Syllabus of FYIPGP in Life Sciences (Botany)

Department of Life Sciences

Approved in the BOS held in 04th June 2024

DIBRUGARH UNIVERSITY

Dibrugarh, Assam

786004

Vision of the Department:

Investigate and analyze biological diversity for designing solutions to mitigate public health issues and climate change through sustainable management of bioresources.

Mission of the Department:

The Department is committed to develop competent human resources in the field of life sciences to address issues associated with sustainable development goals, health and welfare of the society.

Thrust Areas of Research

Inventorization, Bioprospecting and Database Development of Endemic Flora & Fauna of Northeast India

Values of the Department

1. Excellence in Education: Commitment to provide high-quality education in life sciences.
2. Research Integrity: Upholding the highest standards of honesty and ethical practices in
3. research.
4. Innovation: Encouraging creativity and innovation in both teaching and research.
5. Collaboration: Fostering collaborative efforts within the department and with external
6. partners.
7. Diversity and Inclusion: Embracing diversity and striving for an inclusive environment for all students and staff.

Programs offered:

1) M.Sc. in Life Sciences (Botany)
2) M. Sc. in Life Sciences (Zoology)
3) FYIPGP in Life Sciences (Botany)
4) FYIPGP in Life Sciences (Zoology)
5) Ph.D. in Life Sciences

Programme Educational Objectives (PEOs)

1) Formulate strategies to achieve sustainable development in harnessing biological resources.
2) Evaluate environmental problems and design innovative solutions.
3) Demonstrate an attitude to employ multidisciplinary approaches for problem solving.

Programme Outcomes (POs)

1) Develop ideas to assess and inventorize existing biological resources of this region
2) Formulate innovative strategies for conservation of biogenetic resources for human welfare

3) To explore and validate ethnobiological knowledge of Northeast India

4) To provide solutions for existing societal problems using biological knowledge

5) Develop research skills to solve complex biological issues and achieving SDGs

6) Execute good communication skills for disseminating knowledge of biological sciences

7) To promote the attitude to work as a team appreciating ethical values

Programme Specific Outcomes (PSOs)

1) Evaluate the diversity and evolution of organisms

2) Analyze the fundamentals of life sustaining processes

3) Design strategies for issues concerning public health and human welfare

4) Critically analyze the environmental issues and develop strategies to address them

5) Formulate measures to mitigate climate change effects

COURSE STRUCTURE
FYIPGP LIFE SCIENCES (BOTANY)

Year	Sem.	Corse code	Title of the course		Credit
I	I	Core-I	Algae, Fungi, and Archegoniates		4
		Minor-I	Algae, Fungi, and Archegoniates		4
		GEC-I	Natural Resource Management		3
		AEC-I	Modern Indian Language		4
		SEC-I	Seritechnique		3
		VAC-I	Understanding India		2
		Total credit			**20**
	II	Core-II	Angiosperm systematics		4
		Minor-II	Angiosperm Systematics		4
		GEC-II	Biodiversity and human welfare		3
		AEC-II	English Language and Communication Skills		4
		SEC-II	Vermicomposting/Introduction to Artificial intelligence in Biological Sciences		3
		VAC-II	Environmental Science		2
		Total credit			**20**
			UG CERTIFICATE		
II	III	Core-III	Cell biology-I		4
		Core-IV	Biochemistry & Molecular biology - I		4
		Minor-III	Biotechnology, tissue culture, and animal cell culture- I		4
		GEC-III	Ethnobiology		3
		SEC-III	Multi-Disciplinary Course: Basic Analytical Tools and Techniques in Science		3
		VAC-III	Digital and Technological Solutions / Digital Fluency		2
			Total credit		**20**
		Core-V	Genetics and Evolutionary Biology-I		4

	IV	C ore-VI	Microbiology & immunology-I		4
		Core-VII	Bioinformatics and biostatistics		4
		Core-VIII	Lab course based on core courses		4
		Minor-IV	Techniques in Biology-I		4
		Total Credit			**20**
		UG DIPLOMA			
III	V	Core-IX	Anatomy and embryology of angiosperms		4
		Core-X	Plant ecology and phytogeography		4
		Core-XI	Lab course based on core courses		4
		Minor-V	Plant ecology and phytogeography		4
		Int./Comm./project	Field study/project		4
		Total credit			**20**
		Core-XII	Plant physiology-I		4
		Core-XIII	Utilization of Plant resources		4
		Core-XIV	Plant breeding, crop improvement & Phytopathology		4
		Core-XV	Lab course based on core-		4
		Minor-XI	Plant physiology		4
		Total credit			**20**
UG DEGREE					

COURSE DETAILS

SEMESTER-I

Title of the Course : Algae, Fungi, and Archegoniate
Nature of course : CORE-I
Course Code :
Total Credits : 04
Distribution of Marks : 40+60=100

Course outcomes:

1) describe different groups of the plant kingdom
2) organize the organisms into different categories based on morphological Characteristics
3) analyze the interrelationship among different species and genera within each group
of plants

Learning Outcomes:

1) understand the various groups in the Kingdom
2) compare various organisms based on morphology
3) classify different groups of plants

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2,CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.1
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment:

1. One internal examination (theory)
2. One internal examination (Lab)
3. Viva-voce
4. Group discussion
5. Home assignments

Attainment of Cos:

1. Continuous evaluation through in and end semester theory and practical examinations
2. Field collection and identification of specimens
3. Submission of collected specimens
4. Practical record book

Course content:

Section- A

Unit I: Algae: **9 classes**

General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Reserved food; Pigments; Classification of algae; Morphology and life-cycles, Economic importance of algae

Unit II: Fungi: **9 classes**

Introduction- General characteristics, ecology, and significance, range of thallus organization, cell wall composition, nutrition, reproduction, and classification; True Fungi- General characteristics, ecology, and significance, life cycle

