

Choice Based Credit System (CBCS)

**NOWGONG COLLEGE
(AUTONOMOUS)**



SYLLABUS

DEPARTMENT OF BOTANY

Learning Outcomes-based Curriculum Framework (LOCF)

of

Undergraduate Programme

BACHELOR OF SCIENCE (HONOURS) IN BOTANY

(Effective from Academic Year 2020-21)

Syllabus as approved by Academic Council, NC(A) on 17th May, 2021

Core Papers in Botany
B.Sc. (Honours) in Botany
SEMESTER I

Paper : BOTA-HCC-1016
(Phycology and Microbiology)

Total Lectures: 60 Credits: 6 (Theory-4; Practical-2)

Total marks = 100; Theory:(60+20); Practical: 20

Course objective: This paper aims to study the concepts of phycology and microbiology with respect to its diversity and different applications.

Course outcome: After successful completion of the course, students will have a clear picture of the microbial world, viruses and bacteria along with introduction to the world of algae and its respective economic importance.

THEORY

Unit 1: *Introduction to microbial world* (10lectures)

Scope of microbes in industry and environment; Microbial nutrition, growth and metabolism [Only an overview of microbial metabolism- the concept of anabolism (Biosynthesis) and catabolism (ATP-generating Pathways-Respiration and Fermentation)].

Unit 2: *Viruses* (7lectures)

Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV). Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases.

Unit 3:*Bacteria* (7 lectures)

Discovery, general characteristics; Types-archaebacteria, eubacteria,

actinomycetes, mycoplasma, rickettsia, chlamydiae and sphaeroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction). Economic importance of bacteria with reference to their role in agriculture and industry (Alcohol and Antibiotic production).

Unit 4: *Algae* (10 lectures)

General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; methods of reproduction; Classification; Evolutionary significance of *Prochloron*; criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups); Role of algae in the environment, agriculture, biotechnology and industry, Economic importance of Diatoms.

Unit 5: *Cyanophyta* and *Xanthophyta* (8 lectures)

Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of *Nostoc* and *Vaucheria*.

Unit 6: *Chlorophyta*, *Charophyta* and *Bacillariophyta* (10 lectures)

General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Volvox*, *Oedogonium*, *Coleochaete*, *Chara*. General Account of Bacillariophyta.

Unit 7: *Phaeophyta* and *Rhodophyta* (8 lectures)

Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Ectocarpus*, *Fucus* and *Polysiphonia*.

PRACTICAL

Microbiology

1. Electron micrographs/Models of viruses – T-Phage and TMV/ Line drawings/Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root nodule.
3. Gram staining – Preparation of slides.
4. Isolation of soil microflora.

5. Endospore staining with malachite green using the endospores of bacteria.

Phycology

1. Study of vegetative and reproductive structures of *Nostoc*, *Volvox*, *Oedogonium*, *Chara*, *Vaucheria*, *Ectocarpus*, *Fucus* and *Polysiphonia*, Procholoron through electron micrographs, permanent slides.

Suggested Readings: -

1. Studies in Botany: Debabrata Mitra, Jibesh Ghuha & Salil Chowdhury, Vol. I & II, Moulik Library.
2. Botany for Degree Students: A.C. Dutta (Revised by T.C. Dutta), 6 th Edition, Oxford Publisher.
3. Life Sciences: Fundamentals and Practice, Pranab Kumar and Usha Mina, Vol. I & II, Pathfinder Publication.
4. Biodiversity (2020). Ranjit Nath Bhattacharjee. Kalyani Publishers, India
5. A Text Book of Microbiology and Phycology (2020). Bijaya Kumar Mishra and Nirupama Dash. Kalyani Publishers, India.
6. Botany for Degree Students: Algae, B.R Vashishta, Dr. A. K Sinha and Dr. Adarsh Kumar, S Chand & Company; 2nd edition (1 December 2010).
7. Textbook of Algae, O.P. Sharma (Tata McGraw-Hill Education, 2011).
8. Mycology and Microbiology (A Textbook for UG and PG Courses) (K.V.B.R. Tilak, K.V. Mallaiah, C. Manoharachary, I.K. Kunwar; Scientific Publishers (India); Edition: 1, 2016.
9. Microbiology and Phycology; Amit Jain; Mahaveer Publications.
 10. A Textbook of Microbiology; D K Maheshwari and R C Dubey; S Chand Publishing.

