Syllabus of FYIPGP Life Sciences (Zoology)

Department of Life Sciences

JUNE, 2024
DIBRUGARH UNIVERSITY

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

Excellence in Education: Commitment to provide high-quality education in life sciences.
Research Integrity: Upholding the highest standards of honesty and ethical practices in research.
Innovation: Encouraging creativity and innovation in both teaching and research.
Collaboration: Fostering collaborative efforts within the department and with external partners.
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

Program Educational Objectives:

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

Program Outcomes:

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 attitude to work as a team appreciating ethical values

Program Specific Outcomes:

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

Year	Sem.	Corse code	Title of the course	credit
I	I	Core-I	Animal Diversity I : Invertebrates	4
		Minor-I	Animal Diversity I Minor : Invertebrates	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	Animal Diversity II : Vertebrates	4
		Minor-II	Animal Diversity II Minor: Vertebrates	4
		GEC-II	Biodiversity and human welfare	3
		AEC-II	English Language and Communication Skills	4
		SEC-II	Vermicomposting /**I**ntroduction 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: Analytical Tools and Techniques in Science	3
		VAC-III	Digital and Technological Solutions / Digital Fluency	2
			Total credit	**20**
	IV	Core-V	Genetics and Evolutionary Biology-I	4
		C ore-VI	Microbiology & immunology-I	4
		Core-VII	Bioinformatics and biostatistics	4
		Core-VIII	Lab course based on core courses V, VI and VII	4
		Minor-IV	Techniques in Biology-I	4
		Total Credit		**20**
		UG DIPLOMA		
III	V	Core-IX	Comparative Anatomy and Animal Physiology	4
		Core-X	Developmental Biology	4
		Core-XI	Lab course based on Core IX and X	4
		Minor-V	Comparative Anatomy and Animal Physiology-Minor	4
		Int./Comm./project	Field study/project	4
		Total credit		**20**
	VI	Core-XII	Co-ordinating Physiology	4
		Core-XIII	Animal Behaviour and Chronobiology	4
		Core-XIV	Animal Ecology and Wildlife Management	4
		Core-XV	Lab course based on Core XII, XIII, XIV and XV	4

		Minor-XI	Co-ordinating Physiology-Minor	4
		Total credit		**20**
		UG DEGREE		

SEMESTER I

Title of the Course : Animal Diversity I
Course Code :
Nature of the Course : CORE I
Total Credits : 04
Distribution of Marks : 40 (IA) +60 (END) = 100

COs:

1) describe different phyla in animal kingdom
2) organize the organisms in different categories based on morphological characteristics
3) analyze the interrelationship among different species and genera within each group of animals

Learning Outcomes:

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

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 IN-SEMESTER ASSESSMENT:

- One Theory exam
- One Practical exam
- Group Discussion/Seminar/Viva/Assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination
- In and end semester practical examination based on identification of supplied specimens.
- Submission of practical file with record of studied specimens
- Submission of collected specimens
- Viva-voce examination

Section A

Unit 1: **Protista, Parazoa and Metazoa** **12 lectures**

General characteristics and Classification up to Classes
Structural organization & nutrition of *Amoeba ,Euglena*, and *Paramecium.*
Locomotion and Reproduction in Animal protista (Protozoa)

Unit 2: **Porifera, Cnidaria& Ctenophora** **8 lectures**

General characteristics and Classification up to classes with examples
Canal system in sponges and Evolutionary significance

Unit 3: **Platyhelminthes & Nemathelminthes** **8 lectures**

General characteristics and Classification up to classes
Life cycle of *Taenia solium, Fasciola hepatica* and *Ascaris lumbricoides*
Parasitic adaptation in Helminths.

