Four-year Undergraduate Programme
Subject: Botany
Semester: First
Course Name: *Plant and Microbial Diversity*
Existing Base Syllabus: UG CBCS Syllabus
Course Level: 100-199, 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 life:** Theories of the Origin of Life, Concept of Kingdoms, and Tree of Life	3	4
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).	8	10
Unit 3	**Algae:** General features, cell structure, range of thallus structure, reproduction, and classification; a brief account on *Nostoc*, *Oedogonium*, and *Chara*	6	10
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	7	12
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*	10	12
Unit 6	**Gymnosperms and Angiosperms:** Gymnosperms: General features, classification, reproduction, evolutionary trends, and affinities; a brief account on *Cycas*, and *Gnetum*	11	12

	Angiosperms: General features, Concept of an artificial, natural, and phylogenetic system of classification. Floral parts and inflorescence; Brief accounts on Lamiaceae and Orchidaceae		
PRACTICAL [Credit: 01]			
	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.	30	40

Reading list:

1. Bhatnagar SP, Moitra A (1996) Gymnosperms. New Delhi, Delhi: New Age International (P) Ltd Publishers.
2. Campbell NA, Reece JB (2008) Biology, 8th edition, Pearson Benjamin Cummings, San Francisco.
3. Evert RF, Eichhorn SE (2012) Raven Biology of Plants, 8th edition, New York, NY: W.H. Freeman and Company.
4. Ingrouille M, Eddie B (2006) Plants: Evolution and Diversity. Cambridge University Press.
5. Kumar HD (1999) Introductory Phycology, 2nd edition. Delhi, Delhi: Affiliated East-West. Press Pvt. Ltd.
6. Parihar NS (1991) An Introduction to Embryophyta. Vol. II. Pteridophytes. Prayagraj: U.P.: Central Book Depot.
7. Pelczar MJ (2001) Microbiology, 5th edition. New Delhi, Delhi: Tata McGraw-Hill Co.
8. Puri P (1985) Bryophytes. New Delhi, Delhi, Atma Ram and Sons.
9. Sethi IK, Walia SK (2018) Text book of Fungi and Their Allies. 2nd Edition, Med tech Publishers, Delhi.
10. Singh G (2019) Plant Systematics: An Integrated Approach. 4th edition. CRC Press, Taylor and Francis Group.

11. Singh V, Pandey PC, Jain DK (2001) A Text Book of Botany. Meerut, UP: Rastogi and Co.
12. Tortora GJ, Funke BR, Case CL (2007) Microbiology. San Francisco, U.S.A: Pearson Benjamin Cummings.
13. Vashishta PC, Sinha AK, Kumar A (2010) Pteridophyta. New Delhi, Delhi: S. Chand & Co Ltd.
14. Webster J, Weber R (2007) Introduction to Fungi. Cambridge, Cambridge University Press.

Graduate Attributes

Course Objective:

This paper will explain the origin of life, the diversity of Bacteria, Viruses, Algae, Fungi & Lichen, Bryophytes, Pteridophytes, Gymnosperms, and Angiosperms on the planet, and how they may be related to each other. The emphasis will also be on the hands-on approach and laboratory techniques for identification of the plant and microbial groups using various morphological features.

Learning outcome:

On successful completion of the course, students will have:

1. Knowledge with the concept of different kingdoms and the theories behind how life began.
2. Basic understanding of the characteristics, distribution, classification, reproduction, and current status of various microbial and plant communities.
3. Good understanding of virus, algae, fungus, bryophyte, and pteridophyte cell structures, dicotyledonous and monocotyledonous leaf venation patterns, and inflorescence and fruit features.
4. Knowledge to identify various groups of organisms in the laboratory through morphological analysis.

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):

Prof. Bhaben Tanti
Head, Department of Botany,
Gauhati University
Email id: btanti@gauhati.ac.in

Four-year Undergraduate Programme
Subject: Botany
Semester: Second
Course Name: *Cell Biology and Biomolecules*
Existing Base Syllabus: UG CBCS Syllabus
Course Level: 100-199, 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 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.	8	12
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.	6	12
Unit 3	**Cell organelles:** Nucleus: Structure-nuclear envelope, Organization of chromatin, Nucleolus, Ribosome, Chloroplast, Mitochondria, Peroxisomes, Endoplasmic Reticulum, Golgi Apparatus, and Lysosomes.	9	8
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.	9	8
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.	8	10
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;	5	10

	Types of RNA.		
PRACTICAL [Credit: 01]			
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.		30	40

Reading list:

1. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H. Freeman and Company.
2. Campbell MK (2012) Biochemistry, 7th Edition. Published by Cengage Learning
3. Campbell PN, Smith AD (2011) Biochemistry Illustrated, 4th Edition, Published by Churchill Livingstone.
4. Cooper GM, Hausman RE (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
5. Hardin J, Becker G, Skliensmith LJ (2012) Becker's World of the Cell, Pearson EducationInc. U.S.A. 8th Edition.
6. Karp G (2010) Cell Biology, John Wiley & Sons, U.S.A. 6th Edition.
7. Nelson DL, Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition, W.H. Freeman and Company.
8. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd Edition, W.H. Freeman.

