



Date :- 25/04/2025

NOTIFICATION

Sub :- CBCS Syllabi of B. Sc. in Zoology (Sem. V & VI)

Ref. :- Decision of the Academic Council at its meeting held on 22/04/2025.

The Syllabi of B. Sc. in Zoology (Fifth and Sixth Semesters) as per **NATIONAL EDUCATION POLICY – 2020 (2023 Pattern)** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2025-26.

Copy of the Syllabi Shall be downloaded from the College Website
(www.kcesmjcollege.in)

Sd/-
Chairman,
Board of Studies

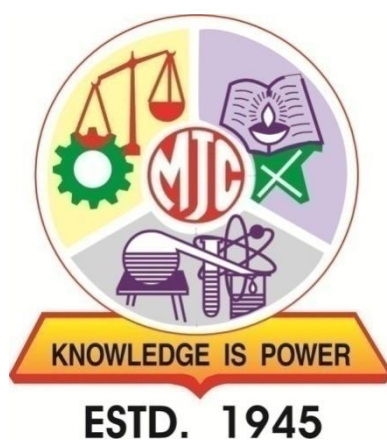
To :

- 1) The Head of the Dept., M. J. College, Jalgaon.
- 2) The office of the COE, M. J. College, Jalgaon.
- 3) The office of the Registrar, M. J. College, Jalgaon.

Knowledge is Power

Khandesh College Education Society's
Moolji Jaitha College, Jalgaon
An "Autonomous College"

Affiliated to
Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon-425001



STRUCTURE AND SYLLABUS

B.Sc. Honours/Honours with Research (T.Y. B.Sc. ZOOLOGY)

**Under Choice Based Credit System (CBCS)
and
as per NEP-2020 Guidelines**

[w.e.f. Academic Year: 2025-26]

Preface

The Zoology faculty has meticulously developed the syllabus for T. Y. B. Sc. Zoology, Semester V, and Semester VI with immense effort and a strong sense of collaboration. This curriculum has been designed to provide students with a comprehensive understanding of Zoology, fostering both academic growth and career readiness. The science of Zoology delves into the fundamentals of animal biology, covering a broad spectrum of Life Sciences topics. The courses encompass Mammalian Histology, Biochemistry, Microtechniques, Structural and Functional Anatomy of Chordates, General Embryology, Bioinformatics, Pest Control, and Structural and Functional Anatomy of Nonchordates, ensuring students gain diverse knowledge at different levels of understanding. The primary objective of the T. Y. B. Sc. Zoology syllabus is to establish a strong foundation and deepen students' grasp of the subject. From the first to the third year, the well-structured curriculum seamlessly integrates fundamental and advanced concepts in Zoology. This structured approach will not only motivate students to pursue higher education in the field but also empower them to explore entrepreneurial opportunities. Furthermore, the syllabus enhances students' prospects for employment in educational institutions, biological research organizations, industries, and various state and federal government departments associated with Zoology.

To support students' holistic development, the syllabus places a strong emphasis on technical proficiency, employability, entrepreneurship, and subject expertise. The curriculum includes diverse topics such as Animal Biotechnology, Endocrinology, Public Health and Hygiene, EthnoZoology, Animal Behaviour, and Anthropology-Human Genetics, catering to the expansive domain of Biological Sciences. Incorporating field trips, educational visits, and on-the-job training, the syllabus promotes learning through practical experiences, thereby reinforcing theoretical concepts discussed in class. This experiential learning approach enhances students' research skills and laboratory expertise. Alongside fostering research aptitude, the program hones critical thinking, analytical reasoning, and problem-solving abilities, making students more competitive in both academic and professional landscapes.

Hence, Board of Studies in Zoology in its meeting held on 22nd March 2025 resolved to accept the revised syllabus for T. Y. B. Sc. (Zoology) based on Choice Based Credit System (CBCS) of UGC, NEP-2020 and the Government of Maharashtra guidelines.

Program Outcomes (PO) for B.Sc. Program:

Program outcomes associated with a B.Sc. degree are as follows:

PO No.	PO
1	Graduates should have a comprehensive knowledge and understanding of the fundamental principles, theories, and concepts in their chosen field of study.
2	Graduates should possess the necessary technical skills and competencies related to their discipline, including laboratory techniques and data analysis.
3	Graduates should be able to identify, analyze, and solve complex problems using logical and critical thinking skills. They should be able to apply scientific methods and principles to investigate and find solutions.
4	Graduates should be proficient in effectively communicating scientific information, both orally and in writing.
5	Graduates should have a basic foundation in research methods and be capable of designing and conducting scientific investigations.
6	Graduates should be able to work effectively as part of a team, demonstrating the ability to collaborate with others, respect diverse perspectives, and contribute to group projects.
7	Graduates should recognize the importance of ongoing learning and professional development. They should be equipped with the skills and motivation to engage in continuous learning, adapt to new technologies and advancements in their field, and stay updated with current research.

Programme Specific Outcome (PSO) for B.Sc. Zoology Honours/Honours with Research:

After completion of this program, students are expected to learn/understand the:

PSO No.	PSO
1	gain comprehensive knowledge of animal biology, including structural and functional anatomy of chordates and non-chordates, evolutionary processes, and ecological interactions. Develop an in-depth understanding of biodiversity, conservation strategies, and the impact of environmental changes on different species.
2	enhance critical thinking, analytical abilities, and problem-solving skills through experimental design, data analysis, and the interpretation of results in subjects such as Biochemistry, Molecular Biology, Microtechniques, and Embryology.
3	gain hands-on expertise in laboratory techniques, fieldwork, taxonomic identification, molecular diagnostics, and biodiversity assessment, fostering independent research capabilities in diverse branches such as EthnoZoology, Animal Behaviour, and Public Health & Hygiene.
4	entrepreneurial and Industry Readiness, Equip students with technical skills and entrepreneurial acumen for careers in aquaculture, sericulture, pest management, biomedical sciences, and environmental conservation, enabling them to contribute to biotechnology and wildlife sectors.
5	explore animal behaviour, neurobiology, and human genetics, understanding their implications in anthropology and medical sciences. Investigate genetic variations, hereditary diseases, and their role in evolution, population genetics, and biotechnology applications.
6	employability and Higher Education Prospects Prepare students for diverse career paths in academia, research institutes, forensic sciences, healthcare, education, and government sectors, while also encouraging them to pursue postgraduate studies, competitive exams, and interdisciplinary research opportunities.

Multiple Entry and Multiple Exit options:

The multiple entry and exit options with the award of UG certificate/ UG diploma/ or three-year degree depending upon the number of credits secured;

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	UG Certificate	40	44	2	1
5.0	UG Diploma	80	88	4	2
5.5	Three Year Bachelor's Degree	120	132	6	3
6.0	Bachelor's Degree- Honours Or Bachelor's Degree- Honours with Research	160	176	8	4

Credit distribution structure for Three/ Four year Honors/ Honours with Research Degree Programme with Multiple Entry and Exit

F.Y. B.Sc.

Year (Lev el)	Sem	Subject-I (M-1)	Subject-II (M-2)	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT, RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
I (4.5)	I	DSC-1(2T) DSC-2(2P)	DSC-1(2T) DSC-2(2P)	DSC-1(2T) DSC-2(2P)	OE-1(2T)	---	AEC-1(2T) (Eng) VEC-1(2T) (ES) IKS(2T)	CC-1(2T)	22	UG Certificate
	II	DSC-3(2T) DSC-4(2P)	DSC-3(2T) DSC-4(2P)	DSC-3(2T) DSC-4(2P)	OE-2(2T) OE-3(2P)	---	AEC-2(2T) (Eng) VEC-2(2T) (CI)	CC-2(2T)	22	
	Cum. Cr.	8	8	8	6	---	10	4	44	
Exit option: Award of UG Certificate with 44 credits and an additional 4 credits core NSOF course/ Internship OR Continue with Major and Minor.										

S.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major*		Subject-II (M-2) Minor #	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
2 (5.0)	III	DSC-5(2T) DSC-6(2T) DSC-7(2P)	---	MIN-1(2T) MIN-2(2T) MIN-3(2P)	---	OE-4(2T)	SEC-1(2T)	AEC-3(2T) (MIL)	CC-3(2T) CEP(2)	22	UG Diploma
	IV	DSC-8(2T) DSC-9(2T) DSC-10(2P)	---	MIN-4(2T) MIN-5(2P)	---	OE-5(2T)	SEC-2(2T) SEC-3(2P)	AEC-4(2T) (MIL)	CC-4(2T) ⊗FP(2)	22	
	Cum .Cr.	12	---	10	---	4	6	4	8	44	
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major & Minor.											

* Student must choose one subject as a Major subject out of M-1, M-2 and M-3 that he/she has chosen at First year

#Student must choose one subject as a Minor subject out of M-1, M-2 and M-3 that he/she has chosen at First year (Minor must be other than Major)

⊗ OJT/Internship/CEP should be completed in the summer vacation after 4th semester

T.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major		Subject-II (M-2) Minor	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
3 (5.5)	V	DSC-11(2T) DSC-12(2T) DSC-13(2T) DSC-14(2P) DSC-15(2P)	DSE-1A/B (2T) DSE-2A/B (2P)	---	---	---	VSC-1(2T) VSC-2(2P)	---	OJT/Int (4)	22	UG Degree
	VI	DSC-16(2T) DSC-17(2T) DSC-18(2T) DSC-19(2T) DSC-20(2T) IKS DSC-21(2P) DSC-22(2P)	DSE-3A/B (2T) DSE-4A/B (2P)	---	---	---	VSC-3(2T) VSC-4(2P)	---	---	22	
	Cum . Cr.	24	8	---	---	---	8	---	4	44	
		Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor									

Fourth Year B.Sc. (Honours)

Year (Level)	Sem	Major Core Subjects		Research Methodology (RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
IV (6.0)	VII	DSC-23(4T) DSC-24(4T) DSC-25(4T) DSC-26(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	---	22	UG Honours Degree
	VIII	DSC-27(4T) DSC-28(4T) DSC-29(4T) DSC-30(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	OJT/Int (4)	22	
	Cum. Cr.	28	8	4	---	---	---	4	44	
Four Year UG Honors Degree in Major and Minor with 176 credits										

Fourth Year B.Sc. (Honours with Research)

Year (Level)	Sem	Major Core Subjects		Research Methodology (RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
IV (6.0)	VII	DSC-23(4T) DSC-24(4T) DSC-26(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	RP(4)	22	UG Honours with Research Degree
	VIII	DSC-27(4T) DSC-28(4T) DSC-30(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	RP(8)	22	
	Cum. Cr.	20	8	4	---	---	---	12	44	
Four Year UG Honours with Research Degree in Major and Minor with 176 credits										

Sem- Semester, **DSC-** Department Specific Course, **DSE-** Department Specific Elective, **OE/GE-** Open/Generic elective, **VSC-** Vocational Skill Course, **SEC-** Skill Enhancement Course, **VSEC-** Vocation and Skill Enhancement Course, **AEC-** Ability Enhancement Course, **IKS-** Indian Knowledge System, **VEC-** Value Education Course, **T-** Theory, **P-** Practical, **CC-** Co-curricular **RM-** Research Methodology, **OJT-** On Job Training, **FP-** Field Project, **Int-** Internship, **RP-** Research Project, **CEP-** Community Extension Programme, **ENG-** English, **CI-** Constitution of India, **MIL-** Modern Indian Language

- Number in bracket indicate credit
- The courses which do not have practical 'P' will be treated as theory 'T'
- If student select subject other than faculty in the subjects M-1, M-2 and M-3, then that subject will be treated as Minor subject, and cannot be selected as Major at second year.

