



**Darrang College
(Autonomous),
Tezpur-784001**

**Syllabus for
FYUGP
B.Sc. Zoology (Minor)**

**Approved by :
Board of Studies meeting held on 19-12-2025 &
&
Academic Council vide Resolution no. 2, dated 29-12-2025**

FOUR-YEAR UNDERGRADUATE PROGRAMME (FYUGP) IN ZOOLOGY, Darrang College (Autonomous)

Introduction:

The Zoology syllabus at Darrang College (Autonomous) has been developed in accordance with the visionary framework of the National Education Policy (NEP) 2020, which advocates for a holistic, multidisciplinary and adaptable education system grounded in Indian values and aimed at cultivating globally competent individuals.

This curriculum is designed to equip students with a solid understanding of the principles and applications of Zoology, while encouraging scientific thinking, critical analysis, creativity and problem-solving skills. In line with NEP 2020, it incorporates flexible entry and exit points, skill-based learning, interdisciplinary connections and continuous formative assessments.

The programme follows a learner-centric structure that integrates core theoretical concepts, hands-on laboratory training, environmental and ethical awareness, and the enhancement of communication and research capabilities. It ensures students not only acquire zoological knowledge but also learn to apply it responsibly in real-life situations, thereby supporting sustainable development and societal well-being.

Darrang College (Autonomous) remains committed to academic excellence, innovation and contributing to nation-building by preparing students to tackle the scientific and technological demands of the modern world.

The Four-Year Undergraduate Programme (FYUGP) in Zoology is crafted to foster comprehensive and in-depth understanding of biological sciences, while encouraging interdisciplinary engagement, research orientation and employability. It aims to develop students' foundational knowledge, technical proficiency and ethical consciousness, preparing them for roles in academia, industry and society.

Aims of the Four-Year Undergraduate Programme (FYUGP) in Zoology:

The FYUGP in Zoology is designed with the following core objectives:

1. To build a solid foundation in the fundamental principles of Zoology and their applications across various branches, including Cell and Molecular Biology, Animal Physiology, Biochemistry, Fish Biology and Fishery Science, Animal Ecology, Wildlife Biology, Immunology, Entomology and Animal Biotechnology.
2. To cultivate critical thinking, scientific reasoning and analytical abilities, enabling students to address scientific challenges with both creativity and systematic approaches.
3. To promote hands-on learning through laboratory experiments, fieldwork and research activities, fostering innovation, curiosity and practical competence.
4. To encourage interdisciplinary learning and curricular flexibility, in line with NEP 2020, by facilitating connections between Zoology and other disciplines such as Botany, Biotechnology, Physics, Chemistry, Environmental Science, Materials science and computational fields.
5. To strengthen communication abilities and ethical awareness, empowering students to share scientific knowledge effectively and apply it responsibly for societal and environmental benefit.
6. To prepare students for a variety of career opportunities—including higher education, research, teaching, industry, entrepreneurship and public service—through skill-based training and value-added courses.
7. To nurture a mindset of lifelong learning and intellectual curiosity aligned with the broader goal of developing capable, compassionate and self-reliant individuals who can contribute meaningfully to national and global progress.

Through these aims, the FYUGP in Zoology at Darrang College seeks to develop graduates who are not only proficient in the Zoology, but also engaged citizens dedicated to sustainable and inclusive development.

Programme Outcome (PO) of (FYUGP) in Zoology:

- **PO1-** Students gain knowledge and skills in the fundamentals of animal sciences and are able to analyze the complex interactions among various animals across different phyla, their distribution and their relationships with the environment.
- **PO2-** Apply knowledge of the internal structure and functions of the cell in regulating various metabolic processes, along with its molecular aspects and understand key concepts of genetics and their significance in human health.
- **PO3-** Demonstrates an understanding of complex evolutionary processes and animal behaviour, along with the principles of environmental conservation, pollution control, biodiversity and the protection of endangered species, while fostering empathy and compassion toward animals.
- **PO4-** Correlates the physiological processes of animals and relationship of organ systems.
- **PO5-** Gain knowledge of small-scale industries such as sericulture, fish farming, beekeeping, aquaculture, animal husbandry and poultry farming, while promoting practical competencies through field visits and hands-on training in operational vermicomposting units; empower students with vocational skills in vermitechnology and organic agriculture to enhance employability and entrepreneurial potential.
- **PO6-** Apply ethical principles and establish a commitment to professional responsibilities and encourage awareness of laboratory ethics and safety standards to prepare students for advanced research environments.
- **PO7-** Apply zoological knowledge and understanding to personal and professional contexts, contributing to national initiatives such as Swachh Bharat, sustainable agriculture and Atmanirbhar Bharat through skill-based biological education.

Teaching-Learning Process:

The Four-Year Undergraduate Programme (FYUGP) in Zoology adopts a diverse range of pedagogical methods to enhance student engagement and understanding, both in classroom settings and laboratory environments. These include:

- Traditional lectures
- Tutorials for concept clarification
- PowerPoint presentations for visual learning
- Project work and dissertations to encourage independent research
- Participation in seminars, workshops, and conferences for academic exposure
- Industry visits and field trips to connect theoretical knowledge with real-world applications

Teaching-Learning Tools:

To support effective delivery of the curriculum, a variety of instructional tools are utilized:

- Whiteboard/Green board/Blackboard
- LCD projectors and monitors
- Smart boards for interactive teaching
- Demonstration models
- Laboratory experiments to reinforce practical learning
- Industry and field visits for experiential learning

Assessment Methods:

Student progress is continuously evaluated through a combination of formative and summative assessment techniques, including:

- Home assignments
- Reports based on projects, industry visits, or fieldwork
- Seminar presentations to develop communication skills
- In-semester/Sessional examinations (both theory and practical)
- End-semester examinations (theory and practical)

