

JSS MAHAVIDYAPEETA



JSS COLLEGE FOR WOMEN (Autonomous)

Saraswathipuram, Mysuru-9

(Autonomous College under University of Mysore: Reaccredited by NAAC with 'A' Grade)

DEPARTMENT OF ZOOLOGY

Proposed Syllabus for Three Years Graduate Programme in

ZOOLOGY

New education policy (NEP)-2020

Preamble

National Education Policy 2020 (NEP 2020) aims at equipping students with knowledge, skills, values, leadership qualities and initiate them for lifelong learning. It is in tune with the global education development agenda reflected in the Goal 4 (SDG4) of the 2030 Agenda for Sustainable Development, adopted by India in 2015, which seeks to –ensure inclusive and equitable quality education and promote lifelong learning opportunities for all by 2030. The stated principle of NEP 2020 is to develop –good human beings capable of rational thought and action, possessing compassion and empathy, courage and resilience, scientific temper and creative imagination, with sound ethical moorings and values. Higher education institutions (HEIs) must empower students in their contexts and at the same time keep them in phase with the pace of technological developments. Their purpose is to enable students to acquire expertise in specialized areas of interest, mould their character by imparting ethical and Constitutional values, kindle their intellectual curiosity and scientific temper, and create imaginative individuals who are service oriented. Students in HEIs should be able to expose themselves to a range of disciplines and obtain practical knowledge in professional, technical, and vocational subjects. Hence,

HEIs must strive to

create a space of multidisciplinary exposure. They must offer exposure to a wide range of subjects and skills and the possibility of obtaining deep knowledge or expertise in any of these subjects or skills. A successful HEI is the one that enables its pupils to combine personal fulfilment with societal concerns: a skilled scholar with a proactive interest in engaging with the society constructively. Their students and in this endeavour; it offers a new vision to all its Under-Graduate courses. Imbibes a Learning Outcome-based Curriculum Framework (LOCF) for all its Under Graduate programs.

The LOCF approach is envisioned to provide a focused, outcome-based syllabus at the undergraduate level with an agenda to structure the teaching-learning experiences in a more student-centric manner. The LOCF approach has been adopted to strengthen students' experiences as they engage themselves in the program of their choice. The Under-Graduate Programs will prepare the students for both, academia and employability. Each program vividly elaborates its nature and promises the outcomes that are to be accomplished by studying the courses. The program also states the attributes that it offers to inculcate at the graduation level. The graduate attributes encompass values related to well-being, emotional stability, critical thinking, social justice and also skills for employability. In short, each program prepares students for sustainability and life-long learning.

The Universities in Karnataka hopes the LOCF approach of the program B.Sc. (Hons.) Zoology will help students in making an informed decision regarding the goals that they wish to pursue in further education and life, at large

B. Sc., Hons in Zoology

Name of the Degree Program: **B. Sc., Hons**

Discipline Core: **Zoology** Total Credits for the Program: **50/100/142/184/268** Starting year of implementation: **2021-22**

PROGRAM OBJECTIVES (POs)

POs1-The Programme offers both classical as well as modern concepts of Zoology in higher education.

POs2-It enables the students to study animal diversity in both local and global environments.

POs3-To make the study of animals more interesting and relevant to human studies more emphasis is given to branches like behavioral biology, evolutionary biology and economic zoology.

POs4-More of upcoming areas in cell biology, genetics, molecular biology, biochemistry, genetic engineering and bioinformatics have been also included.

POs5-Equal importance is given to practical learning and presentation skills of students.

POs6-The lab courses provide the students necessary skills required for their employability.

POs7-Skill enhancement courses in classical and applied branches of Zoology enhance enterprising skills of students.

POs8- The global practices in terms of academic standards and evaluation strategies.

POs9- Provides opportunity for the mobility of the student both within and across the world.

POs 10-The uniform grading system will benefit the students to move across institutions within India to begin with and across countries.

POs11-It will also enable potential employers in assessing the performance of the candidates across the world.

Credit distribution for the course

*In lieu of the research Project, two additional elective papers/ Internship may be offered

Assessment:

Weightage for assessments (in percentage)

Type of Course	Formative Assessment / IAMarks	Summative Assessment Marks
Theory	40	60
Practical	25	25

SEMESTER WISE CURRICULUM STRUCTURE OF COURSES

Semester	Name of the course/credits	What all program outcomes the course addresses (not exceeding three per course)	Pre-requisite course(s)	Concurrent course	Pedagogy	Assessment
1 Semester A1 Major course	Cytology, Genetics and Infectious Diseases (4)	1. The structure and functions of animal cell, cell organelles, cell-cell interactions, process of reproduction leading to new organisms. 2. The principles of inheritance, Mendel's laws and The deviations. 3. Inheritance of chromosomal aberrations in humans by pedigree analysis in families.	Student Must have studied Biology or equivalent subjects in Class 12.	Lab on Cell Biology and Genetics (2)	Lectures/Videos/ Seminars/Case study/Project/ Group discussion/ Problem Solving/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
1 Semester B1 Minor course	Biology of Non-Chordates (4)	1. Learn the systematics and biology of non-chordates through their adaptive features. 2. Study the functional biology of non-chordates through their body organization. 3. Comprehend identification of species and their evolutionary relationships.	Student must have studied Biology or equivalent subjects in Class 12.	Lab on Biology of Non-Chordates (2)	Lectures/Videos/ Seminars/Case study/Project/ Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,

1 Semester OE1 Open Elective course	Economic Zoology (3)	1. Acquaint the knowledge about basic procedure and methodology of integrated animal rearing. 2. Students can start their own business i.e. self employments. 3. Get	Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/ Seminars/Case study/Project/ Group discussion/Problem Solving/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
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		employment in different sectors of Applied Zoology				
SEC 1 Skill Enhancement course	SEC 1 Digital fluency Vermiculture (2)		Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/Seminars/Case study/Project/Group discussion/Problem Solving/Formative Assessment/Summative Assessment	Formative and Summative Assessment/Evaluation/Analysis of result/Application of Heutagogy,
2 Semester A2 Major course	Biochemistry and Physiology (4)	1. In depth understanding of structure of biomolecules like proteins, lipids And carbohydrates. 2. The thermodynamics of enzyme catalyzed reactions. 3. To know various physiological processes of animals.	Student must have studied Biology or equivalent subjects in Class 12.	A2 Lab on Biochemistry, Physiology and Hematology (2)	Lectures/Videos/Seminar/Case study/Project/Formative Assessment/Summative Assessment	Formative and Summative Assessment/Evaluation/Analysis of result/Application of Heutagogy,
2 Semester B2 Minor course	Biology of Chordates (4)	1. Learn the systematics and biology of Chordates through their adaptive features. 2. Study the functional biology of Chordates through their Body organization. 3. Comprehend identification of Chordate species and their evolutionary relationships.	Student must have studied Biology or equivalent subjects in Class 12.	Lab on Biology of Chordates (2)	Lectures/Videos/Seminar/Case study/Project/Formative Assessment/Summative Assessment	Formative and Summative Assessment/Evaluation/Analysis of result/Application of Heutagogy,
2 Semester OE2 Open Elective course	Parasitology (3)		Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/Seminar/Case study/Project/Formative Assessment/Summative Assessment	Formative and Summative Assessment/Evaluation/Analysis of result/Application of Heutagogy,

2 Skill Enhancement course	Environmental Studies Sericulture (2)	1. Sericulture is an agro-based industry which gives economic empowerment to the students. 2. Sericulture may be taken up as a small scale industry by the small farmers and unemployed youth. 3. Get jobs in teaching profession, silk board and other Govt. institutions as technicians.	Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/ Seminar/Case study/Project/ Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
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EXIT OPTION WITH CERTIFICATE (50 CREDITS)

3 A3 Major Core Course	Molecular Biology & Instrumentation & Techniques in Biology (4)		Certificate Course in Zoology	Lab on Molecular Biology, Bioinstrumentation & Techniques in Biology (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
3 B3 Minor Core Course	Comparative Anatomy and Microanatomy (4)		Certificate Course in Zoology	Lab on Comparative Anatomy and Microanatomy (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
3 OE-3 Open Elective course	Endocrinology (3)		Certificate Course in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
3 Semester Skill Enhancement course	SEC 3 Artificial Intelligence Apiculture (2)		Certificate Course in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,

4 A4 Major Core course	GeneTechnology, Immunology and Computational Biology (4)		Certificate Course in Zoology	Lab on Genetic Engineering And Counselling (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
4 B4 Minor Core Course	Cell Biology and Genetics (4)		Certificate Course in Zoology	Lab on Cell Biology and Genetics (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
4 Sem OE 4 Open Elective Course	Animal Behaviour (3)		Certificate Course in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
4 Semester Skill Enhancement course	Constitute of India (2) Poultry		Certificate Course in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
EXIT OPTION WITH DIPLOMA (100 CREDITS)						
5 A5 Major Core Course	Non-Chordates and Economic Zoology (4)		Diploma in Zoology	Lab on Non- Chordates and Economic Zoology (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Zoo/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
5 A6 Major Core Course	Chordates and Comparative Anatomy (3)		Diploma in Zoology	Lab on Chordates (Virtual Dissection) and Comparative Anatomy (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Zoo/Formative	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of

					Assessment/ Summative Assessment	Heutagogy,
5 B5 Minor Core Course	Animal Physiology and Animal Biotechnology (3)		Diploma in Zoology	Lab on Animal Physiology and Animal Biotechnology (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Zoo/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of Heutagogy,
5 DSEC1	Vocational -1 Aquatic Biology (3)		Diploma in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formati ve Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of Heutagogy,
5 SEC 3 Skill Enhanceme nt course	Cyber Security Integrated Animal Rearing (2)		Diploma in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formati ve Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of Heutagogy,
6 A7 Major Core Course	Evolutionary and Developmental Biology (3)		Diploma in Zoology	Lab on Evolutionary and Developmental Biology (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Institute/Formati ve Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of Heutagogy,
6 A8 Major Core Course	Environmental Biology, Wildlife management and Conservation (3)		Diploma in Zoology	Lab on Environmental Biology, Wildlife management and Conservation (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Zoo/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of Heutagogy,
6 B6 Minor Core Course	Animal Behaviour (3)		Diploma in Zoology	Lab on Animal Behaviour (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Zoo/Formative	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of