PAPER: BOTA–HCC-1026

(Biomolecules and Cell Biology)

Total Lectures: 60 Credits: 6 (Theory-4; Practical-2)

Total marks = 100; Theory:(60+20); Practical: 20

Course objective: This paper aims to provide a picture of plant biomolecules and cell biology in details.

Course outcome: After successful completion of the course, students will have a clear picture of chemical bonds among molecules, details of carbohydrates, lipids, proteins, nucleic acids; concepts of bioenergetics; enzymes; characteristics and origin of cells, chemistry, structure and function of plant cell, membrane transport, cell organelles, cytoskeleton and cell division.

THEORY

Unit 1: *Biomolecules*

(20 lectures)

Types and significance of chemical bonds; Structure and properties of water; pH and buffers.

Carbohydrates: Nomenclature and classification; Monosaccharides; Disaccharides; Oligosaccharides and Polysaccharides.

Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacyl glycerols structure, functions and properties; Phosphoglycerides.

Proteins: Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quaternary; Protein denaturation and biological roles of proteins.

Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, C, D, Z types of DNA; Types of RNA.

Unit 2: *Bioenergetics*

(4 lectures)

Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as an energy currency molecule.

Unit 3: *Enzymes*

(6 lectures)

Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced-fit theory), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.

Unit 4: *The cell***(4lectures)**

Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).

Unit 5: *Cell wall and plasmamembrane* (4 lectures) 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, endocytosis and exocytosis.

Unit 6: *Cell organelles***(16 lectures)**

Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus.

Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament.

Chloroplast, Mitochondria and Peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast.

Endomembrane system: Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing; Smooth ER and lipid synthesis, export of proteins and lipids; Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus; Lysosomes

Unit 7: *Cell division***(6 lectures)**

Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle-checkpoints, Role of protein kinases.

PRACTICAL

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/Pollengrains).

5. Cytochemical staining of DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.
6. Study the phenomenon of plasmolysis and de-plasmolysis.
7. Study different stages of mitosis and meiosis (Demonstration).

Suggested Readings: -

1. Fundamentals of Molecular Biology (Theory and Practical) (2021). Arun Chandra Sahu. Kalyani Publishers, India.
2. A Textbook of Plant Physiology, Biochemistry and Biotechnology; S K Verma and Mohit Verma; S Chand Publication. (1995).
3. Plant Physiology and Biochemistry; H. S. Srivastava and N. Shankar; Rastogi Publications (2005).
4. Biochemistry and Physiology of Plant Hormones; Thomas C. Moore; Springer.
5. Plant Physiology and Biochemistry; B.V. Pandey and P. Verma; Ram Prasad Publication (2019).
6. A Quick Approach to Plant Physiology, Biochemistry and Biotechnology; B. Bose, R.K. Singhal and J. Chauhan; Jain Brothers.
7. Developments in Physiology, Biochemistry and Molecular Biology of Plants: Vol. 1; Bandana Bose and A. Hemantaranjan (Editor); New India Publishing Agency (2005).

SEMESTER II
Paper : BOTA-HCC-2016
(Mycology and Phytopathology)

Total Lectures: 60 Credits: 6 (Theory-4; Practical-2)

Total marks = 100; Theory:(60+20); Practical: 20

Course objective: This paper aims to build up a clear knowledge on various applied aspects of mycology and plant pathology.

Course outcome: After successful completion of the course, students will learn about general characteristics, cell wall composition, nutrition and classification of fungi along with respective representative genus in each group. Also, students will learn about general symptoms, geographical distribution of diseases; Host-Pathogen relationships; plant diseases along with its prevention and control.

THEORY

Unit 1: Unit 1: Introduction to true fungi **(6 lectures)**

General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification.

Unit 2: Chytridiomycota and Zygomycota **(5 lecture)**

Characteristic features; Ecology and significance; Thallus organisation; Reproduction; Life cycle with reference to *Synchytrium*, *Mucor*.

Unit 4: Ascomycota **(10 lectures)**

General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; Life cycle and classification with reference to *Saccharomyces*, *Penicillium*, *Alternaria*, *Neurospora* and *Peziza*.

Unit 5: Basidiomycota**(8 lectures)**

General characteristics; Ecology; Life cycle and Classification with reference to Black stem rust on wheat, *Puccinia* (Physiological Specialization), loose and covered smut (symptoms only); *Agaricus*: Bioluminescence; Fairy Rings and Mushroom Cultivation.