CURRICULUM COMPONENTS

Distribution of Credits in Four years

COURSE STRUCTURE OF Four Year Under Graduate Programme (FYUGP) in Zoology

Semester	Course Name	Code	Credit
1	Major 1 Diversity of Non-chordates	ZOO-MJ-01014 (Level-100)	3
	Practical		1
	SEC Basics of Laboratory Practices in Zoology	ZOO-SEC-01013 (Level-100)	2
	Practical		1
	Minor 1 Diversity of Non-chordates	ZOO-MN-01014 (Level-100)	3
	Practical		1
2	Major 2 Diversity of Chordates	ZOO-MJ-02014 (Level-100)	3
	Practical		1
	SEC Vermicomposting and Organic Farming	ZOO-SEC-02013 (Level-100)	2
	Practical		1
	Minor 2 Diversity of Chordates	ZOO-MN-02014 (Level-100)	3
	Practical		1
3	Major 3 Cell Biology	ZOO-MJ-03014 (Level-200)	3
	Practical		1
	Major 4 Animal Taxonomy, Systematics & Biostatistics	ZOO-MJ-03024 (Level-200)	3
	Practical		1
	SEC Ornamental Fish and Aquarium Fish keeping	ZOO-SEC-03013 (Level-200)	2
	Practical		1
	Minor 3 Biodiversity and Conservation Biology	ZOO-MN-03014 (Level-200)	3
	Practical		1
	Major 5 Entomology and Fishery	ZOO-MJ-04014	3

4	Practical	(Level-200)	1
	Major 6 Fundamentals of Biochemistry	ZOO-MJ-04024 (Level-200)	3
	Practical		1
	Major 7 Biodiversity and Conservation Biology	ZOO-MJ-04034 (Level-200)	3
	Practical		1
	Major 8 Developmental Biology	ZOO-MJ-04044 (Level-200)	3
	Practical		1
	Minor 4 Cell Biology and Genetics	ZOO-MN-04014 (Level-200)	3
Practical		1	
5	Major 9 Principles of Genetics	ZOO-MJ-05014 (Level-300)	3
	Practical		1
	Major 10 Fundamentals of Ecology	ZOO-MJ-05024 (Level-300)	3
	Practical		1
	Major 11 Animal Physiology	ZOO-MJ-05034 (Level-300)	3
	Practical		1
Internship	ZOO-MJ-05044 (Level-300)	4	
	Minor 5 Fundamentals of Ecology	ZOO-MN-05014 (Level-300)	3
	Practical		1
6	Major 12 Molecular Biology	ZOO-MJ-06014 (Level-300)	3
	Practical		1
	Major 13 Evolution, Animal Behaviour and Chronobiology	ZOO-MJ-06024 (Level-300)	3
	Practical		1

	Major 14 Endocrinology and Reproductive Biology	ZOO-MJ-06034 (Level-300)	3
	Practical		1
	Major 15 Bioinformatics and Biotechniques and Instrumentation	ZOO-MJ-06044 (Level-300)	3
	Practical		1
	Minor 6 Taxonomy, Evolution and Animal Behaviour	ZOO-MN-06014 (Level-300)	3
	Practical		1
7	Major 16 Advanced Biochemistry	ZOO-MJ-07014 (Level-400)	3
	Practical		1
	Major 17 Immunology	ZOO-MJ-07024 (Level-400)	3
	Practical		1
	Major 18 Research Methodology (to be adopted from Swayam)	ZOO-MJ-07034 (Level-400)	3
	Practical		1
	Major 19 Applied Zoology	ZOO-MJ-07044 (Level-400)	3
	Practical		1
	Minor 7 Applied Zoology	ZOO-MN-07014 (Level-400)	3
	Practical		1
Degree with Honours			
8	Major 20 Genetic Engineering and Cytogenetics	ZOO-MJ-08014 (Level-400)	3
	Practical		1
	Major 21 Advanced Developmental Biology	ZOO-MJ-08024 (Level-400)	3
	Practical		1
	Major 22 Parasitology and Microbiology	ZOO-MJ-08034 (Level-400)	3
	Practical		1

	Research Project/ Dissertation	ZOO-MJ-08044 (Level-400)	4
	Minor 8 Animal Physiology and Biochemistry	ZOO-MN-08014 (Level-400)	3
	Practical		1
or Degree with Honours with Research			
8	Major 20 Genetic Engineering and Cytogenetics	ZOO-MJ-08014 (Level-400)	3
	Practical		1
	Research Project/ Dissertation	ZOO-MJ-080212 (Level-400)	12
	Minor 8 Animal Physiology and Biochemistry	ZOO-MN-08014 (Level-400)	3
	Practical		1

FYUGP in Zoology
Detailed Syllabus of 1st Semester Minor

Title of the Course	Zoology –1/ DIVERSITY OF NON-CHORDATES -MINOR
Paper Code	ZOO-MN-01014
Teaching Method	L-T-P
Total Credits	4 (Theory: 03, Practical: 01)
Distribution of Marks	45 (End Semester Theory) + 25 (End Semester Practical) + 30 (Internal) [Sessional Exam: 15 marks, Home Assignment: 6 marks, Class Test/ Group discussion/ Seminar presentation: 5 marks, Attendance: 4 marks]
Course Outcomes	By the end of this course/module, students will be able to: <ul style="list-style-type: none"> • CO1. Learn about the importance of systematics, taxonomy and structural organization of animals. • CO2. Describe general taxonomic rules on animal classification.

- CO3. Classify Phylum Protozoa to Echinodermata with taxonomic keys.
- CO4. Critically analyze the organization, complexity and characteristic features of non-chordates making them familiarize with the morphology and anatomy of representatives of various animal phyla.
- CO5. Imparts conceptual knowledge of non-chordates, their adaptations and associations in relation to their environment.