					Assessment/ Summative Assessment	Heutagogy,
6 DSEC	Vocational-2 Entomology 3 Internship (2)		Diploma in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of Heutagogy,
6 Skill Enhancement Course	SEC 4 Professional Communication Ornamental Fish Culture (2)		Diploma in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of Heutagogy,
EXIT OPTION WITH B. Sc. DEGREE (142 CREDITS)						
7 A9 Major Core Course	Ethology (3)		Degree in Bachelor Of Science in Zoology	Lab on Ethology @2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Zoo/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of Heutagogy,
7 A8 Major Core Course	Evolution and Zoogeography (3)		Degree in Bachelor Of Science in Zoology	Lab on Evolution and Zoogeography (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Zoo/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of Heutagogy,
7 A9 Major Core Course	Genetics and Computational Biology (3)		Degree in Bachelor Of Science in Zoology	Lab on Advanced Genetics and Computational Biology (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of Heutagogy,
7	RESEARCH METHODOLOGY (3)		Degree in Bachelor Of		Lectures/Videos / Seminars/Case study/Project/ Group	Formative and Summative Assessment/Ev aluation/

			Science in Zoology		discussion/Visit to research lab/Formative Assessment/ Summative Assessment	Analysis of result/ Application of Heutagogy,
7 DSEC	Zoology E-1 (3) Radiation Biology		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
7DSEC	Zoo Management Zoology E-2 (3)		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
8 A12 Major Core Course	Immunology and Stem Cell Biology (3)		Degree in Bachelor Of Science in Zoology	Lab on Immunology and Stem Cell Biology 2	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
8 A13 Major Core Course	Advanced Molecular Biology and Biostatistics (3)		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
8 A 14 Major Core Course	Genomics and Proteomics (3)		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
8	RESEARCH PROJECT (6)		Degree in Bachelor Of		Lectures/Videos / Seminars/Case study/Project/ Group	Formative and Summative Assessment/Evaluation/

			Science in Zoology		discussion/Visit to Industry/Formative Assessment/Summative Assessment	Analysis of result/ Application of Heutagogy,
8DSEC1	<i>Any one of the below 4 choice</i> E-3 Neurosciences (3)		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
8DSEC2	E-3 Parasitology(3)		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
8DSEC3	E-3 Animal Experimentation and Ethics(3)		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
8DSEC4	E-3 Behavioural Biology(3)		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
EXIT OPTION WITH B. Sc. HONOURS DEGREE (184 CREDITS)						
9 A15 Major Core Course	Animal Biotechnology and Genetic Engineering (3)		Degree in Bachelor of Science Honors	Lab on Animal Biotechnology and Genetic Engineering (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
9	Microanatomy		Degree in	Lab on	Lectures/Videos	Formative and

A 16 Major Core Course	Histochemistry and Histopathology (3)		Bachelor of Science Honors	Microanatomy ,Histochemistry and Histopathology (2)	/ Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
9 A 17 Major Core course	Molecular Endocrinology (3)		Degree in Bachelor of Science Honors	Lab on Molecular Endocrinology (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Lab/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
9 A18	Research methodology (3) of 7 th sem) Applied Zoology (In Place of		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
9DSEC1	E-1 Animal Biotechnology (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
9DSEC2	E-1 Toxicology (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
9 Skill Enhancement Course	Cattle Farming (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
10	Physiology of		Degree in	Lab on	Lectures/Videos	Formative and

A 19 Major	Reproduction (3)		Bachelor of Science Honors	Reproductive Physiology 2	/ Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
10 A 20 Major	Developmental Biology (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
10 A 21 Major	Chronobiology (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Lab/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
10 A 22	NanoBiotechnology (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
10 DSEC 1	RESEARCH PROJECT or Any two DSEC Or INTERNSHIP (6)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
10 DSEC 2	E-3 Insect Vector & Diseases (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
10 DSEC 3	E-3 Human		Degree in		Lectures/Videos	Formative and

	Physiology (3)		Bachelor of Science Honors		/ Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
10 DSEC 4	E-3 Food, Nutrition & Health (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
10 Skill Enhancement	E-3 Animal Breeding Techniques (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
EXIT OPTION WITH M. Sc. DEGREE (268 CREDITS)						

Proposed Course content under New Education Policy Year 2021-22 for I Semester BSc Zoology

Core Course Content

Course Title/Code: Cytology, Genetics and Infectious Diseases	Course Credits: 4
Course Code: DSCC5Z00T1	L-T-P per week: 4-0-0
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative AssessmentMarks: 40	Summative AssessmentMarks: 60
Model SyllabusAuthors:	

Core Course prerequisite: To study Zoology in undergraduate, student must have studied Biology or equivalent subject in Class 12.

Semester I- Zoology Core Course I Content:

Content	Hours
Unit I	14
Chapter 1. Structure and Function of Cell Organelles I in Animal cell Chapter 2 Plasma membrane: chemical structure—lipids and proteins Chapter 3 Endomembrane system: protein targeting and sorting, transport, endocytosis and exocytosis	
Chapter 2. Structure and Function of Cell Organelles II in Animal Cell - Cytoskeleton: microtubules, microfilaments, intermediate filaments - Mitochondria: Structure, oxidative phosphorylation; electron transport system - Peroxisome and Ribosome: structure and function	
Unit II	14
Chapter 3. Nucleus and Chromatin Structure - Structure and function of nucleus in eukaryotes - Chemical structure and base composition of DNA and RNA - DNA supercoiling, chromatin organization, structure of chromosomes - Types of DNA and RNA	
Chapter 4. Cell cycle, Cell Division and Cell Signaling - Cell division: mitosis and meiosis - Introduction to Cell cycle and its regulation, apoptosis - Signal transduction: intracellular 11 signaling and cell surface receptors, via G-protein linked receptors - Cell-cell interaction: cell adhesion molecules, cellular junctions	

Unit III	14
Chapter 5. Mendelism and Sex Determination - Basic principles of heredity: Mendel's laws- monohybrid cross and hybrid cross - Complete and Incomplete Dominance - Penetrance and expressivity - Genetic Sex-Determining Systems, Environmental Sex Determination, Sex Determination and mechanism in <i>Drosophilamelanogaster</i>. - Sex-linked characteristics in humans and dosage compensation	
Chapter 6. Extensions of Mendelism, Genes and Environment - Extensions of Mendelism: Multiple Alleles, Gene Interaction. - The Interaction Between Sex and Heredity: Sex-Influenced and Sex-Limited Characteristics - Cytoplasmic Inheritance, Genetic Maternal Effects. - Interaction between Genes and Environment: Environmental Effects on Gene Expression, Inheritance of Continuous Characteristics.	
Unit IV	14
Chapter 7. Human Chromosomes and Patterns of Inheritance - Patterns of inheritance: autosomal dominance, autosomal recessive, X-linked recessive, X-linked dominant. - Chromosomal anomalies: Structural and numerical aberrations with examples. - Human karyotyping and Pedigree analysis.	
Chapter 8. Infectious Diseases - Introduction to pathogenic organisms: viruses, bacteria, fungi, protozoa and worms. - Structure, life cycle, pathogenicity, including diseases, causes, symptoms and control of common parasites: <i>Trypanosoma</i>, <i>Giardia</i> and <i>Wuchereria</i>.	

Suggested Readings :

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA(2004).
2. Alberts et al: Molecular Biology of the Cell: Garland(2002).
3. Cooper: Cell: A Molecular Approach: ASM Press(2000).
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman(2004).
5. Lewin B. Genes VIII. Pearson (2004).
6. Watson et al. Molecular Biology of the Gene. Pearson(2004).
7. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby- Kuby Immunology. W H Freeman (2007).
8. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology, 13th Edition. Wiley Blackwell(2017).
9. Principles of Genetics by B. D. Singh
10. Cell-Biology by C. B. Pawar, Kalyani Publications
11. Economic Zoology by Shukla and Upadhyaya

Pedagogy: Written Assignment/Presentation/Project / TermPapers/Seminar

Formative Assessment	
Assessment Occasion	Weightage in Marks
House Examination/Test	20
Written Assignment/Presentation/Project / Term Papers/Seminar	20
Total	40

Zoology Core Lab Course Content

Semester I

Course Title: Cell Biology &Cytogenetics Lab	Course Credits:2
Course Code: DSCC5Z00P1	L-T-P per week: 0-0-4
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative AssessmentMarks: 25	Summative AssessmentMarks: 25
Model SyllabusAuthors:	

Lab Course Content

List of labs to be conducted	56 rs.
1. Understanding of simple and compound microscopes. 2. To study different cell types such as buccal epithelial cells, neurons, striated muscle cells using 3. Methylene blue/any suitable stain (virtual/ slaughtered tissue). 3. To study the different stages of Mitosis in root tip of <i>Allium cepa</i>. 4. To study the different stages of Meiosis in grasshopper testis (virtual). 5. To check the permeability of cells using salt solution of different concentrations. 6. Study of parasites in humans (e.g. Protozoans, Helminthes in compliance with examples beingstudied in theory) permanent microslides. 7. To learn the procedures of preparation of temporary and permanent stained slides, with available mounting material. 8. Study of mutant phenotypes of <i>Drosophila</i> sp. (from Cultures or Photographs). 9. Preparation of polytene chromosomes (Chironomus larva or Drosophila larva). 10. Preparation of human karyotype and study the chromosomal structural and numerical aberrations from the pictures provided. (Virtual/optional). 11. To prepare family pedigrees. 12. https://www.vlab.co.in 13. https://zoologysan.blogspot.com 14. www.vlab.iitb.ac.in/vlab 15. www.onlinelabs.in 16. www.powershow.com 17. https://vlab.amrita.eduhttps://sites.dartmouth.edu/	

Suggested Readings:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA(2004).
2. Alberts et al: Molecular Biology of the Cell: Garland(2002).
3. Cooper: Cell: A Molecular Approach: ASM Press(2000).
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman(2004).
5. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby- Kuby Immunology. W H Freeman(2007).
6. Kesar, Saroj and Vasishta N.2007 Experimental Physiology: Comprehensive Manual. Heritage Publishers, NewDelhi.

