NEHRU GRAM BHARATI

(Deemed to be University)

Four Year Undergraduate Programme

AS PER NATIONAL EDUCATION POLICY: 2020
[NHEQF Level 4.5 to 6.0]

Syllabus

B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology

(Effective from the Academic Year 2025-2026)

Department of Zoology

Board of Studies

Sr. No.	Name	Designation	Affiliation	
1.	Dr. Amitabh Chandra Dwivedi	Assistant Professor & Head	Department of Zoology, Nehru Gram Bharati (Deemed to be University), Prayagraj (UP)	Chairmen
2.	Dr. Asheesh Shivam	Associate Professor	Department of Zoology, Nehru Gram Bharati (Deemed to be University), Prayagraj (UP)	Member
3.	Dr. Kiran Gupta	Assistant Professor	Department of Zoology, Nehru Gram Bharati (Deemed to be University), Prayagraj (UP)	Member
4.	Dr. Brijesh Kumar Mishra	Assistant Professor	Department of Zoology, H.N.B. Govt. P.G. College, Naini, Prayagraj (UP)	External Member

Introduction of the Programme:

[a] Introduction:

The NEP-2020 offers an opportunity to effect a paradigm shift from a teacher-centric to a student-centric higher education system in India. It is based on Outcome Based Education, where the Graduate Attributes are first kept in mind to reverse-design the Programs, Courses and Supplementary activities to attain the graduate attributes and learning outcomes. The learning outcomes-based curriculum framework for a degree in B.Sc. (Honours/Honours with Research) in Zoology is intended to provide a comprehensive foundation to the subject and to help students develop the ability to successfully continue with further studies and research in the subject while they are equipped with required skills at various stages. The framework is designed to equip students with valuable cognitive abilities and skills so that they are successful in meeting diverse needs of professional careers in a developing and knowledge-based society. The curriculum framework takes into account the need to maintain globally competitive standards of achievement in terms of the knowledge and skills, as well as to develop Scientific temper, spirit of enquiry, problem solving skills and human and professional values which foster rational and critical thinking in students.

[b] Graduate Attributes:

Type of learning outcomes	**The Learning Outcomes Descriptors**
Learning outcomes that are specific to disciplinary/ interdisciplinary areas of learning	Disciplinary/ interdisciplinary Knowledge & Skills
Generic learning outcomes	***Critical Thinking & problem-solving Capacity***
	Creativity
	Communication Skills: The graduates should be able to demonstrate the skills that enable them to: • listen carefully, read texts and research papers analytically, and present complex informationin a clear and concise manner to different groups/audiences, • express thoughts and ideas effectively in writing and orally and communicate with othersusing appropriate media, • confidently share views and express herself/himself, • construct logical arguments using correct technical language related to a field of learning,work/vocation, or an area of professional practice, • convey ideas, thoughts, and arguments using language that is respectful and sensitive togender and other minority groups.
	Analytical reasoning/thinking: The graduates should be able to demonstrate the capability to: • evaluate the reliability and relevance of evidence; • identify logical flaws in the arguments of others; • analyze and synthesize data from a variety of sources; • draw valid conclusions and support them with evidence and examples, and addressingopposing viewpoints.

	Research-related skills: The graduates should be able to demonstrate: • a keen sense of observation, inquiry, and capability for asking relevant/ appropriate questions, • the ability to problematize, synthesize and articulate issues and design research proposals, • the ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation ofdata, and predict cause-and-effect relationships, • the capacity to develop appropriate methodology and tools of data collection, • the appropriate use of statistical and other analytical tools and techniques, • the ability to plan, execute and report the results of an experiment or investigation, • the ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/ in personal research work, regardless of the funding authority or field of study.
	Coordinating/collaborating with others: The graduates should be able to demonstrate the ability to: • work effectively and respectfully with diverse teams, • facilitate cooperative or coordinated effort on the part of a group, • act together as a group or a team in the interests of a common cause and workefficiently as a member of a team.
	Leadership readiness/qualities: The graduates should be able to demonstrate the capability for: • mapping out the tasks of a team or an organization and setting direction. • formulating an inspiring vision and building a team that can help achieve the vision,motivating and inspiring team members to engage with that vision. • using management skills to guide people to the right destination.
	'Learning how to learn' skills: The graduates should be able to demonstrate the ability to: • acquire new knowledge and skills, including 'learning how to learn' skills, that are necessary for pursuing learning activities throughout life, through self-paced and self- directed learning aimed at personal development, meeting economic, social, and cultural objectives, and adapting to changing tradesand demands of the workplace, including adapting to the changes in work processes in the context of the fourth industrial revolution,through knowledge/ skill development/reskilling,
	• work independently, identify appropriate resources required for further learning, • acquire organizational skills and time management to set self-defined goals and targets withtimelines. • inculcate a healthy attitude to be a lifelong learner,
	Digital and technological skills: The graduates should be able to demonstrate the capability to: • use ICT in a variety of learning and work situations, • access, evaluate, and use a variety of relevant information sources, • use appropriate software for analysis of data.
	• ***National & International Perspective considering the current perspective of a Global Village.***
	Value inculcation: The graduates should be able to demonstrate the acquisition of knowledge and attitude that are required to: • embrace and practice constitutional, humanistic, ethical, and moral values in life, including universal human values of truth, righteous conduct, peace, love, nonviolence, scientific temper, citizenship values,

	• practice responsible global citizenship required for responding to contemporary global challenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies, • formulate a position/argument about an ethical issue from multiple perspectives • identify ethical issues related to work, and follow ethical practices, including avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights, • recognize environmental and sustainability issues, and participate in actions to promote sustainable development.
	Autonomy, responsibility, and accountability: The graduates should be able to demonstratethe ability to: • apply knowledge, understanding, and/or skills with an appropriate degree of independence relevant to the level of the qualification, • work independently, identify appropriate resources required for a project, and manage a project through to completion,
	Environmental awareness and action: The graduates should be able to demonstrate the acquisition of and ability to apply the knowledge, skills, attitudes, and values required to take appropriate actions for: • mitigating the effects of environmental degradation, climate change, and pollution, effective waste management, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living.
	Community engagement and service: The graduates should be able to demonstrate the capability to participate in community-engaged services/ activities for promoting the well-being of society.
	Empathy: The graduates should be able to demonstrate the ability to identify with or understand the perspective, experiences, or points of view of another individual or group, and to identify and understand other people's emotions.

[c] Flexibility:

The programmes are flexible enough to allow liberty to students in designing them according to their requirements. The Learner is given freedom of choice in selecting disciplines. Students may select his/her own stream. He/She may select three major disciplines from his her own stream or two major disciplines from his own stream and one major discipline from any other stream . Alongwith major disciplines, a student can select minor disciplines from other streams, languages, generic electives, ability enhancement courses, Vocational/Skill Enhancement Courses (SEC) and Value added Courses including Extra Curricular activities.

Multiple Entry & Exit Options:

ENTRY & EXIT OPTIONS	Credits Required
Certificate upon the Successful Completion of the First Year (Two Semesters) of the multidisciplinary Four-year Undergraduate Programme. **+ 04 Credit Mandatory Internship in Case of Exit.**	**44**
Diploma upon the Successful Completion of the Second Year (Four Semesters) of the multidisciplinary Four-year Undergraduate Programme.	**84**

+ 04 Credit Mandatory Internship in Case of Exit. For Entry to NHEQF Level 5.0, must have completed the NHEQF 4.5 Level of Four Year Undergraduate Programme as per NEP-2020.	
Basic Bachelor Degree at the Successful Completion of the Third Year (Six Semesters) of the multidisciplinary Four- year Undergraduate Programme. For Entry to NHEQF Level 5.5, must have completed the NHEQF 5.0 Level of Four Year Undergraduate Programme as per NEP-2020.	**120**
Bachelor Degree with Honours/Honours with Research in a Discipline at the Successful Completion of the Fourth Year (Eight Semesters) of the multidisciplinary Four-year Undergraduate Programme. For Entry to NHEQF Level 6.0, must have completed the NHEQF 5.5 Level of Four Year Undergraduate Programme as per NEP-2020.	**160**

Pre requisite To study Zoology in undergraduate, a student must have studied Biology in 12 standards
The aim and objective of the B.Sc. Zoology programme **PO1** To provide knowledge to the students about working principles, design guidelines and experimental skills associated with different fields of Zoology.
PO2. To provide knowledge many job and self-employment oriented course such as Genetics and Cell Biology, Biochemistry, Molecular Biology, Biotechnology, Economic Zoology etc.
PO3. To educate about conceptual and practical knowledge of the Ecology, Biostatistics, Biodiversity, Physiology, Endocrinology, Developmental Biology, Biochemical Techniques, Animal tissue culture e
PO4. To aware the students with scientific and technological knowledge for uplifting and improvement of the social and environmental health in the rural areas

B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology
[As Per NEP-2020]

Credit Distribution

Year	Semester	Nomenclature of the Courses/Title	Com/Ele.	Credit	Credit Distribution			Teaching Hours		
					L	T	P	L	T	P
First Year	I	Animal Diversity-I	Compulsory	4	3	0	1	45	0	30
		Introduction to IKS : Zoology	Compulsory	2	2	0	0	30	0	0
		AEC : Communication Skills & Personality Development	Compulsory	2	2	0	0	30	0	0
		Minor Paper for Other discipline : Introduction to Animal Diversity	POOL B	3	3	0	0	45	0	0
		SEC : Paper-I	POOL C	3	1	0	2	15	0	60
		VAC : Inderstanding India	POOL D	2	2	0	0	30	0	0
		Other Major	POOL A	4	4	0	0	60	0	0
		Total Semester Credits		**20**						
	II	Animal Diversity-II (Major-I)	Compulsory	5	3	0	2	45	0	60
		Minor Paper for Other discipline : Chordate Biodiversity	POOL B	3	3	0	0	45	0	0
		AEC: Critical Thinking & Problem Solving	Compulsory	2	2	0	0	30	0	0
		SEC : Paper-II	POOL C	3	1	0	0	15	0	0
		VAC: Indian Constitution	POOL D	2	2	0	0	30	0	0
		Other Major (Contd.)	Compulsory	5	5	0	0	75	0	0
		Total Semester Credits		**20**						
Exit Option : Undergraduate Certificate in Field of Learning/discipline										
Second Year	III	Cell Biology, Molecular Biology & Instrumentation (Major-I)	Compulsory	4	3	0	1	45	0	30
		Applied IKS-I : Zoology	Compulsory	2	2	0	0	30	0	0
		Minor Paper for other discipline: Elementary Cell Biology and Molecular Biology	POOL B	3	3	0	0	45	0	0
		AEC: Soft Skills	Compulsory	2	2	0	0	30	0	0
		SEC : Paper-I (Other than Opted in Sem-I)	POOL C	3	1	0	2	15	0	60
		VAC : Indian Heritage & Culture/NSS/NCC	POOL D	2	2	0	0	30	0	0
		Other Major (Contd.)	Compulsory	4	4	0	0	60	0	0
		Total Semester Credits		**20**						
	IV	Physiology & Elementary Biochemistry (Major-I)	Compulsory	5	3	0	2	45	0	60
		Minor Paper for other discipline: Advance Cell Biology and Molecular Biology	Pool Elective	3	3	0	0	45	0	0
		AEC: Content Writing & Editing	Compulsory	2	2	0	0	30	0	0
		SEC : Paper-II	POOL C	3	1	0	2	15	0	60
		VAC: Food Nutrition & Hygiene	POOL D	2	2	0	0	30	0	0

		Other Major (Contd.)	Compulsory	5	5	0	0	75	0	0
		Total Semester Credits		**20**						
Exit Option : Undergraduate Diploma in Field of Learning/discipline										
Third Year	V	Applied Zoology	Compulsory	4	3	0	1	45	0	30
		Applied IKS-II : Zoology	Compulsory	2	2	0	0	30	0	0
		Minor Paper for other discipline: Environmental Studies	Pool Elective	3	3	0	0	45	0	0
		AEC: Team Building & Leadership	Compulsory	2	2	0	0	30	0	0
		Note: Choose any one Course 1. Environment Biology 2. Fish & Fisheries	Elective	3	3	0	0	45	0	0
		VAC: Environmental Science and Sustainability	Pool Elective	2	2	0	0	30	0	0
		Other Major (Contd.)	Compulsory	4	4	0	0	60	0	0
		Total Semester Credits		**20**						
	VI	Endocrinology & Animal Behaviour	Compulsory	5	3	0	2	45	0	60
		Note: Choose any one Paper (Major-I) 1. Fundamentals of Entomology 2. Biostatistics and Computer Application	Core Elective	3	1	0	2	15	0	60
		Minor Paper for other discipline: Elementary Fisheries	Pool Elective	3	3	0	0	45	0	0
		Internship/Apprenticeship	Compulsory	4	0	0	4	0	0	120
		Other Major (Contd.)	Compulsory	5	5	0	0	75	0	0
		Total Semester Credits		**20**						
Exit Option : Basic UG degree in Field of Learning/discipline										
Fourth Year	VII	Ecology	Compulsory	5	3	0	2	45	0	60
		Research Methodology (Hons. with Research) /Applied Environmental Biology (Honours)	Compulsory	4	4	0	0	60	0	0
		Note: Choose any Two Course (4+4) 1. Evolutionary Biology 2. Toxicology 3. Genetics & Cytogenetics 4. Parasitology	Elective	8	8	0	0	120	0	0
		Minor Paper From other discipline : Applied Zoology	Pool Elective	3	3	0	0	45	0	0
		Total Semester Credits		**20**						
	VIII	Biotechnology	Compulsory	5	3	0	2	45	0	60
		Note: Choose any One Course: 1. Developmental Biology 2. Wild Life Conservation & Management	Elective	3	3	0	0	45	0	0

		Dissertation/Research Project & Viva Voce (Hons. with Research) or Field Visit/Tour based Viva Voce (Honours)	Compursory	12	0	0	12	0	0	360
		Total Semester Credits		**20**						
Completion : UG (Hons./Hons. with Research) degree in Field of Learning/discipline										
		Total Programme Credits		**160**						