Graduate Attributes

Course Objective:

This paper will explain biomolecules, the basic building blocks of living organisms, with a focus on their structural organization, molecule properties, biological roles, and functions. The emphasis will be on the relationship between the structure and function of various biomolecules at the chemical level with a biological perspective, as well as a hands-on approach and laboratory techniques.

Learning outcome:

On successful completion of the course, students will be:

1. Able to obtain knowledge of structure, classification, and physicochemical properties of biomolecules and enzymes.
2. Detailed knowledge of the structure, properties, and functions of a cell and its components.
3. Acquainted with practical knowledge of properties of cell and cell membranes, DNA staining techniques, and microscopy of the plant cell.
4. Able to identify various biomolecules in the laboratory by qualitative tests of biomolecules.

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):

Prof. Bhaben Tanti
Head, Department of Botany,
Gauhati University
Email id: btanti@gauhati.ac.in

Four-year Undergraduate Programme
Subject: Botany
Semester: Third
Course Name: *Laboratory and Field Techniques in Plant Science*
Existing Base Syllabus: UG CBCS Syllabus
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	**Laboratorysafetyandgoodpractices:** 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, Laboratorywastemanagement: radioactive, hazardouschemicalsandbiologicalwastes.	8	8
Unit 2	**Handling and maintenanceofinstruments:** Weighingbalance,pipettesandmicropipettes,magnetic stirrer,autoclave,laminarairflow,pH and conductivity meter(calibrationanduse),Incubator (static and shaker),Luxmeter, hemocytometer, micrometer, spectrophotometer, Agarose gel electrophoresis unit, SDS PAGEunit,centrifuge,distillationunit.	8	12
Unit 3	**Measurementsandcalculations:** Units of measurements, conversion from one unit to another, Weighing,calculations:scientificnotations,powers,logarithmandfractions ; measurement of volumes ofliquids.	4	8
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 Citratebuffer.	6	8
Unit 5	**Microscopy and Culture Techniques:** Microscopes: working principles and types (Light and Electron microscopes), sampleandslidepreparation: fixation, staining, mounting, preservation(for light and electron microscopy). Basicculturemedia(NA, NB, PDA, MS), selective and differential media, Culturetechniques:plating(streak,spread&pour),serial dilution.	8	12

Unit 6	**Biostatistics, computingand field skills:** Datatypes-primaryandsecondary,methodsofdatacollection,sample and samplingmethods-meritsanddemerits;technicalandbiologicalreplicates; Tabulation and presentation of data, Descriptive statistics - Mean,Median,Mode, Variance,StandardDeviation,Standarderror,CoefficientofVariation, MS-Word,PowerPoint,Excel, concept on biologicaldatabases. Collection, Identification, Preparation and Preservation of Herbarium andMuseum specimens.	11	12
PRACTICAL [Credit: 01]			
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 MicrosoftExcel. 9. Preparation of herbarium specimen: Collection, processing, mounting, and labelling of plant specimen.	30	40

Reading list:

1. Bisen PS (2014) Laboratory Protocols in Applied Life Sciences, 1st Edition. CRC Press.
2. Danniel WW (1987) Biostatistics. New York, NY: John Wiley Sons.
3. Evert RF, Eichhorn SE, Perry JB (2012) Laboratory Topics in Botany. W.H. Freeman and Company.
4. Jones AM, Reed R, Weyers J (2016) Practical Skills in Biology, 6th Edition, Pearson
5. Mann SP (2016) Introductory Statistics, 9th edition. Hoboken NJ, John Wiley and Sons Inc.
6. Mesh MS, Kebede-Westhead E (2012) Essential Laboratory Skills for Biosciences. John Wiley & Sons, Ltd.

7. Mu P, Plummer DT (2001) Introduction to practical biochemistry. Tata McGraw- Hill Education.
8. Zar ZH (2010) Biostatistical Analysis, 5th Edition, Pearson Prentice Hall, New Jersey, USA.

Graduate Attributes

Course Objective:

This paper will provide basic knowledge and understanding of good laboratory practices, laboratory waste management, understanding hazards and risks to ensure a safe laboratory environment, measurements, units, and common mathematical calculations, sampling and data collection, and instrument operation and maintenance.

Learning outcome:

On successful completion of the course, students will be:

1. Able tolearnfundamentalskillsimportantforperforminglaboratoryandfieldexperiments.
2. Able to prepare,analysisofdataandinterpretationofresults.

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):

Prof. Bhaben Tanti
Head, Department of Botany,
Gauhati University
Email id: btanti@gauhati.ac.in

Four-year Undergraduate Programme
Subject: Botany
Semester: Fourth
Course Name: *Mycology and Phytopathology*
Existing Base Syllabus: UG CBCS Syllabus
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 *Synchytrium, Phytophthora* and *Mucor*	6	8
Unit 3	**Higher fungi: Ascomycotina&Basidiomycotina:** Characteristic features; Reproduction; Different fruiting bodies; Life cycle with reference to *Aspergillus, Peziza, Puccinia* and *Agaricus*	6	12
Unit 4	**Fungi Imperfecti: Deuteromycotina:** General characteristics; Thallus organization; Reproduction; Heterokaryosis & Parasexuality; Classification with special reference to *Alternaria* and *Colletotrichum*	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,	8	10

	Fermentation, Organic acids & Enzymes); Pharmaceutical (Secondary metabolites); Agriculture (Biofertilizers & Biological control); Mushroom cultivation; Medical mycology.		
PRACTICAL [Credit: 01]			
	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 onfungi 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, 4thedition, Academic Press, U.K.
2. Alexopoulos CJ, Mims CW, Blackwell M (1996) Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
3. GanguleeHC, KarAK. 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. HaitG, BhattacharyaK, GhoshAK (2011) Text Book of Botany, Vol. I & II., New Central Book Agency, Kolkata.
6. MitraJN, MitraD, ChowdhuryS. 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, pharmaceutics, and agriculture will be highlighted.

