

Four-year Undergraduate Programme
Subject: Botany
Semester: Fourth
Major 5
Course Name: Mycology and Phytopathology
Course Level: 200-299, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45			
Unit no.	Unit content	No. of classes	Marks
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.	10	10
Unit 2	Lower Fungi: Mastigomycotina & Zygomycotina: Characteristic features; Reproduction; Heterothallism; Life cycle with reference to <i>Synchytrium</i> , <i>Phytophthora</i> and <i>Mucor</i>	6	8
Unit 3	Higher fungi: Ascomycotina & Basidiomycotina: Characteristic features; Reproduction; Different fruiting bodies; Life cycle with reference to <i>Aspergillus</i> , <i>Peziza</i> , <i>Puccinia</i> and <i>Agaricus</i>	6	12
Unit 4	Fungi Imperfecti: Deuteromycotina: General characteristics; Thallus organization; Reproduction; Heterokaryosis & Parasexuality; Classification with special reference to <i>Alternaria</i> and <i>Colletotrichum</i>	5	8
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, White rust of crucifers	10	12
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.	8	10

PRACTICAL [Credit: 01]		
1. Study of vegetative and reproductive structures of Mastigomycotina (<i>Phytophthora</i>) and Zygomycotina (<i>Mucor/Rhizopus</i>) by temporary mounts and through permanent slides. 2. Study of vegetative and reproductive structures of Ascomycotina (<i>Aspergillus</i> and <i>Penicillium/Peziza</i>) and Basidiomycotina (<i>Agaricus</i> and <i>Puccinia</i>) by temporary mounts and through permanent slides. 3. Study of vegetative and reproductive structures of Deuteromycotina (<i>Alternaria</i> and <i>Colletotrichum/Fusarium</i>) 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	30	40

Reading list:

1. Agrios GN (1997) Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopoulos CJ, Mims CW, Blackwell M (1996) Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
3. Gangulee HC, Kar AK. College Botany, Vol. II., New Central Book Agency, Kolkata.
4. Hait G (2022) A Textbook of Plant Pathology: Principles and Diseases. Global Net Publication, India.
5. Hait G, Bhattacharya K, Ghosh AK (2011) Text Book of Botany, Vol. I & II., New Central Book Agency, Kolkata.
6. Mitra JN, Mitra D, Chowdhury S. Studies in Botany. Vol. I., Moulik Library, Kolkata.
7. Pandey BP (2020) Plant Pathology - Pathogen and plant disease. S. Chand and Company Limited, New Delhi, India.
8. Sethi IK, Walia SK (2011) Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
9. Sharma PD (2011) Plant Pathology, Rastogi Publication, Meerut, India.
10. Webster J, Weber R (2007) Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.

Graduate Attributes

Course Objective:

This paper will explain the general characteristics and reproductive procedures of fungi from different groups such as Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, and Deuteromycotina. The paper will also focus on the basic idea of host-pathogen interaction

during disease development, along with symptomology and the disease cycle of common fungal, bacterial, and viral diseases. Furthermore, the role of fungi in various biotechnological aspects, pharmaceuticals, and agriculture will be highlighted.

Course outcomes:

On successful completion of the course, students will have:

1. Knowledge on general features of fungi and their classification
2. Knowledge on 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
5. Practical knowledge on different classes of fungi based on their morphological and reproductive features
6. Practical knowledge on morphology, anatomical features of symbiotic fungi and locally available important plant pathogens.
7. Understanding biotechnological applications of fungi in industry, agriculture, and medicine.

Theory Credit: 03

Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany
Gauhati University, Guwahati-14

Four-year Undergraduate Programme

Subject: Botany

Semester: Fourth

Major 6

Course Name: *Morphology and Anatomy of Angiosperms*

Course Level: 200-299, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45			
Unit no.	Unit content	No. of classes	Marks
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.	6	10
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.	7	8
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.	5	8
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.	11	14
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; Dendrochronology. Development and composition of periderm, rhytidome and lenticels.	11	12

Unit 6	Adaptive and Protective Systems: Epidermis, cuticle, epicuticular waxes, trichomes (uni- and multicellular, glandular and nonglandular, two examples of each), stomata (classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes and hydrophytes.	5	8
PRACTICAL [Credit: 01]			
1. Study of special types of inflorescences – Cyathium, Hypanthodium, Verticillaster, Hypanthium. 2. Study of special types of fruits- Spurious fruits (<i>Dillenia</i>); Aggregate fruits (Custard apple, <i>Michelia</i> , Periwinkles, <i>Polyalthia</i>); 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.		30	40

Reading list:

1. Dickison WC (2000) Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Evert RF (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.
3. Fahn A (1974) Plant Anatomy. Pergmon Press, USA.
4. Mauseth JD (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

Graduate Attributes

Course Objective:

This paper will explain the detailed account on the morphological and anatomical features of Angiosperms.

Course outcomes:

1. Knowledge on morphology of angiosperms and developmental biology of plant body.

2. Knowledge on structural and anatomical organization of tissue system in plants and their classification.
3. Practical knowledge on inflorescences and fruits of angiosperms.
4. Practical knowledge on anatomical features of plant body parts.