Unit 4: **Introduction to Coelomates, Annelida and Arthropods** **9 lectures**

Evolution of coelom and metamerism
General characteristics and Classification up to classes
Excretion in Annelida. Respiration in Arthropoda

Unit 5: **Onychophora& Mollusca and Echinodermata** **8 lectures**

General characteristics
Classification up to classes
Torsion and detorsion in Gastropoda
Water-vascular system in Asteroidea

Section B **15 lectures**

1) Study of the following specimens:
Protista: Amoeba, Euglena, Plasmodium, Paramecium
Cindaria: Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora and One specimen/slide of anyctenophore
Annelids: Neries, Aphrodite, Chetopterus, Pheretima, Hirudanaria
Arthropods:Limulus,Belastoma, Palamnaeus, Daphnia, Palaemon, Cance, BrachionusBombyx, Periplaneta, Samia ricini. Antherae spp.Termite and honey bee.
Helminths: Ascaris, Taenia, Fasciola.
Molluscs:Chiton,Dentalium,Pila,Doris,Helix,Unio, Sepia, Octopus and Nautilus.
Echinoderms: Pentaceros, Asterias, Ophiura, Echinus, Antedon
2) Study of *Sycon*(T.S. and L.S.), *Hyalonema, Euplectella,Spongilla*

3) Study of whole mount of *Euglena*, *Amoeba* and *Paramecium*, Binary fission and Conjugation in *Paramecium.*
4) Study of mouth parts of periplaneta
5) Study of adult *Fasciola hepatica*, *Taenia solium* and their life cycles (Slides/micro-photographs)
6) Study of adult *Ascaris lumbricoides* and its life stages(Slides/micro-photographs).
7) Study of septal nephridia in earthworm, digestive system of periplaneta (virtual).

Suggested Readings

1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
2. Kingsley J. Text Book of Vertebrate Zoology Publisher: Nabu Press ISBN: 9781171586524, 1171586523
3. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrate

SEMESTER I

Title of the Course : Animal Diversity I Minor
Course Code :
Nature of the Course : Minor-I
Total Credits : 04
Distribution of Marks : 40 (IA) +60 (END) = 100

COs:

1. describe different phyla in animal kingdom
2. organize the organisms in different categories based on morphological characteristics
3. analyze the interrelationship among different species and genera within each group of animals

Learning Outcomes:

1. understand the various phyla in Animal Kingdom
2. compare various organisms based on morphology
3. classify different groups of animals

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
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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 IN-SEMESTER ASSESSMENT:

- One Theory exam
- One Practical exam
- Group Discussion/Seminar/Viva/Assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination

- In and end semester practical examination based on identification of supplied specimens.
- Submission of practical file with record of studied specimens
- Submission of collected specimens
- Viva-voce examination

Section A

Unit 1: **Protista, Parazoa and Metazoa** **12 lectures**

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General characteristics and Classification up to classes with examples
Canal system in sponges and Evolutionary significance

Unit 3: **Platyhelminthes & Nemathelminthes** **8 lectures**

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Life cycle of *Taenia solium, Fasciola hepatica* and *Ascaris lumbricoides*
Parasitic adaptation in Helminths.

Unit 4: **Introduction to Coelomates, Annelida and Arthropods** **9 lectures**

Evolution of coelom and metamerism
General characteristics and Classification up to classes
Excretion in Annelida. Respiration in Arthropoda

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General characteristics
Classification up to classes
Torsion and detorsion in Gastropoda
Water-vascular system in Asteroidea

Section B **15 lectures**

1) Study of the following specimens:
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   Annelids: Neries, Aphrodite, Chetopterus, Pheretima, Hirudanaria
   Arthropods:Limulus,Belastoma, Palamnaeus, Daphnia, Palaemon, Cance, BrachionusBombyx, Periplaneta, Samia ricini. Antherae spp.Termite and honey bee.
   Helminths: Ascaris, Taenia, Fasciola.
   Molluscs:Chiton,Dentalium,Pila,Doris,Helix,Unio, Sepia, Octopus and Nautilus.
   Echinoderms: Pentaceros, Asterias, Ophiura, Echinus, Antedon
2) Study of *Sycon*(T.S. and L.S.), *Hyalonema, Euplectella,Spongilla*
3) Study of whole mount of *Euglena, Amoeba* and *Paramecium,* Binary fission and

Conjugation in *Paramecium.*

4) Study of mouth parts of periplaneta
5) Study of adult *Fasciola hepatica*, *Taenia solium* and their life cycles (Slides/micro-photographs)
6) Study of adult *Ascaris lumbricoides* and its life stages(Slides/micro-photographs).
7) Study of septal nephridia in earthworm, digestive system of periplaneta (virtual).