Unit 6: Allied Fungi**(3 lectures)**

General characteristics; Status of Slime molds; Classification; Occurrence; Types of plasmodia; Types of fruiting bodies.

Unit 7: Oomycota**(4 lectures)**

General characteristics; Ecology; Life cycle and classification with reference to *Phytophthora*, *Albugo*.

Unit 8: Symbiotic associations**(4 lectures)**

Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction; Economic and Ecological importance; Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance.

Unit 9: Applied Mycology**(10 Lectures)**

Role of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides,

Mycoherbicides, Mycoinsecticides, Myconematicides); Secondary metabolites

(Pharmaceutical preparations).

Unit 10: Phytopathology**(10 lectures)**

Terms and concepts; General symptoms; Geographical distribution of diseases; Etiology; Symptomology; Host-Pathogen relationships; Disease cycle and Environmental relation; Prevention and Control of plant diseases, and Role of quarantine.

Bacterial diseases – Citrus canker. Viral diseases – Tobacco Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Black stem rust of wheat, White rust of crucifers.

PRACTICAL

1. Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps).
2. *Mucor*: study of asexual stage and sexual structures.
3. *Penicillium*: study of asexual stage and sexual stage.
4. *Peziza*: Study of reproductive structure; sectioning through ascocarp.
5. *Alternaria*: Study of reproductive structure.
6. *Puccinia*: Herbarium specimens of Black Rust on wheat stem and in infected Barberry leaves; Sections through infected part/ mounts of spores.
7. *Agaricus*: Specimens of button stage and fullgrown mushroom; sectioning of gills of *Agaricus*.
8. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza.
11. Phytopathology: Herbarium specimens of bacterial diseases - Citrus Canker; Viral diseases - TMV, Vein clearing; Fungal diseases – Ring spot of cabbage, Black stem rust of wheat.

Suggested Readings: -

1. Introduction To Principles of Plant Pathology; R S Singh; Medtech (2017).
2. Plant Pathology at a Glance; R P Singh; Daya Publishing House.
3. A Text Book of Mycology and Phytopathology (2019). Bijaya Kumar Mishra and Nirupama Dash. Kalyani Publishers, India.
4. Plant Pathology; R.S. Mehrotra and Ashok Aggarwal (2017).
5. Mycology and Microbiology (A Textbook for UG and PG Courses) (K.V.B.R. Tilak, K.V. Mallaiah, C. Manoharachary, I.K. Kunwar; Scientific Publishers (India); Edition: 1, 2016.
6. An Introduction to Fungi (4 th Edition): H C Dubey. Scientific Publishers, India
7. Botany for Degree Students: Fungi-B R Vashishta, A K Singha and Anil Kumar.S

Chand Publication

8. Illustrated Glossary of Mycology: Vaidya Jitendra. Career Publications

9. Physiology of Fungi: K. S. Bilgrami and R. N. Verma. Scientific Publishers Journals

Dept Publication

**Paper : BOTA-HCC-2026
(Archegoniate)**

Total Lectures: 60 Credits: 6 (Theory-4; Practical-2)

Total marks = 100; Theory:(60+20); Practical: 20

Course objective: This paper aims to study the different groups of plants incorporated under the archigoniates.

Course outcome: After successful completion of the course, students will learn about general account, classification and economic importance of archegoniates; general introduction to the world of bryophytes, pteridophytes and gymnosperms along with their respective type species and economic improtances

THEORY

Unit 1: Introduction (4 lectures)

General account, classification, morphology, anatomy, reproduction, ecology and economic importance of archegoniates; Transition to land habit; Alternation of generations.

Unit 2: Bryophytes (6 lectures)

General characteristics; Adaptations to land habit; Classification; Range of thallus organization.

Unit 3: Type Studies- Bryophytes (12 lectures)

Morphology, anatomy and reproduction of *Riccia*, *Marchantia*, *Anthoceros*, *Sphagnum* and *Polytrichum*; Reproduction and evolutionary trends in *Riccia*, *Marchantia*, *Anthoceros*, *Sphagnum* and *Polytrichum*(developmental stages not included). Ecological and economic importance of bryophytes.

Unit 4: Pteridophytes (6 lectures)

General characteristics; Classification; Early land plants (*Cooksonia* and *Rhynia*).

Unit 5: Type Studies- Pteridophytes (14 lectures)

Morphology, anatomy and reproduction of *Psilotum*, *Selaginella*, *Equisetum* and *Pteris* (Developmental details not to be included). Apogamy, and Apospory,

Heterospory and seed habit, Telome theory, Stelar evolution; Ecological and Economic importance.