Pedagogy: Written Assignment/Presentation/Project / Term Papers/Seminar

Formative Assessment	
Assessment Occasion	Weightage in Marks
House Examination/Test	10
Written Assignment/Presentation/Project / Term Papers/Seminar	10
Class performance/Participation	05
Total	25

Open Elective Course Content

Semester: I

Course Title: Economic Zoology Course Code: OEC5ZOOT1	Course Credits: 3
Total Contact Hours: 42	Duration of ESA: 3 Hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Model Syllabus Authors:	

Course Content

Content	Hrs
Unit I	14
Chapter 1. Sericulture: - History and present status of sericulture in India - Mulberry and non-mulberry species in Karnataka and India - Mulberry cultivation - Morphology and life cycle of <i>Bombyxmori</i> - Silkworm rearing techniques: Processing of cocoon, reeling - Silkworm diseases and pest control Chapter 2. Apiculture: - Introduction and present status of apiculture - Species of honey bees in India, life cycle of <i>Apisindica</i> - Colony organization, division of labour and communication - Bee keeping as an agro based industry; methods and equipments: indigenous methods, extraction appliances, extraction of honey from the comb and processing - Bee pasturage, honey and bees wax and their uses - Pests and diseases of bees and their management	
Unit II	14
Chapter 3. Live Stock Management: Dairy: Introduction to common dairy animals and techniques of dairy management - Types, loose housing system and conventional barn system; advantages and limitations of dairy farming - Establishment of dairy farm and choosing suitable dairy animals-cattle - Cattle feeds, milk and milk products - Cattle diseases Poultry: Types of breeds and their rearing methods - Feed formulations for chicks - Nutritive value of egg and meat - Disease of poultry and control measures Chapter 4. Aquaculture: - Aquaculture in India: An overview and present status and scope of aquaculture - Types of aquaculture: Pond culture: Construction, maintenance and management; carp culture, shrimp culture, shellfish culture, composite fish culture and pearl culture	
Unit – 3	14

Chapter 5. Fish culture:

- Common fishes used for culture.
- Fishing crafts and gears.
- Ornamental fish culture: Fresh water ornamental fishes- biology, breeding techniques
- Construction and maintenance of aquarium: Construction of home aquarium, materials used, setting up of freshwater aquaria, aquarium plants, ornamental objects, cleaning the aquarium, maintenance of water quality. control of snail and algal growth.
- Modern techniques of fish seed production

Chapter 6. Prawn culture:

- Culture of fresh and marine water prawns.
- Preparation of farm.
- Preservation and processing of prawn, export of prawn.

Chapter 7. Vermiculture:

- Scope of vermiculture.
- Types of earthworms.
- Habit categories - epigeic, endogeic and anecic; indigenous and exotic species.
- Methodology of vermicomposting: containers for culturing, raw materials

required, preparation of bed, environmental pre-requisites, feeding, harvesting and storage of vermicompost. • Advantages of vermicomposting. • Diseases and pests of earthworms. Chapter 8.Lac Culture: • History of lac and its organization, lac production in India. • Life cycle, host plants and strains of lac insect. • Lac cultivation: Local practice, improved practice, propagation of lac insect, inoculation period, harvesting of lac. • Lac composition, processing, products, uses and their pests.	
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Text Books

Suggested Readings:

1. Eikichi, H. (1999). Silkworm Breeding (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Ganga, G. (2003). Comprehensive Sericulture Vol-II: Silkworm Rearing and Silk Reeling.
3. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Mahadevappa, D., Halliyal, V.G., Shankar, D.G. and Bhandiwad, R., (2000). Mulberry Silk
5. Reeling Technology Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Roger, M (1990). The ABC and Xyz of Bee Culture: An Encyclopedia of Beekeeping, Kindle Edition.
7. Shukla and Upadhyaya (2002). Economic Zoology, Rastogi Publishers
8. YadavManju (2003). Economic Zoology, Discovery Publishing House.
9. JabdePradip V (2005). Textbook of applied Zoology, Discovery Publishing House, New Delhi.
10. Cherian & Ramachandran Bee keeping in-South Indian Govt. Press, Madras.
11. Sathe, T.V. Vermiculture and Organic farming.
12. Bard. J (1986). Handbook of Tropical Aquaculture.
13. Santhanam, R. A. Manual of Aquaculture.
14. Zuka. R.1 and Hamiyn (1971). Aquarium fishes and plants
15. Jabde, P.V. (2005) Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac culture.
16. Animal Disease- Bairagi K. N. Anmol Publications Pvt.Ltd 2014
17. Economics Of Aquaculture - Singh(R.K.P) - Danika Publishing Company 2003
18. Applied and Economic Zoology (SWAYAM) web https://swayam.gov.in/nd2_cec20_ge23/preview

Course Books published in English and Kannada may be prescribed by the Universities and College

References

Pedagogy: Chalk and Talk, PPT, Group discussion, Seminar, Field visit

Formative Assessment	
Assessment Occasion	Weightage in Marks
House Examination/Test	20
Written Assignment/Presentation/Project / Term Papers/Seminar	20
Total	40

Skill Enhancement Course in Zoology

Course Content

Semester: I

Course Title: Vermiculture Course Code: VEC5ZOOP1	Course Credits: 2
Total Contact Hours: 56 Hours	Duration of ESA: 3 Hrs
Formative Assessment Marks: 15	Summative Assessment Marks: 35
Model Syllabus Authors:	

Course Content

List of labs to be conducted		56Hrs
1	Collection of native earth worm species to study habit and habitat.	
2	Keys to identify different species of earth worm.	
3	Externals and Life cycle of <i>Eisenia fetida</i> and <i>Eudrilus eugeniae</i> .	
4	Dissection of digestive and reproductive system.	
5	Study of vermicomposting equipments and devices.	
6	Preparation of vermibeds and their maintenance.	
7	Study of different vermicomposting methods.	
8	Harvesting, separation of worms, packaging, transport and storage of vermicompost.	
9	Vermi-wash collection and processing.	
10	Small scale earth worm farming for home gardens and studying the effect of vermicompost on garden plants.	
11	Budget and cost scenario of vermiculture (Project).	
12	Diseases and natural enemies of earth worms and their control measures.	
13	Role of vermitechnology in environmental protection.	
14	Economics and Marketing of vermicompost and vermi wash.	
15	Visit to vermiculture farm to acquaint with latest techniques.	

Text Books and references

1. Bhatt J.V. & S.R. Khambata (1959) –Role of Earthworms in Agriculture|| Indian Council of Agricultural Research, New Delhi
2. Edwards, C.A. and J.R. Lofty (1977) –Biology of Earthworms|| Chapman and Hall Ltd., London.
3. Lee, K.E. (1985) –Earthworms: Their ecology and Relationship with Soils and Land Use|| Academic Press, Sydney.

4. Dash, M.C., B.K.Senapati, P.C. Mishra (1980) — Vermes and Vermicomposting|
Proceedings of the National Seminar on Organic Waste Utilization and
Vermicomposting
Dec. 5-8, 1984, (Part B), School of Life Sciences, Sambalpur University, JyotiVihar,
Orissa.
5. Kevin, A and K.E.Lee (1989) — Earthworm for Gardeners and Fisherman||
(CSIRO,Australia, Division of Soils)
6. Satchel, J.E. (1983) -Earthworm Ecology|| Chapman Hall, London.
7. Wallwork, J.A. (1983) -Earthworm Biology|| Edward Arnold (Publishers) Ltd.
London.

Pedagogy

1. Demonstration
2. Assignment
3. Group discussion
4. Field visit
5. Use of Audio-Visual aids.

Formative Assessment	
Assessment Occasion	Weightage in Marks
Class Test	05
Attendance and Assignments	05
Visit to vermicompost unit and report	05
Total	15

Proposed Course content under New Education Policy – Year 2021-22

For II Semester BSc Zoology

Core Course Content

Course Title: Biochemistry and Physiology	Course Credits: 4
Course Code: DSCC5Z00T2	L-T-P per week: 4-0-0
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative AssessmentMarks: 40	Summative AssessmentMarks: 60
Model SyllabusAuthors:	

Core Course content:

Content	Hours
Unit I	14
Chapter 1. Structure and Function of Biomolecules: • Structure and Biological importance of carbohydrates (Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates). • Lipids (saturated and unsaturated Fatty acids, Tri-acylglycerols, Phospho lipids, Glycolipids and Steroids) • Structure, Classification and General Properties of α-amino acids; Essential and non-essential amino acids, Levels of organization in proteins; Simple and conjugate proteins.	
Chapter 2. Enzyme Action and Regulation • Nomenclature and classification of enzymes; Cofactors; Specificity of enzyme action. • Isozymes; Mechanism of enzyme action • Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions ; Equation of Michaelis-Menton, Concept of K_m and V_{max}, Enzyme inhibition • Allosteric enzymes and their kinetics; Regulation of enzyme action.	
Unit 2	14
Chapter 3. Metabolism of Carbohydrates and Lipids • Metabolism of Carbohydrates: glycolysis, citric acid cycle, gluconeogenesis, phosphate pentose pathway Glycogenolysis and Glycogenesis Lipids- Biosynthesis of palmitic acid; Ketogenesis, • β-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms	

Chapter 4. Metabolism of Proteins and Nucleotides • Catabolism of amino acids: Transamination, Deamination, Ureacycle, Nucleotides and vitamins • Peptide linkages	
Unit 3	14
Chapter 5. Digestion and Respiration in humans • Structural organization and functions of gastrointestinal tract and associated glands. • Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Physiology of trachea and Lung. • Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood, Respiratory pigments, Dissociation curves and the factors influencing it; • Control of respiration.	
Chapter 6. Circulation and Excretion in humans • Components of blood and their functions; hemopoiesis • Blood clotting: Blood clotting system, Blood groups: Rh-factor, ABO and MN • Structure of mammalian heart • Cardiac cycle; Cardiac output and its regulation, Electrocardiogram, Blood pressure and its regulation • Structure of kidney and its functional unit; Mechanism of urine formation	
Unit IV	14
Chapter 7. Nervous System and Endocrinology in humans • Structure of neuron, resting membrane potential(RMP) • Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers. Types of synapse • Endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas and adrenal; hormones secreted by them. • Classification of hormones; Mechanism of Hormone action.	
Chapter 8. Muscular System in humans • Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus	

Suggested Readings:

1. Nelson & Cox: Leininger's Principles of Biochemistry: McMillan (2000)
2. Zubay et al: Principles of Biochemistry: WCB (1995)
3. Voet&Voet: Biochemistry Vols I & 2: Wiley (2004)
4. Murray et al: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott: Biochemistry and Molecular Biology: Oxford University Press
5. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology, XI Edition, Hercourt Asia PTE Ltd. /W.B.Saunders Company. (2006).
6. Tortora, G.J. & Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons (2006).
7. Christopher D. Moyes, Patricia M. Schulte. Principles of Animal Physiology. 3rd Edition, Pearson Education (2016).
8. Hill, Richard W., et al. Animal physiology. Vol. 2. Sunderland, MA: Sinauer Associates, (2004).
9. Chatterjee CC Human Physiology Volume I & 2, 11th edition, CBS Publishers (2016).