Learning outcome:

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):

Prof. Bhaben Tanti
Head, Department of Botany,
Gauhati University
Email id: btanti@gauhati.ac.in

Four-year Undergraduate Programme
Subject: Botany
Semester: Fourth
Course Name: *Morphology and Anatomy of Angiosperms*
Existing Base Syllabus: UG CBCS Syllabus
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,	11	12

	rhytidome and lenticels.		
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 (*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.		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 Benjammin/Cummings Publisher, USA.

Graduate Attributes

Course Objective:

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

Learning outcome:

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):

Prof. Bhaben Tanti
Head, Department of Botany,
Gauhati University
Email id: btanti@gauhati.ac.in

Four-year Undergraduate Programme
Subject: Botany
Semester: Fourth
Course Name: *Microbiology*
Existing Base Syllabus: UG CBCS Syllabus
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:**	8	12

	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.		
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 *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 6. Endospore staining of soil bacteria with malachite green 7. 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

Learning outcome:

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):

Prof. Bhaben Tanti
Head, Department of Botany,
Gauhati University
Email id: btanti@gauhati.ac.in

Four-year Undergraduate Programme
Subject: Botany
Semester: Fourth
Course Name: *Plant Resources and Economic Botany*
Existing Base Syllabus: UG CBCS Syllabus
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	12	14

	of sugarcane industry. Potato: 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).	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 Hours:**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, *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).	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.

Learning outcome:

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):

Prof. Bhaben Tanti
Head, Department of Botany,
Gauhati University
Email id: btanti@gauhati.ac.in

Four-year Undergraduate Programme
Subject: Botany
Semester: Fifth
Course Name: *Genetics*
Existing Base Syllabus: UG CBCS Syllabus
Course Level: 300-399, 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	**Mendelian genetics and its extension:** Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Probability and pedigree analysis; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits, Penetrance and Expressivity, Numericals; Polygenic inheritance.	13	14
Unit 2	**Extrachromosomal Inheritance:** Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial inheritance in yeast; Maternal effects-shell coiling in snail; Infective heredity-Kappa particles in *Paramecium*	4	6
Unit 3	**Linkage, crossing over and chromosome mapping:** Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numerical based on gene mapping; Sex Linkage.	8	10
Unit 4	**Variation in chromosome number and structure:** Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy.	6	8
Unit 5	**Fine structure of gene and Gene mutations:** Classical vs molecular concepts of gene; Ciston, Racon, Muton, rII locus; Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: ClB method. Role of Transposons in mutation. DNA repair mechanisms	10	12

Unit 6	**Unit 6. Population and Evolutionary Genetics:** Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation.	4	10
PRACTICAL [Credit: 01]			
1. Mendel's laws through seed ratios. 2. Chromosome mapping using point test cross data. 3. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1,12:3:1, 9:3:4). 4. Permanent Slides showing Translocation Ring, Photograph showing Laggards and Inversion Bridge.		30	40

Reading list:

1. Gardner EJ, Simmons MJ, Snustad DP (2015) Principles of Genetics, John Wiley & sons, India. 8th edition.
2. Griffiths AJF, Wessler SR, Carroll SB, Doebley J (2010) Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
3. Klug WS, Cummings MR, Spencer CA (2012) Concepts of Genetics. Benjamin Cummings, U.S.A. 10th edition.
4. Snustad DP, Simmons MJ (2010) Principles of Genetics, John Wiley & Sons Inc., India. 5thedition.

Graduate Attributes

Course Objective:

To gain knowledgeonclassical and modern concepts of genetics.

Learning outcome:

1. Knowledge of Mendelian and non- Mendelian inheritance in organisms.
2. Knowledge of gene and chromosomal mutations
3. Knowledge of basic concepts of population and evolutionary genetics
4. Ability to work out problems related to Mendel's experiments, Chromosome mapping and gene interaction

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):

Prof. Bhaben Tanti
Head, Department of Botany,

Gauhati University
Email id: btanti@gauhati.ac.in

Four-year Undergraduate Programme
Subject: Botany
Semester: Fifth
Course Name: *Molecular Biology*
Existing Base Syllabus: UG CBCS Syllabus
Course Level: 300-399, 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	**Nucleic acids: Carriers of genetic information:** Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiment.	3	4
Unit 2	**The Structures of DNA and RNA / Genetic Material:** DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, denaturation and renaturation, cot curves; Organization of DNA- Prokaryotes, Viruses, Eukaryotes. Organelle DNA - mitochondria and chloroplast DNA. The Nucleosome Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin.	8	12
Unit 3	**The replication of DNA, Central dogma and genetic code:** Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semi- conservative and semi discontinuous replication, RNA priming; Various models of DNA replication, including rolling circle, θ (theta) mode of replication, replication of linear ds-DNA; Enzymes involved in DNA replication. Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features)	10	12
Unit 4	**Transcription:** Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in *E.coli*. Eukaryotes: transcription factors, heat shock proteins, steroids	10	12

	and peptide hormones; Gene silencing.		
Unit 5	**Processing and modification of RNA:** Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I and group II intron splicing, alternative splicing eukaryotic mRNA processing (5' cap, 3' poly A tail); Ribozymes; RNA editing and mRNA transport.	7	10
Unit 6	**Translation:** Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.	7	10
PRACTICAL [Credit: 01]			
1. DNA isolation from any plant material. 2. DNA estimation by diphenylamine reagent/UV Spectrophotometry (Demonstration). 3. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication). 4. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs. 5. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.		30	40

