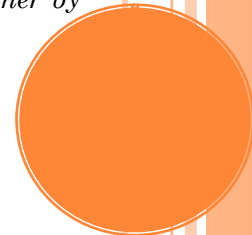


# BABA FARID GROUP OF INSTITUTIONS



*“Microbiology is the study of those life forms that are essentially unicellular and mostly too small to see with the naked eye. It is an exciting and rapidly developing area of the life sciences and underpins much of the molecular biology and medical developments that are revolutionizing our lives. Progress in our knowledge and understanding of life at this level has contributed to major developments in many areas of biology including genetics, biomedical science, pharmaceuticals, biotechnology, agriculture and ecology, environmental processes, indeed most of biology. A degree in microbiology will provide an excellent preparation for a variety of careers, including the Health Service, pharmaceuticals, medical diagnostics, environmental protection, teaching, scientific research and forensic science. Many recent students have gone on to pursue research (either by becoming a research assistant, or via an Mphil or PhD).”*

--Dr. Manish Shrivastav  
In-Charge  
Department of Microbiology



# **B.Sc. (Microbiology)-1<sup>st</sup> Year**

## **BOTANY Paper 1 :Fungi, Microbiology & Elementary Plant pathology.**

UNIT 1- 1: Brief history & Salient features of fungi.

2 :outline classification of alexopoulos & salient features of the important group.

3: Habit,habitat,structure,& method of reproduction of fungi based on the following representatives:

Stemonitis,Synchitrium,Saprolegnia,Mucor,Penicillium,Phyllactinia,Eurotium,Saccharomyces, Morchella,puccinia,agaricus,& Alternaria.

UNIT 2- 1: Distribution & Classification of the micro organisms

2 :Elementary principles of isolation & Purification of the micro organisms.

Identification & differentiation of bacteria on the basis of morphology & stains(negative staining ,gram's stain & Acid fast)

3:Decomposition of the organic matter in soil & the role of the micro organisms in carbon & nitrogen cycles in nature.

UNIT-3: 1) Fine structure of bacteria, their classification,nutrition & reproduction.Economic importance of bacteria.

2) Viruses : Nature,structure,transmission,multiplication & Economic importance.

Bacteriophages-A brief idea.

3) Mycoplasma: General account.

UNIT- 4 : 1) Lichens: Occurrence,Physiology(symbiotic relationship) & general structure.

2) Nutrition & reproduction in lichens with special reference to parmella.

3) Economic importance of lichens.

UNIT-5: 1) General symptoms of plant diseases/

2) General principles of infection & resistance.

3) General methods of chemical & biological control of the plant diseases.

4) The symptoms morphology of the causal organism,diseasecycle & control measures of the following diseases : Wheat rust of crucifers,Late blight of Potato,loose smut of Wheat,black rust of wheat,Wart disease of Potato & Red rot of sugarcane.

## **Botany Paper II Algae and Bryophytes**

Unit I

1. General characteristic of the group (algae) and its position in plant kingdom.

2. Classification of Algae, basic outline of Fritsch's and Smith's classification.

3. Elementary knowledge of organization of thallus in algae.

Unit II

1. Occurrence structure of thallus and mode of reproduction in the following genera: *Chlamydomonas*, *Volvox*, *Hydrodictyon*, *Cladophora*, *Oedogonium*, *Vaucheria* and *Chara*.

2 Ecology of Algae A brief idea of fresh water, marine and terrestrial algae, epiphyte, Parasite and symbiotic algae.

Unit III

1. Occurrence, structure and mode of reproduction of the following genera – *Sargassum*, *Ectocarp*, *Batrachospermum*, *Polysiphonia*.

2. Cyanobacteria : A general account of *Nostoc* and *Spirulina*.

3. Economic importance of Algae as food and fodder in agriculture, industries and public health.

Unit IV

1 Out line and basic principles of classification of the Bryophytes in accordance with the ICBN

- 2 Comparative account of the gross morphology anatomy vegetative and sexual reproduction development and structure of the saprophyte and mechanisms of spore dispersal based in *Riccia* and *Marchantia*
- 3 Habitat and distribution and economic importance of Bryophyte.

#### Unit V

- 1 Comparative account of the gross morphology anatomy vegetative and sexual reproduction development and structure of the saprophyte and mechanisms of spore dispersal based in *Anthoceros*
2. General account of the jungermanniales (*Pellia* and *Porella*), and Mosses (*Funaria* and *Pogonatum*).
3. A brief account of the alternation of generation in Bryophytes.

### **BOTANY Paper 3 : Pteridophytes, Gymnosperms & Elementary Palaeobotany.**

UNIT-1: 1) General characters of the pteridophytes & Classification as proposed by Pichi-Sermolli.

2) A comparative study of Rhynia, Selaginella, Equisetum, Adiantum, & on the basis of the following features : Morphology & Anatomy of the vegetative plant body & Spore producing organs (Strobilus, Sporocarp, Sporophyll, Sporangium & Spores.), sexual reproduction, male & female gametophytes, fertilization.

UNIT-2: 1) A brief account of Telome theory, Stellar system & its evolution.

2) Heterospory & Seed habit in pteridophytes.

3) Apogamy, Agamospory, Apospory in ferns.

UNIT-3: 1) Outlines of classification & distinguishing features of Gymnosperms.

2) Comparative account of the Structure, Life history & Evolutionary trends based on the following examples : Cycas, Pinus, Ephedra.

3) General Anatomy types of wood thickening tracheids, Medullary rays, pitting & resin canals, mesarch & pseudomesarch. Foliar bundles & stomata in three types.

UNIT-4: 1) Distribution of Gymnosperms in India

2) Economic importance of Gymnosperms.

UNIT-5: 1) Fossils : Process of fossilization & types of fossils.

2) A general idea about Geological Era.

3) Living fossils.

## **Zoology Paper-I Non-Chordata**

### UNIT-I

Introduction to Non-Chordata: General character; outline classification up to classes.  
Protozoa: Salient features; Study of *Amoeba*, *Euglena*, *Paramecium* and *Monocystis* With reference to structure, locomotion, nutrition and reproduction (life history)

### UNIT-II

Porifera: Salient features; Study of *Lecosolenia* and *Sycon* With reference to structure, locomotion, nutrition and reproduction (life history); Canal system in sponges, skeletal system. Coelenterata; Salient features; Study of *Obelia* and *Aurelia* With reference to structure, locomotion, nutrition and reproduction (life history); Polymorphism and alternation of generation in Coelenterates; Coral and Coral reefs  
Ctenophora: Salient features of *Beroë* and affinities with Cnidaria.

### UNIT-III

Helminthes: Salient features; Study of *Fasciola*, *Taenia* and *Ascaris* With reference to structure, locomotion, nutrition and reproduction (life history); and parasitic adaptation.

