Department of Higher education

Karnataka State Higher Education Council

National Education Policy - 2020

Proposed Model Curriculum for Undergraduate Programme in Zoology

In

All state Universities and Colleges in Karnataka

For the year 2021-2022

Submitted by

Zoology/Genetics Subject Committee

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 constructivel 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.

1. INTRODUCTION

The learning outcomes-based curriculum framework for B.Sc. degree in Zoology is structured to offer a broad outline within which a Zoology program could be developed. The course is upgraded keeping in mind the aspirations of students, changing nature of the subject as well as the learning environment. Courses within Zoology have been revisited to incorporate recent advancements, techniques to upgrade the skills of learners. The new structure is expected to enhance the level of understanding among students and maintain the standard of Zoology degrees/program across the country. Effort has been made to integrate use of recent technology and use of MOOCs to assist teaching-learning process among students.

This framework permits the review of graduate attributes, qualification descriptors, program learning outcomes and course-level learning outcomes periodically. The framework offers flexibility and innovation in syllabi designing and in methods adopted for teaching- learning process and learning assessment. The major objective is to elevate the subject knowledge of the students, making them critical thinkers and able to solve problems and issues related to Zoology logically and efficiently. Overall, this course has been modified to upgrade skills related to biological science and provide our students a competitive edge in securing a career in academia, industry, pharmaceutical research and development in private as well as public sectors. This course serves as plethora of opportunities in different fields right from classical to applied Zoology.

2. LEARNING OUTCOME BASED CURRICULUM FRAMEWORK IN PROGRAM

Zoology to be studied in an integrated and cross-disciplinary manner with a comprehensive understanding of all living systems, their relationship with the eco-system and unravelling of their application value; the scale, character and rigor of which may vary from one institution to the other, it would, however, be mandatory to bring in uniformity in the learning outcomes with respect to the ‘broad-range skill sets’ related-to-the-discipline of the study and the ‘Social skills’ in 21st century. The framework imbibes a Learning Outcome-based Curriculum Framework (LOCF) for all its Under Graduate program in Zoology.

A comprehensive understanding and appreciation of the organismal differences through ICT tools, MOOCs and well-designed hands on practical exposures along with the field work and if the same principle is followed to understand different phyla through the ladder

of evolution and compare cardinal features for classification involving both morphological and molecular tools, along with associated field and lab work, the final product would be better trained without rote learning. Syllabi required is to impart and assess the quality of critical thinking, analytical and scientific reasoning, reflective thinking, information and digital literacy, and problem-solving capacity. Along with social skills to imbibe values for cooperative team work, moral and ethical awareness and reasoning, multicultural competence, leadership readiness and qualities and self- directed and lifelong learning attitude.

3. AIM OF PROGRAM

Zoology deals with the study of animal kingdom specially the structural diversity, biology, embryology, evolution, habits and distribution of animals, both living and extinct. As it covers a fascinating range of topics, the modern zoologists need to have insight into many disciplines. The learning outcomes-based curriculum framework for a B.Sc. (Hons.) degree in Zoology is designed to cater to the needs of students in view of the evolving nature of animal sciences as a subject.

The Zoology courses designed in terms of concepts, mechanisms, biological designs &functions and evolutionary significance cutting across organisms at B.Sc. (Hons.) level can be delivered by chalk and board, and PowerPoint presentations while teaching-learning process. The students should do the dissertation/ project work under practical of different courses, wherever possible.

4. NATURE AND EXTENT OF THE PROGRAM

The CBCS framework with credit bank system is to assist in the maintenance of the standard of Zoology degrees/programmes across the Karnataka state by reviewing and revising a broad framework of agreed, expected, graduate attributes of qualification with quality, programme learning outcomes and course-level learning outcomes. The framework, however, does not seek to bring about uniformity in syllabi for a programme of study in Zoology, or in teaching-learning process and learning assessment procedures. Instead, the framework is intended to allow for flexibility and innovation in programme design and syllabi development, teaching-learning process, assessment of student learning levels.

5. GRADUATE ATTRIBUTES IN B.Sc. (Hons.) ZOOLOGY

Some of the characteristic attributes of a graduate in Zoology may include the following:

a. Disciplinary knowledge: Capable of demonstrating-

(i) Comprehensive knowledge of major concepts, theoretical principles and experimental findings in Zoology and its different subfields including biodiversity, anatomy, physiology, biochemistry, biotechnology, ecology, evolutionary biology, cell biology, molecular biology, immunology and genetics, and some ofthe other applied areas of study such as wildlife conservation and management, apiculture, sericulture, neurosciences, aquatic biology, fish and fisheries sciences, bioinformatics and research methods;

(ii) Interdisciplinary knowledge of allied biological sciences, environmental science and chemical science;

(iii) Learning of the various techniques, instruments, computational software used for analysis of animal's forms and functions.

b. Effective communicator: Capability to convey the intricate Zoological information effectively and efficiently.

c. Critical thinker and problem solver: Ability to rationally analyze and solve the problems related to animal sciences without relying on assumptions and guess work.

d. Logical thinking and reasoning: Capability of seeking solutions and logically solving them by experimentation and data processing either manually or through software.

e. Team spirit: Ability to work effectively in a heterogeneous team.

f. Leadership quality: Ability to recognize and mobilize relevant resources essential for a project, and manage the project in a responsible way by following ethical scientific conduct and bio-safety protocols.

g. Digitally literate: Capable of using computers for biological simulation, computation and appropriate software for biostatistics, and employing search tools to locate, retrieve, and evaluate zoology-related data.

h. Ethical Awareness: Avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, as well as appreciate environmental and sustainability issues.

i. Lifelong learners: Capable of self-paced and self-directed learning aimed at personal and social development.

6. UALIFICATION DESCRIPTORS:

The qualification descriptors for a Bachelors' Degree program in Zoology may include the following:

Demonstrate a logical and consistent understanding of the broad concepts in Zoology, its applications, and related interdisciplinary subjects.
Technical knowledge that produces varied types of professionals in the fields like research and development, teaching and public sector service.

Utilise wide-range knowledge, logical thinking and skills for evaluating problems and issues related to Zoology.

Collection of pertinent quantitative and/or qualitative data obtained from various sources/experiments, and analysis of the data using appropriate research methodologies to formulate evidence-based solutions.

Effective and precise communication of the investigations undertaken in a variety of contexts using the major concepts, principles and techniques of the subject(s).

Meet one's own learning desires, employing broad range of research and development work and professional materials.

Apply one's subject knowledge and skills to novel circumstances enabling to solve complicated problems with evidence-based well-defined elucidations

DemonstratesubjectrelatedskillsrelevanttoZoologyrelatedjobsandemployment opportunities

5 Curriculum in subjects has to follow these Model Program Structures. The Terminology used in these Program Structures is.

Discipline Core (DSC) refers to Core Courses/Papers in a Core Discipline/ Subject

Discipline Elective (DSE) refers to Elective Courses/Papers in the Core Subject or Discipline.

Open Elective (OE) refers to Elective Courses/Papers in a non-core Subject across all disciplines.

Program Structures also contain Ability Enhancement Compulsory Courses (AECC), Languages, Skill Enhancement Courses

(SEC) (Both skills and value based). Pedagogy involves L+T+P model. Generally subjects with practical involve L+P, while the

subjects without practical involve L+T model. The numbers in parentheses indicate credits allotted to various courses/papers as per

definitions of Choice Based Credit System (CBCS). Generally 1 hour of Lecture or 2 hours of practical per week in a semester is

assigned one credit. Generally core subject theory courses/papers will have 3 or 4 credits, while practical are assigned 2 or 3 credits

Subject prerequisite: To Study Zoology in undergraduate, student must have studied Biology or any other equivalent subject in Class 12.

Model Curriculum Structure for Degree Program

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-TheProgrammeoffersbothclassicalas 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-Tomakethestudy of animals more interesting and relevant to human studies more emphasis is given to branches like behavioural 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 / IA Marks	Summative Assessment Marks
Theory	**40**	**60**
Practical	**20**	**30**
Projects	**45**	**105**
Experiential Learning (Internships etc.)		

IIA. Model Program Structures for the Under-Graduate Programs in Universities and Colleges in Karnataka

Sem.	Discipline Core (DSC) (Credits) (L+T+P)	Discipline Elective(DSE) / Open Elective (OE) (Credits) (L+T+P)	Ability Enhancement Compulsory Courses (AECC), Languages (Credits) (L+T+P)		Skill Enhancement Courses (SEC)		Total Credits
					Skill based (Credits) (L+T+P)	Value based (Credits) (L+T+P)	
I	Zoology A1(4+2) Botany B1(4+2)	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs. each)		SEC-1: Digital Fluency (2) (1+0+2)	Physical Education for Health &Wellness fitness(1)(0+0+2) (1) (0+0+2)	25
II	Zoology A2(4+2) BotanyB2(4+2)	OE-2 (3)	L1-2(3), L2-2(3) (4 hrs. each)	Environmental Studies (2)		Physical Education - NCC/NSS/R&R(S&	25
Exit option with Certificate (50 credits)							
III	Zoology A3(4+2) Botany B3(4+2)	OE-3 (3)	L1-3(3), L2-3(3) (4 hrs. each)		SEC-2: Artificial Inte-lligence (2)(1+0+2)	Physical Education- NCC/NSS/R&R(S&	25
IV	Zoology A4(4+2) Botany B4(4+2)	OE-4 (3)	L1-4(3), L2-4(3) (4 hrs. each)	Constitution of India (2)		Physical Education - NCC/NSS/R&R(S&	25
Exit option with Diploma in Science (100 credits) OR Choose any one of the core subjects as Major and the other as Minor							
V	Zoology A5(3+2) Zoology A6(3+2) Botany B5(3+2)	Vocational-1 (3)			SEC-3: SEC such as Cyber Security (2) (1+0+2)		20
VI	Zoology A7(3+2) Zoology A8(3+2) Botany B6(3+2)	Vocational-2 (3) Internship (2)			SEC-4: Professional Communication (2)		22
Exit option with Bachelor of Science Degree, B. Sc. Degree in Zoology (142 credits) or continue studies with the Major in the third year							
VII	Zoology e A9(3+2) ZoologyA10(3+2) Zoology A11(3)	Zoology E-1 (3) Zoology E-2 (3) Res. Methodology (3)					22
VIII	Zoology A12(3+2) Zoology A13(3) Zoology A14(3)	Zoology E-3 (3) Research Project (6)*					20
Award of Bachelor of Science Honours Degree, B.Sc.(Hons.) Degree in Zoology (184 credits)							

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 A1Major 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			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,

