Four-year Undergraduate Programme
Subject: Botany
Semester: Eighth
Major-20
Course Name: *Molecular Genetics and Cell Signaling*
Course Level: 400-499, 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	Structure and processing of messenger RNA, transfer RNA, ribosomal RNA, small interfering RNAs and micro RNAs, regulation through RNA processing and decay, alternative splicing	6	8
Unit 2	Transcription, RNA polymerases, initiation, elongation and termination; eukaryotic promoters, enhancers, transcription factors, processing of mRNA for translation. Operon concept in prokaryotes, Mutation and DNA repair	8	12
Unit 3	Molecular genetic techniques, Electrophoresis, restriction digestion, ligation, DNA probes and hybridization, DNA cloning, Cloning and expression vectors, genomic and cDNA library, PCR amplification, Plant and bacterial transformation, DNA sequencing. Genetic manipulation in plants	10	10
Unit 4	Applications of molecular genetic techniques: Developing transgenic plants, Genome editing in plants using CRISPR/Cas9 system, Gene silencing using RNAi, Gene therapy	7	10
Unit 5	Cell Signaling I: Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G protein coupled receptors, Ion channel linked receptors, Enzyme linked receptors	6	8
Unit 6	Cell signaling II: Signal transduction pathways, second messengers, regulation of signaling pathways, bacterial chemotaxis and quorum sensing.	8	12
PRACTICAL [Credit: 01]			
1. Isolation of genomic DNA from plant materials, purification, estimation, separation with gel electrophoresis and documentation		30	40

2. RNA isolation and cDNA synthesis 3. PCR reaction and gel electrophoresis 4. Restriction digestion and mapping 5. Transformation of plasmids in bacteria 6. Plasmid isolation 7. Differential gene expression study using semi quantitative PCR or qPCR		

Reading list:

1. Gardner EJ, Simmons MJ, Snustad DP (2015) Principles of Genetics, John Wiley & sons, India. 8th edition.
2. Klug WS, Cummings MR, Spencer CA (2012) Concepts of Genetics. Benjamin Cummings, U.S.A. 10th edition.
3. Snustad DP, Simmons MJ (2010) Principles of Genetics, John Wiley & Sons Inc., India. 5thedition.
4. Pierce BA (2016) Genetics-A conceptual approach, W.H. Freeman and Co. USA, Sixth edition
5. Cooper GM, Hausman RE (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
6. Hardin J, Becker G, Skliensmith LJ (2012) Becker's World of the Cell, Pearson EducationInc. U.S.A. 8th Edition.
7. Karp G (2010) Cell Biology, John Wiley & Sons, U.S.A. 6th Edition.
8. Primerose SB and Twyman RM (2014), Principles of Gene manipulation and genomics. Wiley Blackwell. Seventh Edition.
9. 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:

This paper will provide knowledge of molecular genetics, and various techniques available for molecular genetics study. It will also provide in depth understanding of cell signaling and signal transduction pathways.

Course outcomes:

On successful completion of the course, students will be able to:

1. Identify and describe the different types of RNA (mRNA, tRNA, rRNA, siRNAs, miRNAs) and their roles in gene expression and regulation.
2. Explain the mechanisms of transcription, RNA processing, and the operon concept in prokaryotes, including the roles of RNA polymerases, promoters, enhancers, and transcription factors.
3. Apply molecular genetic techniques such as electrophoresis, restriction digestion, ligation, PCR amplification, and DNA cloning to manipulate and analyze genetic material.

4. Analyze the results of genetic manipulation experiments, such as plant and bacterial transformation, gene silencing using RNAi, and genome editing using CRISPR/Cas9, to assess the effectiveness of these techniques.
5. Evaluate the role and impact of various cell signaling pathways, including hormone-receptor interactions and second messenger systems, in regulating cellular processes and responses.

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: Eighth
Major-21
Course Name: *Fungal Diversity, Genetics, and Applications*
Course Level: 400-499, 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 fungal diversity; Global fungal diversity and Biogeography; Understanding Cryptic fungi; Methods for estimation of fungal diversity and conservation	6	10
Unit 2	Diversity of Soil Fungi; Diversity of Phytopathogenic fungi; Mushroom diversity; Diversity of endophytic fungi and their functional roles	6	6
Unit 3	Molecular genetic analysis of fungi; Extra chromosomal and transposable genetic elements in fungi; Cell cycle control points in yeast	9	10
Unit 4	Mating-Type switching in Yeasts; Extra-chromosomal inheritance in fungi; Sex hormones in fungi; Retroposon and retrotransposon in fungi	9	14
Unit 5	Fungal secondary metabolites (Polyketides, Terpenes, and Indole alkaloids); Heat shock protein in filamentous fungi	5	8
Unit 6	Biotechnological application of fungi in food, industries, medicines, and agriculture; Myconanotechnology; Mycoremediation and mycofumigation; Mycoses (Types, diagnosis, and treatments)	10	12
PRACTICAL [Credit: 01]			
11. Isolation and enumeration of soil fungi 12. Study of phytopathogenic fungi from diseased samples 13. Molecular identification of fungal specimen 14. Fungal tissue- culture; cultivation of edible mushroom 15. Isolation and determination of secondary metabolites from fungi		30	40