### UNIT-IV

Annelida: Salient features; Type and significance of coelom.  
Metamerism and its significance; Study of *Neries* and *Hirudinaria* With reference to structure, locomotion, nutrition and reproduction ; and parasitic adaptation of *Hirudinaria*. Trochophore larva and its significance  
Arthropoda: Salient features; Study of *Palaemon* and *Palamnaeus* With reference to structure, locomotion, nutrition and reproduction ; Zoological importance of *Peripatus* and *Limulus*.

### UNIT-V

Molluca: Salient features; Study of *Pila* and *Unio* With reference to structure, respiration and reproduction (life history) ; Torsion in Gastropoda, Pearl Formation Echinodermata; Salient features; body of *Asterias* with references to structure, locomotion, water vascular system, mode of feeding and reproduction.  
Echinoderm larva and the significance.

## **Zoology Paper-II Taxonomy, Evolution, Palaentology, Biostatistics & Computer**

### UNIT-I

Taxonomy: Definition and scope; relation with systematic  
Zoological nomenclature: Binomial and trinomial ICZN  
Methodology in Taxonomy.  
Component of classification: Linnaean hierarchy.  
Concepts of species: Typological, Nominalistic & Biological  
An elementary idea of Molecular taxonomy

### UNIT-II

Historical development of the concept of evolution.  
Theories of organic evolution: Lamarckism (Neo-Lamarckism); Darwinism (Neo-Darwinism), Modern synthetic theory.  
Evidence in favour of evolution: Comparative Embryology, Palaentology, Biochemistry & Genetics.

### UNIT-III

Palaentology: Fossils & fossilization. Dating fossils. Significance of fossil record.  
Geological distribution of animals. Period of evolution and extinction of major groups.  
Evolution of Horse.

#### UNIT-IV

Biostatistics as a tool in research.

Data collection: Random & non-random sampling.

Data tabulation; data presentation (Graph, histogram, Scatter diagram).

Calculation of Mean, Mode, Median and Standard Deviation and Standard error from given data. Introduction to concept of statistical significance.

#### UNIT-V

What is a computer. Capabilities and limitations of computers; component of computer (Input unit, Memory, central processing unit, out put unit).

Problem solving with computers. Elementary idea of memory (RAM, ROM).

Uses of computers in different fields. E.g. Biology, Medical, Environmental etc.

## **CHEMISTRY PAPER -1: INORGANIC CHEMISTRY**

### **1. Atomic structure**

Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of  $\psi$  and  $\psi^2$ , quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s,p,d orbitals, Aufbau and Pauli's exclusion principles, Hund's multiplicity rule, electronic configuration of the elements, effective nuclear charge.

### **2. Periodic properties**

Atomic and ionic radii, ionization energy, electron affinity and electron negativity-definition, methods of determination or evaluation, trends in periodic table and application in predicting and explaining the chemical behavior.

### **3. Chemical bonding**

a. covalent bond – valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, valence shell electron pair repulsion theory to  $\text{NH}_3$ ,  $\text{H}_3\text{O}^+$ ,  $\text{SF}_6$ ,  $\text{Cl}_3\text{F}$ ,  $\text{IF}_5$ ,  $\text{ClF}_3$  and  $\text{H}_2\text{O}$ . MO theory, homonuclear and heteronuclear ( $\text{CO}$  and  $\text{NO}$ ) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

b. Ionic solids- ionic structures, radius ratio effects and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, hydration energy and solubility of ionic solids, polarizing power and polarizability of ions, Fajan's rule, metallic bond-free electron, valence bond and band theories.

c. weak interactions- hydrogen bonding, van der Waals forces.

### **4. s-block elements**

Comparative study, diagonal relationship, salient features of hydrides, hydration and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls.

### **5. p-block elements**

Comparative study (including diagonal relationships) of group 13-17 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13-16, hydrides of boron-diborane borazines, borohydrides, carbides, fluorocarbons, tetrasulfur, tetranitrides, basic properties of halogens, interhalogens and poly halides

### **6. Chemistry of noble gases**

Chemical properties of noble gases, chemistry of xenon, structure and bonding in xenon compounds.

### **7. Metallurgical processes**

Minerals and ores, general metallurgical operations viz. concentration of ores, calcinations, roasting, smelting, slag and flux, extraction and refining of metals, chemistry of extraction and isolation of lithium and beryllium.

## **CHEMISTRY PAPER-II: ORGANIC CHEMISTRY**

### **1. Structure and bonding**

Hybridization, bond lengths and bond angles, bond energy localized and delocalized chemical bonds, van der Waals interactions, inclusion compounds, clathrates, charge transfer complexes, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding

### **2. Mechanism of organic reactions**

Curved arrow notation, drawing electronic movements with arrows, half headed and double headed arrows, homolytic and heterolytic bond breaking. Types of reagents- electrophiles and

nucleophiles. Types of organic reactions. Energy considerations. Reactive intermediates – carbocations and carbonions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species. Methods of determination of reaction mechanism (product analysis, intermediate, isotopic effects, kinetic and stereochemical studies).

### **3. Stereochemistry of organic compounds.**

Concept of isomerism. Types of isomerism, optical isomerism, elements of symmetry, molecular chirality, enantiomers, stereogenic centers, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion retention and racemisation, relative and absolute configuration, sequence rules, D&L and R&S systems of nomenclature. Geometric isomerism- determination of configuration of geometrical isomers, E & Z System of nomenclature, geometric isomerism in oximes and alicyclic compounds.

Conformational isomerism-conformational analysis of ethane and n-butane, conformations of cyclohexane derivatives. NEWMAN PROJECTION AND SAWHORSE FORMULAE, Fischer and flying wedge formulae. Difference between configuration and conformation.

### **4. Alkanes and cycloalkanes**

IUPAC nomenclature of branched and unbranched alkanes, alkyl groups, classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey-Gouse reaction and decarboxylation of carboxylic acids), physical properties and chemical reactions of alkanes. Mechanism of free radical halogenations of alkanes: orientation, reactivity and selectivity.

Cycloalkanes- nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Ring strain of small rings (cyclopropanes and cyclobutane). Theory of strainless rings, the case of cyclopropane ring – banana bonds.

### **5. Alkenes, cycloalkenes, dienes and alkynes.**

Nomenclature of alkenes, methods of formation, mechanism of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule, Hoffmann elimination. Physical properties and relative stability of alkenes

Chemical reactions of alkenes-mechanism involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration oxidation, oxymercuration reduction, Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with  $\text{KMnO}_4$  Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propane.

Methods of formation, conformation and chemical reaction of cycloalkenes. Nomenclature and classification of dienes: isolated, conjugate and cumulated dienes, Structure of allenes and butadiene, methods of formation, Polymerization Chemical reactions-1,2 and 1,4 additions, Diels-Alder reaction.