Pedagogy: Written Assignment/Presentation/Project / Term Papers/Seminar

Formative Assessment	
Assessment Occasion	Weightage in Marks
House Examination/Test	20
Written Assignment/Presentation/Project / Term Papers/Seminar	20
Total	40

Zoology Semester II Core Course Lab Content

Course Title/Code: Biochemistry and Physiology	Course Credits: 2
Course Code: DSCC5Z00P2	L-T-P per week: 0-0-4
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative AssessmentMarks: 15	Summative AssessmentMarks: 35
Model SyllabusAuthors:	

Course Content

List of labs to be conducted	Hours
1. Preparation of models of nitrogenous bases- nucleosides and nucleotides. 2. Preparation of models of amino acids and dipeptides. 3. Preparation of models of DNA and RNA. 4. Qualitative analysis of Carbohydrates, Proteins and Lipids. 5. Qualitative analysis of Nitrogenous wastes – Ammonia, Urea and Uric acid. 6. Separation of amino acids or proteins by paper chromatography.	20
7. Determination of the activity of enzyme (Urease)-Effect of [S] and determination of Km and Vmax. 8. Determination of the activity of enzyme (Urease) - Effect of temperature and time. 9. Action of salivary amylase under optimumconditions. 10. Quantitative estimation of Oxygen consumption by fresh water Crab. 11. Quantitative estimation of salt gain and salt loss by fresh water.	15
12. Estimation of Hemoglobin in human blood using Sahli'shaemoglobinometer.	15

13. Counting of RBC in blood using Hemocytometer. 14. Counting of WBC in blood using Hemocytometer. 15. Differential staining of human blood corpuscles using Leishman stain. 16. Recording of blood glucose level by using glucometer.	
Virtual Labs (Suggestive sites) https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab www.onlinelabs.in www.powershow.com https://vlab.amrita.edu https://sites.dartmouth.edu	06

Text Books

1. Nelson & Cox: Leininger's Principles of Biochemistry: McMillan (2000)
2. Zubay et al: Principles of Biochemistry: WCB (1995)
3. Voet & Voet: Biochemistry Vols I & 2: Wiley (2004)
4. Murray et al: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott: Biochemistry and Molecular Biology: Oxford University Press
5. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology, XI Edition, Harcourt Asia PTE Ltd. / W.B. Saunders Company. (2006).
6. Tortora, G.J. & Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons (2006).
7. Christopher D. Moyes, Patricia M. Schulte. Principles of Animal Physiology. 3rd Edition, Pearson Education (2016).
8. Hill, Richard W., et al. Animal physiology. Vol. 2. Sunderland, MA: Sinauer Associates, (2004).
9. Chatterjee CC Human Physiology Volume I & 2, 11th edition, CBS Publishers (2016).

Web References:

- Mammalian Physiology– www.biopac.com

Pedagogy: Lectures, Presentations, videos, Virtual Labs, Assignments, Tests, Individual or group Field oriented Project Report on or visit to a research institute.

TOPICS RECOMMENDED FOR SEMINAR/PROJECT REPORT

1. Biochemical pathways, their evolutionary background and regulation.
2. Blood groups and their importance.
3. Vital enzymes for human body.
4. Essential and nonessential amino acids.
5. Important body lipids.
6. Significance of animal proteins.
7. Role of carbohydrates in animal body.
8. Nature of proteins and nurture of animal body.
9. Role of lipids in structural and functional organization of body.

Formative Assessment	
Assessment Occasion	Weightage in Marks
Assignment/Monograph	10
Test	10
Participation in class	05
Total	25

Theory – 04 Hours/Week (04 Credits); Practical - 04Hours/Week (02 Credits) SYLLABUS: DSC-3:

B.Sc., (Hons) Zoology- III Semester

Zoology: Paper - III: Molecular Biology, Bioinstrumentation & Techniques in Biology

Course Title/Code: Molecular Biology, Bioinstrumentation & Techniques in Biology	Course Credits: 4
Course Code: DSCC5ZOOT3	L-T-P per week: 4-0-0
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60

COURSE OUTCOME: (Cos)

CO- 1: After successful accomplishment of the course, the learners will be able to acquire better understanding and comprehensive knowledge regarding most of the essential aspects of Molecular Biology subject which in turn will provide a fantastic opportunity to develop professional skill related to the field of molecular biology.

CO-2: The course will mainly focus on the study of principal molecular events of cell incorporating DNA Replication, Transcription and Translation in prokaryotic as well as eukaryotic organisms.

CO- 3: Acquiring knowledge on instrumentation and techniques in biology

Theory - 04Hours/Week (04 Credits); Practical - 04Hours/Week (02 Credits)

SYLLABUS: DSC-3: B.Sc., (Hons) Zoology- III Semester

Zoology: Paper-III: Molecular Biology, Bioinstrumentation & Techniques in Biology

Unit I	14 Hours
Chapter 1: Process of Transcription	8 Hours
- Fine structure of gene (Cistron, Recon, Muton) with example. RNA polymerases - types and functions Transcription in prokaryotes and eukaryotes	
Chapter 2: Process of Translation	6 Hours
Genetic code and its salient features, Translation in prokaryotes and eukaryotes	
Unit II	14 Hours
Chapter 3: Regulation of gene expression-1	9 Hours
- Regulation of gene expression in prokaryotes- lac operon (inducible) and trp operon (repressible) in <i>E coli</i> - Regulation of gene expression in eukaryotes - Role of chromatin (Euchromatin and heterochromatin) in gene expression - Post-transcriptional Modification: Capping, Splicing, Polyadenylation. Concept of RNA editing (mRNA), gene silencing, and RNAi	

Chapter 4: Regulation of gene expression-II**5 Hours**

- Post-translational modifications: Purpose, advantages, and significance; glycosylation, methylation, phosphorylation, and acetylation.
- Intracellular protein degradation (Lysosomal autophagy) and ubiquitin proteasome pathway)

Unit III**14 Hours****Chapter 5: Microscopy:****9 Hours**

- Principles and applications of Light microscopy, Dark field microscopy, Phase contrast microscopy, Fluorescence microscopy, Confocal microscopy and Electron microscopy (SEM and TEM).

Chapter 6: Centrifugation and Chromatography**5 Hours**

- Centrifugation: Principles, types, and applications (High speed and Ultracentrifugation)
- Chromatography: Principle and applications of: TLC, H-IPLC and GC

Unit IV**14 Hours****Chapter 7: Biochemical Instrumentation****6 Hours**

- Colorimetry and Spectrophotometry: Beer-Lambert's law, Absorption spectrum. UV-VL Spectrophotometer.
- pH meter, measurement of P^H Principle, applications and safety measures of Radiotracer techniques -Autoradiography.

Chapter 8: Molecular Techniques**8 Hours**

- Principle and applications of Agarose gel - electrophoresis, SDS-PAGE, DNA Sequencing (Sanger's Di-deoxy method).
- PCR. DNA Fingerprinting, ELISA, Southern Blotting and Western Blotting.

Formative Assessment for Theory

Assessment Occasion /type	Marks
House Examination/ Test	20
Written Assessment /Presentation/Project/Term Papers/Seminars	20
Total	40 Marks
Formative Assessment as per NEP guidelines are compulsory	

Suggested Readings

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. Molecular Biology of the Cell, 4th edition. New York: Garland Science (2002)
2. Daniel L Hartl and Maryellen Ruvolo. Genetics: Analysis of Genes and Genomes, 8th Edition Burlington, Mass.: Jones & Barden Leaming (2012).
3. Gerald Karp. Cell and Molecular Biology: Concepts and Experiments, 5th Edition. Wiley Publication (2008).
4. Harvey Lodish, Arnold Berk, Paul Maisuda.ira, Chris A Kaiser, Monty Krieger, Freeman. Molecular Cell Biology, 5th edition W. J-I & Company (2003).

5. James D. Watson, Tania A Baker, Stephen P Bell, Alexander Gann, Michael Levine, Richard Losick. Molecular Biology of the Gene, 5th edition Cold Spring Harbor Laboratory Press (2003).
6. Stryer, Lubert Biochemistry, 2nd Edition. W. R Freeman and Company, New York (1981).

Pedagogy: Written Assignment / Presentation / Project / Term Papers / Seminar

DSCC500P3: Core Practical Course

Zoology; III - Semester B.Sc., Hons,

Paper - III: Molecular Biology, Bioinstrumentation & Techniques in Biology

Credits: 2 (L-T-P per week: 0-0-4)

Marks: 50

Total contact hours: 56

Formative assessments: 25

Exam Duration: 3hrs

Summative assessment: 25

Course Title: Molecular Biology, Bioinstrumentation and Techniques in Biology			Course Credits: 2	
Course Code: DSCC5ZOOP3			L-T-P per week 0-0-4	
Total Contact Hours: 56			Duration of ESA: 3 Hours	
Formative Assessment Marks: 25			Summative Assessment Marks: 25	
Pattern of Assessment	C₁ - Test	C₂	Record with Attendance	Total
	10 Marks	10 Marks (Assignment)	05 Marks	25 Marks

List of labs to be conducted:

1. To study the principle and applications of simple, compound and binocular Microscopes.
2. To study the principle and applications of various lab equipments – pH meter, Electronic balance, Vortex mixer,
3. To study the principle and applications of various lab equipments - use of glass and micropipettes, Colorimeter,
4. To study the principle and applications of various lab equipments - Incubator, shaker, Water bath and centrifuge.