Contact hours **45 (Theory) + 30 (Practical)**

DIVERSITY OF NON-CHORDATES

Code: ZOO-MN-01014

Credit: 3 (T) + 1 (P)

THEORY

Credit- 3/ Hours- 45

Unit	Content	Lecture	Tutorial	Practical	Total hours
1	<ul style="list-style-type: none"> • Basis of Classification- Levels of organization (cellular, tissue, organ and organ system), symmetry, body wall, coelom types and its definition, segmentation and notochord. • Phylum Protista- General Characteristics, classification up to class; locomotion, nutrition and reproduction in Protozoa. 	6	1	--	07
2	<ul style="list-style-type: none"> • Phylum Porifera- General Characteristics, classification up to class; Canal system in Porifera; Spicules in Sponges. • Phylum Cnidaria- General Characteristics, classification up to class; Corals and coral reef formation. • Phylum Ctenophora- General Characteristics, classification up to class 	7	1	--	08
3	<ul style="list-style-type: none"> • Phylum Platyhelminthes- General Characteristics, classification up to class; Life cycle of <i>Fasciola hepatica</i> and <i>Wuchereria bancrofti</i>, Parasitic adaptation. • Phylum Nematelminthes- General 	14	1	--	15

	Characteristics, classification up to class; Life cycle of <i>Ascaris lumbricoides</i> .				
	<ul style="list-style-type: none"> • Phylum Annelida- General Characteristics, classification upto class; Metamerism and excretion in Annelida 				
4	<ul style="list-style-type: none"> • Phylum Arthropoda- General Characteristics, classification up to class; Vision and respiration in Arthropoda; Evolutionary significance of Onychophora. • Phylum Mollusca- General Characteristics, classification up to class; Torsion and Detorsion in Gastropoda • Phylum Echinodermata- General Characteristics, classification up to class; Water Vascular System in Echinodermata. 	14	1	--	15
PRACTICALS		Credit- 1/ Hours- 30			
	<ol style="list-style-type: none"> 1. Study of minimum of four representative (specimen/slide/model) of each phylum of non-chordates. 2. Study of larval forms of Arthropoda. 3. T.S through crop and gizzard of Leech; Pharynx, gizzard and typhlosolar intestine of earthworm. 4. Dissection and display of digestive and nervous system of nervous system of cockroach. 5. To prepare an album of GPS photographs of at least five locally available invertebrate species. 	--	--	30	30

Suggested Readings:

1. Ruppert, E.E. and Barnes, R.D. (2006). Invertebrate Zoology, 8th Edition. Holt Saunders International Edition.
 2. Pechenik, J. (2015). Biology of the Invertebrates. 7th Edition, McGraw Hill
 3. Schierwater, B. & DeSalle, R. (2021). Invertebrate Zoology: A Tree of Life Approach. 1st edition, CRC Press
 4. Jordan, K. and P. S. Verma (2019). Invertebrate Zoology, S. Chand and Co. Ltd.
 5. Kotpal, R. L. (2020). Modern text book of Zoology, Invertebrates, 12th Edition, Rastogi Publications.
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FYUGP in Zoology
Detailed Syllabus of 2nd Semester Minor

Title of the Course	Zoology –2/ DIVERSITY OF CHORDATES -MINOR
Paper Code	ZOO-MN-02014
Teaching Method	L-T-P
Total Credits	4 (Theory: 03, Practical: 01)
Distribution of Marks	45 (End Semester Theory) + 25 (End Semester Practical) + 30 (Internal) [Sessional Exam: 15 marks, Home Assignment: 6 marks, Class Test/ Group discussion/ Seminar presentation: 5 marks, Attendance: 4 marks]
Course Outcomes	<p>By the end of this course/module, students will be able to:</p> <ul style="list-style-type: none"> • CO1. Learn about the importance of systematics, taxonomy and structural organization of chordates. • CO2. Describe general taxonomic rules on chordate classification. • CO3. Classify Protochordates to Mammalia with taxonomic keys. • CO4. Critically analyze the organization, complexity and characteristic features of chordates making them familiarize with the morphology and anatomy of representatives of various chordates. • CO5. Imparts conceptual knowledge of chordates, their adaptations and associations in relation to their environment.
Contact hours	45 (Theory) + 30 (Practical)

DIVERSITY OF CHORDATES -MINOR					
Code: ZOO-MN-02014					
Credit: 3 (T) + 1 (P)					
THEORY			Credit- 3/ Hours- 45		
Unit	Content	Lecture	Tutorial	Practical	Total hours
1	<ul style="list-style-type: none"> • Origin of Chordates- Dipleurula concept and Echinoderm theory. General characteristics and outline classification of Chordates. 				

	<ul style="list-style-type: none"> General characteristics of Hemichordata, Urochordata and Cephalochordata. Study of larval forms of protochordates- Tornaria, Ascidian tadpole larva and Amphioxus. Retrogressive Metamorphosis in Ascidia. 	11	1	--	12
2	<ul style="list-style-type: none"> Advanced features of vertebrate over protochordate. Overview of axial and appendicular skeleton, Jaw suspensorium and visceral arches. General characteristics and classification of cyclostomes upto class. Distinguishing features of Petromyzon and Myxine 	09	1	--	10
3	<ul style="list-style-type: none"> General characteristics of Chondrichthyes and Osteichthyes and classification upto order. Swim Bladder in Fishes. Migration in Fishes 	04	1	--	05
4	<ul style="list-style-type: none"> Origin of Tetrapoda General characteristics and classification of Amphibia upto order; Parental care in Amphibia. General characteristics and classification of Reptiles upto order. Biting mechanism in snakes. 	07	1	--	08
5	<ul style="list-style-type: none"> General characteristics and classification of Aves upto order. Archaeopteryx as a connecting link; Aerodynamics of flight in Birds. General characteristics and classification of Mammalia upto order. Affinities in Prototheria; Dentition in Mammals. 	09	1	--	10
PRACTICALS		Credit- 1/ Hours- 30			
	1. Study of museum specimens/ Models -Protochordata (<i>Balanoglossus</i> , <i>Herdmania</i> , <i>Amphioxus</i>), Agnatha (<i>Petromyzon</i> , <i>Myxine</i>), Fishes (<i>Scoliodon</i> , <i>Torpedo</i> , <i>Mystus</i> , <i>Heteropneustes</i> , <i>Labeo</i> , <i>Hippocampus</i> , <i>Tetraodon</i>), Amphibia (<i>Ichthyophis</i> , <i>Necturus</i> , <i>Bufo</i> , <i>Hyla</i>), Reptilia (<i>Chelone</i> , <i>Hemidactylus</i> , <i>Varanus</i> , <i>Chamaeleon</i> , <i>Bungarus</i> , <i>Naja</i>), Aves (Kingfisher , White breasted water hen, Red vented bulbul, Openbilled stork, Common maina, Pied maina, House Sparrow, Water heron, Common tit and Spotted dove), Mammalia (common primates- Lories, Rhesus Macaque), common ungulates- (Sambar Deer, Spotted Deer, Swamp Deer).	--	--	30	30

2. Identification key of venomous and non-venomous snakes.
3. To study the larval forms (Ascidian Tadpole, Tornaria, *Amphioxus*, Ammocoete, *Axolotol* and Frog Tadpole larva through slides/ microphotographs.
4. To submit a project report on any five native Amphibia/ Reptilia/Aves/Mammal with GPS photographs.