Symbiotic Associations-Lichens: General account, reproduction, and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

Unit III: **Bryophytes**: **9 classes**

General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction, Ecology, and economic importance of bryophytes

Unit IV: Pteridophytes: **9 classes**

General characteristics, Early land plants, Classification (up to family), morphology, anatomy and reproduction, Heterospory and seed habit, stellar evolution. ecological and economic importance of Pteridophytes. Life history of *Lycopodium, Selaginella & Isoetes,* Ferns

Unit V: Gymnosperms: **9 classes**

General characteristics, Classification (up to family), morphology, anatomy and Reproduction, Ecological and economic importance; distribution of Gymnosperms in NE India; *Ginkgo, Pinus; Taxus, Gnetum*

Section-B

Lab activities

1. Specimen study of blue-green algae/cyanobacteria (*Anabaena, Nostoc, Gloeotrichia*)
2. Specimen study of Algae (*Volvox, Ulothrix, Ectocarpus, Polysiphonia*)
3. Study of fungi: colony, view of the hyphae under microscope, *Mucor, Rhizopus, Aspergillus, Penicillium, Agaricus*)
4. Specimen study of Bryophytes (*Riccia, Marchantia, Anthoceros, Polytrichum, Funaria*)
5.. Specimen study of Pteridophytes (*Lycopodium, Selaginella, Marsilea, Isoetes, Equisitum)*
6. Specimen study of Gymnosperms (*Cycas, Pinus, Thuja, Gnetum*)

Textbooks

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P.H et al (2006) Biology 7th edition Tata McGraw-Hill Publications, New Delhi
3. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY

Suggested Readings

1. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
2. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 12. 2nd edition.
3. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
4. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

SEMESTER-I

Title of the Course	**:**	**Algae, Fungi, and Archegoniates**
Nature of Course	**:**	**MINOR-I**
Course code	**:**	
Total Credits	**:**	**04**
Distribution of Marks	**:**	**40+60=100**

Course outcomes:

1) describe different groups of the plant kingdom
2) organize the organisms into different categories based on morphological Characteristics
3) to analyze the interrelationship among different species and genera within each group of plants

Learning Outcomes:

1) understand the various groups in the Kingdom
2) compare various organisms based on morphology
3) classify different groups of plants

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1		CO2,CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.1
CO2	3	2	2	2	2	2	2	2..1
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment:

1. One internal examination (theory)
2. One internal examination (Lab)
3. Viva-voce
4. Group discussion
5. Home assignments

Attainment of Cos:

1. Continuous evaluation through in and end semester theory and practical examinations
2. Field collection and identification of specimens
3. Submission of collected specimens
4. Practical record book
5. Seminar/group discussion

Course content:

Section- A

Unit I: Algae: **9 classes**

General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Reserved food; Pigments; Classification of algae; Morphology and life-cycles, Economic importance of algae

Unit II: Fungi: **9 classes**

Introduction- General characteristics, ecology, and significance, range of thallus organization, cell wall composition, nutrition, reproduction, and classification; True Fungi- General characteristics, ecology, and significance, life cycle

Symbiotic Associations-Lichens: General account, reproduction, and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

Unit III: **Bryophytes**: **9 classes**

General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction, Ecology, and economic importance of bryophytes

Unit IV: Pteridophytes: **9 classes**

General characteristics, Early land plants, Classification (up to family), morphology, anatomy and reproduction, Heterospory and seed habit, stellar evolution. ecological and economic importance of Pteridophytes. Life history of *Lycopodium, Selaginella & Isoetes,* Ferns

Unit V: Gymnosperms: **9 classes**

General characteristics, Classification (up to family), morphology, anatomy and Reproduction, Ecological and economic importance; distribution of Gymnosperms in NE India; *Ginkgo, Pinus; Taxus, Gnetum*

Section-B

Lab activities

1. Specimen study of blue-green algae/cyanobacteria (*Anabaena, Nostoc, Gloeotrichia*)
2. Specimen study of Algae (*Volvox, Ulothrix, Ectocarpus, Polysiphonia*)
3. Study of fungi: colony, view of the hyphae under microscope, *Mucor, Rhizopus, Aspergillus, Penicillium, Agaricus*)
4. Specimen study of Bryophytes (*Riccia, Marchantia, Anthoceros, Polytrichum, Funaria*)
5.. Specimen study of Pteridophytes (*Lycopodium, Selaginella, Marsilea, Isoetes, Equisitum)*
6. Specimen study of Gymnosperms (*Cycas, Pinus, Thuja, Gnetum*)

Textbooks

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P.H et al (2006) Biology 7th edition Tata McGraw-Hill Publications, New Delhi
3. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY

Suggested Readings

1. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
2. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 12. 2nd edition.
3. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
4. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

SEMESTER-I

Title of the Course	**:**	**Natural Resource Management**
Nature of course	**:**	**GEC-I**
Course code	**:**	
Total Credits	**:**	**03**
Distribution of Marks	**:**	**40+60=100**

Course outcomes:

1. Distinguish between renewable and non-renewable resources
2. Analyse threats to natural and biological resources of NE India
3. Examine management strategies for sustainable utilization of resources

Learning outcomes

1. Differentiate natural and biological resources of NE India
2. Identify the threats and issues related to the natural resources
3. Execute conservation and management strategies for natural resources

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual				CO1, CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.1
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment:

1. One internal examination (theory)
2. One internal examination (Lab)
3. Viva-voce
4. Group discussion
5. Home assignments

Attainment of Cos:

1. Continuous evaluation through in and end semester theory and practical examinations
2. Field demonstration of natural resources
3. Demonstration of modern tools like GIS
4. Participation in seminar/conference
5. Practical record book

Course content

UNIT-I: Natural resources: 07 classes

Definition and types. Natural resources of NE India. Renewable and non-renewable sources of energy.