Department of Zoology

B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology

SYLLABUS (Based on NEP – 2020)

Session 2025 – 26

YEAR	SEMESTER	PAPER TITLE	Course Code	MAJOR/ MINOR	COM/ EL	(L)	(T)	(P)	TOTAL CREDIT	TEACHING HOURS
1ST [NHEQF 4.5]	I ST	Animal Diversity	ZOO-23101	Major	COM	03	00	01	04	75 (45 + 30)
		Minor Paper for Other discipline : Introduction to Animal Diversity	MZOO01	Minor	ELE	03	00	00	03	45
		Introduction to IKS: Zoology	ZOOIKS-2301	Major	COM	02	00	00	02	30
	II ND	Animal Diversity-II	ZOO-23102	Major	COM	03	00	02	05	105 (45 + 60)
		Minor Paper for Other discipline : Chordate Biodiversity	MZOO02	Minor	ELE	03	00	00	03	45
2ND [NHEQF 5.0]	III RD	Cell Biology, Molecular Biology & Instrumentation	ZOO-23103	Major	COM	03	00	01	04	75(45+30)
		Applied IKS-I: Zoology	ZOOIKS-2302	Major	COM	02	00	00	02	30
		Minor Paper for other discipline: Elementary Cell Biology and Molecular Biology	MZOO03	Minor	EL	03	00	00	03	45
	IV TH	Physiology & Elemetary Biochemistry	ZOO-23104	Major	COM	03	00	02	05	105 (45 + 60)
		Minor Paper for other discipline: Advance Cell Biology and Molecular Biology	MZOO04	Minor	ELE	03	00	00	03	45

3RD [NHEQF 5.5]	V TH	Applied Zoology	ZOO-23105	Major	COM	03	00	01	04	75 (45 + 30)
		Applied IKS-2: Zoology	ZOOIKS-2303	Major	COM	02	00	00	02	30
		Minor Paper for other discipline: Environmental Studies	MZOO05	Mino r	ELE	03	00	00	03	45
		Note: Choose any one Course i.Environmetal Biology ii.Fish & Fisheries	ZOO-23106A/ ZOO-23106B	Major	ELE	03	00	00	03	45
	VI TH	Endocrinology & Animal Behaviour	ZOO-23107	Major	COM	03	00	02	05	105 (45 + 60)
		Note: Choose any one Course i.Fundamentals of Entomology ii.Biostatistics and Computer Application	ZOO-23108A/ ZOO23108B	Major	ELE	03	00	00	03	45
		Minor Paper for other discipline: Elementary Fisheries	MZOO06	Mino r	ELE	03	00	00	03	45
		Internship/Apprenticeship	BOT-23109	Major	COM	0	0	04	04	120
4TH [NHEQF 6.0]	VII TH	Ecology	ZOO-23113	Major	COM	03	00	02	05	105 (45 + 60)
		1.Research Methodology (Honours with Research)/Applied Environmental Biology (Honours)	ZOO-23111A/ ZOO-23111B	Major	COM	04	00	00	04	60

		Note: Choose any Two Course (4+4) i. Evolutionary Biology ii. Toxicology iii. Genetics & Cytogenetics iv. Parasitology	ZOO-23112A/ZOO-23112B/ZOO-23112C/ ZOO-23114A	Major	ELE	08	00	00	08	120
		Minor Paper for Other Discipline : Applied Zoology	MZOO07	Minor	ELE	03	00	00	03	45
	VIII[TH]	Biotechnology	ZOO-23110	Major	COM	03	00	02	05	105 (45 + 60)
		Note: Choose any One Course: i.Developmental Biology ii.Wild Life Conservation & Management	ZOO-23114B/ ZOO-23114C	Major	ELE	03	00	00	03	45
		Dissertation/Research Project Or Viva Voce (Hons. with Research)/Field Visit, Educational Tour based Viva Voce	ZOO-23115A/ZOO-23115B	Major	COM	00	00	12	12	360

B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology

SEMESTER-I

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	**Year: B.Sc. First Year**	**Semester: I**
Subject: Zoology		
Course Code: ZOO-23101	**Course Title: Animal Diversity-I**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Describe unique characters and diversity of Protozoa and Porifera and type study CO.2 Describe unique characters and diversity of coelenterate and Platyhelminthes type study CO.3 Describe unique characters of and Aschelminthes and Annelids type study CO.4.Describe unique characters of arthropods and Mollusca life functions of the organisms CO.5 Describe unique characters of echinoderms and its life functions. Hemichordates life, functions of the organisms belong to this groups		
Credit: 3+0+1	**Paper: Core Compulsory**	
Max. Marks: 40+60(30T+30P)=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials +Practical): 45+0+30		

Unit:	**Topics**	**No. of Lectures**
Unit I	General Classification of non-chordate phyla upto classes. Functional morphology of type forms. Protozoa - Type study: *Trypanosoma, Paramecium* -structure, nutrition, life cycle	8
Unit II	Porifera - Type study: *Sycon (Scypha)*-Structure, Nutrition and Life cycle, Canal system in sponges, cell types, spicules Cnideria - Type study: Obelia, Polymorphism, Alternation of Generation, Coral reefs.	10
Unit III	Platyhelminthes - Type study: *Fasciola heptica*- Structure, Life cycle, Parasitic adaptations in helminths. Adhesive organs in Trematoda & Cestoda, Larval forms in Nematomoda Aschelminthes - Type study: *Woucheria bancrofti* - Structure, Life cycle, Annelida - Type study: Nereis, Metamerism & Trochophore larva	10
Unit IV	Arthropoda - Type study: *Palaeomon* (Prawn)- Morphology, Nutrition, Respiration, Reproduction, Insect Metmorphosis. Mollusca - Type study: *Pila* - Morphology, Nutrition, Respiration, Reproduction, Torsion in Gastropods	11
Unit V	Echinodermata - Type study: Asterias (Starfish) Morphology, Nutrition, Respiration, Reproduction, Water vascular system.	6

Suggested Readings:

1. Barnes, RD: Invertebrate Zoology (4th ed.), Holt-Saunders, 1980.
2. Barrington, EJW: Invertebrate Structure and Function, Nelson, 1987.
3. Hickman, R. & Hickman: Integrated Principles of Zoology (7th ed) Times-Mirror, Mosby, 1984.
4. Kotpal, RL: Modern Text Book of Zoology: Invertebrates, Rastogi Publications, 12th edition, 2019
6. Marshall & William: Text Book of Zoology, Vol I (Parker & Haswell, 7th ed.) Macmillan, 1972.

Course prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	Year: B.Sc. First Year	Semester: I
Subject: Zoology		
Course Code: ZOO-23101	**Course Title: Lab work based on theory Paper (Practicals List)**	
Course Outcome: After completing this course, the students will be able to -		
CO1. Practical understanding through Virtual dissection CO2. Prepare permanent slides and museum conservations. CO3. Know about Taxonomic identification and characteristic features. CO4: Know about permanent slide preparation		
Credit: 0+0+1	**Paper: Core Compulsory**	
Max. Marks: 40+60 (30T+30P)=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+30		
Unit:	**Topics**	**No. of Practical (Hrs)**
Study of museum specimens/slides: **Porifera :** *Leucosolenia, Sycon, Grantia, Cliona, Spongilla, Euspongia, Hylonem* **Cnideria:** *Physalia, Millipora, Aurelia, Rhizostoma, Gorgonia, Pteroids, Adamsia,* **Platyhelminthes:** *Planaria, Fasciola, Taenia solium.* **Aschelminthes** : *Ascaris*, (Male & Female). **Annelida :** *Nereis*, Heteroneries, *Aphrodite, Chaetopterus,* **Mollusca** : Chiton, *Aplysia, Doris, Pecten, Pinctada, Teredo, Loligo, Sepia, Octopus* **Arthropoda:** *Lepus, Balanus, Sacculina, Mysis, Eupagurus, Limulus, Julus, Scolopendra, Prawn, Apis* **Echinodermata :** *Astropecten, Asterias, Holothuria, Antidon* **Permanent Slides:** Protozoa: *Paramecium*, W.M. Binary Fission, Conjugation in *Paramecium, Monocystis, Opalina, Balantidium, Entamoeba, Leishmania*. Porifera : Spongin fibres, gemmule, spicules, L.S. & T.S. of Sycon. Coelenterate:T.S. of *Hydra* through gonads, *Obelia* W.M., *Obelia* medusae, (Cnideria) Ephydra Larva. Helminthes:*Fasciola* through testes; Scolex, mature and gravid proglottid of *Taenia solium*, Miracidium, Redia, Cercaria, Metacercaria, Cysticercus larva. Annelida:T.S. *Nereis*, parapodium of *Nereis* and heteronereis, trochophore larva, T.S. of Leech through Crop. Arthropoda: Megalopa, Mysis, Zoea, Nauplius, Daphnia, Cyclopes, Mouthparts of male and female *Culex* and *Anapheles*, Pediculus W.M., Cimex W.M. Echinodermata: T.S. of arm of starfish, pedicellaria, bipinnaria larva. **Permanent Slide preparation:** *Obelia* colony, Gemmule, Spicule, Parapodium of Nereis, Gill of *Pila & Unio*, Statocyst of Prawn **Virtual dissection:** https://www.vlab.co.in, www/onlinelab.in, https:/vlab.amrita.edu		30
Suggested Readings: 1.Invertebrate Practical- P.S. Verma 2.Invertebrate Practical- S.S. Lal 3.Verma P.S., P.C. Srivastava- Practical Zoology, S. Chand & Co.		
Suggested continuous Evaluation methods-		
Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ; Assignment/Practical/Projects – 05 Marks Internal Class Test – 10 Marks Attendance/Behavior – 05 Marks		

Programme: **B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology**	**Year: B.Sc. 1st Year**	**Semester: Ist**
Pedagogy:		
Course Code: ZOOIKS-2301	Course/Paper Title:	**Introduction to Indian Knowledge System**
Course Outcomes: After completing this course, the students will be able to -		
CO 1: explain the the foundational Concepts & Principles of IKS.		
CO 2: explain the historical development and evolution of Indian Intellectual traditions.		
CO 3: explain the knowledge key texts, thinkers, and schools of thought within the IKS.		
CO 4: analyze the interdisciplinary nature of Indian knowledge, integrating philosophy, spirituality, science, arts, and literature though the study of IKS.		
CO 5: explain the holistic and multidimensional nature of Indian Thought.		
Credit: 02	Paper (Core Compulsory / Elective): Core Compulsory	
Max. Marks : 40+60=100	Minimum Passing Marks: 35	
Total Number of Lectures (Lecture – Tutorials – Practical): 30 + 0 + 0		

Units:	Topics	No. of Lectures
I	**Introduction to Indian Knowledge System** •Definition, Concepts and Scope of IKS •IKS based approache on Indian Knowledge System & Role of Guru (teacher) •Understanding the concepts of dharma, karma, and the four purusharthas (goals of life)	06
II	**Vedic Knowledge and Philosophy** •Study of the Vedas, including the Rigveda, Yajurveda, Samaveda, and Atharvaveda •Introduction to Upanishads and their metaphysical and philosophical teachings •Analysis of the six orthodox (astika) schools of Indian philosophy (e.g., Nyaya, Vaisheshika, Yoga, Samkhya, Mimamsa, and Vedanta)	06
III	**Unit 3: Spiritual and Mystical Traditions** •Exploration of Hindu spiritual traditions, including Bhakti, Karma, Jnana, and Raja Yoga •Study of Advaita Vedanta and its nondualistic philosophy •Introduction to other spiritual paths like Tantra and Sufism in the Indian context	06
IV	**Scientific and Technological Advancements** •Examination of ancient Indian contributions to mathematics, astronomy, and medicine •Study of scientific treatises such as Aryabhatiya, Sushruta Samhita, and Charaka Samhita •Exploration of the Indian concept of time, measurement, and cosmology	06
V	**Indian Arts, Literature, and Aesthetics** •Analysis of Indian classical music, dance, and theater traditions •Study of classical Sanskrit literature, including the works of Kalidasa and Valmiki •Understanding the concept of rasa (aesthetic experience) and its manifestations in Indian arts •Modern Interpretation and Contemporary Relevance	06

Suggested Readings:

- "Indian Philosophy: A Very Short Introduction" by Sue Hamilton
- "A History of Indian Philosophy" by Surendranath Dasgupta
- "Indian Philosophy: A Critical Survey" by Chandradhar Sharma
- "India: A History" by John Keay
- "The Wonder That Was India" by A.L. Basham
- "Ancient India" by R.S. Sharma
- "The Oxford History of India" edited by Percival Spear
- "A History of Indian Literature" (multiple volumes) by Sisir Kumar Das
- "Indian English Literature" by M. K. Naik
- "The Norton Anthology of World Literature: India, Pakistan, and Bangladesh" edited by Sarah Lawall
- "Indian Art" by Partha Mitter
- "The Art and Architecture of the Indian Subcontinent" by J.C. Harle
- "Indian Architecture: Buddhist and Hindu Period" by Percy Brown
- "The Crest of the Peacock: Non-European Roots of Mathematics" by George Gheverghese Joseph
- "Indian Science and Technology in the Eighteenth Century" by Dharampal
- "Raga Mala: The Autobiography of Ravi Shankar" by Ravi Shankar
- "The Ragas of North India" by Walter Kaufmann
- "The Complete Book of Ayurvedic Home Remedies" by Vasant Lad
- "Ayurveda: The Science of Self-Healing" by Vasant Lad
- "The Heart of Yoga: Developing a Personal Practice" by T.K.V. Desikachar
- "The Yoga Sutras of Patanjali" translated by Swami Satchidananda

Suggested continuous E-Valuation Methods –

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Minor Paper : For Students of Other Discipline

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	**Year: B.Sc. First Year**	**Semester: I**
Subject: Zoology		
Course Code: MZOO01	**Course Title: Introduction to Animal Diversity**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 students will know about animal diversity CO.2 To understand the importance of animal diversity CO.3 To understand role of Protozoan in human life CO.4 To understand the importance of Arthropod organisms CO.5 Describe unique characters of echinoderms and Hemichordates		
Credit: 3+0+0	**Paper: Core Compulsory**	
Max. Marks: 40+60: 100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials +Practical): 45+0+0		

Unit:	**Topics**	**No. of Lectures**
Unit I.	Introduction of animal biodiversity General Classification of non-chordate phyla upto classes.	9
Unit II	Protozoa - Type study: *Paramecium* -structure, nutrition, life cycle Porifera - Type study: *Sycon (Scypha)*-Structure, Nutrition and Life cycle, Canal system in sponges	9

Unit III	Platyhelminthes - Type study: *Echinococcus*- Structure, Life cycle, Parasitic adaptations in helminths. Aschelminthes - Type study: *Woucheria bancrofti* - Structure, Life cycle, Annelida - Type study: Nereis, Metamerism & Trochophore	9
Unit IV	Arthropoda - Type study: *Palaeomon*- Morphology, Nutrition, Insect Metmorphosis. Mollusca - Type study: *Pila* - Morphology, Nutrition	9
Unit V	Echinodermata - Type study: Asterias- Morphology, Nutrition	9

Suggested Readings:

1. Barnes, RD: Invertebrate Zoology (4th ed.), Holt-Saunders, 1980.
2. Barrington, EJW: Invertebrate Structure and Function, Nelson, 1987.
3. Hickman, Roberts & Hickman: Integrated Principles of Zoology (7th ed) Times-Mirror, Mosby, 1984.
4. Iyer: A Manual of Zoology, Part I. Viswanathan, 1973.
5. Kotpal, RL: Modern Text Book of Zoology: Invertebrates, Rastogi Publications, 12th edition, 2019
6. Marshall & William: Text Book of Zoology, Vol I (Parker & Haswell, 7th ed.) Macmillan, 1972.