Details of T.Y. B.Sc. (ZOOLOGY)

Course	Course Type	Course Code	Course Title	Credits	Teaching Hours/ Week			Marks			
					T	P	Total	Internal		External	
								T	P	T	P
Semester V, Level – 5.5											
DSC-11	DSC	ZOO-DSC-351	Structural and functional anatomy of Nonchordates	2	2	---	2	20	---	30	---
DSC-12	DSC	ZOO-DSC-352	Biochemistry	2	2	---	2	20	---	30	---
DSC-13	DSC	ZOO-DSC-353	Microtechniques	2	2	---	2	20	---	30	---
DSC-14	DSC	ZOO-DSC-354	Practical on ZOO-DSC-351	2	---	4	4	---	20	---	30
DSC-15	DSC	ZOO-DSC-355	Practical on ZOO-DSC-352 and 353	2	---	4	4	---	20	---	30
DSE-1A	DSE	ZOO-DSE-351A	Mammalian Histology	2	2	---	2	20	---	30	---
DSE-1B	DSE	ZOO-DSE-351B	Bioinformatics*	2	2	---	2	20	---	30	---
DSE-2A	DSE	ZOO-DSE-352A	Practical on ZOO-DSE-351A	2	---	4	4	---	20	---	30
DSE-2B	DSE	ZOO-DSE-352B	Practical on ZOO-DSE-351B	2	---	4	4	---	20	---	30
VSC-1	VSC	ZOO-VSC-351	Pest Control and Management	2	2	---	2	20	---	30	---
VSC-2	VSC	ZOO-VSC-352	Practical on ZOO-VSC-351	2	---	4	4	---	20	---	30
OJT/Int	OJT	ZOO-OJT-351	On Job Ttraining/Internship	4	---	8	8	---	40	---	60
Semester VI, Level – 5.5											
DSC-16	DSC	ZOO-DSC-361	Structural and functional anatomy of Chordates	2	2	---	2	20	---	30	---
DSC-17	DSC	ZOO-DSC-362	Animal Biotechnology	2	2	---	2	20	---	30	---
DSC-18	DSC	ZOO-DSC-363	Endocrinology	2	2	---	2	20	---	30	---
DSC-19	DSC	ZOO-DSC-364	Public Health and Hygiene	2	2	---	2	20	---	30	---
DSC-20	DSC/IKS	ZOO-DSC-365	EthnoZoology	2	2	---	2	20	---	30	---
DSC-21	DSC	ZOO-DSC-366	Practical on ZOO-DSC-361 and 362	2	---	4	4	---	20	---	30
DSC-22	DSC	ZOO-DSC-367	Practical on ZOO-DSC-363, 364 and 365	2	---	4	4	---	20	---	30
DSE-3A	DSE	ZOO-DSE-361A	Animal Behaviour	2	2	---	2	20	---	30	---
DSE-3B	DSE	ZOO-DSE-361B	Anthropology- Human Genetics**	2	2	---	2	20	---	30	---
DSE-4A	DSE	ZOO-DSE-362A	Practical on ZOO-DSE-361A	2	---	4	4	---	20	---	30
DSE-4B	DSE	ZOO-DSE-362B	Practical on ZOO-DSE-361B	2	---	4	4	---	20	---	30
VSC-3	VSC	ZOO-VSC-361	General Embryology	2	2	---	2	20	---	30	---
VSC-4	VSC	ZOO-VSC-362	Practical on ZOO-VSC-361	2	---	4	4	---	20	---	30

*** NPTEL online course ** SWAYAM online course**

Examination Pattern

Theory Question Paper Pattern:

- 30 (External) +20 (Internal) for 2 credits
 - External examination will be of 1½ hours duration
 - There shall be 3 questions: Q1 carrying 6 marks and Q2, Q3 carrying 12 marks each. The tentative pattern of question papers shall be as follows;
 - Q1 Attempt any 2 out of 3 sub-questions; each 3 marks
 - Q 2 and Q3 Attempt any 3 out of 4 sub-question; each 4 marks.

Rules of Continuous Internal Evaluation:

The Continuous Internal Evaluation for theory papers shall consist of two methods:

1. Continuous & Comprehensive Evaluation (CCE): CCE will carry a maximum of 30% weightage (30/15 marks) of the total marks for a course. Before the start of the academic session in each semester, the subject teacher should choose any three assessment methods from the following list, with each method carrying 10/5 marks:

- i. Individual Assignments
- ii. Seminars/Classroom Presentations/Quizzes
- iii. Group Discussions/Class Discussion/Group Assignments
- iv. Case studies/Case lets
- v. Participatory & Industry-Integrated Learning/Field visits
- vi. Practical activities/Problem Solving Exercises
- vii. Participation in Seminars/Academic Events/Symposia, etc.
- viii. Mini Projects/Capstone Projects
- ix. Book review/Article review/Article preparation
- x. Any other academic activity
- xi. Each chosen CCE method shall be based on a particular unit of the syllabus, ensuring that three units of the syllabus are mapped to the CCEs.

2. Internal Assessment Tests (IAT): IAT will carry a maximum of 10% weightage (10/5 marks) of the total marks for a course. IAT shall be conducted at the end of the semester and will assess the remaining unit of the syllabus that was not covered by the CCEs. The subject teacher is at liberty to decide which units are to be assessed using CCEs and which unit is to be assessed on the basis of IAT. The overall weightage of Continuous Internal Evaluation (CCE + IAT) shall be 40% of the total marks for the course. The remaining 60% of the marks shall be allocated to the semester-end examinations. The subject teachers are required to communicate the chosen CCE methods and the corresponding syllabus units to the students at the beginning of the semester to ensure clarity and proper preparation.

Practical Examination Credit 2: Pattern (30+20)

External Practical Examination (30 marks):

- Practical examination shall be conducted by the respective department at the end of the semester.
- Practical examination will be of 3 hours duration and shall be conducted as per schedule.
- Practical examination shall be conducted for 2 consecutive days for 2 hr/ day where incubation condition is required.
- There shall be 05 marks for journal and viva-voce. Certified journal is compulsory to appear for practical examination.

Internal Practical Examination (20 marks):

- Internal practical examination of 10 marks will be conducted by department as per schedule given.

- For internal practical examination student must produce the laboratory journal of practicals completed along with the completion certificate signed by the concerned teacher and the Head of the department.
- There shall be continuous assessment of 30 marks based on student performance throughout the semester. This assessment can include quizzes, group discussions, presentations and other activities assigned by the faculty during regular practicals. For details refer internal theory examination guidelines.
- Finally 40 (10+30) marks performance of student will be converted into 20 marks.

SEMESTER-V

T.Y. B.Sc. Zoology (Major)
Semester-V

ZOO-DSC-351: Structural and functional anatomy of Nonchordates

Total Hours: 30

Credits: 2

Course Objectives	▪ To Understand the Systematic Classification and Habitat of Grasshoppers ▪ To Study the External Morphology and Body Division ▪ To Investigate the Major Physiological Systems ▪ To Explore the Reproductive system and Developmental Stages	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Gain the knowledge of Grasshopper Classification and Habitat ▪ Able to Describe Grasshopper Anatomy ▪ Understanding of Grasshopper Physiological Systems ▪ Interpret the Reproductive Processes and Development	
Unit	Contents	Hours
Unit I	Grasshopper-As an animal type <i>Heiroglyphusbanian</i> Study of grasshopper w.r.t.following ▪ Systematic position habit and habitat ▪ External characters-Shape-size and colour, Division of body–Head, thorax and abdomen.	7
Unit II	Digestive System ▪ Alimentary canal ▪ Digestive glands, ▪ Feeding mechanism and Digestion. Circulatory system of grasshopper ▪ Haemocoel, ▪ Haemolymph, ▪ Heart and aorta, ▪ Circulation of blood.	8
Unit III	Respiratory system of grasshopper ▪ Spiracles, ▪ Trachea. Excretory System of Grasshopper	7
Unit IV	Nervous system of grasshopper ▪ Central Nervous system. ▪ Peripheral nervous system. Reproductive system of grasshopper ▪ Male reproductive system ▪ Female reproductive system. ▪ Metamorphosis and Development	8
Study Resources	▪ P.S. Verma and E.L.Jorden (2009):Invertebrate Zoology, S.C.Chand,New Delhi. ▪ R.L. Kotpal (2019):Modern Textbook of Zoology, Rastogi Publication Meerut. X Edition. ▪ Parker and Haswell (2004):A Textbook of Zoology, Invertebrates,7th de. Vol. I, CBS Publishers, New Delhi. ▪ S.N. Prasad (1980): Life of Invertebrates, Vikas Publishing House Pvt Ltd. ▪ Kotpal R. L (2015). Modern Text Book of Zoology, Invertebrate, Rastogi Publication, Meerut. ▪ Nair N. C, Leelavathi S, Soundrapandian N, Murugan T and Arumugam. N (2013). A TextBook of Invertebrates. Saras Publication.	

T.Y. B.Sc. Zoology (Major)
Semester-V
ZOO-DSC-352: Biochemistry

Total Hours: 30

Credits: 2

Course Objectives	▪ To accustom students with basic terms in biochemistry. ▪ To study of macromolecule such as carbohydrates, protein and fat, their types and Significance. ▪ To learn about enzyme, vitamin and minerals. ▪ To understand the structure, function, and metabolism of key biomolecules, such as proteins, carbohydrates, lipids, and nucleic acids.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand the importance of biochemistry ▪ Understand a deeper in sight in to the fundamentals of biochemistry. ▪ Understand the importance of biological macromolecules ▪ Understand the students in understanding the classification, functions and application aspects of biomolecules.	
Unit	Contents	Hours
Unit I	Introduction to biochemistry: ▪ Introduction, Scope, importance and applications of biochemistry ▪ The structure of an atom, ionization potential ▪ Nature and types of chemical bonding ▪ pH scale and its significance ▪ Concept of pKa ▪ Henderson–Hasselbatchequation ▪ Buffer and its types ▪ Biological buffer system.	7
Unit II	Carbohydrates ▪ Definition, classification, structure and its biological importance. ▪ Monosaccharides- Aldoses and ketoses. ▪ Oligosaccharides- Disaccharides (Sucrose, Lactose, Maltose, Cellobiose ,Trehalose) ▪ Trisaccharides (Rhamninose,Gentianose, Raffinose) ▪ Tetrasaccharides (Stachyose and Scorodose) ▪ Pentasaccharides(Verbascose) ▪ Polysaccharide - Homopolysaccharides (Starch, Glycogen, Insulin,cellulose,pection, chintin) and Heteropolysaccharides - (Hyaluronic acid and chondroitin)	8
Unit III	Lipids ▪ Definition, classification with examples and their biological importance. ▪ Fatty acids –Saturated fatty acids and unsaturated fatty acids. ▪ Essential and Non-essential fatty acids ▪ Triacylglycerol ▪ Steroids ▪ Cholesterol	7