UNIT-II: Sustainable utilization of land and water resources: **15 classes**

Soil degradation and management; water resources (Freshwater, marine, estuarine) wetlands; Threats and management strategies and their management.

UNIT-III: Biodiversity: 08 classes

Definition, types, significance, threats, management strategies, CBD, Bioprospecting

UNIT IV: 15 classes

Contemporary practices in resource management: EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting; Waste management. National and international efforts in resource management and conservation.

SUGGESTED READINGS:

1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.

SEMESTER I

Title of the Course : SERITECHNIQUE
Course Code :
Nature of the Course : SEC I
Total Credits : 03
Distribution of Marks : 60+40=100

Course outcomes

1. Discuss the concept of sericulture.
2. Explain the rearing technique and associated tools.
3. Examine the diseases and learn the control measures.

LEARNING OUTCOMES:

After the completion of this course, the learner will be able to:
CO1: Comprehend the aspects of Seri-technology
CO2: Analyze and develop the skill to rear silkworms for entrepreneurship and explore the challenges in entrepreneurship development.

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual				CO1, CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.1
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	3	1	1	2	2	2.0
AVERAGE	3	2	2.3	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Unit 1: Sericulture:

Introduction: history and present status; Silk route. Sericulture industry in different states, employment, potential in mulberry and non-Mulberry sericulture. Entrepreneurship in sericulture:Identification of wild and domesticated silkworms

Unit 2: Rearing of silkworms:

Mulberry silkworm rearing -Rearing house and rearing appliances, Early age and Lateage rearing. Types of mountages Spinning, harvesting and storage of cocoons. Non mulberry

silkworm rearing: Host plants of nonmulberry silkworm, maintenance of host plants of *Antheraea assamensis*, rearing technology of A*ntheraea* spp and *Samia cynthiaricini*

Unit 3: Pests and diseases:

Pests of silkworm: Uzi fly, *Apanteles*, dermestid beetles and vertebrates. Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial. Symptoms, Control and prevention of pests and diseases.

Unit 4: (12 lectures)

i)Sex separation in larva, pupa and adult of silkworm

ii)Identification of different diseased silkworms based on external symptoms (Grasserie,Flacherie, Muscardine and Pebrine) and Identification

of permanent slide of gut bacteria of silkworm, spores of Pebrine, spores of Muscardine

iii) Rearing of eri silk worm on artificial diet

Unit 5: (12 lectures)

i)Identification and study of Sericulture products

ii)Extraction of protein from silk gland

iii)Extraction of DNA from silk moth legs and purity test

iv) Project

SUGGESTED READINGS

- Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
- Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn. & Pub. Govt. Press,Bangalore
- Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR &TI,Mysore
- Handbook of Silkworm Rearing: Agriculture and Technical Manual1, Fuzi Pub. Co. Ltd., Tokyo, Japan1972.
- Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore1988.
- Silkworm Rearing; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome1988.
- A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI

SEMESTER-II

Title of the Course : Angiosperm Systematics
Nature of Course : CORE-II
Corse Code :
Total Credits : 04
Distribution of Marks : 40+60=100

Course outcomes

1. identify the diversity of angiosperms, including major families, genera, and species.
2. develop proficiency in using taxonomic keys, morphological features, and molecular data to classify and identify angiosperms.
3. ability to interpret phylogenetic trees and understand their implications for classification and evolution
4. evaluation of phylogenetic analyses, and taxonomic controversies within angiosperm

Learning Outcomes:

1. identify angiosperm taxa at the family, genus, and species levels using morphological, anatomical, and molecular characters
2. classify the local angiosperm flora based on their morphological, anatomical, and molecular characters
3. analysis of the evolutionary relationships among angiosperms and major clades of angiosperms
4. examine the phylogenetic analyses, and taxonomic controversies within angiosperm

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural			CO3	CO4		CO2
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.1
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	3	1	1	2	2	2.0
CO4	3	2	3	2	2	2	2	2.3
AVERAGE	3	2	2.5	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment:

1. One internal examination (theory)
2. One internal examination (Lab)
3. Viva-voce
4. Group discussion
5. Home assignments

Attainment of Cos:

1. Continuous evaluation through in and end semester theory and practical examinations
2. Field collection and identification of local flora
3. Submission of collected specimens in the form of herbaria/bottle specimen
4. Practical record book/field book
5. Seminar/group discussion

Course content:

Section-A

Unit 1: Significance of Plant Systematics **9 classes**

Introduction to systematics; Plant identification, Classification, Nomenclature. Evidences from

palynology, cytology, phytochemistry and molecular data. Field inventory; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys:Single access and Multi-access.

Unit 2: Taxonomic hierarchy **5 classes**

Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept

(taxonomic, biological, evolutionary).

Unit 3: Botanical nomenclature **06 classes**

Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.

Unit 4: Systems of classification **10 classes**

Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (upto series) and Engler and Prantl (upto series); Brief reference of Angiosperm Phylogeny Group (APG III) classification.

Unit 5: Biometrics, numerical taxonomy and cladistics **7 classes**

Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences).

Unit 6: Phylogeny of Angiosperms **8 classes**

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 evolutionary relationship (phylogenetic tree, cladogram).

Section- B

Lab activities

1. Study of vegetative and floral characters of the following families
    a. Magnoliaceae
    b. Brassicaceae
    c. Malvaceae
    d. Lamiaceae
    e. Solanaceae
    f. Asteraceae
    g. Poaceae
2. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Suggested Readings

1. Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rdedition.

2. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.

3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.

4. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi.

5. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York

SEMESTER-II

Title of the Course : Angiosperm Systematics
Nature of Course : MINOR-II
Course Code :
Total Credits : 04
Distribution of Marks : 40+60=100

Course outcomes

1. identify the diversity of angiosperms, including major families, genera, and species.
2. develop proficiency in using taxonomic keys, morphological features, and molecular data to classify and identify angiosperms.
3. ability to interpret phylogenetic trees and understand their implications for classification and evolution
4. evaluation of phylogenetic analyses, and taxonomic controversies within angiosperm

Learning Outcomes:

1. identify angiosperm taxa at the family, genus, and species levels using morphological, anatomical, and molecular characters
2. classify the local angiosperm flora based on their morphological, anatomical, and molecular characters
3. analysis of the evolutionary relationships among angiosperms and major clades of angiosperms
4. examine the phylogenetic analyses and taxonomic controversies within angiosperm

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural			CO3	CO4		CO2
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.1
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	3	1	1	2	2	2.0
CO4	3	2	3	2	2	2	2	2.3
AVERAGE	3	2	2.5	1.7	1.7	2	2	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment:

1. One internal examination (theory)
2. One internal examination (Lab)
3. Viva-voce
4. Group discussion
5. Home assignments

Attainment of Cos:

1. Continuous evaluation through in and end semester theory and practical examinations
2. Field collection and identification of local flora
3. Submission of collected specimens in the form of herbaria/bottle specimen
4. Practical record book/field book
5. Seminar/group discussion

Course content:

Section-A

Unit 1: Significance of Plant Systematics **9 classes**

Introduction to systematics; Plant identification, Classification, Nomenclature. Evidences from

palynology, cytology, phytochemistry and molecular data. Field inventory; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys:Single access and Multi-access.

Unit 2: Taxonomic hierarchy **5 classes**

Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept

(taxonomic, biological, evolutionary).

Unit 3: Botanical nomenclature **06 classes**

Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.

Unit 4: Systems of classification **10 classes**

Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (upto series) and Engler and Prantl (upto series); Brief reference of Angiosperm Phylogeny Group (APG III) classification.

Unit 5: Biometrics, numerical taxonomy and cladistics **7 classes**

Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences).

Unit 6: Phylogeny of Angiosperms **8 classes**

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 evolutionary relationship (phylogenetic tree, cladogram).

Section- B

Lab activities

6. Study of vegetative and floral characters of the following families
    h. Magnoliaceae
    i. Brassicaceae
    j. Malvaceae
    k. Lamiaceae
    l. Solanaceae
    m. Asteraceae
    n. Poaceae
7. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Suggested Readings

1. Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rdedition.

2. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.

3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.

4. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi.

5. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York

SEMESTER-II

Title of the Course : Biodiversity and Human Welfare

Nature of Course : GEC-II
Course Code :
Total Credits : 03
Distribution of Marks : 60+40=100

Course outcome

1. Differentiate the level of biological diversity
2. Examine the cause of the loss of biodiversity
3. Analyse the biodiversity conservation strategies
4. Evaluate the role of organisms in human welfare

Learning outcomes

1. Distinguish the biodiversity levels
2. Analyse threats to biodiversity
3. Understand the conservation strategies for biodiversity
4. Examine the role of plants, animals and microbes in human welfare

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural			CO3	CO4		CO2
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.1
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	3	1	1	2	2	2.0
CO4	3	3	2	2	2	1	1	2.0
AVERAGE	3.0	2.2	2.2	1.7	1.7	1.7	1.7	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment:

1. One internal examination (theory)
2. Viva-voce
3. Group discussion
4. Home assignments

Attainment of Cos:

1. Continuous evaluation through in and end-semester theory and practical examinations
2. Field demonstration of local flora and fauna
3. Demonstration of biodiversity conservation models
4. Participation in seminar/conference

Course content

UNIT-I: 09 classes

Biodiversity and its scope- Genetic diversity, Species diversity, Plant and animal diversity at the ecosystem level. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle,

UNIT-II: 12 classes

Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Management of Biodiversity: Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.

UNIT-III: 12 classes

Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation, Social approaches to conservation, Biodiversity awareness programs, Sustainable development.

UNIT-IV: 12 classes

Role of plants and animals in relation to Human Welfare; Importance of forestry and wildlife; their utilization and commercial aspects; Ornamental plants animals (fishes) and of NE India. Uses of microorganisms in human welfare (food, agriculture, medicine)

SUGGESTED READINGS:

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.

SEMESTER II

Title of the Course : Vermicomposting
Nature of the Course : SEC II
Course code :
Total Credits : 03
Distribution of Marks : 60+40=100

Course outcomes:

1) describe the biology of some important species of earth worms used in vermiculture
2) demonstrate skills on production of vermicompost.
3) analyze benefits and problems with vermiculture and vermicompost

Leaning Outcome:

1) identify the earthworm species used in vermiculture
2) understand the benefit of vermiculture
3) display the skill of vermicompost production
4) interpret the problems associated with the vermicomposting technique

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural			CO2	CO3		
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	1	1	1.8
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	2	1	1	2	2	1.8
AVERAGE	3	2	2.0	1.7	1.7	1.7	1.7	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment:

1. One internal examination
2. Viva-voce
3. Group discussion
4. Home assignments

Attainment of Cos:

1. Continuous evaluation through in and end semester theory and practical examinations
2. Hands-onon training on preparation of vermicompost

3. Demonstration of large-scale production of vermicompost
4. Field collection of locally available earthworms for vermicomposting
5. Seminar/group discussion

Unit -1: Introduction to vermiculture (Lecture 7)

Vermiculture - definition, meaning, history, economic importance, value in the maintenance of soil structure, role as four r's of recycling (reduce, reuse, recycle and restore), Role in biotransformation of the residues generated by human activity and production of organic fertilizers, Useful species of earthworms, local and exotic species of earthworms

Unit -2: Biology of certain important earthworms native to NE India (Lecture 8)

Taxonomy and reproduction of Lumbricidae. Vital cycle: alimentation, fecundity, annual reproducer potential; limit factors (gases, diet, humidity, temperature, PH, light, and climatic factors).