Suggested Readings

1. Young, J. Z. (2004). The Life of Vertebrates. 3rd Edition. Oxford University press.
2. Pough F. H. & Janis, C. M. (2018). Vertebrate Life. 10th Edition, Sinauer Associates
3. Verma, P. S. & Jordan, E. L. (2013). Chordate Zoology. 14th edition, S. Chand
4. Kotpal, R. L. (2019). Modern text book of zoology: Vertebrates (Z-3). 5th edition, Rastogi Publications.

Title of the Course	Zoology –3/ BIODIVERSITY AND CONSERVATION BIOLOGY /MINOR
Paper Code	ZOO-MN-03014
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	45 (End Semester Theory) + 25 (End Semester Practical) + 30 (Internal) [Sessional Exam: 15 marks, Home Assignment: 6 marks, Class Test/ Group discussion/ Seminar presentation: 5 marks, Attendance: 4 marks]
Course Outcomes	<p>By the end of this course/module, students will be able to:</p> <ul style="list-style-type: none"> ▪ CO1: Understand the concepts, components, evolution and global patterns of biodiversity, including the influence of climate, land use and human population pressures. ▪ CO2: Explain the values, uses, and conservation approaches for biodiversity, including in situ and ex situ methods, restoration techniques and sustainable resource management. ▪ CO3: Analyse conservation priorities, sustainable development goals, gender perspectives and legal frameworks governing biodiversity and wildlife protection. ▪ CO4: Describe wildlife habitat management, ecological restoration and the use

of GIS, remote sensing and field techniques in studying and monitoring wildlife populations.

- **CO5:** Identify major wildlife groups, apply field survey tools and methods, interpret indirect animal signs and conduct basic wildlife activity and habitat assessments.

Contact hours **45 (Theory) + 30 (Practical)**

Zoology –3/ BIODIVERSITY AND CONSERVATION BIOLOGY
CODE- ZOO-MN-03014
CREDIT- 3(T) + 1(P)

THEORY

Credit- 3/ Hours- 45

Unit	Content	Lecture	Tutorial	Practical	Total hours
1	<ul style="list-style-type: none"> ▪ Concept and history of biodiversity , Major elements of global diversity, Evolution and distribution, Components of Biodiversity (Genetic, Organismal and Ecological) ▪ Biodiversity in different levels (Country, Global, Regional) ▪ Magnitude and pattern of Biodiversity, Carrying capacity, land use and population pressure on Biodiversity ▪ Impact of climate Change, Global health and diseases on Biodiversity 	10	02	--	12
2	<ul style="list-style-type: none"> ▪ Value of Biodiversity (Species and Ecosystems), Utilization of Biodiversity ▪ Methods and tools for biodiversity conservation (<i>ex situ, in situ</i>, Restoration and Rehabilitation, Sustainable land use practices) ▪ Priority setting: Criteria for conservation, Concept of sustainable development, Sustainable development goals, Harnessing and benefit sharing ▪ Integrating gender perspectives in biodiversity conservation ▪ Challenges in Biodiversity Conservation: Impacts of population pressure, land use changes and urbanization on biodiversity; Impact of climate Change on biodiversity loss, public health and disease dynamics. ▪ Legal instruments for biological diversity conservation 	15	03	--	18

3	<ul style="list-style-type: none"> ▪ Habitat management of wildlife in different ecosystems, Restoration of degraded habitats, Concepts of GIS and Remote sensing and their utility in wildlife habitat management ▪ Wildlife protected areas in India, National Parks, Sanctuaries, Man and Biosphere Reserve, Community reserves, Sacred Groves. ▪ Concepts of elephant and tiger reserves, Ramsar sites, Concepts and management of renewable natural resources and wildlife's welfare factors. 	12	03	--	15
PRACTICALS		Credit- 1/ Hours- 30			
7	<ol style="list-style-type: none"> 1. Identification of wild fauna (Mammals, Birds, Herpetofauna and Butterflies) 2. Demonstration and applicability of basic equipment needed for wildlife studies (Compass, Range finder, GPS, Camera Traps). 3. Demonstrations of field study techniques: line transect and quadrat sampling. 4. Importance of indirect evidences in wildlife survey and its identification [Animal Footprints (Pug mark & hoof mark), Animal Droppings (Scat, Dung, Pellet), Other animal signs, Antlers, Nests of birds]. Animal trail survey or trail monitoring, use of plaster of Paris for wildlife survey (for the indirect survey). 5. Activity budgeting of bird/mammal. 	--	--	30	30

Suggested Readings:

1. M.Kato (Ed) ; The Biology of Biodiversity: Springer-Verlag, 2000
2. Anne E. Magurran; Measuring Biological Diversity; Blackwell Publishing, 2004
3. K. C. Agrawal: Global Biodiversity, Nidhi Publishers (India), 2002
4. Kelvin J. Gaston & John I Spicer: Biodiversity An Introduction; 2nd Edn. Blackwell Publishing; 2004
5. Caughly, G. and Sinclair, A. R. E. (1994). Wildlife Ecology and Management. Blackwell Scientific Publications, 1-334pp.
6. Shekhar, S. Kolipaka, (2014). A Field Guide to Tracks & Signs of Indian Wildlife. 1-385pp.
7. Sinclair, A.R. E., John M. Frysell, and Graeme Caughley (2006). Wildlife Ecology, Conservation, and Management, Blackwell Publishing, 1-463, pp.
8. Raj, M. (2012). Wildlife Ecology and Management (With special reference to Northeast India). Assam Book Depot, Panbazar, Guwahati-1, 1-294pp.