	▪ Biological role of Lipids.	
Unit IV	Proteins, Enzyme, Vitamins and Minerals ▪ Amino acids-Classification and general properties and importance of essential and non-essential amino acid. ▪ Proteins- Definition, biological significance of proteins ▪ Structure of proteins-primary, secondary, tertiary and quaternary ▪ Denaturation of proteins. ▪ Defensive proteins-Definition and antibodies Enzyme–Nomenclature and classification; ▪ Co-factors, ▪ Specific of enzyme action; ▪ Isozymes; ▪ Mechanism of enzyme action- Michaelis-Menten equation ▪ Enzyme kinetics; ▪ Factor affecting rate of enzyme catalyst reactions Vitamins–Definition and classification ▪ Types of vitamin –water and fat soluble vitamins ▪ Vitamins as Coenzymes Minerals-Definition and general functions of microminerals and macrominerals.	8
Study Resources	▪ Jain J.L.Jain S.(2007),Biochemistry, Chand Publication, Meerut. ▪ Kulkarni, M.V., Thonte,S, publication. ▪ Lehninger, A.L.(2013),Biochemistry, Publisher ▪ Outline of biochemistry(2006),Cohn and Stumpt, Publisher ▪ Powar CB and Chatwal GR (2008) ▪ Rastogi,S.C.(2010),Biochemistry,Mc Graw Hill ▪ Thimmaiah S. K.(1999), Standard Methods of Biochemical Analysis, Kal Publication. ▪ U. Satyanarayanan Biochemistry (2013),Publisher : Elsevier; 4th edition ▪ LehningerPrinciples of Biochemistry: International EditionpublisherW. H. Freeman & Co Ltd 29 January 2021	

T.Y. B.Sc. Zoology (Major)
Semester-V
ZOO-DSC-353: Microtechniques

Total Hours: 30

Credits: 2

Course Objectives	▪ To prepare the whole mounts microscopic slides and staining reactions. ▪ To study of microscopically sectioning. ▪ To study the preservation and storage of histological slides. ▪ To understand Embedding, Block making, Trimming and Mounting	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Study cell tissue structure, histology of tissues and details of morphology of animals. ▪ Understand applications and scope of microtechnique. ▪ Understand Cell tissue structure, histology of tissues and details of morphology of animals. ▪ The learner will get Job opportunities in Health institutes, Hospitals and Pathological labs.	
Unit	Contents	Hours
Unit I	Tissue and skin Introduction,process of Microtechnique ▪ Definition, Scope and Applications of Microtechnique. ▪ Collection of specimen or tissue. ▪ Kinds of preparation of specimen or tissue: ▪ Whole mounts, Teasing and smearing. ▪ Preparation whole mounts: Euglena, Paramecium, Chick embryo and Insects. ▪ Fixation: Definition and Importance and Theory of fixation. ▪ Qualities of good fixative. ▪ Types of fixative–Primary and Compound fixatives Washing, Dehydration, Clearing ▪ Washing: Theory and Significance of washing ▪ Dehydrating agents: Definition, types, Significance and use of dehydrating agents. ▪ Clearing: Definition, Clearing agents their merits and demerits and importance of clearing.	08
Unit II	Title of the unit Embedding, Block making, Trimming and Mounting ▪ Cold and hot infiltration ▪ Paraffin ▪ Melting and handling of paraffin. ▪ Types of ovens and its uses. ▪ Embedding: Embedding Containers: a)Paper trays b)L-shaped metal pieces c) Glass dishes/lids. ▪ Embedding procedure, multiple embedding and embedding faults. ▪ Block making, labeling of block and storage of block. ▪ Trimming ▪ Mounting of trimmed block on microtome peg.	07

Unit III	▪ Microtome: Types, its uses, precautions and handling of Rotary and rocking microtome. ▪ Microtome knives: Types, care, sharpening, honing and stropping of knife. ▪ Affixing and processing of sections: i) Mayer's albumen, ii) Slide warmers	07
Unit IV	Staining, Mounting, Clearing and camera lucida ▪ Theory of staining. ○ Types of stain: Acidic, basic, neutral and vital stain. ○ Preparation of Haematoxylin, Eosin stain and Giemsa stain ○ Mordants: Definition, importance and common mordants. ○ Double staining: Processing of paraffin section during staining. ○ Special staining methods for Mitochondria and chromosomes. ▪ Mounting media: DPX and Canada balsam. ▪ Clearing, labeling and preservation of permanent slides. ▪ Use of camera lucida and micrometer scale.	08
Study Resources	▪ Weesner. F.M.(1968), General zoological microtechniques. Maryl and, U.S.A.: The Williams & Wilkins Company ▪ Mr. Jeremy Sanderson (1994) Biological Microtechnique by Garland Science publishers: First edition ▪ Baker F. I. and R. E. Silverton, (2008) Introduction to Medical Laboratory Technique. ▪ R. Marimuthu (2011) Microscopy and Microtechnique published by MJP Vonnice D.C. Sheild and Thomas Heinbokel Microtechnique. ▪ Peter Gray (1952) Basic Microtechnique published by The Blackiston company, Toronto. ▪ Dr. M. K. Prasad (2000) Outlines of Microtechnique published by Emkay. ▪ Brian Bracegirdle (1978) A History of Microtechnique published by Heinemann Educational books Ltd. ▪ Richard W. Horobin (1982) Histochemistry published by Butterworth Educational books Ltd.	

T.Y. B.Sc. Zoology (Major)
Semester-V
ZOO-DSC-354: Practical on ZOO-DSC-351

Total Hours: 60

Credits: 2

Course Objectives	- To examine the External Morphology and Sexual Dimorphism in Grasshoppers. - To analyze the Digestive and Circulatory Systems. - To understand the Nervous and Respiratory Systems. - To explore the Reproductive Systems and Field Observations.	
Course Outcomes	After successful completion of this course, students are expected to: - Identification and Description of External Features and Sexual Dimorphism. - Comprehension of Digestive and Circulatory Systems. - Understanding of Nervous and Respiratory Systems. - Knowledge of Reproductive Systems and Field Study Application.	
Sr. No.	Contents	Hours
1	Study of external characters of grasshopper. (To Study of following with the help of charts/ models/ simulations etc)	4
2	Study of sexual dimorphism of grasshopper. (To Study of following with the help of charts/ models/ simulations etc)	4
3	Study of mouth parts of grasshopper. (To Study of following with the help of charts/ models/ simulations etc)	4
4	Study of digestive system of grasshopper. (To Study of following with the help of charts/ models/ simulations etc)	4
5	Study of heart and aorta of grasshopper. (To Study of following with the help of charts/ models/ simulations etc)	4
6	Study of nervous system of grasshopper. (To Study of following with the help of charts/ models/ simulations etc)	4
7	Study of male reproductive system of grasshopper. (To Study of following with the help of charts/ models/ simulations etc)	4
8	Study of female reproductive system of grasshopper. (To Study of following with the help of charts/ models/ simulations etc)	4
9	Study of haemocytes of grasshopper. (To Study of following with the help of charts/ models/ simulations etc)	4
10	Study of trachea of grasshopper. (To Study of following with the help of charts/ models/ simulations etc)	4
11	Study of cornea of grasshopper. (To Study of following with the help of charts/ models/ simulations etc)	4
12	Study of antenna of grasshopper. (To Study of following with the help of charts/ models/ simulations etc)	4
13	Study of spiracles of grasshopper. (To Study of following with the help of charts/ models/ simulations etc)	4
14	Study of Brain of Grasshopper. (To Study of following with the help of charts/ models/ simulations etc)	4
15	Field visit to any suitable habitat of grasshopper.	4
Study Resources	- Dr. J.P. Shukla, Dr. K. Pandey (2017): Non-Chordate (Invertebrate) Zoology Practical, Himalaya Publishing House Pvt. Ltd. S. S. Lal (2016): Practical Zoology Invertebrate, Rastogi Publications.	

***Mandatory to perform any 12 practical from above.**

T.Y. B.Sc. Zoology (Major)
Semester-V

ZOO-DSC-355: Practical on ZOO-DSC-352 and 353

Total Hours: 60

Credits: 2

Course Objectives	- To study the analyses of biomolecule for various perspectives of applied - To study the influence and role of structure in reactivity of biomolecules. - To prepare the whole mounts microscopic slides and staining reactions. - To introduce different instrument used in microtechnique and micrometer scale.	
Course Outcomes	After successful completion of this course, students are expected to: - Analyze and evaluation of biochemical experimental techniques - Understand the quantitative and qualitative estimation of biomolecules. - Understand the use and application of basic equipment in the laboratory. - Cell tissue structure, histology of tissue and details of morphology of animals. Job opportunities in Health institutes. Hospitals and pathological Laboratory.	
Sr. No.	Contents	Hours
1	Preparation of Solution –Normality, molarity and percent solution.	4
2	Determination of isoelectric point of amino acid (pKa).	4
3	Paper chromatography of amino acid	4
4	Estimation of Ascorbic acid (Vitamin–c)	4
5	Estimation of Protein by any suitable method	4
6	Isolation of casein from milk.	4
7	Study of activity of salivary amylase under various factor.	4
8	Estimation of glucose GOD/POD method.	4
9	Temporary preparation whole mount of <i>Amoeba/Euglena/Paramecium</i> .	4
10	Temporary preparation whole mount of <i>Chick embryo</i> .	4
11	Preparation whole mount of any 5 Insects.	4
12	Preparation of histological slides	4
13	Sketching by camera Lucida.	4
14	Calibration of micrometer scale of cell diameter from the given permanent slide. (E)	4
15	Submission of permanent slide (5 Whole mounts and 5 histological Sections).	4
Study Resources	- Rastogi, S.C. (2010), Biochemistry, Mc Graw Hill - Thimmaiah S. K. (1999), Standard Methods of Biochemical Analysis, Kal Publication. U. Satyanarayanan Biochemistry (2013), Publisher : Elsevier; 4th edition R. Marimuthu (2011) Microscopy and Microtechnique published by Mjp - Vonnie D.C. Sheild and Thomas Heinbokel Microtechnique. - Peter Gray (1952) Basic Microtechnique published by The blakiston company, toronto. - Dr. M.K. Prasad (2000) Outlines of Microtechnique published by Emkay.	