Unit-3: Process of Vermicomposting (Lecture 8)

Small scale earthworm farming for home gardens - earthworm compost for home gardens
Conventional commercial composting - earthworm composting larger scale (pit, brick and, heap systems)
Earthworm farming, extraction (harvest), vermicomposting harvest and processing. Vermiwash collection, composition and use.
Enemies of earthworms, sickness and worm's enemies; frequent problems – prevention and fixation.

Unit-4: Applications of vermiculture (Lecture 7)

Benefits of vermicompost, Use of vermicompost in agriculture, Basic characteristics of earthworm suitable for vermicomposting, Problems in vermicomposting, vermicomposting of dairy waste.

Hands-on activities

1. Key to identify different types of earthworms.
2. Study of Life stages & development of earthworms.
3. Study of Vermiculture, Vermiwash& Vermicompost equipments, devices.
4. Preparation vermibeds, maintenance of vermicompost & climatic conditions.
5. Study of verms diseases & enemies
6. Field trip- collection of native earthworms & their identification

Suggested Readings:

Bhatt J.V. & S.R. Khambata (1959) “Role of Earthworms in Agriculture” Indian Council of Agricultural Research, New Delhi

Edwards, C.A. and J.R. Lofty (1977) “Biology of Earthworms” Chapman and Hall Ltd., London.

Lee, K.E. (1985) “Earthworms: Their ecology and Relationship with Soils and Land Use”

Academic Press, Sydney.

Wallwork, J.A. (1983) "Earthworm Biology" Edward Arnold (Publishers) Ltd. London.

Kevin, A and K.E.Lee (1989) "Earthworm for Gardeners and Fisherman" (CSIRO, Australia, Division of Soils).

Dash, M.C., B.K.Senapati, P.C. Mishra (1980) " Verms and Vermicomposting" Proceedings of the National Seminar on Organic Waste Utilization and Vermicomposting Dec. 5-8, 1984, (Part B), School of Life Sciences, Sambalpur University, Jyoti Vihar, Orissa.

Kumar, A. (2005) Verms and Vermitechnology, APH Publishing.

Lekshmy, M. S., Santhi R. (2012) Vermitechnology, Sara Publications, New Delhi, India

Chauhan, A. (2012) Vermitechnology, Vermiculture, Vermicompost and Earthworms: Vermiculture, Vermicomposting, Vermitechnology and Mirobes,Lambert Academic Publishing, Germany

Semester-II

Title of the Course	**:**	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE (AI) IN BIOLOGICAL SCIENCES**
Course Code	**:**	
Nature of the Course	**:**	**SEC-II**
Total Credits	**:**	**3**
Distribution of Marks	**:**	**60+40=100**

COURSE OUTCOMES:

CO1: Comprehend the concept of AI

CO2: Explore the concept of data in terms of biological sciences and will understand how biological data are generated

CO3: Learn how AI is applied in the field of biological sciences

CO4: Explain the ethical consideration of using AI in biological sciences

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural		CO4	CO2 CO3			
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	2	2	2	2	2	1	1	1.7
CO2	2	2	2	2	2	2	2	2.0
CO3	2	2	2	1	1	2	2	1.7
CO4	2	1	1	1	1	1	1	1.1
AVERAGE	2.0	1.7	1.7	1.5	1.5	1.5	1.5	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

UNITS	CONTENTS	L	T	P	Total Hours
1 **(Marks)** **10TH**	**Overview of Artificial Intelligence in Biological Sciences:** Introduction to Artificial Intelligence (AI). Understanding the basics of machine learning and deep learning in the context of biological data analysis.	04	01	00	05
2 **(Marks)** **10TH + 2 PR**	**Biological Data and Data Collection Techniques:** Introduction to biological data: types, sources, and characteristics, Methods for collecting and preprocessing biological data. Ethical considerations in data collection and handling . **Practical/Case studies on above topics**	04	01	02	05
3 **(Marks)** **10TH + 2 PR**	**Overview of AI applications in Pharmaceutical sciences, Biotechnology, and Life sciences:** Case studies highlighting the use of AI in drug discovery, areas of Life Sciences, biotechnology. Challenges and opportunities in integrating AI into biological research workflows. **Practical/case studies on above topics**	04	01	02	05
4 **(Marks)** **10TH + 3 PR**	**Role of AI in biological data analysis:** Predictive modeling, biomarker discovery, and personalized treatment, Application of AI in precision medicine: patient stratification, disease diagnosis, and treatment optimization, AI-driven approaches in environmental biotechnology: biodiversity conservation, pollution monitoring and ecological modeling. **Practical/case studies on above topics**	10	01	03	15
5 **(Marks)** **10TH + 3 PR**	**Ethical Considerations in AI-driven Biology Research:** Understanding bias and fairness issues in biological data and AI algorithms. Addressing privacy concerns associated with the use of biomedical data in AI-driven studies, Promoting transparency, accountability, and responsible conduct in AI-based biological research. Ethical guidelines **Practical/case studies on above topics**	10	01	03	15
	Total (in Hrs)	**32**	**05**	**10**	**45**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(40 Marks)**

- One Internal (TH) Examination - **10 Marks**
- One Internal (PR) Examination - **10 Marks**
- Others - **20 Marks**
  - Quiz
  - Seminar presentation
  - Assignment

SUGGESTED READINGS/REFERENCES:

1. "Hands-On Artificial Intelligence for Beginners: An introduction to AI concepts, algorithms, and their implementation" By Patrick D. Smith, David Dindi. 2018. Packt.
2. Artificial Intelligence by Meenu Kumar. ISBN-10 - 8119416910; ISBN- 13 : 978-8119416912. 2018.2023. Orange House Pvt Ltd
3. An Introduction to Artificial Intelligence and Machine Learning – I : By Day-To-Day Examples by by Manikandan Paneerselvam. **ISBN-13 :** 979-8890267610
4. Artificial Intelligence : New Horizon in health Sciences, AI and Health Sciences: By Dr. Sivanesan and Dr. Juhi Agarwal. ISBN-13 : 978-9358471212 and ISBN-10:9358471212, 2024. Adhyyan Books
5. Artificial Intelligence and Molecular Biology by Lawrence E. Hunter. ISBN: 9780262581158 . 1993. AAAI Press
6. Fundamentals of Artificial Intelligence by KR Choudhury. ISBN 978-81-322-3970-3 ; ISBN 978-81-322-3972-7 (e Book). 2020, Springer.

