Course Outcome
Department of Botany
Handique Girls' College
Guwahati- 781001

FYUGP 1st Semester

Paper Name: Plant and Microbial Diversity **Course Level:** 100-199

Course Outcome	Unit No. and Topics as per the Syllabus	Bloom's Taxonomy Domain
THEORY		
1. Knowledge with the concept of different kingdoms and the theories behind how life began. 2. Understand the characteristics, distribution, classification and types of reproduction in Bacteria and Viruses. 3. Able to understand the characteristics, thallus organization, classification and types of reproduction in Algae with specific representative. 4. Understand the characteristics, distribution, classification, types of reproduction and economic importances of Fungi and Lichens. 5. To get the concept about the characteristics, distribution, classification, reproduction, evolutionary facts and affinities of Bryophytes and Pteridophytes. 6. Understand the characteristics, distribution,	**Unit 1: Origin of life:** Theories of the Origin of Life, Concept of Kingdoms, and Tree of Life.	Remember, understand
	Unit 2: Bacteria and Viruses: Bacteria: General features, cell structure, reproduction, conjugation, transformation, and transduction; introduction to Archaebacteria Viruses: General features, replication, reproduction (Lytic and Lysogenic life cycles), RNA virus (TMV), DNA virus (Cauliflower Mosaic Virus).	Remember, understand, apply
	Unit 3: Algae: General features, cell structure, range of thallus structure, reproduction, and classification; a brief account on *Nostoc*, *Oedogonium*, and *Chara.*	Remember, understand, apply, evaluate
	Unit 4: Fungi & Lichens: General features, distribution of fungi and its current status in the living world, reproduction, and classification (Anisworth, 1973); a brief account of *Mucor*, *Ascobolus*, and *Agaricus*; a brief account on lichens: structure, types, and economic importance.	Remember, understand, apply
	Unit 5: Bryophytes and Pteridophytes: Bryophytes: General features, adaptation to land habits, classification, and evolutionary trends; a brief account on *Marchantia* and *Polytrichum* Pteridophytes: General features, classification, reproduction, evolutionary trends (stellar evolution), and affinities; a brief account on *Lycopodium*, *Selaginella*, and *Pteris.*	Remember, understand, apply

classification, reproduction, evolutionary facts and affinities of Gymnosperms. 7. To know the characteristics, different system of classification, description of flower, pattern of inflorescence of monocotyledons and dicotyledons.	**Unit 6: Gymnosperms and Angiosperms:** Gymnosperms: General features, classification, reproduction, evolutionary trends, and affinities; a brief account on *Cycas*, and *Gnetum* Angiosperms: General features, Concept of an artificial, natural, and phylogenetic system of classification. Floral parts and inflorescence; Brief accounts on Lamiaceae and Orchidaceae	Remember, understand, apply
PRACTICAL		
1. Knowledge to identify various groups of organisms in the laboratory through vegetative and reproductive structure analysis. 2. Knowledge to identify diriment types of fruits and inflorescences.	1. Study of structure of TMV and Bacteriophage (electron micrographs/models). 2. Study of morphology of *Nostoc, Oedogonium, Chara* (Temporary preparation of slides). 3. Study of *Mucor, Ascobolus, Agaricus* (Temporary preparation of slides). 4. Study of vegetative and reproductive parts of *Marchantia* and *Polytrichum*(preparation of slides). 5. Study of *Lycopodium/ Selaginella* (morphology, strobilus, and spores), *Adiantum/ Pteris* (morphology). 6. Study of *Cycas*/ *Pinus* and *Gnetum* (morphology, leaf/ needle, megasporophyll and microsporophyll) 7. Study of leaf venations in dicots and monocots (at least two specimens each) 8. Study of different types of inflorescences and fruits.	Remember, understand, apply

