Friedal Craft alkylation and acylation.

PO14: Orientation effect of disubstitution in aromatic systems with suitable examples.

PO15: **Nucleophilic substitution at saturated carbon:** Mechanism of SN1, SN2, SNi

PO16: Reactions–effect of solvent, substrate and leaving group, neighboring group participation, substitution at vinylic and allylic carbon.

PO17: **Aromatic nucleophilic substitution reactions:** Substitution of hydrogen, substitution other than hydrogen,

PO18: SNAR reactions, SN1, SN2 and benzyne mechanism, Bucherer reaction.

UNIT-IV **16 hours**

STEREOCHEMISTRY

PO19: **Optical isomerism:** Concepts of chirality-symmetry elements and cause for optical activity, chiral structures,

PO20: :relative configuration- Fischer's DL notation, threo and erythro nomenclature , absolute configurations- R, S nomenclature.

PO21: Molecular presentation: Sawhorse, Newman, Fischer and fly wedge formulae

PO22: enantiomers, epimers, anomers, recemic mixtures, resolution of racemic mixtures-Mechanical, biochemical and chemical method.

PO23: New methods of asymmetric synthesis: using optically active reagents, optically active substrates and optically active catalysts with suitable examples.

PO24: Enantio selective synthesis and diastereo selective synthesis.

PO25: **Conformational analysis:** Simple acyclic systems (butane, 1,2-dichloroethane) and cyclic systems(chair and boat forms of cyclohexane)

PO26 :Effect of conformation on reactivity in acyclic and cyclic systems with suitable examples

PO27: stereoisomerism in biphenyls, allenes, and spirans.

PO28: **Geometrical isomerism:** Cis-trans, E-Z and syn-anti notations for geometrical isomers, Geometrical isomerism in substituted alkenes, oximes, monocyclic

PO 29: Geometrical isomerism fused and bridge ring system

PO 30: Determination of configuration of geometrical isomers-physical and chemical methods.

COURSE SPECIFIC OUTCOME

UNIT-I

CO1: Student will be learning concept of hybridization: sp^3, sp^2, sp – with examples.

CO2: Analysis by the student for various effects of organic chemistry.

CO3: Various reagents and reactions shall be studied and the utilisation of various intermediates in the reactions shall be focused upon.

CO4: Concept of organic acid, bases and the various substietuent effects on acidity and basicity.
CO5: Student shall learn determination of reaction mechanisms
CO6: Rate laws interpreting the kinetic data and various external effects and few equations applicable to the method shall be studied.
CO7: Interpretation of the products formed, intermediates that are responsible for the reaction certain experiments to predict the products and limitations of those experiments shall be studied

UNIT II

CO8: After completion of the course students will understand the mechanistic pathways of the various organic addition elimination reactions across C=C.
CO9: Stereochemistry of addition with specific rules of addition will be learnt
CO10:Various type of substrate addition across C=O and their reactivity could be analysed by the student
CO11: In elimination reactions the student will understand certain rules of elimination like Saytzeff rule and Hoffmann elimination.
CO12: Various named reactions for eliminations can be studied and along with that dehalogenation of vic dihalides. Comparision of elimination v/s substitution

UNIT-III

CO13: Students shall learn general mechanisms of aromatic electrophilic substitution reaction with various examples and applications.
CO14: Student shall focus upon orientation effects of disubstitution on aromatic compounds
CO15: Various mechanisms for nucleophilic substitutions will be learnt.
CO16: External factors effects on the mechanism of reactions and substitution at C=C and allylic carbons shall be studied.
CO17: Learning about aromatic nucleophilic substitution reactions.
CO18: Various reaction mechanisms for nucleophilic substitution reactions shall be focused upon.

UNIT-IV

CO19: Students will become competent to predict the various symmetry elements and optical activity.
CO20 : Fischer, R/S and threoerythreo nomenclature will be studied by the student.
CO21: learning various projection formulae.
CO22: Classification of mirror images and other images of the molecules and separation of these mixtures by various methods will be studied.
CO23: Asymmetric synthesis will be learnt by the student.
CO24: Students will become competent for enantioselective and diasteroslective synthesis.
CO25: Conformational analysis of cyclic and acyclic systems will be studied.
CO26: Conformational effect on reactivity on cyclic and acyclic systems.
CO27: Stereoisomerism will be studied in some molecules.
CO28: Geometrical isomerism will be studied by the students.
CO 29: Geometrical isomerism in fused ring system shall be dealt upon.

CO30: Student shall learn determination of configuration by chemical and physical methods

CHOPr-1.7: ORGANIC CHEMISTRY PRACTICAL-I

Laboratory hours per week : 04 Credits : 02

Total hours : 64

TWO STEP PREPARATIONS

01. Preparation of acetanilide from aniline
02. Preparation of p-bromoacetanilide from acetanilide
03. Preparation of hydrolysis of p-bromoacetanilide to p-bromoaniline
04. Preparation of p-nitroacetanilide from acetanilide
05. Preparation of hydrolysis of p-nitroacetanilide to p-nitroaniline
06. Preparation of benzoic acid from benzaldehyde
07. Preparation of 2-hydroxynaphthaldehye from 2-naphthol
08. Preparation of 2,4,6 tribromo benzene from aniline
09. Preparation of phenylazo-β-naphthol
10. Preparation of 1-phenyl-3-methyl-pyrazolone

Course specific outcome

Students acquire all essential practical skills and learn techniques through Multistep preparations, estimations, extractions, separations, isolations, distillations, chemical and spectral characterization which provides deeper understanding of subject and confidence for implementation of newer ideas helping them to pursue higher education and R&D activities.

PG Department of Chemistry
M.Sc. I Semester

CHPT 1.3, PHYSICAL CHEMISTRY

PROGRAMME OUTCOME

UNIT-I **16 hours**

QUANTUM CHEMISTRY-I

PO 1 : A brief resume of black body radiation, comparative studies between classical and quantum theory (classical and Plank quantum theory, term symbols).
PO 2 : Photoelectric and Compton effects.
PO 3 : Derivation of Bohr's principle of quantization of angular momentum of electron from de-Broglie's relationship, consequences of de-Broglie equation, de-Broglie concept (To be derived).
PO 4 : Uncertainty principle, mathematical expression for uncertainty principle.
PO 5 : Postulates of quantum mechanics, operators, algebra of operators, ψ properties.
PO 6 : Hamiltonian operators and their properties.

PO 7 : Schrödinger's equation (with respect to space and time time). Physical significance and characteristics of wave function.
PO 8 : Eigen function and eigen values, probability distribution function.
PO 9 : Normalization of ψ, orthogonality of ψ boundary valued condition.
PO 10 : Application of equation to one dimension box.

UNIT-II **16 hours**

THERMODYNAMICS-I
PO 11 : Review of basic principles of thermodynamics (I and II laws of thermodynamics, concept of free energy and entropy, combined form of first and second laws of thermodynamics).

PO 12 : Criteria for equilibrium and spontaneity, derivation of the variation of free energy with temperature and pressure.
PO 13 : Maxwell's relation (to be derived). Thermodynamic equations of equipartition of energy.
PO 14 : Classius-Clapeyron equation (to be derived) and its application.
PO 15 : Entropy of vaporization. Vant-Hoff's equation, integrated form of van't Hoff's equation.

UNIT-III **16 hours**

ELECTROCHEMISTRY-I
PO 16 : Electrolytic conductance, specific conductance, electrolytic conductance.
PO 17 : Theory of ionic conductance in solutions, strong electrolytes, ionic atmosphere, relaxation and electrophoretic effects.
PO18 : Debey-Huckel- Onsagar equation(derivation) and Debey-Huckel limiting law(derivation).
PO 19 : Quantitative and qualitative treatment of Debye-Huckel limiting law, Onsagar activity co-efficient, mean ionic strength (Debey-Huckel limiting law).
PO 20 : Fundamentals of batteries, classification of batteries, size of batteries, battery characteristics.
PO 21 : Primary batteries, dry cell, alkaline MnO_2 batteries and other batteries.
PO 22 : Secondary batteries-lead acid, alkaline storage batteries and fuel cells types and applications.

UNIT-IV **16 hours**

POLYMER AND NANOSCIENCE
PO 23 : Polymers: Basic concepts: Monomers, polymers and degree of polymerization, general classification of polymers, homopolymers, copolymers, terpolymers. Linear, branched and graft network polymers.
PO 24 : Polymer molecular weight: Number average and weight average molecular weights, polydispersity and molecular weight distribution in polymers.
PO 25 : Viscoelastic behavior of polymers(Stress Strain curve).

PO 26 : Addition polymers and condensation polymers, comparison between thermoplastics and thermosetting polymers.
PO 27 : Techniques of free radical polymerization: Bulk, solution, emulsion and precification polymerization.
PO 28 : Nanoscience: Introduction to nano particles, one dimension, two dimension, three dimension and quantum dots.
PO 29 : Synthesis: Chemical vapour deposition (CVD), sol-gel method, hydrothermal method,Sonochemical method.
PO 30 : Metal oxides nanoparticles, synthesis of gold, silver and Fe_2O_3 nanoparticles.
PO 31 : Carbon nanotubes: Introduction, Types-Zigzag, Armchair, Helical.
PO 32 : Synthesis–Electric arc discharge and Chemical vapour deposition (CVD).
PO 33 : Applications of nanomaterials in renewable energy.
PO 34 : Aerogels: Types – silica aerogel, Resorcinol Formaldehyde and Carbon aerogels, Applications.

COURSE SPECIFIC OUTCOME

UNIT-I

CO 1 : Student learn black body radiation and comparative studies between classical and quantum theory.
CO 2 : Student understand Photoelectric and Compton effects.
CO 3 : Student learn Derivation of Bohr's principle of quantization of angular momentum of electron from de-Broglie's relationship and consequences of de-Broglie equation.
CO 4 : Student understand Uncertainty principle and its mathematical expression.
CO 5 : Student get to know Postulates of quantum mechanics, operators, algebra of operators, ψ properties.
CO 6 : Student understand Hamiltonian operators and their properties.

CO 7 : Student learn Schrödinger's equation and Physical significance, characteristics of wave function.
CO 8 : Student get to know eigen function and eigen values, probability distribution function.
CO 9 : Student understand normalization of ψ, orthogonality of ψ boundary valued condition.
CO 10 : Student learned Application of equation to one dimension box.

UNIT-II

CO 11 : Student learn I and II laws of thermodynamics, concept of free energy and entropy, combined form of first and second laws of thermodynamics.
CO 12 : Student get to know Criteria for equilibrium and spontaneity. Derivation of the variation of free energy with temperature and pressure.
CO 13 : Student learn Maxwell's relation and Thermodynamic equations of equipartition of energy.

CO 14 : Student learn Classius-Clapeyron equation and its application.
CO 15 : Student get to know Entropy of vaporization. Vant-Hoff's equation, integrated form of van't Hoff's equation.