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Other Courses to Opt:

Ability Enhancement Course
Skill Enhancement Course (SEC) : To be Choosed from POOL C
Value Added Course : To be Choosed from POOL D

SEMESTER-II

Programme: **B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology**	**Year: B.Sc. First Year**	**Semester: II**
Subject: Zoology		
Course Code: ZOO-23102	**Course Title: Animal Diversity-II**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Understand unique characters of Urochordates, cephalochordates CO.2 Understand unique characters of fishes and type study CO.3 Understand unique characters amphibian and reptiles and their features CO. 4 Understand unique characters of birds and their migration features CO.5 Understand unique characters of mammals		
Credit: 3+0+2	**Paper: Core Compulsory**	
Max. Marks: 40+60(30T+30P)=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials +Practical): 45+0+60		

Unit:	**Topics**	**No. of Lectures**
Unit I.	Introduction to Chordata: General characters and classification up to Classes, Hemichordata- *Herdmania*: Morphology, reproductive system and development	9
Unit II	Cephalochordata: *Branchiostoma* (=*Amphioxus*): Morphology, reproductive system and development Cyclostomata: External features of *Petromyzon* Comparison between Lampreys and Hagfishes	8
Unit III	Pisces: General characters of cartilaginous and bony fishes;	8

	External features, Digestive, Respiratory and Urinogenital system of *Scoliodon*; Scales of fishes	
Unit IV	Amphibia: General characters and classification, Elementary idea of parental care Reptilia: General characters and classification, Poisonous and non-poisonous snakes; Biting mechanism in snakes; Venom and Anti venom	8
Unit V	Aves: General characters and classification; Morphology, Digestive, Respiratory and reproductive system of *Columba*; Feathers in Birds; Aerial adaptations in birds Mammalia: General character and classification; Aquatic & Aerial Adaptation in mammals	12

Suggested Readings:

1. Barnes, RD (1980); Invertebrate Zoology (4th ed.), Holt-Saunders.
2. Barrington, EJW (1987) Invertebrate Structure and Function, Nelson
3. Hickman, Roberts & Hickman (1984) Integrated Principles of Zoology,7th ed Times-Mirror, Mosby
4. Iyer (1973) A Manual of Zoology, Part I. Viswanathan.
5. Kotpal, RL (2019) Modern Text Book of Zoology: Invertebrates, Rastogi Publications, 12th ed,
6. Marshall & William (1972.) Text Book of Zoology, Vol I (Parker & Haswell, 7th ed.) Macmillan,

Course prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Programme: **B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology**	**Year: B.Sc. First Year**	**Semester: II**
Subject: Zoology		
Course Code: ZOO-23102	**Course Title: Lab work based on theory Paper (Practicals List**	
Course Outcome: After completing this course, the students will be able to -		
CO1. Practical understanding through Virtual dissection CO2. Prepare permanent slides and museum conservations. CO3. Know about Taxonomic identification and characteristic features. CO4: Know about permanent slide preparation		
Credit: 0+0+2	**Paper: Core Compulsory**	
Max. Marks: 40+60 (30T+30P)=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+60		
Unit:	**Topics**	**No. of Practical (Hrs)**
Study of museum specimens/slides: **Museum Speciation** **Protochordata :** *Herdmania, Amphioxus* **Cyclostomes:** *Petromyzon*, Ammocoete larva, *Myxine* **Pisces:** *Trygon, Pristis, Torpedo, Protopterus, Hilsa, Labeo, Wallago, Exocoetus, Hippocampus, Anabas, Chiemera, Diodon, Synaptura, Echeneis, Tetradon* **Amphibia:** *Icthyophis, Ambystoma, Axolotal larva, Salamendra, Amphiuma, Proteus* **Reptilia:** *Chelone, Testudo, Sphenodon, Chaemeleon, Phrynosoma, Draco, Iguana, Haloderma, Typhlops, Python, Bangarus, Naja, Hydrophis, Viper, Natrix, Crotalus* **Aves:** *Pigeon, Fowl, Chick*, W.M. Flight Feather **Mammals:** *Hedgehog, Manis, Hystrix*, Bat **Permanent Slides** Protochordata :W.M. *Salpa, Doliolum,* T.S. of *Amphioxus*, Spicules of *Herdmania*. Amphibia :V.S. of Skin, T.S. through alimentary canal, C.S. of Liver, C.S. of Lung, T.S. of Kidney, T.S. of gonads. Aves :W.M. of filoplumes, W.M. of down feather Mammals :V.L.S. through Skin, T.S. of Liver, T.S. of Lung, T.S. of Kidney, T.S. of Gonads. **Permanent Slide preparation**: Ampulla of Lorenzini, Placoid scales. Striated and unstriated muscles		60

Virtual dissection: https://www.vlab.co.in, www/onlinelab.in, https:/vlab.amrita.edu	
Suggested Readings: 1 Practical Zoology-Robert William Hegner 2.Vertebrate Practical - P.S. Verma 3.Vertebrate Practical- S.S. Lal 4.Vertebrate Practical- Asthana, Agrawal and Jindal, Pragati Prakashan 5.Vertebrate Practical- O.P. Saxena	
Suggested continuous Evaluation methods-	
Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ; Assignment/Practical/Projects – 05 Marks Internal Class Test – 10 Marks Attendance/Behavior – 05 Marks	

Minor Paper: For Students of Other Discipline

Programme: **B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology**		**Year: B.Sc. First Year**	**Semester: II**
Subject: Zoology			
Course Code: MZOO02		**Course Title: Chordate Biodiversity**	
Course Outcome: After completing this course, the students will be able to -			
CO.1 students will know about animal diversity CO.2 To understand the importance of animal diversity CO.3 To understand role of Protozoan in human life CO.4 To understand the importance of Arthropod organisms CO.5 Describe unique characters of echinoderms and Hemichordates			
Credit: 3		**Paper: Core Compulsory**	
Max. Marks: 40+60		**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials +Practical): 45+0+0			
Unit:		**Topics**	**No. of Lectures**
Unit I.	Chordata: General characters and classification up to Classes, Hemichordata- *Balanoglossus*: Morphology and development: *Herdmania*: Morphology and development		9
Unit II	Cephalochordata: *Branchiostoma* (=*Amphioxus*): Morphology and development Cyclostomata: External features of *Petromyzon* and *Myxine*;		9
Unit III	Pisces: General characters of cartilaginous and bony fish; Dipnoi fishes: Distribution, General characters of *Scoliodon* Respiratory organs in fish		9
Unit IV	Amphibia: General characters and classification Reptilia: Terrestrial Adaptations; General characters and distribution, Poisonous and non-poisonous snakes		9
Unit V	General characters; Morphology of *Columba* Feathers in Birds; Aerial adaptations in birds Mammalia: General organization, salient features and distribution		9
Suggested Readings: 1. Barnes, RD (1980); Invertebrate Zoology (4th ed.), Holt-Saunders. 2. Barrington, EJW (1987) Invertebrate Structure and Function, Nelson 3. Hickman, Roberts & Hickman (1984) Integrated Principles of Zoology,7th ed Times-Mirror, Mosby 4. Iyer (1973) A Manual of Zoology, Part I. Viswanathan. 5. Kotpal, RL (2019) Modern Text Book of Zoology: Invertebrates, Rastogi Publications, 12th ed, 6. Marshall & William (1972.) Text Book of Zoology, Vol I (Parker & Haswell, 7th ed.) Macmillan,			
Course prerequisite: To study this course, the students must have had subject biology in class 12th			
Suggested continuous Evaluation methods-			
Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90			

Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Other Courses:

Ability Enhancement Course
Skill Enhancement Course (SEC) : To be Choosed from POOL C
Value Added Course : To be Choosed from POOL D

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EXIT OPTION: **Undergraduate Certificate (in the field of learning/discipline)** for those who exit after the first year (two semesters) of the undergraduate programme. (Programme duration: first yearor two semesters of the undergraduate programme) **[NHEQF Level 4.5]**

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SEMESTER-III

Programme: **B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology**	**Year: B. Sc. Second Year**	**Semester: III**
Subject: Zoology		
Course Code: ZOO-23103	**Course Title: Cell Biology, Molecular Biology & Instrumentation**	
Course Outcome: After completing this course, the students will be able to -		
CO.1Students will understand cell theory & cell organelles CO.2 They will know about DNA and their genetic role in the organism CO.3 They will understand RNA and their role the organism. CO.4 Students will understand the genetic regulation in eukaryote and prokaryote. CO.5 Students will understand the various instruments and their function.		
Credit: 3+0+1	**Paper: Core Compulsory**	
Max. Marks: 40+60 (30T+30P)	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials +Practical): 45+0+30		

Unit:	**Topics**	**No. of Lecture**
Unit I	Introduction to Cell theory; Comparison of a generalised Prokaryote & Eukaryote cell. Structure & function of plasma membrane, cytoplasm; Introduction to the Cell organelles: Endoplasmic reticulum, Golgi, complex, Lysosome, Nucleus & Nucleolus; Ribosome; Mitochondria & cytoskeleton, Cell Division	9
Unit II	DNA as genetic material: Structure of DNA, Types of DNA; Replication of DNA: Prokaryote & Eukaryote, DNA damage, types of damage, mechanism and types of DNA repair	9
Unit III	RNA structure and types of RNA: Transcription, in prokaryotes and eukaryotes - RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains; RNA splicing and processing, Genetic code & its characteristics; aminoacyl tRNA synthetases	9
Unit IV	Translation: Mechanism of initiation, elongation and termination of polypeptides, Regulation of gene expression and translation: Regulation of gene expression in prokaryotes- Operon concept (inducible & repressible system),	9
Unit V	Light & Phase Contrast Microscopy, Confocal and Electron Microscopy, (TEM & SEM), Principles and applications of pH meter, centrifuge, Electrophoresis, Chromatography	9

Suggested Readings: 1. Alberts et al.: Molecular Biology of the Cell, Garland Pub., New York, 1989. 2. DeRobertis & DeRobertis: Cell & Molecular Biology, 1996 3. Friefelder: Molecular Biology. Narosa Publ. House, 1996 4. Sharma, V.K.: Techniques in Microscopy and Cell Biology, Tata McGraw Hill, 1991 5. Verma, P.S. et al. Cell Biology, Genetics, Molecular biology, Evolution and Ecology (S.Chand 6. Pandey, B.N. B.Sc. Zoology Series: Cytology, Genetics and Molecular Genetics. Tata McG Hill
Course prerequisite: To study this course, the students must have had subject biology in class 12th
Suggested continuous Evaluation methods-
Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ; Assignment/Practical/Projects – 05 Marks Internal Class Test – 10 Marks Attendance/Behavior – 05 Marks

Programme: **B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology**	**Year: B. Sc. Second Year**	**Semester: III**
Subject: Zoology		
Course Code: ZOO-23103	**Course Title: Lab work based on theory Paper** **(Practicals List)**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Student will practically understand about cell and organelles. CO. 2 Student will understand the cell division process by practical CO. 3 To know DNA isolation by practical method. CO. 4 To know electrophoresis techniques. CO. Diagrammatic study of transcription and translation.		
Credit: 0+0+1	**Paper: Core Compulsory**	
Max. Marks: 40+60 (30T+30P)=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials +Practical): 0+0+30		
Unit:	**Topics**	**No. of Practical (Hrs)**
1. Photographs of prokaryotic cell 2. Photographs of cell organelles 3. Stages of Mitosis by squash technique 4. Photographs of structure of DNA, RNAs 5. Diagrams of translation, transcription 6. Preparation of solutions for Molecular Biology experiments. 7. Isolation of chromosomal DNA from bacterial cells. 8. Isolation of Plasmid DNA by alkaline lysis method 9. Agarose gel electrophoresis of genomic DNA & plasmid DNA 10. Preparation of restriction enzyme digests of DNA samples 11. Demonstration of AMES test or reverse mutation for carcinogenicity		30
Suggested Readings: 1. Alberts et al.: Molecular Biology of the Cell, Garland Pub., New York, 1989. 2. DeRobertis & DeRobertis: Cell & Molecular Biology, 1996 3. Biological Instrumentation and Methodology (Tools & Techniques) S Chand & Co Ltd 4. Sharma, V.K.: Techniques in Microscopy and Cell Biology, Tata McGraw Hill, 1991 5. Pandey, B.N. B.Sc. Zoology Series: Cytology, Genetics and Molecular Genetics. Tata McGraw Hill, 2012,		
Course prerequisite: To study this course, the students must have had subject biology in class 12th		