Nomenclature, structure and bonding in alkynes: Methods of formation. Chemical reaction of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reaction, Hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization.

### **6. Arenes and Aromaticity**

Nomenclature of benzene derivatives. The aryl group. Aromatic nucleus and side chain. Structure of benzene: molecular formula and Kekulé structure. Stability and carbon-carbon bond length of benzene, resonance structure, MO picture. Aromaticity-the-Huckel rule, aromatic ions.

Aromatic electrophilic substitution-general pattern of the mechanism, role of  $\pi$  and  $\sigma$  complexes. Mechanism  $\pi$  complexes. Mechanism of nitration, halogenations, sulphonation, mercuriation

and Friedel Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Birch reduction. Method of formation and chemical reaction of alkylbenzenes, alkynylbenzenes and biphenyl.

### **7. Alkyl and Aryl Halides**

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanism of nucleophilic substitution reaction of alkyl halides,  $S_N2$  and  $S_N1$  reactions with energy profile diagrams.

Polyhalogen compounds-chloroform, carbon tetrachloride.

Methods of formation of aryl halides, nuclear and side chain reaction. The additional elimination and the elimination addition mechanism of nucleophilic aromatic substitution reactions.

Relative reactivities of allyl, vinyl and aryl halides. Synthesis and uses of DDT and BHC.

## **CHEMISTRY PAPER –III : PHYSICAL CHEMISTRY**

### **1. Gaseous States**

Postulate of kinetic theory of gases, deviation from ideal behaviour, vander waals equation of state. Critical phenomena-PV isotherms of real gases, continuity of states, the isotherms of vander waals equation, relationship between critical constant and vander waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases(based on Joule Thomson effect).

### **2. Liquid State**

Intermolecular forces, structure of liquids(a qualitative description). Structure of liquids and gases. Physical properties of liquids including their methods of determination(surface tension, viscosity and refractive index). Liquid crystal-difference between liquid crystal, solid and liquid.

### **3. Solid state**

Definition of space lattice, unit cell crystal planes, Miller indices.

Laws of crystallography-(i) law of constancy of interfacial angles (ii) law of rationality of indices (iii) law of symmetry. Symmetry elements in crystals.

X-ray diffraction by crystal, Derivation of Bragg equation. Determination of crystal structure of NaCl, KCl and CsCl(Laue's method and powder methods).

### **4. Colloidal State**

Definition of colloids, classification of colloids.

Solids in liquids (sols): properties-Kinetic, Optical and electrical, stability of colloids, protective action, Hardy-schulze law, gold number. Liquids in liquids(emulsions): type of emulsions, preparation.emulsifier.

Liquids in solids (gels): classification, preparation and properties, inhibition, general applications of colloids.

### **5. Chemical Kinetics and Catalysis**

Chemical Kinetics and its scope, rate of reaction, factors influencing the rate of a reaction-concentration, pressure, solvent, light, catalyst. Concentration dependence of rates, mathematical characteristics of simple chemical reaction-zero order, first order,



second order, pseudo order, half life and mean life. Determination of the order of reaction-differential method, method of integration, method of half life period and isolation method, concept of activation energy. Radioactive decay as a first order phenomenon. Catalysis, characteristics of catalysed reaction, classification of catalysis, miscellaneous examples.

## **6. Thermodynamics**

Definition of thermodynamic terms, system, surrounding etc. Types of systems, intensive and extensive properties, state and path function and their differentials, intensive and extensive thermodynamic process, concept of heat and work.

First law of thermodynamics, statement, definition of internal energy and enthalpy. Heat capacity-heat capacities at constant volume and pressure and their relationship, Joule's law. Joule's Thomson coefficient and inversion temperature, Calculation of  $w$ ,  $q$ ,  $dU$  &  $dH$  for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

Thermochemistry-standard state, standard enthalpy of formation Hess's law of heat summation and its applications, heat of reaction at constant volume. Enthalpy of neutralization, bond dissociation energy and its calculation from thermochemical data, temperature dependence of enthalpy, Kirchoff's equation.

## **SPECIALIZATION (MICROBIOLOGY)**

### **Paper -1 General microbiology.**

#### **Unit 1-**

History of microbiology , scope of microbiology, prokaryotic and eukaryotic cell structure, place of microorganism in the biological world, general classification of microbial world, bacteria cyanobacteria ,Archaea. Actinomycetes, fungi algae and protozoa.

#### **Unit -2**

Pure culture and cultural characteristic: Control of microorganism, microorganism culture media, pure culture technique for microorganism, aerobic and anaerobic cultivation, staining techniques, maintenance and preservation of microorganisms.

#### **Unit -3**

Morphology and ultra-structure of bacteria ; size, shape, cell wall, cell membrane , pilli. Flagella cyst, spore. Bacterial genome and plasmid , specialised bacterial organelles: gas vesicles magnetosomes carboxysomes reserve food material, nutritional classification ,bacterial growth and reproduction.

#### **Unit -4**

Fungi: Habitat fungal structure and thallus organisation , wall structure hyphal growth sexual and asexual reproductive structures general classification fungal growth and reproduction. Algae: General account of habitat, cell structure , pigments, flagellum, reserve food and silent feature of classification . Algal growth and reproduction.

#### **Unit-5**

Nature and definition of viruses. Structure and cultivation of viruses , viral taxonomy, viral multiplication, plant and animal viruses, bacterial viruses, prions, antiviral drugs.

Suggested Reading :

1. Dubey, R.C.& D.K.Maheshwari. A text Book of Microbiology. S.Chand & Co. New Delhi.
2. Pelczar, M.J...E.C.S. Chan & N.R. Krieg. Microbiology. Tata Mc Graw Hill.
3. Prescott. L.J.. J.P.M. Harley & A.D.Klein. Microbiology .Tata McGraw Hill.

### **Paper -2 Instrumentation and techniques in Microbiology.**

#### **Unit-1**

Principle, basic apparatus, types and application of Ph meter, laminar air flow cabinet. Anaerobic chamber and autoclave Structure and function of industrial fermenters.

#### **Unit-2**

Principle, basic apparatus and applications of simple microscope, compound microscope, fluorescent microscope, phase contrast microscope, transmission electron microscope and scanning electron microscope .

#### **Unit-3**

Principle, basic apparatus and applications of paper chromatography, thin layer chromatography. Column chromatography, gas chromatography (GC) and high pressure liquid chromatography (HPLC).

#### **Unit-4**

Principle, basic apparatus and applications of flame photometer, spectrophotometer atomic absorption spectrophotometer and scintillation counter.

#### **Unit-5**

Principle, basic apparatus and application of electrophoresis, thermocyclar (PCR) and its types. Centrifuge and its types, blotting techniques, ELISA and RIA.

