

University of Khartoum
Faculty of Science
Syllabi

Department of Botany

FIRST YEAR BIOLOGY
FIRST SEMESTER

Bio. 111 Biological Concepts. (3+3): 4.

Introducing Biology: Science: Definition, philosophy, methods, classification. **Biology:** definition, branches. Life on earth: origin, conditions necessary for life.

Chemical Basis of Life: Chemical bonds, water: hydrogen bonds, properties, dissociation, acids and bases, pH scale, buffers, importance to life. **Organic Molecules:** Carbon, functional groups, monomers and polymers, chemical structure, properties, classification and gross functions of : carbohydrates, lipids, proteins, and nucleic acids. **Energetics of Chemical Reactions:** the first and second laws of thermodynamics, free energy, factors affecting the rates of chemical reactions. Enzymes: Definition, nomenclature, function, properties, regulation of enzyme activity, cofactors and metabolic pathways. **Glycolysis and cellular respiration:** ATP, oxidation-reduction reactions, phosphorylation, Glycolysis and anaerobic pathways, oxidation of pyruvate, Krebs` cycle, electron transport chain, mitochondrial membranes and chemiosmosis. **Catabolic pathways of :** starch, fats and proteins. **Photosynthesis:** nature of light and the spectrum electromagnetic radiation, absorption spectrum of chlorophyll, chloroplasts and thylakoid membranes, photosynthetic pigments, light dependent reactions, electron flow in photo-system (I) and (II), Phosphorylation, light independent reactions, photorespiration, C₃ and C₄ plants, importance of photosynthesis to life on earth.

Introduction to cytology ad cyto-physiology: The cell theory, methods of studying cells, main types of cells(prokaryotic, eukaryotic, animal plant), structural components of eukaryotic and prokaryotic cells, their gross functions. Cell size, plasma membrane (fluid mosaic model), movement of material into and out of cells, linkage and communication between cells, wall and glycocalyx, cell movements(creeping, gliding, swimming, cytoplasmic streaming).

Bio. 112 Diversity Of Life I (3+3): 4

Biology of Lower Forms of Life. Origin of Life: Formation of solar system and planet earth, a biogenesis and biopoiesis. **Introduction to classical taxonomy:** Definition, methods (homology and phylogeny), activities (classification, nomenclature, identification), definition of species, taxonomic hierarchy, the Five Kingdom Concept. Characteristics, classification, life activities, importance, evolution of Viruses, Viroids, Monera, Protista and Fungi.

SECOND SEMESTER

Bio.121 Diversity of Life II (3+3):4

Plant Biology. Major plant Characteristics, origin of multicellularity, basic plant life cycles. **Bryophyta:** Characteristics, life cycle. **Pteridophyta:** Characteristics, support and transport, life cycle. **Seed plants:** Origin, characteristics, major subdivisions. **Gymnosperms:** Characteristics, classification, reproduction, importance. **Anthophyta (= Angiosperms): Plant morphology:** structure, gross functions and modifications of leaves, stems and roots. Plant nutrition, transport and support. Reproduction, development, and growth- hormones and growth regulation. Diversity of flowering plants- importance.

Bio. 122 Diversity Of Life III: (3+3): 4

Introducing Animalia: Characteristics of major divisions, origin of multicellularity. Characteristics, diversity, structure and functions, adaptations, importance of Porifera, Cnidaria, Ctenophora, Platyhelminthes, Nemartina, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata, Hemichordata. **Comparative functional anatomy of Vertebrates:** Characteristics and classification of chordates, structure and function of vertebrate body systems.

SECOND YEAR
BIOLOGY
FIRST SEMESTER

Bio211 PLANT AND ANIMAL DEVELOPMENT (3+3): 4

Introduction: Gametogenesis. Early embryonic development (Cleavage, blastulation, gastrulation and organogenesis) of Amphioxus, frog, Chicken and a placental mammal. Regeneration, artificial production of twins, embryo storage and transfer, cloning.