Reading list:

1. Griffiths AJF, Wessler SR, Carroll SB, Doebley J (2010) Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
2. Klug WS, Cummings MR, Spencer CA (2009) Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
3. Russell PJ (2010) iGenetics - A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
4. Snustad DP, Simmons MJ (2010) Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th edition.
5. Watson JD, Baker TA, Bell SP, Gann A, Levine M, Losick R (2007) Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.

Graduate Attributes

Course Objective:

To have detailed knowledge of DNA, RNA and central dogma of molecular biology

Learning outcome:

1. Knowledge of structure, organization, and replication mechanism of DNA
2. Detailed knowledge of central dogma, mechanism of transcription and processing of different types of RNA
3. Knowledge of genetic code, molecular mechanisms associated with various steps in protein synthesis and post translational modifications
4. Ability to isolate genomic DNA from plant 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):

Prof. Bhaben Tanti
Head, Department of Botany,
Gauhati University
Email id: btanti@gauhati.ac.in

Four-year Undergraduate Programme
Subject: Botany
Semester: Fifth
Course Name: *Plant Ecology, Phytogeography and Climate Change*
Existing Base Syllabus: UG CBCS Syllabus
Course Level: 300-399, 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	**Ecology and Ecosystem:** Ecology: Basic concepts, Levels of organization, Inter-relationships between the living world and the environment. Ecosystem: Structure, functions, and types, trophic organisation, food chains and food webs, ecological pyramids, homeostasis.	8	8
Unit 2	**Ecological Factors:** Climatic, Edaphic and Biotic Factors, Factorial interactions, Plant adaptation to environmental factors (light, temperature, wind, and fire); autotrophy, heterotrophy; symbiosis, commensalism, ammensalism, parasitism, parasitoidism. Aquatic ecology- concept.	8	8
Unit 3	**Population ecology:** Population characteristics, Growth curve, Lotka-Volterra model, population regulation, *r* and *k*-selection. Types of ecological speciation, Ecological equivalents.	7	12
Unit 4	**Plant communities:** Plant Community: Basic concept, types, characters (analytical and synthetic), Dynamics: succession – processes, types, models; climax concepts, Habitat and Niche: concept &types.	7	12
Unit 5	**Functional Ecology:** Principles and models of energy flow; Production and productivity; Ecological efficiencies; Ecological energetics; Biogeochemical cycles (C, N and P) and water cycle.	7	10
Unit 6	**Phytogeography and Climate Change:** Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra);	8	10

	Phytogeographical division of India;Vegetation types of NE India with special reference to Assam. Climate change: Basic concepts; global warming, causes and consequences (Rise in Sea levels, Glacier melting, Biodiversity Loss), Adaptation, Mitigation, Global and National Efforts, Concept on Sustainable Development, Sustainable Development Goals (SDGs).		
PRACTICAL [Credit: 01]			
1. Determination of minimal quadrat size and number for the study of herbaceous vegetation in the college campus by species area curve method (species to be listed). 2. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus. 3. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law. 4. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter. 5. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests. 6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources. a) Study of morphological adaptations of hydrophytes and xerophytes (four each). b) Study of biotic interactions of the following: Stem parasite, Root parasite, Epiphytes, Predation (Insectivorous plants). 7. Local field visit to nearby areas to familiarise students with various plant communities. 8. Soil respiration study in two agricultural systems to determine the CO_2 evolution.	30	40

Reading list:

1. Ambasht and Ambasht (2002) A text book of Plant Ecology. CBS publisher and Distributors.
2. Bhattacharya K, Ghosh AK, HaitG (2017) A Text Book of Botany. New Central Book Agency (P), Kolkata, India.
3. Bowmen WD, Hacker SD, Cain ML (2018) Ecology, Oxford University Press.
4. Deka U, Dutta T (2022) Plant Ecology and Phytogeography. Asian Humanitities Press, Guwahati, Assam.
5. KapurP, GovilSR (2000, 2007). Experimental Plant Ecology. CBS Publishers and Distributors, New Delhi (India).
6. Kormondy EJ (1996) Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.
7. Misra R (1968, Reprinted in 2019). Ecology Workbook. Scientific Publishers (India), Jodhpur
8. OdumEP (2005) Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
9. Raj M, Deka H (2022) Plant Ecology and Phytogeography. Ashok Book Stall, Guwahati, Assam.
10. Sharma PD (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
11. Smith TM, Smith RL (2015) Elements of ecology. Pearson publishers., London. 9th Edition
12. StilingPD (1996) Ecology: theories and applications (Vol. 4). Upper Saddle River: Prentice Hall.
13. Verma PS, Agarwal VK (2003) Environmental Biology-Principles of Ecology. S Chand & Company Ltd. Ramnagar, New delhi-110055.
14. Wilkinson DM (2007) Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.