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- Kingsley J. Text Book of Vertebrate Zoology Publisher: Nabu Press ISBN: 9781171586524, 1171586523
- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrate

SEMESTER I

Title of the Course : Natural resource management
Course Code :
Nature of the Course: Generic Elective Course-I
Total Credits : 03
Distribution of Marks: 40 IA+60 END = 100

COs:

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. Internal examination
2. Viva-voce/Group discussion/Home assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination

- Viva-voce examination

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 : SEC
Nature of the Course : SEC I
Total Credits : 03
Distribution of Marks : 40 IA+60 END = 100

COs:

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

Modes of internal assessment:

- Internal examination
- Viva-voce/Group discussion/Home assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination
- Viva-voce examination

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 (5 lectures)

Unit 2: Rearing of silkworm: Silkworm rearing -Rearing house and rearing appliances, Early age and Lateage rearing. Types of mountagesSpinning,harvesting and storage of cocoons. Pests and diseases Pests of silkworm: Uzi fly, Apantelesand vertebrates. Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial. Symptoms, Control and prevention of pestsand diseases. (10 lectures)

Unit 3: Host plants for Eri silkworms: *Ricinus communis* , *Heteropanax fragrans* , their phytochemical profile, cultivation and management; primary and alternative host plants for Muga silkworm: *Machilus gamblei* , *Litsea monopetala* and *Litsea cubeba*, their nutritional profile. (6 lectures)

Unit 4:
i)Sex separation in larva, pupa and adult ofsilkworm
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 (12 lectures)

Unit 5:
i)Identification and study of Sericulture products, types of yarns
ii)morphology and identification of *Ricinus communis*, *Heteropanax fragrans* , *Machilus gamlei* , *Litsea monopetala* and *Litsea cubeba*
iii) Project
iv)Field visit (12 lectures)

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 Manual-1, 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 : Animal Diversity II

Course Code :
Nature of the Course : CORE II
Total Credits : 04
Distribution of Marks : 40 (IA) +60 (END) = 100

COs:

1. describe different phyla in animal kingdom
2. organize the organisms in different categories based on morphological characteristics
3. analyze the interrelationship among different species and genera within each group of animals

Learning Outcomes:

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

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	2.14
CO2	3	2	2	2	2	2	2	2.14
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 IN-SEMESTER ASSESSMENT:

- One Theory exam
- One Practical exam
- Group Discussion/Seminar/Viva/Assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination
- In and end semester practical examination based on identification of supplied specimens.
- Submission of practical file with record of studied specimens
- Submission of collected specimens
- Viva-voce examination

Section A

Unit 1: **Introduction to Chordates:** General characteristics and outline classification **Protochordata:** General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates*;* Retrogressive metamorphosis in Urochordata
Origin of Chordata: Theories of origin of chordates, Advanced features of vertebrates over Protochordata **11 lectures**

Unit 2: **Agnatha & Pisces** **9 lectures**

Agnatha: General characteristics and classification of cyclostomes up to class with example

Pisces: General characteristics of Chondrichthyes and Osteichthyes, classification up to order Osmoregulation

Unit 3: **Amphibia & Reptilia** **9 lectures**
Amphibia: Origin of *Tetrapoda* (Evolution of terrestrial ectotherms); General characteristics and classification up to order; Reptilia: General characteristics and classification up to order; Affinities of *Sphenodon*; Poison apparatus and Biting mechanism in snakes

Unit 4: **Aves & Mammals** **9 lectures**

Aves: General characteristics and classification up to order *Archaeopteryx*-- a connecting link; Principles and aerodynamics of flight, Flight adaptations