Suggested continuous Evaluation methods-
Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ; Assignment/Practical/Projects – 05 Marks Internal Class Test – 10 Marks Attendance/Behavior – 05 Marks

Programme: B..Sc. (Honours/Honours with Research) in Zoology	**Year: Second Year**	**Semester: III**
Pedagogy:		
Course Code: ZOOIKS-2302	**Course Title: Applied IKS-1 : Zoology**	
Course Outcome: After completing this course, the students will be able to -		
CO1. Demonstrate Understanding of Indian Philosophical Perspectives: Students should be able to explain key philosophical concepts from Indian traditions, such as interconnectedness, dharma, and ahimsa (non-violence), and understand how these concepts relate to the study and treatment of animals in the field of zoology. CO2. Integrate Traditional Wisdom with Modern Zoological Concepts: Students should be able to identify points of convergence between traditional Indian knowledge systems and modern zoological concepts, illustrating how indigenous wisdom can enrich our understanding of animals, ecosystems, and biodiversity. CO3. Apply Ethical Frameworks to Zoological Studies: Students should be able to analyze ethical dilemmas in zoological research, conservation, and practices through the lens of Indian ethical philosophies. They should be able to propose solutions that align with both scientific rigor and cultural values. CO4. Critically Evaluate Representations of Animals in Indian Culture: Students should be able to critically examine how animals are represented in Indian art, literature, and religious texts, and understand how these representations influence societal perceptions, conservation efforts, and ethical considerations related to animals. CO5. Synthesize Comprehensive Views on Animal Welfare: Students should be able to synthesize multidisciplinary perspectives, combining zoological knowledge with insights from Indian knowledge systems, to formulate holistic approaches to animal welfare, conservation, and sustainable interactions with animals.		
Credit: 2+0+0	**Paper: Core Compulsory**	
Max. Marks: 40+60 = 100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials +Practical): 30+0+0		
Unit:	**Topics**	**Lectures (Hrs.)**
Unit 1: Introduction to Indian Knowledge Systems •Overview of Indian knowledge systems: Ayurveda, Yoga, Sankhya, etc. •Historical development and cultural significance. •Relevance of integrating Indian knowledge with modern zoological studies.		06
Unit 2: Ethnozoology in Indian Traditions •Traditional uses of animals in rituals, folklore, and daily life. •Cultural practices involving animals in different regions. •Ethical considerations, conservation implications, and modern perspectives.		06
Unit 3: Zoological Concepts in Indian Texts •Analysis of animal references in ancient Indian texts: Vedas, Puranas, etc. •Symbolism and allegorical meanings of animals in Indian literature. •Exploration of zoological observations in philosophical and cosmological contexts.		06
Unit 4: Ayurveda and Animal Health •Introduction to Ayurvedic principles and classification of living beings. •Ayurvedic insights into animal physiology, health, and diseases. •Case studies: Traditional Ayurvedic treatments for animals.		06
Unit 5: Yoga and Animal Behavior •Exploring connections between yoga, meditation, and animal behavior. •Influence of yogic practices on human-animal interactions and ethology. •Yogic principles applied to understanding animal cognition.		06

Suggested Readings:

- "Srimad Bhagavad Gita" - The Bhagavad Gita contains philosophical insights that could be applied to the study of zoology, particularly in understanding the interconnectedness of life and the ethical implications of studying and interacting with animals.
- "The Web of Life: A New Scientific Understanding of Living Systems" by Fritjof Capra - While not specifically about Indian knowledge systems, this book explores the interconnectedness of life and ecosystems, which could align with some Indian philosophies.
- "The Knowledge Book: Key Concepts in Philosophy, Science and Culture" by National Book Trust - This book provides an overview of various philosophical and cultural concepts, including some from Indian traditions, which could be used to contextualize zoological concepts.
- "Indian Zoology: Humane Approach" by Ramesh Gupta - This book discusses zoology with a focus on ethical and humane treatment of animals, which could resonate with Indian philosophical perspectives.
- "Ethics for Our Times: Essays in Gandhian Perspective" by M.M. Verma - This book delves into ethics from a Gandhian viewpoint and could be used to explore ethical considerations in zoology from an Indian perspective.

Course prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Minor Paper : For Students of Other Discipline

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	**Year: Second Year**	**Semester: III**
Subject: Zoology		
Course Code: MZOO03	**Course Title: Elementary Cell Biology and Molecular Biology -I**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Student will know about differentiate between prokaryotes and eukaryotes cells and functions CO.2 To understand the importance of the nucleus and components. CO.3 To understand how the endoplasmic reticulum and Golgi apparatus interact with one another and know with which other organelles they are associated CO.4 To understand structure and functions of DNA and RNA. CO. 5. To understand gene and its function and also gene expressions in various models		
Credit: 3	**Paper: Elective (Miner)**	
Max. Marks: 40+60	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0		

Unit	**Topics**	**No. of Lecture**
Unit I	Introduction to Cell theory; Comparison of a generalised Prokaryote & Eukaryote cell Elementary knowledge of the structure & function of plasma membrane, cytoplasm	9
Unit II	Introduction to the organelles constituting endomembrane system (Endoplasmic reticulum, Golgi complex, Lysosome, Peroxisome	9
Unit III	DNA as genetic material: Structure of DNA Types of DNA Replication of DNA in prokaryotes and eukaryotes:	9
Unit IV	Semiconservative nature of DNA replication	9

	Bi-directional replication	
Unit V	DNA polymerases; primosome, replisome	9

Suggested Readings:

1. Alberts et al.: Molecular Biology of the Cell, Garland Pub., New York, 1989.
2. DeRobertis & DeRobertis: Cell & Molecular Biology, 1996
3. Friefelder: Molecular Biology. Narosa Publ. House, 1996
4. Sharma, V.K.: Techniques in Microscopy and Cell Biology, Tata McGraw Hill, 1991
5. Verma, P.S. & Agarwal, V. K. Cell Biology, Genetics, Molecular biology, Evolution and Ecology (S Chand.)
6. Power C.B.

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Other Courses:

Ability Enhancement Course
Skill Enhancement Course (SEC) : To be Choosed from POOL C
Value Added Course : To be Choosed from POOL D

SEMESTER-IV

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	**Year: B.Sc. Second Year**	**Semester: IV**
Subject: Zoology		
Course Code: ZOO-23104	**Course Title: Physiology and Elementary Biochemistry**	

Course Outcome: After completing this course, the students will be able to -

CO.1 Student will understand physiological activity of the various system of the body
CO.2 Student will understand respiration and excretory system
CO.3 Student will understand blood groups and reproductive biology
CO. 4 They will understand about food and their enzymatic functions and also mechanism
CO.5 They will also understand about the metabolism of various types of food items.

Credit: 3+0+2	**Paper: Core Compulsory**
Max. Marks: 40+60 (30T+30P)=100	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+60

Unit	Topics	No. of Lecture
Unit I	Introduction to Biomolecules: Carbohydrates, Proteins, Lipids & Enzymes: structure, types and functions.	7
Unit II	Glycolysis, Kreb's cycle, Gluconeogenesis, glycogen metabolism, electron transport chain, transamination, deamination, urea cycle, β- oxidation of fatty acids	9
Unit III	Digestive system: component of alimentary canal, digestive enzymes, mechanism of digestion, absorption of carbohydrates, proteins, lipids. Circulatory system: Composition of Blood, Blood clotting, Rh factor, ABO blood group, Lymph, Homeostasis, Heart structure, Origin and conduction of the cardiac impulse, cardiac cycle. .	11
Unit IV	Respiratory system: structure of respiratory tract; gaseous exchange, transport of oxygen and carbon dioxide in blood. Excretory system: Structure of nephron, mechanism of urine formation, regulation, micturition	9
Unit V	Introduction of Nervous system, Structure of a neuron, Types of neurons; Introduction of muscular system, types of muscle, Ultrastructure of skeletal muscle, muscle contraction.	9

	Endocrine system: Introduction of endocrine gland, structure and function of pituitary, thyroid, parathyroid, pancreas, adrenal and gonads	

Suggested Readings:

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H. Freeman and Co.
2. Hall, John E. (2015). Guyton and Hall Textbook of Medical Physiology, W.B. Saunders Company
3. Jain, A.K. (2018). Textbook of Physiology, Arya Publications B.Sc. Second Year (IV Semester) 14
4. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H Freeman
5. Singh, HR and N. Kumar Animal Physiology and related Biochemistry, SL, Nagin Chand and Co, Delhi
6. Tortora, G.J.& Derrickson, B.H. (2009). Principles of Anatomy and Physiology, 12th edn., John Wiley &
7. Widmaier, E.P., Raff, H. & Strang, K.T. (2008) Vander's Human Physiology, 11th edn., McGraw Hill

Course prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	**Year: B.Sc. Second Year**	**Semester: IV**
Subject: Zoology		
Course Code: ZOO-23104	**Course Title: Lab work based on theory (Practicals List)**	

Course Outcome: After completing this course, the students will be able to -

CO.1 Students will know how to prepare slide of haemin crystal
CO. 2 Study of permanent slides of various organ parts of the Chordate body
CO.3 Photographic /model exercise to understand heart and nervous.
CO. 4 Identification of unknown carbohydrates in given solutions.
CO.5 To understand enzymatic functions with enzymatic exercise

Credit:0+0+2	**Paper: Core Compulsory**	
Max. Marks: 40+60 (30T+30P)	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+60		
Unit:	**Topics**	**No. of Practical (Hrs)**
1. Preparation of hemin crystals 2. Examination of permanent histological sections of mammalian pituitary, thyroid, parathyroid, pancreas, adrenal 3. Examination of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage, blood cells 4. Models/ Photographs: Structure of neuron, types and structure of muscles, structure of heart 5. Charts/ Photographs: Glycolysis, Kreb's cycle, electron transport chain B. BIOCHEMISTRY 1. Identification of unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose) 2. Colour reactions to identify functional group in the given solution of proteins 3. Study of activity of salivary amylase under optimum condition.		60

Suggested Readings:

1. Alberts et al.: Molecular Biology of the Cell, Garland Pub., New York, 1989.
2. De Robertis & De Robertis: Cell & Molecular Biology, 1996
3. Biological Instrumentation and Methodology (Tools & Techniques) S Chand & Co Ltd
4. Sharma, V.K.: Techniques in Microscopy and Cell Biology, Tata McGraw Hill, 1991
5. Pandey, B.N. B.Sc. Zoology Series: Cytology, Genetics and Molecular Genetics. Tata McGraw Hill, 2012,
6. Power, C.B. (1994), Cell Biology, Himalayan Publishing House, Mumbai

Course prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks Internal Class Test – 10 Marks Attendance/Behavior – 05 Marks

Minor Paper: For Students of Other Discipline

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	**Year: Second Year**	**Semester: IV**
Subject: Zoology		
Course Code: MZOO04	**Course Title: Elementary Cell Biology and Molecular Biology -II**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Student will know about differentiate between prokaryotes and eukaryotes cells and functions CO.2 To understand the importance of the nucleus and components. CO.3 To understand how the endoplasmic reticulum and Golgi apparatus interact with one another and know with which other organelles they are associated CO.4 To understand structure and functions of DNA and RNA. CO. 5. To understand gene and its function and also gene expressions in various models		
Credit: 3+0+0	**Paper (Code compulsory/Elective): Core**	
Max. Marks: 40+60 =100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0		

Unit	**Topics**	**No. of Lecture**
Unit I	Introduction and structure of Nucleus Introduction and structure of Ribosome Introduction and structure Mitochondria & Chloroplast;	10
Unit II	Introduction to cytoskeleton Basic features of Cell cycle, Mitosis & Meiosis	10
Unit III	RNA structure and types of RNA: Transcription in prokaryotes—Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation Elongation and termination of RNA chains; Transcription in eukaryotes —Eukaryotic RNA polymerases, transcription factors, promoters, enhancers.	10
Unit IV	Regulation of gene expression and translation: Regulation of gene expression in prokaryotes—Operon concept (inducible and repressible system), aminoacyl tRNA synthetases	10
Unit V	Mechanism of initiation, elongation and termination of polypeptides	05

Suggested Readings:

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H. Freeman and Co.
2. Hall, John E. (2015). Guyton and Hall Textbook of Medical Physiology, W.B. Saunders Company
3. Jain, A.K. (2018). Textbook of Physiology, Arya Publications B.Sc. Second Year (IV Semester) 14
4. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H Freeman
5. Singh, HR and N. Kumar Animal Physiology and related Biochemistry, SL, Nagin Chand and Co, Delhi
6. Tortora, G.J.& Derrickson, B.H. (2009). Principles of Anatomy and Physiology, 12th edn., John Wiley &
7. Widmaier, E.P., Raff, H. & Strang, K.T. (2008) Vander's Human Physiology, 11th edn., McGraw Hill

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Other Courses:

Ability Enhancement Course
Skill Enhancement Course (SEC) : To be Choosed from POOL C
Value Added Course : To be Choosed from POOL D

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Exit Option: Undergraduate Diploma (in the field of learning/discipline)for those who exit after two years (four semesters) of the undergraduate programme (Programme duration: First two years or four semesters of the undergraduate programme) **[NHEQF 5.0]**

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SEMESTER-V

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	**Year: B.Sc. Third Year**	**Semester: V**
Subject: Zoology		
Course Code: ZOO-23105	**Course Title: Applied Zoology**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Student will understand epidemiology of disease and its transmission CO.2 Student will know about various protozoan diseases and theirs impact. CO.3 Student will know about the helminthes dieses on human health CO.4 They will able to learn about the insects with medical role. CO.5 They will learn about fish technology, poultry and aquaculture		
Credit: 3+0+1	**Paper: Core Compulsory**	
Max. Marks: 40+60(30T+30P)=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+30		