Suggested readings;

1. Pelczar, M.J.E.C.S. Chan. N.R.Kreig . Microbiology . McGraw Hill.

2. Prescott, L.J., J.P.M. Harley & A.D. Klein. Microbiology. Tata McGraw hill.
3. Sharma, B.K. Instrumental methods of chemical analysis. S. Chad & co.

# **B.Sc. (Microbiology)-2<sup>nd</sup> Year**

## **BOTANY PAPER-I TAXONOMY OF ANGIOSPERMS**

### UNIT I

Angiosperm origin and evolution. Some example of primitive angiosperms. Angiosperm taxonomy fundamental components.

Historical development in plant taxonomy in pre linneus and post linneus periods.

Comparison and evolution of the system of classification as proposed by Linneus, Bentham-Hooker and Hutchinson.

### UNIT II

Nomenclature: International code of botanical nomenclature(ICBN), history, scientific names of plants and priority types , validity, nomina conservanda.

Collection and preservation of plant specimen technique for herbarium and museum.

Botanical gardens and herbaria. A brief idea of Botanical Survey Of India.

### UNIT III

Taxonomy, important distinguishing features classification and economic importance of following families.

#### A. Dicotyledons

Polypetalea: Ranunculaceae, Papavaraceae, Caryophyllaceae. Malvaceae, Meliaceae, Rutaceae, Fabaceae, Roseceae, Cucurbitaceae, Apiaceae.

### UNIT IV

Gamopetalea: Rubeaceae, Solanaceae, Convolvulaceae, Apocynaceae, Asclepiadaceae, Acanthaceae and Lamiaceae.

Monochlamydae: Euphobiaceae, Moraceae and Polygonaceae.

Monocotyledonae: Orchidaceae, Liliaceae and Poaceae.

### UNIT V

Biodiversity: basic concept, biodiversity at global and national level and causes of loss of biodiversity.

Biodiversity conservation action plan In situ and Ex situ conservation gene bank, introductory account of biosphere reserve, national park and sanctuaries.

Floristic regions of India Floral vegetation, Indian Flora and endemism, characteristic of Western Himalayan flora with refrence to Uttaranchal Himalaya.

## **BOTANY Paper II ANATOMY, EMBRYOLOGY AND ELEMENTARY MORPHOGENESIS.**

### UNIT I

The technique for study of plant anatomy.

Meristem Primary and secondary meristem, characteristics and function. Various type of permanent tissues.

### UNIT II

Secretory structures.

Origin and structures and function of vascular cambium and anomalous behavior with refrence to Boegainvillea, Salvadora, Nyctanthus, Beta, Ficus, Orchids and Tinospora.

Structures of xylem and phloem including the electron microscopic view of cork cambium its activity and products.

### UNIT III

Structures of anther, microsporogenesis and male gametophyte in angiosperms.

Structures of ovule, megasporogenesis and development of female gametophyte with refrence to polygonum type comparison with bisporic and tetrasporic types.

Pollination, fertilization and life cycle of typical angiosperm.

### UNIT IV

Endosperm and embryo development with special refrence to the onagard type.

Polyembryony and apomixes.

Seed germination and dormancy elementary plant movement.

#### UNIT V

Basic body plan of a flowering plant modular type of growth.

Diversity in plant forms in annual, biennials and perennials, development of tree habit in higher plant.

Plant growth regulators Auxin, Gibberellins, Cytokinins and Abscissic acid.

Physiology of flowering plants: Photoperiodism and vernalization.

### **BOTANY Paper III Ecology and Biostatistics**

#### Unit I

1. Definition and scope of Ecology.
2. Ecosystem: type, abiotic and biotic components, food chain, food web and ecological pyramids, specialized ecosystem, Homeostasis fluctuation in ecosystem.
3. Energy flow and ecological energetics, Lindeman's concept of energy flow.
4. Productivity, type, measurement of primary productivity; Turn over, food chain and food web.

#### Unit II

1. Biogeochemical cycle: A brief discussion of concept by giving example of carbon, nitrogen and Phosphorous cycle.
2. Ecological niche, Bio indicator and their role in environmental monitoring, guild.
3. Population ecology : definition, population characters, survivorship curve, population age distribution , basic concept of growth rate, growth forms and growth curves, Carrying capacity, population fluctuation.
4. Community ecology: Community characteristics, ecological succession, Structure, composition and tropical organization, quantitative and qualitative and synthetic features, life form and biological spectrum.

#### Unit III

1. Applied ecology: Soil erosion and conservation , conservation and management of some Natural Resources. Forest and Rangeland management.
2. Pollution of air, water and soil, environmental toxicology, Noise incidence, Thermal and radioactive pollution, Prevention and control of pollution.
3. Global warming, desertification and ozone depletion.
4. Biogeographical region of India; vegetation type in Uttarakhand.

#### Unit IV

1. Aerial photo- interpretation and remote sensing an outline with special reference to the type of aerial photography and map.
2. Physical basis for remote sensing aerial and space platform.
3. Application of remote sensing in ecology.

#### Unit V

1. Methods of representation of statistical data diagrams.
2. Measurement of central tendency – mean, median, mode, harmonic mean and geometric mean.
3. Measure of dispersion- range, mean deviation and standard deviation, standard error.
4. Coefficient and correlation.
5. Test of significant – chi – square test.

## **CHEMISTRY PAPER-1: Inorganic Chemistry**

### 1:-Chemistry of Elements of First Transition Series

Characteristics properties of d-block elements. Properties of the elements of the transition series, their binary compounds and complexes illustrating stability of their oxidation states, coordination number and geometry.

### 2:-Chemistry of Elements of Second and Third Transition Series

General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation state, magnetic behaviour, spectral properties and stereochemistry.

### 3:-Oxidation and Reduction

Standard electrode potential, Use of redox potential, data, reaction feasibility and computation of equivalent weights.

### 4:-Coordination Compounds

Werner's Coordination theory and its experimental verification, Effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

### 5:-chemistry of lanthanides

Electronic structure, oxidation states, ionic radii, lanthanide contraction, complex formation, methods of separation of lanthanides-fractional crystallization, fractional precipitation, change in oxidation state, ion exchange, and solvent extraction.

### 6:-Chemistry of Actinides

General features of actinides-electronic configuration, atomic and ionic radii, ionization potential, oxidation state and complex formation.

### 7:-Acid and Base

Athenius, Bronsted-Lowery, Lux-Flood solvent system and Lewis concepts of acids and bases.

### 8:-Non-aqueous Solvents

Physical properties of a solvent, types of solvent and their general characteristics, reactions in non-aqueous with reference to liquid  $\text{NH}_3$  and liquid  $\text{SO}_2$ .