PLANT ANATOMY. Introduction: Plant anatomy and growing plants. Differentiation, totipotency, polarity, pattern formation and unequal cell divisions, factors controlling differentiation. **The plant cell content and ergastic substances:** The cell wall, components and structure of the cell wall, intercellular spaces, Plasmodesmata. **Cells and tissues:** Parenchyma, and collenchyma, sclerenchyma. Fibers, their origin and development, economic use. Cambium and pteridium. **Epidermis:** root and aerial parts. Trichoplasts, cuticle, silica, cork and crystal cells. **Stomata:** their distribution, types, structure and formation. **Xylem:** Its origin and fine structure, phylogeny, genetic aspects. **Phloem:** Sieve elements, control of phloem differentiation, transfer cells, secretory structures, economic importance of plant secretions. **Secretory cells and tissues:** Classification, mechanism and purpose of secretion. **Stem:** Arrangement of tissues, development of steles. **Leaf:** Structure, development, relationship with reference to function and environment. **Root:** Structure and function, mycorrhizae, root nodules and nitrogen fixation. **Ecological anatomy:** Study of roots, stems and leaves of hydrophytes, mesophytes and xerophytes. Economic aspects of applied plant anatomy.

Bio. 212 PRINCIPLES OF ECOLOGY (3+3):4

Environmental Factors: Factors interaction. Factors interdependence. **Climatic factors:** Light as an environmental factor. Temperature. Topography. Water and humidity. **Biotic factors:** Animal and plant interactions. Plant/ plant interactions. Competition. Human impact. **Edaphic factors:** What is soil? Soil composition, humus. Chemical composition of soil. **Plant succession:** Primary succession, secondary succession, climax.

SECOND SEMESTER

Bio. 223 PRINCIPLES OF GENETICS (1+3): 2

Mendelian Principles: Gene interaction, lethal genes, environmental effects on gene expression. Sex determination and sex linkage. General linkage and gene mapping in diploids (dihybrid crosses). **Molecular genetics:** Structure and replication of the genetic material. The genetic code. Gene mutations: Chemical, physical and biological mutagens. Mutagenic agents and human activities. Co-linearity between DNA nucleotide sequence and amino acid sequence.

Bio.222 PLANT SYSTEMATICS AND EVOLUTION (3+3): 4

The Evolution of Life. The Concept of the Six Kingdoms of Life: its relation to plant systematics. The Viruses, Bacteria, Fungi and Algae. **Non-vascular plants:** Hepaticophyta, Anthocerotophyta, Bryophyta. **Vascular Plants: Seedless vascular plants:** Lycopphyta,

Sphenophyta, Pterophyta. **Vascular Seed Plants** (Angiosperms): Anthophyta: Monocotyledonous plants, Dicotyledonous plants. Evolutionary trends in the plant Kingdom.

Bio. 223 INVERTIBRATES (1+3):2

Introduction to taxonomy: Classification of invertebrates. Phylum Protozoa, Porifera, Colelentrata, Mollusca, Platyhelmintha, Nematoda, Annelida, Arthropoda, Echinodermata. **Study of examples from different phyla:** Biology, structure and function. Inter-relations between organisms and their environments.

THIRD YEAR
FIRST SEMESTER

Bot. 311 BIOCHEMISTRY I (2+3): 3

Carbohydrates and lipids: Nature, classification, occurrence, structure. **Role in plants:** Biological functions in living organisms, examples of and detailed study of structure and function, their biochemical reactions in living organisms.

Bot. 312 BIostatistics I (2+3): 3

Descriptive statistics: Measures of location (central tendency): mean, median, mode. **Measures of Dispersion:** Variance, standard deviation, coefficient of variation. **Principles of Probability Theory:** Probability distributions: normal distribution, binomial distribution, Poisson distribution, t-distribution, F-distribution, Chi-square (χ^2) distribution.

Bot. 313 GENETICS I (1+3): 2

Chromosomal variations: their origin and cytological behaviour during meiosis, effect on fertility, gene expression and speciation. Cytoplasmic inheritance and maternal effects. **Genetic constitution of populations:** Hardy-Weinberg Law, factors affecting gene frequency and equilibrium. Variation of gene frequencies under simplified and less simplified conditions. Continuous variation- values and means of a population. Inbreeding depression and heterosis. Genetic analysis: analysis of morphological characters and their use in chromosome mapping in dihybrid and trihybrid crosses. Tetrad analysis in Fungi.