9. Berwick S. H. and Saharia, V. B. (1995). Development of International principles of Wildlife Research and Management (Asian and American approaches). Oxford University Press, Delhi, Bombay, Madras. 1-481. pp.
 10. Vivek Menon, (2014). Indian mammals, A Field Guide. Hachetta Book Publishing India Pvt. Ltd. 4th and 5th Floor Corporate centre, Plot No. 94, Sector 44, Gurgaon, 122001, India.
 11. Hunter M. L., Gibbs, J. B. and Sterling, E. J. (2008). Problem-Solving Conservation Biology and Wildlife Management: Exercise for class, Field and laboratory, Blackwell Publishing.
 12. Southerland, W. J. (2000). The conservation handbook: Research management and Policy. Blackwell Sciences.
 13. Bookhout, T. A. (1996). Research and management techniques for wildlife and habitats, 5th edition. The Wildlife Society, Allen Press.
 14. Woodroffe, R., Thirgood, S. and Rabinowitz, A. (2005). People and Wildlife, Conflict or Co-existence? Cambridge University.
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Title of the Course	Zoology –4/ CELL BIOLOGY AND GENETICS/ MINOR
Paper Code	ZOO-MN-04014
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	45 (End Semester Theory) + 25 (End Semester Practical) + 30 (Internal) [Sessional Exam: 15 marks, Home Assignment: 6 marks, Class Test/ Group discussion/ Seminar presentation: 5 marks, Attendance: 4 marks]
Course Outcomes	<p>By the end of this course/module, students will be able to:</p> <ul style="list-style-type: none"> ▪ CO1: Understand the structural and functional aspects of prokaryotic cells, eukaryotic cells, viruses, viroids, mycoplasma, prions and various cellular organelles as well as cell junctions. ▪ CO2: Interpret chromosome organization, nucleosome packaging, cell cycle regulation and the processes of mitosis and meiosis. ▪ CO3: Understand Mendelian and post-Mendelian inheritance patterns, including gene interactions, penetrance, expressivity and the inheritance of sex-linked, sex-influenced and sex-limited traits. ▪ CO4: Explain linkage, crossing over, recombination frequencies and construct gene maps using two-point and three-point test crosses, including concepts like interference and coefficient of coincidence. ▪ CO5: Describe chromosomal and gene-level mutations and their molecular

	basis. ▪ CO6: Analyse genetic, environmental, and hormonal mechanisms of sex determination, dosage compensation, extranuclear inheritance and maternal effect phenomena
Contact hours	45 (Theory) + 30 (Practical)

CELL BIOLOGY AND GENETICS-MINOR Code: ZOO-MN-04014 Credit: 3 (T) + 1 (P)						
THEORY			Credit- 3/ Hours- 45			
Unit	Content	Lecture	Tutorial	Practical	Total hours	
CELL BIOLOGY						
1	1. Overview of Cells Prokaryotic and Eukaryotic Cells. 2. Plasma membrane Models of plasma membrane structure, Transport across membrane. 3. Cytoplasmic Organelles Structure and function of Nucleus, Mitochondria, Golgi body, Endoplasmic Reticulum, Lysosomes, Ribosome. 4. Cytoskeleton Structure and function of Microtubules, Microfilaments and Intermediate Filaments. 5. Chromosome Giant Chromosomes, Types of Eukaryotic Chromosomes based on centromere, Euchromatin and Heterochromatin 6. Cell Cycle and Cell Division Mitosis, Meiosis and Cell cycle.	20	02	--	22	
GENETICS						
2	1. Mendelian Genetics Principles of inheritance, incomplete dominance, codominance 2. Gene Interaction Penetrance and Expressivity, Epistasis, Pleiotropy 3. Linkage and Crossing Over Linkage, Crossing Over, Cytological basis of	07	02	--	22	

crossing over, recombination frequency, linkage map.

4. Mutation

Types of Mutation, Structure and Numerical Chromosomal aberration, Molecular basis of mutation, Mutagens.

5. Sex Determination

Sex Determination in *Drosophila* and Man, Dosage compensation.

PRACTICALS

Credit- 1/ Hours- 30

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|--|----|----|----|----|
| 1. Study of prokaryotic and eukaryotic cells through permanent slides. | | | | |
| 2. Preparation of permanent slide to show the presence of bar body in human female cheek cells. | | | | |
| 3. Preparation of permanent slide of blood and study of different types of blood cells. | | | | |
| 4. Identification of various mutant types of <i>Drosophila</i> through culture/ Photomicrographs. | -- | -- | 30 | 30 |
| 5. Study of Mendelian Laws and gene interaction and their verification by chi- square analysis using seeds, beads, <i>Drosophila</i> . | | | | |
| 6. Study of linkage maps based on data from <i>Drosophila</i> crosses | | | | |

Suggested Readings:

1. Alberts, B et al. (2014). 6th edition. Molecular Biology of the Cell. W. W. Norton & Company. ISBN-13: 978-0815345244
2. Karp, G. (2019). 9th Edition. Cell and molecular biology: New Jersey, USA: Wiley Publishers. ISBN-978—1-119-59816-9
3. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. 8th edition. Wiley India.
4. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. 5th edition. John Wiley and Sons Inc
5. Klug, W.S., Cummings, M.R., Spencer, C.A. (2020). Concepts of Genetics. 10th edition. Benjamin Cummings. Russell, P.J. (2009). Genetics- A molecular approach. 3rd edition. Benjamin Cummings.
6. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to genetic Analysis. 9th edition. W.H. Freeman and Co.
7. Tamarin R.H. (2017). Principles of Genetics. Tata McGraw Hill Edition
8. Brown, T.A. (2023). Genomes 5. 5th edition, CRC Press.