FYUGP 2nd Semester

Paper Name: Cell Biology and Biomolecules **Course Level:** 100-199

Course Outcome	Unit No. and Topics as per the Syllabus	Bloom's Taxonomy Domain
THEORY		
1. Able to understand the detail about structure, function, types of divisions, regulation mechanism of cell cycle and differences between prokaryotic and eukaryotic cells. 2. Understand about the structure, function and importance of cell wall and plasma membrane of plant cell. 3. Detailed knowledge of the structure, properties and functions of cellular components. 4. Acquire knowledge on structure, properties and functions of different biomolecules. 5. Able to understand the structure, physicochemical nature, functions and types of nucleic acids.	**Unit 1: Introduction to cell:** Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory); Cytoskeleton, Cell division: Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle.	Remember, understand
	Unit 2: Cell wall and plasma membrane: Chemistry, structure and function of Plant cell wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport.	Remember, understand
	Unit 3: Cell organelles: Nucleus: Structure-nuclear envelope, Organization of chromatin, Nucleolus, Ribosome, Chloroplast, Mitochondria, Peroxisomes, Endoplasmic Reticulum, Golgi Apparatus, and Lysosomes.	Remember, understand
	Unit 4: Carbohydrates and Lipids: Carbohydrates: Nomenclature and classification. Lipids: Definition and major classes of storage and structural lipids; Structure, properties and functions of Essential fatty acids.	Remember, understand
	Unit 5: Aminoacids and Proteins: Structure and classification of amino acids; Levels of protein structure (primary, secondary, tertiary, and quarternary); Protein denaturation and biological roles of proteins.	Remember, understand
	Unit 6: Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA.	Remember, understand

PRACTICAL		
1. Able to identify various biomolecules in the laboratory by qualitative tests of biomolecules. 2. Acquainted with practical knowledge of properties of cell and cell membranes, DNA staining techniques, and microscopy of the plant cell. 3. Able to understand different stages of cell division in the laboratory.	1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins. 2. Study of plant cell structure with the help of epidermal peel mount of Onion/ *Rhoeo*/ *Crinum*. 3. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* and *Vallisnaria*leaf. 4. Counting the cells per unit volume with the help of haemocytometer. (Yeast/ pollen grains). 5. Cytochemical staining of: DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique. 6. Study different stages of mitosis and meiosis.	Remember, understand, evaluate, apply

FYUGP 3rd Semester

Paper Name: Laboratory and Field Techniques in Plant Science **Course Level:** 200-299

Course Outcome	Unit No. and Topics as per the Syllabus	Bloom's Taxonomy Domain
THEORY		
1. Able to understand about different safety measures and good practices in the laboratory. 2. Able to understand proper to handling and maintenance different laboratory instruments. 3. Gain knowledge about different units of measurements to calculate weight, length and volume of solid and liquid substances. 4. Gain knowledge about different types of solutions and buffer. 5. Able to understand different types of microscopes with their operational procedure and culture media with pure culture techniques. 6. Understand about the biostatistical calculations and applications along with basics of Microsoft software and herbarium technique.	**Unit 1: Laboratory safety and good practices:** General laboratory safety: dos and don'ts, lab safety measures, code of conduct in laboratory, safe handling of chemicals, glass apparatus, instruments, electrical appliances; First aid practices (acid spills, burns and other injuries), safety symbols, classes/ grades of chemicals, Laboratory waste management: radioactive, hazardous chemicals and biological wastes.	Remember, understand, apply
	Unit 2: Handling and maintenance of instruments: Weighing balance, pipettes and micropipettes, magnetic stirrer, autoclave, laminar air flow, pH and conductivity meter (calibrationanduse), Incubator (static and shaker), Luxmeter, hemocytometer, micrometer, spectrophotometer, Agarose gel electrophoresis unit, SDS PAG Eunit, centrifuge, distillation unit.	Remember, understand, apply
	Unit 3: Measurements and calculations: Units of measurements, conversion from one unit to another, Weighing, calculations: scientific notations, powers, logarithm and fractions; measurement of volumes of liquids.	Remember, understand, apply
	Unit 4: Solutions and Buffers: Preparation of solutions: stock solution, standard solution. Types of solutions: Normal, Molar, Molal, Percentage, ppm, ppb. Dilution and dilution factors, Acids, Bases, adjustment of pH, Buffers - phosphate, Tris- HCl and Citrate buffer	Remember, understand, apply
	Unit 5: Microscopy and Culture Techniques: Microscopes: working principles and types (Light and Electron microscopes), sample and slide	Remember, understand, apply