Bot. 314 MICROBIOLOGY I (2+6): 4

1. Introduction: Position of Fungi in The Five Kingdom concept. **Comparison between:** bacteria, Algae and Fungi, cellular structure, genomic composition and nutrition. **2. Kingdom Fungi:** Occurrence, importance, structure, Myxomycota, Eumycota, unicellular yeast. **3. Nutrition:** Saprophytes and parasites, economic importance, environmental importance. Nutritional requirements. **Fungal physiology: Effects of :** humidity, temperature oxygen and pH. **Importance:** Plant diseases, industry, scientific research. **5. Growth and sexual and asexual reproduction,** their importance. **6. Classification according to Ainsworth, 1973:** Kingdom- Divisions: Myxomycota, Eumycota, Sub-divisions: Oomycetes, Zygomycetes, Ascomycetes, Basidiomycetes, hyphomycetes. Selected examples to study the structure of a representative of each of the sub-division. Examples to elucidate theoretical, economic, scientific importance. Classification to species level.

Bot. 315 PLANT PHYSIOLOGY I (1+3): 2

Plant-water Relationships: A. Water and plants- classification of plants according to water availability- water cycle- the role of water in plants- water content of plants. **B.** Chemical and physical properties of water. **C. Water and soil:** soil properties- soil water- water movement in the soil- determination of soil-water content. **D. Cell-water relationships:** cell structure- **Terminology in plant-water relationships:** Plasmolysis- cell permeability- water movement within the cell- determination of water potential component in plants. **E. Water movement to the plant:** Root structure- movement of water to the xylem- factors affecting water absorption- the ascent of sap in the xylem. **F. Loss of water from the plant:** Transpiration- leaf anatomy- transpiring surfaces- stomata- measurement of transpiration- factors affecting the rate of transpiration.

Bot. 316 PLANT TAXONOMY I (1+3): 2

Introduction: identification and nomenclature of plants. **Taxonomic criteria:** use of taxonomic characters in classification of plants- Deme terminology- The use of keys- Herbarium in identification of plants- Systems of classification. Practical : the use and construction of taxonomic keys in identification of plants. Field trips to selected areas.

SECOND SEMESTER

Bot. 321 BIOCHEMISTRY II (1+3):2

Biological Membranes (biomembranes): Introduction, surfaces and intersurfaces. **Chemical composition:** lipids, proteins and carbohydrates. Structure of membranes, physico-chemical techniques, isolation of membranes. **Morphology and interaction of different biological membranes:** plasma membrane, mitochondrion, chloroplast, mesosome, endoplasmic reticulum, golgi apparatus, lysosome, tonoplast, nucleus and other membranes. **Membrane transport of:** non-electrolytes, transport of ions, transport of water. **Transport by special mechanisms:** receptor and ligand interaction.

Bot. 322 ECOLOGY I (2+6): 4

Climatic factors: their effect on vegetation and as limiting factors in terrestrial plants distribution. **Vegetation belts(biomes):** global-vegetation belts in Sudan. **Field trips:** elucidation of some vegetation types e.g. semi-arid in north Khartoum State- The Sunut Forest etc. **Practicals:** Field studies to elucidate plant modifications in response to climate, use of instruments and devices to measure climatic variables.

Bot. 323 GENETICS II (1+3):2

Microbial Genetics. Genetic recombination in bacteria: transformation, general transduction, specialized transduction, abortive transduction, sex-duction. Analysis of f recombinants as a means for mapping bacterial chromosomes. Genetic recombination in Fungi: analysis of ordered and non-ordered tetrads, mapping of fungal chromosomes.

Bot. 324 MICROBIOLOGY II (Algae) (1+3): 2

Introduction: ecological distribution of algae- historical background of algal classification. **Modern trends in algal taxonomy:** study of selected examples from algal classes to illustrate the diversity of structure, reproductive methods, life cycles and economic importance. Emphasis is made on classes Chlorophyta, Bacillariophyta and Phaeophyta. **Culture and growth of algae:** isolation and purification methods for some algal species.

Laboratory training:

Laboratory training comprises: morphological studies of selected examples from different orders and classes, methods of collection, preservation and identification of algae. **Use of taxonomic keys and taxonomic references.** Methods of isolation and culturing of algae as a basic tool in laboratory training.

Bot. 325 PLANT PHYSIOLOGY II (2+3): 3

Mineral nutrition in plants: Introduction, mineral absorption, membrane equilibrium (Donnan equilibrium). **Mass flow:** active absorption and carrier concept. **Essential and beneficial elements:** macro-elements, microelements, available forms, functions and deficiency symptoms. **Toxic effects of mineral elements:** mineral antagonism, salt requirement, **Translocation in plants:** Introduction- principal substances trans-located- xylem translocation- phloem translocation. Transpiration- cohesion theory- root pressure. **Mechanisms:** The pressure-flow hypothesis- The cytoplasmic streaming hypothesis- The activated diffusion hypothesis.