5. To prepare Buffer solutions (Phosphate, Citrate, Tris-HCl buffer)
6. To estimate amount of RNA by Orcinol method.
7. To estimate amount of protein by Biuret method.
8. To identify different unknown amino acids using ascending paper chromatography
9. Extraction of DNA from the given sample.
10. To estimate amount of DNA by di-phenyl amine (DPA) method.

Scheme of Practical Examination

3 Hours; 25 Marks

1. Extraction of DNA from the given sample. (or) Estimation of DNA/RNA/ Proteins. **10M**
2. Identify, Write the Principle and Application of **Spot A** (Simple/ Compound/ Binocular Microscopes) **05M**
3. Identify and write the working principle and application of the Spotters B and C. (pH meter, Electronic balance, Vortex mixer, use of glass and micropipettes, Colorimeter, Incubator, shaker, Water bath and centrifuge) **05 x 2=10M**

Scheme of Valuation

1. Principle & Procedure -05, Experiment- 05 / Principle & Procedure- 05. Tabulation, Graph & Report-05
2. Identification 01, Principle-02, Applications - 02
3. Identification 01, Principle-02, Applications – 02

Semester IV- Zoology

Semester: IV Semester, B. Sc., (Hons) Zoology Core Course IV Content

Course Title: Core Course Content: Gene Technology Immunology and Computational Biology	Course Code: DSCC5ZOOT4
Course Type: Discipline Core Theory, L-T-P: 4-0-0	Course Credits: 4
Total Contact Hours: 56	Duration of ESA: Hrs,
Formative Assessment Marks: 40	Summative Assessment Marks:60

COURSE OUTCOMES (Cos):-

CO- 1: Acquaint knowledge on versatile tools and techniques employed in genetic engineering and recombinant DNA technology.

CO -2: An understanding on application of genetic engineering techniques in basic and applied experimental biology.

CO- 3: To acquire a fundamental working knowledge of the basic principles of immunology.

CO-4: To understand how these principles, apply to the process of immune function.

CO-5: Use, and interpret results of, the principal methods of statistical inference and design; helps to communicate the results of statistical analyses accurately and effectively; helps in usage of appropriate tool of statistical software.

Theory - 04Hours/Week (04 Credits); Practical - 04Hours/Week (02 Credits) SYLLABUS: DSC-4: B.Sc., (Hons) Zoology- IV Semester

Zoology: Paper - IV: Gene Technology Immunology and Computational Biology

Unit I	14 Hours
Chapter 1: Principles of Gene Manipulation	07 Hours
- Recombinant DNA Technology: Introduction. steps involved. - Restriction Enzymes and Ligases and Nucleic acid modifying enzyme. - Gene cloning Vector: Concept of plasmids-pBR322, Lamda phage vectors, oCosmids - Gene transfer techniques (Direct and indirect). Screening and selection of recombinant colonies	
Chapter 2: Applications of Genetic Engineering	07 Hours

- Transgenic animals (Transgenic cow, Transgenic Fish); transgenic plants (cry protein); Gene silencing (Knock out and Knockin mouse).
- Production of Human Recombinant insulin and
- Hybridoma technology: Synthesis and applications of Monoclonal Antibodies□Gene Therapy (SCID).
- Biosensors and its applications

Unit II	14 Hours
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Chapter 3: Introduction to the Immune System	07 Hours
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- Defense against diseases: introduction, First and second line of defense, Innate and acquired immunity; Antigen presenting cells (APC's), Role of B and T lymphocytes (Humoral immunity and cell mediated immunity), primary and secondary immune response.
- Types of immunity
- Functional aspects of organs of the Immune system - Thymus and bonemarrow, spleen, Lymph Node, Small intestine and Liver (Peyers patches and Von Kupffer cells)

Chapter 4: Antigens and Antibodies	07 Hours
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- Antigens and heptane: Properties (foreignness, molecular size, heterogeneity).
- B and T cell epitopes.
- Structure of IgG and functions of different classes of immunoglobulins. Major histocompatibility complex - Structure of MHC I & II.

Unit III	14 Hours
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Chapter 5: Clinical Immunology	07 Hours
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- Immunity against diseases of viral, bacterial and protozoan infections.
- Vaccines: Types and Uses - Immunization schedule for children.
- Transplantation immunology: Transplantation of organ- Types, graft rejection and immune-suppressors.

Chapter 6: Bioinformatics	07 Hours
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- Databases: Sequence and structural
- Sequence analysis (homology): Pairwise and Multiple Sequence alignment - BLAST, CLUSTALW, Sequence alignment- FASTA. Scope and applications of Bio-informatics.

Unit IV	14 Hours
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Chapter 7: Biostatistics I	07 Hours
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- Measures of central tendency: Mean, Median, Mode.
- Data summarizing: Frequency distribution, Graphical presentation - bar diagram, pie diagram, Histogram. Elementary idea of probability and its applications.

Chapter 8: Biostatistics II	07 Hours
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- Measures of dispersion: Range, Standard Deviation, Variance.
- Correlation and Regression. Tests of significance: F-test, ANOVA, t-test and Chi square test.

Formative Assessment for Theory	
Assessment Occasion /type	Marks

House Examination/ Test	20
Written Assessment /Presentation/Project/Term Papers/Seminars	20
Total	40 Marks
<i>Formative Assessment as per NEP guidelines are compulsory</i>	

Recommended Books:

1. Primrose & Twyman Principles of Genome Analysis and Genomics. Blackwell (2003).
2. Hartl & Jones. Genetics: principles & Analysis of Genes & Genomes. Jones & Bartlett (1998).
3. Sambrook et al. Molecular Cloning Vols I, II, **UI**. CSHL (2001).
4. Primrose. Molecular Biotechnology. Panima (2001).
5. Clark & Switzer. Experimental Biochemistry. Freeman (2000)
6. Sudbery, Human Molecular Genetics. Prentice-Hall (2002).
7. Wilson Clinical Genetics-A Short Course, Wiley (2000).
8. Pasternak. An Introduction to Molecular Human Genetics. Fitzgerald (2000).
9. Bio-statistical Analysis (Fourth Edition) by Jerrold H. Zar, Pearson Education Inc., Delhi
10. Statistical Methods (Eighth Edition) by G. W. Snedecor and W. G. Cochran, Wiley Blackwell I I.
11. Biostatistics (Tenth Edition) by **W.W.** Daniel and C. L Cross, Wiley
11. Introductory Biological Statistics (Fourth Edition) by John E. Havel, Raymond E. Hampton and Scott J. Meiners.

DSCC500P4: Core Practical Course Zoology; IV - Semester B.Sc., Hons,

Zoology: Paper - IV: Gene Technology Immunology and Computational Biology

Credits: 2 (L-T-P per week: 0-0-4)

Marks: 50

Total contact hours: 56

Formative assessments: 25

Exam Duration: 3hrs

Summative assessment: 25

Course Lab Content

Course Title: Gene Technology, Immunology and Computational Biology	Course Credits: 02
Course Type: Minor Discipline Core Practical, L-T-P: 0-0-4	Course Code: DSCC5ZOOP41
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative Assessment Marks: 25	Summative Assessment Marks: 25

Pattern of Assessment	C₁ - Test	C₂	Record with Attendance	Total
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	10 Marks	10Marks (Assignment)	05 Marks	25 Marks
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List of labs to be conducted:

1. Calculate the mean, median, mode and standard deviation (with suitable examples).
2. Measure the height and weight of all students *in* the class and Construct Bar diagram / Histogram.
3. Determination of ABO Blood group and Rh factor.
4. To detect genetic mutations by Polymerase Chain Reaction (PCR) using teaching kits (Demonstration only).
5. Demonstration of Agarose gel electrophoresis for detection of DNA.
6. Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for detection of proteins.
7. To calculate molecular weight of unknown DNA and protein fragments from gel pictures. (<https://voutube/mCiCi00dbg>)
8. To learn nucleotide sequence database.
9. To learn sequence alignment: Pairwise alignment (Protein/ DNA).

Scheme of Practical Examination

3 Hours; 25 Marks

1. Determine the blood group of the given sample and Comment **05M**
2. Problem on practical 1 **06M**
3. Problem on practical 2 **06M**
4. Identify and Comment on the given spotters A and B **04x02=08M**
(AGE/PCR/PAGE/FASTA/BLAST/Database)

Scheme for Valuation

1. Procedure-02; Identification & Comment-03
2. Formula-01; Tabulation-02; Calculation-03
3. Graph- 03; Comment-03
4. Identification- 01 Principle & Comment-03

Paper V: Non-Chordates and Economic Zoology (Theory)

Program Name	B.Sc.	V Semester	
Course Title	Paper V: Non-Chordates and Economic Zoology (Theory)		
Course Code:	ZOOC	No. of Credits	4
Contact hours	60 Hours	Duration of SEA/Exam	2 1/2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

COURSE OUTCOME (COs):-

CO-1: Understand basics of classification of non-chordates. 2. 3CO-2: Learn the diversity of habit and habitat of these species.

CO-3: Develop the skills to identify different classes and species of animals.

CO-4: Know uniqueness of a particular animal and its importance.