Mammals: General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages

Unit 5: **Zoogeography** **7 lectures**
Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, distribution of vertebrates in different realms

Section B **15 lectures**

1. To study the following specimen:
   Protochordata; Balanoglossus, Herdmania, Branchiostoma, Colonial Urochordata. Sections of Balanoglossus through proboscis and branchiogenital regions,
   Fishes; *Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/ Diodon, Anabas,* Flat fish,*Channa* spp. *Puntius*spp. *Trichogaster, Heteropneusteus* spp., *Clarias* spp., *Mystus* spp.
   Amphibia; *Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandr*
   Reptilia; *Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus*

Aves; Study of six common birds from different orders.
Mammalia; Sorex, Bat (Insectivorous and Frugivorous), Funambulus, Loris, Herpestes, Erinaceous.

2. Dissection of weberian ossicles of *Mystus.*
3. To study and prepare a chart of keys of identification of poisonous and non-poisonous snakes.
4. Study of animal organ system: Urinogenital System of fish (locally available fish).
5. Sections of Amphioxus through pharyngeal, intestinal and caudal regions. Permanent slide of Herdmania spicules, Placoid and Cycloid Scales in Fishes, Types of beaks and claws, pecten from Fowlhead .
6. To submit a Project Report on any related topic to larval forms.

Suggested Readings

- Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford universitypress.
- Pough H. *Vertebrate life,* VIII Edition, PearsonInternational.
- Darlington P.J. *The Geographical Distribution of Animals*, R.E. Krieger PubCo.
- Hall B.K. and Hallgrimsson B. (2008).*Strickberger's*
- *Evolution*. IV Edition. Jones and Bartlett PublishersInc.

SEMESTER II

Title of the Course : Animal Diversity II Minor
Course Code :
Nature of the Course : Minor II
Total Credits : 04
Distribution of Marks : 40 (IA) +60 (END) = 100

COs:

1) describe different phyla in animal kingdom
2) organize the organisms in different categories based on morphological characteristics
3) analyze the interrelationship among different species and genera within each group of animals

Learning Outcomes:

1. understand the various phyla in Animal Kingdom
2. compare various organisms based on morphology
3. classify different groups of animals

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	2.4
CO2	3	2	2	2	2	2	2	2.4
CO3	3	2	3	1	1	2	2	2.0
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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 IN-SEMESTER ASSESSMENT:

- One Theory exam
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- Group Discussion/Seminar/Viva/Assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination

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1. To study the following specimen:
   Protochordata; Balanoglossus, Herdmania, Branchiostoma, Colonial Urochordata. Sections of Balanoglossus through proboscis and branchiogenital regions,
   Fishes; *Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/ Diodon, Anabas,* Flat fish,*Channa* spp. *Puntius*spp. *Trichogaster, Heteropneusteus* spp., *Clarias* spp., *Mystus* spp.
   Amphibia; *Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandr*
   Reptilia; *Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus*
   Aves; Study of six common birds from different orders.
   Mammalia; Sorex, Bat (Insectivorous and Frugivorous), Funambulus, Loris,

Herpestes, Erinaceous.

2. Dissection of weberian ossicles of *Mystus.*
3. To study and prepare a chart of keys of identification of poisonous and non-poisonous snakes.
4. Study of animal organ system: Urinogenital System of fish (locally available fish).
5. Sections of Amphioxus through pharyngeal, intestinal and caudal regions. Permanent slide of Herdmania spicules, Placoid and Cycloid Scales in Fishes, Types of beaks and claws, pecten from Fowlhead .
6. To submit a Project Report on any related topic to larval forms.

MODES OF IN-SEMESTER ASSESSMENT:

- One Theory exam
- One Practical exam
- Group Discussion/Seminar/Viva/Assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination
- In and end semester practical examination based on identification of supplied specimens.
- Submission of practical file with record of studies specimens
- Viva-voce examination

SUGGESTED READINGS

- Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford universitypress.
- Pough H. *Vertebrate life*, VIII Edition, PearsonInternational.
- Darlington P.J. *The Geographical Distribution of Animals*, R.E. Krieger PubCo.
- Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett PublishersInc.