FOURTH YEAR
FIRST SEMESTER

Bot. 411 BIOCHEMISTRY III (2+3): 3

Amino Acids: Protein and non-protein amino acids. Structure, formulae, physical properties, reactions, titration, stereoisomerism, ionic properties, general and specific tests.

Proteins: Structure, peptide synthesis, peptide bond, classification, primary, secondary, tertiary and quaternary structure. Solubility, fractionation, analysis, precipitation, colour and non-colour tests. Biological importance.

Nucleic Acids: Occurrence, ribose and deoxyribose nucleic acids, nitrogenous bases, nucleosides, nucleotides, Primary, secondary and tertiary structure of DNA, structure of RNA. Structure of RNA. Biological importance. **Enzymes:** Definitions, nature, nomenclature, classification, zymogens, isoenzymes, co-enzymes and vitamins, specificity, activity. Purification, reaction order, kinetics.

Bot. 412 BIOCHEMISTRY IV (2+3): 3

Metabolism: Definitions, principles of metabolism, forms of energy, high energy, bioenergetics, formation of ATP in living cells, mechanisms of ATP action. **Biological oxidation:** Glycolysis, Krebs` cycle. **Biological techniques:** Principles in biological techniques, methods in instrumental analysis, methods of separation(different chromatographic methods: thin layer, paper, column, gas, electrophoresis ...etc). **Electron transport systems:** Systems and oxidative phosphorylation, hexose monophosphate shunt.

Bot. 413 ECOLOGY II (2+3): 3

Introduction: Sources of ecological knowledge. **A. Evolution of Global ecosystems:** Ancient and present. **B. Environmental changes:** Abiotic (physical changes), biotic activities; mainly human. **Negative changes:** e.g. pollution/ overexploitation of natural resources. **Positive changes:** Advances in science and technology, genetics and control of epidemic diseases. **Energy:** Alternative sources; sun, wind. **C. Strategic programs for disasters and risks evasion:** New approaches to monitor and evaluate magnitudes of changes in: Social settings, quantitative and qualitative competition, degradation, density, dynamics. **Prominent changes with:** Local, regional and global impact; 1. Salinity/ loss of fertility/ fire. 2. Epidemics/ pests/ atomic residues/ desertification and drought. 3. Water and air pollution/ green-house effect.

Bot. 414 MICROBIOLOGY(Bacteriology) III (2+3): 3

Introduction: General characteristics of prokaryotes. Prokaryotic cell structure and functions. Cultural characteristics and shapes of bacterial cells. **Bacterial growth, nutrition and metabolism:** Factors influencing bacterial growth, the concept of asepsis. **Bacterial genetics:** recombination and plasmids. **The control of bacteria:** Chemical, physical and biological means of control. **Classification of bacteria :** Classification according to Bergy`s Manual of Systematic Bacteriology. Survey of bacterial groups with emphasis on the structure and characteristics of economically important groups. Effect of bacteria on the environment. **Fermentation Techniques:** Fermentation and importance of bacteria in biotechnology.

Bot. 415 PLANT TAXONOMY II (2+6): 4

Reproduction: Sexual and asexual reproduction, Apomictic reproduction. **Breeding systems:** Out breeding and inbreeding, hybridization, factors affecting hybridization; using examples of important plants. **Geographical isolation in relation to speciation:** Polyploidy and it`s taxonomic treatment, Origin of species. Study of important crops in Sudan. **Practicals:** Taxonomic studies of important monocotyledonous plants e.g. The gramminae. **Reproduction in plants:** Study of different methods of reproduction, construction of taxonomic keys to differentiate between species.

SECOND SEMESTER

Bot. 421 BIOSTATISTICS II (2+3): 3

Sampling and sampling distributions. Inferential statistics. Tests of hypotheses: using z and t tests to compare sample and population means. Use of G and χ^2 in tests of association and goodness of fit. **Principles and methods of analysis of variance:** (ANOVA) and methods of comparisons of means. Linear correlation and regression. The analysis of co-variance (ANCOVA). Non-parametric statistical methods.

Bot. 422 ECOLOGY III (2+3):3

Feasible solutions for environmental problems. Public awareness, field and laboratory approaches. Population dynamics in plants and animals. Field trip (10 days) outside Khartoum State.