## **CHEMISTRY PAPER-II ORGANIC CHEMISTRY**

### 1:-Electromagnetic Spectrum : Absorption Spectra

Ultraviolet (UV) absorption spectroscopy - molecular laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones.

Infrared (IR) absorption spectroscopy-molecular vibrations, Hookes' law, selection rules, finger print region, characteristics absorptions of various functional groups and interpretation of IR spectra of simple organic compounds.

### 2:-ALCOHOL

Classification and nomenclature.

Monohydric alcohol-nomenclature, methods of formation by reduction aldehydes, ketones, carboxylic acids and esters.

Hydrogen Bonding Acidic nature. Reactions of alcohols.

Dihydric alcohols- nomenclature, methods of formation, chemical reaction of vicinal glycols, oxidative cleavage [ $\text{Pb}(\text{OAc})_4$  and  $\text{HIO}_4$ ] and pinacol-pinacolone rearrangement.

Trihydric alcohols-nomenclature and method of formation, chemical reactions of glycerol.

### 3:-PHENOLS

Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reaction of phenols-electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gattermann synthesis, Hauben-Hoesch reaction, Leaderer-Manasse reaction and Reimer-tiemann reaction.

### 4:-Ethers and Epoxides

Nomenclature of ethers and methods of their formation, physical properties. Chemical reactions-cleavage and autoxidation, Ziesel's method. Synthesis of epoxides. Acid and base-catalysed ring opening of epoxides, orientation of epoxide ring opening, reactions for Grignard and organolithium reagents with epoxides.

### 5:-Aldehydes and Ketones

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acids chlorides, synthesis of aldehyde and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids, Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensations with ammonia and its derivatives. Wittig reaction. Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyers-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, LiAlH<sub>4</sub> and NaBH<sub>4</sub> reductions. Halogenations of enolizable ketones. An introduction to  $\alpha$ - $\beta$  unsaturated aldehydes & Ketones.

### 6:-Carboxylic Acids

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acids strength. Preparation of carboxylic acids. Reactions of carboxylic acids. Hell-Volhard-Zorlinsky reaction. Synthesis of acid chlorides, esters, and amides. Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of formation and chemical reaction of halo acids. Hydroxy acids-malic, tartaric and citric acids. Dicarboxylation acids-methods of formation and effect of heat and dehydrating agents.

### 7:-Carboxylic Acid Derivatives

Structure and nomenclature of acids chlorides, esters, amides (Urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic and derivatives, chemical reactions. Mechanisms of esterification and hydrolysis (acidic and basic).

### 8:-Organic Compounds of Nitrogen

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitutions in nitroarenes and their reductions in acidic, neutral and alkaline media, picric acid. Halonitroarenes-reactivity. Structure and nomenclature of amines, physical properties. Separation of a mixture of primary, secondary, and tertiary amines. Structural features affecting basicity of amines. Amine salts as phase transfer catalysts. Preparation of alkyl and aryl amines, (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction. Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, axo coupling.

### 9:-Organic Synthesis via enolates

Acidity of hydrogen, alkylation of diethylmalonate and ethylacetoacetate. Synthesis of ethyl acetoacetate, the Claisen condensation, Keto-enol tautomerism of ethylacetoacetate.

## CHEMISTRY PAPER -3<sup>RD</sup> PHYSICAL CHEMISTRY

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### 1. Thermodynamics-II

Second law of thermodynamics, need for the law, different statement of the law. Carnot-cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature.

Concept of entropy : entropy as a state function, entropy as a function of V&T, entropy of a function of P&T, entropy change in physical change, Clausius inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases. Gibbs and Helmholtz functions, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A&G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of G and A with P, V and T.

### 2. Chemical Equilibrium

Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Effect of temperature on equilibrium constant. Reaction isotherm and reaction. Isochore-Claapeyron equation Clausius-Claapeyron equation, applications.

### 3. Phase Equilibrium

Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO<sub>2</sub> and S.

Phase equilibria of two component system-solid-liquid equilibria, simple eutectic-Bi—Cd, Pb-Ag system, desilverisation of lead.

Solid solutions-compound formation with congruent melting point.(Mg-Zn) and incongruent melting point (NaCl- H<sub>2</sub>O, FeCl<sub>3</sub>- H<sub>2</sub>O) and CuSO<sub>4</sub>-H<sub>2</sub>O system. Freezing mixtures, acetone-dry ice.

Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law. Non-ideal system-azeotropes HCl-H<sub>2</sub>O and ethanol-water system.

Partially miscible liquids-phenol-water, trimethylamine-water, nicotine-water system, Lower upper consolute temperature. Effect of impurity on temperature. Immiscible liquids, steam distillation.

Nernst distribution law-thermodynamic derivation, applications.

### 4. Electrochemistry

Electrical transport-conduction in metals in electrolyte solutions, specific conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolyte, Ostwald's dilution and its uses and limitations.

Debye-Huckel theory, equation for strong electrolytes (elementary treatment only). Migration of ions, Transport number, definition and determination by Hittorf method and moving boundary methods, Kohlrausch's law.

Application of conductivity measurement-determination of degree of dissociation, determination of K<sub>a</sub> of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.



## 5. Electrochemistry-II

Types of reversible electrodes-gas-metal ion, metalion, metal-insoluble salt-anion and redox electrodes. Electrode reaction, Nernst equation, derivation of cell E.M.F and single electrode potential, standard hydrogen electrode-reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cell-reversible and irreversible cells, conventional representation of electrochemical cells.

EMF of a cell and its measurement. Computation of cell EMF. Calculation of thermodynamic quantities of cell reactions ( $\Delta G$ ,  $\Delta H$  and  $K$ ) polarization decomposition potentials, over potential and hydrogen over voltage. Definition of pH and  $PK_a$ , determination of pH using hydrogen, quinhydrone, and glass electrodes by potentiometric methods. Buffers-mechanism of buffer action, Henderson equation, Hydrolysis of salts.

## 6. Surface chemistry

Types of adsorption, Freundlich's and Langmuir's adsorption isotherm and their applications, charge on the colloidal particle, size of the colloidal particle, Perrin's method of determination of the Avogadro's number.

## ZOOLOGY PAPER I- Chordata.

### Unit 1

General characters and outline classification of Chordates. Hemichordates: Classification General organization with special reference to *Balanoglossus* and affinities. Urochordates: classification; general organization with special reference to *Herdmania* and affinities.

### Unit 2

Cephalochordata: classification general organization with special reference to *Branchiostoma*(= *Amphioxus*) and affinities. Cyclostomata classification External features of *Petromyzon* and *Myxine*. Comparison between Lamprey and Hagfish.

### Unit 3

Pisces Origin; General characters; and affinities.

External features, digestive, blood vascular, nervous and urinogenital system of *Scoliodon*.