UNIT-III

CO 16 : Student learn Electrolytic conductance, specific conductance, electrolytic conductance.
CO 17 : Student get to know theory of ionic conductance in solutions, strong electrolytes, ionic atmosphere, relaxation and electrophoretic effects.
CO18 : Student learn Debey-Huckel- Onsagar equation and Debey-Huckel limiting law.
CO 19 : Student learn quantitative and qualitative treatment of Debye-Huckel limiting law, Onsagar activity co-efficient and Debey-Huckel limiting law.
CO 20 : Student understand Fundamentals of batteries, classification of batteries, size of batteries and battery characteristics.
CO 21 : Student learn primary batteries, dry cell, alkaline MnO_2 batteries and other batteries.
CO 22 : Student understand secondary batteries-lead acid, alkaline storage batteries and fuel cells types and applications.

UNIT-IV

CO 23 : Student learn Basic concepts, general classification of polymers.
CO 24 : Student learn different Polymer molecular weight, polydispersity and molecular weight distribution in polymers.
CO 25 : Student learn Viscoelastic behavior of polymers (Stress Strain curve).
CO 26 : Student get to know Addition polymers and condensation polymers. comparison between thermoplastics and thermosetting polymers.
CO 27 : Student learn different Techniques of free radical polymerization.
CO 28 : Student learn Introduction and type of nano particles.
CO 29 : Student get to know different method of Synthesis of nano material.
CO30 : Student learn different method of synthesis of Metal oxides.
CO 31 : Student understand Introduction and Types of n Carbon nanotubes.
CO 32 : Student understand Synthesis of nanotube by Electric arc discharge and Chemical vapour deposition method.
CO 33 : Student learn Applications of nanomaterials in renewable energy.
CO 34 : Student understand Types, preparation and application of Aerogels.

PG Department of Chemistry
M.Sc. I Semester

CHOT-1.4, SPECTROSCOPY-I

PROGRAMME OUTCOME

UNIT–I **16 hours**

MICROWAVE and UV-VISIBLE SPECTROSCOPY

PO 1: Electromagnetic radiation: Interaction of radiation with matter-absorption, emission, reflection, refraction, transmission, dispersion, polarization, interference and scattering, natural line width and broadening (Doppler effect).
PO-2: Heisenberg uncertainity and intensity of spectral lines, regions of electromagnetic spectrum and their corresponding energies: rotational, vibrational and electronic transitions and their energy levels.

PO-3: Microwave spectroscopy: Diatomic molecules-**r**igid and non rigid rotator model(No derivation),rotational quantum number and the selection rule, effect of isotopic substitution on rotation spectra.
PO-4: Relative intensities of the spectral lines, classification of polyatomic molecules based on moment of inertia-linear, symmetric top, asymmetric top and spherical molecules, rotation spectra of polyatomic molecules(CO_2, CH_3F and BCl_3).
PO-5: Moment of inertia expression for linear tri-atomic molecules, experimental techniques-microwave spectrometer, applications-principles of determination of bond length and moment of inertia from rotational spectra and determination of dipole moments.
PO-6: UV-visible spectroscopy: Types of transitions and their theoretical interpretation, Beer's law, Lambert's law, Beer's-Lambert's law, limitations, chromophores, auxochromes.
PO-7: Effect of substituents on the position of lmax, prediction of lmax for polyenes, a,b-unsaturated aldehydes and ketones (Woodward- Fisher rules), aromatic systems and their derivatives. basic components of instrumentation-single and double beam designs, applications-analysis of binary mixtures, measurement of dissociation constants of acids and bases.

UNIT–II **16 hours**
IR and RAMAN SPECTROSCOPY

PO-8: IR spectroscopy: Vibration of diatomic molecules, vibrational energy curves for simple harmonic oscillator, effects of anharmonic oscillation, vibration-rotation spectra of carbon monoxide(No derivation), expressions for fundamental and overtone frequencies.
PO-9: Vibrations of polyatomic molecules–The number of degrees of freedom of vibration, , modes of vibration(CO2 and H2O).
PO-10: Fundamental, overtone, combination, hot bands, Fermi resonance, force constant and its significance.
PO-11: Theoretical group frequency, intensity of absorption band and types of absorptions, identification of functional groups alkanes, alkenes, aromatics, carboxylic acids, carbonyl compounds(aldehydes and ketones, esters).
PO-12: Amides and amines, fingerprint region, vibrational coupling, hydrogen bonding, steric effect and ring strain.
PO-13:Raman spectroscopy: Introduction, Raman and Rayleigh scattering, Stokes and anti-Stokes lines, polarization of Raman lines, depolarization factor, polarizability ellipsoid.

PO-14: Theories of Raman spectra classical and quantum theory, comparison of Raman and IR spectra, rule of mutual exclusion principle, advantages of Raman spectra.

COURSE SPECIFIC OUTCOME

UNIT-I

CO 1: Able to understand Interaction of radiation with matter and Doppler effect.
CO 2: Able to learn Heisenberg uncertainity principle, intensity of spectral lines and regions of electromagnetic spectrum
CO 3: Have understood Microwave spectroscopy ofDiatomic molecules.
CO 4: Able to understand rotation spectra of polyatomic molecules(CO_2, CH3F and BCl_3)

CO 5: Students acquire the knowledge of the instrumentation and principle.
CO 6: Learnt types of transitions and their theoretical interpretation.
CO 7: Learnt about Woodward- Fisher rules and instrumentation-single and double beam designs and its applications.
UNIT-II

CO 8: Able to understand Vibration of diatomic molecules and Hook's law.
CO 9: Have understood vibrational spectroscopy ofpolyatomic molecules like CO_2 and H_2O.
CO 10: Learnt about different types of transitions, force constant and its significance.
CO 11: Able to interpret the spectral data for structural elucidation of organic compounds.
CO 12: Have understood effect of hydrogen bonding, steric effect and ring strain on vibrational frequency.
CO 13 : Students acquire the knowledge of principle involved in Raman spectroscopy.**CO 14 :** Learnt about Theories of Raman spectra ,comparison of Raman and IR spectra, rule of mutual exclusion principle and advantages of Raman spectra.

PG Department of Chemistry
M.Sc. I Semester

CHOT-1.5 ANALYTICAL CHEMISTRY

PROGRAMME OUTCOME

UNIT-I **16 hours**
DATA ANALYSIS
PO 1: Classification of analytical methods: Types of instrumental analysis, analytical methods on the basis of simple size. Errors, types of errors, determinate and indeterminate errors, accuracy and precision.
PO 2: Distribution of random errors, frequency distributions normal error curves. Statistical treatment of finet samples.

PO 3: Measure central tendency -mean, medium, range, average deviation, relative average deviation, standard deviation and variance.
PO 4: Students' confidence interval of the mean. Testing for significance, comparison of two means and two standard deviations.
PO 5: Criteria for rejection of a observation-Q test, control chart, propagation of errors, significant figures. Least square methods of deriving calibration of plots.
PO 6: Principles of sampling the sampling step. Methods for sampling solid, liquid and gaseous samples. Effect of sampling uncertainties. Sampling hazards, need for quality assurance: ISO 9000 series of quality of system.

UNIT–II **16 hours**
CHROMATOGRAPHY

PO 7: Introduction, Principles, classifications, fundamentals of chromatography (Partition coefficient,Retardation factor, retention volumes).
PO 8: Dynamics of chromatography (Efficiency, zone spreading, eddy diffusion) chromatograms, retention time and column efficiency, plate theory and rate theory, Van-Deemeters equation, column resolution, factors influencing resolution.
PO 9:THIN LAYER CHROMATOGRAPHY Introduction, stationary and mobile phase systems, Rf value calculation, various technique of developments, visualization and applications.
PO 10: ION EXCHANGE CHROMATOGRAPHY
Introduction, principle, classification of ion exchange resins, mechanism of ion exchange,synthesis of ion exchange resins (cation and anion)
PO 11: Characteristics of ion exchange resins (size, capacity, crosslinking and swelling and resistance) applicationsin analytical and metal separations.
PO 12:HIGH PERFORMANCE LIQUID CHROMATOGRAPHY
Introduction, principles, instrumentation, mobile phase, stationary phase, types of column, variousdetectors used, and applications.

UNIT–III **16 hours**
SEPERATION TECHNIQUES and THERMAL METHODS OF ANALYSIS

PO 13: Solvent Extraction:Definition, types, principle and efficiency of extraction, sequence of extraction process.
PO 14: Factors affecting extraction-pH, oxidation state, modifiers, synergistic, masking and salting outagents, techniques-batch and continuous extraction, applications, Separation of lanthanides.
PO 15: Electrophoresis**:** Introduction, types and techniques of electrophoresis, factor affecting migration of ions.
PO 16: Continuous electrophoresis, thin layer electrophoresis, moving boundary electrophoresis, zone electrophoresis, and Curtain electrophoresis.
PO 17: Reverse osmosis electro dialysis, capillary electrophoresis and applications.
PO 18: Thermal Methods of Analysis:Introduction, thermogravimetric analysis (TGA), types of thermogravimetric analysis, principle and method, automatic thermogravimetric analysis.

PO 19: Instrumentation, types of recording thermos balances, sample holders, factors influencing thermograms and applications, isothermal analysis, Differential Thermal Analysis (DTA), principle of working.
PO 20: Theory and instrumentation, simultaneous DTA-TGA curves, factors affecting results and applications.
PO 21: Differential Scanning Colorimetry(DSC), principle of working, theory, instrumentation and applications. Types of titrations and gravimetric analysis.

UNIT–IV **16 hours**
ELECTROANALYTICAL TECHNIQUES

PO 22: Introduction, electrochemical cells, faradic and non-faradic current, mass transfer in cells, galvanic and electrolytic cells. anodes and cathodes, liquid junction potential, schematic representation of cells.
PO 23: Polarography: Theory, principle and applications classical polarography, dropping mercury electrode,polarogram, polarographic measurements.
PO 24: Polarographic current, Ilkovic equation, current and concentration relationship, half wave potential, oxygen interference- advantages and limitations.

PO 25: Qualitative and quantitative analysis. Derivative polarography, Amperometry and Coulometryat controlled potential and at constant current.
PO 26: Cyclic voltametry- basic principles, instrumentation and applications, stripping voltammetry and its Applications.
PO 27: Electrogravimetry - theory, electrode reactions, over-voltage, characteristics of a good deposit,completeness of deposition, Determination of copper and nickel in Cu-Ni alloy.

COURSE SPECIFIC OUTCOME

UNIT-I

CO 1: Able to understand basics of analytical methods, analytical errors, accuracy and precision.
CO 2: Able to learn Distribution of random errors, frequency distributions normal error curves.
CO 3: Able to understand basics of data analysis
CO 4: Able to understand t-test and its significance.
CO 5: Students acquire the knowledge of Q-test and its significance.
CO 6: Learnt principles and methods of sampling.
UNIT-II

CO 7: Learnt basics of chromatography.
CO 8: Able to understand Dynamics of chromatography (Efficiency, zone spreading, eddy diffusion) chromatograms, retention time and column efficiency

CO 9: Students acquire the knowledge ofTLC principles and its applications.
CO 10: Learnt about , principle, classification and mechanism of ion exchange resins
CO 11: Able to understand characteristics and applications of ion exchange chromatography.
CO 12: Have understood , principles, instrumentation of HPLC.