SEMESTER II

Title of the Course : Biodiversity and human welfare
Course Code :
Nature of the Course : GEC II
Total Credits : 03
Distribution of Marks : 40 IA + 60 END = 100

COs:

1. Differentiate the levels of biological diversity
2. Examine the causes of loss of biodiversity
3. Analyze the biodiversity conservation strategies
4. Evaluate the role of different organisms in human welfare

Learning Outcomes:

1. Distinguish the biodiversity levels
2. Analyze threats to biodiversity
3. Understand the conservation measures 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	CO2, CO3	CO4	
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 IN-SEMESTER ASSESSMENT:

- One Theory exam
- One Practical exam
- Group Discussion/Seminar/Viva/Assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination
- In and end semester practical examination based on identification of supplied specimens.
- Submission of assignment on relevant topic
- Viva-voce examination

UNIT-1: Biodiversity and its scope **(Lectures 9)**

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

UNIT-2: Loss of Biodiversity **(Lectures 12)**

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-3: Conservation of Biodiversity **(Lectures 12)**

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

UNIT-4: Role of plants and animals in relation to Human Welfare **(Lectures 12)**

Importance of forestry and wildlife to human welfare: their utilization and commercial aspects; Ornamental plants and animals (fishes) 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
Course Code :
Nature of the Course : SEC II
Total Credits : 03
Distribution of Marks : 40 IA + 60 END= 100

COs:

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/Group discussion/Home assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination
- In and end semester practical examination

- Submission of practical file
- Viva-voce examination

Unit -1: Introduction to vermiculture (Lecture 7)

Vermiculture - definition, meaning, history, economic importance, value in maintenance of soil structure, role as four r's of recycling (reduce, reuse, recycle and restore), Role in bio transformation 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 earthworm native to NE India (Lecture 8)

Taxonomy Anatomy, physiology and reproduction of Lumbricidae. Vital cycle: alimentation, fecundity, annual reproducer potential and 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, brickand, 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.

Practical activities 15 lectures

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	**:**	**100 (60 END + 40 IN)**

COs:

1. Comprehend the fundamentals of AI
2. Analyze the concept of Data in terms of Biological Sciences
3. Explore the diverse applications of AI in biological research ,including healthcare, precision medicine, and bioinformatics.
4. To develop an awareness of the ethical and societal implications of AI driven biology research,including issues related to bias, fairness, privacy, and data security.

Learning Outcomes:

- Understand the fundamental concept of AI
- Discuss the concept of Data in Biology
- Examine applications of AI and have awareness about ethical and societal implications

Modes of internal assessment:

- One internal examination
- Viva-voce/Group discussion/Home assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination
- In and end semester practical examination
- Viva-voce examination

Mapping of CO with Bloom's taxonomy

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1				
Procedural		CO4	CO2CO3			
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	1.8
CO2	2	2	2	2	2	2	2	2.1
CO3	2	2	2	1	1	2	2	1.8
CO4	2	1	1	1	1	1	1	1.0
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	**Overview of Artificial Intelligence in Biological Sciences:** IntroductiontoArtificialIntelligence(AI).Understandingthebasics of machine learning and deep learning in the contextof biological data analysis.	04	01	00	05
2	**Biological Data and Data Collection Techniques:**Introductiontobiologicaldata:types,sources,andcharacteristics,Methodsforcollectingandpreprocessingbiologicaldata.Ethicalconsiderationsindatacollectionandhandling. **Practical/Case studies on above topics**	04	01	02	05
3	**OverviewofAIapplicationsinPharmaceuticalsciences,Biotechnology,andLifesciences:** Case studies highlighting the use of AI in drug discovery,areas of Life Sciences, biotechnology.ChallengesandopportunitiesinintegratingAIintobiologicalresearchworkflows. **Practical/case studies on above topics**	04	01	02	05