Teleosts: Scales and fins of fishes, Aquatic and aerial respiratory organs,

Air bladder in fishes.

Hill stream adaptations; Fish migration

Dipnoi: Distribution; General characters and affinities.

### Unit 4

Amphibia: Origin; Parental care; Neotany and Paedogenesis.

Gymnophiona: General characters

Reptila: Origin, Terrestrial adaptation, General organization, distribution and affinities of Chelonia.

Rhynchocephalia, Ophidia and Crocodilia; Poisonous and non-poisonous snakes; Biting mechanism in snakes; venom and antivenum.

### Unit 5

Aves: Origin and general characters; external features, digestive, respiratory, and urinogenital system of *Columba*; Feathers in birds, flightless birds and their distribution; Adaptations for aerial mode of life; Migration in birds.

Mamalia: Origin, general organization, distribution and affinities of Prototheria, Metatheria and Eutharia.

Aerial and aquatic adaptations in mammals; Dentitions in mammals.

## **MICROBIOLOGY Paper 3 : Microbial biochemistry & physiology.**

### **Unit -1**

Structure of biological macromolecule; protein, lipids, carbohydrates, nucleic acids, chemical structure of bases, phosphodiester bond, hydrogen bond, amino acid structure, folding of proteins. Types of DNA, Circular and helical DNA, RNA as genetic material, organization and functioning of prokaryotic genetic material Cytoplasmic membrane, properties and functions.

### **Unit-2**

Enzyme: structure, classification properties, coenzymes, cofactor, prosthetic group. Isozyme ribozymes, allostery, Water; structure dissociation of water and its ionic products.  $K_w$ , water as a solvent, hydrophilic, hydrophobic and amphiphilic substances.  $pH$ , acid base reaction buffer biological and physiological buffers.

### **Unit-3**

Law of thermodynamics, Gibb's free energy standard free energy & its determination. energy rich compounds, ATP, 1,3-bisphosphoglycerate phosphoenol pyruvate, acetyl CO-A and phosphocreatin. substrate level phosphorylation and ATP generation.

### **Unit -4**

Microbial metabolism: anabolism and catabolism, energy production in aerobic anaerobic process and photosynthesis, chemiosmotic hypothesis of ATP synthesis. Utilization of energy and biosynthesis.

### **UNIT-5**

Transport of nutrients by active and passive transport, bacterial growth and its kinetics effects of environment on growth turbidostate, chemostat autotrophy, heterotrophy, chemolithotrophy. Bacterial electron transport chain. fermentation.

## **MICROBIOLOGY Paper -4 : microbial genetics & molecular biology.**

### **Unit -1**

DNA as genetic material, basic mechanism of replication, enzymes involved in replication enzymes involved in transcription mechanism , genetic code , mechanism of translation regulation of gene expression ; transcription and translation in microbes.

### **Unit-2**

Genetic recombination : requirements ,molecular basis. Genetic analysis of recombination in bacteria. Mutations: spontaneous and induced , basis pair changes, frame shifts deletions.

Inversions,tandem duplications, insertion , useful phenotypes (autotrophic ,conditional lethal,resistance) reversion vs suppressions , Ames test.

### **Unit -3**

DNA repair and restriction, types of repair systems, restriction modification system types of restriction enzymes, properties and uses, methylation . Bactriophages, lytic and lysogenic pahges.

### **Unit-4**

Bacterial Genetics: concepts of haploid genomes, genetic exchange through conjugation .transformation and transduction (generalized and specialized). Competence, DNA uptake role of natural transformation, artificially induced competence, elecporation and protoplast fusion conjugation ; self transmissible plasmids, F factor and Hfr stains.

### **Unit -5**

Plasmid and phage vector restriction, ligation of vector and passenger DNA transformation of host cells selection screenings of recombinant colonies analysis of recombination clones, elecporation, DNA sequencing.

## **B.Sc. (Microbiology)-3<sup>rd</sup> Year**

### **CHEMISTRY PAPER-I INORGANIC CHEMISTRY**

#### **1. Hard and Soft Acids and Bases (HSAB)**

Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.

#### **2. Metal-ligand Bonding in transition Metal Complexes**

Limitations of Valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.

#### **3. Magnetic Properties of Transition Metal Complexes**

Types of magnetic behaviour, methods of determining magnetic susceptibility Gouy's and Quincknes methods, spin-only formula, correlation of  $m_s$  and  $m_{eff}$  values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.

#### **4. Electron Spectra of Transition Metal Complex**

Types of electronic transition, selection rules for d-d transitions spectroscopic ground states, Spectrochemical series. Orgel-energy level diagram for d1 and d2 states discussion of the electronic spectrum of  $[Ti(H_2O)_6^{3+}]$  complex.

#### **5. Thermodynamic and Kinetic Aspects of Metal Complexes**

A brief outline of thermodynamic and kinetic stability of metal complexes and Factors affecting the stability, substitution reaction of square planar complexes.

#### **6. Organometallic Chemistry**

Mononuclear carbonyls and nature of bonding in metal carbonyls. Definition, nomenclature, classification, general methods of preparation of organometallic compounds and a brief account of metallocenes.

#### **7. Bioinorganic Chemistry**

Essential and trace elements in biological processes, metalloproteins with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to haemoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to  $C^{2+}$  and Nitrogen fixation.

#### **8. Silicates and Phosphazenes**

Silicates and Phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.

### **CHEMISTRY PAPER-II ORGANIC CHEMISTRY**

#### **1. Spectroscopy**

Nuclear magnetic resonance (NMR) spectroscopy.

Proton magnetic resonance (PMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,2, 2-tribromethane, ethyl acetate, toluene and acetophenone.

Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

#### **2. Organometallic compounds**

Organomagnesium compound: the Grignard reagents-formation, structure and chemical reactions.

### 3. Organosulphur compounds

Nomenclature, structural features, method of formation and chemical reactions of thiols, thioethers, sulphonic acid, sulphonamides and sulphaguanidine.

### 4. Heterocyclic Compounds

Introduction: molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reaction in pyridine derivation. Comparisons of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed five and six membered heterocycles. Preparation and reactions of quinoline and isoquinoline with special reference to Fischer indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of quinoline and isoquinoline.

### 5. Carbohydrates

Classification and nomenclature. Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters.

Determination of ring size of monosaccharides. Cyclic structure of  $\alpha$ -D-glucose. Mechanism of mutarotation. General study of disaccharides (structure determination not required).

General introduction of structure of ribose and deoxyribose.

### 6. Amino Acids, Peptides, Proteins and Nucleic Acids

Classification, structure and stereochemistry of amino acids, acid-base behavior, isoelectric point and electrophoresis. Preparation and reaction of amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination and group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Structure of peptides and proteins. Level of protein structure. Protein denaturation/renaturation.