Unit	**Topics**	**No. of Lecture**
Unit I	Introduction to Host-parasite relationship: Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Epidemiology of Diseases: Transmission, Prevention and control of diseases, Covid-19	9
Unit II	Rickettsiae and Spirochaetes: Brief account of Rickettsia prowazekii, Borrelia recurrentis and Treponema pallidum	8
Unit III	Parasitic Protozoa: Life history and pathogenicity of *Entamoeba histolytica, Plasmodium vivax, Leishmania donovani* and *Trypanosoma gambiense*	10
Unit IV	Parasitic Helminthes: Life history and pathogenicity of *Ancylostoma duodenale* and *Wuchereria bancrofti*. Parasitic Zoonasis (Protocephalasis), *Trichinalla spiralis*	9
Unit V	Economic Importance of insects: Biology Control and damage caused by *Pyrilla perpusilla* and *Papilio demoleus*, *Callosobruchus chinensis* and *Sitophilus oryzae* Insects of Medical Importance: Life cycle	9

Suggested Readings:

1. Arora, D. R and Arora, B. (2001). Medical Parasitology. II Edition. CBS Publications and Distributors.
2. Atwal, A.S. (1986). Agricultural Pests of India and South East Asia, Kalyani Publishers.
3. Dennis, H. (2009). Agricultural Entomology. Timber Press (OR).
4. Dunham R.A. (2004). Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications,
5. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher
6. Kumar, Vinay et al. (2014). Robbins And Cotran Pathologic Basis of Disease South Asia Edition
7. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall

Course prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	Year: B.Sc. Third Year	Semester: V
Subject: Zoology		
Course Code: ZOO-23105	**Course Title: Lab work based on theory [Practicals List]**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 student will learn about practical knowledge on various protozoan and helminths disease. CO.2 Student will study about the disease-causing vectors CO.3 Student will know about the stored grain pest and their slides. CO.4 Student will know about the economic importance of the various insects. CO.5 Student will lean by field visit to various industry and centre.		
Credit: 0+0+1	**Paper: Core Compulsory**	
Max. Marks: 40+60(30T+30P)=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials +Practical): 0+0+30		
Unit:	**Topics**	**No. of Practical (Hrs)**
1. Study of *Plasmodium vivax, Entamoeba histolytica, Trypanosoma gambiense, Ancylostoma duodenale, Leishmania donovani* and *Wuchereria bancrofti* and their life stages through permanent slides/photomicrographs or specimens. 2. Study of arthropod vectors associated with human diseases: *Pediculus, Culex, Anopheles, Aedes and Xenopsylla.* 3. Study of insect damage to different plant parts/stored grains through damaged products/photographs. 4. Identifying feature and economic importance of *Helicoverpa armigera, Papilio demoleus, Pyrilla perpusilla, Callosobruchus chinensis, Sitophilus oryzae and Tribolium castaneum* 5. Visit to poultry farm or animal breeding centre and submission of visit report. 6. Preparation and maintenance of freshwater aquarium.		30
Suggested Readings: 1. Arora, D. R and Arora, B. (2001). Medical Parasitology. II Edition. CBS Publications and Distributors. 2. Atwal, A.S. (1986). Agricultural Pests of India and South East Asia, Kalyani Publishers. 3. Dennis, H. (2009). Agricultural Entomology. Timber Press (OR). 4. Dunham R.A. (2004). Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, 5. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher 6. Kumar, Vinay et al. (2014). Robbins And Cotran Pathologic Basis of Disease South Asia Edition 7. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall		
Course prerequisite: To study this course, the students must have had subject biology in class 12th		
Suggested continuous Evaluation methods-		
Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ; Assignment/Practical/Projects – 05 Marks Internal Class Test – 10 Marks Attendance/Behavior – 05 Marks		

Programme: B..Sc. (Honours/Honours with Research) in Zoology	Year: Third Year	Semester: V
Pedagogy:		
Course Code: ZOOIKS-2303	**Course Title: Applied IKS-2 : Zoology**	
Course Outcome: After completing this course, the students will be able to -		
CO1: *Explain the relevance of traditional ecological knowledge in biodiversity conservation, with emphasis on Indian case studies and ethical considerations.* **CO2:** *Compare and contrast Indian and Western ethical and philosophical perspectives regarding animal rights and welfare.* **CO3:** *Assess the similarities, differences, and integration potential between Ayurvedic practices and modern veterinary science.* **CO4:** *Evaluate contemporary zoological research that incorporates Indian knowledge systems, with emphasis on conservation, behavior, and ecology.*		

CO5: *Design and conduct field studies to document and critically analyze traditional ethnozoological practices, reflecting on their modern-day relevance.*

Credit: 2+0+0	**Paper: Core Compulsory**	
Max. Marks: 40+60=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials +Practical): 30+0+0		
Unit:	**Topics**	**Lectures (Hrs.)**
Unit 1: Indigenous Knowledge in Biodiversity Conservation •Traditional ecological knowledge and its relevance to biodiversity conservation. •Case studies: Successful conservation initiatives rooted in Indian knowledge. •Ethical dimensions of incorporating indigenous wisdom.		6
Unit 2: Ethical and Philosophical Aspects •Exploring the ethical treatment of animals in Indian traditions. •Philosophical viewpoints on animal rights and duties towards animals. •Comparative analysis of Western and Indian ethical perspectives.		6
Unit 3: Ayurveda and Modern Veterinary Science •Comparative study of Ayurvedic and modern approaches to animal healthcare. •Challenges and opportunities in integrating traditional wisdom with modern practices. •Case studies: Collaborative efforts between Ayurvedic and veterinary experts.		6
Unit 4: Contemporary Applications in Zoology •Contemporary research integrating Indian knowledge systems with zoology. •Case studies: Applications in animal behavior, conservation, and ecology. •Exploring the potential for interdisciplinary collaboration.		6
Unit 5: Field Studies and Student Projects •Field trips to study ethnozoological practices and traditional ecological knowledge. •Student projects: Documentation of local practices, analysis, and presentations. •Reflection on the implications of Indian knowledge in modern zoology.		6

Suggested Readings:

- "Srimad Bhagavad Gita" - The Bhagavad Gita contains philosophical insights that could be applied to the study of zoology, particularly in understanding the interconnectedness of life and the ethical implications of studying and interacting with animals.
- "The Web of Life: A New Scientific Understanding of Living Systems" by Fritjof Capra - While not specifically about Indian knowledge systems, this book explores the interconnectedness of life and ecosystems, which could align with some Indian philosophies.
- "The Knowledge Book: Key Concepts in Philosophy, Science and Culture" by National Book Trust - This book provides an overview of various philosophical and cultural concepts, including some from Indian traditions, which could be used to contextualize zoological concepts.
- "Indian Zoology: Humane Approach" by Ramesh Gupta - This book discusses zoology with a focus on ethical and humane treatment of animals, which could resonate with Indian philosophical perspectives.
- "Ethics for Our Times: Essays in Gandhian Perspective" by M.M. Verma - This book delves into ethics from a Gandhian viewpoint and could be used to explore ethical considerations in zoology from an Indian perspective.

Course prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Minor Paper: For Students of Other Discipline

Programme: B.A./B.Sc./B.Com. (Honours/Honours with Research) in Zoology	**Year: B. A. 3rd Year**	**Semester: Vth**
Pedagogy:		
Course Code: MZOO05	Course/Paper Title: **Environmental Studies**	

Course Objective & Outcomes:
To know about surrounding environment and its impact on human being and other organism.
By the end of the Course, the student will be able to:

CO1.Know about pollution and its impact on human health.
CO2.Know about natural resources
CO3.Know about biodiversity and its role in environment
CO4.Know about solid waste management
CO5.Know about different kinds of organism

Credit: 3+0+0	Paper (Core Compulsory / **Elective**): Elective (**minor**)
Max. Marks: 40+60	Min. Passing Marks : 35

Total Number of Lectures (Lecture – Tutorials – Practical): 45+0+0

Units:	Topics:	No. of Lectures
I	Definition and type of pollution. Sources of water, air, soil and noise pollution. Effect of water pollution on aquatic biodiversity.	9
II	Water quality assessment, Water borne diseases. Green house effect, global warming, Acid rain and Ozone depletion.	9
III	Definition and type of Biodiversity. Measurement of biodiversity hotspots of biodiversity.	9
IV	Definition and importance of biodegradation. Bioremediation, solid waste management.	9
V	Planktons, Nektons, Diatoms	9

Suggested Readings:

H. R. Singh. Ecology and Environmental Science.

P. D. Sharma. Environmental biology and toxicology

This course can be opted as an elective by the students of other discipline.

Suggested continuous E-Valuation Methods –

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

ELECTIVE (MAJOR) FOR ZOOLOGY DISCIPLINE: ANY ONE

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	**Year: Third Year**	**Semester: V-VI**
Subject: Zoology		
Course Code: ZOO-23106A	**Course Title: Environmental Biology**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Know about pollution and its impact on human health CO.2 Know about various kinds of natural resources CO.3Understand about biodiversity concept and its role in environment CO.4 Know about various kinds of techniques for environment conservation CO.5 Know solid –waste management and its role		
Credit: 3+0+0	**Paper: Elective (Major)**	
Max. Marks: 40+60=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0		

Unit	**Topics**	**No. of Lecture**
Unit I	Environmental Pollution – Definition, Type and control measures. Source of water, air, soil and noise pollution and their control measure. Greenhouse effect, Global warming, Acid rain and ozone layer depletion	9
Unit II	Conventional and non-conventional sources of energy; types and application, Environment and human health, Water quality assessment, oligotrophic, mesotrophic and eutrophic condition of water bodies water borne diseases	9
Unit III	Environmental hazards of radiations and safety measures, Environmental Impact Assessment, Hydroelectric Project, Ecosystem services, Bio-indicators: Diatom, Benthic macroinvertebrate	10
Unit IV	Biodiversity: Types of biodiversity, measurement of biodiversity, evenness, Hotspots; Threats to biodiversity,	6
Unit V	Biodegradation: definition and importance, Biomagnifications; definition and importance, Bioremediation; Biodegradation: definition and importance, Solid waste management: Causes, effects and control measures,	11

Suggested Readings:

1 1.Willimer, Stone & Stone: Environmental Physiology (Blackwell Sci. Oxford 4K)
2.Singh H.R.- Ecology & Environmental Science
3.Sharma P.D. - Environmental Biology and toxicology
4.Introduction to instrumental analysis - Robert Brown, Mc.Graw Hill, International Edition

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Or

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	**Year: Third Year**	**Semester: V-VI**
Subject: Zoology		
Course Code: ZOO-23106B	**Course Title: Fish & Fisheries**	
Course Outcome: After completing this course, the students will be able to -		

CO.1 Know the basic concepts of fish biology and fisheries which will enable the students to utilize the knowledge in fish biology researches.
CO2. Understand the status of fish resources of India.
CO3. Have the concept of fish stocks, which will be helpful to mark the fast-growing individuals
CO4. To know fecundity of the different groups of the fish belonging to the same species.
CO5. Culture the fish in ponds which would generate job and livelihood

Credit: 3+0+0	**Paper: Elective (Major)**
Max. Marks: 40+60=100	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0

Unit	**Topics**	**No. of Lecture**
Unit I	Definition of fish, Fish Morphology and Anatomy Fins, Scales and l: Types, structure and function Food and feeding habit of fishes	10
Unit II	Fish Physiology: digestion, Excretion & osmoregulation, Respiratory system, Reproductive system: Gonads, reproductive cycle	9
Unit III	Aquaculture and Pond Management, Lay-out of different types of ponds (Nursery, Rearing and Stocking), Artificial feed, manure and fertilizers	11
Unit IV	Water quality parameters, Freshwater fisheries (*Catla catla, Labeo rohita, Cirrhinus mrigala*), Cold water fisheries (Mahseer), Brackish water fisheries, Marine fish resources of India, Exclusive Economic Zone (EEZ)	7
Unit V	Fish diseases: Fungal, Bacterial, Viral and Protozoan Diseases	8

Suggested Readings:

1.Lagler KF, Bardach, JE, Miller, RR, Passino DRM.1977. Freshwater Fishery Biology by Ichthyology, N.York
2. Santosh Kumar and Manju Tembhre. 2011. Fish and Fisheries.
3. Jayaram KC. 2008. Fundamentals of Fish Taxonomy.
4. Gopal Ji Srivastava. 1995. Fishes of U.P. and Bihar.
5. Paul J.B. Hart and John D. Reynolds. 1979. Handbook of Fish Biology and Fisheries.
6. Brown ME. 1966. Physiology of fishes. Vol. I and II Academic Press. New York.
7. Jhingran VG. 1991. Fish and Fisheries of India, Hindustan Publishing Corporation.
8. Nikolsky GV. 193. Ecology of Fishes, Academic Press.

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Other Courses to Opt:

Ability Enhancement Course
Value Added Course : To be Choosed from POOL D

SEMESTER-VI

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	Year: B. Sc. Third Year	Semester: VI
Subject: Zoology		
Course Code: ZOO-23107	**Course Title: Endocrinology and Animal Behaviour**	

Course Outcome: After completing this course, the students will be able to -

CO.1 Student will know about the various endocrine gland and their function.
CO.2 Student will be known about the mechanism of hormones.
CO.3 Student will know about the reproductive cycle and neural regulation.
CO.4 Student will know about the behavioural study of animals.
CO.5 Student will know about the various types of behaviour and chemical role.