Bot. 423 GENETICS III (2+3): 3

Molecular genetics: Physical, chemical and biological evidence that DNA is the genetic material, the genetic dogma. **Structures of DNA and RNAs:** Macro and micro organization of the genetic material in prokaryotes and eukaryotes. **Gene Mutations:** Types of mutations, mutagenic agents, mechanism of action of some mutagens, classification of mutations at the molecular level, some aspects of the environmental effects of mutagens and their importance. **Replication of DNA:** Replication in prokaryotes, eukaryotes and some models for replication of viral genetic material. **DNA Repair:** Repair of errors of replication and mutations, revertants in genetic analysis. **Gene Expression:** Regulation of Gene Expression in prokaryotes and eukaryotes. **Introduction to recombinant DNA technology.**

Bot. 424 MICROBIOLOGY V (Virology) (2+3): 3

Viruses: Introduction, history and general properties, cultivation, purification and assays. **Virions:** structure and size, helical, icosahedral capsids, viral envelopes and enzymes. **Viral genetic material:** DNA and RNA viruses. **Principles of virus taxonomy:** Bacterial viruses: Reproduction of DNA phages and lytic cycles, reproduction of RNA viruses and lysogeny. Animal viruses: Classification and reproduction. Plant viruses: Taxonomy, reproduction and transmission. Viruses of : insects, fungi and algae. **Viroids and prions.**

Bot. 425 MICROBIOLOGY VI (2+3): 3

Principles of plant pathology. Introduction: parasitism and development of disease. **Mechanisms of disease formation:** Mechanisms of infection by pathogenic organisms, effect of pathogenesis on physiological functions of plants, mechanisms of defence in plants. **Genetics as related to plant pathology:** Resistance, susceptibility and tolerance, environmental influence on development of infective plant diseases. **Host-parasite relationships:** Concept of plant/microbe interactions, disease formation and host/parasite systems. **Molecular genetics of pathogenesis:** Molecular mechanisms in disease formation, molecular genetics methods in identification of parasites. Regulation of parasite enzymes and its role in disease formation, plant parasite interactions. The role of hydrolytic enzymes in plant resistance to disease formation, partial response of plants to disease, molecular responses to disease, genetic and molecular aspects of resistance in response to infection or chemical substances, tumor formation in plants, parasitic flowering plants.

Bot. 426 PLANT PHYSIOLOGY III (3+6): 5

Growth and development in plants. Introduction: Growth processes; germination of seeds, seed types and chemical composition of seeds. Seed dormancy and methods of breaking seed

dormancy. Economical, ecological and developmental importance of seed dormancy. **Differentiation:** Introduction- Principles of molecular differentiation. **Growth movements:** Tropisms and other growth movements resulting from external stimuli. **Phytochrome and plant growth:** Responses of plants to phytochromes during growth. **Reproductive growth:** The life-cycle of flowering plants- the flowering process, photoperiodism and vernalization. **Senescence and death.** **Control and co-ordination in plants.** **Plant growth hormones:** Introduction- Growth factors- The chemistry of major groups of plant hormones: Auxins, Gibberelins, Cytokinins. Phenolic inhibitors and Abscisic acid. Ethylene, Polyamines. **Metabolic pathways:** Biosynthesis, destruction(oxidation), inactivation ...etc). Transport and it's role in controlling growth and development- Synthetic plant growth substances. **Stress physiology:** **A. Water stress:** Morphological changes resulting from water stress, physiological responses to water stress. **B. Heat stress.** **C. Nutrients stress.** **D. Disease stress.**

FIFTH YEAR
1- PHYSIOLOGY BIOCHEMISTRY

FIRST SEMESTER

Bot. 511 BIOCHEMISTRY V (2+3): 3

Sucrose and starch metabolism in plants: Synthesis versus degradation pathways- synthesis of cellulose, pectic substances and other cell wall polysaccharides. **Lipid metabolism:** Biosynthesis of fatty acids- **Biosynthesis of proteins:** Stages of protein synthesis in the ribosome. **Regulation of metabolism:** Compartmentalization of enzymes. Alternate pathways for metabolism of a substrate. Kinetic factors. Control of enzyme concentration by regulation of transcription and translation. Allosteric enzymes. Some important biological carriers.