UNIT-III

CO 13 : Students acquire the knowledge of types, principle and efficiency of extractions.
CO 14 : Learnt about factors affecting separation techniques and its applications.
CO 15: . On the completion of the course students will have the understanding of basics of Electrophoresis**:** Introduction, types and techniques
CO 16: understoodvarious types of electrophoresis.
CO 17: Students acquire the knowledge of reverse osmosis electro dialysis, capillary electrophoresis and applications.
CO 18: Able to understand , principles of TGA
CO 19: Learnt about types, instrumentation and application of TGA.
CO 20: Have understood theory and instrumentation, simultaneous DTA-TGA curves, factors affecting results and applications.
CO 21: Learnt about principles, types, instrumentation, working and application of Differential Scanning Colorimetry(DSC)

UNIT-IV
CO 22: Students acquire the knowledge of electrochemical cells and representation of cells.
CO 23: Have understood theory, principles, instrumentation and applications of polarography.
CO 24: Able to understand Polarographic current, Ilkovic equation, current and concentration relationship, half wave potential
CO 25: Learnt about Qualitative and quantitative analysis. Derivative polarography.Amperometry and Coulometry.
CO 26: Have understood theory, principles, instrumentation and applications of cyclic voltammetry.
CO 27: Students acquire the knowledge of electrogravimetry.

PG Department of Chemistry
M.Sc. II Semester

CHIT-2.1, INORGANIC CHEMISTRY –II

PROGRAMME OUTCOME

UNIT-I **16 hours**
SYMMETRY AND GROUP THEORY
PO 1 : Symmetry elements and symmetry operations, rotation axis.

PO 2 : Rules for orientation of molecules, plane of symmetry, rotation-reflection axis, centre of symmetry and identity element of symmetry, Products of symmetry operations.
PO 3 : General relations among symmetry elements and symmetry operations.
PO 4 : Concept of a group, definition of a point group.
PO 5 : Procedure for classification of molecules into point groups, subgroups.
PO 6 : Schoenflies and Hermann-Maugin symbols for point groups.
PO 7 : multiplication tables for the symmetry operations of simple molecules, matrix notation for the symmetry elements and for geometric transformations.
PO 8 : Class of a group and similarity transformation.
PO 9 : Reducible and irreducible representations.
PO 10 : Great Orthogonality theorem and its consequences.
PO 11 : Labeling of irreducible representations.
PO 12 : Group theory and hybrid orbitals to form bonds, character tables (C_s, C_i, C_2, C_{2v} and C_{3v}).
PO 13 : Applications of group theory to crystal field theory.
PO 14 : Bonding in octahedral and tetrahedral complexes.
PO 15 : Symmetry and dipole moments, symmetry and optical activity.

UNIT-II **16 hours**

COORDINATION CHEMISTRY-REACTIONS, KINETICS AND MECHANISMS
PO 16 : Types of mechanisms in substitution reactions-dissociation, interchange and association.
PO 17 : Metal-ligand equilibria step-wise and overall stability/formation constant, factors affecting stability of Metal complexes.
PO 18 : Determination of stability constant by spectrophotometric (Job's) method.
PO 19 : Trans effect, substitution reactions in square planar complexes.

PO 20 : Rate law and mechanism of nucleophilic substitution in square planar complexes.
PO 21 : Thermodynamic and kinetic stability.
PO 22 : Ligand field effects and reaction rates, mechanism of substitution in octahedral complexes.
PO 23 : Reaction rates influenced by acid and base.
PO 24 : Mechanism of redox reactions-outer sphere and inner sphere mechanisms, Marcus theory.
PO 25 : Photochemistry of metal complexes-types of photochemical reactions.
PO 26 : Photo-substitution and photoredox reactions and excited state outer sphere electron transfer reactions (solar energy conversion).
PO 27 : Complimentary and non-complimentary reactions.

UNIT-III **16 hours**

SOLID STATE AND STRUCTURAL CHEMISTRY

PO 28 : Types of solids, close packing of identical solid spheres, tetrahedral and octahedral voids, packing fraction, radius ratio.
PO 29 : Crystallographic systems: Bravias lattices, Miller indices, external features of crystals.
PO 30 : Structures of selected crystals: normal and inverse spinels, hexagonal structures, pervoskites.
PO 31 : Defects in solids: Point defects (stoichiometric and non-stoichiometric), line defects and plane defects, stacking faults and grain boundaries.
PO 32 : Solid solutions : Hume – Rothery rules, substitutional solid solutions and interstitial solid solutions, solid solution mechanism.
PO 33 : Alloy systems: Phase diagram and their features with respect to alloys - two and three component systems.
PO 34 : copper–zinc system, steels with reference to iron-carbon systems.

UNIT-IV **16 hours**

NUCLEAR CHEMISTRY
PO 35 : Radioactivity, nuclear reactions, nuclear power reactors–radioactivity.
PO 36 : Determination of half life, radioactive decay kinetics, parent-daughter decay-growth relationships, secular and transient equilibria.
PO 37 : Nuclear reactions, spallation, nuclear fission and fusion.
PO 38 : Types of nuclear power reactors, basic features and components of a nuclear power reactor, safety measures.
PO 39 : An introduction to breeder reactors, applications of radioisotopes.
PO 40 : Synthesis of various useful radioisotopes, physico-chemical and analytical applications-isotope dilution method.
PO 41 : Activation analysis, radiometric titration and 14C dating, medical, agricultural and industrial applications of isotopes.
PO 42 : Interaction of matter with radiation, radiation dosimetry-units .
PO 43 : Measurement of chemical dosimeters (Fricke and ceric sulphate dosimeters).
PO 44 : Radiation chemistry of water, a brief introduction to radiolysis of liquids and solids.
PO 45 : Industrial applications of radiation chemistry (radiation polymerization, food irradiation and
radiation synthesis).
PO 46 : Biological effects of radiation, hazards in radiochemical work.
PO 47 : Radiation protection, decontamination procedures, permissible exposure doses.
PO 48 : Nuclear waste management including waste storage and disposal procedures.

COURSE SPECIFIC OUTCOME

UNIT-I
CO 1 : Symmetry elements and symmetry operations, rotation axis.

CO 2 : Student learn rules for orientation of molecules, plane of symmetry, rotation-reflection axis, centre of symmetry and identity element of symmetry, Products of symmetry operations.
CO 3 : Student understand General relations among symmetry elements and symmetry operations.
CO 4 : Student learn Concept of a group, definition of a point group.
CO 5 : Student learn the Procedure for classification of molecules into point groups, subgroups.
CO 6 : Student learned Schoenflies and Hermann-Maugin symbols for point groups.
CO 7 : Student learn the multiplication tables for the symmetry operations of simple molecules, matrix notation for the symmetry elements and for geometric transformations.
CO 8 : Student get to know class of a group and similarity transformation.
CO 9 : Student learn Reducible and irreducible representations.
CO 10 : Student understand Great Orthogonality theorem and its consequences.
CO 11 : Student learned labeling of irreducible representations.
CO 12 : Student learn group theory and hybrid orbitals to form bonds, character tables .
CO 13 : Student learn applications of group theory to crystal field theory.
CO 14 : Student learn bonding in octahedral and tetrahedral complexes.
CO 15 : Student understands symmetry and dipole moments, symmetry and optical activity.

UNIT II
CO 16 : Student learn Types of mechanisms in substitution reactions-dissociation, interchange and association.
CO 17 : Student learn Metal-ligand equilibria step-wise and overall stability/formation constant, factors affecting stability of metal complexes.
CO 18 : Student get to know Determination of stability constant by spectrophotometric (Job's) method.
CO 19 : Student understand Trans effect, substitution reactions in square planar complexes.

CO 20 : Student learn Rate law and mechanism of nucleophilic substitution in square planar complexes.
CO 21 : Student understand thermodynamic and kinetic stability.
CO 22 : Student learn Ligand field effects and reaction rates, mechanism of substitution in octahedral complexes.
CO 23 : Student get to know reaction rates influenced by acid and base.
CO 24 : Student learned mechanism of redox reactions-outer sphere and inner sphere mechanisms, Marcus theory.
CO 25 : Student understand photochemistry of metal complexes-types of photochemical reactions.
CO 26 : Student learn photo-substitution and photoredox reactions and excited state outer sphere electron transfer reactions .
CO 27 : Student learned complimentary and non-complimentary reactions.

UNIT-III

CO 28 : Student get to know Types of solids, close packing of identical solid spheres, tetrahedral and octahedral voids, packing fraction, radius ratio.
CO 29 : Student learn Bravias lattices, Miller indices, external features of crystals.
CO 30 : Student learn normal and inverse spinels, hexagonal structures, pervoskites structure.
CO 31 : Student understand Point defects, line defects and plane defects, stacking faults and grain boundaries.
CO 32 : Student learn Hume – Rothery rules, substitutional solid solutions and interstitial solid solutions, solid solution mechanism.
CO 33 : Student get to know Phase diagram and their features with respect to alloys - two and three component systems.
CO 34 : Student learned copper–zinc system, steels with reference to iron-carbon systems.
UNIT-IV
CO 35 : Student learned Radioactivity, nuclear reactions, nuclear power reactors– radioactivity.

CO 36 : Student able to determination of half life, radioactive decay kinetics, parent-daughter decay-growth relationships, secular and transient equilibria.
CO 37 : Student learn nuclear reactions, spallation, nuclear fission and fusion.
CO 38 : Student understand different types, basic feature and components of nuclear power reactors.
CO 39 : Student learn introduction to breeder reactors and applications of radioisotopes.
CO 40 : Student understand synthesis of various useful radioisotopes, physico-chemical and analytical applications-isotope dilution method.
CO 41 : Student learn activation analysis, radiometric titration and ^{14}C dating, medical, agricultural and industrial applications of isotopes.
CO 42 : Student learn Interaction of matter with radiation, radiation dosimetry-units .
CO 43 : Student learned different measurement of chemical dosimeters.
CO 44 : Student learn radiation chemistry of water, a brief introduction to radiolysis of liquids and solids.
CO 45 : Student learn different industrial applications of radiation chemistry.
CO 46 : Student understand Biological effects of radiation, hazards in radiochemical work.
CO 47 : Student learn radiation protection, decontamination procedures, permissible exposure doses.
CO 48 : Student understands nuclear waste management including waste storage and disposal procedures.