Graduate Attributes

Course Objective:

This course will provide an understanding on ecology and ecosystems, biotic and abiotic interactions, ecosystem processes, terrestrial and aquatic environment, population and community interactions, plant distribution and effect of climate change on natural environment. Emphasis will be given on the hands-on approach, field, and laboratory techniques.

Learning outcome:

On successful completion of the course, students will:

1. Understand the concept of ecology, ecosystems, and importance of factors.
2. Understand the population, community, biodiversity, and conservation strategies.
3. Understand the concept of phytogeography, endemism, and floristic distributions.
4. Understand the science of climate change and sustainable developmentstrategies
5. Know the adaptation and mitigation against climate change-induced phenomena.

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):

Prof. Bhaben Tanti
Head, Department of Botany,
Gauhati University
Email id: btanti@gauhati.ac.in

Four-year Undergraduate Programme
Subject: Botany
Semester: Fifth
Course Name: *Plant Systematics*
Existing Base Syllabus: UG CBCS Syllabus
Course Level: 300-399, 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	**Significance of Plant systematics:** Introduction to systematics; Plant identification, Classification, Nomenclature. Evidences from palynology, cytology, phytochemistry and molecular data. Functions and importance of Herbarium and botanical garden; Important herbaria and botanical gardens of the world and India; Virtual herbarium; Categories and taxonomic hierarchy; Concept of taxa (family, genus, species).	8	8
Unit 2	**Botanical nomenclature:** History, Principles and Rules (ICN); Ranks and names; Typification, Author citation, Effective and Valid publication, Rejection of names, Principle of priority and its limitations.	5	8
Unit 3	**Systems of classification:** Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker, Engler and Prantl, Takhtajan; Brief account of Angiosperm Phylogeny Group (APG) classification.	9	12
Unit 4	**Numerical taxonomy and cladistics:** OTUs, characters, character weighting and coding; Cluster analysis; Phenograms & Cladograms (definitions and differences).	6	8
Unit 5	**Phylogeny of Angiosperms:** Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin and evolution of angiosperms; Co-evolution of angiosperms and animals; Methods of illustrating	6	10

	evolutionary relationship (phylogenetic tree, cladogram).		
Unit 6	**Angiospermic Families:** Detail study of the following families: Magnoliaceae, Fabaceae, Asteraceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Orchidaceae, Musaceae, Zingiberaceae, Poaceae.	11	14
PRACTICAL [Credit: 01]			
1. Study of vegetative and floral characters of locally available angiospermic plants belonging to 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): Fabaceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Musaceae, Orchidaceae. 2. Field visits to familiarise students with vegetation of an area and identification of plant species / Visit to Academic or Research Institutions. 3. Mounting of properly dried and pressed specimens of at least 10 (ten) wild plant species with herbarium labels (to be submitted with the record book).		30	40

Reading list:

1. Jeffrey C (1982) An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
2. Judd WS, Campbell CS, Kellogg EA, Stevens PF (2002) Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
3. Mitra JN (1988) An Introduction to Systematic Botany and Ecology. The World Press Private Ltd. Calcutta.
4. Mondal AK (2009) Advanced Plant Taxonomy. New Central Book Agency (P) Ltd.
5. Naik VN (1984) Taxonomy of Angiosperms. Tata Mc Graw-Hill.
6. Pandey BP (2018) A Textbook of Botany: Angiosperm. S. Chand Publishing, 7361, Ram Nagar, Qutab Road, New Delhi-110055.
7. Simpson MG (2006) Plant Systematics. Elsevier Academic Press.
8. Singh G (2012) Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

Graduate Attributes

Course Objective:

This paper will provide an understanding of knowledge on plant systematics, basic understanding of plant identification, classification systems and plant nomenclature, significance of systematics in different fields/branches of botany, phylogenetic and evolutionary relationships of angiosperms. The paper will also focus on knowledge about

herbaria and botanical gardens in India and abroad and their significant role in plant identification.

Learning outcome:

On successful completion of the course, students will be:

1. Able to obtain knowledge on plant identification and classification systems, plant nomenclature.
2. Detailed knowledge of the phylogenetic and evolutionary relationships of angiosperms.
3. Able to obtain knowledge on various herbaria and botanical gardens in India and abroad, their role in plant systematics.
4. Acquainted with practical knowledge on vegetative and reproductive structures of angiosperms.
5. Acquainted students with practical knowledge on vegetation of an area.