Unit 6: Gymnosperms (18 lectures)

General characteristics, classification (up to family), morphology, anatomy and reproduction of *Cycas*, *Pinus* and *Gnetum* (Developmental details not to be included); Ecological and Economic importance.

PRACTICAL

1. *Marchantia*- Morphology of thallus, vertical section of thallus, vertical section of Antheridiophore and Archegoniophore.
3. *Anthoceros*- Morphology of thallus/sporophyte.
4. *Polytrichum*- Morphology of thallus and reproductive structures – antheridia, archegonia, capsule and protonema.
5. *Psilotum*- Morphology, transverse section of synangium.
6. *Selaginella*- Morphology, Strobilis, Microsporophyll and megasporophyll.
7. *Equisetum*- Morphology, Strobilus, Sporangiphore, Rhizome.
8. *Pteris*- Morphology, Sporophyll, Sporangium, Prothallus with sex organs and young sporophyte.
9. *Cycas*- Morphology (coralloid roots, bulbil, leaf), Anatomy of leaflet, microsporophyll and ovule.
10. *Pinus*- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), Anatomy of needle, male cone and female cone.
11. *Gnetum*- Morphology (stem, male & female cones), Anatomy of stem and ovule.

Suggested Readings: -

1. A Text Book of Archegoniate (For CBCS 2 nd Sem Honours), Akhil Baruah, Ashok Publications, Guwahati, Assam, India, 2021.
2. A Text Book of Archegoniate (2020). Biman Chandra Acharya, Kalyani Publishers, India.
3. A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany; A. V. S. S. Sambamurty, 2013.
4. Pteridophyta, O. P. Sharma; McGraw Hill Education; 1 July 2017.

Semester-III

BOTA–HCC-3016

(Morphology and Anatomy of Angiosperms)

Total Lectures: 60 Credits: 6 (Theory-4; Practical-2)

Total marks = 100; Theory:(60+20); Practical: 20

Course objective: This paper aims to study about general morphology and anatomy of the angiospermic group of the plant kingdom.

Course outcome: After successful completion of the course, students will learn about introduction and scope of plant anatomy, structure and development of plant body tissue system, meristems, vascular cambium and along with adaptive and protective systems in plants

THEORY

Unit 1: Introduction and scope of Plant Anatomy (4 Lectures)

Applications in systematics, forensics and pharmacognosy.

Unit 2: Structure and Development of Plant Body (6 Lectures)

Internal organization of plant body: The three tissue systems, types of cells and tissues.

Development of plant body: Polarity, Cytodifferentiation and organogenesis during embryogenic

development.

Unit 2: Tissues

(12 Lectures)

Classification of tissues; Simple and complex tissues (no phylogeny); cytodifferentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances. Hydathodes, cavities, lithocysts and laticifers.

Unit 3: Apical meristems

(15 Lectures)

Evolution of concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cytohistological zonation); Types of vascular bundles; Structure of dicot and monocot stem. Origin, development, arrangement and diversity in size and shape of leaves; Structure of dicot and monocot leaf, Kranz anatomy. Organization of root apex (Apical cell theory, Histogen theory, Korpe-Kappe theory); Quiescent centre; Root cap; Structure of dicot and monocot root; Endodermis, exodermis and origin of lateral root.

Unit 4: Vascular Cambium and Wood

(15 Lectures)

Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Development and composition of periderm, rhytidome and lenticels.

Unit 5: Adaptive and Protective Systems

(8 Lectures)

Epidermal tissue system, cuticle, epicuticular waxes, trichomes (uni and multicellular, glandular and non-glandular), Stomata (structure and types); Adcrustation and incrustation; Anatomical adaptations of xerophytes and hydrophytes.

PRACTICAL

1. Preparation of temporary slides/ permanent slides/ macerations and museum specimens.
2. Apical meristem of root and shoot; Vascular cambium through permanent slides/photographs.

3. Xylem: Tracheary elements-tracheids, vessels; thickenings; perforation plates;xylem fibres.
5. Wood: Ring porous, diffuse porous; Tyloses; Heartwood and sapwood.
6. Phloem: Sieve tubes-sieve plates; Companion cells; Phloem fibres.
7. Epidermal system: Cell types, Stomata types; Trichomes - non-glandular and glandular.
8. Secondary growth of monocot and dicot roots.
9. Primary, secondary and anomalous growth of monocot and dicot stem.
10. Leaf: isobilateral, dorsiventral, C₄ leaves.
11. Adaptive Anatomy: xerophytes and hydrophytes.
12. Secretory tissues: cavities, lithocysts and laticifers.