		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)				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,
EXIT OPTION WITH CERTIFICATE (50 CREDITS)						
3 A3 Major Core Course	MolecularBiolog Bioinstrumentation & Techniques in Biology (4)		Certificate Course in Zoology	Lab on MolecularBiology, 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)				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 curse	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)				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/Evaluation/ 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/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
5 SEC 3 Skill Enhancement course	**Cyber Security** Integrated Animal Rearing (2)		Diploma 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,
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/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ 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/Evaluation/ 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/Evaluation/ Analysis of result/ Application of

					Assessment/ Summative Assessment	Heutagogy,
6 DSEC	Vocationa-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/Evaluation/ 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/Evaluation/ 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/Evaluation/ 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/Evaluation/ 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/Evaluation/ 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/Evaluation/

			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	*Any one of the below 4 choice* 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 7thsem) 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 Cpourse	Cattle Farming (3)		Degreein 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 B.Sc. 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 Assessment Marks: **40**	Summative Assessment Marks:**60**
Model Syllabus Authors:	

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

Course Outcomes (COs):

At the end of the course the student should be able to understand:

1. The structure and function of the cell organelles.
2. The chromatin structure and its location.
3. The basic principle of life, how a cell divides leading to the growth of an
4. Organism and also reproduces to form a new organisms.
5. How a cell communicates with its neighboring cells.
6. The principles of inheritance, Mendel's laws and the deviations.
7. How environment plays an important role by interacting with genetic factors.
8. Detect chromosomal aberrations in humans and study of pedigree analysis.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	**CCT1**	**CC 2**	**CC 3**	**CC 4**	**CC 5**	**CC 6**	**CC 7**	**CC 8**	**CC 9**	**CC 10**	**CC 11**
I Core competency	X										
II Critical thinking	X										
III Analytical reasoning	X										
IV Research skills	X										
V Team work	X										

Note: Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Semester I- Zoology Core Course I Content:

Content	**Hours**
Unit I	**14**
Chapter 1. Structure and Function of Cell Organelles I in Animal cell • Plasma membrane: chemical structure—lipids and proteins • 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 (3:1- Body colour in Drosophila) and Incomplete Dominance (1:2:1- Plumage pigmentation in fowl) • Penetrance and expressivity • Genetic Sex-Determining Systems, Environmental Sex Determination, Sex Determination and mechanism in *Drosophila melanogaster.* • Sex-linked characteristics in humans and dosage compensation	
Chapter 6. Extensions of Mendelism, Genes and Environment • Extensions of Mendelism: Multiple Alleles (ABO blood groups in humans), Gene Interaction. (Supplementary factors - 9:3:3:1 - Comb pattern in fowls Dominant Epistasis - 12:3:1 - Plumage colour in Leghorn and Wyandotte Recessive Epistasis - 9:3:4 - Coat colour in Guinea pigs Complementary factors - 9:7 - Flower colour in sweet peas) . • The Interaction Between Sex and Heredity: Sex-Influenced and Sex-Limited Characteristics • Cytoplasmic Inheritance (in Paramecium), Genetic Maternal Effects. • Interaction between Genes and Environment: Environmental Effects on Gene Expression, Inheritance of Continuous Characteristics (Polygenic inheritance in man – skin colour)	
Unit IV	**14**
Chapter 7. Human Chromosomes and Patterns of Inheritance • Patterns of inheritance: autosomal dominance (Achondroplasia), autosomal recessive (Sickle cell anaemia), X-linked recessive (Colour blindness),X-linked dominant (Vitamin D-resistant rickets). • Chromosomal anomalies: Structural and numerical aberrations with examples (Structural – deletion, duplication, translocation, inversion; Numerical – Aneuploidy – Klinefelter's, Turner's and Down Syndrome). • 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: *Plasmodium vivax ,Giardia and Wuchereria.*	

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	15
Class performance/Participation	05
Total	40

Date: Co-ordinator **Subject Committee Chairperson**

Scheme of Examination: Theory (Semester I)

Question No.	**PART - A**	Marks
I	Answer any SIX Questions out of EIGHT Questions (2 questions of 2 marks from each unit)	6 x 2 = 12
	PART - B	
	Unit - I	
II **III**	3 Marks Questions (Answer any TWO out of THREE) 6 Marks Questions (Answer any ONE out of TWO)	3 x 2 = 6 6 x 1 = 6
	Unit - II	
IV **V**	3 Marks Questions (Answer any TWO out of THREE) 6 Marks Questions (Answer any ONE out of TWO)	3 x 2 = 6 6 x 1 = 6
	Unit - III	
VI **VII**	3 Marks Questions (Answer any TWO out of THREE) 6 Marks Questions (Answer any ONE out of TWO)	3 x 2 = 6 6 x 1 = 6
	Unit - IV	
VIII **IX**	3 Marks Questions (Answer any TWO out of THREE) 6 Marks Questions (Answer any ONE out of TWO)	3 x 2 = 6 6 x 1 = 6
	Total	**60**

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 Assessment Marks: **20**	Summative Assessment Marks: **30**
Model Syllabus Authors:	

Course Outcomes (COs):

At the end of the course the student should be able to:

1. To use simple and compound microscopes.
2. To prepare stained slides to observe the cell organelles.
3. To be familiar with the basic principle of life, how a cell divides leading to the growth of an organism and also reproduces to form new organisms.
4. The chromosomal aberrations by preparing karyotypes.
5. How chromosomal aberrations are inherited in humans by pedigree analysis in families.
   The antigen-antibody reaction.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	**CC P1**	**CC 2**	**CC 3**	**CC 4**	**CC 5**	**CC 6**	**CC 7**	**CC 8**	**CC 9**	**CC 10**	**CC 11**
I Core competency	X										
II Critical thinking	X										
III Analytical reasoning	X										
IV Research skills	X										
V Team work	X										

Note: Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark ‘X’ in the intersection cell if a course outcome addresses a particular program outcome.

Lab Course Content

List of labs to be conducted	56 Hrs.
1. Understanding of simple and compound microscopes. 2. To study different cell types such as buccal epithelial cells, neurons, striated muscle cells using Methylene blue/any suitable stain (virtual/ slaughtered tissue). 3. To study the different stages of Mitosis in root tip of *Allium cepa* (Permanent slides and squash preparation. 4. To study the different stages of Meiosis in grasshopper testis (virtual or permanent slides). 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 being studied in theory) permanent microslides (*Plasmodium* signet ring and *Microfilaria*). 7. To learn the procedures of preparation of temporary and permanent stained slides, with available mounting material.(Coelenterate colony or crustacean/insect larva) 8. Study of mutant phenotypes of *Drosophila* sp. (from Cultures or Photographs) (any four). 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, New Delhi.

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	05
Class performance/Participation	05
Total	20

Date: **Course Co-ordinator** **Subject committee Chairperson**

Course Title/Code: Cell Biology & Cytogenetics Lab
(BSCC5ZOOP1)
Scheme of Practical Examination

Time: 3 hours Max. marks: 30

I. Identify and comment on the permanent slides **A** & **B** with labeled diagrams. 2 x 3 =06
(1- mitosis and 1- meiosis)
(Identification - ½ Mark; Labeled diagram – 1 Mark; Comments - 1½ Marks)

II. Squash - Make a stained squash preparation of onion root tip and Report.

or

Make a stained squash preparation of Polytene chromosomes and Report. = 06
(Stained slide preparation with at least one dividing stage - 3 Mark; Report - 3 Mark
or Stained slide preparation of Polytene chromosome - 3 Mark; Report - 3 Mark)

III. Identify the *Drosophila* mutant **C** with reasons. = 02
(Identification - ½ Mark; Chromosome number and site - ½ Mark; Characters -1 Mark)

IV. Identify the parasite D with reasons. = 02
(Identification - ½ Mark; Report - 1½ Mark)

V. Study of permeability of animal cells using salt solutions of different concentrations and report (experiment - 3 Marks; report- 2 Mark)

or

Prepare a stained slide of the buccal epithelial cells and report.
(Slide preparation - 3 Marks; report- 2 Mark) = 05

VI. Preparation of human karyotype **or** construction of a family pedigree chart. = 04

VII. Class Records. = 05

Minor Course Content

Semester: **I Semester, B. Sc., (Hons) Zoology**

Course Title: **BIOLOGY OF NON-CHORDATES**	Course Code: **MDC5ZOOT1**
Course Type: **Minor Discipline Core Theory, L-T-P: 4-0-0**	Course Credits: **4**
Total Contact Hours: **56**	Duration of ESA: **3 Hrs**
Formative Assessment Marks: **30**	Summative Assessment Marks: **70**
Model Syllabus Authors:	

Course Outcomes (COs):

At the end of the course the student should be able to:

1. Learn the structural biology of non-chordates through their adaptive features.
2. Study the functional biology of non-chordates through their body organization and its function.
3. Comprehend identification of species and their evolutionary relationships.
4. Enhancement of research skills like critical thinking.
5. Develop abilities required for industrial employment as well as self-employment.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) /(POs)	MDC5ZOOT1	MDC5ZOOT2	MDC5ZOOT3	MDC5ZOOT4	MDC5ZOOT5	MDC5ZOOT6
I Core competency	X					
II Critical thinking	X					
III Analytical reasoning	X					
IV Research skills	X					
V Team work	X					

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Course Content	Hrs
Unit I	**14**
Chapter 1. Animal Architecture- Body symmetry- asymmetry, radial, biradial and bilateral symmetry with suitable example and Significance. Body organization- Protoplasmic, cellular, tissue and organ level of organization with suitable examples and Significance. Diploblasty (apparent and absolute) and Triploblasty with suitable Examples and Significance. Coelom- Acoelom, Pseudocoelom, and Eucoelom with suitable examples and Significance. Metamerism- Psuedometamerism (Strobilization), Eumetamerism with suitable examples and Significance. Cephalization- origin and significance. **Chapter 2.** General characters and classification of major Invertebrate phyla- Protozoa,	