Contents	60 Hrs
Unit-I	15
1. Protozoa to Coelenterate Protozoa-General characters, classification up to classes with suitable examples; <i>Paramecium</i> (Morphology and Reproduction) Porifera – General characters, classification up to classes with suitable examples; Morphology of <i>Sycon</i>, Canal System-Ascon, Sycon, Leucon and types. Coelenterata – General characters, classification up to classes with suitable examples; <i>Obelia</i> (Morphology and Reproduction).	
2. Ctenophora to Nemathelminthes Ctenophora –Salient features and affinities. Platyhelminthes - General characters, classification up to classes with suitable examples <i>Taeniasolium</i>(Tapeworm) (Morphology and Reproduction). Nemathelminthes - General characters, classification up to classes with suitable examples; <i>Ascaris lumbricoides</i> (Morphology and Reproduction).	
Unit-II	15

3. Annelida: □ Annelida – General characters, classification up to classes with suitable examples; <i>Hirudinaria</i> (Leech) (Morphology, and Reproduction).		
4. Arthropoda □ Arthropoda – General characters, classification up to classes with suitable examples; <i>Palaemon</i> (Prawn) Morphology, Appendages, Nervous System and Reproduction).		
Unit-III		15
6. Mollusca & Echinodermata • Mollusca – General characters, classification up to classes with suitable examples; <i>Pila</i> (Morphology, Shell, Respiration, Nervous System and Reproduction • Echinodermata – General characters, classification up to classes with suitable examples; <i>Pentoceros</i> (Morphology and Water Vascular System).		
Unit-IV		15
7. Economic Zoology: Vectors and Pests		
□ Life cycle and their control of following pests: Gundhi Bug, Sugarcane leafhopper, Rodents, Termites and Mosquitoes and their control		
8. Economic Zoology: Lac-culture, Vermiculture and Poultry		
Formative Assessment for Theory		
Assessment Occasion/type		Marks
House Examination/Test		20
Written Assessment/Presentation/Project/Term Papers/Seminars		20
Total		40Marks
Formative Assessment as per NEP guidelines are compulsory		

Course Title	Paper V: Non-Chordates and Economic Zoology (Practical)	Practical Credits	2
Course Code	ZOO C10-P	Contact Hours	4 hrs/ Week
Formative Assessment	25 Marks	Summative Assessment	25 Marks
Course Pre-requisite(s):			
Practical Content			
- Preparation and observation of protozoan culture. Protozoa: <i>Amoeba</i>, <i>Euglena</i>, <i>Noctiluca</i>, <i>Paramecium</i> and <i>Vorticella</i> (Permanent slides). Porifera: <i>Sycon</i>, <i>Euplectella</i>, <i>Spongilla</i> and <i>Euspongia</i> (Specimens). Study of permanent slides of T.S of <i>Sycon</i>, spicules and gemmules. Cnidaria: <i>Aurelia</i> and <i>Metridium</i> (Specimens). Slides of <i>Hydra</i>, <i>Obelia</i> and <i>Ephyra</i> larva, T.S. of <i>Metridium</i> passing through mesenteries. Study of Corals - <i>Astraea</i>, <i>Fungia</i>, <i>Meandrina</i>, <i>Corallium</i>, <i>Gorgonia</i>, <i>Millepora</i> and <i>Pennatula</i>. Helminthes: <i>Planaria</i>, <i>Fasciola hepatica</i> and <i>Taenia solium</i>, <i>Ascaris</i> - Male and female (Specimens). Slides of T.S. of <i>Planaria</i>, T.S of male and female <i>Ascaris</i>. Annelida: <i>Nereis</i>, <i>Heteronereis</i>, <i>Aphrodite</i> (Specimens), Slide of T.S. of Earthworm through typhlosole. Arthropoda: <i>Limulus</i>, <i>Penaeus</i>, Millipede, Centipede, Scorpion, Spider, Rhinoceros beetle, Palaemon, Termite Queen, Butterfly, Praying mantis, Astracus. Slide of Larvae - Nauplius, Zoea and Mysis. [ANY 6 specimens] Mollusca: <i>Chiton</i>, <i>Mytilus</i>, <i>Aplysia</i>, <i>Pila</i>, <i>Octopus</i>, <i>Sepia</i> (Specimens) and Glochidium larva (Slide) Shell Pattern - <i>Unio</i>, <i>Cypraea</i>, <i>Nautilus</i>, <i>Dentalium</i>. Echinodermata: Sea-star, Brittle star, Sea Urchin, Sea cucumber, Sea lily (Specimens). Slides of Bipinnaria larva, Echinopluteus larva and Pedicellaria. Harmful Non chordates: Soil Nematodes (<i>Rhabditis</i>). Agricultural (Sugarcane leaf hopper), veterinary (Tick) and human pests of Arachnida (Mite) and Arthropoda (Bed bug).			

13. **Beneficial Non-chordates:**
- **Sericulture:** Lifecycle of *Bombyx mori* (Morphology & beneficial aspects)
 - **Apiculture:** *Apis indica* & *A. mellifera* (Morphology & beneficial aspects)
 - **Pearl Culture:** Pearl Oyster (Morphology & beneficial aspects)
14. **Virtual Dissection/Cultured specimens:** Earthworm – Nervous system, Leech-Digestive System
15. **Dissection/Cultured specimens:** Prawn-Nervous system.
Cockroach-Salivary Apparatus and Digestive system.

Pedagogy: Lectures, Presentations, Videos, Assignments and Weekly Formative Assessment Tests

Note: Field visit to nearby National park/ Wildlife sanctuary/ any National laboratory at the end of semester is compulsory and the report of this is to be submitted along with practical record as a part of practical examination/ Self-study report.

References

1. Barnes, R.S.K.; Calow, P.; Olive, P.J.W.; Golding, D.W.; Spicer, J.I. (2002) The Invertebrates: Synthesis, Blackwell Publishing.
2. Hickman, C.; Roberts, L.S.; Keen, S.L.; Larson, A. and Eisenhour, D. (2018) Animal Diversity, McGraw-Hill.
3. Holland, P. (2011) The Animal Kingdom: A Very Short Introduction, Oxford University Press.
4. Kardong, K.V. (2006) Vertebrates: Comparative Anatomy, Function, Evolution (4th edition), McGraw-Hill.
5. Barrington, E.J.W. (1979) Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.
6. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
7. Bushbaum, R. (1964) Animals without Back bones. University of Chicago Press.

Zoology Practical – V (Non-Chordates & Economic Zoology)

Total Marks: 50

- Internal Assessment = **25 Marks**.
- Semester end Examination = **25 Marks** (Examination Proper).

Evaluation of Internal Assessment Marks* Evaluation Mode:

Pattern of Assessment	C ₁ - Test	C ₂	Record with Attendance	Total
	10 Marks	05 Marks (Assignment)	10 Marks	25 Marks

Examination Proper (C₃) = 25 Marks Time: 3 hours:

1. Identify the specimens 'A' and 'B' with reasons. **2 x 4= 08 Marks**
2. Identify the slides 'C' (specimens/larva) and 'D' (T.S) and comment on it. **2x 08 Marks**
3. Identify the shell 'E' and comment on it. **04 Marks**
4. Identify and comment on the spot 'F' (Harmful/ Useful non-chordates/ Dissections). **05Mark**

* The candidate has to submit the duly certified record at the time of practical examination. The record is for the reference of the examiners, but not for assessment (since it is already assessed for IA).

Scheme of evaluation:

1. Identification with classification – **1** mark; diagram – **1** mark; reasons – **2** marks.
2. Identification -**1** mark; diagram – **1** mark; comment – **2** marks.
3. Identification – **1** mark; diagram – **1** mark; comment – **2** marks.
4. Identification – **1** mark; comment/ labeling – **4** marks.

Paper VI: Chordates and Comparative Anatomy (Theory)

Program Name	B.Sc.	Semester	V
Course Title	Paper VI: Chordates and Comparative Anatomy (Theory)		
Course Code:	ZOOC11-T	No. of Credits	4
Contact hours	60 Hours	Duration of SEA/Exam	2 ½ hours
Formative Assessment Marks	40	Summative Assessment	60 Marks

COURSE OUTCOME (Cos):

CO-1: To demonstrate comprehensive identification abilities of chordate diversity

CO-2: Able to explain structural and functional diversity of chordate diversity

CO-3: To understand evolutionary relationship amongst chordates

CO-4: To take up research in biological sciences.

CO-5: To realize that very similar physiological mechanisms are used in very diverse organisms.

CO-6: To Get a flavor of research by working on project besides improving their writing skills. It will further enable the students to think and interpret individually

Contents	60Hrs
Unit-I	15 hrs

Chapter 1: Chordates: Origin of Chordates. Basic characters of chordates and outline of classification up to classes. Chapter 2: Hemichordata: Type Study of <i>Balanoglossus</i> – Habit and Habitat, Morphology, Tornaria larva. Affinities of Hemichordata and systematic position of Hemichordata. Chapter 3: Urochordata: Type Study of <i>Herdmania</i>- Habit and Habitat, Morphology, Ascidian tadpole-structure and its retrogressive metamorphosis. Chapter 4: Cephalochordata: Type Study of <i>Branchiostoma</i>(<i>Amphioxus</i>) - Habit and Habitat, Morphology, Digestive system, Feeding mechanism. Chapter 5: Agnatha: General characters of Agnatha and classification up to classes. Salient features of Cyclostomata with orders examples. ! Ammocoete larva and its significance.	
Unit-II	15
Chapter 6: Vertebrates: General characters and Classification of different classes of vertebrates (Pisces, Amphibia, Reptilia, Aves, Mammalia) up to the order with five characters for each order citing examples. ✦ General characters of Chondrichthyes and Osteichthyes. ✦ Interesting features and evolutionary significance of Dipnoi. ✦ Interesting features of <i>Sphenodon</i>, crocodile and <i>Archaeopteryx</i>. ✦ Salient features of Ratitae and Carinatae with examples. ✦ Interesting features of mammalian orders (Insectivora, Carnivora, Chiroptera, Cetacea, Proboscidea, Ungulata–Perissodactyla and Artiodactyla, and Primates–Platyrrhini and Catarrhini) with examples.	
Unit-III	15
Chapter 7: General account of Chordates: ✦ Types of caudal fins, scales and swim bladder in fishes. ✦ Origin of Amphibia. ✦ Neoteny and Paedogenesis (Ex. Axolotl larva). ✦ Adaptive radiation in extinct reptiles with suitable examples. Temporal fossae in reptiles.	