***Mandatory to perform any 12 practical from above.**

T.Y. B.Sc. Zoology (Elective)
Semester-V
ZOO-DSE-351A: Mammalian histology

Total Hours: 30

Credits: 2

Course objective	- To learn about the basic of histology of mammals. - To study the basic structure tissues and organs and describe their contribution to digestion. - To study the Histological structure of circulatory and excretory systems of mammals. - To develop an in depth understanding of mammalian tissue structure of reproductive organ, endocrine and nervous systems	
Course outcome	After successful completion of this course, students are expected to: - Enrich themselves with histology of different tissues - Know the gross anatomical structure of different organ Systems in Mammals - Learn the architecture of integrative histology. - Enrich with histology of reproductive organ, endocrine and nervous systems for study.	
Unit	Topic	Hours
Unit I	Introduction, Tissue and Skin - Definitions, History, Application of histology. - Derivative of three germinal layers - Tissue: Types and Characteristics (Definition and location only): - Epithelial tissues - Connective tissue - Muscular tissue - Nervous tissue - Structure and function of skin and its Derivatives - Horns, Nails, Hair, Sweat and Sebaceous gland.	7
Unit II	Digestive and Respiratory system - Histology of tooth and tongue: Structure and functions. - Histology of alimentary Canal: Oesophagus, stomach, duodenum, colon and rectum. - Histology of digestive glands – salivary glands, liver, pancreas (exocrine and endocrine), - Histological structure of trachea and lung.	08
Unit III	Circulatory and Excretory system - Structure and function of blood vessels: Artery, Vein and Capillary. - Blood: Composition, types of blood cells and their functions. - Histology of Kidney: L.S. of Kidney, Bowman's capsule and Glomerulus, Uriniferous tubules, Juxtra Glomerular complex (JG complex).	08
Unit IV	Reproductive, Endocrine system, Nervous system and Sense Organs T. S. Testis T. S. Ovary - Pituitary gland. T. S. Thyroid and Parathyroid gland. T. S. Adrenal gland.	07

	▪ T. S. Brain meninges: Histological Structure. ▪ T. S. Spinal cord: Histological Structure. ▪ T. S. Eye ▪ T. S. Ear	
References	▪ Freeman, W. H., & Bracegirdle, B. (1976). An advanced atlas of histology. Heinemann. ▪ Muzammih Ullah, (1980). Histology and Genetics: Theoretical and Applied (including Histological and Cytological Techniques. Kedar Nath Ram Nath Publisher. ▪ Turner and Bungera (1971). General Endocrinology. W.B. Saunders Company. 5th edition . ▪ Pearse A.G.E.(1985). Histochemistry – Vol. I and II. Fourth edition. Churchill Livingstone. Edinburgh. ▪ Tembhare D.B. (2010). Techniques in LifeSciences. Publisher HimalayaPublishingHouse	

T.Y. B.Sc. Zoology (Elective)
Semester-V
ZOO-DSE-351B: Bioinformatics
 (NPTEL Course ID-noc25-bt06)

Total Hours: 30

Credits: 2

Course Objectives	▪ To introduced to the basic concepts of Bioinformatics and its significance ▪ To describe generation and different types of computers with basic programming languages. ▪ To understand types of biological data and database search tools. ▪ To get exposed to computational methods, tools and algorithms employed for proteomics and genomics.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand the basic concepts of Bioinformatics and its significance ▪ Apply their knowledge of generations, types of computers and programming languages ▪ Understand the process of sequence alignment methods using web resources ▪ Appreciate the tools used in proteomics and genomics with their significance	
Unit	Contents	Hours
Unit I	Introduction to Bioinformatics ▪ Definition, Objectives and scope of Bioinformatics ▪ Bioinformatics web resource (NCBI, EBI, OMIM, PubMed) ▪ Applications of Bioinformatics	08
Unit II	Computer generations ▪ Concept of Computer generations and Type of computer ▪ Programming Languages: PERL and Java	05
Unit III	Biological Databases ▪ Concept and types of databases ▪ Databases – Tools and their uses ▪ Nucleic acid sequence databases (GenBank, EMBL-EBI, DDBJ) ▪ Sequence alignment ○ BLAST, types and applications. ○ FASTA, format and application	08
Unit IV	Proteomics and Genomics ▪ Definition, Protein structure visualization tools-RasMol and SwissPDB viewer ▪ Protein sequence databases- PIR, SWISS-PROT, TrMBL ▪ Structural classification databases- SCOP, CATH, ▪ Protein folding and disorders ▪ Applications of Proteomics ▪ Gene, Genotype, Genome of E. coli, S. cerevisiae, C. elegans, and Homo sapiens. ▪ Single nucleotide polymorphisms (SNPs), Structure and application of DNA microarray. ▪ Nucleotide sequence database, GenBank (NCBI, EMBL and DDBJ), cDNA libraries and ESTs, Databases of metabolic pathways- KEGG. ▪ Genomics in medicine- disease monitoring, Drug designing and	09

	development.	
Study Resources	▪ Aluru, Srinivas, (2006): Ed. Handbook of Computational Molecular Biology. Chapman & Hall/Crc, ISBN 1584884061 (Chapman & Hall/Crc Computer and Information Science Series) ▪ Attwood, T.K., Michie, A.D. and Jones, M.L. (1996): DbBrowser: integrated access to database worldwide. TiBS. Vol. 21(5), 191. ▪ Barnes, M.R. and Gray, I.C. (2003): Eds., Bioinformatics for Geneticists, first edition. Wiley, ISBN 0-470-84394-2 ▪ Curtis Jamison. (2003): Perl Programming for Biologists. By Hoboken, NJ: John Wiley & Sons, Inc. ▪ Prakash S.Lohar (2011): Bioinformatics ISBN 978-81-8094-066-8 MJP Publishers, Triplicane, Chennai. ▪ Lesk, A.M. (2001): Introduction to Protein Architecture: The Structural Biology of Proteins (Oxford: Oxford University Press)	

T.Y. B.Sc. Zoology (Elective)
Semester-V
ZOO-DSE-352A: Practical on ZOO-DSE-351A

Total Hours: 60

Credits: 2

Course objective	- To prepare the temporary preparation of microscopic slides and staining. - To study the histological differences in various organ. - Student learns the architecture of various type of tissue. - Student learns the histological structure of sense organ.	
Course outcome	After successful completion of this course, students are expected to: - understand the stained structure of tissue. - understand the structural differentiation in various tissue. - understand the differences in architecture of various type of tissues - understand structure & histology of tissues & details of morphology of animals.	
Sr. no.	Practicals	Hours
1.	Study of Squamous epithelial tissue, Cuboidal epithelial tissue and Columnar epithelial tissue with the help of chart / permanent slides /simulations (D)	4
2.	Study of Ciliated epithelial tissue, Areolar connective tissue, and Blood smear with the help of chart / permanent slides /simulations (D).	4
3.	Temporary preparation of Striated and Smooth muscle fibre the following tissue of preserved Rat (E).	4
4.	Temporary preparation of Medullated nerve fibres and Hyaline cartilage the following tissue of preserved Rat (E).	4
5.	Study of histological structure of Skin, V. S. of Tooth and V. S. of Tongue with the help of permanent slide (D)	4
6.	Study of histological structure of T. S. of oesophagus, T. S. of stomach with the help of permanent slide (D)	4
7.	Study of T. S. of histological structure of duodenum and rectum with the help of permanent slide (D)	4
8.	Study of C. S. of Salivary gland (Parotid gland), T. S. of pancreas, C. S. of liver with the help of permanent slide (D)	4
9.	Study of C. S. of trachea, C. S. of lung with the help of permanent slide (D)	4
10.	Study of T. S. of artery, T. S. of vein, T. S. of capillary with the help of permanent slide (D)	4
11.	Study of L. S. of kidney with the help of permanent slide of excretory system (D)	4
12.	Study of T. S. of testis, L. S. of ovary with the help of permanent slide of reproductive systems. (D)	4
13.	Study of T. S. of pituitary gland, T. S. of adrenal gland and C. S. of thyroid gland with the help of chart / permanent slides / simulations (D)	4
14.	Study of Structure of sense organ- T. S. of Eye and T. S. of ear with the help of chart / permanent slides /simulations (D).	4
15.	Prepare a model of any one cell type / tissue type / organ by using any suitable material (Plaster of Paris / clay / silicon / ceramic etc.) (Activity based practical)	4
Study Resources	- Muzammih Ullah, (1980). Histology and Genetics: Theoretical and Applied (including Histological and Cytological Techniques. Kedar Nath Ram Nath Publisher. - Turner and Bungera (1971). General Endocrinology. W.B. Saunders Company. 5th edition .	

***Mandatory to perform any 12 practical from above.**

T.Y. B.Sc. Zoology (Elective)
Semester-V
ZOO-DSE-352B: Practical on ZOO-DSE-351B

Total Hours: 60

Credits: 2

Course Objectives	▪ To get introduced to the basic concepts of Bioinformatics and its significance ▪ Explain generation and different types of computers with basic programming languages. ▪ Overview about types of biological data and database search tools. ▪ To get exposed to computational methods, tools and algorithms employed for proteomics and genomics	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand the basic concepts of Bioinformatics tools and its significance ▪ Apply their knowledge of generations, types of computers and programming languages ▪ Understand the process of sequence alignment methods using web resources ▪ Appreciate the tools used in proteomics and genomics with their significance	
Sr. No.	Contents	Hours
1	PERL or JAVA programming translation of String of DNA.	4
2	Demonstrate dot plot method using any programming language.	4
3	Use of internet for survey of literature using protein and nucleotide databases(NCBI)	4
4	Data bases: Primary and Secondary data bases, DNA and Protein data bases	4
5	Study of particular human hereditary disease using OMIM website	4
6	Evaluation of similarity percentage using sequence alignment tool.	4
7	Visualization of PDB files using SPDBV software.	4
8	Login to KEGG homepage to study of any suitable metabolic pathway.	4
9	Using NCBI resources find out nucleotide database of any one gene on achromosome of human.	4
10	Exploring BLAST tool (nucleotide sequence comparison)	4
11	Exploring the integrated database system at NCBI server and querying (Querying a nucleotide sequence, querying a protein sequence, use of operators (AND, OR & NOT).	4
12	Exploring bibliographic database PubMed (Data mining-Downloading a research paper on subject of interest, use of operators (AND, OR & NOT).	4
13	Web browsing at SwisProt, PIR PSD, UniProtKB	4
14	Construction of Phylogenetic Trees for DNA and Proteins.	4
15	Visit to any bioinformatics-based laboratory/industry	4
Study Resources	▪ Balon E.K., (1984), Patterns in the Evolution of Reproductive Styles in Fishes, in Fish Reproduction - Strategies and Tactics, G.W. Potts & R.J. Wootton (eds), London, Academic Press: 35-53. ▪ Chattopadhyay, S. (2011), Introduction to Lac and Lac culture. Department of forest and biology and tree improvement faculty of Forestry. Birsa Agriculture University, Ranchi.	

	▪ McKenzie-Lake, Angela. "Facts About Goats." College of Engineering Sciences, Technology, and Agriculture Bulletin, no. 2, vol. 1., 2010, pp. 1-12. ▪ Busvine J.R., (1980), Insects and Hygiene: The biology and control of insect ▪ Busvine J.R., (1982), Control of Domestic Flies, Ross Institute Bulletin No. ▪ Chapman, R.F. (1998), The Insects: Structure and Function. IV Edition, Cambridge University Press, UK	
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***Mandatory to perform any 12 practical from above.**

T.Y. B.Sc. Zoology (Vocational)
Semester-V
ZOO-VSC-351: Pest control and Management

Total Hours: 30

Credits: 2

Course Objectives	- Explain the concept, scope, and classification of pests in agriculture, public health, storage, and structural contexts. - Analyse various pest control methods, including mechanical, cultural, legislative, quarantine, and chemical approaches. - Assess the principles, advantages, and limitations of biological control and integrated pest management strategies. - Demonstrate practical knowledge in using pesticide application tools, handling pests for study, and preparing herbal pesticides like neem extracts and tobacco solutions.	
Course Outcomes	After successful completion of this course, students are expected to: - Develop foundational knowledge of pest taxonomy and their ecological and economic impacts. - Apply problem-solving skills to evaluate and implement pest control techniques while recognizing chemical control drawbacks. - Promote sustainability through innovative pest management approaches that minimize environmental impact. - Develop hands-on expertise in safe and sustainable pest management practices and pesticide handling protocols.	
Unit	Contents	Hours
Unit I	Introduction to Pest - Concept and Scope of Pest - Classification of pests: Agricultural pest, Store grain pest, Animal husbandry pest, Public health pest, and Structural Pest Study of selected insect pest with respect to their marks of identification, nature of damage and control measures - Banana – Banana stem borer, Banana thrips - Cotton-Red cotton bug, Pink boll worm - Sugarcane-Sugarcane leafhopper- Pyrilla - Mango-Mango stem borer - Jowar- Jowar stem borer - Brinjal-Brinjal shoot & fruit borer - Wood-White ants –termite - Store grain –<i>Sitophilus</i>, <i>Callosobruchus</i>.	
Unit II	Control Measure of Insect Pest - Primary Control Measures: Mechanical measures, Physical measures, Cultural measures, Legislative measures, Quarantine measures - Chemical Control: Classification of insecticides-based on the modes of their entry with one example each: Stomach poisons, Contact poisons, Systematic poison, and Fumigants - Insecticidal formulations and dilutions - Drawback of Chemical Control.	
Unit III	Biological Control of Insect Pest - Introduction, definition - Biological agents - Desired qualities of biological agents. - Autocidal control: The male sterile techniques, The genetic technique, Pheromonal technique, and Hormonal control	