Porifera, Coelenterata, Helminthes, Annelida, Arthropoda, Mollusca and Echinodermata up to the level of classes with suitable examples.	
Unit II	**14**
Chapter 3. Diversity of life sustaining systems in nonchordates: (with an example for each type of system) Locomotion: Protozoa- amoeboid (Sol-Gel theory), Flagellar, euglenoid and ciliary movements. Hydrostatic movements in Annelida-Earthworm and Echinodermata-starfish. Nutrition: In Protozoa. Feeding apparatus and mechanism: In Annelida-filter feeding, Arthropoda-Prawn, Mollusca-Pila and Echinodermata-Sea Star. Respiration: In Protozoa-diffusion, Helminthes-parasitic, Annelida-cutaneous, Arthropoda (any one type), Mollusca (Gill) and Echinodermata (Dermal papillae and Tube feet). Circulation: In Protozoa (cyclosis), Annelida- Earthworm, Arthropoda-Prawn, Mollusca-Pila and Echinodermata- Sea Star. Osmoregulation and excretion: In Protozoa-Contractile vacuoles, Platyhelminthes- Flame cells, Annelida-Nephredia and Arthropoda-Green glands.	
Unit III	**14**
Chapter 4. Diversity of coordinating systems and generative systems in nonchordates: (with an example for each type of system) Nervous system in Coelenterata, Platyhelmintes, Annelida, Arthropoda, Mollusca and Echinodermata. Neuroendocrine system and pheromones in Insecta. Sense organs: Mechanoreceptors, Photoreceptors, Chemoreceptors, thigmoreceptors, rheoreceptors and proprioreceptors. Reproduction: Asexual and sexual reproduction in Protozoa, Porifera, Coelenterate, Annelida and Echinodermata. Metamorphosis in Insecta. Larval forms of Coelenterata, Annelida and Echinodermata.	
Unit IV	**14**
Chapter 5. Beneficial non-chordates: Non-chordates used as food; Arthropoda and Mollusca. Non-chordates in Industry and Industrial products; Silkworm-silk, Lac Insect-shellac, Honey bees-bee wax, Pearl Oysters- pearls, Corals, sponges, shells dyes and pigments. Non-chordates in medicinal use-Leeches, Maggot larva and honey. Non-chordates in agriculture-earthworms, pollinators and pest controllers. Non-chordates in food chain and as scavengers. **Chapter 6.** Harmful non-chordates Parasitic Platyhelminthes. Soil Nematodes. Agricultural, veterinary and human pests of Arachnida. Agricultural, veterinary and human pests of Arthropoda.	07 07

Topics Suggested for Assignment/ Formative Assessment:

Animal connecting links. 2. Polymorphism 3. Parasitic adaptations 4. Metamorphosis 5.Freshwater sponges 6. Molluscans of industrial value 7. Coral reefs and their role in ecosystem generation 8. Invertebrate minor phyla 9. Regeneration in sponges and *Planaria*10.Soil and water protozoa

Recommended Books:

- Barnes, R. S. K.; Calow, P.; Olive, P. J. W.; Golding, D. W.; Spicer, J. I. (2002) The Invertebrates: a Synthesis, Blackwell Publishing.
- Hickman, C.; Roberts, L.S.; Keen, S.L.; Larson, A. and Eisenhour, D. (2018) Animal Diversity, McGraw-Hill.
- Holland, P. (2011) The Animal Kingdom: A Very Short Introduction, Oxford University Press.
- Barrington, E.J.W. (1979) Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.
- Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
- Bushbaum, R. (1964) Animals without Backbones. University of Chicago Press.

Web Sources:

Animal Diversity (https://swayam.gov.in/courses/5686-animal-diversity)

Advances in Animal Diversity, Systematics and Evolution

(https://swayam.gov.in/courses/5300-zoology)

ePGPathshala (MHRD)Module 10, 18, 19 of the paper P-08 (Biology of Parasitism)
https://epgp.inflibnet.ac.in/ahl.php?csrno=35

Pedagogy: Lectures, Presentations, videos, Assignments and Weekly Formative Assessment Tests.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Assignment/ Field Report/ Project	15 Marks
Test	10 Marks
Participation in class	05 marks
Total	**30 Marks**

Date: **Co-Ordinator** **Subject Committee Chairperson**

Minor Course Lab Content

Semester: **I**

Course Title: **Lab on BIOLOGY OF NON-CHORDATES**	Course Credits: **02**
Course Type: **Minor Discipline Core Practical, L-T-P: 0-0-4**	Corse Code: **MDC5ZOOP1**
Total Contact Hours: **56**	Duration of ESA: **03 Hours**
Formative Assessment Marks: **15**	Summative Assessment Marks: **35**
Model Syllabus Authors:	

Course Outcomes (COs):

At the end of the course the student should be able to:

1. Understand basics of classification of non-chordates.
2. Learn the diversity of habit and habitat of these species.
3. Develop the skills to identify different classes and species of animals.
4. Know uniqueness of a particular animal and its importance
5. Enhancement of basic laboratory skill like keen observation and drawing.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	**MDC5ZOOP1**	**MDC5ZOOP2**	**MDC5ZOOP3**	**MDC5ZOOP4**	**MDC5ZOOP5**	**MDC5ZOOP6**
I Core competency	X					
II Critical thinking	X					
III Analytical reasoning	X					
IV Research skills	X					
V Team work	X					

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

MDC Lab I Course Content

List of labs to be conducted	**Hours**
1. Preparation and observation of protozoan culture. *2.* **Protozoa**: Systematics of *Amoeba, Euglena, Noctiluca, Paramecium* and *Vorticella* (Permanent slides). 3. **Porifera:** Systematics of *Sycon, Euplectella, Hyalonema, Spongilla*and *Euspongia*(Specimens). Study of permanent slides of T.S of *Sycon*, spicules and gemmules. 4. **Cnidaria:** Systematics of *Aurelia* and *Metridium*(Specimens). Slides of *Hydra, Obelia*-polyp and medusa, and *Ephyra* larva, T.S. of *Metridium* passing throughmesenteries. *5.* **Study of Corals**-*Astraea, Fungia, Meandrina, Corallium, Gorgonia, Millepora* and *Pennatula.*	56

6. **Helminthes:** Systematics of *Planaria, Fasciola hepatica* and *Taenia solium,* Ascaris-Male and female (Specimens). Slides of T.S. of *Planaria*, T.S of male and female *Ascaris*, 7. **Annelida:** Systematics of *Nereis, Heteronereis, Sabella, Aphrodite* (Specimens).Slide of T.S. of Earth worm through typhlosole. 8. **Arthropoda**: Systematics of Panaeus, Palaemon, Astracus, Scorpion, Spider, Limulus, Peripatus, Millipede, Centipede, Praying mantis, Termite Queen, Moth, Butterfly, Dung beetle/Rhinocerous beetle (Any six specimens).Slide of Larvae-Nauplius, Zoea, Mysis. 9. **Mollusca:** Systematics of *Chiton, Mytilus, Aplysia, Pila, Octopus, Sepia,*Glochidium larva (Specimens). 10. **Shell Pattern**-*Unio, Ostrea, Cypria, Murex, Nautilus, Patella, Dentalium,*Cuttle bone. 11. **Echinodermata**: Systematics of Sea star, Brittle star, Sea Urchin, Sea cucumber, Sea lilly (Specimens).Slide of Bipinnaria larva, Echinopluteus larva and Pedicellaria. 12. **Harmful Nonchordates:** Soil Nematodes. Agricultural, veterinary and human pests of Arachnida. Agricultural, veterinary and human pests of Arthropoda. **13. Beneficial Nonchordates:** 14. **Sericulture:** Life cycle of *Bombyxmori*, Uzi fly, Cocoon, Raw silk. 15. **Apiculture**: Any 2 Species of honey bee, bee wax. 16. **Pearl Culture**: Pearl Oyster and Natural Pearls. 17. **Virtual Dissection/Cultured specimens:** Earthworm – Nervous system Leech-Digestive System 18. **Virtual Dissection/ Cultured specimens:** Prawn - Nervous system. Cockroach-Salivary Apparatus and Digestive system.	

Recommended Books:

- Barnes, R. S. K.; Calow, P.; Olive, P. J. W.; Golding, D. W.; Spicer, J. I. (2002) The Invertebrates: a Synthesis, Blackwell Publishing.
- Hickman, C.; Roberts, L.S.; Keen, S.L.; Larson, A. and Eisenhour, D. (2018) AnimalDiversity, McGraw-Hill.
- Holland, P. (2011) The Animal Kingdom: A Very Short Introduction, OxfordUniversity Press.
- Barrington, E.J.W. (1979) Invertebrate Structure and Functions. II Edition. E.L.B.S.and Nelson.
- Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia PublishingHome.
- Bushbaum, R. (1964) Animals without Backbones. University of Chicago Press.

Web References:

Anatomy of earthworm: The dissection works (CD); www.scienceclass.com, www.neosci.com
Cockroach dissection- www.ento.vt.edu

Pedagogy: Lectures, Presentations, videos, Labs, Assignments, Tests, Individual or group Field oriented Project Report on**,** Visit to one research institute/ one wild life sanctuary / museum / zoo.

TOPICS RECOMMENDED FOR PROJECT/ MONOGRAPH PREPARATION

General account of protozoan ooze.
Monograph on sea anemones.
Monograph on polychaetes.
Monograph on leeches.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Assignment/Monograph	05
Test	05
Participation in class	05
Total	**15**

Date: **Co-Ordinator** **Subject Committee Chairperson**

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 Outcomes (COs):

At the end of the course the student will be able to:

1. Gain knowledge about silkworms rearing and their products.
2. Gain knowledge in Bee keeping equipment and apiary management.
3. Acquaint knowledge on dairy animal management, the breeds and diseases of cattle and learn the testing of egg and milk quality.
4. Acquaint knowledge about the culture techniques of fish and poultry.
5. Acquaint the knowledge about basic procedure and methodology of vermiculture.
6. Learn various concepts of lac cultivation.
7. Students can start their own business i.e. self-employments.
8. Get employment in different applied sectors

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	**CC 1**	**CC 2**	**CC 3**	**CC 4**	**CC 5**	**CC 6**	**CC 7**	**CC 8**	**CC 9**	**CC 10**	**CC 11**	**CC 12**
I Core competency	X											
II Critical thinking	X											
III Analytical reasoning	X											
IV Research skills	X											
V Team work	X											

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark ‘X’ in the intersection cell if a course outcome addresses a particular program outcome.

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 *Bombyx mori* • 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 *Apis indica* • 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.	

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	**15**
Class performance/Participation	**05**
Total	**40**

Date: Course Co-Ordinator **Subject Committee Chairperson**

Scheme of Examination: Open elective (Semester I)

Question No.	**PART - A**	Marks
I	Answer any SIX Questions out of NINE Questions (3 questions of 2 marks from each unit)	6 x 2 = 12
	PART - B	
	Unit - I	
II **III**	3 Marks Questions (Answer any THREE out of FOUR) 7 Marks Questions (Answer any ONE out of TWO)	3 x 3 = 9 7 x 1 = 7
	Unit - II	
IV **V**	3 Marks Questions (Answer any THREE out of FOUR) 7 Marks Questions (Answer any ONE out of TWO)	3 x 3 = 9 7 x 1 = 7
	Unit - III	
VI **VII**	3 Marks Questions (Answer any THREE out of FOUR) 7 Marks Questions (Answer any ONE out of TWO)	3 x 3 = 9 7 x 1 = 7
	Total	**60**

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 Outcomes (COs):

At the end of the course the student:

1. Understands the importance of earthworms in maintaining soil quality.
2. Learns that the vermicomposting is an effective organic solid waste management method.
3. Gets acquainted with the importance of earthworms in agro-based economic activity.
4. Vermicomposting leads to organic farming and healthy food production.
5. Vermicomposting may be taken up as a small scale industry by the farmers and unemployed youth.
6. Get jobs in teaching institutions or vermiculture units as technicians.
7. Learn the concept of vermicomposting as bio fertilizers thus student can become an entrepreneur after completion of the course.
8. Best opportunity for self-employment and lifelong learning with farmers.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)		VEC5ZOOP1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
i	Core competancy.	**X**											
ii	Critical thinking.	**X**											
iii	Analytical reasoning.	**X**											
iv	Research skill.	**X**											
v	Team work.	**X**											

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark ‗X' in the intersection cell if a course outcome addresses a particular program outcome.