PG Department of Chemistry
M.Sc. II Semester

CHIT-2.2, ORGANIC CHEMISTRY –II

PROGRAMME OUTCOME

UNIT-I **16 hours**

NAMED REACTIONS

PO1: C-C bond forming reactions: Aldol condensation, Dickmann condensation,
PO2: Stobbe condensation, Micheal addition,
PO3: Perkin reaction, Reimer-Tiemann reaction,
PO4: Reformtsky reaction, Wittig reaction,
PO5: Mannich reaction, Shapario reaction.
PO6: C-N bond forming reactions: Chichibabin reaction, Barton reaction,
PO7: Hofmann-Loffler-Freytag reaction,Stork enamine reaction.
PO8: C-O bond forming reactions: Sharpless asymmetric epoxidation, Bayer-Villeger reaction.
PO9: C-Cl bond forming reaction: Hell-Volhard-Zelinski reaction.

UNIT-II **16 hours**

OXIDATION AND REDUCTION REACTIONS

PO10: Oxidation reactions: Introduction, Oxidation reactions examples
PO11: Applications of chromium series-K2Cr2O7, PDC, PCC,
PO12: Sorret and Jones reagents.
PO13: Manganese compounds-KMnO4, MnO2.
PO14: Oxidation reactions involving ozone, peracids, lead tetraacetatate,
PO12: Periodic acid, osmanium tetroxide,
PO13: Selenium dioxide, Oppenauer oxidation.
PO14:Reduction reactions: Introduction, Catalytic hydrogenation-both heterogeneous (examples Nickel and palladium) and homogeneous,
PO15: Metal hydride reductions (NaBH4 and LiAlH4),
PO16: Reduction with dissolved metal, diimide reduction,
PO17: Clemmensen, Wolf Kishner, Meerwin-Varley-Ponndorf reduction,
PO18: Leukart reaction and reductions with diborane.

UNIT –III **16 hours**

REARRANGEMENT REACTIONS

PO19: Classification and general mechanistic treatment of nucleophilic, electrophilic and free radical rearrangements.
PO20: Rearrangement reactions involving migration to electron deficient carbon: Wolf, Wagner-Meerwein, Pinacol-pinacolone and Benzil-benzilic acid rearrangement.
PO21: Rearrangement reactions involving migration to electron rich carbon: Favorskii, Sommlet-Houser
PO22: Naber and Steven rearrangement.
PO23: Rearrangement reactions involving migration to electron deficient nitrogen: Hoffmann, Lossen, Curtius,
PO24: Schmidt, Beckmann rearrangement.
PO25: Rearrangement reactions involving migration to electron deficient oxygen: Dakin, Bayer- Villiger and Hydroperoxide rearrangement.

UNIT-IV **16 hours**

HETEROCYCLIC COMPOUNDS

PO26: Nomenclature of heterocyclic compounds-Hantz-Wiedamann system.
PO27: Synthesis and reactions of 3-Membered heterocyclic compounds – aziridines, azirines, oxiranes
PO28: Oxirenes and thiiranes.
PO29: 4-Membered heterocyclic compounds with one and two hetero atoms – azitidines, oxetanes and thietanes
PO30: 6-Membered heterocyclic compounds with one and two hetero atoms – pyridine, pyrimidine, quinoline.
PO31: 7-Membered heterocyclic compounds – azepines, oxepines, thiepines.

COURSE SPECIFIC OUTCOME

UNIT-I

CO1: Students get to know about C-C bond forming reactions: through named reactionsAldol condensation, Dickmann condensation,
CO2: An insight about Stobbe condensation, Micheal addition ill be gained by students
CO3: Students shall gain knowledgePerkin reaction, Reimer-Tiemann reaction
CO4: Students shall learnaboutReformtsky reaction, Wittig reaction,
CO5: Mannich reaction, Shapario reaction will be learnt by the students.
CO6: An insight about C-N bond forming reactions: through named reactions like Chichibabin reaction, Barton reaction will be focused upon.
CO7: Students shall learn Hofmann-Loffler-Freytag reaction,Stork enamine reaction.
CO8: Knowledge about C-O bond forming reactions:through named reactions like Sharpless asymmetric epoxidation, Bayer-Villeger reaction will be gained by students.
CO9: Students shall learn about C-Cl bond forming reaction: Hell-Volhard-Zelinski reaction.

UNIT-II

CO10: Introduction about Oxidation reactions will be learn by students.
CO11: Knowledge aboutapplications of chromium series-K2Cr2O7, PDC, PCC will be gained.
CO12: Students shall learn aboutSorret and Jones reagents.
CO13: Acquiring knowledge aboutManganese compounds-KMnO4, MnO2.
CO14: Gaining an insight about Oxidation reactions involving ozone, peracids, lead tetraacetatate
CO12: Students learn aboutPeriodic acid, osmanium tetroxide,
CO13: Students understand about Selenium dioxide, Oppenauer oxidation.
CO14: Introduction to Reduction reactions:Catalytic hydrogenation-both heterogeneous (examples Nickel and palladium) and homogeneous.
CO15: Metal hydride reductions ($NaBH_4$ and $LiAlH_4$) will be learnt.
CO16: Students gain an insight about Reduction with dissolved metal, diimide reduction,
CO17: Knowledge about Clemmensen, Wolf Kishner, Meerwin-Varley-Ponndorf reduction will be gained.
CO18: Acquiring knowledge aboutLeukart reaction and reductions with diborane.

UNIT –III

CO19: Students learn aboutClassification and general mechanistic treatment of rearrangements.
CO20: Students aquire knowledge aboutRearrangement reactions involving migration to electron deficient carbon: with named reactions like Wolf, Wagner-Meerwein, Pinacol-pinacolone and Benzil-benzilic acid rearrangement.
CO21: Acquiring knowledge aboutRearrangement reactions involving migration to electron rich carbon: Favorskii, Sommlet-Houser by the students.
CO22: Named reactions likeNaber and Steven rearrangement will be learnt by students.
CO23: An insight about Rearrangement reactions involving migration to electron deficient nitrogen through Hoffmann, Lossen, Curtius reactions will be learnt by students.
CO24: Learning about naming reactionsSchmidt, Beckmann rearrangement.
CO25: Students gain competence aboutRearrangement reactions involving migration to electron deficient oxygen through named reactions Dakin, Bayer- Villiger and Hydroperoxide rearrangement.

UNIT-IV

CO26: Students understand about Nomenclature of heterocyclic compounds by Hantz-Wiedamann system.
CO27: Knowledge will be gained aboutSynthesis and reactions of 3-Membered heterocyclic compounds like aziridines, azirines, oxiranes by the students
CO28: Learning aboutOxirenes and thiiranes.
CO29: Students acquire knowledge about 4-Membered heterocyclic compounds with one and two heteroatoms through molecules azitidines, oxetanes and thietanes
CO30: 6-Membered heterocyclic compounds with one and two hetero atoms – pyridine, pyrimidine, quinoline.
CO31: By studying this part students learn about 7-Membered heterocyclic compounds with molecules like azepines, oxepines, thiepines.

PG Department of Chemistry
M.Sc. II Semester

CHPT-2.3, PHYSICAL CHEMISTRY –II

PROGRAMME OUTCOME

UNIT-I **16 hours**
THERMODYNAMICS-II
PO 1 : Statistical thermodynamics: Introduction to statistical thermodynamics.
PO 2 : Energy states, quantum mechanical and statistical aspects, unit cells, microscopic state and macroscopic state, phase space.

PO 3 : System, assembly and ensemble, use of ensemble, microcononical ensemble, canonical ensemble.
PO 4 : Probability, thermodynamic probability, molecular basis of residual entropy.
PO 5 : Classical statistics, Sterling's approximation, Maxwell Boltzmann distribution law and its applications.
PO 6 : Bose-Einstein statistics, Fermi-direc statistics and their comparisons.

PO 7 : Derive the relationship between entropy and thermodynamic probability, partition function.
PO 8 : Thermodynamic functions in terms of partition function (energy, heat capacity, entropy, Gibb's free energy, enthalpy Helmholtz free energy).
PO 9 : Evaluation of different types of partition function. i) Translational partition function. ii) Rotational partition function for diatomic molecule iii) vibrational partition function for diatomic molecule ,electronic
partition function iv) nuclear partition function, separation of partition function, residual entropy .

UNIT-II **16 hours**
QUANTUM CHEMISTRY-II
PO 10 : One dimensional simple harmonic oscillator in classical mechanics and quantum mechanics.
PO 11 : Wave functions of the harmonic oscillators.
PO 12 : The applications of Schrödinger's equations to the H atom derivation (separation of R, θ, φ equations and their solutions).
PO 13 : Quantum number and their characteristics.
PO 14 : Approximate methods in quantum mechanics, variations method.
PO 15 : Linear and non linear variation functions, application to the He atom, ant symmetric and asymmetric exclusion principle.
PO 16 : Slater's determination wave functions, terms symbols and spectroscopic status.
PO 17 : Hydrogen like wave functions, angular and radial wave functions and its application to hydrogen atom.
PO 18 : General equation and general determination.
PO 19 : Application of variation method to hydrogen molecule, ion and normal and degenerate states.
PO 20 : Orbital diagram need for variation methods.
PO 21 : Perturbation theory, first and second order perturbation theory and its application to linear harmonic oscillator.

UNIT-III **16 hours**
CHEMICAL DYNAMICS
PO 22 : Chemical kinetics in solution, influence of salt and solvents on reaction rates.

PO23 : Primary salt effect, secondary salt effect (Bronsted-Bjerrum equation).
PO 24 : Diffusion controlled reactions in solutions (Debye Slomuchowski equation).
PO 25 : Study of fast reactions. I) NMR ii) relaxation methods iii) pulse method (flash photolysis, flash radiolysis) iv) shock tubes v) stopper flow method,
PO 26 : Reactions in molecular beams (scattering as a probe of reaction dynamics).

PO 27 : Potential energy surfaces, absolute rate theory applied to reactions.
PO 28 : Molecular momentum of rate of slow reactions.
PO 29 : Linear free energy relationship. Thermodynamic simplications of linear free relationship.
PO 30: Hammett's relationship. Derivations of Hammett equation.
PO 31: Taft equation, solvent effects on rates.

UNIT-IV **16 hours**
PHOTOCHEMISTRY AND PHOTODEGRADATION

PO 32 : PHOTOCHEMISTRY: Electronic transitions in molecules, The Franck-Condon principle.
PO 33 : Electronically excited molecules - singlet and triplet states. Life times of excited states of atoms and molecules.
PO 34 : Quantum yield and its determination. Actinometry – ferrioxalate, uranyl oxalate, MGL and Reinekke's salt actinometers.
PO 35 : A review of laws of photochemistry –Grottus-Draper law, Beer-Lambert law, Stark-Einstein law.
PO 36 : Photo physical processes – kinetics of unimolecular reactions, experiments in photochemistry.
PO 37 : Photo properties - fluorescence, phosphorescence, chemiluminescence. Delayed fluorescence – E-type and P-type.
PO 38 : State diagrams, Stern-Volmer equation (to be derived), lasers in photochemical kinetic studies.
PO 39 : Photo electrochemistry, solar energy conversion and storage.
PO 40 : Photochemical processes – types of photochemical reactions – electron transfer, photodissociation.