Reading list:

5. Introduction to Fungi. John Webster and Roland W. S. Weber
6. Introduction to Mycology. C. J. Alexopoulos, C. W. Mims and M. Blackwell.
7. Fungi Nutrition & Physiology. Michael O. Garraway and Robert C. Evans.
8. Physiology of Fungi. Lilian E. Hawker

9. The Mycota; Vol: III: Biochemistry and Molecular Biology. K. Esser and P. A. Lemke.
10. The Mycota; Vol: VII: Systematics and Evolution (Part A). K. Esser and P. A. Lemke.

Graduate Attributes

Course Objective:

This paper will explain the detailed account on the diversity, genetics, and applications of Fungi.

Course outcomes:

On completion of the course, students will-

5. Demonstrate an understanding of the diversity of fungi, their global distribution, and the methods used for estimating and conserving fungal diversity.
6. Analyze the roles of different types of fungi in various ecosystems, including soil, plants, and their applications in agriculture and medicine.
7. Apply molecular genetic techniques to analyze fungal genomes, understand the mechanisms of genetic inheritance, and explore the molecular basis of fungal traits and behaviors.
8. Evaluate the significance of genetic elements, such as mating-type switching and retrotransposons, in fungal evolution and adaptation to different environments.
9. Design and propose biotechnological applications of fungi in food production, industrial processes, medicine, and environmental remediation, considering the principles of mycology and practical feasibility.

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: Eight

Major-22

Course Name: *Exploring Cryptogams and Gymnosperms*

Course Level: 400-499, 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	**Algae**: Recent trends in the classification, pigmentation, phylogeny and interrelationships among different groups, patterns of life cycle and post fertilization stages in Chlorophyta, Xanthophyta, Phaeophyta and Rhodophyta	6	10
Unit 2	Ecological importance in different habitats, Algal indicators, Algal blooms, Eutrophication, Productivity in fresh water and marine environment, symbiotic association, Algal culture.		
Unit 3	**Bryophytes**: Origin, evolution, classification, diversity and distribution in North East India, Economic importance. Morphological, anatomical and reproductive diversity, Morphogenesis, Evolution of gametophytes and sporophytes; Bryophytes as pollution indicator and monitoring.	6	10
Unit 4	**Pteridophyta**: Origin and evolution of Pteridophytes; Telome concept; heterospory and origin of seed habit; classification of vascular cryptogams. Morphological, anatomical and reproductive diversity, soral evolution in ferns.	8	15
Unit 5	**Palaeobotany:** Geological time scale, fossilization process, techniques in studying fossils.	2	10
Unit 6	**Gymnosperms**: Classification and salient features of major taxa; characteristics, affinities and relationships of Ginkgoales, Coniferales, Taxales and Gnetales.	8	15
PRACTICAL [Credit: 01]			
1. Study of some important genera of Algae with respect to their morphology, anatomy and reproductive structures. Algal culture technique. 2. Study of some important genera of Bryophytes available in NE India with respect to their morphology, anatomy and reproductive structures. 3. Study of some important fossil and living members of major groups of Pteridophytes. 4. Study of morphological, anatomical and reproductive features of gymnosperms available in the region.		30	40

Reading list:

1. Bhatnagar SP, Moitra A (1996) Gymnosperms. New Delhi, Delhi: New Age International (P) Ltd Publishers.
2. Kumar HD (1999) Introductory Phycology, 2nd edition. Delhi, Delhi: Affiliated East-West. Press Pvt. Ltd.
3. Puri P (1985) Bryophytes. New Delhi, Delhi, Atma Ram and Sons.
4. Singh V, Pandey PC, Jain DK (2001) A Text Book of Botany. Meerut, UP: Rastogi and Co.
5. Vashishta PC, Sinha AK, Kumar A (2010) Pteridophyta. New Delhi, Delhi: S. Chand & Co Ltd.
6. Parihar NS (1991) An IntroductiontoEmbryophyta.Vol. II.Pteridophytes. Prayagraj: U.P.: Central Book Depot.
7. Singh S. R. (2006). A Text Book of Bryphota. Campus Book International. New Delhi.
8. Chopra RN and Kumar P K. (1989) Biology of Bryophytes. New York, Wiley.
9. Singh V, Pandey PC, Jain DK (2001) A Text Book of Botany. Meerut, UP: Rastogiand Co.
10. Vashishta PC, Sinha AK, Kumar A (2010) Pteridophyta. New Delhi, Delhi: S. Chand & Co Ltd.