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 ***Eisenia fetida*** and ***Eudrilus eugeniae.***	
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 varmicompost.	
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) ― Verms and Vermicomposting‖ Proceedings of the National Seminar on Organic Waste Utilization and Vermicomposting
   Dec. 5-8, 1984, (Part B), School of Life Sciences, Sambalpur University, 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

Date: **Course Coordinator** **Subject Committee Chairperson**

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

For II Semester B.Sc.

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 Assessment Marks: **40**	Summative Assessment Marks: **60**
Model Syllabus Authors:	

Course outcomes:

The student at the completion of the course will learn:

1. To develop a deep understanding of structure of biomolecules like proteins, lipids and carbohydrates.
2. How simple molecules together form complex macromolecules.
3. To understand the thermodynamics of enzyme catalyzed reactions.
4. Mechanisms of energy production at cellular and molecular levels.
5. To understand various functional components of an organism.
6. To explore the complex network of these functional components.
7. To comprehend the regulatory mechanisms for maintenance of function in the body.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	CC 1	CC T2	CC 3	CC 4	CC 5	CC 6	CC 7	CC 8	CC 9	CC 10	CC 11
I Core competency		X									
II Critical thinking		X									
III Analytical reasoning		X									
IV Research skills		X									
V Team work		X									

Note: Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

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) (Structure of Glucose, Lactose and Glycogen only) • Lipids (saturated and unsaturated Fatty acids, Tri-acylglycerols, Phospho lipids, Glycolipids and Steroids) • Structure, Classification and General Properties of 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 Michaela's -Mendon, Concept of Km and V max, Enzyme inhibition • Clinical importance of enzymes.	
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 andcapacities; 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 and functions. • 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:

I. Nelson & Cox: Leininger's Principles of Biochemistry: McMillan (2000)

2. Zubay et al: Principles of Biochemistry: WCB (1995)

3. Voet & Voet: Biochemistry Vols l & 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, Xl 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. Anima l physiology. Vol. 2. Sunderland, MA: Sinauer Associates, (2004).

9. Chatterjee CC Human Physiology Volume l & 2, 11th edition, CBS Publishers (20 I 6).

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	15
Class performance/Participation	05
Total	**40**

Date: Coordinator **Subject Committee Chairperson**

Scheme of Examination: Theory (Semester II)

Question No.	**PART - A**	Marks
I	Answer any SIX Questions out of EIGHT Questions (2 questions of 2 marks from each unit)	6 x 2 = 12
	PART - B	
	Unit - I	
II **III**	3 Marks Questions (Answer any TWO out of THREE) 6 Marks Questions (Answer any ONE out of TWO)	3 x 2 = 6 6 x 1 = 6
	Unit - II	

IV **V**	3 Marks Questions (Answer any TWO out of THREE) 6 Marks Questions (Answer any ONE out of TWO)	3 x 2 = 6 6 x 1 = 6
	Unit - III	
VI **VII**	3 Marks Questions (Answer any TWO out of THREE) 6 Marks Questions (Answer any ONE out of TWO)	3 x 2 = 6 6 x 1 = 6
	Unit - IV	
VIII **IX**	3 Marks Questions (Answer any TWO out of THREE) 6 Marks Questions (Answer any ONE out of TWO)	3 x 2 = 6 6 x 1 = 6
	Total	**60**

Zoology Semester II Core Course Lab Content

Course Title/Code: **Biochemistry andPhysiology Lab**	Course Credits: **2**
Course Code: **DSCC5Z00P2**	L-T-P per week: **0-0-4**
Total Contact Hours**: 56**	Duration of ESA: **3 Hours**
Formative Assessment Marks: **20**	Summative Assessment Marks: **30**
Model Syllabus Authors:	

Course Outcomes (COs):

At the end of the course the student should be able to understand:
Basic structure of biomolecules through model making.
Develop the skills to identify different types of blood cells.
Enhance basic laboratory skill like keen observation, analysis and discussion.
Learn the functional attributes of biomolecules in animal body.
Know uniqueness of enzymes in animal body and their importance through enzyme kinetics.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	**CC P1**	**CC P2**	**CC 3**	**CC 4**	**CC 5**	**CC 6**	**CC 7**	**CC 8**	**CC 9**	**CC 10**	**CC 11**
I Core competency		X									
II Critical thinking		X									
III Analytical reasoning		X									
IV Research skills		X									
V Team work		X									

Note: Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

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 (Molisch's test, Iodine test, Benedict's test), Proteins (Xanthoproteic test/Biuret test/Ninhydrin test-any 2 tests) and Lipids (Greasy spot test). 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 (amylase) - Effect of temperature and time. 9. Action of salivary amylase under optimum conditions. 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's haemoglobinometer.	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.inwww.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 l & 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, Xl 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. Anima l physiology. Vol. 2. Sunderland, MA: Sinauer Associates, (2004).
9. Chatterjee CC Human Physiology Volume l & 2, 11th edition, CBS Publishers (20 I 6).

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/ASSIGNMENT/MONOGRAPH

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/Seminar/Project Report	10
Test	05
Participation in class	05
Total	**20**

Date: Coordinator **Subject Committee Chairperson**

Course Title/Code: Biochemistry and Physiology Lab
(BSCC5ZOOP2)
Scheme of Practical Examination

Time: 3 hours Max. marks: 30

I. Biochemistry experiment (by lots). = 10
Conduct suitable qualitative tests for the detection of Organic compounds/Nitrogenous Wastes in the sample provided and report.
(Name of the test - 1 Mark; Principle - 2 Marks; Conducting the test - 3 Marks; Procedure/observation/inference (in tabular form) -3 Marks; Result -1 Mark)

II. Conduct tests and report the salivary amylase activity of human saliva = 05
(Common for all) (Conducting the test - 3 Marks; report – 2 Marks)

III. Physiology experiment (by lots). =10
Conduct Physiology experiment as per lots and report
(Conducting the test - 4 Marks; Principle/Procedure/observation/calculation/ Inference - 4 Marks; Result - 2 Marks)

IV. Class Records = 05

Course Content

Semester: I**I Semester B. Sc., (Hons) Zoology** **Minor Core course**

Course Title: **PAPER I-BIOLOGY OF CHORDATES**	Course Code: **MDC5ZOOT2**
Course Type: **Minor Discipline Core Theory, L-T-P: 4-0-0**	Course Credits: **4**
Total Contact Hours: 5**6**	Duration of ESA: **3 Hrs**
Formative AssessmentMarks:**30**	Summative Assessment Marks: **70**
Model Syllabus Authors:	

Course Outcomes (COs):

At the end of the course the student should be able to:

1. Learn the structural biology of Chordates through their adaptive features.
2. Study the functional biology of Chordates through their body organization and functions.
3. Comprehend the identification of species and their evolutionary relationships.
4. Enhancement of research skills like critical thinking.
5. Develop abilities required for industrial employment as well as self-employment.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) /(POs)	**MDC5ZOO T1**	**MDC5ZOOT2**	**MDC5ZOOT3**	**MDC5ZOOT4**	**MDC5ZOOT5**	**MDC5ZOOT6**
I Core competency		X				
II Critical thinking		X				
III Analytical reasoning		X				
IV Research skills		X				
V Team work		X				

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Course Content	Hrs
Unit I	**14**
Chapter 1: Hemichordata: Type Study of *Balanoglossus* – Habit and Habitat, Morphology, Coelom. Tornaria larva and its affinities. Affinities and systematic position of Hemichordata. **Chapter 1: Chordates:** Origin of Chordates. Basic characters of chordates and classification upto classes. **Chapter 3:Urochordata :** Type Study of *Herdmania*-Habit and Habitat, Morphology, Ascidian tadpole- structure and its retrogressive metamorphosis. **Chapter 4: Cephalochordata :** Type Study of *Branchiostoma* (*Amphioxus*)-Habit and Habitat, Morphology,Digestive system, Feeding mechanism and circulatory system. **Chapter 5:Agnatha** General characters of Agnatha and classification upto classes. Salient features of Cyclostomata and Ostracodermi with orders and examples. Ammocoete larva and its significance.	
Unit II	**14**
Chapter 6: Vertebrates: General characters and Classification of different classes of vertebrates (Pisces, Amphibia, Reptilia, Aves, Mammalia) up to the order withexamples. General characters of Chondrichthyes and Osteichthyes. Interesting features and evolutionary significance of Dipnoi. Salient features of Placodermi with examples. Interesting features of Sphenodon. Interesting features of Archaeopteryx. Salient features of Ratitae and Carinatae with examples. Interesting features of mammalian orders (Insectivora, Carnivora, Chiroptera, Cetacea, Proboscidia, Ungulata – Perissodactyla and Artiodactyla, and Primates –Platyrhini and Catarhini) with examples.	
Unit III	**14**
Chapter 7: General account of Chordates: Types of caudal fins and tails in fishes. Osmoregulation and Swim bladder in Fishes. Origin of Amphibia. Neoteny and Paedogenesis. Adaptive radiation in extinct reptiles with suitable examples. Temporal fossae in reptiles. Poison apparatus and biting mechanism in snakes. Parental care in Pisces, Amphibians, Reptiles, Birds and Mammals. Dentition in mammals. Evolution of molar tooth. Migration in Pisces, and Birds and Mammals. **Chapter 8:** Type study of *Rattus:* Morphology, Endoskeleton (Axial and appendicular skeleton, except hands and feet) Digestive system, circulatory system, reproductive system.	
Unit IV	**14**
Beneficial Chordates:	

Chapter 9:Pisciculture Meaning of Aquaculture and Pisciculture, inland and marine fisheries. Inland Pisciculture – Procedure, composite fish forming and significance. A brief account of fishing gears and crafts. Fish processing and preservation. **Chapter 10:Poultry** Definition, breeds of Fowls. Indigenous and exotic breeds with suitable examples. Poultry products and by-products. Diseases of poultry – Ranikhet, Fowl pox, Fowl Cholera, Fowl Typhoid. **Chapter 11:Dairy** Breeds of cattle: indigenous and exotic breeds. Improvements in cattle breeding – artificial insemination, MOET. Pasteurization and gobar gas. Diseases in cattle- Foot and Mouth diseases, causes and effects.	