Title of the Course	Zoology –5/ FUNDAMENTALS OF ECOLOGY/ MINOR
Paper Code	ZOO-MN-05014
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	45 (End Semester Theory) + 25 (End Semester Practical) + 30 (Internal) [Sessional Exam: 15 marks, Home Assignment: 6 marks, Class Test/ Group discussion/ Seminar presentation: 5 marks, Attendance: 4 marks]
Course Outcomes	<p>By the end of this course/module, students will be able to:</p> <ul style="list-style-type: none"> ▪ CO1: Understand the basic concepts of ecology and ecosystem organization, including autecology, synecology, limiting factors and the structural and functional components of ecosystems. ▪ CO2: Explain trophic interactions, food chains, food webs, ecological pyramids, energy flow, nutrient cycling and the impacts of human-modified ecosystems. ▪ CO3: Analyse population attributes such as density, natality, mortality, growth patterns, life tables, survivorship curves and regulatory mechanisms including r–K strategies. ▪ CO4: Describe community structure, species diversity, stratification, ecotones, edge effects and ecological succession leading to climax communities. ▪ CO5: Apply ecological field methods to assess population density, diversity indices, water quality parameters and ecosystem characteristics, and interpret ecological data through practical investigations and field visits.
Contact hours	45 (Theory) + 30 (Practical)

Zoology –5/ FUNDAMENTALS OF ECOLOGY CODE- ZOO-MN-05014 CREDIT- 3(T) + 1(P)					
THEORY				Credit- 3/ Hours- 45	
Unit	Content	Lecture	Tutorial	Practical	Total hours
1	Introduction to Ecology and Ecosystem <ul style="list-style-type: none"> ▪ Basic concept of ecology and ecosystem, Autecology and synecology, Levels of organization, Laws of limiting factors 				

	<ul style="list-style-type: none"> ▪ Structural components of Ecosystem ▪ Functional attributes of Ecosystem- Trophic structure, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem ▪ Ecological pyramids and Ecological efficiencies Nutrient and biogeochemical cycle with one example of Nitrogen cycle Human modified ecosystem. 	15	03	--	18
2	<p>Population</p> <ul style="list-style-type: none"> ▪ Unitary and Modular populations ▪ Unique and group attributes of population: Density, Natality, Mortality, Life table, Fecundity tables and Survivorship curve, Age ratio, Sex ratio, Dispersion and Dispersal, Exponential and logistic growth, equation and patterns, r and K strategies ▪ Biotic potential and Environmental resistance ▪ Population regulation - density-dependent and independent factors Population interactions, Gause's Principle, Lotka-Volterra equation 	15	02	--	17
3	<p>Community</p> <ul style="list-style-type: none"> ▪ Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, ▪ Ecotone and edge effect ▪ Ecological succession with one example, Theories pertaining to climax community 	09	01	--	10
PRACTICALS		Credit- 1/ Hours- 30			
7	<ol style="list-style-type: none"> 1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided 2. Determination of population density by quadrat method and calculation of Shannon Weiner diversity index in a natural/ hypothetical community 3. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, 	--	--	30	30

4. Determination of pH, and Dissolved Oxygen content (Winkler's method) and free CO₂ in an ecosystem
5. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary

Suggested Readings:

1. Colinvaux, P.A. (1973). Ecology. 2nd Edition. John Wiley and Sons Inc.
2. Krebs, C. J. (2001). Ecology. 6th Edition. Benjamin Cummings.
3. Odum, E.P. (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
4. Smith, R. L., Smith, T.M. (2000). Ecology and field biology Harper and Row publisher
5. Ricklefs, R.E. (2000). Ecology. V Edition. Chiron Pres

Title of the Course	Zoology –6/ TAXONOMY, EVOLUTION AND ANIMAL BEHAVIOUR/ MINOR
Paper Code	ZOO-MN-06014
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	45 (End Semester Theory) + 25 (End Semester Practical) + 30 (Internal) [Sessional Exam: 15 marks, Home Assignment: 6 marks, Class Test/ Group discussion/ Seminar presentation: 5 marks, Attendance: 4 marks]
Course Outcomes	<p>By the end of this course/module, students will be able to:</p> <ul style="list-style-type: none"> ▪ CO1: CO1: Understand the foundations of animal taxonomy, including taxonomic categories, species concepts and the role of systematics in biological research ▪ CO2: Explain modern trends in taxonomy such as chemotaxonomy, cytotaxonomy, molecular taxonomy and the key principles of zoological nomenclature under ICZN ▪ CO3: Explain major evolutionary concepts including origin of life, Darwinism vs. Neo-Darwinism, fossil evidences, geological timescale and key evolutionary transitions such as horse and human evolution.

- **CO4:** Describe fundamental concepts of ethology, behavioural patterns, communication systems, navigation and social organization in animals

Contact hours **45 (Theory) + 30 (Practical)**

**ZOOLOGY-6/ TAXONOMY, EVOLUTION AND ANIMAL BEHAVIOUR ICS -MINOR
CODE- ZOO-MN-06014
CREDIT- 3(T) + 1(P)**

THEORY

Credit- 3/ Hours- 45

Unit	Content	Lecture	Tutorial	Practical	Total hours
TAXONOMY					
1	<ul style="list-style-type: none"> ▪ Introduction to Taxonomy and systematics & their Contribution to biology; Taxon and Phenon ▪ Taxonomic categories; concepts of species – typological, nominalistic, biological and evolutionary ▪ Taxonomic keys – various types; dichotomous nature of keys ▪ Taxonomic characters – morphological, behavioural, ecological, and geographical ▪ Trends in taxonomy – chemotaxonomy, cytotoxonomy and molecular taxonomy ▪ Zoological Nomenclature – ICZN, Principles, functions and importance of The Code of nomenclature 	14	01	--	15
EVOLUTION					
2	<ul style="list-style-type: none"> ▪ Origin of life - From chemogeny to biogeny, Experimental evidences, RNA world ▪ Evolutionary perspectives – Pre-Darwinian concepts, Darwinism vs Neo-Darwinism ▪ Paleontological evidences of evolution, Geological timescale ▪ Natural selection – concept of fitness, selection coefficient, kin selection, sexual selection ▪ Evolution of Horse, Human Evolution 	13	01	--	14
ANIMAL BEHAVIOUR					
	<ul style="list-style-type: none"> • Concept of Ethology, Proximate and ultimate 				