✚Poison apparatus and biting mechanism in snakes. ✚Parental care in Pisces and Amphibians. ✚Flight adaptations in birds. ✚Dentition in mammals: Structure of a tooth, types of teeth and dental formula of rabbit, dog and human ✚Migration in Pisces, Birds and Mammals.	
Unit-IV	15
Comparative Anatomy of Vertebrates: Chapter 8: Integumentary System: Structure of skin and its derivatives. Chapter 9: Skeletal System ✚Comparative account of Axial Skeletal system vertebrates; Skull- Amphibian (Frog), Reptiles (Lizard), Aves (Pigeon) and Mammals (Rabbit). ✚Comparative account of Appendicular skeletal system in vertebrates Pectoral and Pelvic girdles of Amphibian (Frog), Reptiles (Lizard), Aves (Pigeon) and Mammals (Rabbit). Chapter 10: Respiratory system ✚Comparative account of respiratory system in vertebrates: Pisces (Scoliodon), Amphibian (Frog), Reptiles (Lizard), Aves (Pigeon) and Mammals (Rabbit). Chapter 11: Circulatory System ✚Comparative account of heart and aortic arches in vertebrates: Pisces (Scoliodon), Amphibian (Frog), Reptiles (Lizard), Aves (Pigeon) and Mammals (Rabbit). Chapter 12: Excretory System ✚Succession of kidney in vertebrates – Pronephrous, mesonephrous&metanephrous. Chapter 13: Nervous system ✚Comparative account of brain in vertebrates: Pisces (Scoliodon), Amphibian (Frog), Reptiles (Lizard), Aves (Pigeon) and Mammals (Rabbit).	

Formative Assessment for Theory	
Assessment Occasion /type	Marks
House Examination/ Test	20
Written Assessment /Presentation/Project/Term Papers/Seminars	20
Total	40 Marks
<i>Formative Assessment as per NEP guidelines are compulsory</i>	

References

- 1 Colbert *et al*: Colbert's Evolution of the Vertebrates:A history of the back boned animals through time. (5th ed 2002, Wiley–Liss).
- 2 Hildebrand: Analysis of vertebrate Structure (4thed 1995, JohnWiley)
- 3 Kenneth V. Kardong (20015) vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill
- 4 McFarland *et al.*,: Vertebrate Life (1979, Macmillan publishing)
- 5 Parker and Haswell: Text Book of Zoology, Vol. II(1978,ELBS)
- 6 Romerand Parsons: The Vertebrate Body (6thed1986, CBS Publishing Japan)
- 7 Young: The Life of vertebrates (3rded 2006,ELBS/Oxford)
- 8 Weichert C. K. and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills

Course Title	Paper VI: Chordates and Comparative Anatomy (<i>Practicals</i>)	Practical Credits	2
Course Code	ZOO C12-P	Contact Hours	4 hrs/ Week
Formative Assessment	25Marks	Summative Assessment	25Marks
Course Pre-requisite(s):			

Practical Content

1. **Protochordata:** Balanoglossus and its T. S. through proboscis
Ascidian/*Herdmania* and *Amphioxus*, T.S. of *Amphioxus* through pharynx and intestine.
2. **Cyclostomata:** *Petromyzon*, Ammocoete larva and *Myxine*.
3. **Pisces:** Cartilaginous Fishes – *Narcine*, *Trygon*, *Pristis*.
4. **Bony Fishes** – Hippocampus, Ostracion, Tetradon, Echeneis.
5. **Ornamental fishes:**
✦ Neon tetra, Guppies, Goldfish, Angle fish, Mollies.
6. **Accessory respiratory organs**– *Sacco branchus*, *Clarias* and *Anabas*.
7. **Amphibia:** *Bufo*, *Rana*, *Ambystoma*, *Axolotl* larva and *Ichthyophis*.
8. **Reptilia:** Turtle, Calotes, Chameleon, Varanus.
✦ Snakes – Rat snake, Dryophis, Brahmini, Cobra, Krait, Russell's viper and Hydrophis
9. **Aves:** Beak and feet modifications in the following examples: Duck, Parrot, Kingfisher, Eagle, Crow, Sparrow, Woodpecker, Owl.
10. **Mammalia:**
✦ Squirrel, Pangolin, Rat and Loris, Mongoose, Hedgehog, Rabbit, Bat.
11. **Virtual Dissection/Cultured specimens:**
✦ Shark/Bony fish: Afferent and efferent branchial systems, glosso-pharyngeal and vagus nerves.
12. **Virtual Dissection/Cultured specimens:**
✦ Rat: Dissection (only demonstration)– Circulatory system (arterial and venous),
Urinogenital system.
- 14-16. **Skeletal System in Shark/ Frog/ Pigeon/ Rabbit:** Skull, vertebrae, girdles and limb bones

Note: Field visit to nearby National park/ Wildlife sanctuary/ any National laboratory at the end of semester is compulsory and the report of this is to be submitted along with practical record as a part of practical examination/ Report on beak and feet modification.

Zoology Practical – VI (Chordates & Comparative anatomy): Examination Assessment Pattern.

Total: 50 Marks.

- Internal Assessment = **25 Marks.**

- Semester end Examination = **25 Marks** (Examination Proper).

Evaluation of Internal Assessment Marks*

Pattern of Assessment	C ₁ - Test	C ₂	Record with Attendance	Total
	10 Marks	10 Marks (Report)	05 Marks	25 Marks

Examination Proper (C₃) = 25 Marks Time: 3 hours:

1. Identify the specimens 'A' and 'B' with reasons. **2 x 4 = 08 Marks**
2. Identify the spot 'C' (section/ accessory respiratory organs) and comment on it. **05 Marks**
3. Identify the endoskeletons 'D' and 'E' and comment on it. **2 x 4 = 08 Marks**
4. Identify the system and label the parts (Dissections). **04 Marks**

* The candidate has to submit the duly certified record at the time of practical examination. The record is for the reference of the examiners, but not for assessment (since it is already assessed for IA).

Scheme of evaluation:

1. Identification with classification – **1** mark; diagram – **1** mark; reasons – **2** marks.
2. Identification -**1** mark; diagram – **2** marks; comment – **2** marks.
3. Identification – **1** mark; diagram – **1** mark; comment – **2** marks.
4. Identification – **1** mark; labeling – **3** marks.

Paper VII: Evolutionary & Developmental

Biology (Theory)

Program Name	B.Sc.	Semester	VI
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Course Title	Paper VII: Evolutionary & Developmental Biology (Theory)		
Course Code:	ZOOC15-T	No. of Credits	4
Contact hours	60 Hours	Duration of SEA/ Exam	2 ½ hours
Formative Assessment Marks	40	Summative Assessment Marks	60

COURSE OUTCOME (Cos):

CO-1: Understand that by biological evolution we mean that many of the organisms that inhabit the earth today are different from those that inhabited it in the past.

CO-2: Understand that natural selection is one of several processes that can bring about evolution, although it can also promote stability rather than change.

CO-3: Understand how the single cell formed at fertilization forms an embryo and then a full adult, organism. Integrate genetics, molecular biology, biochemistry, cell biology, anatomy and physiology during embryonic development.

CO-4: Understand a variety of interacting processes, which generate an organism's heterogeneous, shapes, size, and structural features.

CO-5: Understand how a cell behaves in response to an autonomous determinant or an external signal, and the scientific reasoning exhibited in experimental life science.

Contents	60 Hrs
Unit-I	15
1.Theories of Evolution: Origin of Life (brief note), Historical review of evolutionary concept: Lamarckism, Darwinism (Natural, Sexual and Artificial selection), Modern synthetic theory of evolution, Adaptive radiations: Patterns of evolution (Divergence, Convergence, Parallel, Co-evolution)	
2.Population Genetics: Microevolution and Macroevolution: allele frequencies, genotype frequencies, Hardy- Weinberg equilibrium and conditions for its maintenance, Forces of evolution: mutation, selection, genetic drift	
Unit-II	15
3. Direct Evidences of Evolution: Geological time scale, Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse.	
4. Species Concept and Extinction: Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric), Mass extinction (Causes, Names of five major extinctions.	
Unit-III	15

5. Gamete Fertilization and Early Development: Gametogenesis, Fertilization in Sea urchin. Cleavage pattern, Development of frog- Blastulation, fate map of blastula, Gastrulation, and organogenesis.	
6. Developmental Genes: General concepts of organogenesis, Introduction to genetic basis of embryonic development and Developmental control genes (Homeobox genes. eg. Drosophila)	
Unit-IV	15
7. Early Vertebrate Development: Early development of mammals including- implantation, placentation, gestation, parturition. Environmental regulation of development	
8. Late Developmental Processes: Development of eye, kidney, limb in amphibian, Mammalian female reproductive cycles- estrous cycle and menstruation, Aging: the biology of senescence	

Formative Assessment for Theory	
Assessment Occasion /type	Marks
House Examination/ Test	20
Written Assessment /Presentation/Project/Term Papers/Seminars	20
Total	40 Marks
<i>Formative Assessment as per NEP guidelines are compulsory</i>	

Course Title	Paper VII: Evolutionary & Developmental Biology (Practical)		Practical Credits	2
Course Code	ZOO C16-P		Contact Hours	4 hrs/ week
Formative Assessment	25 Marks	Summative Assessment	25Marks	

Practical Content

1. Study of fossils from models/ pictures.
2. Study of homology and analogy from suitable specimens
3. Study and verification of Hardy-Weinberg Law by chi square analysis (Any three problems)
4. Graphical representation and interpretation of data of height / weight of a sample of 100 humans in relation to their age and sex.
5. Types of eggs based on quantity and distribution of yolk: Sea urchin, insect, frog, Chick.
6. Study of development of chick embryo through incubated chick eggs up to 96h (Window techniques).
7. Study of adaptive radiations in feet of birds and mouth parts of insects.
8. **Frog embryology:** Egg, Sperm, Early cleavage stages,
9. **Frog embryology:** Blastula, Gastrula and Neurula
10. **Chick Embryology:** Egg, Sperm, 18 hrs, 24 hrs,
11. **Chick Embryology:** 36 hrs and 48 hrs embryo whole mounts.