Topics Suggested for Assignment/ Formative Assessment:

1. Animal connecting links. 2. Migration in Birds 3. Communication in Primates 4. Parental Care in Animals 5. Neoteny 6. Paedogenesis 7. Poultry management 8. Dairy Management 9. Fisheries management 10.Products and by-products of Diary.

Suggested Readings:

1. Harveyetal: TheVertebrate Life (2006)
2. Colbertetal:Colbert'sEvolutionoftheVertebrates:Ahistoryofthebackbonedanimalsthroughtime (5thed2002,Wiley-Liss)
3. Hildebrand:AnalysisofVertebrateStructure(4thed1995,JohnWiley)
4. KennethV.Kardong(2015)Vertebrates:ComparativeAnatomy,Function,EvolutionMcGrawHill
5. McFarlandetal:VertebrateLife(1979,MacmillanPublishing)
6. ParkerandHaswell:TextBookofZoology,Vol.II(1978,ELBS)
7. Romer and Parsons: The Vertebrate Body(6thed 1986,CBSPublishingJapan)
8. Young:TheLifeofvertebrates(3rded2006,ELBS/Oxford)
9. WeichertC.KandWilliamPresch(1970).ElementsofChordateAnatomy,TataMcGrawHills

Web Sources:

1. https://www.khanacademy.org/science/biology/crash-course-bio-ecology/crashncourse-biology-science/v/crash-course-biology-123
2. https://opentextbc.ca/biology2eopenstax/chapter/chordates/

Pedagogy: Lectures, Presentations, videos, Assignments and Weekly Formative Assessment Tests.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Assignment/ Field Report/ Project	15 Marks
Test	10 Marks
Participation in class	05 marks
Total	**30 Marks**

Date: Co-Ordinator **SubjectCommitteeChairperson**

Minor Core Course Lab Content

Semester: II Zoology

Course Title: **Lab on Biology of Chordates, L-T-P: 0-0-4**	Course Credits: **2**
Total Contact Hours: 5**6**	Duration of ESA: **3 Hours**
Formative AssessmentMarks:**15**	Summative Assessment Marks: **35**
Model Syllabus Authors:	

Course Outcomes (COs):

At the end of the course the student should be able to:

1. Understand basics of classification of Chordates.
2. Learn the diversity of habit and habitat of animal species.
3. Develop the skills to identify different classes and orders of Chordates.
4. Know uniqueness of particular animal and its importance
5. Enhancement of basic laboratory skill like keen observation and drawing.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	**MDC5ZOOP1**	**MDC5ZOOP2**	**MDC5ZOOP3**	**MDC5ZOOP4**	**MDC5ZOOP5**	**MDC5ZOOP6**
I Core competency		X				
II Critical thinking		X				
III Analytical reasoning		X				
IVResearch skills		X				
V Team work		X				

Note: Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark ‘X’ in the intersection cell if a course outcome addresses a particular program outcome.

Minor Course Lab Content

List of labs to be conducted	56 Hours
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, Myolobaties* - Bony Fishes –Zebra fish, Hippocampus, Muraena, Ostracion, Tetradon, Pleuronectus, Diodon, Echeneis. **4. Ornamental fishes:** -Siamese, Koi, Oscar, Betta Sp., Neon tetra, Guppies, Gold fish, Angle fish, Rainbow fish, Mollies. **5. Accessory respiratory organs** – Saccobranchus, Clarias and Anabas. **6. Amphibia**: -Frog, Bufo, Ambystoma, Axolotl larva, Necturus and Ichthyophis. **7. Reptilia**: -Turtle, Tortoise, Mabuya, Calotes, Chameleon, Varanus. snakes –Dryophis, Rat snake, Brahmini, Cobra, Krait, Russell‘s viper and Hydrophis; Poison apparatus. **8. Aves:**Beak and feet modifications in the following examples: Duck, Crow, Sparrow, Humming bird, Parrot, King fisher, Eagle or Hawk. **9. Mammalia**: -Mongoose, Squirrel, Pangolin, Hedge Hog, Rabbit, Rat, Monkey and Loris. **10. Virtual Dissection/Cultured specimens:** -Shark/Bony fish: Afferent and efferent branchial systems, glossopharyngeal and vagus nerves. **11.Virtual Dissection/Cultured specimens:** - Frog: Origin and distribution of trigeminal nerve. **12. Virtual Dissection/Cultured specimens:** -Rat: Dissection (only demonstration) – Circulatory system (arterial and venous), urinogenital system. **Beneficial Chordates:** **13. Pisciculture:** **Cultured varieties of fishes-** fresh water and marine water fishes (locally available) **Diseases**- (Bacterial, viral, fungal and parasitic) **Products and by products-** (Meat, gelatin, Insulin, Isinglass, protein and chitin)	

14. Poultry: Cultured varieties- Indigenous and exotic species. **Diseases**- Bacterial and viral. **Products and by-products** –Meat, Eggs, albumin flakes and manure. **15. Dairy**: Cultured varieties-Indigenous and exotic breeds. **Diseases**- Infectious, hereditary and deficiency. **Products and by-products** – Milk, Cheese, Yougurt.	

Suggested Readings:

1. Harveyetal:TheVertebrateLife(2006)
2. Colbertetal:Colbert'sEvolutionoftheVertebrates:Ahistoryofthebackbonedanimalsthroughtime (5thed2002, Wiley-Liss)
3. Hildebrand: Analysis of Vertebrate Structure(4thed1995,JohnWiley)
4. KennethV.Kardong(2015)Vertebrates:ComparativeAnatomy,Function,EvolutionMcGrawHill
5. McFarlandetal:VertebrateLife(1979,MacmillanPublishing)
6. Parkerand Haswell: Text Book of Zoology, Vol. II(1978,ELBS)
7. Romerand Parsons: The Vertebrate Body(6thed 1986,CBSPublishingJapan)
8. Young: The Life of vertebrates(3rded2006,ELBS/Oxford)
9. WeichertC.KandWilliamPresch(1970).ElementsofChordateAnatomy,TataMcGrawHills

Web Sources:

1. https://www.khanacademy.org/science/biology/crash-course-bio-ecology/crashncourse-biology-science/v/crash-course-biology-123
2. https://opentextbc.ca/biology2eopenstax/chapter/chordates/

Pedagogy: Lectures, Presentations, videos, Assignments and Weekly Formative Assessment Tests.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Assignment/Monograph	05
Test	05
Participation in class	05
Total	**15**

Date: Co-Ordinator **Subject Committee Chairperson**

Open Elective Course Content

Semester**: II Zoology**

Course Title: **Parasitology** Course Code: **OEC5ZOOT2**	Course Credits:**3**
Total Contact Hours**: 42**	Duration of ESA: 3 Hours
Formative Assessment Marks: **40**	Summative Assessment Marks: **60**
Model Syllabus Authors:	

Course Outcomes (COs):

At the end of the course the students will be able to:

9. Know the stages of the life cycles of the parasites and infective stages.
10. Develop ecological model to know population dynamics of parasite, establishment of parasite population in host body, adaptive radiations and methods adopted by parasite to combat with the host immune system.
11. Develop skills and realize significance of diagnosis of parasitic infection and treatment.
12. Understand about diseases caused by Protozoa, Helminthes, Nematodes and Arthropods at molecular level.
13. Develop their future career in medical sciences and related administrative services.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	CC 1	CC 2	CC 3	CC 4	CC 5	CC 6	CC 7	CC 8	CC 9	CC 10	CC 11	CC 12
I Core competency	X											
II Critical thinking	X											
III Analytical reasoning	X											
IV Research skills	X											
V Team work												

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Course Content

Content	42Hrs
Unit – 1	
Chapter 1. General Concepts • Introduction, Parasites, parasitoids, host, zoonosis • Origin and evolution of parasites • Basic concept of Parasitism, symbiosis, phoresis, commensalisms and mutualism • Host-parasite interactions and adaptations • Life cycle of human parasites • Occurance, mode of infection and prophylaxis **Chapter 2. Parasitic Platyhelminthes** • Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of • *Fasciolopsis buski* • *Schistosoma haematobium* • *Taenia solium* • *Hymenolepis nana* **Chapter 3. Parasitic Protists** • Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of • *Entamoeba histolytica* • *Giardia intestinalis*	**14**

• *Trypanosoma gambiense* • *Plasmodium vivax*	
Unit – 2	**14**

Chapter 4. Parasitic Nematodes
• Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of
  • *Ascaris lumbricoides*
  • *Ancylostoma duodenale*
  • *Wuchereria bancrofti*
  • *Trichinella spiralis*
• Nematode plant interaction; Gall formation
Chapter 5. Parasitic Arthropods
• Biology, importance and control of
  • Ticks (Soft tick *Ornithodoros*, Hard tick *Ixodes*)
  • Mites (*Sarcoptes*)
  • Lice (*Pediculus*)
  • Flea (*Xenopsylla*)
  • Bug (*Cimex*)
• Parasitoid (Beetles)
Chapter 6. Parasitic Vertebrates
• Cookicutter Shark
• Hood Mocking bird and
Vampire bat and their parasitic behavior and effect on host	

Unit – 3	**14**

Chapter 7.Molecular diagnosis & clinical parasitology
• General concept of molecular diagnosis for parasitic infection
• Advantages and disadvantages of molecular diagnosis
• Fundamental techniques used in molecular diagnosis of endoparasites
• Immunoassay or serological techniques for laboratory diagnosis of endoparasites on the basis of marker molecules like *G.intestinalis, B. coli, E. histolytica, L. donovani*, Malarial parasite using
  • ELISA, RIA
  • Counter Current Immunoelectrophoresis (CCI)
  • Complement Fixation Test (CFT) PCR, DNA, RNA probe	

Suggested Readings:

19. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors.
20. E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea &Febiger.
21. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group.
22. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi.
23. Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers.
24. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd.
25. Gunn, A. and Pitt, S.J. (2012). Parasitology: an Integrated Approach. Wiley Blackwell.
26. Noble, E. R. and G.A.Noble (1982) Parasitology: The biology of animal parasites. V th Edition, Lea &Febiger.
27. Paniker, C.K.J., Ghosh, S. [Ed} (2013). Paniker‘s Text Book of Medical Parasitology. Jaypee, New Delhi.
28. Parija,S.C.Text book of medical parasitology, protozoology & helminthology (Text and color Atlas), IIEdition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi.
29. Roberts, L.S and Janovy, J. (2009). Smith & Robert‘s Foundation of Parasitology. 8th. Edn. McGraw Hill.