Suggested Readings:

1. Plant Anatomy and Embryology (2020) Ranjit Nath Bhattacharya. Kalyani Publishers, India
 2. Plant Anatomy and Embryology. S. N. Pandey and A. Chadha. Vikas Publishing House.
 3. Anatomy and Embryology of Angiosperms. V Singh, P. C. Pande and D. K. Jain. Rastogi Publications.
 4. A text book of Botany; Angiosperms. B. D. Pandey. S. Chand Publication.
 5. Integrative Plant Anatomy. W. C. Dickison (2000). Harcourt Academic Press, USA.
 6. Plant Anatomy. A. Fahn (1974). Pergmon Press. USA.
 7. Plant Anatomy. J. D. Mauseth. The Benjammin Cummings Publishers, USA.
 8. Esau's Plant Anatomy: Meristems, cells and tissues of the Plant Body: Their structure, function and development. John Wiley & Sons, Inc.
8. A Text Book of Plant Anatomy and Embryology (2021). Akhil Baruah. Ashok Book Stall,

BOTA–HCC-3026

(Economic Botany)

Total Lectures: 60 Credits: 6 (Theory-4; Practical-2)

Total marks = 100; Theory:(60+20); Practical: 20

Course objective: The paper deals with the significance of economic botany.

Course outcome: After successful completion of the course, students will learn about

origin of cultivated plants; origin, morphology, processing and uses of cereals, legumes; sources of sugars and starches, spices, beverages, oils and fats; natural rubber; drug-yielding plants; timber plants and fibers.

THEORY

Unit 1: Origin of Cultivated Plants (6 lectures)

Concept of Centres of origin, their importance with reference to Vavilov's work. Plant introduction; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity.

Unit 2: Cereals (6 lectures)

Origin, morphology, processing & uses of Rice and Wheat; Brief account of millets.

Unit 3: Legumes (6 lectures)

Origin, morphology and uses of Chick pea, Pigeon pea and fodder legumes. Importance to man and ecosystem.

Unit 4: Sources of sugars and starches (4 lectures)

Morphology and processing of sugarcane, products and by-products of sugarcane industry.
Potato – morphology, propagation & uses.

Unit 5: Spices (6 lectures)

Listing of important spices, their family and part(s) used. Economic importance with special

reference to fennel, saffron, clove and black pepper.

Unit 6: Beverages (4 lectures)

Morphology, processing & uses of Tea and Coffee.

Unit 7: Sources of oils and fats (10 lectures)

General description, classification, extraction, their uses and health implications. Botanical name, family & uses of groundnut, coconut, linseed, soybean and mustard. Essential Oils:

General account, extraction methods, comparison with fatty oils & their uses.

Unit 8: Natural Rubber (3 lectures)

Para-rubber: tapping, processing and uses.

Unit 9: Drug-yielding plants (8 lectures)

Therapeutic and habit-forming drugs with special reference to *Cinchona*, *Digitalis*, *Papaver* and *Cannabis*; Tobacco (Morphology, processing, uses and health hazards).

Unit 10: Timber plants (3 Lectures)

General account with special reference to teak and sal.

Unit 11: Fibers (4 lectures)

Classification based on the origin of fibers; Morphology, extraction and uses of Cotton, Coir and Jute.

PRACTICAL

1. Cereals: Wheat and Rice (habit sketch, grain, starch grains, micro-chemical tests).
2. Legumes: Chick pea, Pigeon pea, and Soybean (habit, fruit, seed structure, micro-chemical tests).
3. Sources of sugars and starches: Sugarcane and potato (habit sketch; cane juice-micro-chemical tests, starch grains in tuber).
4. Spices: Black pepper, Fennel and Clove (habit Sketch).
5. Beverages: Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
6. Sources of oils and fats: Coconut, Groundnut and Mustard: plant specimen, seeds/fruit, tests for fats.

7. Rubber: Specimen – plant & natural rubber, samples of rubber products.
8. Fiber-yielding plants: Cotton (structure of seed – lint & fuzz and test for cellulose), Jute (structure of fibre and test for lignin).