SEMESTER-III

Title of the Course : Cell Biology-I
Nature of Course : CORE-III
Course Code :
Total Credits : 04
Distribution of Marks : 40+60=100

Course Outcomes:

1) differentiate the structure and functions of cellular components
2) evaluate the cell division mechanism and cell cycle.
3) analyze cell signalling mechanism.

Learning Outcomes:

1) understand the cell structure and functions of cell organelles.
2) analyze cell division and cell cycle mechanisms.
3) interpret the cell signalling mechanisms.

Mapping of CO with Bloom Taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual				CO1, CO3	CO2	
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.1
CO2	3	2	2	2	3	2	2	2.3
CO3	3	2	3	3	3	2	2	2.5
AVERAGE	3.0	2.0	2.3	2.3	2.7	2.0	2.0	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment

1. One internal examination (theory)
2. One internal examination (Lab)
3. Viva-voce
4. Group discussion
5. Home assignments

Attainment of Cos:

1. Continuous evaluation through in and end semester theory and practical examinations
2. Laboratory practices on cells, cellular organelles and cellular processes
3. Practical record book/field book
4. Seminar/group discussion

Course contents

Section-A

Unit-I: Overview of cell: Prokaryotic and Eukaryotic cells **10 classes**

Plasma Membrane and Cytoskeleton: Various models of plasma membrane structure, Transport across membranes: Active and Passive transport, Cell junctions: Tight junctions, Desmosomes, Gap junctions, Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

Unit-II: Endomembrane System: Structure and Functions: **08 classes**

Endoplasmic Reticulum, Golgi Apparatus, Lysosomes

Unit-III: Mitochondria and Peroxisomes: **09 classes**

Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis, Peroxisomes

Unit-IV: Nucleus: **09 classes**

Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome).

Unit-V: **Cell Division and Cell Signalling** **09 classes**

Mitosis, Meiosis, Cell cycle and its regulation, GPCR and Role of second messenger (cAMP).

Section-B

Lab activities

1. Introduction to basic tools of biochemistry
2. Preparation of different biochemical solutions, dilutions, preparation of buffer solutions etc.
3. Qualitative tests of functional groups in carbohydrates, proteins and lipids, ascorbic acid, free phosphate
4. Separation of amino acids by paper/TLC and determination of Rf value.
5. Preparation of permanent slide to demonstrate: Mucopolysaccharides by PAS reaction Proteins by Mercurobromophenol blue/FastGreen
6. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.

Textbooks

1. Karp G., Cell and Molecular Biology: Concepts and Experiments, 7th Edition (John Wiley & Sons, Inc., 2013).
2. Scott, M. P. et al, Molecular Cell Biology, 6th Edition (W. H. Freeman, 2007).
3. Alberts, B. et al., Molecular Biology of the Cell, 5th Edition (Garland Publishing, 2008).
4. Becker, W. M. et al., The World of Cell, 8th Edition (Benjamin Cummings, 2011).

Suggested Readings

1. Molecular and Cell Biology (Schaum's Outlines series special Indian edition) by W. D.Stansfield, J. S.C. Colome, R. J. Cano and R. N. Sharan (2010), McGraw Hill Education.

2. Cooper, G. M. and Hausman, R. E., The Cell: A Molecular Approach, 5th Edition (ASM Press and Sinauer Associates, Inc., 2009).

SEMESTER-III

Title of the Course	**:**	**Biochemistry and Molecular biology-I**
Nature of Course	**:**	**CORE-IV**
Course code	**:**	
Total Credits	**:**	**04**
Distribution of Marks	**:**	**40+60=100**

Course outcomes:

1) differentiate the biomolecules of living organisms, their interactions for perpetuation of life
2) analyze structure-function relationships of nucleic acids and protein
3) distinguish between replication, transcription and translation in prokaryotes and eukaryotes
4) interpret the gene expression mechanisms

Learner Outcome:

1) identify the various biomolecules and understand their function
2) differentiate the cellular processes such as replication, transcription and translation
3) understand gene expression mechanism

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual			CO4	CO1, CO2, CO3		
Procedural						
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.1
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	3	1	1	2	2	2.0
CO4	3	3	2	2	2	1	1	2.0
AVERAGE	3.0	2.2	2.2	1.7	1.7	1.7	1.7	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment

1. One internal examination (theory)

2. One internal examination (Lab)
3. Viva-voce
4. Group discussion
5. Home assignments

Attainment of Cos:

1. Continuous evaluation through in and end-semester theory and practical examinations
2. Laboratory practices on biochemical and molecular biology processes
3. Practical record book/field book
4. Seminar/group discussion

Section-A

Course content

Unit I **7 classes**

Introduction to Biochemistry, scopes; chemical basis of life, functional groups; water as solvent, ionization of water, weak acids; pH, buffer solution; types of chemical bonds in biological systems and types of biomolecules (Macro and small molecules) and functions.

Unit-II **8 classes**

Proteins: Classification and functions of proteins. Amino acids, properties, and functions. Peptide bonds and peptide groups; structural organization of protein- primary, secondary, tertiary, and quaternary. The structural and functional relationship of protein- Ribonuclease-A, myoglobin, hemoglobin; protein denaturation and renaturation.