	preparation: fixation, staining, mounting, preservation (for light and electron microscopy). Basic culture media (NA, NB, P D A, MS), selective and differential media, Culture techniques: plating (streak, spread & pour), serial dilution.	
	Unit 6: Biostatistics, computing and field skills: Datatypes primary and secondary, methods of data collection, sample and sampling methods merits and demerits; technical and biological replicates; Tabulation and presentation of data, Descriptive statistics - Mean, Median, Mode, Variance, Standard Deviation, Standard error, Coefficient of Variation, MS-Word, Power Point, Excel, concept on biological databases. Collection, Identification, Preparation and Preservation of Herbarium and Museum specimens.	Remember, understand, apply
PRACTICAL		
1.Able to learn fundamental skills important for performing laboratory and field experiments. 2. Able to prepare, analysis of data and interpretation of results. 3. Able to prepare slides with proper staining. 4. Able to prepare herbarium specimens.	1. Preparation of solutions- molar, molal, normal, percentage, stock solution and dilution 2. Measurement of pH of solutions using pH meter/ pH strip and preparation of buffers (Phosphate /citrate buffer) 3. Working with instruments - Centrifuge, autoclave, laminar air flow, hot air oven, incubator, light microscope, spectrophotometer/colorimeter, 4. Slide preparation and staining of plant materials. 5. Determination of cell/spore size using micrometer. 6. Preparation of PDA/NA medium for growth and maintenance of fungal/bacterial cultures. 7. Calculation of mean, mode, median, standard deviation using data set. 8. Drawing of tables, graphs and to carry out statistical calculation using Microsoft Excel. 9. Preparation of herbarium specimen: Collection, processing, mounting, and labelling of plant specimen.	Remember, understand, evaluate, apply

FYUGP 4th Semester

Paper Name: Mycology and Phytopathology **Course Level:** 200-299

Course Outcome	Unit No. and Topics as per the Syllabus	Bloom's Taxonomy Domain
Theory		
1. Gain knowledge on general features of different types of fungi and their classification 2. Able to understand about different classes of fungi, symbiotic fungi and their characteristics. 3. Knowledge on the application of fungi in different fields. 4. Knowledge of plant pathogens and some important plant diseases.	**Unit 1: Introduction to Fungi:** General characteristics of fungi; hyphal forms; Cell and Cell wall composition; Nutrition; Origin of fungi; Classification of Fungi (Alexopoulos, 1962 & Ainsworth, 1973); General characteristics of Myxomycota and Eumycota; Symbiotic fungi (Lichen & Mycorrhiza): Structural organization and types.	Remember, understand,
	Unit 2: Lower Fungi: Mastigomycotina & Zygomycotina: Characteristic features; Reproduction; Heterothallism; Life cycle with reference to *Synchytrium*, *Phytophthora* and *Mucor*	Remember, understand, apply
	Unit 3: Higher fungi: Ascomycotina & Basidiomycotina: Characteristic features; Reproduction; Different fruiting bodies; Life cycle with reference to *Aspergillus*, *Peziza*, *Puccinia* and *Agaricus*	Remember, understand, apply
	Unit 4: Fungi Imperfecti: Deuteromycotina: General characteristics; Thallus organization; Reproduction; Heterokaryosis & Parasexuality; Classification with special reference to *Alternaria* and *Colletotrichum*	Remember, understand, apply
	Unit 5: Phytopathology: Concept of plant disease; Symptoms of plant diseases; Etiology and disease cycle; Host-pathogens interaction; Control of plant diseases and quarantine; Bacterial diseases - Citrus canker and angular leaf spot of cotton. Viral diseases - Tobacco Mosaic viruses, vein clearing. Fungal diseases - Early blight of potato, Black stem rust of wheat,	Remember, understand, apply