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):

Prof. Bhaben Tanti
Head, Department of Botany,
Gauhati University
Email id: btanti@gauhati.ac.in

Four-year Undergraduate Programme
Subject: Botany
Semester: Sixth
Course Name: *Reproductive Biology of Angiosperm*
Existing Base Syllabus: UG CBCS Syllabus
Course Level: 300-399, 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 reproductive biology of Angiosperms:** History (contributions of G.B. Amici, W. Hofmeister, E. Strasburger, S.G. Nawaschin, P. Maheshwari, B.M. Johri, W.A. Jensen, J. Heslop-Harrison) and scope.	4	4
Unit 2	**Reproductive development:** Induction of flowering; flower as a modified determinate shoot. Flower development: genetic and molecular aspects.	4	6
Unit 3	**Anther and pollen biology:** Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance. Micro-gametogenesis; Pollen wall structure, MGU (male germ unit) structure; Palynology and scope (a brief account); NPC system; Pollen wall proteins; Pollen viability, storage and germination; Abnormal features: Pseudomonads, polyads, massulae, pollinia.	10	14
Unit 4	**Ovule:** Structure; Types; Special structures– endothelium, obturator, aril, caruncle and hypostase; Female gametophyte- megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of *Polygonum* type); Organization and ultrastructure of mature embryo sac.	6	10
Unit 5	**Pollination and fertilization:** Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization. Basic concept of Self incompatibility (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self- incompatibility: mixed pollination, bud	12	12

	pollination, stub pollination; Intra-ovarian and *in vitro* pollination; Modification of stigma surface, parasexual hybridization; Cybrids, *in vitro* fertilization.		
Unit 6	**Embryo, Endosperm and Seed:** Structure and types; General pattern of development of dicot and monocot embryo and endosperm; Suspensor: structure and functions; Embryo-endosperm relationship; Nutrition of embryo; Unusual features; Embryo development in *Paeonia*. Seed structure, importance, and dispersal mechanisms. Polyembryony and apomixis: Introduction; Classification; Causes and applications.	9	14
PRACTICAL [Credit: 01]			
1. **Anther:** Wall and its ontogeny; Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bi-celled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation. 2. **Pollen grains:** Fresh and acetolyzed showing ornamentation and aperture, psuedomonads, polyads, pollinia (slides/photographs, fresh material), ultrastructure of pollen wall(micrograph); Pollen viability: Tetrazolium test for germination: Calculation of percentage germination in different media using hanging drop method. 3. **Ovule:** Types-anatropous, orthotropous, amphitropous/ campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs). 4. **Female gametophyte through permanent slides/ photographs:** Types, ultrastructure of mature egg apparatus. 5. Intra-ovarian pollination; Test tube pollination through photographs. 6. **Endosperm:** Dissections of developing seeds for endosperm with free-nuclear haustoria. 7. **Embryogenesis:** Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages.	30	40

Reading list:

1. Bhattacharya M, Bhattacharya. (2012). A Textbook of Palynology: Basic and Applied. New Central Book Agency (P) Ltd. Guwahati.
2. Bhojwani SS, Bhatnagar SP (2011) The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
3. Johri BM (1984) Embryology of Angiosperms, Springer-Verlag, Netherlands.
4. Raghavan V (2000) Developmental Biology of Flowering plants, Springer, Netherlands.
5. Shivanna KR (2003) Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.

Graduate Attributes

Course Objective:

This paper will explain the detailed accounts on reproductive and developmental characteristics of Angiosperm.

Learning outcome:

1. Knowledge on detailed morphological andreproductive structures of angiosperm.
2. Knowledge on embryology and embryological abnormalities in angiosperms.
3. Practical knowledge on developmental biology of embryo and endosperms.

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):

Prof. Bhaben Tanti
Head, Department of Botany,
Gauhati University
Email id: btanti@gauhati.ac.in

Four-year Undergraduate Programme
Subject: Botany
Semester: Sixth
Course Name: *Plant Physiology*
Existing Base Syllabus: UG CBCS Syllabus
Course Level: 300-399, 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	**Plant-water relations:** Water Potential and its components; Water absorption by roots: aquaporins; Pathway of water movement: symplast, apoplast, transmembrane pathways; Ascent of sap: Mechanisms, cohesion-tension theory, root pressure, guttation; Transpiration: Factors affecting transpiration, anti-transpirants, mechanism of stomatal movement.	5	8
Unit 2	**Mineral nutrition and nutrient uptake:** Criteria for essentiality of mineral elements, macro and micronutrients, nutrient solutions for plant growth experiments, roles of essential elements, mineral deficiency symptoms, chelating agents, Ion antagonism and toxicity. Soil as a nutrient reservoir; Transport of ions across cell membrane: Passive and active absorption, electrochemical gradient, facilitated diffusion, carrier systems, proton ATPase pump and ion flux, uniport, symport, antiport, co-transport.	10	10
Unit 3	**Translocation of organic solutes:** Phloem as the path of organic solute translocation: Experimental evidences, Mechanisms of solute transport, Pressure-Flow Model and Munch's hypothesis, Phloem loading and unloading, Source - sink relationship.	4	8
Unit 4	**Plant growth regulators (PGRs):** Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxins, Gibberellins, Cytokinins, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid; Synthetic PGRs; Application of PGRs in agriculture and horticulture.	10	14