Credit: 3+0+2	**Paper: Core Compulsory**
Max. Marks: 40+60(30T+30P)=100	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+60

Unit	Topics	No. of Lecture
Unit I	Endocrine messengers: Hormones, neurohormones. Endocrine glands in mammals: Pituitary, Thyroid, parathyroid, Pancreas, Gastro-intestinal tract, Adrenal gland, Thymus & Pineal, pheromones.	9
Unit II	Mechanism of action of hormones and Catecholamines: membrane bound receptors, Cyclic nucleotide cascade Organisation, Inhibin.	8
Unit III	Neuroendocrine control of testicular functions (Gn RH regulation, FSH- effects on germinal epithelium, LH-effects on Leydig cells, negative feedback regulation), Mammalian Ovary: Folliculogenesis, Ovulation, Luteinization, Mensuration cycle and estrous cycle.	8
Unit IV	Animal behaviour: scope and terminology. Instinct and learning behaviour: Definition, characteristics and types. Imprinting. Instinct versus learning behaviour. Biological rhythms and Biological Clock	11
Unit V	Communication: Visual, olfactory, acoustic (bird songs, amphibian calls); echolocation in bats, Chemoreception: Chemicals (pheromones) as signals in insects and mammals. Sexual behaviour. Hormonal Control of behaviour	9

Suggested Readings:

1. Bentley P.J.: Comparative Vertebrate Endocrinology S. Chand & Company Ltd, Ram Nagar New Delhi,
2. Chester-Jones: Fundamentals of Comparative Vertebrate Endocrinology Plenum Press, New York &
3. Gardner, David G. & Dolores M. Shobac: Greenspan's Basic and Clinical Endocrinology, 10th edition (A&L
4. Goldsworthy G J et al: Endocrinology, Blackie, 1981
5. Goodenough et al.: Perspectives on Animal Behaviour. Wiley & Sons, New York. 1993.
6. Grier, JW: Biology of Animal Behaviour, Mosby, 1984
78. Krebs, NB & JR Davies: An Introduction to Behavioural Ecology (3rd ed.), Blackwell, 1993

Course prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	Year: B.Sc. Third Year	Semester: VI
Subject: Zoology		
Course Code: ZOO-23107	**Course Title: Lab work based on theory [Practicals List]**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Photographic study of various endocrine disorder CO.2 Slide study of thyroid gland. CO.3 Slide study of Pituitary gland CO. Practical knowledge of animal behaviour of aquarium fishes CO.5 Practical knowledge of neurobehavioral experiment of mice/fish		
Credit: 0+0+2	**Paper: Core Compulsory**	
Max. Marks: 40+60(30T+30P)=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+60		
Unit:	**Topics**	**No. of Practical (Hrs)**
Practical will be based on the theory topics. Animal behaviour of aquarium fishes on various toxic elements Neurobehavioral experiment on mice/fishes. **Virtual dissection:** https://www.vlab.co.in, www/onlinelab.in, https:/vlab.amrita.edu		60
Suggested Readings: 1. Bentley P.J.: Comparative Vertebrate Endocrinology S. Chand & Company Ram Nagar New Delhi, 2. Chester-Jones: Fundamentals of Comparative Vertebrate Endocrinology Plenum Press, New York 3. Gardner, David G. & Dolores M. Shobac: Greenspan's Basic and Clinical Endocrinology, 10th edition (A&L 4. Goldsworthy G J et al: Endocrinology, Blackie, 1981 5. Goodenough et al.: Perspectives on Animal Behaviour. Wiley & Sons, New York. 1993. 6. Grier, JW: Biology of Animal Behaviour, Mosby, 1984 7. Halliday, T.R.: Animal Behaviour Vol. 1 & 2 Communication, 1983 8. Krebs, NB & JR Davies: An Introduction to Behavioural Ecology (3rd ed.), Blackwell, 1993		
Course prerequisite: To study this course, the students must have had subject biology in class 12th		
Suggested continuous Evaluation methods-		
Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ; Assignment/Practical/Projects – 05 Marks Internal Class Test – 10 Marks Attendance/Behavior – 05 Marks		

Major Elective : Choose any One Course

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	Year: Third Year	Semester: VI
Subject: Zoology		
Course Code: ZOO-23108A	**Course Title: Fundamentals of Entomology**	
Course Outcome: After completing this course, the students will be able to -		

CO.1 To know about classification and identification of insects
CO.2 To understand morphology, anatomy of insects
CO3. To understand physiology of insects
CO.4 To understanding of pest population dynamics
CO.5 To understanding of pest management measures

Credit: 3+0+0	**Paper: Elective (Major)**
Max. Marks: 40+60 =100	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0

Unit	Topics	No. of Lecture
Unit I	Insect taxonomy: General organization of the insect body, General Organization of insect head, thorax and abdomen Overview of insect classification with emphasis on economically important insects	10
Unit II	Insect Physiology, Integument, Digestive system, Circulatory system, Respiratory system, Endocrine system	8
Unit III	Insect Physiology, Nervous system and sense organs, Reproductive system, Various modes of reproduction, Insect Development, Communication in insects	9
Unit IV	Applied Entomology: Insects of Medical and Veterinary Importance, Components of Insect Pest Management including Mechanical, Physical, Cultural, Chemical, Legal, Ecological, Biological, Microbial, Recent trends	11
Unit V	Concept and Procedure of Integrated Pest Management Mode of action of organochlorine, organophosphorous and carbamate pesticides, Pyrethroids and neem products.	7

Suggested Readings:

1.Imms, A. D., Richards, O. W., & Davies, R. G. (Eds.). (2012). Imms' General Textbook of Entomology: Volume 2: Classification and Biology. Springer Science & Business Media.
2. B. Danforth& C. Marshall. 2003. Eickworth's Manual of Insect Morphology. (Posted PDF files on Carmen.osu.edu.
3. Snodgrass, R.E. 1993 (originally 1935). Principles of Insect Morphology (with new forward by George Eickwort). Cornell University Press. 667pp.
4. Grimaldi, D.A. and M.S. Engel. 2005. Evolution of the Insects. Cambridge University, Press. 755 pp.
5. McGavin: Essential Entomology (2001, Oxford University Press)
6. Srivastava: A Text Book of Applied Entomology (Vol. I & II, 2nd ed.) Kalyani Publ., 2001
7. A Textbook of Applied Entomology Vol. I and II by Srivastava and Dhaliwal

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Or

Programme: **B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology**	**Year: Third Year**	**Semester: VI**
Subject: Zoology		
Course Code: ZOO-23108A	**Course Title: Biostatistics and Computer Applications**	
Course Outcome: After completing this course, the students will be able to -		

CO.1 Understand biological data collection and analysis
CO.2 Know about data presentation in various method like charts, graphs,
CO.3 Know about determining the level of data significance and various methods for data testing
CO.4 Student will know about computer use in biostatistics
CO 5. Student will know about statistical software in biostatistics

Credit: 3+0+0	**Paper: Elective (Major)**
Max. Marks: 40+60 = 100	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0

Unit	**Topics**	**No. of Lecture**
Unit I	Importance of statistics in biological research; Introduction to some distributions of random variables: Binomial, Poisson, normal; Basic/Descriptive statistics: Negative Bionomial distribution	8
Unit II	Measures of central tendency and measures of dispersion, Skewness & kurtosis; Simple correlation and linear regression (scatter diagram, regression coefficients, regression lines), Coefficient of determination	9
Unit III	Unit II. Students-t, chi-square and F-Tests of Significance testing and their purpose, Non -Parametric test (Mann -Whitney test & Kruskal-Wallis test), Coefficient of Correlation, ANOVA, Introduction to Statistical software (MS Excel and their purpose)	9
Unit IV	Introduction to Computers: Mini, micro, mainframe and super computers; Components of a computer system (CPU, I/O units). Data storage device, Memory concepts	8
Unit V	Software and types of software. Computer applications in biology and information communications (databases, e-mail and local networks)	11

Suggested Readings:

1. Balagurusamy, E.: Fundamentals of Computers, McGraw Hill Education, 2011
2. Khan, Khanum, Shiba Khan: Fundamentals of Biostatistics, Ukaaz Publications, 1994
3. Khanal, A.B.: Mahajan's Methods in Biostatistics, The Health Sciences Publishers, 2015
4. Le, C.T.: Introductory Biostatistics, John Wiley & Sons Publication, 2003
5. Rajaraman, V.: Fundamentals of Computers, 5th edition, PHI Learning Pvt. Ltd., 2010
6. Sinha, P., Sinha, P.K.: Computer Fundamentals: Concepts, Systems and Applications, 8th edition, BPB
Publications, 2004
7. Zar, JH.: Biostatistical Analysis, Prentice-Hall/Pearson, 2010

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Minor Paper : For Students of Other Discipline

Programme: B.A./B.Sc./B.Com. (Honours/Honours with Research) in Zoology	Year: B. A. 3rd Year	Semester: VIth
Pedagogy:		
Course Code: MZOO06	Course/Paper Title: **Elementary Fisheries**	

Course Objective & Outcomes:
Course Objectives: To know about fishery resources, fish biodiversity and fish culture technique in respect of employment.
By the end of the Course, the student will be able to:
CO1.Know about fish resources of India.

CO2.Know about Indian fishes, exotic fishes and ornamental fishes.
CO3.Understanding the fish culture technology and self-employment.
CO4.Know about artificial breeding of fishes and different stages of life spawn.
CO5.Know about fish diseases.

Credit: 3+0+0	Paper (Core Compulsory / Elective): Elective (minor)
Max. Marks : 40+60=100	Min. Passing Marks : 35

Total Number of Lectures (Lecture – Tutorials – Practical): 45+0+0

Units:	Topics:	No. of Lectures
I	Definition of fish and fisheries. Fishery resources: fresh water, estuarine water and marine water fishes.	9
II	Carp fishes, catfishes, Air breathing fishes, predatory fishes and weed fishes. Indian major carp (IMC) and Exotic major carp. Ornamental fishes.	9
III	Composite fish culture/polyculture: type of ponds, ideal pond size, stocking of fishes, stocking density of fishes, artificial feeding, preparation of artificial feed.	9
IV	Artificial breeding of fishes. Hatchery, Spawn, fry and fingerlings.	9
V	Food and feeding nature of fishes. Common fish diseases.	9

Suggested Readings:
S. S. Khanna and Neeraj Kapoor 2021. A text book of fish biology and fisheries.
R. P. Parihar 2015. A handbook of fish biology and Indian fisheries.
K.C. Jayaram 2008. Fundamental of fish taxonomy.

This course can be opted as an elective by the students of other discipline.

Suggested continuous E-Valuation Methods –

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Other Courses to Opt:

Internship/Apprenticeship (Compulsory) [ZOO-23109]

Value Added Course : To be Choosed from POOL D

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Exit Option: Bachelor' Degree (Programme duration: Three years or six semesters) .

[NHEQF Level 5.5]

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Programme: B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	Year: B. Sc. Fourth Year	Semester: VII
Subject: Zoology		
Course Code: ZOO-23113	**Course Title: Ecology**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Student will understand the concept of ecology and its type and various ecosystems. CO.2 Student will know about various natural biogeochemical cycles and energy flow. CO.3 Student will know about the biome/biosphere and population dynamics CO4. To understand the conservations of wild life and about endangered flora and fauna CO.5 To know about the national parks and sanctuaries and their role		
Credit: 3+0+2	**Paper: Core Compulsory**	
Max. Marks: 40+60(30T+30P)=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+60		

Unit	Topics	No. of Lecture
Unit I	Ecology: Definition, aim & scope, Ecological factors: Abiotic factors, biotic factors Adaptation: Definition, types with adaptive features and examples	9
Unit II	Concept of ecosystem: Definition and types, Terrestrial and Aquatic. Energy flow in ecosystem, Food chain- grazing and detritus, Food web and trophic levels, Pyramids of number, biomass and energy	9
Unit III	Ecological succession. Introduction to the laws of limiting factors Liebig's law of minimum and Shelford's law of tolerance. Biosphere: Hydrosphere, Lithosphere and Atmosphere.	9
Unit IV	Biogeochemical cycles: Carbon and Nitrogen cycles. Population: Definition & characteristics: density, natality, mortality, migration, emigration and immigration, growth and growth-curves. Bio invasion and Bio-invasive species, Salinity gradients influencing pathways of bio-invasion	9
Unit V	Dispersion and aggregation. Negative and positive, interactions including commensalism, mutualism, predation, competition and parasitism, Bioindicators & Accumulator effectors, Bioremediation	9

Suggested Readings:

1.E.P. Odum and Grey W. Barrett (1971): Fundamental of Ecology, Saunders
2.C.J. Krebs (2016). Ecology: The experimental analysis and distribution and abundance. Pearson Education.
3.T.M. Smith and R.L. Smith (2014). Elements of Ecology, Pearson, Education.
4. Singh H.R. : Ecology & Environmental Science. Narendra Publication, New Delhi
5. Karmoond: Concept of Ecology

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	Year: B.Sc. Third Year	Semester: VII
Subject: Zoology		
Course Code: ZOO-23113	**Course Title: Lab work based on theory [Practicals List]**	
Course Outcome: After completing this course, the students will be able to -		

CO.1 Photographic study of various endocrine disorder
CO.2 Slide study of thyroid gland.
CO.3 Slide study of Pituitary gland
CO. Practical knowledge of animal behaviour of aquarium fishes
CO.5 Practical knowledge of neurobehavioral experiment of mice/fish

Credit: 0+0+2	**Paper: Core Compulsory**
Max. Marks: 40+60 (30T+30P)	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+60

Unit:	**Topics**	**No. of Practical (Hrs)**
	Practical will be based on the theory topics. Animal behaviour of aquarium fishes on various toxic elements Neurobehavioral experiment on mice/fishes. **Virtual dissection:** https://www.vlab.co.in, www/onlinelab.in, https:/vlab.amrita.edu	60

Suggested Readings:

1. Bentley P.J.: Comparative Vertebrate Endocrinology S. Chand & Company Ram Nagar New Delhi,
2. Chester-Jones: Fundamentals of Comparative Vertebrate Endocrinology Plenum Press, New York
3. Gardner, David G. & Dolores M. Shobac: Greenspan's Basic and Clinical Endocrinology, 10th edition (A&L
4. Goldsworthy G J et al: Endocrinology, Blackie, 1981
5. Goodenough et al.: Perspectives on Animal Behaviour. Wiley & Sons, New York. 1993.
6. Grier, JW: Biology of Animal Behaviour, Mosby, 1984
7. Halliday, T.R.: Animal Behaviour Vol. 1 & 2 Communication, 1983
8. Krebs, NB & JR Davies: An Introduction to Behavioural Ecology (3rd ed.), Blackwell, 1993

Course prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Programme: **B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology**	**Year: B.Sc. Fourth Year**	**Semester: VII**
Subject: Zoology		
Course Code: ZOO-23111A	**Course Title: Research Methodology** [For Students pursuing Hons with Research in the discipline]	

Course Outcome: After completing this course, the students will be able to -

CO.1 Understand and ensure uniformity, consistency, reliability and reproducibility of experience
CO2. To understand experimental data and interpretation.
CO3. To understand the principles and applications of basic laboratory methods and instruments
CO4. To know about imply appropriate tools and techniques to solve the problems
CO5.To know about ethic in research field

Credit: 4+0+0	**Paper: Core Compulsory**
Max. Marks: 40+60 =100	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 60+0+0

Unit	**Topics**	**No. of Lecture**
Unit I	Unit I. Foundations of Research: Meaning, Objectives, Motivation: Research Methods vs Methodology, types of Research: Analytical vs Descriptive, Quantitative vs Qualitative, Basic vs Applied	10

Unit II	Unit II. Research Design: Need for research design— Features of good design, Important concepts related to good design; Observation and Facts, Prediction and Explanation, Development of Models. Developing a research plan: Problem identification, Experimentation, Determining experimental and sample designs	12
Unit III	Unit III. Data Collection, Analysis and Report Writing, Observation and Collection of Data-Methods of data collection- Sampling Methods, Data Processing and Analysis Strategies, Technical Reports and Thesis writing, Preparation of Tables and Bibliography. Data Presentation using digital technology	16
Unit IV	Biostatistics: Designing of experiments, Null hypothesis, probability, Correlation, regression, Distribution and measurement of central tendency, Chi Square test, Student t test F- test (one way ANOVA, two way ANOVA)	12
Unit V	Unit IV. Ethical Issues, Intellectual Property Rights, Commercialization, Copy Right, Royalty, Patent law, Plagiarism, Citation, Acknowledgement	10

Suggested Readings:

1.Seiler, J.P. (2005). Good Laboratory Practice: the Why and the How. Springer
2.Webster, J. G. (2004). Bioinstrumentation. John Wiley & Sons Incorporated
3.Reilly, M.J. (2016) Bioinstrumentation. CBS Publishers & Distributor
4.Ross, M.H. and Reith, E.J. (1995). Histology A Text and Atlas. Harper International Edition
5.Kiernan j.A. (2015) Histological and Histochemical Methods: Theory and Practice. Pergamon Press
6.Sundar Rao P.S.S. and Richard J. (2012). Introduction to Biostatistics and Research Methods. PHI Private Ltd
7.Sokal R.R. and Rohlf F.J. (2009). Introduction to Biostatistics. Dover Publications.