	White rust of crucifers	
	Unit 6: Applied Mycology: Role of fungi in biotechnology; food industry (Flavour & texture, Fermentation, Organic acids & Enzymes); Pharmaceutical (Secondary metabolites); Agriculture (Biofertilizers & Biological control); Mushroom cultivation; Medical mycology.	Remember, understand, apply
PRACTICAL		
1. Practical knowledge on different classes of fungi based on their morphological and reproductive features 2. Practical knowledge on morphology, anatomical features of symbiotic fungi and locally available important plant pathogens. 3. Practical knowledge of plant pathogens and some important plant diseases. 4. Understanding biotechnological applications of fungi in industry, agriculture, and medicine.	1. Study of vegetative and reproductive structures of Mastigomycotina (*Phytophthora*) and Zygomycotina (*Mucor/Rhizopus*) by temporary mounts and through permanent slides. 2. Study of vegetative and reproductive structures of Ascomycotina (*Aspergillus* and *Penicillium*/*Peziza*) and Basidiomyctina (*Agaricus* and *Puccinia*) by temporary mounts and through permanent slides. 3. Study of vegetative and reproductive structures of Deuteromycotina (*Alternaria* and *Colletotrichum/ Fusarium*) by temporary mounts and through permanent slides; Study of thallus and reproductive structures of lichen and mycorrhiza through permanent slides/ photographs. 4. Study of symptoms of locally available plant diseases caused by fungi, bacteria, and virus by preparation of disease album and bottle specimens. 5. Applied mycology: Photographs/report on fungi used in medicine, fungi used as biological control agents, fungi used in industry, fungi causing human infections	Remember, understand, apply

FYUGP 4th Semester

Paper Name: Morphology and Anatomy of Angiosperms **Course Level:** 200-299

Course Outcome	Unit No. and Topics as per the Syllabus	Bloom's Taxonomy Domain
Theory		
1. Knowledge on morphological and anatomical structures of angiosperms. 2. Knowledge on structural and anatomical organization of tissue system in plants and their classification. 3. Gain knowledge about developmental biology of plant body. 4. Able to understand about different adaptive and protective systems in plant body.	**Unit 1: Introduction to Plant Morphology and Anatomy:** Morphology of inflorescence, stamens and carpel, fruit; Telome theory, phyllode theory; Role of morphology in plant classification. Plant anatomy: Application in systematics, forensics and pharmacognosy.	Remember, understand
	Unit 2: Tissue and Tissue Systems: Classification of tissues; Simple and complex tissue, Tissue systems, Pits and plasmodesmata; Wall ingrowths and transfer cells, Types of vascular bundles; Endodermis, exodermis and origin of lateral root. Hydathodes, cavities, lithocysts and laticifers; Ergastic substances.	Remember, understand,
	Unit 3: Structure and Development of Plant Body: Internal organization of plant body: Development of plant body: Polarity, Cytodifferentiation and organogenesis during embryogenic development. Origin and development of leaves; Structure of dicot and monocot stem, root and leaf; Kranz anatomy.	Remember, understand
	Unit 4: Apical meristems: Concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory); Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap.	Remember, understand
	Unit 5: Vascular Cambium and Wood: Structure, function and seasonal activity of cambium; Secondary growth in stem and root. Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses;	Remember, understand