30. Bogitsh, B. J. and Cheng, T. C. (2000). Human Parasitology. 2nd Ed. Academic Press, New York.
31. Chandler, A. C. and Read. C. P. (1961). Introduction to Parasitology, 10th ed. John Wiley andSons Inc.
32. Cheng, T. C. (1986). General Parasitology. 2nd ed. Academic Press, Inc. Orlando.U.S.A.
33. Schmidt, G. D. and Roberts, L. S. (2001). Foundation of Parasitology. 3rd ed. McGraw Hill Publishers.
34. Schmidt, G. D. (1989). Essentials of Parasitology. Wm. C. Brown Publishers (Indian print1990, Universal Book Stall).
35. John Hyde (1996) Molecular Parasitology Open University Press.
36. J Joseph Marr and Miklos Muller (1995) Biochemistry and Molecular Biology of Parasites 2 ndEdn Academic Press.

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

Pedagogy: Chalk and Talk, PPT, Group discussion, Seminar, Interaction, virtual lab, Lab visit

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
House Examination/Test	**20**
Written Assignment/Presentation/Project / Term Papers/Seminar	**15**
Class performance/Participation	**05**
Total	**40**

Date: **Course Co-Ordinator** **Subject Committee Chairperson**

Scheme of Examination: Open elective (Semester II)

Question No.	**PART - A**	Marks
I	Answer any SIX Questions out of NINE Questions (3 questions of 2 marks from each unit)	6 x 2 = 12
	PART - B	
	Unit - I	
II **III**	3 Marks Questions (Answer any THREE out of FOUR) 7 Marks Questions (Answer any ONE out of TWO)	3 x 3 = 9 7 x 1 = 7
	Unit - II	
IV **V**	3 Marks Questions (Answer any THREE out of FOUR) 7 Marks Questions (Answer any ONE out of TWO)	3 x 3 = 9 7 x 1 = 7
	Unit - III	
VI **VII**	3 Marks Questions (Answer any THREE out of FOUR) 7 Marks Questions (Answer any ONE out of TWO)	3 x 3 = 9 7 x 1 = 7
	Total	**60**

Skill Enhancement Course Content

Semester: II Zoology

Course Title: Sericulture Course Code: VEC5ZOOP2	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 Outcomes (COs):

At the end of the course the student acquires the following knowledge:

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.
4. Student can be self-employed after successful completion of the course.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)		VEC5ZOOP1	VEC5ZOOP2	3	4	5	6	7	8	9	10	11	12
i	Core competancy.		**X**										
ii	Critical thinking.		**X**										
iii	Analytical reasoning.		**X**										
iv	Research skill.		**X**										
v	Team work.		**X**										

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark _X' in the intersection cell if a course outcome addresses a particular program outcome.

Course Content

List of Lab to be conducted		42 Hrs
1	Morphology and taxonomy of mulberry.	
2	Raising of saplings – cutting preparation, planting and maintenance of nursery.	
3	Agronomical practices in mulberry cultivation-weeding, manuring, irrigation and harvesting.	
4	Diseases and pests of mulberry.	
5	Silk producing insects – non mulberry and mulberry silk worms.	
6	Life cycle and morphology of ***Bombyx mori.***	
7	Dissection of digestive system and silk glands of ***Bombyx mori.***	
8	Silk worm rearing equipments.	
9	Rearing process – incubation, chawki rearing, late age worm rearing, mounting and harvesting of cocoons.	
10	Silk worm diseases and pests – Grasserie, Flacherie, Muscardine, Pebrine, Uzi fly and Beetles.	
11	Grainages – production of silk worm eggs**.**	
12	Physical and commercial characteristics of cocoons.	
13	Reeling and weaving process – stiffling , cooking , brushing, reeling and re-reeling, different types of looms.	
14	Visit to mulberry farm and sericulture centre.	
15	Economics of silk production (Project)	

Text Books and References

1. Govindan , R.,Narayanswami,T.K and Devaiah, M.C.1998,Principles of silk worm pathology.Ser Publishers ,Banglore.
2. Tazima, Y.1964 –The genetics of the silk worm‖ Logos Press Ltd.London .
3. Tazima Y 1978 The silk worm an important laboratory tool Kodnasha Ltd. Tokyo.
4. Ganga G ,SulochanaChetty J An introduction to sericulture Oxford and IBH Publishing Co.Pvt. Ltd. New Delhi.
5. Ullal and Narasimhanna Hand book of practiclesericulture .
6. FAO Mannuals on sericulture vol . 1-4.
7. Tazima Y 1958 Silkworm egg CSB Publication ,Bombay .
8. Yashimoro Tanaka 1964 Sericology CSB Publication , Bombay.

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 Mulberry Farm and Sericulture centre.	05
Total	15

Date: **Course Co-Ordinator** **Subject Committee Chairperson**

Mangalore University

National Education Policy-2020 (NEP-2020)

Curriculum Structure for Degree Program
B. Sc. in Zoology
(Basic and Honours)

Syllabus and Scheme of Examination of
Discipline Core and Open Elective courses
For III and IV Semesters

Academic Year 2022-23 onwards

Syllabus for B.Sc. (Basic & Honours) in Zoology

Name of the Degree Program: **B. Sc. (Basic & Hons)** Discipline Core: **Zoology** Total Credits for the Program: **50/100/142/184/268** Starting year of implementation: **2021-22 (I & II sem)** **2022-23 (III & IV sem)**	Progressive Certificate, Diploma, Bachelor Degree or Bachelor Degree with Honours Provided at the End of Each Year of Exit of the Four-year Undergraduate Programme/ Five-year Integrated Master's Degree Programme.

Introduction:

The curriculum framework takes into account the need to maintain globally competitive standards of achievement in terms of the knowledge and skills in Zoology and allied courses, as well develop scientific orientation, spirit of enquiry problem solving skills and human and professional values which foster rational and critical thinking in the students. This course serves as plethora of opportunities in different fields right from classical to applied Zoology.

AIMS AND OBJECTIVES OF UG PROGRAM IN ZOOLOGY

- The Program offers both classical as well as modern concepts of Zoology in higher education.
- It enables the students to study animal diversity in both local and global environments.
- To make the study of animals more interesting and relevant to human studies more emphasis is given to branches like behavioural biology, evolutionary biology and economic Zoology.
- More of upcoming areas in cell biology, genetics, molecular biology, biochemistry, genetic engineering and bioinformatics have also been included.
- Equal importance is given to practical learning and presentation skills of students.
- The lab courses provide the students necessary skills required for their employability.
- Skill enhancement courses in classical and applied branches of Zoology enhance enterprising skills of students.
- The global practices in terms of academic standards and evaluation strategies.
- Provides opportunity for the mobility of the student both within and across the world.
- The uniform grading system will benefit the students to move across institutions within India to begin with and across countries.
- It will also enable potential employers in assessing the performance of the candidates across the world.

Course content under New Education Policy Year 2022-23 for III Semester B.Sc. Zoology Core Course Content

Course Title/Code: **Molecular Biology, Bioinstrumentation & Techniques in Biology**	Course Credits: **4**
Course Code: **BSCZOCN301**	L-T-P per week: **4-0-0**
Total Contact Hours**: 56**	Duration of ESA: **2 Hours**
Formative Assessment Marks: 4**0**	Summative Assessment Marks: **60**

Course Outcomes (COs):

At the end of the course the student should be able to understand:

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.
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.
3. Acquiring knowledge on instrumentation and techniques in biology.

Semester III - Zoology Core Course Content:

Content	Hours
Unit -I	14
Chapter 1: Process of Transcription • Fine structure of gene: Cistron, Recon, Muton. • RNA polymerases: Types and functions. • Protein synthesis: Introduction, phases-transcription, translation. • Transcription in prokaryotes and eukaryotes: Steps involved, differences between prokaryote and eukaryote transcription.	8
Chapter 2: Process of Translation • Genetic code: Definition, salient features. • Translation in prokaryotes and eukaryotes: Steps involved.	6
Unit II	**14**
Chapter 3. Regulation of gene expression-I • Regulation of gene expression in prokaryotes: lac operon (inducible) and trp operon (repressible) in *E. coli.* • Regulation of gene expression in eukaryotes - Role of chromatin	9

(euchromatin and heterochromatin) in gene expression. • Post-transcriptional modification: capping, splicing, polyadenylation. • Concept of RNA editing (mRNA), gene silencing, and, RNAi (RNA interference).	
Chapter 4. Regulation of gene expression-II • Post-translational modifications: purpose, advantages and significance; glycosylation, methylation, phosphorylation, and acetylation. • Intracellular protein degradation (lysosomal autophagy and ubiquitin proteosome pathway).	5
Unit III	**14**
Chapter 5: Microscopy • Principles and applications of Light microscopy, Dark field microscopy, Phase contrast microscopy, Fluorescence microscopy, Confocal microscopy and Electron microscopy (SEM and TEM).	9
Chapter 6: Centrifugation and Chromatography • Centrifugation: Principles, types and applications. (High speed and Ultracentrifugation) • Chromatography: Principle and applications of TLC and HPLC and GC.	5
Unit IV	**14**
Chapter 7: Biochemical Instrumentation • Colorimetry and Spectrophotometry: Definition, principle and applications. Beer-Lambert's law, UV-Vis Spectrophotometer. • pH meter, measurement of pH. • Principle, applications and safety measures of Radio-tracer techniques - Autoradiography.	6
Chapter 8: Molecular Techniques • Principle and applications of Agarose gel-electrophoresis, SDS-PAGE, DNA Sequencing (Sanger's Dideoxy method), • PCR, DNA Fingerprinting, ELISA, Southern Blotting and Western Blotting.	8

Suggested Reading:

1. Chromatography: https://microbenotes.com/chromatography-principle-types-and-applications/
2. David Freifelder. 2003. Molecular Biology, 2nd edition, Narosa Publishing House, New Delhi.
3. E.D.P. De Robertis, E.M.F. De Robertis, Jr. 2001. Cell and Molecular Biology, 8th edition, Wolters Kluwer (India) Pvt. Ltd, New Delhi.
4. Gurdeep R. Chatwal, Sham K. Anand. 2007. Instrumental methods of chemical analysis, Himalaya Publishing House, Bangalore.
5. H. Kaur. 2016. Instrumental methods of chemical analysis, XII edition, Pragati Prakashan, Meerut.
6. H.D. Kumar. Molecular Biology, 2nd edition, Vikas publishing house Pvt Ltd, New Delhi.
7. Lodish, Berk, Matsudaira, Kaiser, Krieger, Scott, Zipursky, Darnell. 2003. Molecular Biology, 5th edition, W.H. Freeman and Company, New York.

8. Neal U, Thorpe. 1984. Cell Biology-Methods in Cell Biology, John Wiley & Sons, Inc. USA.
9. P.K. Gupta. 2015. Cell and Molecular Biology, 4th edition, Rastogi Publications, Meerut.
10. Primrose SB, Richard M, Twyman RM and Old RW. 2002. Principles of Gene Manipulation, 6th edition, Blackwell Publishers.
11. R.C. Dubey. 2010. A text book Biotechnology. S Chand and Company Ltd, New Delhi.
12. S.C. Rastogi. 2009. Biotechnology-Principles and Applications, Narosa publication. New Delhi.
13. U. Satyanarayana. 2006. Biotechnology, Books and Allied (p) Ltd, Kolkata (India).