Bot. 512 SECONDARY PLANT PRODUCTS (2+3): 3

Introduction. Classification of natural products. Methods of collection of natural plant products: Separation and purification of secondary natural plant products. Identification of chemical structure of secondary compounds. Physical methods. Chemical methods. **Biosynthesis of natural products in plants:** Terpenes and steroids. Alkaloids. Natural Phenolic compounds.

Bot. 513 MEDICINAL, AROMATIC & POISONOUS PLANTS (2+3):3

Introduction: Historical background on medicinal and aromatic plants (Egyptians, Arabs and Muslims and Red Indians). **Introduction to the plant Kingdom:** Classification of plants into: Medicinal, aromatic and poisonous plants including; scientific description of the plants, common names in Sudan and other countries, propagation of medicinal and aromatic plants. **Collection and identification of medicinal plants resources:** Cultivation in different substrata, climatic zones ...etc of exotic and wild species of commercial interest. Introductory studies on selected examples. Genetic improvement of some genera. Phytochemical studies on medicinal plants. Chemotaxonomy of medicinal plants. Effective principles extracted from medicinal plants. **Aromatic plants:** Common aromatic plants in Sudan/ other countries. Plant parts commonly used; seeds, leaves, wood ...etc. **Poisonous plants.**

SECOND SEMESTER

Bot. 524 PLANT TISSUE AND CELL CULTURE (2+6): 4

Introduction: History of plant and cell tissue culture. **Basic Techniques and procedures:** Types of culture from plant cells, tissues and organs, induction of callus, differentiation and morphogenesis, regeneration of plants from tissue culture. **Molecular basis of regeneration:** Meristem culture, embryo culture, anther culture and haploid production. **Cell culture:** Isolation and culture of protoplasts, somatic hybridization and genetic engineering. **Tissue culture and nitrogen fixation. The role of tissue culture in basic and applied research:** Production of virus free plants, improvement of productivity and propagation of useful plants. Tissue culture as a classical technique of plant improvement.

Bot. 525 DESIGN AND ANALYSIS OF EXPERIMENTS (2+6): 4

Basic concepts. The completely randomized design. Randomized complete blocks. The Latin Square design. Factorial designs: 2X2 and 3X2 factorials. The split-plot and split-split plot (Nested) designs.

Bot. 526 BIOSTATISTICS III (1+3): 2

Sampling techniques. Tests of normality, independence and homogeneity of variance. Transformations. Analysis of frequencies. Multiple and partial correlation and regression. Miscellaneous methods: combining probabilities from tests of significance. Randomization tests. Use of computer packages for data analysis.

Bot. 500 GRADUATION PROJECT : 6 UNITS.

2- ECOLOGY –TAXONOMY FIRST SEMESTER

Bot. 517 APPLIED ECOLOGY (2+3): 3

Natural resources(Traditional). **Plant production systems:** Range/Agriculture/ Forestry. **Non-conventional resources:** Saline habitats, seas and oceans. **Marginal/Arid habitats:** Feasible ways to exploit- remote sensing-. **Economic plants:** Medicinal plants, gum timber, oil etc. **Conservation and biodiversity: Ozone, acid rain ...etc.** **Sociology:** Human migration. Ecological equilibrium. Data documentation. Co-operation and linkages with other sciences.

Bot. 518 PLANT TAXONOMY III (2+3): 3

Cytotaxonomy: Karyotypic analysis, mutations, polyploidy and hybridization, apomixes(their application to taxonomy). **Numerical taxonomy:** Introduction, methods of analysis, species relationships and variations. **Chemotaxonomy:** Introduction. Use and limitations. Survey of some common compounds found in plants and their relevance to families, genera or species where they occur. **Practicals:** Karyotypic analysis and chemical analysis of some plant families. Application of numerical methods in the study of variations.

Bot. 519 PALAEOECOLOGY & VEGETATION HISTORY (2+3): 3

Differences between Ecology and Palaeoecology. **Philosophical principles of Palaeoecology** and the nature of Palaeoecological evidence. Pollen analysis as an important evidence: The fate of the pollen grain from the flower to the slide. Laboratory techniques of pollen analysis. Pollen grain morphology. New frontiers in pollen analysis. **Practicals:** Study of prepared slides to show variations in pollen grain types. Preparation of slides from: Sediments., honey, animal remains& others.