	Dendrochronology. Development and composition of periderm, rhytidome and lenticels.	
	Unit 6: Adaptive and Protective Systems: Epidermis, cuticle, epicuticular waxes, trichomes (uni-and multicellular, glandular and non-glandular, two examples of each), stomata (classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes and hydrophytes.	Remember, understand
PRACTICAL		
1. Practical knowledge on inflorescences and fruits of angiosperms. 2. Practical knowledge on anatomical features of plant body parts.	1. Study of special types of inflorescences – Cyathium, Hypanthodium, Verticillaster, Hypanthium. 2. Study of special types of fruits- Spurious fruits (*Dillenia*); Aggregate fruits (Custard apple, *Michelia*, Periwinkles, *Polyalthia*); Multiple fruits (Pineapple, Jack fruits). 3. Study of anatomical details through permanent slides/temporary stain mounts / macerations / museum specimens with the help of suitable examples. 4. Apical meristem of root, shoot and vascular cambium (permanent slides/ photographs) 5. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular. 6. Root anatomy: monocot and dicot 7. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels. 8. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy). 9. Adaptive Anatomy: xerophytes, hydrophytes. 10. Secretory tissues: cavities, lithocysts and laticifers.	Remember, understand, apply

FYUGP 4th Semester

Paper Name: Microbiology **Course Level:** 200-299

Course Outcome	Unit No. and Topics as per the Syllabus	Bloom's Taxonomy Domain
Theory		
1. Able to gain knowledge on history and development of microbiology. 2. Understand microbial diversity and distribution in different habitats 3. Knowledge on ecological and economic importance of microorganisms. 4. Knowledge on growth, reproduction and life cycles of viruses and microorganisms 5. Knowledge on plant, animal and human pathogenic microorganisms	**Unit 1: Introduction to microbial world:** History of development of Microbiology as a subject, Germ theory of diseases, Koch postulates, Major groups of microorganisms, Mode of nutrition and metabolic diversity in microbes, Growth and growth curves, Ecological importance of microorganisms.	Remember, understand,
	Unit 2: Viruses: Characteristics of viruses, viroids and prions; Biomolecules and genetic materials of viruses; Baltimore system of classification; Morphological structure of TMV and Corona viruses; Life cycle and reproduction of bacteriophage; Replication of viral RNA and DNA; Viral diseases of common plants and animals	Remember, understand, apply
	Unit 3: Bacteria: General characteristics of bacteria, shapes and sizes, ultra-cellular structure, major groups of bacteria with their general characteristics; Actinomycetes, Mycoplasma and Rickettsiae; growth and nutrition, reproduction – binary fission and endospore formation, horizontal gene transfer and genetic recombination in bacteria (conjugation, transformation and transduction). Examples of agriculturally and industrially important bacteria.	Remember, understand, apply
	Unit 4: Environmental Microbiology: Microorganisms in different habitats: Air, soil and water; Soil microorganisms and their role in soil health; Role of microorganisms in biogeochemical cycles (C, N, P and S);	Remember, understand, apply

	Microorganisms in extreme environments (cold desert, hot water spring, marine water, hydrothermal vent, aquifers)	
	Unit 5: Pathogenic microorganisms and Host Immunity: Bacterial pathogens causing diseases in plants, animals and humans; fungal pathogens causing diseases in agriculturally important crops; host pathogen interactions; pathogenesis; disease symptoms; host defence mechanisms; Host immunity - immune responses against pathogens; types of immunity; humoral and cell mediated immunity; hypersensitivity and autoimmunity; concept of Rh antigens.	Remember, understand, apply
	Unit 6: Applied Microbiology: Application of microorganisms in food industries for food fermentation and SCP production; in agriculture for biofertilizer, biopesticides, biocompost production; in pharmaceuticals for insulin and antibiotics production; in industries for alcohol and organic acid productions; citric acid and acetic acid; in genetic engineering for GMO development and other research purposes; in space and oil exploration and in pollution and waste management.	Remember, understand, apply
PRACTICAL		
1. Practical knowledge on microscopy, slide preparation, staining and morphological study of microorganisms 2. Knowledge on pathogenic microorganisms, host-pathogen interaction, and immunity 3. Practical knowledge on isolation and pure culture of bacteria/fungi from soil samples	1. Slide preparation and Gram staining of bacteria (urd bacteria, nodule bacteria) 2. Slide preparation and study of *Nostoc*, *Anabaena*, *Mucor*, *Rhizopus*, *Aspergillus*, *Penicillium*, *Colletotrichum*, *Cladosporium* 3. Pure culture isolation of soil bacteria/fungi through serial dilution plating and subsequent sub-culturing methods, population estimation by CFU and haemocytometer. 4. Measurement of microbial cells/spores with the help of micrometers or inbuilt software in microscopic camera**.** 5. Study on symptoms of plant viral diseases	Remember, understand, apply