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Programme: **B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology**	**Year: B.Sc. Fourth Year**	**Semester: VII**
Pedagogy:		
Course Code: ZOO-23111B	**Course Title: Applied Environmental Biology** [For Students pursuing Honours in the discipline]	

Course Outcome: After completing this course, the students will be able to -

CO.1 Understand and environmental flow and its role in the river ecosystem.
CO2. To understand environmental management about the changes in the environmental.
CO3. To understand environmental Impact Assessment and its importance.
CO4. To know about Hydroelectric Projects and role.
CO5.To know Biodiversity act and regulations

Credit: 4+0+0	**Paper: Core Compulsory**
Max. Marks: 40+60 =100	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 60+0+0

Unit	Topics	No. of Lecture
Unit I	Environmental flow: Definition and types, flow Assessment methodology, Steps of flow assessment, Reconnaissance/Survey Scoping, Pre -feasibility Steps, Feasibility Steps, Design & Constructions, Operation	16
Unit II	Components of the EFA: Hydrology, Fluvial Geomorphology and hydraulic modeling Habitat preferences, Economic and Livelihood, Assessment of Cultural & Spiritual, Water Quality and Pollution	12
Unit III	Environmental management Programme (EMP): Definition, types of EMP, Legal enforceability of EMP, Integration part of EMP, Public involvement	10
Unit IV	Hydroelectric Projects (HEP): concept and definition, Purpose of Study, Steps of study, Scientific and socioeconomic aspect, HEPs in India and their role in economy, public participation in HEPs	12

Unit V	Environmental Impact Assessment (EIA); definition, objectives, Role of EIA in sustainable development of environment, Methodology, data collection, analysis of data, report writing, and recommendations	10

Suggested Readings:

8.Anti – Pollution Acts (3) and Commentaries published theorem.
9.Constitution of India [Referred articles from Part-III, Part-IV and Part-IV-A].
10.Pares Distn. Environmental Lows in India (Deep. Deep, Lated edn.)
11.P. Leelakrishnan, Environmental and the last (Bullorthworths, Latold, edn.).
12.Basic environmental technology: Jerry; A. Nathanson.
13.Canter, L. W. Environmental Impact Assessment, Mc. Graw Hill Publication, New York.

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

ELECTIVE (MAJOR) FOR ZOOLOGY DISCIPLINE: Select ANY TWO

Programme: B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	**Year: Fourth Year**	**Semester: VII**
Subject: Zoology		
Course Code: ZOO-23112A	**Course Title: Evolutionary Biology**	

Course Outcome: After completing this course, the students will be able to -

CO1.To understand the concept, process and patterns of evolution.
CO2. To acquire knowledge and reasoning skills useful to interpret biological phenomena evolution.
CO3. To understand how the single cell formed at fertilization forms an embryo and then a full adult organism
CO4. To know variety of interacting processes.
CO5. To know about an organism's heterogeneous shapes, size, and structural features,

Credit: 4+0+0	**Paper (Code compulsory/Elective): Core**
Max. Marks: 40+60 =100	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 60+0+0

Unit	**Topics**	**No. of Lecture**
Unit I	Historical development of the concept of evolution. Theories of organic evolution: Lamarckism (Neo-Lamarckism); Darwinism (Neo- Darwinism); Modern synthetic theory.	12
Unit II	Evidences in favour of evolution: Comparative anatomy, Comparative Embryology, Palaeontology, Biochemistry & Genetics	10
Unit III	Processes of Evolutionary Change: Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection.	14
Unit IV	Species Concept: Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)	10
Unit V	Palaeontology: Fossils and fossilization, Incompleteness of fossil record, Dating of fossils, Significance of fossil record; Geological distribution of animals; Mass extinction (Causes, five major extinctions, K-T extinction in detail), Role of extinction in evolution; Evolution of Horse	14

Suggested Readings:

1. Futuyma, Douglas J. and Kirkpatrick Mark. Evolution (4th Edition) Sinauer
2. Veer Bala Rastogi (2017) Organic Evolution. Med Tech
3. Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co.
4. Darwin, Charles (2003). The Origin of Species: 150th Anniversary Edition

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days)

respectively. Marks of Each Internal Assesment will be distributed as under ; Assignment/Practical/Projects – 05 Marks Internal Class Test – 10 Marks Attendance/Behavior – 05 Marks

Or

Programme: **B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology**	**Year: Fourth Year**	**Semester: VII**
Subject: Zoology		
Course Code: ZOO-23112B		**Course Title: Toxicology**
Course Outcome: After completing this course, the students will be able to -		
CO.1 To examine the application how xenobiotics disrupt normal cellular processes of genomics, CO2. To know use clinical and laboratory findings in the treatment of acute toxic exposures CO3. To understand the xenobiotics, their categories and effects on organisms CO4. To gain knowledge about bio-informatics and data base study of nucleic acid sequence CO.5 Know about scientific role of bioinformatics in research		
Credit: 4+0+0		**Paper (Code compulsory/Elective): Core Elective**
Max. Marks: 40+60=100		**Min Passing Marks: 35**
Total Number of Lectures (Lecture +Tutorials + Practical): 60+0+0		

Unit	**Topics**	**No. of Lecture**
Unit I	Different routes/methods of exposure, frequency & duration of exposure, Human exposure, Dose-response relationship, Selective toxicity, concept, significance Basic mechanisms of selective toxicity	10
Unit II	Bioassay, Acute toxicity tests for terrestrial and aquatic animals, Chronic toxicity tests, Concept of maximum acceptable toxicant concentration (MATC) and safe concentration, Factors related to the chemical exposure, Surrounding medium and the organisms	14
Unit III	Local and systemic effects, Immediate and delayed effects Reversible and irreversible effects, Biochemical and physiological effects of xenobiotics, Nanotoxicology	10
Unit IV	Concept of bioconcentration, bioaccumulation and biomagnifications; Bioconcentration factor Process of bioaccumulation in the biological system Biotransformation of Xenobiotics, Concept of biotransformation and metabolism. Sites of biotransformation, Biotransformation enzymes and general biotransformation reactions,	15
Unit V	Toxic effects on Digestive system, Circulatory system, Respiratory system, Excretory system, Reproductive system, Endocrine system, Nervous system, Mutagenicity, Teratogenicity, Carcinogenicity, Toxicogenomic	11

Suggested Readings:

1.Sharma PD (2018). Environmental Biology and Toxicology. Rastogi Publications
2.Klaassen, C. & Watkins, J. (2005) Casarett &Doull's Essentials of Toxicology, 3rd ed. Lange Publications
3.Ernest Hodgson (2010) A Textbook of Modern Toxicology. Wiley
4.Beddows, C. (2017) Comprehensive Toxicology. Elsevier

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days)

respectively. Marks of Each Internal Assesment will be distributed as under ; Assignment/Practical/Projects – 05 Marks Internal Class Test – 10 Marks Attendance/Behavior – 05 Marks

Or

Programme: **B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology**	**Year: Fourth Year**	**Semester: VII**
Subject: Zoology		
Course Code: ZOO-23112C	**Course Title: Genetics & Cytogenetics**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Understand comprehensive and detailed understanding of the chemical basis of heredity. CO. 2 Understand about role of mutation and nucleic acid in genetics and CO. 3 Understand results of genetic experimentation in animals and cytoplasmic inheritance CO4. To understand the structure and function of the cell organelles and the process of cell division. CO5. To understand the structure of gene, Mendelian principles and learn how the information contained within them gets transferred from one generation to another.		
Credit: 4+0+0	**Paper (Code compulsory/Elective): Core**	
Max. Marks: 40+60=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 60+0+0		

Unit	**Topics**	**No. of Lecture**
Unit I	Elements of Heredity and Variation. Mendel's Laws of inheritance, Linkage & type, Crossing over Sex linked inheritance: Hemophilia, Colour blindness,	12
Unit II	Sex determination: Human beings and Drosophila Blood Groups, Dosage compensation,	10
Unit III	Nucleic acids: as genetic material, Hershey - Chase & Fraenkel - Conrat experiment, Chromosome: types (polytene and lampbrush), organisation of chromatin. Heterochromatin, and euchromatin	14
Unit IV	Cell division (Mitosis and Meiosis), mitotic spindle and mitotic apparatus, chromosome movement Cell Cycle	10
Unit V	Mutation: Chromosomal mutations (deletion, duplication, inversion, translocation, aneuploidy and polyploidy), Gene mutation and mutagenesis, Cytoplasmic inheritance ,Pedigree analysis, Hereditary diseases of men	14

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. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India
5. Brown, T.A. Genomes 4. 4th Edition. Garland Science
6. Krebs et al. Lewin's GENES XII, Twelfth Edition. Jones and Bartlett Learning

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Or

Programme: B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	Year: Fourth Year	Semester: VII
Subject: Zoology		
Course Code: ZOO-23114A	**Course Title: Parasitology**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 To identify the most common parasites of medical and veterinary importance. CO2. To discuss the parasite-host relationship CO3. To describe the effects parasites have on their hosts. CO4. To describe the basic biology, life history, physiology, immunology CO5.To know about ecology of selected parasites.		
Credit: 4+0+0	**Paper (Code compulsory/Elective): Core**	
Max. Marks: 40+60=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 60+0+0		

Unit	Topics	No. of Lecture
Unit I	Introduction to Parasitology, General introduction; Basic definitions and concepts, Types of hosts and parasites, Types of parasite associations (phoresy, symbiosis, mutualism, symbiosis, parasitism), Classification of Cestodal Nematoda up to orders	14
Unit II	Morphology, biology, lifecycle and control of protozoan and arthropod parasites, Parasitic protozoans: *Entamoeba, Giardia, Plasmodium, Trypanosoma*, Parasitic arthropods, Ticks and mites, Sucking lice, Crustaceans & parasitic castration	12
Unit III	Morphology, biology, lifecycle and control of helminth parasites, Parasitic trematodes (*Fasciola, Schistosoma*), Parasitic cestodes (*Echinococcus*), Parasitic nematodes (*Wuchereria bancrafti, Ancylostoma*, *Bothriocephalus*)	12
Unit IV	Physiology and ecology of parasites (Micro -& Macro-environment of parasite), Parasitic adaptations in Trematodes & Cestodes, Parasitic immunity and immune response, Host defence. Larval forms in Trematodes & Cestodes	12
Unit V	Parasite immune evasion, Parasitic granuloma, General concepts on parasite ecology, co-evolution of hosts and parasites. Population and community ecology, Parasites as bioindicators	10

Suggested Readings:

1.Arora, D.R, Arora, B.: Medical Parasitology. II Edition. CBS Publications and Distributors.
2.Smyth, J.D.: Introduction to Animal Parasitology, Cambridge University Press, 1994
3.Parija, S. C. Textbook of Medical Parasitology, Protozoology & Helminthology (Text and colour Atlas), II
4.Chatterjee, K.D.: Parasitology, Protozoology and Helminthology 13 edition, CBS, 2022
5.Human Parasitology by BJ Bogitsh, CE Carter, TN Oeltmann. Academic Press.
6.Parasitology by Chaterjee K.D. Medical Publisher Calcutta.