SECOND SEMESTER

Bot. 525 DESIGN AND ANALYSIS OF EXPERIMENTS (2+6): 4

Basic concepts. The completely randomized design. Randomized complete blocks. The Latin Square design. Factorial designs: 2X2 and 3X2 factorials. The split-plot and split-split plot (Nested) designs.

Bot. 526 BIOSTATISTICS III (1+3): 2

Sampling techniques. Tests of normality, independence and homogeneity of variance. Transformations. Analysis of frequencies. Multiple and partial correlation and regression. Miscellaneous methods: combining probabilities from tests of significance. Randomization tests. Use of computer packages for data analysis.

Bot. 500 GRADUATION PROJECT : 6 UNITS.

3- GENETICS-MICROBIOLOGY

FIRST SEMESTER

Bot. 5110 APPLIED MICROBIOLOGY (2+3): 3

Introduction: Microbial growth processes, culture media, growth conditions, culture assay and kinetics of growth. **Biochemistry and Physiology of Micro-organisms:** Microbial exo- and end-enzymes, strategies for energy transfer, microbial photosynthesis, regulation and control of metabolic pathways. **Fermentation Techniques:** Strain selection, isolation and preservation, improvement of strains used in industrial processes. Culturing techniques. Optimization and monitoring of industrial processes. **Food Microbiology:** Food preservation methods, spoilage and food poisoning. **Processes involved in:** production of indigenous fermented foods, industry, production of economically important products. **Environmental Microbiology:** The role of micro-organisms in biogeochemical processes, cycling of elements and impact on soil fertility. Biodegradation management and Biodegradation enhancement. **Microorganisms as indicators of water and air pollution:** Treatment of Sewage, industrial effluents and pollutants. **Micro-organisms as agents of diseases in:** Animals, plants and humans. Micro-organisms as tools of research and in genetic engineering and transgenesis of plants.

Bot. 5111 PLANT PATHOLOGY (1+3): 2

Historical introduction to plant pathology. Classification of symptoms of plant disease. Relation of environment to disease development. Dispersal of plant pathogens. Control of plant diseases. **Study of some plant diseases:** Fungal diseases, bacterial diseases, viral diseases, nematode diseases, protozoan diseases and diseases caused by mycoplasmas.

Bot. 5112 MICROBIAL GENETICS (2+3): 3

Organization of bacterial genetic material: Chromosomes and plasmids. Classification of plasmids and their genetic characteristics: types of, molecular sizes, copy numbers, compatibility...etc. and an introductory treatment of the plasmid exclusion concept. Some aspects of bacterial plasmids in mitigation of environmental pollution, agriculture and industry. Host-directed restriction and modification: Definitions, classification and nomenclature of enzymes, mode of action and importance. **Gene expression in bacteria:** Negative and positive controls. Examples of inducible and repressible operons.

Bot. 5213 SEED PATHOLOGY (1+3): 3

Pathogenesis - Diseases - Hosts: Mechanisms of seed transmission. **Principles of control:** Seed health, testing methods, assessment of seed-borne inoculums.

SECOND SEMESTER

Bot. 5214 GENETIC ENGINEERING (2+3): 3

Introduction. Definition of the science and its basic problems,. Solutions to the problems: Restriction and restriction mapping of genomes. Methods of gene isolation: from genomes, mRNA, immunological methods. **Gel electrophoresis:** Gel electrophoresis as a preparative and a diagnostic method. Ligation: enzymes, adaptors, methodologies. Gene sequencing. Cloning Vectors: Natural and recombinant vectors, properties, selection. Gene Libraries: genomic and cDNA libraries. Gene amplification: cloning and PCR. Transformation and transgenesis. Role of recombinant DNA technology in industry, agriculture and biotechnology. Objectives of transgenesis of Plants: resistance to pests, pathogens, improvement of horticultural and crop plants. Production of important plant products.

Bot. 525 DESIGN AND ANALYSIS OF EXPERIMENTS (2+6): 4

Basic concepts. The completely randomized design. Randomized complete blocks. The Latin Square design. Factorial designs: 2X2 and 3X2 factorials. The split-plot and split-split plot (Nested) designs.

Bot. 526 BIOSTATISTICS III (1+3): 2

Sampling techniques. Tests of normality, independence and homogeneity of variance. Transformations. Analysis of frequencies. Multiple and partial correlation and regression. Miscellaneous methods: combining probabilities from tests of significance. Randomization tests. Use of computer packages for data analysis.

Bot. 500 GRADUATION PROJECT : 6 UNITS.