	6. Endospore staining of soil bacteria with malachite green 7. Collection and study of diseases caused by virus, bacteria and fungi in crop plants	

FYUGP 4th Semester

Paper Name: Plant Resources and Economic Botany **Course Level:** 200-299

Course Outcome	Unit No. and Topics as per the Syllabus	Bloom's Taxonomy Domain
Theory		
1. Know the centre of origin, domestication, and loss of genetic diversity 2. Understand the evolution of new crops /varieties 3. Know about the germplasm diversity	**Unit 1: Origin of Cultivated Plants:** Centres of Origin, their importance with reference to Vavilov's work. Introductions, domestication, and loss of crop genetic diversity; evolution of new crops/varieties, importance of germplasm diversity and conservation. Classification of plant resources on the basis of their uses.	Remember, understand,
4. Understand the economic values of various plant species. 5. Understand the importance of ethnobotany in the present context.	**Unit 2: Food and Food Adjuncts:** Cereals and millets: Rice and wheat (origin, morphology, processing, post-harvest management & uses); Brief account of millets and their climatic and nutritional importance. Legumes: Origin, morphology, cultivation, uses and commercial importance of Chick pea, Pigeon pea and fodder legumes. Importance of legumes to man and ecosystem. Spices: Listing of important spices, their family and part used. Economic importance with special reference to Assam. Study of fennel, saffron, clove and black pepper. Beverages: Tea, Coffee (morphology, processing, cultivation, Types & uses).	Remember, understand, apply
	Unit 3: Plants and Plant Products of Industrial Value: Oils and Fats: General description, classification, extraction, their uses and health implications groundnut, coconut, soybean, and mustard. Essential Oils: General account, extraction methods, comparison with fatty oils & their uses. Non edible oil yielding trees and importance as biofuel. Sugar and starches: Morphology, new varieties and processing of sugarcane, products and by-products of sugarcane industry. Potato:	Remember, understand, apply

	morphology, propagation, post-harvest management, uses of potato and starches. Natural Rubber**:** Para-rubber: tapping, processing and uses. Fibres: Classification based on the origin of fibres; Cotton, Coir and Jute (morphology, extraction and uses).	
	Unit 4: Drug-yielding plants: Therapeutic and habit forming drugs with special reference to C*inchona, Digitalis, Aloe vera* and *Cannabis*; Tobacco (Morphology, processing, uses and health hazards).	Remember, understand, apply
	Unit 5: Forest Products: Forest and forest products. Timber and Non-Timber Forest Products (NTFP), Forest types of Assam and their conservation strategies; Community forestry.	Remember, understand, apply
	Unit 6: Ethnobotany Hours: Definition, concept and scope; relevance of ethnobotany in the present context; Traditional knowledge and IPR.	Remember, understand, apply
PRACTICAL		
1. Practical knowledge on useful parts and chemical constituents of various economically important plants.	1. Cereals: Study of useful parts: Rice/Bean (habit sketch, study of paddy and grain, starch grain, micro-chemical test). 2. Legumes: Bean, (habit, fruit, seed structure, micro chemical tests). 3. Beverages: Tea (plant specimen, tea leaves). 4. Oils and fats: Coconut and Mustard, Groundnut, 5. Rubber: Specimen, photograph/model of tapping, samples of rubber products. 6. Test for alkaloids: Neem, *Vinca rosea*. 7. Fibre-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fibre and test for cellulose), Jute (specimen, transverse section of stem, test for lignin).	Remember, understand, apply