Theory Credit: 03

Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany
Gauhati University, Guwahati-14

Four-year Undergraduate Programme
Subject: Botany
Semester: Fourth
Major 7
Course Name: Microbiology
Course Level: 200-299, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45			
Unit no.	Unit content	No. of classes	Marks
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.	6	6
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	8	10
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.	8	12
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); Microorganisms in extreme environments (cold desert, hot water spring, marine water, hydrothermal vent, aquifers)	8	8
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	8	12

	immunity - immune responses against pathogens; types of immunity; humoral and cell mediated immunity; hypersensitivity and autoimmunity; concept of Rh antigens.		
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.	7	12
PRACTICAL [Credit: 01]			
	1. Slide preparation and Gram staining of bacteria (urd bacteria, nodule bacteria) 2. Slide preparation and study of <i>Nostoc</i>, <i>Anabaena</i>, <i>Mucor</i>, <i>Rhizopus</i>, <i>Aspergillus</i>, <i>Penicillium</i>, <i>Colletotrichum</i>, <i>Cladosporium</i> 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 6. Endospore staining of soil bacteria with malachite green 7. Collection and study of diseases caused by virus, bacteria and fungi in crop plants	30	40

Reading list:

1. Aneja KR, Jain P, Aneza R (2021) A Textbook of Basic and Applied Microbiology. New Age International Publisher.
2. Aneja KR (2022) Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology. New Age International Publisher
3. Bhattacharya IK, Bhattacharya RN (2017) Fundamentals of Microbiology.
4. Pelczar MJ (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
5. Sharma PD (2009) Microbiology. latest edition, Rastogi Publication, Meerut.
6. Singh RS (2017) Plant Diseases.
7. Wiley JM, Sherwood LM and Woolverton CJ (2013) Prescott's Microbiology. McGraw Hill International.

Graduate Attributes

Course Objective:

1. To give concise knowledge on basic microbiology
2. To give practical knowledge on handling of microorganisms
3. To inculcate knowledge on usefulness of microorganisms for sustainable development

Course outcomes:

1. Knowledge on microbial diversity and distribution in different habitats
2. Knowledge on ecological and economic importance of microorganisms in our day-to-day life
3. Knowledge on growth, reproduction and life cycles of viruses and microorganisms
4. Knowledge on genetic recombination of bacteria
5. Practical knowledge on microscopy, slide preparation, staining and morphological study of microorganisms
6. Knowledge on pathogenic microorganisms, host-pathogen interaction, and immunity
7. Practical knowledge on isolation and pure culture of bacteria/fungi from soil samples

Theory Credit: 03**Practical Credit: 01****No. of Required Classes: 75 (Theory: 45; Practical: 30)****No. of Contact Classes: 75 (Theory: 45; Practical: 30)****No. of Non-Contact Classes: Nil****Particulars of Course Designer (Name, Institution, email id):**

CCS, Department of Botany
Gauhati University, Guwahati-14

Four-year Undergraduate Programme

Subject: Botany

Semester: Fourth

Major 8

Course Name: *Plant Resources and Economic Botany*

Course Level: 200-299, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45			
Unit no.	Unit content	No. of classes	Marks
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.	6	8
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).	12	14
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: morphology, propagation, post-harvest management, uses of potato and starches.	12	14

	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 <i>Cinchona</i> , <i>Digitalis</i> , <i>Aloe vera</i> and <i>Cannabis</i> ; Tobacco (Morphology, processing, uses and health hazards).	5	8
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.	5	8
Unit 6	Ethnobotany: Definition, concept and scope; relevance of ethnobotany in the present context; Traditional knowledge and IPR.	5	8
PRACTICAL [Credit: 01]			
	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, <i>Vinca rosea</i>. 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).	30	40

Reading list:

1. Chrispeels MJ, Sadava DE (1994) Plants, Genes and Agriculture. Jones & Bartlett Publishers.
2. Gonsalves J (2010) Economic Botany and Ethnobotany. Mittal Publications, New Delhi, India.
3. Hill AF (1972) Economic Botany: A Textbook of Useful Plants and Plant Products. Tata McGraw-Hill, New Delhi, India.
4. Jain SK, Mudgal V (1999) A Hand Book of Ethnobotany. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
5. Kochhar SL (2012) Economic Botany in Tropics, MacMillan & Co. New Delhi, India.

6. Samba Murty AVSS, Subramanyam NS (1989) A Textbook of Economic Botany. Wiley Eastern Limited, New Delhi.
7. Wickens GE (2001) Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
8. Wickens GE (2006) Economic Botany Principles and Practices, Springer India, New Delhi.

Graduate Attributes

Course Objective:

This paper will provide an understanding of major introduced plant species, concept of centre of origin and their importance, domestication of crops and loss of genetic diversity, evolution of new crops /varieties. This paper will also provide knowledge on germ plasm diversity, importance of ethnobotany and economic importance of various plants.

Course outcomes:

On successful completion of the course, students will:

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
4. Understand the economic values of various plant species.
5. Understand the importance of ethnobotany in the present context.

Theory Credit: 03

Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany
Gauhati University, Guwahati-14