PO 41 : Oxidation and isomerization reactions with examples. Photosensitization. Flash photolysis.
PO 42 : PHOTODEGRADATION: Photocatalyst – ZnO, TiO2, principle.
PO 43 : Application of ZnO/TiO2 in the photo degradation of dyes (IC), pesticides (DDT) and in industrial effluents.
PO 44 : Effect of photo degradation on COD value.

COURSE SPECIFIC OUTCOME

UNIT-I
CO 1 : Student learned Introduction to statistical thermodynamics.
CO 2 : Student get to know Energy states, quantum mechanical and statistical aspects, unit cells, microscopic state and macroscopic state, phase space.
CO 3 : Student learn system, assembly and different types of ensemble.
CO 4 : Student understand probability, thermodynamic probability and molecular basis of residual entropy.
CO 5 : Student learn Classical statistics, Sterling's approximation, Maxwell Boltzmann distribution law and its applications.

CO 6 : Student get to know Bose-Einstein statistics, Fermi-direc statistics and their comparisons.
CO 7 : Student understand the way to Derive the relationship between entropy and thermodynamic probability, partition function.

CO 8 : Student understand thermodynamic functions in terms of partition .
CO 9 : Student learn different types of partition function and separation of partition function, residual entropy.

UNIT-II
CO 10 : Student learn One dimensional simple harmonic oscillator in classical mechanics and quantum mechanics.
CO 11 : Student understand wave functions of the harmonic oscillators.
CO 12 : Student understand applications of Schrödinger's equations to the H atom.
CO 13 : Student understand Quantum number and their characteristics.

CO 14 : Student get to know Approximate methods in quantum mechanics and variations method.
CO 15 : Student learn linear and non linear variation functions and its application to the He atom.
CO 16 : Student understand Slater's determination wave functions, terms symbols and spectroscopic status.
CO 17 : Student get to know Hydrogen like wave functions, angular and radial wave functions and its application to hydrogen atom.
CO 18 : Student learn General equation and general determination.
CO 19 : Student understand application of variation method to hydrogen molecule, ion and normal and degenerate states.
CO 20 : Student learned Orbital diagram need for variation methods.
CO 21 : Student understand Perturbation theory, first and second order perturbation theory and its application to linear harmonic oscillator.

UNIT-III
CO 22 : Student understand Chemical kinetics in solution, influence of salt and solvents on reaction rates.
CO 23 : Student get to know primary salt effect, secondary salt effect.
CO 24 : Student learn diffusion controlled reactions in solutions.
CO 25 : Student understand different methods to study fast reactions.
CO 26 : Student learn reactions in molecular beams.
CO 27 : Student understand potential energy surfaces, absolute rate theory applied to reactions.
CO 28 : Student learn Molecular momentum of rate of slow reactions.
CO 29 : Student get to know Linear free energy relationship. Thermodynamic simplications of linear free relationship.
CO 30 : Student learn Hammett's relationshipand its derivations.
CO 31 : Student understand Taft equation, solvent effects on rates.

UNIT-IV

CO 32 : Student learn Electronic transitions in molecules, The Franck-Condon principle,
CO 33 : Student understand different electronically excited molecules, Life times of excited states of atoms and molecules.
CO 34 : Student learn Quantum yield and its determination by different actinometry.
CO 35 : Student learned different laws of photochemistry.
CO 36 : Student get to know different Photo physical processes.
CO 37 : Student learn fluorescence, phosphorescence, chemiluminescence. Delayed fluorescence – E-type
and P-type.
CO 38 : Student understand State diagrams, Stern-Volmer equation, lasers in photochemical kinetic studies.
CO 39 : Student learn photo electrochemistry, solar energy conversion and storage.
CO 40 : Student understand Photochemical processes and types of photochemical reactions.
CO 41 : Student learn oxidation and isomerization reactions with examples.
CO 42 : Student get to know about Photocatalyst – ZnO, TiO2 , principle,
CO 43 : Student understand application of ZnO/TiO2 in the photo degradation of dyes (IC), pesticides (DDT) and in industrial effluents.
CO 44 : Student learn Effect of photo degradation on COD value.

PG Department of Chemistry
M.Sc. II Semester

CHIGT-2.4, SPECTROSCOPY

PROGRAMME OUTCOME

UNIT–I **16 hours**

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

PO1: Magnetic properties of nuclei (magnetic moment, g factor, nuclear spin).
PO2 :effect of external magnetic field on spinning nuclei, Larmor precessional frequency
PO3: resonance conditions, population of nuclear magnetic energy levels, relaxation processes,
PO4 :relaxation time, line width and other factors affecting line width.
PO5 : Chemical shift, reference standards employed in NMR,
PO6 :factors influencing chemical shiftelectronegativity(shielding and deshielding), anisotropic effect, vanderWalls deshielding,
PO7 :effect of restricted rotation, H-bonding.
PO8 : Nature of protons bonded to carbon and other nuclei, Proon integrals,
PO9 :spin-spin coupling-coupling constant, types of coupling,
PO10 : Karplus equations-variation of coupling constants with dihedral angle.

PO11 : Instrumentation-Frequency sweep instruments, field sweep instruments and pulsed FT-NMR instruments,
PO12 : Chemical equivalence and magnetic equivalence, proton exchange reactions.
PO13: First order spectra, non first order spectra,
PO14 :simplification of complex spectra- increasing magnetic field strength, double resonance, deuterium exchange reactions, and lanthanide shift reagents.
PO15 : Nuclear Overhauser Effect (NOE), variable temperature probe.
PO16 :^{13}C-NMR Spectroscopy: Comparison of ^{1}H-NMR and ^{13}C-NMR,
PO17 :proton decoupling or noise decoupling or broad band decoupling,
PO18 :chemical shift positions of carbon atoms in organic molecules.
PO19: Two dimensional NMR Spectroscopy: COSY, NOESY, DEPT Spectra and MRI.

UNIT–II **16 hours**

MASS SPECTROMETRY

PO20: Introduction, basic theory, instrumentation-single focusing, double focusing,
PO21: Quadrupole mass filter, TOF instruments. Methods of generation of positively charged ions-electron impact ionization,
PO22: Chemical ionization, fast atom bombardment(FAB), matrix assisted laser desorption ionization.
PO23: Resolving power, base peak, molecular ion peak, meta stable peak, isotopic peaks- calculation of percentage intensity of (m+1) and (m+2) peaks.

PO24: Exact molecular mass, molecular formula, hydrogen
PO25:deficiency index, preliminary analysis of structure.
PO26: Modes of fragmentation- fragmentation rules, McLafferty rearrangement, retro Diels-Alder reaction,
PO27: Ortho effect, fragmentation of following class of organic compounds – alkanes, alkenes, alcohols,
PO28:aldehydes, ketones, carboxylic acids, amino compounds.

Combined applications of spectroscopic techniques

PO29: Combined applications of IR, UV-Visible, 1H NMR, 13C NMR and Mass spectrometry in the structural elucidation of organic compounds.Structure analysis when spectral data of the organic compound is given.
PO30: Structure analysis when spectra of organic compound are given

COURSE SPECIFIC OUTCOME

UNIT–I

CO1: Introducing the student toMagnetic properties of nuclei (magnetic moment, g factor, nuclear spin).
CO2 : Students learn about effect of external magnetic field on spinning nuclei, Larmor precessional frequency
CO3: Knowledge will be gained aboutresonance conditions, population of nuclear magnetic energy levels, relaxation processes.

CO4 : Acquiring knowledge about relaxation time, line width and other factors affecting line width.
CO5 : Students gain an insight aboutChemical shift, reference standards employed in NMR,
CO6 : Learning aboutfactors influencing chemical shiftelectronegativity(shielding and deshielding), anisotropic effect, vander Walls deshielding by the students.
CO7 : Gaining knowledge about effect of restricted rotation, H-bonding by the students.
CO8 : Students learn about Nature of protons bonded to carbon and other nuclei, Proon integrals,
CO9 : Spin-spin coupling-coupling constant, types of coupling will be learnt by student
CO10 : Students learn about Karplus equations-variation of coupling constants with dihedral angle.
CO11 : Getting knowledge aboutInstrumentation-Frequency sweep instruments, field sweep instruments and pulsed FT-NMR instruments by the students.
CO12 : Students shall understand aboutChemical equivalence and magnetic equivalence, proton exchange reactions.
CO13: Student acquire an insight aboutFirst order spectra, non first order spectra,
CO14 : Students gain competetance insimplification of complex spectra- increasing magnetic field strength, double resonance, deuterium exchange reactions, and lanthanide shift reagents.
CO15 : Learning the concept of Nuclear Overhauser Effect (NOE), variable temperature probe by the student
CO16 : Gaining knowledge about ^{13}C-NMR Spectroscopy:Comparison of ^{1}H-NMR and ^{13}C-NMR,
CO17 : Student shall be able to understand Proton decoupling or noise decoupling or broad band decoupling,
CO18 : Learning about chemical shift positions of carbon atoms in organic molecules by the students,
CO19: Gaining knowledge aboutTwo dimensional NMR Spectroscopy: COSY, NOESY, DEPT Spectra and MRI by the students.

UNIT–II

CO20: Students get introduced to mass spectrometry and its instrumentation.
CO21: Students gain knowledge about Quadrupole mass filter, TOF instruments. Methods of generation of positively charged ions-electron impact ionization,
CO22: Students acquire knowledge about Chemical ionization, fast atom bombardment(FAB), matrix assisted laser desorption ionization.
CO23: Resolving power, base peak, molecular ion peak, meta stable peak, isotopic peaks- calculation of percentage intensity of (m+1) and (m+2) peaks will be learnt by student.
CO24: Students gain an insight about Exact molecular mass, molecular formula, hydrogen
CO25: Student learn to calculatedeficiency index, preliminary analysis of structure.
CO26: Students gain an knowledge about Modes of fragmentation- fragmentation rules, McLafferty rearrangement, retro Diels-Alder reaction,

CO27: Students learn about Ortho effect, fragmentation of following class of organic compounds – alkanes, alkenes, alcohols,
PO28: Fragmentation ofaldehydes, ketones, carboxylic acids, amino compounds will be learnt by students
Combined applications of spectroscopic techniques
CO29: Students gain competence in solvingproblems onCombined applications of IR, UV-Visible, ^{1}H NMR, 13C NMR and Mass spectrometry in the structural elucidation of organic compounds.Structure analysis when spectral data of the organic compound is given.
CO30: Students gain competence in solving problems onStructure analysis when spectra of organic compound are given.