Unit-III **8 classes**

Carbohydrates: Sources, and biological functions; Classification- monosaccharide, disaccharide, and polysaccharide. Classes and structure of mono and disaccharides, glycosidic bond: Stereoisomerism, mutarotation, anomer, epimer etc.; glycoproteins and glycolipids.

Unit-IV **7 classes**

Lipids: Structure, classification, and biological functions of lipids; storage and membrane lipids, lipoprotein. Fatty acids: classification; saturated, unsaturated, polyunsaturated; essential and non-essential fatty acids.

Unit-V Molecular biology **15 classes**

Nucleic acids: Types and functions of DNA, RNA; constituent monomers (nucleotides and nucleoside), DNA as genetic material, Structure of DNA and tRNA

DNA replication: Chemistry of replication, DNA polymerases, synthesis of leading and lagging strands

Prokaryotic transcription: RNA polymerase, promoters, sigma factors, initiation, elongation, and termination (Rho-dependent and independent), Eukaryotic transcription: types of RNA polymerases

Translation: Translation in prokaryotes and eukaryotes: Ribosome, tRNA, amino-acyl tRNA synthetases, genetic code, translation-initiation, elongation, termination, and ribosome recycling. Regulation of gene expression in prokaryotes: Transcriptional regulation in bacteria: regulation of lac and trp operons in bacteria

Section-B

Lab activities

1. Preparation of different biochemical solutions, dilutions, preparation of buffer solutions, etc.
2. Identification of unknown carbohydrates (starch, sucrose, glucose, galactose, and fructose)
3. Quantitative estimation of ascorbic acid
4. Quantitative estimation of glucose
5. Quantitative estimation of protein
6. Quantitative estimation of free phosphate
7. Separation of amino acids by TLC and determination of Rf value.
8. Bead and stick model of nucleic acid
9. Study of chromatin organization
10. DNA isolation and agarose gel electrophoresis

SUGGESTED READINGS:

1. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons.Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins,Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates,MA.
4. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London.
5. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons.Inc.
6. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins,Philadelphia.
7. Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates,MA.
8. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London

SEMESTER III

Title of the Course : Biotechnology, tissue culture, and animal cell culture- I
Nature ofCourse : MINOR-III
Course code :
Total Credits : 04
Distribution of Marks: 40+60=100

Course outcomes:

1) To interpret the principle, practices and application of biotechnology.
2) To examine the process of genetic engineering.
3) To demonstrate plant tissue culture and animal cell culture.

Learning Outcomes:

1) To apply the concept of biotechnology
2) To discuss the tools and techniques involves in genetic engineering.
3) To understand the process of plant tissue culture and animal cell culture.

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual						
Procedural			CO1, CO3	CO2		
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	3	2	2	2	2	2	2	2.1
CO2	3	2	2	2	2	2	2	2.1
CO3	3	2	3	3	3	2	2	2.6
AVERAGE	3.0	2.0	2.3	2.3	2.3	2.0	2.0	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment

1. One internal examination (theory)
2. One internal examination (Lab)
3. Viva-voce
4. Group discussion

5. Home assignments

Attainment of Cos:

1. Continuous evaluation through in and end semester theory and practical examinations
2. Laboratory practices on biotechnology, cell and tissue culture
3. Practical record book/field book
4. Seminar/group discussion

Course content

Section-A

Unit 1: Recombinant DNA technology (Lecture: 5)

Introduction to biotechnology; Restriction Endonucleases (History, Types I-IV, biological role and application); Cloning Vectors; types

Unit-2: Gene Cloning (Lecture: 8)

Recombinant DNA technology, Bacterial Transformation and selection of recombinant clones, PCR mediated gene cloning, DNA libraries, cDNA libraries, colony hybridization; Somatic cell nuclear transfer.

Unit-3: Applications of Biotechnology (Lecture: 12)

Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Gentically Engineered Products–Human Growth Hormone; Humulin; Biosafety concerns.

Unit-4: Animal cell culture (Lecture: 8)

Historical perspective; Composition of media; Nutrient and hormone requirements, maintenance of aseptic condition, types of cell lines, Application of cell culture, flow cytometry, MTT assay

Unit-5: Plant Tissue Culture (Lecture: 12)

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; Tissue culture applications (micropropagation, androgenesis, Cryopreservation; Germplasm Conservation).

Section-B

Lab activities

1. Preparation of MS medium and callus.
2. Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants of tobacco, Datura, Brassica etc.
3. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
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, Flavr Savr tomato through photographs.
7. Isolation of plasmid DNA.
8. Restriction digestion and gel electrophoresis of plasmid DNA.
9. Demonstration of animal cell culture technique through photographs/animation

Suggested Readings

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.

2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

3. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition.

4. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.

5. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A

SEMESTER III

Title of the Course : Ethnobiology
Course Code :
Nature of the Course : GEC-III
Total Credits : 03
Distribution of Marks : 60+40=100

Course outcome:

1) Discuss the indigenous practices of ethnic groups of Northeast India
2) Use of traditional knowledge system of the region for sustainable development
3) Compare medicinal and agronomic values of biological resources of the region
4) Protection of traditional knowledge through IPR

Learning outcome:

1) Understand the traditional practices of ethnic communities of the region
2) Implementation of IKS for sustainable development goals
3) Apply the indigenous knowledge in daily life
4) Analyze the IPR for protection of traditional knowledge

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1			CO4	
Procedural			CO2	CO3		
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	2	2	3	3	2	2	2	2.3
CO2	2	2	3	3	2	2	2	2.3
CO3	2	2	3	3	2	2	2	2.3
CO4	2	2	3	3	2	1	1	2.0
AVERAGE	2.0	2.0	3.0	3.0	2.0	1.8	1.8	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment

1. One internal examination (theory)
2. Viva-voce
3. Group discussion
4. Home assignments

Attainment of Cos:

1. Continuous evaluation through in and end semester theory and practical examinations

2. Demonstration of traditional practices of ethnic communities (medicine, food, beverages)
3. Demonstration of traditional methods of conservation of food and beverages
4. Participation in seminar/conference

Course content

Unit 1: Ethnobiology (Lectures 15)

Concept, history and theory; hypotheses, evolution and scope; Indigenous knowledge and traditional practices, ethnobiology of northeast India. Major ethnic groups in North East India; their social institutions, livelihood, cultural and religious practices, other belief systems, sacred groove. Methods of biological resource conservation & ecorestoration. Scope for development of plant resources.