Unit 5	**Physiology of flowering and seed dormancy:** Photoperiodism: SDPs and LDPs, flowering stimulus, florigen concept; Vernalization; Photoreceptors: Phytochrome, crytochrome and phototropin; Discovery, chemical nature, mechanism of action, role in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR); Seed dormancy: Significances, causes of dormancy, mechanisms to break dormancy.	8	12
Unit 6	**Plant stress physiology:** Abiotic and biotic stress: Plants' responses to drought, water logging, salinity, heavy metals, freezing, heat stress and pathogen attack. Oxidative stress: Generation of reactive oxygen species (ROS); Effect of ROS on metabolism; ROS detoxification mechanisms in plants; Stress mitigation strategies (Enzymatic and non-enzymatic).	8	8
PRACTICAL [Credit: 01]			
1. Determination of osmotic potential of plant cell sap by the method of plasmolysis. 2. Determination of water potential of given tissue (e.g., potato tuber) by weight method. 3. Study of the effect of sunlight on the rate of transpiration in excised twig/leaf. 4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of mesophyte/ xerophyte. 5. Effect of carbon dioxide concentration on the rate of photosynthesis. 6. To study the effect of different concentrations of IAA on Gram/Pea/Moong root (IAA Bioassay). 7. Determination of seed germination percentage in different physical conditions (Demonstration) 8. To demonstrate water stress by application of PEG/ water withdrawal in germinating seeds /growing plants (Demonstration) 9. Fruit ripening/Rooting from cuttings (Demonstration).		30	40

Reading list:

1. Bajracharya D (1999) Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.
2. Bhatla SC, Lal MA (2018) Plant Physiology, Development and Metabolism. Springer Nature Singapore Pte Ltd.

3. Devlin RM (2017) Outline of Plant Physiology. Medtech: Scientific International Pvt. Ltd.
4. Devlin RM, Witham FH, Blaydes DF (2017) Devlin's Exercises in Plant Physiology. Medtech: Scientific international Pvt. Ltd.
5. Hopkins WG, Huner A (2008) Introduction to Plant Physiology (4th edition). John Wiley and Sons. U.S.A.
6. Kochhar SL, Gujral SK (2021) Plant Physiology: Theory and Applications (2nd edition). Cambridge University Press.
7. Malik CP, Srivastava (2015) Text Book of Plant Physiology. Kalyani Publishers, New Delhi.
8. Salisbury FB, Ross CW (2004) Plant Physiology (4th edition). Cengage Learning India Pvt. Ltd., New Delhi, India.
9. Taiz L, Zeiger E, MØller IM, Murphy A (2015) Plant Physiology and Development (6th edition). Sinauer Associates Inc. USA.

Graduate Attributes

Course Objective:

Students will be able to learn the plant and water relation and thus will be able to elucidate the crucial role of water in diverse physiological functions of plants, by studying this paper. The paper will also highlight the importance of mineral elements in plant physiology and various mechanisms applied to uptake mineral elements by plants. It will provide the basic idea of pathways and mechanisms of translocation of organic solutes synthesised in plant. Furthermore, this paper will explain the role and mechanisms of action of various plant growth regulators as well as physiology of flowering and dormancy of seeds. Additionally, the paper will also focus on the different abiotic and biotic stresses encountered by the plants in their environment as well as various stress mitigation strategies employed by plants to overcome the effects of stress.

Learning outcome:

1. Knowledge on mechanisms of water, minerals, and nutrient absorption of plants
2. Knowledge on roles of plant hormones and mechanism of flowering in plants
3. Practical knowledge on effects of growth regulators on plant parts
4. Practical knowledge on determination of osmotic and water potential

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):

Prof. Bhaben Tanti
Head, Department of Botany,
Gauhati University
Email id: btanti@gauhati.ac.in

Four-year Undergraduate Programme
Subject: Botany
Semester: Sixth
Course Name: *Plant Metabolism and Biochemistry*
Existing Base Syllabus: UG CBCS Syllabus
Course Level: 300-399, 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	**Concepts of metabolism:** Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes; classification, nomenclature, and importance of enzyme; Concept of coenzyme, apoenzyme and prosthetic group; Enzyme inhibition (allosteric, covalent modulation); Isozymes.	6	8
Unit 2	**Carbon assimilation:** Role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centers, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q-cycle, CO_2 reduction: C3, C4-pathways, Crassulacean acid metabolism; Photorespiration.	8	12
Unit 3	**Carbon oxidation and ATP Synthesis:** Glycolysis and its regulation, oxidative decarboxylation of pyruvate, TCA cycle and regulation, amphibolic role, anaplerotic reactions, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, pentose phosphate pathway; Factors affecting respiration; ATP synthesis: substrate level phosphorylation, chemiosmotic mechanism, ATP synthase, Boyer's conformational model, Racker's experiment, Jagendorf'sexperiment, role of uncouplers.	10	12
Unit 4	**Carbohydrate, Lipid and Nitrogen metabolism:** Synthesis and catabolism of sucrose, starch and cellulose, Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α-oxidation. Nitrogen assimilation: biological nitrogen fixation (examples of legumes and non-legumes), biochemistry of nitrogen	12	14

	fixation, ammonia assimilation and transamination.		
Unit 5	**Mechanisms of Signal Transduction:** Receptor-ligand interactions, Second messenger concept, Calcium-calmodulin, MAP kinase cascade, two-component system.	5	8
Unit 6	**Secondary Metabolites:** Shikimate Pathway: Role in biosynthesis of secondary metabolites; Biosynthesis and physiological roles of terpenes, phenols and nitrogenous compounds.	4	6
PRACTICAL [Credit: 01]			
1. Chemical separation of photosynthetic pigments by solvent method/paper chromatography 2. Estimation of sugar content by DNSA method 3. Determination of titratable acid number (TAN) in plant materials 4. Quantification of chlorophyll a, b and total chlorophyll and determination of chlorophyll a/b ratio 5. Estimation of phenol/tannin/flavonoid by colorimetric method 6. Estimation of protein in plant sample by Lowry's method/Biuret method 7. Separation of amino acids by paper chromatography 8. Demonstration of Thin layer chromatography (TLC)/Column chromatography 9. To compare the rate of respiration by Ganong's respirometer in different parts of plant (Demonstration)		30	40