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Minor Paper: For Students of Other Discipline

Programme: **B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology**	**Year: Fourth Year**	**Semester: VII**
Subject: Zoology		
Course Code: MZOO07	**Course Title: Applied Zoology**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Understand the life history of vectors and pests, the diseases caused and their control CO2. Understand the life history of parasites of domestic animals CO3. Gain knowledge of Agro based small Scale industries CO4. Study the culture of various organisms for economic benefit CO5. Have a broad array of career options and activities in human medicine, biomedical research and allied health professions		
Credit: 3+0+0	**Paper (Code compulsory/Elective): Core**	
Max. Marks: 40+60=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 4+0+0		

Unit	**Topics**	**No. of Lecture**
Unit I	Introduction to Host-parasite relationship: Definitive host, Intermediate host	9
Unit II	Parasitism, Epidemiology of Diseases: Transmission, Covid-19	9
Unit III	Parasitic Protozoa and human diseases: Life history and pathogenicity of *Entamoeba histolytica, Plasmodium* sp*, Leishmania donovani* and *Trypanosoma gambiense*	9
Unit IV	Life history & Pathogenicity of *Trichuris trichiura*, Visceral Larva migrans, Bothriocephalus, Helminthes zoonoses (Cestode zoonosis, Anisakiasis	9
Unit V	Economic Importance of insects: Biology Control and damage caused by *Pyrilla perpusilla* (pest of sugarcane) and *Papilio demoleus* (Lemon butter fly), *Callosobruchus chinensis* (pulse beetle) and *Sitophilus oryzae* (Rice weevil) Insects of Medical Importance: medical importance and control of *Anopheles*, *Culex*, Aedes	9

Suggested Readings:

1. Arora, D. R and Arora, B. (2001). Medical Parasitology. II Edition. CBS Publications and Distributors.
2. Atwal, A.S. (1986). Agricultural Pests of India and South East Asia, Kalyani Publishers.
3. Dennis, H. (2009). Agricultural Entomology. Timber Press (OR).
4. Dunham R.A. (2004). Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications,
5. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher
6. Kumar, Vinay et al. (2014). Robbins And Cotran Pathologic Basis of Disease South Asia Edition
7. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

SEMESTER VIII

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	Year: B.Sc. Fourth Year	Semester: VIII
Subject: Zoology		
Course Code: ZOO-23110	**Course Title: Biotechnology**	
Course Outcome: After completing this course, the students will be able to -		
CO.1 Student will understand biotechnological knowledge and genetic engineering. CO.2 Students will understand applications of biotechnology CO.3 Students will understand environmental biotechnology CO.4 Student will learn about the cloning and industrial use of biotechnology CO.5 They will learn about the immunity of the animals		
Credit: 3+0+2	**Paper (Code compulsory/Elective): Core**	
Max. Marks: 40+60 (30T+30P)=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+60		

Unit		Topics	No. of Lecture
Unit I	Biotechnology: Definition, scope and applications Genetic Engineering: Tools and techniques. Restriction Enzymes, endonuclease. Ligases, Alkaline phosphatase, Reverse transcriptase, DNA polymerase Vectors: plasmids, phages, cosmids.		10
Unit II	Biotechnology in human health. Therapeutic products (Hormones, regulatory proteins, antibiotics). Prenatal diagnosis of genetic diseases. Vaccines, Gene therapy.		12
Unit III	Introduction to Environmental Biotechnology, Bioprocessing Techniques. Enzyme Biotechnology, Single cell proteins.		12
Unit IV	Introduction, Animal Cloning (Therapeutic and Reproductive), Genetic manipulation at organism level: Transgenesis Industrial genetics: Cell fusion, hybridoma techniques and C-DNA library		14
Unit V	An Introduction to cellular basis of Immunity: Active & Passive immunity , Characteristics of antigen and antibody, Antigen -Antibody reaction, MHC Molecules, Immune disorder: AIDS.		12

Suggested Readings:

1. Das H.K.: Textbook of Biotechnology, Wiley India Pvt. Limited, ISBN 8126505567, 2004
2. Thieman, William, Michael A. Palladino: Introduction to Biotechnology, Pearson Education India; 3rd ed
3. B.D. Singh: Basic of Biotechnology
4. Kuby: Immunology
5.W.W. Daniel : Biostatistics, Wiley India, Publication
6. Prasad S.G.: Biostatistics

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	Year: B.Sc. Fourth Year	Semester: VIII
Subject: Zoology		
Course Code: ZOO-23110	**Course Title: Lab work based on theory [Practicals List]**	
Course Outcome: After completing this course, the students will be able to -		
CO 1. Student will gain the practical knowledge of biotechnology. CO.2 Students will learn separation techniques of the DNA CO.3 Student will learn separation technique of protein. CO.4 Student will learn separation technique of RNA CO.5 Student will learn immunological practical.		
Credit: 0+0+2	**Paper: Core Compulsory**	
Max. Marks: 40+60 (30T+30P)=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 0+0+60		
Unit:	**Topics**	**No. of Practical (Hrs)**
Biotechnological exercises based on molecular sheet Isolation of DNA from m Banana Isolation of RNA & Protein from provided materials. Immunological exercises. Biostatistical exceces.		60
Suggested Readings: 1. Das H.K.: Textbook of Biotechnology, Wiley India Pvt. Limited, ISBN 8126505567, 2004 2. Thieman, William, Michael A. Palladino: Introduction to Biotechnology, Pearson Education India; 3rd ed 3. B.D. Singh: Basic of Biotechnology 4. Kuby: Immunology 5.W.W. Daniel : Biostatistics, Wiley India, Publication 6. Prasad S.G.: Biostatistics **Virtual dissection:** https://www.vlab.co.in, www/onlinelab.in, https:/vlab.amrita.edu		
Course prerequisite: To study this course, the students must have had subject biology in class 12th		
Suggested continuous Evaluation methods-		
Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ; Assignment/Practical/Projects – 05 Marks Internal Class Test – 10 Marks Attendance/Behavior – 05 Marks		

MAJOR (Elective)

Programme: B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology	Year: Fourth Year	Semester: VIII
Subject: Zoology		
Course Code: ZOO-23114B	**Course Title: Developmental Biology**	
Course Outcome: After completing this course, the students will be able to -		
CO1.To understand the concept, process and patterns of evolution. CO2. To acquire knowledge and reasoning skills useful to interpret biological phenomena evolution. CO3. To understand how the single cell formed at fertilization forms an embryo and then a full adult organism CO4. To know variety of interacting processes. CO5. To know about an organism's heterogeneous shapes, size, and structural features,		
Credit: 3+0+0	**Paper (Code compulsory/Elective): Core Ele**	
Max. Marks: 40+60=100	**Min Passing Marks: 35**	
Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0		
Unit	**Topics**	**No. of Lecture**

Unit I	Basic concepts in developmental biology; Gametogenesis: Events in spermatogenesis. Morphology of mature mammalian spermatozoon; Events in Oogenesis, Significance of oogenesis. Vitellogenesis in birds; Comparison between Spermatogenesis & Oogenesis.	10
Unit II	Fertilization: Mechanism of fertilization; Capacitation, Molecular events - Block to polyspermy. Egg activation; Elementary idea of parthenogenesis.	8
Unit III	Types of eggs and cleavage. Role of yolk during cleavage; Products of cleavage (Morula and Blastula). Fate map: fate map of early blastula of Frog, Fate of germ layers. Types of morphogenetic movements. Gastrulation in sea urchin, frog, chick and mammal. Neurogenesis & Notogenesis.	9
Unit IV	Extra Embryonic Foetal Membrane (Chick). Development of chick embryo up to 72 hours. Types, formation and function of Placenta in mammals. Metamorphic events in frog life cycle and its hormonal regulation.	9
Unit V	Elementary concept of primary organizer; Induction; nature and its mechanism of action; Development of eye and limbs; Totipotency; Teratogenesis; Drosophila development up to gastrulation; Differential expression of genes in Drosophila.	9

Suggested Readings:

1. Berrill, NJ: Developmental Biology, Tata McGraw-Hill Publishing Co. Ltd., 1979
2. Gilbert, SF: Developmental Biology, 3rd edition, Sinauer Associates, 1991
3. Twyman, RM: BIOS Instant Notes in Developmental Biology, Taylor & Francis, 2000
4. Balinsky, BI: An Introduction to Embryology. W.B. Saunders Company. Philadelphia and London, 1960
5. Carlson, B.M.: Patten's Foundations of Embryology. (2014) 6th Edition. ISBN-9780072871708, 2014

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;

Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Or

Programme: **B.Sc./B.Sc. (Honours)/B.Sc.(Honours with Research) in Zoology**	**Year: Fourth Year**	**Semester: VIII**
Subject: Zoology		
Course Code: ZOO-23114C	**Course Title: Wild Life Conservation & Management**	

Course Outcome: After completing this course, the students will be able to -

CO.1 To examine the application how xenobiotics disrupt normal cellular processes of genomics,
CO2. To know use clinical and laboratory findings in the treatment of acute toxic exposures
CO3. To understand the xenobiotics, their categories and effects on organisms
CO4. To gain knowledge about bio-informatics and data base study of nucleic acid sequence
CO.5 Know about scientific role of bioinformatics in research

Credit: 3+0+0	**Paper (Code compulsory/Elective): Core Ele**
Max. Marks: 40+60=100	**Min Passing Marks: 35**

Total Number of Lectures (Lecture +Tutorials + Practical): 45+0+0

Unit	Topics	No. of Lecture
Unit I	Wild life - Values of wild life; Our conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies, Habitat analysis; Evaluation and management of wild life - Physical parameters, Biological Parameters (food, cover, forage, browse and cover estimation); Standard evaluation procedures: remote sensing and GIS	10
Unit II	Management of habitats - Setting back succession; Grazing logging;	9

	Mechanical treatment; Advancing the successional process; Cover construction; Preservation of genetic diversity, Population density, Natality, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores: Hair identification	
Unit III	National Organizations involved in wild life conservation; Wildlife Legislation – Wildlife Protection, Act - 1972, its amendments and implementation; CITES; IUCN Red Data Book	8
Unit IV	Management planning of wild life in protected areas; Estimation of carrying capacity; Ecotourism / wild life tourism in forests; Concept of climax persistence; Management of excess population and translocation; Bio- telemetry; Care of injured and diseased animal; Quarantine;	9
Unit V	Zoogeographic areas of Indian Subcontinent; Protected Areas: National Parks/ Sanctuaries/Biosphere, Reserves of Indian subcontinent; Tiger conservation – Tiger reserves in India	9

Suggested Readings:

1.Sharma PD (2018). Environmental Biology and Toxicology. Rastogi Publications
2.Sharma, BD: High Altitude Wildlife of India. Oxford 7 IBH Publ. Co. Pvt. Ltd. 1994.
3.Negi, SS: Himalayan Wildlife: Habitat and Conservation. Indus Publ. Company, New Delhi 1992.
4.Pullin, AS: Conservation Biology, Cambridge University Press, 2002.

Course. prerequisite: To study this course, the students must have had subject biology in class 12th

Suggested continuous Evaluation methods-

Continuous Internal Evaluation shall be of 40% in two Steps in a Semester , C1(After 45 Days) & C2 (After 90 Days) respectively. Marks of Each Internal Assesment will be distributed as under ;
Assignment/Practical/Projects – 05 Marks
Internal Class Test – 10 Marks
Attendance/Behavior – 05 Marks

Programme: B.Sc. (Honours/Honours with Research) in Zoology	**Year: B.Sc. 4th Year**	**Semester: VIIIth**
Pedagogy:		
Course Code: ZOO-23115A	Course/Paper Title: Disseration/Research Project & Viva voce [For Hons. with Research Students]	
Course Outcomes: After completing this course, the students will be able to -		
CO 1: acquire Research Skills and awareness about Methodology		
CO 2: develop critical thinking skills for evaluating existing literature and research gaps.		
CO 3: develop Communication Skills, Analytical and Problem-Solving abilities.		
CO 4: develop Project Management and will be able to contribute to existing knowledge		
CO 5: Collaborate in Interdisciplinary Skills.		
Credit: 0+0+12	Paper (Core Compulsory / Elective): Elective	
Max. Marks : 100	Minimum Passing Marks : 35	

Total Number of Lectures (Lecture – Tutorials – Practical): 0+0+12		
Units:	Topics:	No. of Practical Hours
I	Dissertation/ Research Project & Viva Voce	360

Suggested Readings:

1."Research Design: Qualitative, Quantitative, and Mixed Methods Approaches" by John W. Creswell and J. David Creswell
This book covers various research designs and approaches, helping you select the most appropriate one for your dissertation. It's suitable for both qualitative and quantitative research.

2."The Craft of Research" by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams
This book is a comprehensive guide to the research process, from formulating research questions to presenting findings. It offers practical advice and strategies for effective research.

3."How to Write a Better Thesis" by David Evans, Paul Gruba, and Justin Zobel
Geared towards graduate students, this book provides practical guidance on planning, writing, and revising a thesis or research project. It covers a range of disciplines and research methods.

4."Completing Your Qualitative Dissertation: A Roadmap from Beginning to End" by Linda Dale Bloomberg and Marie F. Volpe
Focused on qualitative research, this book offers step-by-step guidance on the entire dissertation process, including choosing a topic, data collection, analysis, and writing.

5."Writing Your Dissertation in Fifteen Minutes a Day" by Joan Bolker
This book offers practical strategies to help you overcome writer's block and procrastination while writing your dissertation. It emphasizes consistent writing habits.

6."The Dissertation Journey: A Practical and Comprehensive Guide to Planning, Writing, and Defending Your Dissertation" by Carol M. Roberts
This book provides a holistic approach to the dissertation process, covering topics such as time management, literature review, research design, and defense preparation.

7."How to Design, Write, and Present a Successful Dissertation Proposal" by Elizabeth A. Wentz
Focusing on the proposal stage, this book offers guidance on crafting a clear and effective dissertation proposal, including outlining research questions and methodologies.

8."Writing the Successful Thesis and Dissertation: Entering the Conversation" by Irene L. Clark
This book emphasizes the importance of contributing to the scholarly conversation in your field and provides practical advice on how to structure and present your research.

9."The Literature Review: Six Steps to Success" by Lawrence A. Machi and Brenda T. McEvoy
A comprehensive guide to conducting a literature review, a crucial component of any research project or dissertation.

10."Demystifying Dissertation Writing: A Streamlined Process from Choice of Topic to Final Text" by Peg Boyle Single
This book offers a straightforward and organized approach to the dissertation process, helping you break down the tasks and stay on track.

Suggested continuous E-Valuation Methods –

Component Marks

A. Dissertation Report 50%
B. Viva Voce (Oral Examination) 50%

Or

Field Visit/ Educational Tour Visit based Viva Voce [Course Code : ZOO-23115B] for (Hons. Students)

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Completion of the Programme: Bachelor Degree with Honours/Honours with Research in Major Discipline at the Successful Completion of the Fourth Year (Eight Semesters) of the multidisciplinary Four-year Undergraduate Programme. [NHEQF Level 6.0]

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