PG Department of Chemistry
M.Sc. III Semester

CHORT-3.1 : ORGANIC CHEMISTRY-IIIA

PROGRAMME OUTCOME

UNIT–I **16 hours**

NATURE AND BONDING IN ORGANIC MOLECULE

PO 1: Delocalized chemical bonding, conjugation, cross conjugation, resonance, hyper-conjugation, bonding in fullerenes.
PO 2: Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, energy level of π-molecules orbitals.
PO 3: Annulenes, antiaromaticity, homoaromaticity.
Aromatic character and chemistry of cyclopentadienyl anion, tropylium cation, tropone and tropolone.
PO 4: Bonds weaker than covalent-addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.
PO 5: Synthetic applications of enamines and imines anions in organic synthesis, phase transfer catalysis, crown ethers and graphene.

UNIT–II **16 hours**

PHOTOCHEMISTRY

PO 6: Interaction of radiation with matter, types of excitation, rate of excited molecules, quenching, quantum efficiency, quantum yield, transfer of excitation energy,actinometry.

PO 7: Singlet and triplet states, experimental methods in photochemistry of carbonyl compounds, and transition, Norrish type I and Norrish type II reactions.
PO 8: Paterno–Buchi reaction, photoreduction, photochemistry of enones, hydrogen abstraction rearrangement of unsaturated ketones and cyclohexadienones.
PO 9: Photochemistry of p-benzoquinones, photochemistry of aromatic compounds with reference to isomerization, addition and substitution, photochemical isomerization of cis and trans alkenes.
PO 10: Photo-Fries rearrangement, Barton reaction, Hoffmann-Loefler-Freytag reaction, photochemistry of vision.

UNIT–III **16 hours**

PERICYCLIC REACTIONS

PO 11: Pericyclic Reactions: Classification of pericyclic reactions, molecular orbital symmetry, frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene, allyl system.
PO 12: Woodward-Hoffman correlation diagram method and Perturbation of molecular orbital (PMO) approach of pericyclic reaction under thermal and photochemical conditions, FMO and PMO approach to the following reactions.
PO 13: Electrocyclic reactions- Con rotatory and dis rotatory ring closure 4n and 4n+2 and allylic systems, Woodward and Hoffmann selection rules for pericyclic reactions.
PO 14: Cycloadditions reactions - Antrafacial and suprafacial additions, more emphasis on [2+2] and [4+2] Cycloadditions, Diels-Alder reaction, 1,3-dipolar cycloaddition reactions.
PO 15: Sigmatropic rearrangements: Antrafacial and suprafacial shift involving carbon moieties, retention and inversion of configuration.

UNIT–IV **16 hours**

DYNAMIC STEREOCHEMISTRY

PO 16: Prochirality: Homotopic, heterotopic, enantiotopic and diastereotopic ligands and faces, identification using addition, substitution and symmetry criteria.
PO 17: Nomenclature of stereoheterotopic ligands and faces, symbols for stereoheterotopic ligands in molecules with one or more prochiral centres, chiral and prochiral centre
PO 18: Prochiral plane, symbols for enantiotopic and diastereotopic faces.
PO 19: Dynamic Stereochemistry: Stereoselectivity in organic synthesis: stereospecific and stereoselective reactions, principle of stereoselectivity-enantioselectivity and diastereoselectivity.
PO 20: Use of chiral reagents, Cram's and Prelog's rules, stereoselectivity in addition, elimination, substitution reactions, Ene, Claisen and Cope reaction.

COURSE SPECIFIC OUTCOME

UNIT-I

CO 1: Able to understand Delocalized chemical bonding, conjugation and hyperconjugation.
CO 2: Able to learn aromaticity, antiaromaticity in organic molecules.
CO 3: Understood aromaticity of annulenes.
CO 4: Able to understand bonds weaker than covalent-addition compounds.

CO 5: Students acquire the knowledge of synthetic applications of enamines and imines anions in organic synthesis, phase transfer catalysis, crown ethers.

UNIT-II

CO 6: Learnt Interaction of radiation with matter, types of excitation

CO 7: Learnt Norrish type I and Norrish type II reactions and its applications.
CO 8: Able to understand Paterno–Buchi reaction, photoreduction, photochemistry of enones
CO 9: Have understood photochemistry of p-benzoquinones, photochemistry of aromatic compounds
CO 10: Learnt about different types of photochemical reactions.
UNIT-III

CO 11: Able to interpret the molecular orbital symmetry, frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene, allyl systems.
CO 12: Have understood FMO and PMO approach. of pericyclic reaction under thermal and photochemical conditions.
CO 13 : Students acquire the knowledge of Electrocyclic reactions.
CO 14 : Learnt about Cycloadditions reaction like Diels-Alder reaction, 1,3-dipolar cycloaddition reactions.
CO 15: . On the completion of the course students will have the understanding of basics of Sigma tropic rearrangements reactions. Various theories/rules governing these reactions will help them to predict the products with stereochemistry involved in these reactions.
UNIT-IV

CO 16: Understood prochirality, ligands and faces

CO 17: Students acquire the knowledge of nomenclature of stereoheterotopic ligands and faces. symbols for stereoheterotopic ligands in molecules with one or more prochiral centres, chiral and prochiral centre **.**
CO 18: Able to interpret**:** prochiral plane, symbols for enantiotopic and diastereotopic faces.
CO 19: Learnt about different types of stereospecific and stereoselective reactions, principle of stereoselectivity-enantioselectivity and diastereoselectivity.
CO 20: Have understood Cram's and Prelog's rules, Ene, Claisen and Cope reactions.

PG Department of Chemistry
M.Sc.III Semester

CHOT 3.2, ORGANIC CHEMISTRY

PROGRAMME OUTCOME

UNIT-I **16 hours**

CARBOHYDRATES

PO1: Definition, classification, constitution of glucose and fructose(open chain and ring structure)
PO2: Inter conversion–aldose to ketose and ketose to aldose
PO3:chain lengthening and chain shortening of aldoses, epimerisation.(conversion of glucose to mannose)

PO4:mechanism of mutarotation, conformations of monosaccharides, anomeric effect, Hudson's rules, epimerization.
PO5: Synthesis, industrial and biological importance of glycosides and amino sugars.
PO6: Disaccharides - Elucidation of structure of maltose and sucrose.
PO7: Polysaccharides-structural elucidation of starch, structure of cellulose, glycogen, importance of starch, cellulose and glycogen as energy and structural materials
PO8: structure and importance of chitin and insulin.

UNIT-II **16 hours**

AMINO ACIDS, POLYPEPTIDES, PROTEINS **AND NUCLEIC ACIDS**

PO9: Amino acids: Introduction, classification, structure, methods of synthesis (Gabriel phthalimide, malonic ester, Strecker method) and physical properties.
PO10: Polypeptides: synthesis of polypeptides- Use of blocking agents, Bruce-Merrifield synthesis of polypeptides.
PO11: Proteins: structure of proteins, Primary secondary, tertiary and quaternary structure, end group analysis(Edman's and Sanger's methods), biological importance of proteins.
PO12: Nucleic acids: Introduction, classification, components of nucleic acids, structures and synthesis of nucleosides and nucleotides, Watson-Crick model of DNA, role of DNA and RNAs in protein synthesis, genetic code-salient features.

UNIT-III **16 hours**

ANTHOCYANINS CAROTENOIDS AND PORPHYRINS

PO13: Anthocyanins: Classification, method of isolation, basic structural features of anthocyanins
PO14: Structural elucidation of cyanin chloride, pelargonin chloride, delphonin chloride.
PO15: Structural elucidation of quercetin and wedelactone (synthesis not included).
PO16: Carotenoids: Methods of isolation. Structural relationship of α-, β- and γ-carotenes. Structure elucidation and synthesis of β-carotene.
PO17: Porphyrins: Structure elucidation and synthesis of haemin, chlorophyll-a.

UNIT-IV **16 hours**

OILS, FATS AND LIPIDS

PO18: Oils, fats and waxes: Definition, chemical composition,
PO19: Chemical properties-hydrogenation, hydrogenolysis, hydrolysis, drying oils, rancidity, analysis of oils.
PO20: fats-saponification value, iodine and acid value.
PO21: Soaps-Manufacture of soaps by hot process, cleansing action.
PO22: Synthetic detergents, comparison of soaps and detergents, types of detergents (cationic, anionic and nonionic).
PO23: Animal and plant waxes-composition, examples.
PO24: Lipids: Sphingolipids, phospholipids and glyco1ipids,
PO25: naturally occurring fatty acids and their triglycerides, essential fatty acids, unusual fatty acids,
PO26: methods of isolation: Gunstone's partition method,

PO26: reactions of fatty acids-Fischer and trans esterification,
PO27: oxidation and acyl group transfer reactions,
PO28: analytical values-cetane number, emulsions and biodiesel.

COURSE SPECIFIC OUTCOME

UNIT-I

CO1: Students acquire knowledge on definition, classification, constitution carbohydrates (open chain and ring structure)
CO2: Inter conversion will be learnt by the student
CO3:Knowledge on step up and step down reaction of carbohydrates will be aquired by student
CO4:Students learn various mechanisms and rules applied to carbohydrates
CO5: Importance (synthesis and biological importance) of glycosides and amino sugars will be learnt by the students.
CO6: Students acquire knowledge on Disaccharides
CO7: Students learnPolysaccharides with few examples and their importance.
CO8: Structure and importance of chitin and insulin will be learnt by the student

UNIT-II

CO9: Students become competant on the concept of amino acids and various methods of synthesis.
CO10: Aquiring knowledge on polypeptides, synthesis and use of blocking agents.
CO11: Learning about proteins structure and importance of proteins,(Edman's and Sanger's methods).
CO12: Students gain an insight on Nucleic acidscomponents of nucleic acids, structures and synthesis of nucleosides and nucleotides, Propsed model of DNA and its role in genetic code and protein synthesis.

UNIT-III

CO13: Acquiring insights on Anthocyanins and their features.
CO14: Students gain competance inStructural elucidationof few anthocyanins
CO15: Structural elucidation of few flavones will be learnt by the students.
CO16: Students gain knowledge on Carotenoids and their synthesis.
CO17: Students learn porphyrins and their synthesis.

UNIT-IV

CO18: Students get intoduced to Oils, fats and waxes
CO19: Chemical properties of oils will be learnt by students
CO20: Students gain competance on variousvanalytical values of oils and fats.
CO21: Soaps and their characterization will be learnt by students.
CO22: Students will be able to learnSynthetic detergents,

CO23: Gaining an insight on waxes with examples.
CO24: Few examples and classification of lipids will be learnt by students.
CO25: Students will be able to understand about naturally occurring fatty acids a
CO26: Students gain competance uponmethods of isolation of oils and fats
CO26: Students gain knowledge on reactions of fatty acids
CO27: Students gain knowledge on reactions of fatty acids- oxidation and acyl group transfer reactions,
CO28: Knowledge will be gained on analytical values by the students.