3	<p>causes of behaviour; Animal behaviour and Human society</p> <ul style="list-style-type: none"> ▪ Behavioural Equipments: Sign, Stimuli and Stimulus filtering, Patterns of behaviour - instinct vs. learned behaviour; Animal orientation - Taxis vs. Kinesis; Navigation; Methods of studying behaviour ▪ Learning Definition, Types of learning, Neural mechanism of learning; Concept of Motivation, Physiological basis of motivation, control of hunger drive and thirst drive in animals Fixed Action Pattern, ▪ Animal Communication - Dance Language in honey bees; Schooling behaviour in fishes; Social behaviour in monkeys. ▪ Major social behaviours; Altruism: Reciprocal altruism, group selection, kin selection, Inclusive fitness, cooperation /reciprocation; Selfishness; Eusociality 	15	01	----	16
PRACTICALS		Credit- 1/ Hours- 30			
7	<ol style="list-style-type: none"> 1. To identify and distinguish species of insects/ fishes/ amphibians/ reptiles/ birds of North-East India using appropriate taxonomic keys. 2. Preparation and study of skeleton of fish. 3. Study of fossils from models/pictures 4. Study of homology and analogy from suitable specimens (insects, birds and mammals) 5. To study nest and nesting habits of birds/social insects 6. To study behavioural activities of animals in home/backyard garden and prepare a short report by student. 	--	--	30	30

Suggested Readings:

1. Hall B.K. & Hallgrimsson B. (2013). Strickberger's Evolution. 5th Edition, Jones and Bartlett Publishers, Inc.
2. Futuyama, D. J. (2017). Evolution. 4th Edition, Sinauer Associates
3. Ridley, M. (2020). Evolution. 2nd edition (South Asia Edition), Oxford University Press
4. Manning, A. & Dawkins, M. S. (2012). An Introduction to Animal Behaviour. Cambridge University Press, 6th edition.

5. Barnard, C. (2003). Animal Behaviour: Mechanism, Development, Function and Evolution. Pearson, 1st edition.
6. Mechanism of Animal Behaviour, Peter Marler and J. Hamilton; John Wiley & Sons, USA
7. Animal Behaviour, David McFarland, Pitman Publishing Limited, London, UK
8. Animal Behaviour, John Alcock, Sinauer Associate Inc., USA
9. Lehner, P. N. (1996). Handbook of Ethological Methods. Cambridge University Press, 2nd edition
10. Kumar, V. (2017). Biological Timekeeping: Clocks, Rhythms and Behaviour. Springer, 1st edition
11. Nelson, R.J. (2000). An introduction to behavioural Endocrinology, 2nd edition.
12. Binkley, S. (1990). The clockwork sparrow: time, clocks and calendars in biological organisms.
13. Chadrashekar, M.K. (1985). Biological rhythms. Madras science foundation, Chennai

Title of the Course	Zoology -7/ APPLIED ZOOLOGY/ MINOR
Paper Code	ZOO-MN-07014
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	45 (End Semester Theory) + 25 (End Semester Practical) + 30 (Internal) [Sessional Exam: 15 marks, Home Assignment: 6 marks, Class Test/ Group discussion/ Seminar presentation: 5 marks, Attendance: 4 marks]
Course Outcomes	<p>By the end of this course/module, students will be able to:</p> <ul style="list-style-type: none"> ▪ CO1: Understand the concepts of ethnozooology and IKS and recognize traditional animal-based practices of India and Assam. ▪ CO2: Describe the biology, rearing and economic importance of Muga and Eri silkworms in Assam's sericulture sector. ▪ CO3: Explain the biology and management of honey bees and apply basic techniques of sustainable apiculture. ▪ CO4: Understand the cultivation, processing and economic value of lac and pearls, with emphasis on Assam's potential. ▪ CO5: Apply basic principles of poultry and dairy management and perform

essential field/practical skills related to applied zoology.

Contact hours **45 (Theory) + 30 (Practical)**

Zoology -7/ APPLIED ZOOLOGY
CODE- ZOO-MN-07014
Credit: 3 (T) + 1 (P)

THEORY

Credit- 3/ Hours- 45

Unit	Content	Lecture	Tutorial	Practical	Total hours
1	<p>Ethnozoology & Indian Knowledge Systems (IKS)</p> <p>Concept, scope and relevance of ethnobiology and ethnozoology. Traditional animal-based practices in India and Assam: Indigenous knowledge of Muga/Eri rearing, Traditional beekeeping. Folk medicinal uses of animal products. Aquatic resource use in local communities. Documentation methods: field interviews, participatory observation, ethical considerations, benefit-sharing. Role of ethnozoology in biodiversity conservation, livelihood sustenance and cultural preservation.</p>	06	01	--	07
2	<p>Sericulture (with special focus on Muga & Eri)</p> <p>History, scope and economic importance of sericulture in India and Assam. Classification and biology of silkworms: <i>Antheraea assamensis</i> (Muga) and <i>Samia ricini</i> (Eri). Host plants of silkworms. Rearing methods: outdoor rearing for Muga, indoor/outdoor for Eri; grainage techniques; disease management. Post-cocoon technology: cocoon processing, reeling, spinning, weaving; special focus on Muga/Eri enterprises and GI tag. Sericulture-based rural livelihoods in Assam</p>	07	01	--	08
	<p>Apiculture (Beekeeping)</p> <p>Introduction, significance and commercial potential of apiculture in India. Types of honey bees: <i>Apis cerana indica</i>,</p>				

3	<i>Apis mellifera</i> , <i>Apis dorsata</i> . Bee biology: caste system, communication, foraging behaviour, pollination. Beekeeping equipment: indigenous vs modern hives; colony management; seasonal management. Bee diseases, pests and their control. Honey extraction, wax processing, value-added hive products; Assam-specific floral resources and beekeeping potential.	07	01	--	08
4	Lac Culture Biology and taxonomy of lac insect (<i>Kerria lacca</i>). Host plants and lac strains; life cycle and lac secretion process. Cultivation practices: inoculation, pruning, crop management and harvesting. Lac processing: seedlac, shellac and value-added products. Economic importance and prospects of lac culture as a cottage industry in NE India.	06	01	--	07
5	Pearl Culture (Freshwater & Marine) Introduction to pearls: natural and cultured pearls; economic significance. Biology of pearl-producing molluscs: marine oysters and freshwater mussels (including species found in NE India). Site selection and environmental requirements. Techniques of pearl culture: grafting, nucleation, implantation methods; husbandry practices. Pearl quality, harvesting, grading and marketing; potential for freshwater pearl culture in Assam's ponds/beels.	07	01	--	08
6	Livestock Rearing (Poultry & Dairy) Role of livestock in Indian and Assamese rural economy. Poultry: breeds, housing, feeding, breeding, incubation, vaccination schedule, disease management; backyard poultry systems used in Assam. Dairy: cattle breeds (Indian, crossbred); feeding and nutrition; housing; health management; artificial insemination basics. Farm management: record keeping, small-scale enterprise planning, government schemes for Assam.	06	01	--	07
PRACTICALS		Credit- 1/ Hours- 30			
	1. Identification of silkworm species and host plants; cocoon sorting. 2. Demonstration of honey extraction/ hive inspection. 3. Identification of freshwater mussels/oysters; water-quality assessment. 4. Visit to poultry/dairy unit and preparation of farm report. 5. Ethnozoological documentation of one Assamese	--	--	30	30