Suggested Readings:

1. A Text Book of Plant Resource Utilization (2016). Akhil Baruah Assam Book Dipot, India
2. A Hand Book of Plant Resource Utilization and Conservation (2015). Bijan Bihari Dutta. Authorspress, India.
3. Economic Botany – A Profile, Akhil Baruah, Eastern Book House, Guwahati, Assam, India, 2012.
4. Economic Botany. B. P. Pandey. S. Chand & Co Ltd.
5. Economic Botany. Bhabananda Baruah. Kalyani Publishers. India.
6. A Text Book of Economic Botany. A Narsimha Reddy, K. Shailaja and A. Rajani.

BOTA–HCC-3036

(Genetics)

Total Lectures: 60 Credits: 6 (Theory-4; Practical-2)

Total marks = 100; Theory:(60+20); Practical: 20

Course objective: This paper aims to study about general concept of genetics.

Course outcome: After successful completion of the course, students will learn about

Mendelian genetics and its extension; extrachromosomal inheritance; linkage, crossing over and chromosome mapping; variation in chromosome number and structure; gene mutations; fine structure of gene; population and evolutionary genetics; principles and methods of plant breeding.

THEORY

Unit 1: Mendelian genetics and its extension

(14 lectures)

Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Probability and pedigree analysis; Pleiotropy, Penetrance and

Expressivity, Deviations of Mendelism: Incomplete dominance and Codominance; Lethal alleles, Epistasis (Dominant and recessive), Complementary and Inhibitory factors; Numericals; Multiple alleles, Polygenic inheritance.

Unit 2: Extrachromosomal Inheritance (6 lectures)

Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast; Maternal inheritance and Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in Paramecium.

Unit 3: Linkage, crossing over and chromosome mapping (12 lectures)

Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numericals based on gene mapping; Sex Linkage.

Unit 4: Variation in chromosome number and structure (8 lectures)

Euploidy (Polyploidy: autopolyploidy and allopolyploidy) and Aneuploidy Deletion, Duplication, Inversion, Translocation, Position effect,

Unit 5: Gene mutations (8 lectures)

Types of mutations; Molecular basis of Mutations: Frame shift and Substitution mutation (Transition and Transversion), Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: CIB method. Role of Transposons in mutation. DNA damage and repair mechanisms.

Unit 6: Fine structure of gene (4 lectures)

Classical vs molecular concepts of gene; Cis-Trans complementation test for functional allelism; Structure of Phage T4, rII Locus.

Unit 7: Population and Evolutionary Genetics (4 lectures)

Gene pool, Gene frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation.

Unit:8 Plant Breeding (4 lectures)

Principles and methods of plant breeding: Introduction, Selection, Hybridization and Back cross method; Mutation breeding; Heterosis and inbreeding depression and Male sterility

PRACTICAL

1. Meiosis through temporary squash preparation.

2. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square.
3. Chromosome mapping using point test cross data.
4. Pedigree analysis for dominant and recessive autosomal and sex-linked traits.
5. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
6. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes (Photographs).
7. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
8. Study of human genetic traits (photograph): Sickle cell anemia, Xeroderma Pigmentosum, Albinism, Red-green Colour blindness, Widow's peak, Rolling of tongue, Hitchhiker's thumb and Attached ear lobe.
9. Hybridization techniques: Selection and preparation of parents, floral biology study, emasculation, bagging, tagging and pollination.
10. Study of pollen morphology, measurement and viability.

Suggested Readings:

1. Fundamentals of Genetics (2017). B.D. Singh and Payal Bansal; Kalyani Publishers.
2. Principles of Genetics; Gardner E.J., M. J. Simmons and D. P. Snustad (1991); John Wiley & Sons India; 8 th Edition (2015).
3. Cell Biology, Genetics, Molecular Biology; Verma P.S.; S Chand & Co Ltd.
4. Cytology, Genetics, Evolution and Plant Breeding; P.K Gupta (1996). Rastogi Publications.
5. Genetics and Biostatistics (2011). R. P. Meyyan. Saras Publication, Kanyakumari, India.

Regular Core Course / Honours Generic Elective Course

Semester-I

BOTA-RCC-1016 / BOTA-HGE-1016

(Biodiversity - Microbes, Algae, Fungi and Archegoniate)

Total Lectures: 60 Credits: 6 (Theory-4; Practical-2)

Total marks = 100; Theory:(60+20); Practical: 20

Course objective: This paper aims to provide a general idea of microbes, algae, fungi and archigoniates.