	- Advantages and Drawbacks of biological control. - Biological control management Integrated pest management - Introduction and Principle - Integrated tactics: Plant resistance, Cultural method, Biological control, and Pesticides - Pest management strategies - Integrated pest management modeling	
Unit IV	Pesticide-appliances - Sprayers and Dusters - Pesticide safety Preparation and method of application of herbal pesticides - Neem extracts- leaves /seeds/bark - Dashparni ark - Tobacco extracts - Camphor	
Study Resources	- Pruthi, H. S. (1969). Textbook on agricultural entomology. Indian Council of Agricultural Research, New Delhi - Little, V. A. (1972). General and Applied Entomology. New York, Harper & Row. - Pradhan S. (1998). Insect Pest of Crops National Book Trust, India. - Tembhare T. B. (2023). Modern Entomology. Himalaya Publishing House. - Srivastava K.P. and Dhaliwal G.S. (2010). A Textbook of Applied Entomology. Kalyani Publishers. - Srivastava, P. D., & Singh, R. P. (1997). Introduction To Entomology (an). Concept Publishing Company.	

T.Y. B.Sc. Zoology (Vocational)
Semester-V
ZOO-VSC-352: Practical on ZOO-VSC-351

Total Hours: 60

Credits: 2

Course objectives	- Analyze the effect of BHC and Neem extracts on pest control and evaluate eco-friendly alternatives. - Demonstrate the rearing of Guppy fish and its role in biological pest control. - Identify and study major agricultural pests, their life stages, and damage patterns. - Develop hands-on skills in pest collection, preservation, and modern pesticide application techniques	
Course outcome	After successful completion of this course, students are expected to: - Apply scientific methods to evaluate the efficacy of chemical and botanical pesticides in pest control. - Develop sustainable pest management strategies through biological and herbal pest control methods. - Enhance practical knowledge of pest identification, preservation, and integrated pest management techniques. - Gain field exposure to real-world pest management practices and modern pesticide application equipment.	
Sr.No.	Practical	Hours
1.	To study the effect of BHC on any suitable pest	4
2.	Preparation of aqueous Neem extracts from leaves /seeds /bark	4
3.	To study the effect of Neem extract on any suitable pest	4
4.	Study of rearing of Guppy and demonstration of feeding on mosquito larvae	4
5.	Preparation of Dashparni ark	4
6.	Preparation of Tobacco extracts	4
7.	Study of the following pests with emphasis on the appropriate stages causing damage- Banana stem borer, Banana thrips Red cotton bug, Pink boll worm	4
8.	Study of the following pests with emphasis on the appropriate stages causing damage-, Mango stem borer, Jowar stem borer, Brinjal shoot & fruit borer	4
9.	Study of the following pests with emphasis on the appropriate stages causing damage-, , Termite, <i>Sitophilus</i> , <i>Callosobruchus</i>	4
10.	Study of the following pests with emphasis on the appropriate stages causing damage- Banana stem borer, Banana thrips Mango stem borer, Sugarcane leafhopper- <i>Pyrilla</i>	4
11.	Preparation of different types of poison baits for the control of rat.	4
12.	Collection, preservation and submission of any five pests	4
13.	Compulsory field visit to observe different pest in their natural habitat.	4
14.	Study of modern pesticide appliances-sprayers and dusters.	4
15.	Study of Pheromonal trap	4
Study Resources	- Avasthi V. B. Introduction to General and Applied Entomology - Koul O. Dhaliwal G.S. Biopesticides and Pest Management - Larry P. Pdigo, Entomology and Pest management - Atwal. A.S.Agricultural pests of India and South East Asia - Vasant Raju David, B. 2001.Elements of economic entomology., Popular Book Depot, Chennai	

***Mandatory to perform any 12 practical from above.**

T.Y. B.Sc. Zoology (On Job Training)
Semester-V
ZOO-OJT-351: On Job Training/Internship

Total Hours: 120

Credits:4

Course objectives	- To provide the students with actual work experience - To make aware prescribe standards and guidelines at work - To develop the employability of participating student - To avail an opportunities to eventually acquire job experiences
Course outcomes	After successful completion of this course, students are expected to: - Get actual work experience with office and virtual exposure to various management styles, technical, industrial, and procedural systems - Acquaint the knowledge related to working hours, work protocols and guidelines - Understand the roles and responsibilities of employee as well as team work - Justify job experiences that match their potentials, skills, and competencies

Internship

An internship is a professional learning experience that offers meaningful, practical work related to a student's field of study or career interest. An internship gives a student the opportunity for career exploration and development, and to learn new skills.

On the job training

On the job training is a form of training provided at the workplace. During the training, employees are familiarized with the working environment they will become part of. Employees also get a hands-on experience using machinery, equipment, tools, materials, etc.

Internship / OJT Process:

- Pre-Approval:** Students should seek approval from the college before starting the Internship / OJT. This ensures that the Internship / OJT aligns with the curriculum and meets the necessary criteria.
- Mentor and Supervisor:** Each student should have an assigned mentor at the organization/industry where they are interning. Additionally, an Internship / OJT supervisor from the college will be appointed to guide and monitor the progress.
- Regular Reporting:** Students should maintain regular communication with their supervisor and mentor, providing progress reports and seeking feedback.
- Professional Conduct:** Students must adhere to professional conduct throughout the Internship / OJT, including punctuality, respect for colleagues, and adherence to the organization's/industry's policies and guidelines.
- Student Diary:** Students should maintain a diary to document their experiences, challenges faced, and lessons learned during the Internship / OJT.
- Final Report:** At the end of the Internship / OJT, students should submit a comprehensive final report, summarizing their accomplishments, contributions, and key takeaways.
- Evaluation:** The Internship / OJT is worth 4 credits (equivalent to 100 marks), and the evaluation will be divided into two categories: one by the mentor and the other by the Internship / OJT supervisor. The mentor's evaluation (internal examination) will carry 40 marks, and it will be based on the student's performance during the Internship / OJT. External examination will be conducted by mentor and supervisor which will be based on the student's diary, the final report prepared by the student, and their performance in the final viva voce, and will carry 60 marks. The total marks obtained by the students in both evaluations will be added together for the purpose of final evaluation. The evaluation of the students will be conducted by the mentor using the evaluation sheet provided by the college.

Internal Evaluation Criteria for Students by the Mentor:

1. **Quality of Work** (10 marks): How well did the student perform their assigned tasks during the Internship / OJT? Evaluate the accuracy, thoroughness, and attention to detail in their work.
2. **Initiative and Proactiveness**(10 marks): Did the student show initiative in taking on additional responsibilities or tasks beyond their assigned role? Did they demonstrate a proactive attitude towards problem-solving?
3. **Communication Skills** (10 marks): Assess the student's ability to communicate effectively with colleagues, superiors, and clients (if applicable). Consider both written and verbal communication.
4. **Problem-Solving Skills and Time Management** (10 marks): Evaluate the student's ability to analyze problems, propose solutions, and implement effective strategies to overcome challenges. How well did the student manage their time during the Internship / OJT? Were they able to meet project deadlines and handle multiple tasks efficiently?

External Evaluation Criteria for Students by the Supervisor and Mentor:

1. **Student Diary** (15 marks): Review the student's diary to understand their reflections, insights gained, and self-assessment of their performance during the Internship / OJT.
2. **Final Report** (15 marks): Evaluate the quality and comprehensiveness of the student's final report, including the clarity of their achievements and contributions.
3. **Presentation of Student in Viva Voce** (30 marks): Evaluate the responses given by the student to the questions asked by the faculty in the Viva Voce.

Evaluation Criteria for Final Viva Voce:

1. Presentation Skills
2. Knowledge of the Internship / OJT Project
3. Practical Application and Work Experience
4. Problem-Solving and Critical Thinking
5. Communication and Professionalism

SEMESTER-VI

T.Y. B.Sc. Zoology (Major)
Semester-VI
ZOO-DSC-361: Structural and functional anatomy of Chordates

Total Hours: 30

Credits: 2

Course objectives	- Explain the systematic position, external features, and adaptations of Scoliodon to its habitat. - Describe the structure and functioning of the digestive, respiratory, circulatory systems, nervous systems urinogenital systems and the reproductive processes of Scoliodon. - Analyze the sensory adaptations of Scoliodon, including olfactory, photoreceptive, and mechanoreceptive organs. - Explain the role of accessory respiratory organs and the air bladder in fishes, emphasizing their evolutionary significance.	
Course outcome	After successful completion of this course, students are expected to: - Build foundational knowledge of taxonomy and functional morphology in vertebrates. - Analyze the internal organ systems of vertebrates and their physiological processes. - Develop insights into the evolution and specialization of sensory organs in fishes. - Evaluate the respiratory adaptations in aquatic environments and their physiological implications.	
Unit	Topic	Hours
Unit I	Study of Scoliodon w.r.t. following - Systematic position, Habits and Habitat. - External Characters - - Shape, Size and Colour. - Division of the body - Head, Trunk and Tail. - Skin and its derivatives. - Locomotion. - Coelom.	8
Unit II	Study of Internal anatomy - Digestive system - Alimentary canal, digestive glands, food, feeding and physiology of digestion. - Respiratory system-Respiratory organs, Mechanism and physiology of respiration. - Circulatory system - Blood, structure and working of heart. - Arterial system: Ventral aorta and afferent branchial arteries, Efferent branchial and Epibranchial arteries, Hypobranchial blood plexus, Arteries of head, Dorsal aorta and its branches. - Venous System : Anterior cardinal system, posterior cardinal or renal portal system, sub intestinal or hepatic portal system, lateral abdominal system, cutaneous system	7
Unit III	Nervous System - Central nervous system - Brain and Spinal cord. - Peripheral nervous system - Cranial and spinal nerves. - Autonomic nervous system. Study of Urinogenital System - Male urinogenital system. - Female urinogenital system. - Reproduction : Copulation, Fertilization and Development	7

Unit IV	Study of Sense organs ▪ Olfactory organs. ▪ Photoreceptors. ▪ Statoacoustic organs. ▪ Lateral line receptors, Neuromast organs, Pit organs. ▪ Ampullae of Lorenzini.	8
Study Resources	▪ Kotpal, R. L. (2012). Modern textbook of Zoology: Vertebrates (10thed.). Rastogi Publications. ▪ Jordan, E. L., &Verma, P. S. (2013). Chordate Zoology (14th ed.). S. Chand Publishing. ▪ Prasad, S. N. (2009). Textbook of Vertebrate Zoology. KitabMahal. ▪ Romer, A. S., & Parsons, T. S. (1985). The vertebrate body (6th ed.). Saunders College Publishing. ▪ Kent, G. C., & Carr, R. K. (2001). Comparative anatomy of the vertebrates (9th ed.). McGraw-Hill. ▪ Harder, W. (1975). Anatomy of fishes (Vol. 1). E. Schweizerbart'scheVerlagsbuchhandlung. ▪ Moyle, P. B., &Cech, J. J. (2004). Fishes: An introduction to ichthyology (5th ed.). Pearson Prentice Hall. ▪ Bone, Q., & Moore, R. H. (2008). Biology of fishes (3rd ed.). Taylor & Francis. ▪ Parker, T. J., &Haswell, W. A. (1974). A textbook of Zoology: Volume II. Macmillan. ▪ Lagler, K. F., Bardach, J. E., Miller, R. R., &Passino, D. R. M. (1977). Ichthyology (2nd ed.). John Wiley & Sons. ▪ Nelson, J. S. (2006). Fishes of the world (4th ed.). Wiley.	