Reading list:

1. Cox MM, Nelson DL (2017) Principles of Biochemistry (7th Edition). WH Freeman & Co., Newyork.
2. Goodwin TW, Mercer EI (2005) Introduction to Plant Biochemistry. CBS Publishers and Distributors Pvt. Ltd., New Delhi.
3. Jain J L, Jain S, Jain N (2016) Fundamentals of Biochemistry (7th edition). S Chand & Co. PVT. Ltd., New Delhi, India;
4. Palmer T, Bonner P (2008) Enzymes: Biochemistry, Biotechnology, Clinical Chemistry. East West Press Pvt. Ltd., New Delhi;
5. Plummer D (2017) An Introduction to Practical Biochemistry (3rd edition). McGraw Hill Education, New Delhi, India
6. Sadasivam A, Manickam S (2022) Biochemical Methods (4th edition). New Age International Pvt. Ltd.
7. Satyanarayana U, Chakrapani U (2021) Biochemistry (6th edition). Elsevier;
8. Voet D, Voet JG, Pratt CW (2018) Principles of Biochemistry (5th edition). J Wiley & Sons, Singapore Pte. Ltd.

Graduate Attributes

Course Objective:

Students will be acquainted with the elaborate concept of plant metabolism and biochemical pathways, by studying this paper. The paper will highlight the carbon assimilation pathways as well as carbon oxidation and ATP synthesis mechanisms in plant body. It will provide the detailed idea of pathways and mechanisms of carbohydrate, lipid, and nitrogen metabolism in plants. Furthermore, this paper will explain the various aspects and cascades of signal transduction mechanism. Additionally, the paper will also focus on the biosynthesis and physiological roles of secondary metabolites in plants.

Learning outcome:

1. Knowledge in basic understanding of plant metabolism and their regulation
2. Knowledge in concepts of carbon assimilation, oxidation, ATP synthesis
3. Knowledge in basic concepts of carbohydrate, Lipid and Nitrogen metabolism
4. Knowledge in basic concepts of signal transduction
5. Practical knowledge in separation of pigments, estimation of sugars, rate of respiration.
6. Ability to perform experiments on chromatographic techniques, spectrophotometric analysis.

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):

Prof. Bhaben Tanti
Head, Department of Botany,
Gauhati University
Email id: btanti@gauhati.ac.in

Four-year Undergraduate Programme
Subject: Botany
Semester: Sixth
Course Name: *Applied Plant Biology*
Existing Base Syllabus: UG CBCS Syllabus
Course Level: 300-399, 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	**Plant Tissue Culture:** Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion.	8	10
Unit 2	**Application of tissue culture:** Micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm conservation.	4	6
Unit 3	**Recombinant DNA technology:** Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC).	8	10
Unit 4	**Gene Cloning:** Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR- mediated gene cloning; Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; PCR	9	12
Unit 5	**Methods of gene transfer:** *Agrobacterium*-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics - selectable marker and reporter genes (Luciferase, GUS, GFP).	6	10

Unit 6	**Applications of genetic engineering:** Pest resistant (Bt-cotton); herbicide resistant plants (Round Up Ready soybean); Transgenic crops with improved quality traits (FlavrSavr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug).	10	12
PRACTICAL [Credit: 01]			
1. (a) Preparation of MS medium. (b) Demonstration of *in vitro* sterilization and inoculation methods using leaf and nodal explants of any plant species. 2. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs. 3. Isolation of protoplasts. 4. Construction of restriction map of circular and linear DNA from the data provided. 5. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment. 6. Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs. 7. Isolation of plasmid DNA. 8. Restriction digestion and gel electrophoresis of plasmid DNA.		30	40

Reading list:

1. Bhojwani SS, Bhatnagar SP (2011) The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition.
2. Bhojwani SS, Razdan MK (1996) Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Ganguli P (2001) Intellectual Property Rights: Unleashing the Knowledge Economy. New Delhi: Tata McGraw-Hill Pub.
4. Glick BR, Pasternak JJ (2003) Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
5. Kuhse H (2010) Bioethics: An Anthology. Malden, MA: Blackwell.
6. Snustad DP, Simmons MJ (2010) Principles of Genetics. John Wiley and Sons, U.K.
7. Stewart CNJr (2008) Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.

Graduate Attributes

Course Objective:

To gain knowledge on plant tissue culture, recombinant DNA technology and applications of genetic engineering techniques.

Learning outcome:

1. Knowledge of various methods of Plant tissue culture and their application
2. Knowledge of gene cloning, recombinant DNA technology and various methods of gene transfer in plants
3. Knowledge of the application of genetic engineering techniques for agriculture.
4. Ability to demonstrate tissue culture technique; isolate plasmid DNA and to carry out DNA manipulation using restriction enzymes

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):

Prof. Bhaben Tanti
Head, Department of Botany,
Gauhati University
Email id: btanti@gauhati.ac.in