Unit 2:Traditional Knowledge (Lectures 10)

Traditional knowledge system of different indigenous communities of North Eastern India. Application and practices of traditional knowledge system in agriculture, healthcare, livelihood and alternative food & fodder. Sustainable utilization of biological resources and biodiversity conservation. Current status of Ethnobiology, biodiversity and traditional knowledge.

Unit 3: Ethnobiology and Its Relevance in Contemporary Research (Lectures 8)

Ethnobiology & drug discovery; Ayurvedic drug preparation and drug adulteration. Chemical composition of few medicinal and aromatic plants, extraction, and uses pertaining to typical Indian formulation of drugs. Ethnopharmacological validation of traditional medicine; approaches to drug discovery from ethnobotanical leads.

Unit 4: Traditional Agronomic Practices: (Lectures 5)

Shifting cultivation, weeds and their management, beekeeping, Aquaculture

Unit 5 : Protection of Traditional Knowledge (Lectures 7)

Ethnobiology & IPR; biopiracy, National Biodiversity protection initiatives; Convention on Biological Diversity, Nagoya protocol.

Suggested Readings

1) S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2) S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981

3) Lone et al, Palaeoethnobotany
4) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, _Lucknow, India.
5) S.K. Jain, 1990. Contributions of Indian ethnobotny.Scientific publishers, Jodhpur.
6) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – _Chichester
7) Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India.Botanical Survey of India. Howrah._8) Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-1996_9) Faulks, P.J. 1958.An introduction to Ethnobotany, Moredale pub. Ltd

SEMESTER III

Title of the Course : Analytical Tools and Techniques in Science (Multi disc.)
Course Code :
Nature of the Course : SEC-III
Total Credits : 03
Distribution of Marks : 60+40=100

Course Outcomes:

1) analyze different separation techniques
2) compare various microscopic techniques
3) examine the structure of DNA and its amplification
4) contrast among blotting techniques
5) investigate biological and chemical samples through the application of different tools and techniques

Learning Outcome:

1) demonstrate various separation techniques
2) operate different microscopes
3) describe DNA structure and amplification
4) distinguish between blotting techniques
5) evaluate biological and chemical samples with the use of various tools and techniques

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual						
Procedural				CO1, CO2, CO3, CO4		CO5
Metacognitive						

Mapping of Course outcomes to Programme outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	AVERAGE
CO1	2	2	2	3	2	2	2	2.1
CO2	2	2	2	2	2	2	2	2.0
CO3	2	2	3	2	2	2	2	2.0
CO4	2	2	2	2	2	1	1	1.7
CO5	2	2	2	2	2	1	1	1.7
AVERAGE	2.0	2.0	2.2	2.2	2.0	1.6	1.6	

3 for highest correlation, 2 for moderate correlation, and 1 for lowest correlation

Modes of internal assessment:

1. One internal examination (theory)
2. One internal examination (lab)
3. Viva-voce
4. Group discussion
5. Home assignments

Attainment of Cos:

1. Continuous evaluation through in and end semester theory and practical examinations
2. Demonstration of the major equipment used in analytic techniques
3. Practical record book
4. Hands-on activities in operating instruments

Unit 1: Chromatographic methods:

Adsorption and partition principle. Thin layer chromatography (TLC), Paper (radial, ascending, descending), and column chromatography. Fundamentals of spectroscopic techniques: (a) UV-vis spectroscopy: Overview of spectroscopy techniques, Basic principles of electromagnetic radiation, Interaction of light with matter, Components of a UV-Vis spectrophotometer, Sample handling techniques, Beer-Lambert Law and its application in UV-Vis spectroscopy, Factors affecting absorbance spectra (solvent, pH, temperature, etc.), Applications of UV-Vis Spectroscopy in qualitative and quantitative analysis, in kinetic studies (monitoring reaction rates). (b) IR Spectroscopy: Introduction to IR Spectroscopy, Components of an IR spectrometer, Sample handling techniques, Vibrational modes of molecules, Theory behind IR spectra interpretation.

Unit 2: Microscopy:

Concept of Resolution and Magnification, Optical Microscopy- Bright Field Microscopy, Dark Field Microscopy, Phase Contrast Microscopy, Fluorescence Microscopy and Electron Microscopy. Centrifugation technique- Principle of centrifugation, Differential and Density gradient centrifugation (Rate Zonal Centrifugation, Isopycnic Centrifugation). Concept of DNA structure, PCR-based DNA amplification: PCR chemicals and principle of PCR. Electrophoretic separation of biomolecules-principle; Blotting techniques—Southern, Northern, and Western.

Unit 3: Lab. activities

1. Separation of biological/chemical samples using Paper Chromatography and TLC
2. Spectrophotometric estimation of biological/chemical samples
3. Structural elucidation of unknown compounds using IR spectroscopy
4. Handling of Microscope and visualization of different samples
5. Separation of samples using centrifuge
6. Amplification of DNA using PCR
7. Agarose gel electrophoresis of PCR amplified DNA

Suggested readings:

1. Biophysical chemistry: principles and techniques. Upadhyaya, Upadhyaya & Nath, Himalaya publishing house, ISBN-978-93-5142-227-3