Nucleic acids introduction. Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

### 7. Fats, Oils and Detergents

Natural fats and common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value and acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates.

### 8. Synthetic Polymers

Addition of chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step-growth polymerization. Polymer, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers.

### 9. Synthetic Dyes

Color and constitution (electronic concept). Classification of dyes. Synthesis and uses of Methyl orange, Malachite green, Phenolphthalein, Fluorescein, Alizarin and Indigo.

### 10. Natural Products

Classification extraction and general methods of structure determination of :  
terpenoides : limonene citral and alkaloids : nicotine, cocaine.

## CHEMISTRY PAPER-III PHYSICAL CHEMISTRY

### 1. Elementary Quantum Mechanism

Black-body radiation, Planck's radiation law, photoelectric effect, Bohr's model of hydrogen atom (no derivation) and its defect.

Compton effect. deBroglie hypothesis, Heisenberg's uncertainty principle, sinusoidal wave equation and its operator concept, Hamiltonian operator, Schrödinger wave equation and its importance, physical interpretation of the wave function.

### 2. Spectroscopy

Introduction : electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born Oppenheimer approximation, degree of freedom, Rotational spectrum : Diatomic molecules. Energy levels of a rigid rotor (Semi-classical principle), selection rules, spectral intensity, distribution using population distribution (Maxwell Boltzmann distribution), determination of bond length qualitative description of non-rigid rotor, isotope effect.

Vibrational Spectrum: Infrared spectrum: energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups. Raman spectrum: concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules. Electronic Spectrum: Concept of potential energy curves for bonding and antibonding molecular orbitals qualitative description of  $\sigma$ ,  $\pi$  and  $\nu$  M.O., their energy levels and the respective transition.

### 3. Photochemistry

Interaction of radiation with matter difference between thermal and photochemical process. Laws of photochemistry: Grothuss-Draper law, Stark-Einstein law, Jablonski diagram depicting various processes. Laws of photochemistry: Grothuss-Draper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, Qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple example).

### 4. Physical Properties and Molecular Structure

Optical activity and its relation with chemical constitution, Polarization (Clausius-Mosotti equation), Orientation of dipoles in an electric field, dipole moment, induced dipole moment, Measurement of dipole moment- temperature method and refractivity, dipole moment and structure.

### 5. Solution, Dilute solutions and colligative properties

Ideal and Non-ideal solution, methods of expressing concentration of solution, activity and coefficients, Dilute solutions, Colligative Properties, Raoult's law, relative lowering of vapour pressure, Molecular weight determination. Osmosis law of Osmotic Pressure. Elevation of boiling point and depression freezing point. Thermodynamic derivation relation between molecular weight and elevation boiling point and depression freezing point. Experimental methods

for determining various colligative properties. Abnormal molar mass, Degree of dissociation and association of solutes.

#### **6. Thermodynamic-III**

Statement and concept of residual entropy and enthalpy, third law of thermodynamics, unattainability of absolute zero. Nernst heat theorem. Evaluation of absolute entropy from heat capacity data.

### **ZOOLOGY PAPER-III DEVELOPMENTAL BIOLOGY AND TOXICOLOGY**

#### **UNIT-I**

Gametogenesis: Events in spermatogenesis. Morphology of mature mammalian spermatozoa. Events in oogenesis. Fertilization: step in fertilization; mechanism of fertilization; molecular events. Fate map, elementary idea of parthenogenesis

#### **UNIT-II**

Type of egg and cleavage. Role of Yolk during cleavage. Products of cleavage (Morula and Blastula). Comparison of gastrulation in sea urchin, frog, chick and mammalian up to the formation of three germ layers. Fate of germ layer. Extra embryonic fetal membrane (chick)

#### **UNIT-III**

Determination and differentiation: elementary concept of primary organizer; induction; nature and its mechanism of action totipotency. Teratogenesis. Genetic control of development (Drosophila).

Development of chick embryo up to 72 hrs.

Differentiation and organogenesis of vertebrate eye.

#### **UNIT-IV**

Concept of toxicology; definition purpose and scope of study. Major source of toxicants; sewage, industries and agriculture field.

General classification of toxicants: industrial chemicals, carcinogenic substances, domestic wastes, pesticides, fungicides, herbicides etc.

Measurement of toxicities: Bioassay, LC50, LD50. Determination of safe concentration.

Lethal concentration. Acute chronic toxicity.

#### **UNIT-V**

Dose response curve: response of test organism (fish, insect, rat etc.) different doses of DDT. Detergent and dieldrin.

Bioaccumulation and biomagnification of hydrocarbons, pesticides and heavy metals in animals.

Excretion of toxic substances from animal body.



## **BOTANY PAPER-II PLANT PHYSIOLOGY AND BIOCHEMISTRY**

### **UNIT I**

Cell physiology, diffusion, permeability,

plasmolysis, imbibition, water potential and osmotic potential.

types of soil, water holding capacity, water requirement and wilting coefficient.

active and passive absorption, anatomical features of xylem in relation to path of water transport ascent of sap.

### **UNIT II**

Loss of water from plants, transpiration, factor affecting transpiration, guttation, anatomy of leaf with special reference to the loss of water,

structure of stomata, mechanism of stomatal movement and diffusive capacity of the stomata.

mechanism of absorption of mineral salt

translocation of solute, theories and mechanism of translocation, anatomical features of the phloem tissue with reference to translocation of solute.

### **UNIT III**

Elementary knowledge of macro and micronutrients.

symptoms of mineral deficiency, technique of water and sand culture.

nitrogen cycle and nitrogen fixation, importance of nitrate reductase and its regulation, ammonia assimilation.

### **UNIT IV**

Photosynthesis, historical background and importance of the process, role of primary pigment, concept of two photo system. Z scheme, photophosphorylation, calvin cycle, factor affecting photosynthesis, chemosynthesis

respiration, glycolysis, krebs cycle, electron transport mechanism( chemiosmotic theory), ATP biological currency, redox potential, oxidative phosphorylation, pentose phosphate pathway, CAM plant, factor affecting respiration, fermentation.

### **UNIT V**

Type and strength of solution, acid base and salts, pH, buffer solution and their importance, redox potential.

enzyme action.

kinetics, active sites, michaelis-menten constant, classification of enzymes, factor affecting enzyme activity, coenzymes and cofactors,

carbohydrates- classification, properties, structures and biological role

protein and amino acids- classification, structures and chemical bond in protein structures and properties.

lipids- structures and functions, fatty acid biosynthesis, Beta oxidation, saturated and unsaturated fatty acid, storage and mobilization of fatty acids.

## **BOTANY PAPER III ( ECONOMIC BOTANY AND PLANT BREEDING)**

### **Sessions 1 (September to November)**

#### **Unit I.**

- 1 Importance of plants to mankind
- 2 Origin of cultivated plants, Monophyletic and Polyphyletic origin, Centres of origin of some important plants.