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	**15**
Class performance/Participation	**05**
Total	**40**

Scheme of Examination: Theory (Semester III)

Question No.	PART - A	Marks
I	Answer any **SIX** Questions out of **EIGHT** Questions (2 questions of 2 marks from each unit)	**6 x 2 = 12**
	PART - B	
	Unit - I	
II	**3** Marks Questions (Answer any **TWO** out of **THREE**)	**3 x 2 = 6**
III	**6** Marks Questions (Answer any **ONE** out of **TWO**)	**6 x 1 = 6**
	Unit - II	
IV	**3** Marks Questions (Answer any **TWO** out of **THREE**)	**3 x 2 = 6**
V	**6** Marks Questions (Answer any **ONE** out of **TWO**)	**6 x 1 = 6**
	Unit - III	
VI	**3** Marks Questions (Answer any **TWO** out of **THREE**)	**3 x 2 = 6**
VII	**6** Marks Questions (Answer any **ONE** out of **TWO**)	**6 x 1 = 6**
	Unit - IV	
VIII	**3** Marks Questions (Answer any **TWO** out of **THREE**)	**3 x 2 = 6**
IX	**6** Marks Questions (Answer any **ONE** out of **TWO**)	**6 x 1 = 6**
	Total	**60**

Zoology Core Course Lab Content

Semester III

Course Title: **Molecular Biology, Bioinstrumentation and Techniques in Biology**	Course Credits:**2**
Course Code: **BSCZOPN302**	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**

Course Outcomes (COs):

At the end of the course the student should be able to:

1. At the end of the course, students will be able to understand the applications of biophysics and principle involved in bio-instruments.
2. Understand the methodology involved in bio techniques.
3. Students can demonstrate knowledge and practical skills of using instruments in biology and medical field.
4. They can perform techniques involved in molecular biology and diagnosis of diseases.

Lab Course Content

List of labs to be conducted	56 Hours
1. To study the principle and applications of simple, compound and binocular microscopes.	1
2. To study the principle and applications of various lab equipments- Electronic balance, Vortex mixer, use of glass and micropipettes, Laminar air flow, Incubator, shaker, Water bath and centrifuge.	2
3. Calibration of pH meter and determination of pH of natural samples (milk, honey, urine).	1
4. To prepare Buffer solutions (Phosphate, Citrate, Tris-HCl buffer).	1
5. To learn working of Colorimetry and Spectrophotometry (using cadmium chloride).	1
6. To estimate amount of RNA by Orcinol method.	1
7. To estimate amount of protein by Lowry's method (liver tissue).	1
8. To estimate amount of DNA by di-phenylamine (DPA) method.	1
9. Demonstration of differential centrifugation techniques to fractionate components in a given mixture (blood or liver tissue).	1
10. To identify different unknown amino acids using ascending paper chromatography (using amino acid kit).	1 1
11. Extraction of DNA using suitable animal tissue sample.	1
12. Study of different forms of DNA (A, B and Z) and types of RNA (t, r, m): Models or Photos.	1

Suggested Reading:

1. Bal Ram Singh, Raj Kumar. 2022. Practical Techniques in Molecular Biotechnology, Cambridge University Press, USA.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter 2002. Molecular Biology of the Cell, 4th edition. New York: Garland Science.
3. Daniel L. Hartl and Maryellen Ruvolo. 2012. Genetics: Analysis of Genes and Genomes, 8th edition. Burlington, Mass.: Jones & Bartlett Learning.
4. Gerald Karp. Cell and Molecular Biology. 2008. Concepts and Experiments, 5th edition. Wiley Publication.
5. Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger, Freeman. 2003. Molecular Cell Biology, 5th edition. W. H. & Company.
6. Herman Sunil D Souza, Shyam Prasad Sajankila, K Satyamoorthy. 2012. Manipal University Press, Manipal, India.
7. James D. Watson, Tania A. 2003. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick. Molecular Biology of the Gene, 5th edition. Cold Spring Harbor Laboratory Press.
8. Stryer, Lubert. 1981. Biochemistry, 2nd edition. W. H. Freeman and Company, New York.

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

Formative Assessment	
Assessment Occasion	Weightage in Marks
House Examination/Test	**10**
Project*	**05**
Class performance/Participation	**05**
Record writing and timely submission	**05**
Total	**25**

***Topic for the project may be selected from the practical syllabus**

Course Title/Code: **Molecular Biology, Bioinstrumentation and Techniques in Biology (BSCZOPN302)**

Scheme of Practical Examination

B.Sc. Zoology III Semester

Duration: 3 hours **Max. Marks: 25**

I. Extraction of DNA from the given animal tissue.

(Flow chart of the procedure-2 Marks; principle-1 Mark; DNA Isolation-4 Marks; Report-1Mark)

OR

Estimation of DNA / RNA / Proteins. **08**

(Flow chart of the procedure-2 Marks; principle-1 Mark; conducting the experiment-4 Marks; Report-1 Mark)

II. Separate and identify the given unknown amino acids by using ascending paper chromatography. **06**

(Procedure-2 Marks; conducting the experiment-2 Marks; Identification & Report-2 Marks)

III. Identify and give the working principle of the spotters A and B.

(Equipments/photographs of the instruments). **3X2=06**

(Identification-1 Mark; working principle-2 Marks)

IV. Class record **05**

Total=25

Note: Questions must be framed as per the scheme provided.

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Open Elective Course Content

Zoology

Semester: III

Course Title: **Endocrinology** Course Code: **BSCZOEN301**	Course Credits: **3**
Total Contact Hours**: 42**	Duration of ESA: **2 Hours**
Formative Assessment Marks: **40**	Summative Assessment Marks: **60**

Course Outcomes (COs):

At the end of the course the student should be able to:

Differentiate among endocrine, paracrine and autocrine systems.

1. Describe the different classes and chemical structures of hormones.
2. Identify the glands, organs, tissues and cells that synthesize and secrete hormones, hormone precursors and associated compounds.
3. Identify and discuss the integration of the endocrine system in general with focus on specific interactions.
4. Explain the consequences of under- and overproduction of hormones.

Course Content

Content	Hours
Unit I	**14**
Chapter 1. Endocrine glands • Endocrine glands and classifications of hormones. • Characteristics and transport of hormones. **Chapter 2. Hypothalamus - Hyphophysis** • Hypothalamus as a neuroendocrine organ. • Pituitary gland: Structure and functions. • Pituitary hormones: Chemical nature, mode of action and functions. • Pituitary disorders. **Chapter 3. Pineal gland** • Structure and functions. • Hypo and hyperactive states.	
Unit II	**14**
Chapter 4. Thyroid and parathyroid glands • Chemical nature, mode of action and functions of the hormones. • Hypo and hyperactive states. **Chapter 5. Adrenal gland** • Hormones: Chemical nature and functions. • Hypo and hyperactive states. **Chapter 6:** Prostaglandins • Chemical nature and functions.	
Unit – III	**14**
Chapter 7: Pancreas • Pancreatic islets: Chemical nature and functions. Hormonal control of blood sugar. • Hyperinsulinism and diabetes mellitus.	

Chapter 8: Gastro-intestinal hormones • Functions and regulation of secretion. **Chapter 9: Different types of rhythms** • Ultradian, circadian, infradian. Different zeitgebers and their relation with circadian clock. • Sleep-wakefulness cycle. Time keeping genes. Jet-lag and shift work.	

Suggested Reading:

1. Eric Widmaier and Hershel Raff and Kevin Strang. 2019. Vander's Human Physiology, McGraw-Hill, Higher Education.
2. H.E. De Wardener. 1985. The Kidney: An Outline of Normal and Abnormal Function, 5th revised edition, Churchill Livingstone.
3. Knut Schmidt- Nielsen. 1998. Animal Physiology: Adaptation and environment, 5th edition, Cambridge University Press.
4. Leslie J. De Groot, J. Larry Jameson, Leslie J. Degroot, J. Larry Jameson. 2001. Endocrinology (3-Volume Set) 4th edition.
5. Mac Hadley, Jonathan Levine. 2006. Endocrinology, 6th edition, Pearson.
6. Mohan P. Arora. Animal physiology, Himalaya Publishing house, 5th edition, Bangalore.
7. R. Nagabhushanam, M.S. Kodarkar. 1978. A text book of Animal Physiology, Oxford & IBH publishing Company, New Delhi.
8. R.A. Agarwal, Anil K, Srivastava, Kaushal Kumar. 2015. Physiology and Biochemistry, S. Chand and Company Pvt Ltd, New Delhi.
9. S.C. Rastogi. 2001. Essentials of Animal Physiology, 3rd edition, New age international (P) Ltd, New Delhi.
10. Shlomo Melmed, Kenneth Polonsky, P. Reed Larsen, Henry Kronenberg. 2016. Williams Textbook of Endocrinology, 13th edition, An Imprint of Elsevier.
11. Sujit Kumar Chaudhuri. 2011. Concise Medical Physiology, New Central Book Agency.

Pedagogy: Chalk and Talk, PPT, Group discussion, Seminar.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
House Examination/Test	**20**
Written Assignment / Case Presentation/Project/ Seminar	**15**
Class performance/Participation	**05**
Total	**40**

Scheme of Examination: Open elective (Semester III)

Question No.	PART - A	Marks
I	Answer any **SIX** Questions out of **NINE** Questions (3 questions of 2 marks from each unit)	**6 x 2 = 12**
	PART - B	
	Unit - I	
II **III**	**3** Marks Questions (Answer any **THREE** out of **FOUR**) **7** Marks Questions (Answer any **ONE** out of **TWO**)	**3 x 3 = 9** **7 x 1 = 7**
	Unit - II	
IV **V**	**3** Marks Questions (Answer any **THREE** out of **FOUR**) **7** Marks Questions (Answer any **ONE** out of **TWO**)	**3 x 3 = 9** **7 x 1 = 7**
	Unit - III	
VI **VII**	**3** Marks Questions (Answer any **THREE** out of **FOUR**) **7** Marks Questions (Answer any **ONE** out of **TWO**)	**3 x 3 = 9** **7 x 1 = 7**
	Total	**60**

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Course content under New Education Policy-Year 2022-23
For IV Semester B.Sc., (Hons)

Zoology Core Course Content

Course Title/Code**: Gene Technology, Immunology and Computational Biology**	Course Credits**: 4**
Course Code**: BSCZOCN401**	L-T-P per week**: 4-0-0**
Total Contact Hours**: 56**	Duration of ESA**: 2 Hours**
Formative Assessment Marks**: 40**	Summative Assessment Marks**: 60**

Course Outcomes (COs):

At the end of the course the student should be able to:

1. Acquaint knowledge on versatile tools and techniques employed in genetic engineering and recombinant DNA technology.
2. An understanding on application of genetic engineering techniques in basic and applied experimental biology.
3. To acquire a fundamental working knowledge of the basic principles of immunology.
4. To understand how these principles, apply to the process of immune function.
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.