T.Y. B.Sc. Zoology (Major)
Semester-VI
ZOO-DSC-362: Animal biotechnology

Total Hours: 30

Credits: 2

Course objectives	- To impart knowledge about stem cell biotechnology. - To study animal tissue culture techniques - To understand genetically engineered products for human and animal welfare - To learn about transgenic animals, hybridoma technique and production of antibodies	
Course outcome	After successful completion of this course, students are expected to: - Acquire knowledge about stem cell research and its ethical issues - Acquire knowledge about media culture media and their role in growth and tissue culture techniques. - Come to know genetically engineered products for human and animal welfare. - Understand Developing embryo-transfer technology, cloning, and transgenic animals. Understand applications of hybridoma technique and functions of antibodies.	
Unit	Topic	Hours
Unit I	Introduction of Animal biotechnology - Introduction, scope and significance of Animal Biotechnology. - Stem Cell Biotechnology: Types of Stem Cell- embryonic stem cells and adult stem cells, and their uses. - Current scenario and future prospects of Stem cell in Biotechnology - Ethical issues in stem cell Biotechnology.	7
Unit II	Animal tissue culture and its applications - Laboratory facility for animal tissue culture - Tissue culture technique: Definition and Types of culture media– Natural and Artificial media, sterilization techniques, incubation. - Primary culture, Examples of Cell lines. - Advantages and disadvantages of animal tissue culture. - Applications of animal tissue culture.	8
Unit III	Molecular Techniques in Gene manipulation - Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage - Restriction enzymes: Nomenclature with example - Transformation techniques: Calcium chloride method and electroporation. - Application of genetic engineering: production of human Insulin and vaccines.	7
Unit IV	Genetically Modified Organisms and Hybridoma technology - Transgenic animals: Nuclear Transplantation, DNA micro injection techniques. - Applications of transgenic animals in: pharmaceuticals, donor organs, knockout mice. - Methods for production of monoclonal antibodies - Significance of Monoclonal antibodies	8
Study resources	- Dubey, R. C. (1993). A textbook of Biotechnology. S. Chand Publishing. - Satyanarayana, U. (2013). Biochemistry. Elsevier Health Sciences.	

	▪ Brooks, G. (2002). Gene therapy. The use of DNA as a drug. The Pharmaceutical Press. ▪ Karp, G., Iwasa, J., & Marshall, W. (2020). Karp's Cell and Molecular Biology. John Wiley & Sons. ▪ Lewin, B. (2004), Genes VIII, Oxford University Press, New York ▪ Lohar Prakash S. (2012), Textbook of Biotechnology ISBN: 9788180941047 MJP Publishers, Chennai	
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T.Y. B.Sc. Zoology (Major)
Semester-VI
ZOO-DSC-363: Endocrinology

Total Hours: 30

Credits: 2

Course Objectives	▪ To understand the Fundamental Concepts of Endocrinology ▪ To study classification of Hormones ▪ To examine the Mechanisms of Hormone Action ▪ To explore Endocrine Glands and Associated Disorders	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Able to describe Fundamental Concepts of Endocrinology. ▪ Familiar with different types of hormones. ▪ Gain the knowledge about Mechanisms of Hormone Action. ▪ Interpret and summarize endocrine disorders.	
Unit	Topic	Hours
Unit I	Introduction to Endocrinology ▪ Concept and Scope of endocrinology. ▪ Classification of hormones (Peptides, Steroids and amino acid derived). ▪ Hormone receptors. ▪ Hormones as chemical messengers. ▪ The hypothalamus and anterior pituitary. ▪ Mechanism of action of peptide hormones and steroid hormones. ▪ Feedback Mechanism of Hormones -Positive feedback and Negative feedback.	8
Unit II	Histology of vertebrate endocrine glands ▪ Pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland, Pineal, Thymus gland, Ovary and Testis	7
Unit III	Hormones and disorders of endocrine glands. ▪ Pituitary hormones and major Disorders- Gigantism and Dwarfism ▪ Thyroid hormones and disorders- Cretinism, myxoedema, Grave's disease and Goiter. ▪ Parathyroid hormones and disorders- Hyperparathyroidism and Hypoparathyroidism ▪ Adrenal Gland hormones and Disorders- Addison's disease and Cushing's syndrome.	8
Unit IV	Endocrine Glands in Invertebrates ▪ Neurosecretory cells and Neurosecretion ▪ Hormones of insects: Neurohormones, Molting hormones, Pheromones ▪ Hormones of crustaceans and crustacean metamorphosis	7
Study Resources	▪ Turner and Bungera (1971). General Endocrinology. W.B. Saunders Company. 5th edition . ▪ Stephen Nussey and Saffron Whitehead (2001). Endocrinology: An Integrated Approach; Oxford: BIOS Scientific Publishers. ▪ Hadley, M.E. and Levine J.E. (2007), Endocrinology, 6th Edition. ▪ David O. Norris, Vertebrate Endocrinology, Pearson Prentice-Hall, Pearson Education Inc., New Jersey. ▪ Robert H. Williams, (1981) Text book of Endocrinology, W. B. Saunders Company	

T.Y. B.Sc. Zoology (Major)
Semester-VI
ZOO-DSC-364: Public health and hygiene

Total Hours: 30

Credits: 2

Course objectives	- Explain the roles of personal, community health, and global health programs by WHO and NGOs. Identify and promote personal, oral, mental, and social hygiene practices for better health - Understand the significance of balanced diets, food sanitation, and the prevention of food adulteration. - Analyze the relationship between environmental factors like water, air, and radiation, and their effects on health. - Recognize the causes, prevention, and control measures of communicable and non-communicable diseases.	
Course outcome	After successful completion of this course, students are expected to: - Develop foundational knowledge of public health systems and their impact on community well-being. Apply knowledge of hygiene to improve health practices and reduce risks in daily life. - Enhance public awareness of nutrition and food safety to promote healthier lifestyles. - Develop sustainable practices to mitigate environmental health risks and improve living conditions. - Contribute to community health initiatives by implementing disease prevention and management strategies.	
Unit	Topic	Hours
Unit I	Introduction to Public Health and Hygiene: - Scope and Importance of Public Health and Hygiene - Definition of Health, Personal and community health, Health education-WHO Program, and NGO (Non-Governmental voluntary health organization). - Hygiene - Hygiene and health factors at home, Personal hygiene, Oral Hygiene, Mental Hygiene, and Social Hygiene-Accidents.	8
Unit II	Food - Introduction and classification of food - Balanced diets - Vitamins as accessory food - Food adulterations - Food Sanitation	7
Unit III	Environment and health - Water supply-Sources - Impurities and pollution of water. - Purification and water quality standard. - Air-pollution, Ventilation system-Natural and official - Radiation effects. Sanitation - Disposal of Human and animal Excreta. - Solid waste, sewage and their management	7

Unit IV	Communicable and Non Communicable Diseases Communicable Diseases: Introduction, transmission and control Measles, Poliomyelitis, Tuberculosis, STD, and Encephalitis Non Communicable Diseases: Cancer, Coronary Heart diseases, Diabetes mellitus, Mental illness, Alcoholism and drug dependence.	8
Study Resources	▪ American Public Health Association. (n.d.). Control of communicable diseases manual. APHA Press. Retrieved from https://www.apha.org/publications/published-books/ccdm ▪ Banatvala, N., & Bovet, P. (Eds.). (2023). Noncommunicable diseases: A compendium. Taylor & Francis. Retrieved from https://www.taylorfrancis.com/books/oa-edit/10.4324/9781003306689 ▪ Hurster, M. (1995). Communicable and non-communicable disease basics: A primer. ABC-CLIO. ▪ Newsholme, A. (2020). Hygiene: A manual of personal and public health (New edition). Nova Science Publishers. ▪ Open Book Publishers. (2020). Non-communicable disease prevention. Retrieved from https://www.openbookpublishers.com/books/10.11647/obp.0195 ▪ Porter, C. (1912). Elements of hygiene and public health. London: Macmillan. ▪ Tuttle, T. D. (1921). Principles of public health. The Macmillan Company. Retrieved from https://www.gutenberg.org/ebooks/53974 ▪ Various Authors. (2021). Textbook of public health and hygiene. Google Books. Retrieved from https://books.google.com/books/about/Textbook_of_PUBLIC_HEALTH_AND_HYGIENE.html	

T.Y. B.Sc. Zoology (Major with IKS)
Semester-VI
ZOO-DSC-365: EthnoZoology

Total Hours: 30

Credits: 2

Course objectives	- Understand the origins, historical context, and importance of ethnoZoology in human communities. - Explain the significance of animals in Indian customs, encompassing myths, symbols, and cherished convictions. - Analyse the therapeutic use of items derived from animals in both conventional and contemporary medicine. - Evaluate how ethnozoological methods affect the preservation of biodiversity and the wise use of resources.	
Course outcome	After successful completion of this course, students are expected to: - Acquire knowledge to classify and identify different zoo-therapeutic techniques and how they are used in conventional medicine. - Analyse the role of animals in historical and contemporary contexts, including their depictions on flags, pillars, and religious texts. - Evaluate the ethical, environmental, and conservation issues surrounding ethnozoological methods.	
Unit	Topic	Hours
Unit I	Basics of EthnoZoology - Definition and scope of EthnoZoology - Historical background and development of the discipline - Importance in understanding human-animal relationships - Methods of study in EthnoZoology (ethnographic fieldwork, interviews)	8
Unit II	Traditional Animal Knowledge and Practices - Indigenous knowledge of animals and their uses - Domestication and management of animals in traditional societies - Medicinal and ritualistic uses of animals - Folklore, myths, and legends related to animals - Ethnozoological practices in hunting and fishing	7
Unit III	Human-Animal Relationships and Conservation - The role of animals in cultural identity and symbolism - Impact of human activities on animal populations (hunting, habitat destruction) - Conservation ethics and sustainable practices in ethnoZoology - Role in animal studies and biodiversity conservation - Indigenous knowledge in wildlife conservation.	7
Unit IV	Applied EthnoZoology and Future Directions - Modern applications in agriculture, medicine, food, Decoration, Traction and Transport - Animals as indicator of Weather and Climate - Contemporary issues and challenges in EthnoZoology - Future trends and interdisciplinary approaches - Role of EthnoZoology in global conservation and policy-making.	8
Study Resources	- Goswamy, B. N. (2017). Indian Art: Animals in Indian Art. Roli Books. - Gandhi, M. (2015). Animals in Indian Mythology. HarperCollins India. - Pattanaik, D. (2006). Myth = Mithya: Decoding Hindu Mythology. Penguin India. - Cort, J. E. (2000). Animals in Indian Literature and Tradition. Oxford University Press.	