## Unit II

- 1 Origin history , Botanical feature and cultivation of cereals – wheat., paddy, maize and bajra
- 2 Legumes – An introduce to the economically important legumes
- 3 Oils – castor oil linseed oil, and mint oil

## Unit III

- 1 General account of fruits (apple, Banana, citrus, litchi and mango) and vegetable (root, stem, leaf and fruit vegetable) plants.
- 2 Fibres (coir, cotton, flax, hemp) medicinal (Aconitum, Atropa, Cinchona, Ephedra and rauwolfia) plants.
- 3 Common timbers yielding plants (Chir, Deodara, Sal, Shisham and Teak) of western Himalaya.

## Unit IV

- 1 Plant Breeding : Aim and object ,Basic technique of plant breeding
- 2 Crop improvement method Plant introduction , selection , acclimatization, and hybridization, Vegetative propagation and grafting
- 3 Mutational breeding and breeding for diseases resistance

## Unit V

- 1 Improved seed – production multiplication and distribution
- 2 Maintenance and seed testing
- 3 National Seed Corporation and seed testing laboratories.

# **PAPER I (CYTOGENETIC, MOLECULAR BIOLOGY AND BIOTECHNOLOGY)**

## Unit I

1. Structure and function of nucleus: Ultra structure, nuclear membrane; Nucleus, Structure and functions of other organelles; Golgi, ER, Peroxisomes, Vacuoles, the cell envelopes: plasma membrane, bilayer lipid structure, function of the cell wall
2. Cell division: Mitosis, meiosis, comparison
3. Chromosome organization: Morphology, centromere and telomere, chromosome alteration in chromosome numbers, aneuploidy, polyploidy, sex chromosome.
4. Extranuclear genome: Presence and function of mitochondrial and plastid DNA, plasmids.

## Unit II

1. Genetic inheritance: Mendelism: Law of segregation and independent assortment, Incomplete dominance.
2. Interaction of gene: Linkage- complete and incomplete linkage, linkage group; crossing over.
3. Sex- linked inheritance; determination of sex.
4. Genetic variation: mutation, transposable genetic elements, DNA damage and repair.

## Unit III

1. DNA, the genetic material: DNA structure, replication, DNA protein interaction. The nucleosome model satellite and repetitive DNA.
2. RNA structure and type.
3. Gene concept. Classical and modern concept of gene, operon concept.

## Unit IV

1. Protein structure: 1D, 2D and 3D structure.
2. genetic code and protein synthesis
3. Regulation on gene expression in prokaryotes and eukaryotes.

## Unit V

1. Genetic engineering: tool and techniques of DNA technology, cloning vectors, genome and cDNA libraries, transposable elements, techniques of gene mapping and chromosome walking.
2. Biotechnology: functional definition, basic concept of tissue culture, storage of germ plasm (cryopreservation), differentiation and morphogenesis, biology and agrobacterium, vectors for gene delivery and marker gene.

3. A brief account of industrial biotechnology (fermentation and production) Agriculture biotechnology (Mycotoxin and health hazards, control of mycotoxin production, single cell protein).
4. Elementary idea of ( i ) Gene Bank (ii) Nif gene (iii) Nod gene (iv) Totipotency (v ) Antibiotics (vi)Mycoprotein

## **SPECIALIZATION : Applied Microbiology I**

### **UNIT-1**

Normal microbial flora of human body , epidemiology.host parasite relation ships, infection. Invasion .pathogen pathogenicity, virulence,carrier sepsis septicaemia infectious process,bacterial virulence factors , Anti-microbial chemotherapy: Anti-bacterial Anti –viral Anti-fungal modern approaches for diagnosis of infectious diseases:

### **Unit -2**

Salient features of the diseases; bacterial; disease caused by the following genera: *Clostridium Bacillus Staphylococcus Streptococcus, Hellicobacter, Haemophilus, Bordetella Brucella Yarsinia, Neisseria, Mycobacteria*, Infections caused by anaerobic bacterial, spirochetes.chlamydia, rickettsiae. Viruses: viral hepatitis, influenza rabies, polio and AIDS, dengue fever, small pox, chicken pox, conjunctivitis. Fungi: superficial subcutaneous, systemic and opportunistic mycoses. Protozoa; malaria, amoebiasis &leishmaniasis.

### **Unit-3**

Food as a substrate for micro-organisms, microbial spoilage of different food-stuffs, principles and methods of food preservation. Dairy starter cultures, fermented dairy products other fermented foods: Idli, dosa, sauerkraut, soy sauce, tampeh and wines. Food-borne diseases. Mycotoxins with reference to aflatoxins.

### **Unit-4**

Microbe-plant interactions; Roots, aerial plants surfaces, biological nitrogen fixation (symbiotic non symbiotic), phosphate solubilisation, biofertilizers, mycorrhiza.

### **Unit-5**

Concept of plant disease: signs and symptoms associated with microbial plant pathogens Microbial enzymes, toxins, growth regulators & suppressors of plant defences in plant diseases. Effects of pathogens on plant physiology, concepts of passive and active resistance mechanisms in plants, concepts of monocyclic & polycyclic diseases. Physical, chemical and biological control, integrated eco-friendly approach of plant disease control.

## **SPECIALIZATION : Applied microbiology II**

### **UNIT -1**

Microorganisms and their natural habitats; Terrestrial, aquatic, air (aeromicroflora) animal (microbes on the surface & in the elementary tract) and extreme environments, Biogeochemical cycles; Carbon: degradation of organism carbon sources, methanogenesis, aceto-genesis. Nitrogen; ammonification, nitrification denitrification . Phosphorous: phosphate immobilization and phosphate solubilisation .Sulphur; oxidative and reductive sulphur transformation,

**Unit-2**

Sewage treatment and disposal: primary secondary (aerobic: activated sludge, oxidation ponds trickling filters and anaerobic: septic tank, imhoff tank, anaerobic digesters) Microbial assessment of water quality and treatment. Bioremediation of contaminated sites.

**Unit-3**

Isolation of industrially important microbial strains, strain development. Preservation and maintenance of industrial microbes. Media for industrial fermentation: Molasses, corn steep liquor, sulphite waste liquor, whey, yeast extract. Down stream processing, immobilization & its applications. Antifoams.

**Unit-4**

Fermentation processes: Batch, fed-batch and continuous fermentations; solid state and submerged fermentation. Components in a typical bioreactor and types. Maintenance of pH  
Temperature, dissolved oxygen and aeration.

**Unit-5**

Microbial production of industrial products: citric acid ethanol acetone penicillin streptomycin, vitamin B12 riboflavin, amylases. Single cell protein. Biofertilizers. Bioinsecticides.