Course outcome: After successful completion of the course, students will have a clear picture of the microbial world, viruses and bacteria; general characteristics, ecology and distribution, reproduction; classification of algae, fungi, bryophytes, pteridophytes and gymnosperms along with types, species and economic importance.

THEORY

Unit 1: Microbes (10 Lectures)

Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

Unit 2: Algae (12 Lectures)

General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas*, *Oedogonium*, *Vaucheria*, *Fucus*, *Polysiphonia*. Economic importance of algae.

Unit 3: Fungi (12 Lectures)

Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium* (Ascomycota), *Puccinia*, *Agaricus* (Basidiomycota); **Symbiotic Associations**- Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.

Unit 4: Introduction to Archegoniate (2 Lectures)

Unifying features of archegoniates, Transition to land habit, Alternation of generations.

Unit 5: Bryophytes (10 Lectures)

General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

Unit 6: Pteridophytes (8 Lectures)

General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.

Unit 7: Gymnosperms (6 Lectures)

General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included). Ecological and economical importance.

PRACTICAL

1. EMs/Models of viruses –T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining.
4. Study of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas* (electron micrographs), *Oedogonium*, *Vaucheria*, *Fucus** and *Polysiphonia* through temporary preparations and permanent slides.
5. *Rhizopus* and *Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.
6. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
7. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
8. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
9. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
10. *Marchantia*- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
11. *Funaria*- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
12. *Selaginella*- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
13. *Equisetum*- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry) (temporary slides); t.s. rhizome (permanent slide).
14. *Pteris*- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
15. *Cycas*- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).

16. *Pinus*- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarf shoot, t.s. needle, t.s. stem, l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s.&r.l.s. stem (permanentslide).

Suggested Readings:

1. Botany for Degree Students: A.C. Dutta (Revised by T.C. Dutta), 6 th Edition, Oxford Publisher.
2. A Text Book of Botany, Microbiology and Phycology (2019-2020). V. Singh, P C Pandey and D K Jain. Rastogi Publications, Meerut.
3. A Textbook of Microbiology; D K Maheshwari and R C Dubey; S Chand Publishing.
4. An Introduction to Fungi (4 th Edition): H C Dubey. Scientific Publishers, India
5. A Text Book of Archegoniate (2021). Akhil Baruah, Ashok Publications, Guwahati, Assam, India.
6. Biodiversity (2020) For 1 st Semester General course. Ranjit Nath Bhattacharjee. Kalyani Publishers, India
7. A Text Book of Archegoniate (2020). Biman Chandra Acharya, Kalyani Publishers, India.
8. Udvid Bigyan: Jibor Boichitrata (For 1 st Semester)-Dr. Suresh Bharali, Surya Prakash, Panbazar, Guwahati. (Assamese Version)
9. Algae, Fungi, Bryophytes and Plant Pathology (2014). Saras Publication, Kanyakumari, India.
10. Onujibor Boichitrata aru Opuspak Udvid (Diversity of Microbes and Cryptogams). Karuna Kanta Das. Assam Book Depot, Panbazar, Guwahati. (Assamese Version)

Semester II

BOTA–RCC-2016 / BOTA-HGE-2016 (Plant Ecology and Taxonomy)

Total Lectures: 60 Credits: 6 (Theory-4; Practical-2)

Total marks = 100; Theory:(60+20); Practical: 20

Course objective: This paper aims to provide a general idea of plant ecology and taxonomy.

Course outcome: After successful completion of the course, students will have a clear picture of the concept, scope of plant ecology; various ecological factors; plant communities; ecosystems; principal biogeographical zones and endemism. Students will also get introduced to the basics of plant taxonomy; importance of herbarium and botanical garden; botanical nomenclature as well as different classification systems.

THEORY

Unit 1: Introduction to Plant Ecology

(2 Lectures)

Definition, Concept, Scope, Relation with other disciplines and Importance.

Unit 2: *Ecological factors* (10 Lectures)

Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.

Unit 3: *Plant communities* (6 Lectures)

Characters; Ecotone and edge effect; Succession; Processes and types.

Unit 4: *Ecosystem* (8 Lectures)

Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous.

Unit 5: *Phytogeography* (4 Lectures)

Principal biogeographical zones; Endemism

Unit 6: *Introduction to Plant Taxonomy* (2 Lectures)

Identification, Classification, Nomenclature.