4	**RoleofAIinbiological data analysis:** Predictivemodeling,biomarkerdiscovery,andpersonalizedtreatment, Application of AI in precision medicine: patientstratification,diseasediagnosis,andtreatmentoptimization,AI-drivenapproachesinenvironmentalbiotechnology:biodiversityconservation,pollutionmonitoringandecologicalmodeling. **Practical/case studies on above topics**	10	01	03	15
5	**Ethical Considerations in AI-driven Biology Research:**Understandingbiasandfairnessissuesinbiological dataand AI algorithms. Addressing privacy concerns associatedwiththeuseofbiomedicaldatainAI-drivenstudies,Promotingtransparency,accountability,andresponsibleconductinAI-basedbiologicalresearch. Ethical guidelines **Practical/case studies on above topics**	10	01	03	15
	Total(inHrs)	**32**	**05**	**10**	**45**

Where, L:Lectures T:Tutorials P:Practicals

SEMESTER III

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

COs:
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	2.4
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/Group discussion/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

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 **15 lectures**

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**
Course Code	**:**	
Code	**:**	**CORE-IV**
Total Credits	**:**	**04**
Distribution of Marks	**:**	**40 (IA) +60 (END) = 100**

COs:

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

Learning 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/Group discussion/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

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 **15 lectures**

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 : Basics of Biotechnology & Cell and Tissue Culture
Course Code :
Nature of the Course: Minor
Total Credits : 04
Distribution of Marks: 40 (IA) +60 (END) = 100

COs:

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

Learning Outcomes:

1) apply the concept of biotechnology

2) discuss the tools and techniques involves in genetic engineering.
3) 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/Group discussion/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

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 15 lectures

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
Total Credits : 03
Distribution of Marks : 40 IA + 60 END = 100

COs:

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 IN-SEMESTER ASSESSMENT:

- One Theory exam
- Group Discussion/Seminar/Viva/Assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination
- Submission of assignment on relevant topic
- Viva-voce examination

Unit 1: Ethnobiology **(Lectures 15)**

concept, history, theory; hypotheses, evolution and scope;

Indigenous knowledge and traditional practices, ethnobiology of north east India or some Himalayan communities. Major ethnic group 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

community of North Eastern India. Application and practices of traditional knowledge system in agriculture, healthcare, livelihood and alternative food; fooder. 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, weed and flood management, bee keeping,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. Ethnobotany, Oxford and I B H, New Delhi – 1981

3) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists,Lucknow, India.

4) S.K. Jain, 1990. Contributions of Indian ethnobotny.Scientific publishers, Jodhpur.

5) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – _Chichester

6) 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

Course: Multidisciplinary Course on Analytical Tools and Techniques in Science
Course Code:
Course Nature: SEC III
Marks: 40 IA +60 END = 100

Course Outcome:

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 IN-SEMESTER ASSESSMENT:

- One Theory exam
- One Practical exam
- Group Discussion/Seminar/Viva/Assignments

Attainment strategy:

- Continuous evaluation through in and end semester theory examination
- Submission of assignment on relevant topic
- Practical demonstration of the major analytical equipments
- Submission of practical record book
- Hands on activities in operating equipment
- Viva-voce examination

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:
• Separation of biological/ chemical samples using paper Chromatography and TLC
• Spectrophotometer estimation of biological/ chemical samples
• Structural elucidation of unknown compounds using IR spectroscopy
• Handling of Microscope and visualization of different samples
• Separation of samples using centrifuge
• Amplification of DNA using PCR
• Agarose gel electrophoresis of PCR amplified DNA

Suggested Readings:

1) Biophysical Chemistry: Principles and Techniques. Upadhyay, Upadhyay and Nath. Himalaya Publishing House. ISBN: 978-93-5142-227-3
2) Wilson And Walker's Principles And Techniques Of Biochemistry And Molecular Biology. Andreas Hofmann (Editor), Samuel Clokie (Editor). ISBN: 978-1316614761
3) Biological Instrumentation & Methodology. Bajpai P.K. (Author) ISBN: 978-8121926331