Graduate Attributes

Course Objective: This course will provide an understanding on the origin and evolutionary history of Algae, Bryophytes, Pteridophytes, and Gymnosperms. Understand the structural adaptations and reproductive strategies unique to each group with their importance to economic and ecological prospective.

Course outcomes:

On successful completion of the course, students will have:

1. Knowledge on Classification of algae based on recent trends.
2. Evaluate ecological roles and importance of these groups.
3. Analyze the evolutionary history and diversity of Algae, Bryophytes, Pteridophytes and Gymnosperms.
4. Synthesize knowledge of morphology and reproduction to understand evolutionary adaptations in Cryptograms.
5. Interpret the classification and characteristics of gymnosperm taxa to infer evolutionary relationships

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: Eight
Major-23
Course Name: *Plant Growth and morphogenesis*
Course Level: 400-499, 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	**Photomorphogenesis:** Photochemical and biochemical properties of phytochromes, cryptochromes and phototropins; phytochrome biosynthesis, cellular localization, roles; Mechanism of action of photomorphogenetic receptors.	8	12
Unit 2	**Plant developments:** Plant developments: Biochemical changes during development of seeds; Plant movement: tropic and nastic movements.	6	8
Unit 3	**Post-harvest physiology:** Ripening of fruit and its regulation, post-harvest management; Fruit and vegetable preservation: chemical and non-chemical preservation techniques, nutritional changes during preservation.	7	8
Unit 4	**Plant Growth Regulators:** A brief idea about discovery, role and possible mechanism of action of Triacontanol, Salicylic acid, and Polyamines. A brief idea about role of plant growth retardants- CCC, Maleic hydrazide, Trizoles and TIBA.	8	10
Unit 5	**Senescence and Programmed Cell Death (PCD):** Biochemical changes during senescence of leaves and petals and regulation of senescence. PCD: Biochemical changes in cellular level, regulation of PCD, caspases and metacaspases.	8	10
Unit 6	**Applied Plant physiology:** Foliar nutrition: Conditions, factors affecting efficiency of Foliar nutrition; Advantages, and disadvantages. Chelators and soil conditioners. Phytoremediation: History, Mechanisms and types, Advantages, and disadvantages. Role of tissue culture, and mutants in plant physiological studies.	8	12
	PRACTICAL [Credit: 01]		
1. Study of changes in starch / protein content during seed development. 2. Study of lipid accumulation during development of oil seeds. 3. Demonstration of hormonal regulation of leaf and petal senescence. 4. To study the effect of different PGRs on seedling growth.		30	40

Suggested Readings:

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:

The course objective is to enable students to demonstrate a comprehensive understanding of plant photomorphogenesis, including the photochemical and biochemical properties of phytochromes, cryptochromes, and phototropins, as well as the mechanisms of action and roles of these photomorphogenetic receptors in plant development. Additionally, students will gain insights into biochemical changes during seed development, plant movement mechanisms, and post-harvest physiology with a focus on fruit ripening, preservation techniques, and nutritional changes. Furthermore, the course aims to familiarize students with plant growth regulators such as Triacontanol, Salicylic acid, Polyamines, and growth retardants like CCC, Maleic hydrazide, Trizoles, and TIBA, elucidating their roles and possible mechanisms of action. Finally, students will explore senescence, program med cell death (PCD), and applied plant physiology topics including foliar nutrition, chelators and soil conditioners, phytoremediation mechanisms and applications, as well as the role of tissue culture and mutants in advancing plant physiological studies.

Course outcomes:

On successful completion of the course, students will be able to:

1. Apply knowledge of the mechanism of action of photomorphogenesis receptors in plant responses to light.
2. Apply knowledge of tropic and nastic movements in plants and their adaptive roles.
3. Evaluate the advantages and disadvantages of chemical and non-chemical preservation techniques on nutritional changes in fruits and vegetables.
4. Evaluate the advantages and disadvantages of chemical and non-chemical preservation techniques on nutritional changes in fruits and vegetables.

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