CHORPr-3.6 : ORGANIC CHEMISTRY-IIIB

Total hours : 64

MULTISTEP **ORGANIC PREPARATION**

01. Preparation of 2-bromo-3-phenyl propionic acid from cinnamic acid.
02. Preparation of anthralinic acid from phthalimide.
03. Preparation of p-chlorotoluene from p-toluidine.
04. Preparation of benzophenoneoxime and its rearrangement to benzanilide.
05. Preparation of adipic acid from cyclohexanol.
06. Preparation of methyl red from anthralinic acid.
07. Preparation of benzopinacolone from benzophenone.
08. Preparation of 6,8-nitro-4-methyl-7-hydroxycoumarine from resorcinol.
09. Preparation of benzocaine from p-nitrotoluene.
10. Preparation of β-anilino-β-phenyl propiophenone from acetaphenone and benzaldehyde.

Course specific outcome

Students acquire all essential practical skills and learn techniques through Multistep preparations, estimations, extractions, separations, isolations, distillations, chemical and spectral characterization which provides deeper understanding of subject and confidence for implementation of newer ideas helping them to pursue higher education and R&D activities.

PG Department of Chemistry
M.Sc.III Semester

CHOT 3.3, ORGANIC CHEMISTRY

PROGRAMME OUTCOME

UNIT–I **16 hours**

ELECTRON SPIN RESONANCE SPECTROSCOPY

PO1: Basic principle interaction between spin and magnetic field,

PO2: origin of spectral line-intensity, width and position of spectral lines, relaxation process, multiplicity in ESR,
PO3: hyperfine splitting, g-value and factor affecting.
PO4: Rules for interaction of spectra, zero field splitting and Krammer's degeneracy,
PO5: John-Teller distortion, isotropic and anisotropic coupling constants, nuclear quadrupole coupling interaction, spin hamiltonian,
PO6: ESR spectra of radical containing a single set of equivalent protons-methyl, p-benzoquinone, cyclopentadienyl, benzene.
PO7: ESR spectra of transition metal complexes, applications.

UNIT–II **16 hours**

NUCLEAR QUADRUPOLE RESONANCE and MOSSBAUER SPECTROSCOPY

PO8: Nuclear quadrupole resonance spectroscopy: Consequence of nuclear spin larger than ½, prolate and oblate nucleus.
PO9: Nuclearquadrapolar charge distribution-theory and instrumentation, relationship between electric field gradients and molecular structure.
PO10: applications and interpretation of eQq data, effect of crystal lattice on the magnitude of eQq, structural information from NQR spectra.
PO11: Mossbauer spectroscopy: Theory and principles.

PO12: Experimental methods, isomer shift, quadrapole interactions,
PO13: Electron density, magnetic interactions;
PO14: Time and temperature dependent effect,
PO15: Application-Iodine trihalides, Prussian blue, trisirondodecacarbonyl, tin halides, hexacyano ferrate and nitroprussides.

UNIT–III **16 hours**

FLAME EMISSION and CHIROPTICAL SPECTROSCOPY

PO16: Flame emission spectroscopy: Introduction, types of spectra.

PO17:types of emission spectra, principle, instrumentation, delivery of sample.
PO18: Flames, excitation profiles in flames, chemical reactions in flames.
PO19: Types of fuels and oxidants, flame temperatures.
PO20: Total consumption and premix burners, factors influence intensity of emitted radiation.
PO21: interferences in flame emission spectra, applications both qualitative and quantitative.
PO22: Chiroptical **spectroscopy:** Introduction, Polarized light,
PO23: Types of polarized light, optical activity, Specific rotation.
PO24: instrumentation of Polarimeter, optical rotary dispersion (ORD) and Circular Dichroism, difference between CD and ORD.
PO25: applications of CD and ORD, cotton effect, plane curves,
PO26: anomalous curves, octant and haloketone rules.
PO27: applications in the determination of conformation of cyclic and steroidal ketones.

PO28: application of optical rotation method in the determination of rate constants acid catalyzedmuta-rotation of glucose and inversion of cane sugar.

UNIT–IV **16 hours**

MOLECULAR LUMINESCENCE and PHOTOELECTRON SPECTROSCOPY

PO29: Molecular luminescence spectroscopy: Theoretical basis for the fluorescence and phosphorescence. Singlet and triplet excited states.

PO30: Variables affecting luminescence-quantum efficiency, transition types, structure and structural rigidity, temperature and solvent effects, effect of pH, dissolved oxygen and concentration effect.

PO31: Excitation and emission spectra us emission spectra. Fluorescence instrumentation- fluorophores and spectrofluorometers.

PO32: Sensitivity and selectivity. Modification necessary to measure phosphorescence. General scope of applications of luminescence.

PO33: Photoelectron spectroscopy: Introduction, principles, chemical shifts photoelectron spectra of simple molecules

PO34: X-ray photoelectron and Auger electron spectroscopy, applications.

COURSE SPECIFIC OUTCOME

UNIT–I

CO1: Students get introduced to electron spin resonance spectroscopy.

CO2: Interpretation of the width and position of spectral lines and multiplicity.

CO3: Students gain an insight on splitting and g factor.

CO4: Knowledge of rules of spectra will be learnt by students.

CO5: Gaining an insights on few effects in ESR spectroscopy by students

CO6: Learning about the interpretation of the spectra of radicals with few examples

CO7: Students will be competent with the application of ESR spectra of transition metal complexes

UNIT–II

CO8: Getting introduced to Nuclear quadrupole resonance spectroscopy for prolate and oblate nucleus.

CO9: Students gain insight on theory and instrumentation of NQR.

CO10: Students will gain fundamental knowledge about applications of NQR.

CO11: Students will gain fundamental knowledge about Mossbauer spectroscopy: Theory and principles.

UNIT–III

CO16: Exposure to fundamental concepts of Flame emission spectroscopy.

CO17: Gaining knowledge about principle and instrumentation.

CO18: Students understand about Flames and their various reactions.

CO19: Acquiring knowledge abouttypes of fuels and oxidants, flame temperatures.

CO20: Students learn about factors influence intensity of emitted radiation.

CO21: Knowledge gained aboutinterferences and applications
CO22: Introducing to Chiroptical spectroscopy
CO23: Types of polarized light, optical activity, Specific rotation will be learnt by the students
CO24: Gaining an insight aboutinstrumentation of Polarimeter (ORD) and Circular Dichroism.
CO25: Students shall study applications of CD and ORD and effects.
CO26: Students shall learn anomalous curves, octant and haloketone rules.
CO27: Acquiring knowledge onapplications in the determination of conformation of cyclic and steroidal ketones.
CO28: gaining an insight on application of ORD by applying to a specific example.
UNIT–IV
CO29: Introduction to Molecular luminescence spectroscopy
CO30: Knowledge will be imparted on Variables affecting luminescence.
CO31: Student shall compare spectra and understand and interpret the spectra and learn about instrumentation.
CO32: Sensitivity and selectivity of phosphorescence and fluoroscence and general applications will be focused upon.
CO33: Introduction to Photoelectron spectroscopy and dealing with simple molecule spctra.
CO34: Students will gain competance with principles of X-ray photoelectron and Auger electron spectroscopy, and their applications applications.

PG Department of Chemistry
M.Sc. IV Semester

CHOT-4.1 ORGANIC CHEMISTRY

PROGRAMME OUTCOME

UNIT-I **16 hours**

MEDICINAL CHEMISTRY

PO 1: Introduction, definition of drug, requirements of drugs, chemotherapy, pharmacokinetics, pharmacodynamics, metabolites and anti metabolites.
PO 2: Prodrug and soft drugs, agonists and anti-agonists, concept of drug receptor, elementary treatment of drug receptor interactions.
PO 3: Theories of drug activity-occupancy theory, rate theory, induced fit theory, classification of drugs.

PO 4: Sulphonamides: Introduction, classification, synthesis and SAR studies of sulphathiazole, sulphanilamide, sulphadiazine. **Antimalarials:** Introduction, classification, synthesis and drug action-Chloraquin and Pamaquin.

PO 5: Analgesics: Introduction, classification, synthesis and drug action-Paracetamol, Aspirin, Salol, Cinophen, Phenyl butazone, Antipyrine. **Anti-inflammatory:** Introduction, classification, synthesis and drug action-Indomethacin and ibuprofen.

UNIT–II **16 hours**

CHEMISTRY OF DYES

PO 6: Definition, requirements, theory of colour and constitution-chromophore-auxochrome theory, modern theory, classification of dyes-based on methods of dyeing, structure.

PO 7: Azo dyes: classification, synthesis and applications of acid azo dyes-methyl orange, basic azo dyes-Bismarck brown, direct azo dyes-Congo Red.

PO 8: Triphenylmethane dyes: synthesis and applications of malachite green, phenolphthalein, crystal violet. Cyanine dyes: synthesis and applications of quinoline blue, sensitol red.

PO 9: Fluorescent brightening agents, photographic sensitizers(cyanines), color photography(additive and subtractive process), chemistry of colour developers, instant colour processes.

UNIT–III **16 hours**

GREEN CHEMISTRY

PO 10: Concept of green chemistry, need for green chemistry, goals, limitations. Principles – Introduction, twelve principles.

PO 11: Synthetic methods-Concept of atom economy, concept of selectivity, use of auxillary substances, designing of synthetic methodologies, designing of products.

PO 12: Use of green solvents, catalytic reagents, analytical methodologies, energy requirements and mode of supply of energy to reactions- use of microwaves, use of sonification with examples.

PO 13: Designing of green synthesis-Choice of starting materials, reagents, catalysts-biocatalysts, polymer supported catalysts, choice of solvents.

PO 14: Green synthesis of adipic acid, catechol, paracetamol, acetaldehyde.

UNIT–IV **16 hours**

HETEROCYCLIC CHEMISTRY

PO 15: Nomenclature-Hantsz-Wiedmann nomenclature of simple and fused systems.

PO 16: 5-Membered heterocyclic compounds with one and two hetero atoms-furan, thiophene, pyrrole, imidazole, oxazoles, thiazoles.

PO 17: Fused hetereocycles: Synthesis, and chemical reactions of indole, quinoline, benzothiazole, benzimidazole, coumarin, chromones and flavones

COURSE SPECIFIC OUTCOME

UNIT-I

CO 1: Able to understand definition of drug, requirements of drugs, chemotherapy, pharmacokinetics, pharmacodynamics, metabolites and anti metabolites.

CO 2: Able to learn prodrug and soft drugs, agonists and anti-agonists, concept of drug receptor

CO 3: Able to understand theories of drug activity.

CO 4: Able to understand Introduction, classification, synthesis of sulphonamide and antimalarial drugs..

CO 5 Able to understand Introduction, classification, synthesis and mode of action of analgesics and anti-inflammatory drugs.

UNIT-II

CO 6: Students acquire the knowledge of basics and theories of dyes.
CO 7: Learnt about Azo dyes: classification, synthesis and its applications.
CO 8: Able to understand Triphenylmethane dyes classification synthesis and applications**.**
CO 9: Students acquire the knowledge of applications of dyes in Fluorescent brightening agents, photographic sensitizers(cyanines), color photography(additive and subtractive process), chemistry of colour developers, instant colour processes.