traditional practice.

Recommended Readings:

1. Economic Zoology. Shukla and Upadhyay. Rastogi Publications.
2. Textbook of Fish Biology and Fisheries 3rd edn (PB). Khanna S. S. and H. R. Singh. Narendra Publishing House.
3. Sericulture with Special Reference to Assam. Tarali Kalita. Eastern Book House.
4. Ethnozoological Knowledge in Northeast India: Opportunities and Prospects. Kuldip Sarma, Amal Bawri, Imlikumba and Robindra Teron. Northeastern Institute of Ayurvedic and Folk Medicine Research.

Title of the Course	Zoology -8/ ANIMAL PHYSIOLOGY AND BIOCHEMISTRY/ MINOR
Paper Code	ZOO-MN-08014
Teaching method	L-T-P
Total Credits	04 (Theory: 03, Practical: 01)
Distribution of Marks	45 (End Semester Theory) + 25 (End Semester Practical) + 30 (Internal) [Sessional Exam: 15 marks, Home Assignment: 6 marks, Class Test/ Group discussion/ Seminar presentation: 5 marks, Attendance: 4 marks]
Course Outcomes	By the end of this course/module, students will be able to: <ul style="list-style-type: none">▪ CO1: Understand the structures and biological roles of carbohydrates, protein, lipids and nucleic acids including major classes such as monosaccharides, polysaccharides, amino acids, fatty acids, phospholipids , steroids and nucleotides.▪ CO2: Interpret enzyme classification, catalytic mechanisms, enzyme kinetics including Km and Vmax and the effects of inhibitors, cofactors and allosteric regulation.▪ CO3: Explain and analyze the metabolic pathways like Glycolysis, Krebs cycle , Fatty acid synthesis along with oxidative phosphorylation.▪ CO4: Describe the physiology of digestion, respiration and circulation, including nutrient absorption, gas exchange mechanisms, oxygen transport dynamics and the cardiac cycle with ECG interpretation.▪ CO5: Analyse excretory physiology, nephron structure, urine formation, nitrogenous waste patterns and regulatory mechanisms such as the counter-

current system and urea cycle.

Contact hours **45 (Theory) + 30 (Practical)**

Zoology – 8/ ANIMAL PHYSIOLOGY AND BIOCHEMISTRY
CODE- ZOO-MN-08014
CREDIT- 3(T) + 1(P)

THEORY

Credit- 3/ Hours- 45

Unit	Content	Lecture	Tutorial	Practical	Total hours
PHYSIOLOGY					
1	<ul style="list-style-type: none"> • Digestive System Digestion and absorption of carbohydrates, proteins and lipids • Respiratory System Mechanism of Breathing, Transport of oxygen and Carbon dioxide, Oxygen- Haemoglobin curve and Borh 's effect ▪ Cardiovascular System Structure of Heart, Neurogenic and myogenic heart, cardiac cycle and ECG ▪ Muscles Structure, kinds and characteristics of Muscle, Mechanism of muscle contraction ▪ Nervous System Structure of Neuron, Generation of Action potential and transmission of nerve impulse ▪ Excretory System Structure of Nephron and Kidney, Types of nitrogenous wastes in different animal groups, Urea cycle and Urine formation. 	22	01	--	23
BIOCHEMISTRY					
3	<ul style="list-style-type: none"> ▪ Biomolecules Structure, Classification and Biological importance of Carbohydrates, Proteins, Lipids and Nucleic Acid ▪ Enzymes Classification of Enzymes, Factors affecting rate of enzyme catalysed reaction, Mechanism of Enzyme action, Derivation of Michaelis- Menten equation, 	21	01	--	22

Cofactors, Allosteric enzymes, Enzyme Inhibition.

▪ **Metabolic Pathways**

Glycolysis, Krebs's Cycle, Electron Transport Chain and Oxidative phosphorylation, β -oxidation of fatty acid and fatty acid synthesis.

PRACTICALS

Credit- 1/ Hours- 30

7

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|--|----|----|-----------|-----------|
| 1. Determination of ABO blood groups | | | | |
| 2. Estimation of Haemoglobin using Sahli's Haemoglobinometer | | | | |
| 3. Preparation of Haemin Crystals | | | | |
| 4. Study of permanent slides of Liver, Lung, Stomach, Duodenum, Cardiac muscles, Smooth muscle, Skeletal muscle and Kidney | | | | |
| 5. Qualitative test to identify functional groups of Carbohydrates, Proteins and Lipids | -- | -- | 30 | 30 |
| 6. Estimation of Protein by Biuret Method.. | | | | |

Suggested Readings:

1. Hill, R. (2021) Animal Physiology. Sinauer Associates Inc; 5th edition.
2. Guyton, A.C. and Hall, J.E. (2011) Textbook of Medical Physiology. XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
3. Kesar, S. and Vashisht, N. (2007) Experimental Physiology. Heritage Publishers.
4. Prakash, G. (2012) Lab Manual on Blood Analysis and Medical Diagnostics. S. Chand and Company Ltd
5. Cinnamon, V., Regan J., Russo A.F. (2022) Seelay's Anatomy and Physiology. McGraw Hill Education.
6. Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., NewYork.
7. Das M, Dutta A and Kalita A (2022). Advanced Biochemistry. Kalyani Publications.