Unit 7: *Identification* (4 Lectures)

Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora and Manual, Keys: single access and multi-access.

Unit 8: Taxonomic evidences from palynology, cytology, phytochemistry and molecular data. (6 Lectures)

Unit 9: *Taxonomic hierarchy* (2 Lectures)

Ranks, categories and taxonomic groups

Unit 10: *Botanical nomenclature* (6 Lectures)

Principles and rules (ICN); ranks and names; binominal system, typification, author's citation, valid and effective publication, rejection of names, principle of priority and its limitations.

Unit 11: *Classification* (6 Lectures)

Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (uptoseries), Engler and Prantl (upto series), Concept of APG system of classification with recent modifications.

Unit 12: *Biometrics, numerical taxonomy and cladistics* (4 Lectures)

Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).

PRACTICAL

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH from soil and water samples.
3. Study of morphological adaptations of hydrophytes and xerophytes (two each).
4. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)

5. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
6. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Verbenaceae, Solanaceae, Lamiaceae, Malvaceae
7. Mounting of a properly dried and pressed specimen of any four wild plants with herbarium label.

Suggested Readings

1. Text book of Plant Systematics (2021). Akhil Baruah, Kalyani Publishers, India.
2. Plant Taxonomy (2013), Akhil Baruah, EBH Publishers, India
3. Plant Ecology and Taxonomy with Practical (2020). Ranjit Nath Bhattacharya. Kalyani Publishers, India.
4. Advanced Plant Taxonomy (2009), A.K Mondal, New Central Book Agency, India.

Semester III

BOTA–RCC-3016 / BOTA-HGE-3016

(Plant Anatomy and Embryology)

Total Lectures: 60 Credits: 6 (Theory-4; Practical-2)

Total marks = 100; Theory:(60+20); Practical: 20

Course objective: This paper aims to provide a general idea of plant anatomy and embryology.

Course outcome: After successful completion of the course, students will have a clear picture of the different tissue systems; secondary growth in roots and stem; adaptive and protective systems in plants; structural organization of flower; pollination mechanisms and adaptations; Double fertilization; dispersal mechanisms; endosperm types, structure and functions; dicot and monocot embryo; Embryo- endosperm relationship; apomixis and polyembryony.

THEORY

Unit 1: Meristematic and permanent tissues

(8 Lectures)

Root and shoot apical meristems; Simple and complex tissues.

Unit 2: Organs

(4 Lectures)

Structure of dicot and monocot root stem and leaf.

Unit 3: Secondary Growth (8 Lectures)

Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).

Unit 4: Adaptive and protective systems (8 Lectures)

Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Unit 5: Structural organization of flower (8 Lectures)

Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.

Unit 6: Pollination and fertilization (8 Lectures)

Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.

Unit 7: Embryo and endosperm (8 Lectures)

Endosperm types, structure and functions; Dicot and monocot embryo; Embryo- endosperm relationship.

Unit 8: Apomixis and polyembryony (8 Lectures)

Definition, types and practical applications.

PRACTICAL

1. Preparation of temporary slides and permanent slides
2. Study of meristematic and permanent tissues (parenchyma, collenchyma and sclerenchyma).
3. Anatomical study of Stem (monocot and dicot): Primary and secondary growth.

4. Anatomical study of Root (monocot and dicot): Primary and secondary growth.
5. Anatomical study of Leaf (monocot and dicot).
6. Adaptive anatomy: Xerophyte (*Nerium/Aloe vera* leaf); Hydrophyte (*Eichhornia* petiole/*Hydrilla* stem)
7. Structure of anther (young and mature).
8. Study of different types of ovules.
9. Female gametophyte: Polygonum (monosporic) type of Embryo sac Development.
10. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle).
11. Dissection of embryo/endosperm from developing seeds.
12. Calculation of percentage of germinated pollen in a given medium.

Suggested Readings:

1. Plant Anatomy and Embryology (2020) Ranjit Nath Bhattacharya. Kalyani Publishers, India
2. Plant Anatomy and Embryology (2021). Namita Nath and Dharmeswar Barman, Ashok Book Stall, Panbazar, Guwahati, Assam. (Assamese Version)
3. A Text Book of Plant Anatomy and Embryology (2021). Akhil Baruah. Ashok Book Stall, Panbazar, Guwahati, Assam.
4. Anatomy and Embryology of Angiosperms. V Singh, P. C. Pande and D. K. Jain. Rastogi Publications.