References

- 1 Ridley, M (2004) Evolution (3rd edition) Black well Publishing 2 Hall, B.K. and Hallgrimson, B (2008) Evolution (4th edition) Jones and Barlett Publishers 3 Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
- 4 Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings.
- 5 Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
- 6 Developmental Biology: T. Subramaniam, (Reprint), Narosa Publishing House Pvt. Ltd., New Delhi
- 7 Developmental biology: Werner A. Müller, Springer Science & Business Media. (2012).
- 8 Human Embryology and Developmental Biology E-Book: Bruce M. Carlson, Elsevier Health Sciences.
- 9 Developmental Biology: Michael J. F. Barresi, Scott F. Gilbert, Oxford University Press. (2019).

Pedagogy: Lectures, Presentations, Videos, Assignments and Weekly Formative Assessment Tests

Zoology Practical – VII (Evolutionary & Developmental Biology): Examination Assessment Pattern.

Total: 50 Marks.

- Internal Assessment = **25 Marks.**
- Semester end Examination = **25 Marks** (Examination Proper).

Evaluation of Internal Assessment Marks* Evaluation Mode:

Pattern of Assessment	C ₁ - Test	C ₂	Record with Attendance	Total
	10 Marks	10 Marks (Assignment)	05 Marks	25 Marks

Examination Proper (C₃) = 25 Marks Time: 3 hours:

1. Identify the spots 'A' and 'B' with reasons. **2 x 4= 08 Marks**
2. Hardy Weinberg Problem/ Graphical representation/ Adaptive radiation. **05 Marks**
3. Identify the spots 'C', 'D' and 'E' and comment on it (egg/ frog developmental stages /chick developmental stages) **3 x 4 = 12 Marks**

* The candidate has to submit the duly certified record at the time of practical examination. The record is for the reference of the examiners, but not for assessment (since it is already assessed for IA).

Scheme of evaluation:

1. Identification– **1** mark; diagram – **1** mark; reasons – **2** marks.
2. Problem/ Graph/Comment – **5** marks.
3. Identification – **1** mark; diagram – **1** mark; comment – **2** marks.

Program Name	B.Sc.	Semester	VI
Course Title	Paper VIII: Environmental Biology, Wildlife Management & Conservations (Theory)		
Course Code:	ZOO C17-T	No. of Credits	4
Contact hours	60 Hours	Duration of SEA/Exam	Hours
Formative Assessment Marks	40	Summative Assessment Marks	60

COURSE OUTCOME (Cos):

CO-1: Develop an understanding of how animals interact with each other and their natural environment.

CO-2: Develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues.

CO-3: Develop the ability to work collaborative team-based projects.

CO-4: Gain an appreciation for the modern scope of scientific inquiry in the field of wildlife conservation management.

CO-5: Develop an ability to analyze, present and interpret wildlife conservation Management in formation

Contents	60Hrs
Unit-I	15
1. Ecology: Introduction to ecology, Definition, ecosystem, types of ecosystem Terrestrial (Desert, Grassland, and Forest), Aquatic (Marine: Coastal & Estuary as an ecotone, Freshwater: (Lentic & Lotic). Food chain (Grassing and Detritus) and food web (Simple & Complex). Trophic levels (Pyramid of number, biomass and energy). ✚ Environmental Biology: Adaptive features of plants and animals to different environment - light, water, temperature (ectotherms & endotherms). ✚ Ecological factors-Abiotic factors: Light, Temperature, Soil and water. ✚ Biotic factors-Interspecific relationships: Positive interaction (Symbiosis) Commensalism, Proto co-operation and Mutualism. Negative interaction (Antagonism)- Predation, parasitism and antibiosis. weather, climate, ozone layer.	
Unit-II	15
2. Pollution: Definition, types of pollution: air, soil, water and thermal pollution – Causes and effects of pollution and Preventive measures. Ozone layer depletion, Bio-magnifications, bioaccumulation and bioremediation.	
Unit-III	15

3. Wildlife Conservation:Ex-situ - zoo, captive breeding, botanical garden and gene and sperm bank and in-situ conservation - National parks, Wildlife sanctuaries, biosphere reserve.	
Wildlife Protection Act 1972. Project tiger. Project Elephant. Habitat preservation.	
Unit-IV	15
4. Wildlife Management: Values of wildlife,Causes and depletion of wildlife, inventory and classification of wetlands and their biotic components, general strategies and issues, concept of home range, wildlife corridors and territory, animal census, tracing movement and remote sensing and GIS.	

Formative Assessment for Theory	
Assessment Occasion /type	Marks
House Examination/ Test	20
Written Assessment /Presentation/Project/Term Papers/Seminars	20
Total	40 Marks
<i>Formative Assessment as per NEP guidelines are compulsory</i>	

Course Title	Paper VIII: Environmental Biology, Wildlife Management & Conservation (Practicals)	Practical Credits	2
Course Code	ZOO C-18-P	Contact Hours	4 hrs/ Week
Formative Assessment	25 Marks	Summative Assessment	25 Marks
Practical Content			

1. Estimation of Dissolved Oxygen (O₂) in the water sample.
2. Estimation of Carbon dioxide (CO₂) in the water sample.
3. Estimation of chlorides in the water sample.
4. Estimation of Hardness in the water sample.
5. **Visit of pond or lakes:** Collection and identification of flora and fauna of selected ecosystems.
6. Study of phytoplanktons, zooplanktons and insect larva.
7. Demonstration of field equipments used in wildlife census: Compass, Binoculars, Spotting scope,
8. Demonstration of field equipments used in wildlife census: Range Finders, Global Positioning System, Various types of cameras and lenses.
9. Identification wild animals: Wild animal's pugmarks, hoof marks scats, pellet groups, nest, antlers (Photo identification).
10. Study of field techniques for wild flora and fauna.

References

- 1 Colinvaux, P. A.(1993) Ecology (2ndedition)Wiley, John and Sons, Inc.
- 2 Krebs,C. J.(2001)Ecology(6thedition) Benjamin Cummings.
- 3 Odum,E.P., (2008) Fundamentals of Ecology. IndianEdition. Brooks/Cole. (3rdEdition) BlackwellSci.
- 4 Kendeigh, FC.(1984) Ecology with Special Reference to Animal and Man. Prentice HallInc.
- 5 Caughley,G. and Sinclair, A.R.E.(1994)Wildlife Ecology and Management. Blackwell Science.
- 6 Woodroffe,R., Thirgood, S. and Rabinowitz,A. (2005) People and Wildlife, Conflict Or Co-existence? Cambridge University.
- 7 Bookhout,T.A. (1996) Research and Management Techniques for Wildlife and Habitats (5thedition) The Wildlife Society,Allen Press.
- 8 Sutherland, W.J. (2000)The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
- 9 Hunter M.L., Gibbs,J.B. and Sterling,E.J.(2008) Problem solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing

Pedagogy: Lectures, Presentations, Videos, Assignments and Weekly Formative Assessment Tests

Note: Field visit to nearby National park/ Wildlife sanctuary/ any National laboratory at the end of semester is compulsory and the report of this is to be submitted along with practical record as a part of practical examination / Report on field techniques for wild flora and fauna.

**Zoology Practical – VIII (Environmental Biology, Wildlife Management & Conservation):
Examination Assessment Pattern.**

Total: 50 Marks.

- Internal Assessment = **25 Marks.**
- Semester end Examination = **25 Marks** (Examination Proper). **Evaluation of Internal Assessment Marks***

Pattern of Assessment	C ₁ - Test	C ₂	Record with Attendance	Total
	10 Marks	10 Marks (Assignment)	05Marks	25 Marks

Evaluation Mode:

Examination Proper (C₃) = 25 Marks Time: 3 hours:

- | | |
|--|-----------------|
| 1. Estimate the amount of Dissolved Oxygen or CO ₂ in the water sample. | 08 Marks |
| 2. Estimate the amount of Chloride or Hardness in the water sample. | 08 Marks |
| 3. Identify the spots 'A' and comment on it (field equipments) | 05 Marks |
| 4. Identify the spots 'B' and comment on it (Photo identification) | 04 M |

* The candidate has to submit the duly certified record at the time of practical examination. The record is for the reference of the examiners, but not for assessment (since it is already assessed for IA).

Scheme of evaluation:

1. Principle & procedure – **4 marks**; experiment & calculation – **4 marks**.
2. Principle & procedure – **4 marks**; experiment & calculation – **4 marks**.
3. Identification – **1 mark**; comment – **4 marks**.
4. Identification – **1 mark**; comment – **3 marks**

Scheme of Examination for I and II & III Year B.Sc., Zoology (NEP Scheme), 2023 – 2024 DSC & OE Papers

Theory: Total 100 Marks

- Internal Assessment = **40 Marks**.
- Semester end Examination = **60 Marks** (Examination Proper).

Evaluation of Internal Assessment Marks*

(In the 7 - 8 week from the commencement = C₁ assessment & 14 -15 week = C₂ assessment) **Evaluation Mode:**

Pattern	C ₁ - Test	C ₂ - Assignment
	20 Marks	20 Marks
Total	40 marks	

* No need to incorporate in the BOS proceedings, It will be presented in the general regulations framed by the UOM and College.

Examination Proper = 60 Marks.

Duration of Examination = 2 ¹/₂ Hours

Question Paper Pattern

Answer the following questions

1 × 5 = 05 Marks

- 1.
- 2.
- 3.
- 4.

5.

Write short note on any FIVE of the Following

3 × 5 = 15 Marks 2. a).

6.

7.

8.

9.

10.

11.

12.

13.

14.

Write explanatory note on any FOUR of the following

5 × 4 = 20 Marks

15.

16

17.

18.

19.

20.

Answer any TWO of the following

10 × 2 = 20 Marks

21.

22.

23.

24.

Question Paper Pattern: PART

I. One mark questions / Objective type questions (5 Compulsory questions) 01 × 05 = 05 Marks

II. EIGHT Short Answer questions to be asked, student should attend any FIVE questions

3 × 5 = 15 Marks.

III. Explanatory note; Out of SIX questions students should attend FOUR questions.

5 × 4 = 20 Marks.

IV. Essay type questions; Out of FOUR questions students should attend only TWO questions.

10 × 2 = 20 Marks

Chairperson

(JNANESHWARI.C)