	▪ Harle, J. (1990). The Art and Architecture of Indian Temples. Cambridge University Press. ▪ Joy, K. P. (2005). Sacred Invertebrates: A Cultural Perspective. Sarup& Sons. ▪ Reade, E. G. (2011). Mythical Creatures and Real-Life Invertebrates in Indian Lore. Routledge India. ▪ Doniger, W. (2009). The Hindus: An Alternative History. Penguin Books. ▪ Shastri, A. M. (1996). The Ocean in Indian Mythology: Fish and Amphibians. MotilalBanarsidass. ▪ Rosen, S. J. (2004). Holy Cow: The Hare Krishna Contribution to Vegetarianism and Animal Rights. Lantern Books. ▪ Krishna, N. (2010). Sacred Animals of India. Penguin Books. ▪ Kramrisch, S. (1981). The Presence of Shiva. Princeton University Press. ▪ SainudeenPattazhy, An Introduction to EthnoZoology, Lambert Academic Publishing ▪ Romulo RomeuNobrega Alves, Ulysses Paulino Albuquerque, EthnoZoology: Animals in Our Lives, Academic Press, 2017, ISBN0128099143, 9780128099148	
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T.Y. B.Sc. Zoology (Major)
Semester-VI
ZOO-DSC-366: Practical on ZOO-DSC-361 and 362

Total Hours: 60

Credits: 2

Course objectives	- Explain the systematic position, external morphology, and sexual dimorphism in <i>Scoliodon</i>. - Analyze the anatomical structures of <i>Scoliodon</i>, including its digestive, bronchial, urinogenital, and nervous systems using models and simulations. - To study animal cell and tissue culture techniques	
Course outcome	Students will be able to: - Develop a comprehensive understanding of vertebrate anatomy and physiology through comparative analysis using <i>Scoliodon</i> as a model organism. - Apply practical skills in microscopy and specimen preparation, including temporary mounting of placoid scales and studying anatomical models. - Utilize observational and analytical skills to study the functional aspects of various organ systems in <i>Scoliodon</i> using digital and physical resources. - Foster environmental awareness and conservation strategies by studying marine vertebrate biodiversity through field visits and research activities.	
Sr.No.	Practical	Hours
1.	Study of systemic position and External characters in <i>Scoliodon</i> .	4
2.	Study of the Digestive system of <i>Scoliodon</i> (with the help of models / chars / pictures / simulation) (D)	4
3.	Study of the Bronchial system of <i>Scoliodon</i> (with the help of models / chars / pictures / simulation) (D)	4
4.	Study of the Brain and Cranial nerves (Dorsal and ventral view) of <i>Scoliodon</i> (with the help of models / chars / pictures / simulation) (D)	4
5.	Study of the Urinogenital systems of <i>Scoliodon</i> (with the help of models / chars / pictures / simulation) (D)	4
6.	Study of the Placoid scales of <i>Scoliodon</i> (with the help of models / chars / pictures / simulation) (D)	4
7.	Temporary mounting of Placoid scales of <i>Scoliodon</i>	4
8.	Visit to a sanctuary, seashore for the study of vertebrate animals.	4
9.	Preparation of primary culture media for cell culture (D)	4
10.	Estimation of DNA in a given sample by Diphenylamine Method €.	4
11.	Estimation of RNA in a given sample by Orcinol method €	4
12.	Isolation of genomic DNA. €	4
13.	Isolation of plasmid DNA. €	4
14.	Detection of DNA by using Agarose gel electrophoresis €	4
15.	To study of cell viability by trypan blue	4
Study Resources	- Kotpal, R. L. (2012). Modern textbook of zoology: Vertebrates (10thed.). Rastogi Publications. - Jordan, E. L., &Verma, P. S. (2013). Chordate Zoology (14th ed.). S. Chand Publishing. - Prasad, S. N. (2009). Textbook of Vertebrate Zoology.	

	KitabMahal. • Romer, A. S., & Parsons, T. S. (1985). The vertebrate body (6th ed.). Saunders College Publishing. • Kent, G. C., & Carr, R. K. (2001). Comparative anatomy of the vertebrates (9th ed.). McGraw-Hill. • Brown, T.A. (2010) Gene Cloning and DNA Analysis. VI Edition, Wiley-Blackwell publishing (Oxford, UK), ISBN: 978-1-4051-8173-0. • Glick, B.R., Pasternak, J.J. and Patten, C.L. (2010). Molecular Biotechnology Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA. • Primrose, S.B., and Twyman, R. M. (2006). Principles of Gene Manipulation and Genomics. VII Edition, Blackwell publishing (Oxford, UK) • Wilson K. and Walker J. Principles and techniques of Biochemistry and Molecular biology • Jogdand S. N. 2007. Advances in Biotechnology, 6th Edn, Himalaya Publishing House. Cambridge University Press. • Kalaichelvan P.T., I Arul Pandi (2007), Bioprocess Technology, MJP Publishers, Chennai. • Ankan De, Jagan Mohanrao Gali, Parthsarathi Behera and Sani Nandi (2023). Practical handbook on veterinary biochemistry and Biotechnology, ISBN-9789394023215	
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***Mandatory to perform any 12 practical from above.**

T.Y. B.Sc. Zoology (Major)
Semester-VI
ZOO-DSC-367: Practical on ZOO-DSC-363, 364 and 365

Total Hours: 60

Credits: 2

Course Objectives	▪ To comprehend the basic ideas of endocrinology ▪ To research hormone categorisation ▪ Examine the connection between environmental elements such as radiation, air, and water and how they affect health. ▪ Examine how products made from animals are used therapeutically in both traditional and modern medicine.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Compile and explain endocrine diseases. ▪ Increase public knowledge about food safety and nutrition to encourage better living. ▪ Learn to categorise and recognise various zoo-therapeutic methods and their applications in traditional medicine.	
Sr. No.	Contents	Hours
1	Study of Endocrine glands with the help of Slides/Photographs.	4
2	Qualitative estimation of hCG in Human urine samples.	4
3	Study of Histology of Endocrine glands, Pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland, Pineal, Thymus gland, Ovary and Testis.	4
4	Study of Hormones and disorders of Endocrine glands, Pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland.	4
5	Study of molting hormones of insects.	4
6	To detect adulterants in the food samples by appropriate tests. (E)	4
7	Prepare a health plan for Adult and pregnant women's	4
8	Epidemiological study of measles, tuberculosis and poliomyelitis. (D)	4
9	Study of life cycle of mosquito	4
10	Biological control of mosquito larvae	4
11	Documentation of any 5 animal uses in Indian tradition and their uses in folklore	4
12	Study of any 5 animals in cultural identity, symbolism, agriculture, food, decoration and Transport	4
13	Study of any 5 Animals/their products as medicine /research	4
14	Case study: Biodiversity and ethnozoological knowledge in local communities	4
15	Study of Methodology for Ethnozoological Survey and Fieldwork	4
Study Resources	▪ Goswamy, B. N. (2017). <i>Indian Art: Animals in Indian Art</i>. Roli Books. ▪ Gandhi, M. (2015). <i>Animals in Indian Mythology</i>. HarperCollins India. ▪ Pattanaik, D. (2006). <i>Myth = Mithya: Decoding Hindu Mythology</i>. Penguin India. ▪ Cort, J. E. (2000). <i>Animals in Indian Literature and Tradition</i>. Oxford University Press. ▪ Harle, J. (1990). <i>The Art and Architecture of Indian Temples</i>. Cambridge University Press. ▪ Joy, K. P. (2005). <i>Sacred Invertebrates: A Cultural Perspective</i>. Sarup & Sons. ▪ Reade, E. G. (2011). <i>Mythical Creatures and Real-Life Invertebrates in</i>	

	<i>Indian Lore</i>. Routledge India. ▪ Doniger, W. (2009). <i>The Hindus: An Alternative History</i>. Penguin Books. ▪ Shastri, A. M. (1996). <i>The Ocean in Indian Mythology: Fish and Amphibians</i>. Motilal Banarsidass. ▪ Rosen, S. J. (2004). <i>Holy Cow: The Hare Krishna Contribution to Vegetarianism and Animal Rights</i>. Lantern Books. ▪ Krishna, N. (2010). <i>Sacred Animals of India</i>. Penguin Books. ▪ Kramrisch, S. (1981). <i>The Presence of Shiva</i>. Princeton University Press.	
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***Mandatory to perform any 12 practical from above.**

T.Y. B.Sc. Zoology (Elective)
Semester-VI
ZOO-DSE-361A: Animal behaviour

Total Hours: 30

Credits: 2

Course objective	▪ Student will learn the behavioral pattern of animal. ▪ Student will learn the homing behavior, Neural behavior and parental care in Animal ▪ Students learn the pattern of Food selection, optimal forage theory, Anti predation defenses, Aggression. ▪ Students learn the biological rhythm pattern of animals.	
Course outcome	After successful completion of this course, students are expected to: ▪ Student understand the general concepts of different behavioral pattern ▪ Students acquire the knowledge about homing behavior, neural behavior and parental care. ▪ Student understands pattern of behavior belongs to Food selection, optimal forage theory, Anti predation defenses, Aggression actions. ▪ Student understands the importance of biological rhythm and learning in their life.	
Unit	Topic	Hours
Unit I	Introduction ▪ Ethology as a branch of biology, Animal psychology, Classification of behavioral patterns, Analysis of behavior (Ethogram), Innate Behavior. ▪ Control of behavior- Introduction, Neural behavior, Hormonal behavior	8
Unit II	Communication- Introduction, Chemical, Visual, Light, Audio, Specific specificity of Songs, Evolution of Language (primates) Ecological aspects of behavior- Introduction, Habitat selection, Food selection, Optimal forage theory, Anti predation defenses, Aggression, Homing, Territoriality, Dispersal, Host parasite relations	7
Unit III	Social behavior- Introduction, Aggression, Schooling in fishes, Flocking in birds, Herding in mammals, Group selection, Kin selection, Social organization in Insects and Primates Reproductive behavior- Introduction, Evolution of Sex and Reproductive strategies, Mating systems, Courtship, Sperm competition, Sexual selection	8
Unit IV	Biological rhythms- Introduction, Circadian and Circa-annual rhythms, Orientations and navigation, Migration of fishes, turtles and birds Learning and Memory- Introduction, Conditioning, Habituation, Insight learning, Association learning, Reasoning, Cognitive skills	7
Study Resources	▪ Agarwal, V.K., 2010, Animal Behavior (Ethology), S. Chand and Company, New Delhi, India. ▪ Natarajan, P. and Arumugum N., 2019., Ethology Animal Behavior, Saras Publication, India ▪ Mathur, R., 2018, Animal Behaviour, Rastogi Publication, Meerut, India. ▪ Alcock, J. 2010. Animal behavior, an evolutionary approach. 9 th Edition. Sinauer Publishers. ▪ Bradury, J.W., and S.L Vehrencamp- Principle of animal communication	

T.Y. B.Sc. Zoology (Elective)
Semester-VI
ZOO-DSE-361B: Anthropology- Human genetics
(Swayam Online Course)