UNIT-III

CO 10: Learnt about , principles and concepts of green chemistry.
CO 11: Students acquire the knowledge of atom economy, concept of selectivity, use of auxillary substances, designing of synthetic methodologies, designing of products. .
CO 12: Students will now understand use of green solvents, catalytic reagents, analytical methodologies, use of microwaves, use of sonification.
CO 13 : Students will now be able to apply the principles of green chemistry to synthesise organic compounds by green methods.
CO 14 : Learnt about Green synthesis of adipic acid, catechol, paracetamol, acetaldehyde.

UNIT-IV

CO 15: Students acquire the knowledge ofHantsz-Wiedmann nomenclature of simple and fused systems
CO 16: Learntabout 5-Membered heterocyclic compounds their synthesis and reactions.
CO 17: Learnt about Fused hetereocyclic compounds their synthesis and reactions.

PG Department of Chemistry
M.Sc. IV Semester

CHOT-4.2 ORGANIC CHEMISTRY

PROGRAMME OUTCOME

UNIT-I **16 hours**

ALKALOIDS

PO 1: Definition, nomenclature and physiological action, occurrence, isolation.
PO 2: general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants.
PO 3: structure, stereochemistry, structural elucidation and synthesis of the following: ephedrine, (+)-conine, nicotine, atropine, quinine, structure and uses of reserpine and morphine.

UNIT-II **16 hours**

TERPENOIDS

PO 4: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule, structure .

PO 5:, structural elucidation and synthesis of the following representative molecules: citral, geraniol, α-terpeneol, menthol, zingiberene.

PO 6: structure and uses of farnesol, phytol, abietic acid.

UNIT–III **16 hours**

STEROIDS AND PROSTAGLANDINS

PO 7: Steroids: Introduction, classification and nomenclature, Diels hydrocarbon- its importance and synthesis, stereochemistry of cholesterol.

PO 8: Structural elucidation of cholesterol-Blanc's rule, location of double bond, hydroxy group, angular methyl groups and side chain in cholesterol, total synthesis.

PO 9: Prostaglandins: Introduction, classification and biological importance, structural elucidation of PGE1, synthesis of PGE1 by Corey's and Upjohn's approach.

UNIT-IV **16 hours**

ANTIBIOTICS, VITAMINS AND HORMONES

PO 10: Antibiotics: Introduction, classification, penicillins, chloramphenicol, streptomycin, chloromycitin and tetracyclins–structure and their importance.

PO 11: synthesis of cephalosporin-C, structural elucidation of Pencillin-G.

PO 12: Vitamins: Definition, Classification and biological importance, synthesis of vitamin C from D(+)-Glucose, synthesis of vitamin A.

PO 13: Hormones: Definition, Classification, Biological importance of hormones, synthesis of adrenaline and thyroxin.

COURSE SPECIFIC OUTCOME

UNIT-I

CO 1: Students understand nomenclature and physiological action, occurrence and isolation of alkaloids.

CO 2: Able to learngeneral methods of structure elucidation, degradation and classification of alkaloids.

CO 3: Able to understand general methods of structure elucidation and synthesis of alkaloids and their uses.

UNIT-II

CO 4: Students understand nomenclature, occurrence and isolation of terpenoids.

CO 5 Able to understand general methods of structure elucidation and synthesis of terpenoids.

CO 6: Students acquire the knowledge of some terpenoids and their uses.

UNIT-III

CO 7: Students acquire the knowledge ofnomenclature ,physiological action, occurrence and stereochemistryof cholesterol.

CO 8: Able to understand general methods of structure elucidation and synthesis of cholesterol.

CO 9: Students acquire the knowledge ofIntroduction, classification and biological importance, structural elucidation of PGE1 and synthesis of PGE1

UNIT-IV

CO 10: Learnt about Introduction, classification, penicillins, chloramphenicol, streptomycin, chloromycitin and tetracyclins–structure and their importance

CO 11: Students acquire the knowledge of synthesis of cephalosporin-C, structural elucidation of Pencillin-G.

CO 12: students will now understand Definition, Classification and biological importanceand synthesis of vitamins.

CO 13: Students acquire the knowledge of Definition, Classification and biological importanceand synthesis of hormones.

PG Department of Chemistry
M.Sc. IV Semester

CHOT-4.3 ORGANIC CHEMISTRY

PROGRAMME OUTCOME

UNIT–I **16 hours**

PESTICIDES AND INSECTICIDES

PO1: Introduction, classification, naturally occurring insecticides - rotanones, pyrethrins.

PO2: Synthetic insecticides: synthesis and properties of DDT, BHC,

PO3: Synthetic insecticides:chlordane, aldrine, malathion.

PO4: Introduction to the use of following in the control of pests and insects - fumigants, nematicides, acaricides,

PO5: Juvenile hormones, insect repellents, Molluscicides, rodenticides.

PO6: Insect pheromones: Introduction, classification, pheromones in pest control,

PO7: Syntheses of grandisol (component of boll weevil pheromone) and farenal (trail pheromone of pharaoh's ants).

UNIT–II **16 hours**

ORGANIC SYNTHESIS

PO8: Disconnection Approach: An introduction to synthons and synthetic equivalents, disconnection approach,

PO9: functional group inter-conversions, the importance of the order of events in organic synthesis,

PO10:one group C-X and two group C-X disconnections, chemoselectivity,

PO11: reversal of polarity, cyclization reactions, amine synthesis.

PO12: One Group C-C Disconnections: Alcohols and carbonyl compounds.

PO13: regioselectivity, alkene synthesis, use of acetylenes in organic synthesis.

PO14: Two Group C-C Disconnections: Diels-Alder reaction, 1,3-difunctionalised compounds.

PO15: α,β-unsaturated carbonyl compounds, control in carbonyl condensations.

PO16:1,5-difunctionalised compounds, Michael addition and Robinson annulations.

PO17: Retrosynthesis: Retrosynthesis of benzocaine, 4-methoxy acetophenone,

PO18: Retrosynthesis: Retrosynthesis of saccharin, bisavalone, cubane,

PO19: Retrosynthesis: Retrosynthesis of estrone, cantharidin and lycorane.

UNIT–III **16 hours**

PHASE TRANSFER CATALYSTS, CROWN ETHERS AND PROTECTING GROUPS

PO20: Phase transfer catalysis: Introduction, definition, mechanism of phase transfer catalysis.

PO21: Types of phase transfer catalysts and reactions and their advantages,

PO22:PTC in application in substitution, elimination

PO23:PTC in addition and alkylation reactions.

PO24: Crown ethers: Introduction, nomenclature, features

PO25: Nature of donor site, general synthesis of crown ethers.

PO26:Protecting Groups: Illustration of protection and deprotection in organic synthesis,

PO27: Protection of hydroxyl, carboxyl groups

PO28: Protection of carbonyl, thiol and amino groups.

PO29: Functional Group Interconversions(FGI).

UNIT –IV **16 hours**

REAGENTS IN ORGANIC SYNTHESIS

Use of the following reagents in organic synthesis and functional group transformation:

PO30: 01. Gilmann reagent 02. Lithium diisopropyl amide (LDA)

PO31:03. Dicyclohexylcarbodimide (DCC) 04. 1,3-Dithiane (reactivity umpolung)

PO32:05. Trimethylsilyl iodide 06. Tri-n-butyl tin hydride (TNBH)

PO33:07. DDQ 08. Woodward-Prevost hydroxylation

PO34:09. Osmium tetroxide 10. Peterson synthesis

COURSE SPECIFIC OUTCOME

UNIT–I

CO1: Students get introduced to insecticides and pesticides andclassification, and they learn about naturally occurring insecticides - rotanones, pyrethrins.

CO2: Students learn about Synthetic insecticides: synthesis and properties of DDT, BHC,

CO3: Knowledge aboutSynthetic insecticides:chlordane, aldrine, malathion will be gained.

CO4: Students get an insight aboutthe use of following in the control of pests and insects - fumigants, nematicides, acaricides,

CO5: Juvenile hormones, insect repellents,Molluscicides, rodenticides will be learnt by students.

CO6: An insight aboutInsect pheromones: Introduction, classification, pheromones in pest control shall be focused upon.

CO7: Students shall have a competence inSyntheses of grandisol (component of boll weevil pheromone) and farenal (trail pheromone of pharaoh's ants).

UNIT–II

CO8: Students shall be able to learn aboutDisconnection Approach: An introduction to synthons and synthetic equivalents, disconnection approach,

CO9: Variousfunctional group inter-conversions, the importance of the order of events in organic synthesis will be learnt by students

CO10: This part shall give an insight about one group C-X and two group C-X disconnections, chemoselectivity,
CO11: Knowledge about reversal of polarity, cyclization reactions, amine synthesis will be aquired.
CO12: Acquiring the concept of One Group C-C Disconnections: Alcohols and carbonyl compounds by the student.
CO13: Students shall be prepared forregioselectivity, alkene synthesis, use of acetylenes in organic synthesis.
CO14: Two Group C-C Disconnections: Diels-Alder reaction, 1,3-difunctionalised compounds will be learnt by students.
CO15: Students shall get an insight aboutα,β-unsaturated carbonyl compounds, control in carbonyl condensations.
CO16: 1,5-difunctionalised compounds, Michael addition and Robinson annulations will be focused upon by the students.
PO17: Application of Retrosynthesis: Retrosynthesis of benzocaine, 4-methoxy acetophenone will be studied by students.
CO18: Application of Retrosynthesis: Retrosynthesis of saccharin, bisavalone, cubane will be studied by students.
CO19: Application of Retrosynthesis: Retrosynthesis of estrone, cantharidin and lycorane will be studied by students.

UNIT–III

CO20: Students get introduced to Phase transfer catalysis:
CO21: Learning aboutTypes of phase transfer catalysts and reactions and their advantages by the students.
CO22: Gaining knowledge about PTC in application in substitution, elimination
CO23: Students shall get to study aboutPTC in addition and alkylation reactions.
CO24: Students get introduced toCrown ethers:
CO25: Nature of donor site, general synthesis of crown etherswill be learnt by students.
CO26: Students shall gain competence in Protecting Groups:Illustration of protection and deprotection in organicsynthesis.
CO27: Learning about Protection of hydroxyl, carboxyl groups by students.
CO28: Acquiring the knowledge aboutProtection of carbonyl, thiol and amino groups by students.
CO29: Gaining an insight aboutFunctional Group Interconversions(FGI) by the students

UNIT –IV

CO30: Students learn about Gilmann reagent, Lithium diisopropyl amide (LDA)
CO31: Gaining an insight about application ofDicyclohexylcarbodimide (DCC), 1,3-Dithiane (reactivity umpolung) by students.
CO32: Application ofTrimethylsilyl iodide, Tri-n-butyl tin hydride (TNBH) shall be studied by students.
CO33: Acquiring knowledge about DDQ, Woodward-Prevost hydroxylation by the students.
CO34: Competence shall be gained by students to apply Osmium tetroxide, Peterson reaction for various synthesis