Total Hours: 30

Credits: 2

Course Objectives	- Understanding the principles of human evolution, genetic diversity, and adaptation, emphasizing mutation, gene flow, and genetic drift in shaping human populations. - Acquire knowledge about the heredity, Mendelian and non-Mendelian inheritance, chromosomal aberrations, and genetic disorders. - Analyze the molecular and biochemical mechanisms underlying genetic traits, disorders, and syndromes. - Understand the significance of DNA fingerprinting, genetic screening and their applications in anthropological studies, medical research, and biotechnology.	
Course Outcomes	After successful completion of this course, students are expected to: - Understand the Human Evolution and Genetic Variation - Analyze the Genetic Basis of Human Traits and Disorders - Evaluate the Role of Genetics in Health and Disease - Develop Practical Skills in Genetic Analysis	
Unit	Contents	Hours
Unit I	Introduction Anthropology-Human Genetics - Main branches of Anthropology, their scope and relevance - History of Human Genetics - Introduction to Hereditary and Inheritance - Concept of non-mendelian inheritance and complex diseases - Genetic Counselling	8
Unit II	Introduction to Genomic Variation - Human Genome - Origins of Genetic Diversity - Genomic Polymorphisms - Introduction to Genomic Diversity & Human Evolution - Human Evolution: An Overview	7
Unit III	Genotype-phenotype correlations - Introduction to Epigenetics - Common mechanisms of Epigenetics - Epigenetics and diseases	7
Unit IV	Pedigree Analysis and Expressivity - Chromosomal Basis of Genetic Disorders - Karyotypes and identification of chromosome variation - Cytogenetic mapping - Genetic mapping (Microsatellite and other DNA polymorphisms) - Evidences from Y-chromosome	8
Study Resources	- Human Molecular Genetics by Tom Strachan, Andrew P. Read Garland Science/Taylor & Francis Group, 2011 - Essentials Of Human Genetics Fifth Edition (University Press) By Manu L. Kothari, Lopa A. Mehta · 2009 - Human Genetics: Concepts and Applications by Ricki LewisMcGraw Hill Publishers 2020. - Human Genetics, 6th Edition, SD Gangane, Elsevier Publishers 2021 - Principles of Genetics by EJ Gardner, MA, Simmons and DP Snustad, 8th Edition, Willey Press 2006.	

T.Y. B.Sc. Zoology (Elective)
Semester-VI
ZOO-DSE-362A: Practical on ZOO-DSE-361A

Total Hours: 60

Credits: 2

Course objective	▪ Students learn the different behavioral mechanisms. ▪ Students learn communication patterns and ecological aspect of behavior. ▪ Students learn the biological rhythm, migration patterns of animals. ▪ To impart knowledge about animal responses to external stimuli.	
Course outcome	After successful completion of this course, students are expected to: ▪ To develop a critical scientific understanding on animal behavior. ▪ Student can acquire the knowledge of animal behavior to handle fear and aggression to safely and humanely work with domestic animals in research. ▪ Student understands daily behavioral rhythms in diurnal and nocturnal periodicities. ▪ To Predict and anticipate variety of animal actions as assessed by innate and learned behavior.	
Sr. no.	Practicals	Hours
1.	Study of honey bee dance with reference to food location	4
2.	Study of individual behaviors 1. Preening in Birds 2. Dusting in birds and mammals 3. Cleaning of eyes and antetulli in insects	4
3.	Study of following comfort movements. 1. Stretching in body in mammals. 2. Yawning in mammals 3. Feather setting in birds. 4. Pecking actions in young birds	4
4.	Study of ways of ultrasonic communications among animals-In bats.	4
5.	Study of territorial marking in animals-Dogs.	4
6.	Socials organization in honeybees.	4
7.	Calling behavior of Cricket for courtship.	4
8.	Study of migratory routes in birds using maps.	4
9.	Photo tactic response in Earthworm or any suitable organism.	4
10.	Communication in Earthworm by Pheromones.	4
11.	Effect of toxicants on Opercular movement in fishes.	4
12.	Food preference in stored grain insect pest.	4
13.	Maternal behavior and pup retrieval in any suitable animal.	4
14.	Parental care in animal- Pipa, Sea horse.	4
15.	Visit to the sanctuary	4

Study Resources	▪ Mathur, R., 2018, Animal Behaviour, Rastogi Publication, Meerut, India. ▪ Agarwal, V.K., 2010, Animal Behavior (Ethology), S. Chand and Company, New Delhi, India.	
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***Mandatory to perform any 12 practical from above.**

T.Y. B.Sc. Zoology (Elective)
Semester-VI
ZOO-DSE-362B:Practical on ZOO-DSE-361B

Total Hours: 60

Credits: 2

Course Objectives	▪ Understanding Basic Genetic Principles Through Practical Applications ▪ Developing Skills in Karyotyping and Chromosomal Analysis ▪ Pedigree Analysis and Genetic Counseling ▪ Hands-on Experience in DNA Extraction and Molecular Techniques	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Demonstrate Proficiency in Mendelian and Non-Mendelian Genetics ▪ Perform Karyotyping and Identify Chromosomal Aberrations ▪ Construct and Interpret Pedigree Charts ▪ Execute DNA Extraction and Molecular Genetics Techniques	
Sr. No.	Contents	Hours
1	Isolation of DNA from any suitable sample of Human	4
2	Detection of ABO blood group	4
3	Study of Human evolution timeline	4
4	To study following techniques through photographs (DNA Sequencing (Sanger's Method), PCR and DNA fingerprinting)	4
5	PTC testing in a population and calculation of allele and genotype frequencies.	4
6	To test / survey for colour blindness using Ishihara charts	4
7	Haemoglobin typing by agarose gel electrophoresis.	4
8	Demonstration of sickle cell haemoglobin from human blood.	4
9	Qualitative and quantitative analysis of DNA using spectrophotometer	4
10	Preparation and analysis of Pedigree Charts	4
11	Study and verification of Hardy-Weinberg Law by chi square analysis	4
12	Study of Karyotypes I: Normal Karyotypes in Human	4
13	Study of Karyotypes II: Abnormal Karyotypes (Down's syndrome (autosomal), Turner's syndrome (sex chromosomal), Klinefelter's syndrome (sex chromosomal))	4
14	Students make a model of chromatin and use it to show how chemical tags that bond to the chromatin can influence its uncoiling.	4
15	Visit to Natural History Museum and submission of report	4
Study Resources	▪ Human Molecular Genetics by Tom Strachan, Andrew P. Read Garland Science/Taylor & Francis Group, 2011 ▪ Essentials Of Human Genetics Fifth Edition (University Press) ▪ By Manu L. Kothari, Lopa A. Mehta · 2009 ▪ Human Genetics: Concepts and Applications by Ricki Lewis	

	▪ McGraw Hill Publishers 2020. ▪ Human Genetics, 6th Edition, SD Gangane, Elsevier Publishers 2021 ▪ Principles of Genetics by EJ Gardner, MA, Simmons and DP Snustad, 8th Edition, Willey Press 2006.	
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***Mandatory to perform any 12 practical from above.**

T.Y. B.Sc. Zoology (Vocational)
Semester-VI
ZOO-VSC-361: General embryology

Total Hours: 30

Credits: 2

Course Objectives	▪ To understand the Fundamental Concepts of Embryology ▪ To know the Process of Gametogenesis ▪ To learn the Mechanisms of Fertilization ▪ To study the Cleavage, Blastulation and Gastrulation	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Able to describe the Fundamental Concepts of Embryology. ▪ Able to Compare Spermatogenesis and Oogenesis ▪ Familiar with Fertilization Mechanisms ▪ Gain the knowledge about Cleavage, Blastulation and Gastrulation.	
Unit	Topic	Hours
Unit I	Introduction to embryology ▪ Concept and scope of embryology ▪ Growth, Differentiation, De-differentiation, Regeneration, Induction, Organizer, Totipotency, Fate-map. Gametogenesis ▪ Spermatogenesis ▪ Oogenesis ▪ Difference between spermatogenesis and oogenesis ▪ Significance of gametogenesis.	8
Unit II	Structure of Gametes ▪ Sperm-Ultra structure of human- sperms ▪ Ovum-General structure, ▪ Types of eggs-Classification based on the amount of yolk and distribution of yolk. ▪ Egg membranes-primary, secondary, tertiary.	7
Unit III	Fertilization ▪ Definition and types [external and internal]. ▪ Monospermy, polyspermy-physiological and pathological ▪ Process of fertilization ▪ Attraction and recognition of sperm and Androgamones, Gynogamones, fertilizin and antifertilizin. ▪ Penetration-Mechanism and activation, Acrosome reaction, Cortical reaction, Fertilization membrane ▪ Amphimixis, Significance of fertilization	8
Unit IV	Cleavage ▪ Definition, Planes of cleavage, ▪ Types-Holoblastic-Equal and unequal. ▪ Meroblastic-Discoidal, Superficial, Determinate and Indeterminate cleavage ▪ Patterns of cleavage with examples-Radial, Spiral, Bilateral and Asymmetrical Blastulation ▪ Definition and types Gastrulation ▪ Definition and concept	7

	▪ Basic cell movement in gastrulation	
Study Resources	▪ Pawar Kishor (2019): GENERAL EMBRYOLOGY, Nirali Prakashan. ▪ Puranik P.G (1986): A Text book of Animal Embryology, S. Chand and co. ▪ Sandhu, Srivastava and Arora : A Text book of Embryology, Anmol Publication Pvt. Ltd. New Delhi. ▪ Berry A. K. : A T. B. of Embryology ▪ Gilbert S.F. : Developmental Biology, 1997, 3rd Edition, Saunder, Associates Inc. U.S.A.	

T.Y. B.Sc. Zoology (Vocational)
Semester-VI
ZOO-VSC-362: Practical on ZOO-VSC-361

Total Hours: 60

Credits: 2

Course Objectives	▪ To examine the External Morphology and Sexual Dimorphism in Grasshoppers. ▪ To analyze the Digestive and Circulatory Systems. ▪ To understand the Nervous and Respiratory Systems. ▪ To explore the Reproductive Systems and Field Observations.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Identification and Description of External Features and Sexual Dimorphism. ▪ Comprehension of Digestive and Circulatory Systems. ▪ Understanding of Nervous and Respiratory Systems. ▪ Knowledge of Reproductive Systems and Field Study Application.	
Sr. No.	Practical	Hours
To Study of following with the help of charts/ models/ simulations etc		
1	Study of Spermatogenesis.	4
2	Study of Oogenesis.	4
3	Study of sperms of human.	4
4	Study of egg structure.	4
5	Study of Egg Membranes: Primary, Secondary, and Tertiary Structures	4
6	Study of types of eggs based on the amount of yolk [D].	4
7	Study of types of eggs based on distribution of yolk.	4
8	Study of types of fertilization.	4
9	Study of types of cleavage.	4
10	Study of Planes of cleavage.	4
11	Study of Patterns of cleavage.	4
12	Study of blastulae of amphioxus, frog, bird and mammals. [D]	4
13	Study of gastrulae of amphioxus, frog, bird and mammals. [D]	4
14	Study of types ofblastula.	4
15	Study of regeneration in planaria (E).	4
Study Resources	▪ Dr. J.P. Shukla, Dr. K. Pandey (2017): Non-Chordate (Invertebrate) Zoology Practical, Himalaya Publishing House Pvt. Ltd. ▪ S. S. Lal (2016): Practical Zoology Invertebrate, Rastogi Publications.	

***Mandatory to perform any 12 practical from above.**