Core Course content:

Course Content	**56 Hrs.**
Unit I	**14**
Chapter 1: Principles of Gene Manipulation • Recombinant DNA Technology: Introduction, steps involved. • Restriction enzymes, Ligases and Nucleic acid modifying enzyme. • Gene cloning vector: Concept of plasmids-pBR322, Lambda phage vectors, cosmids. • Gene transfer techniques (Direct and indirect). • Screening and selection of recombinant colonies.	07
Chapter 2: Applications of Genetic Engineering • Transgenic animals (Transgenic cow, Transgenic fish); Transgenic plants (cry protein); Gene silencing (Knock out and Knock in mouse). • Production of Human Recombinant insulin and • Hybridoma technology: Synthesis and applications of Monoclonal antibodies. • Gene Therapy: Definition, types (In vivo and ex vivo), application (SCID). • Biosensors: Definition, applications.	07
Unit II	**14**

Chapter 3: Introduction to the Immune System • Types of immunity: Innate, acquired, active and passive immunity. • Cells of the immune system: Macrophages, neutrophils, eosinophils, basophils, lymphocytes, APC's. • Organs of the immune system: Bone marrow, Thymus, Spleen, Lymph node; Small intestine (Peyer's patches). • Primary and secondary immune response. • Role of B and T-lymphocytes.	07
Chapter 4: Antigens and Antibodies • Antigens, haptens and immunogen: Definitions, intrinsic properties (foreignness, molecular size, heterogeneity). • B and T cell epitopes: Definitions. • Structure of IgG and functions of different classes of immunoglobulins. • Major histocompatibility complex -Structure of MHC I & II.	07
Unit III	**14**
Chapter 5: Clinical Immunology • Immunity against diseases of viral (Hepatitis B), bacterial (TB) and protozoan infections (Malaria). • Vaccines: Types and Uses-Immunization schedule for children. • Transplantation immunology: Transplantation of organ- Types, graft rejection and Immuno-suppressors.	07
Chapter 6: Bioinformatics • Scope and applications of Bioinformatics. • Databases: Definition, Biological databases – Nucleotide databases (Gene bank, EMBL, DDBJ), Protein databases (Swiss-PROT, TrEMBL, PROSITE). • Sequence analysis (homology): Pairwise and Multiple Sequence alignment-BLAST, CLUSTALW, FASTA.	07
Unit IV	**14**
Chapter 7: Biostatistics I • 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.	07
Chapter 8: Biostatistics II • Measures of dispersion: Range, Standard Deviation, Variance. • Correlation and Regression. • Tests of significance: F-test, ANOVA, t-test and Chi square test.	07

Suggested Reading:

1. Anil Kumar, Ashwani Pareek, Sanjay Mohan Gupta. 2013. Biotechnology in Medicine and Agriculture: Principles and Practices, I.K. International Publishing house Pvt Ltd, Bangalore.
2. Attwood, T.K. and Parry-Smith, D.J. 1999. Introduction to Bioinformatics, Published by Prentice Hall.
3. B.D. Singh. 2010. Biotechnology Expanding Horizon, Kalyani Publishers, New Delhi.
4. C.S.V. Murthy. 2016. Bioinformatics, Himalaya Publishing House.
5. C.V. Rao. 2002. An Introduction to Immunology. Narosa Publishing house, New Delhi.
6. Desmond S.T. Nicholl. 2002. An Introduction to Genetic Engineering, 2nd edition, Cambridge University press.
7. Gurumani N. 2015. An Introduction to Biostatistics, 2nd edition, MJP Publisher.
8. Hepsyba, Hemalatha. 2019. Basic Bioinformatics. MJP Publishers; 1st edition.
9. K Visweswara Rao. 1999. Biostatistics: A Manual of statistical methods for use in health, nutrition and anthropology, Jaypee Brothers- Medical Publishers (p) Ltd, New Delhi.
10. Kumaresan, Sundaralingam. 2021. Bioinformatics, Saras Publication.
11. P K Gupta. 2008. Elements of Biotechnology, Rastogi Publications, New Delhi.
12. P. Joshi. 2003. Genetic Engineering and its Applications. Agro Botanica, India.
13. Philip L. Carpenter. 1965. Immunology and Serology, 2nd edition, W.B. Sanders Company Philadelphia and London Toppan Company, Limited Tokyo, Japan.
14. R.C. Dubey. 2010. A text book Biotechnology. S Chand and Company Ltd, New Delhi.
15. Ramakrishnan P. Biostatistics. Saras Publication.
16. U. Satyanarayana. 2006. Biotechnology, Books and Allied (p) Ltd, Kolkata (India).
17. Wayne W. Daniel, Chad L. Cross. 2013. Biostatistics: A Foundation for Analysis in the Health Sciences.

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

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
House Examination/Test	**20**
Written Assignment/Presentation/ /Project/ Term Papers/Seminar	**15**
Class performance/Participation	**05**
Total	**40**

Scheme of Examination: Theory (Semester IV)

Question No.	**PART - A**	**Marks**
I	Answer any **SIX** Questions out of **EIGHT** Questions (2 questions of 2 marks from each unit)	**6 x 2 = 12**
	PART - B	
	Unit - I	
II	**3** Marks Questions (Answer any **TWO** out of **THREE**)	**3 x 2 = 6**
III	**6** Marks Questions (Answer any **ONE** out of **TWO**)	**6 x 1 = 6**
	Unit - II	
IV	**3** Marks Questions (Answer any **TWO** out of **THREE**)	**3 x 2 = 6**
V	**6** Marks Questions (Answer any **ONE** out of **TWO**)	**6 x 1 = 6**
	Unit - III	
VI	**3** Marks Questions (Answer any **TWO** out of **THREE**)	**3 x 2 = 6**
VII	**6** Marks Questions (Answer any **ONE** out of **TWO**)	**6 x 1 = 6**
	Unit - IV	
VIII	**3** Marks Questions (Answer any **TWO** out of **THREE**)	**3 x 2 = 6**
IX	**6** Marks Questions (Answer any **ONE** out of **TWO**)	**6 x 1 = 6**
	Total	**60**

Zoology Semester IV Core Course Lab Content

Course Title/Code: **Gene Technology, Immunology and Computational Biology**	Course Credits: **2**
Course Code: **BSCZOPN402**	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**

Course Outcomes (COs):

At the end of the course the student should be able to:

1. Accurately, safely and appropriately use all the equipment regularly used in Molecular Biology (DNA manipulation, including balances, pipettes, electrophoresis and centrifuges).
2. Prepare chemical solution and reagents to the precision appropriate to the task.
3. Demonstrate knowledge of the biochemical basis underpinning the molecular biology.

Course Content:

List of labs to be conducted	**56 Hours**
1. To study Restriction enzyme digestion using teaching kits (Demonstration only).	1
2. To detect genetic mutations by Polymerase Chain Reaction (PCR) using teaching kits (Demonstration only).	1
3. Demonstration of agarose gel electrophoresis for detection of DNA.	1
4. Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for detection of proteins.	1
5. Determination of ABO Blood group and Rh factor.	1
6. Identification of cells of Immune system- Macrophages, neutrophils, eosinophils, basophils, lymphocytes, APC's (slides/photographs).	1
7. Identification of organs of immune system – Bone marrow, Thymus, Lymph nodes, Spleen, Peyer's patches (slides/photographs).	1
8. To calculate molecular weight of unknown DNA and protein fragments from gel pictures. (https://youtube/mCiCiO0cfbg)	1
9. Calculate the mean, median, mode and standard deviation (with suitable examples).	1
10. Representation of data by bar diagram, pie diagram and histogram.	1
11. Measure the height and weight of all students in the class and apply statistical measures (Correlation, Regression, ANOVA, t-test).	1
12. To learn nucleotide sequence database (GenBank, EMBL, DDBJ).	1
13. To learn sequence alignment: Pairwise alignment (Protein/ DNA).	1
14. BLAST, CLUSTALW, FASTA Programme colour charts for identification.	1

Suggested Reading:

1. Attwood, T.K. and Parry-Smith, D.J. 1999**.** Introduction to Bioinformatics, Published by Prentice Hall.
2. C.S.V. Murthy. 2016. Bioinformatics, Himalaya Publishing House.

3. Gurumani N. 2015. An Introduction to Biostatistics, Kindle Edition, 2nd edition, MJP Publisher.
4. Hepsyba, Hemalatha. 2019. Basic Bioinformatics. MJP Publishers; 1st edition.
5. K Visweswara Rao. 1999. Biostatistics: A Manual of statistical methods for use in health, nutrition and anthropology, Jaypee Brothers- Medical Publishers (p) Ltd, New Delhi.
6. Kumaresan, Sundaralingam. 2021. Bioinformatics, Saras Publication.
7. Orpita Bosu, Simminder Kaur Thukral. 2007. Bioinformatics: databases, tools, algorithms. Oxford University Press, New Delhi.
8. P Joshi.2006. Genetic Engineering. Agrobios (India).
9. Ramakrishnan P. Biostatistics. Saras Publication.
10. Sandhya Mitra. 2015. Genetic Engineering: Principles and Practice, 2nd edition, McGraw Hill Education (India) Private Limited.
11. Sharma, Munjal, Shanker. 2018. A text book of Bioinformatics. Rastogi publications.
12. Sundar Rao, J. Richard. 2006. Introduction to Biostatistics and Research Methods. Prentice-Hall of India Pvt. Limited.
13. Wayne W. Daniel, Chad L. Cross. 2013. Biostatistics: A Foundation for Analysis in the Health Sciences.

Pedagogy: Lectures, Presentations, Videos, Labs, Assignments, Tests, Individual or group Field oriented Project Report**.**

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Test	**10**
Project*	**05**
Participation in class	**05**
Record writing and timely submission	**05**
Total	**25**

***Topic for the project may be selected from the practical syllabus**

Course Title/Code: **Gene Technology, Immunology and Computational Biology (BSCZOPN402)**

Scheme of Practical Examination

B.Sc. Zoology IV Semester

Duration: 3 hours **Max. Marks: 25**

I. Identify the ABO and Rh blood group of the given blood sample and comment on the significance of blood typing. **04**

(Identification of ABO and Rh blood group- ½+½=1 Mark; Reasons- 1+1= 2 Marks; significance-1 Mark)

II. Identify and comment on the spotter A (Immune cells and organs-slides/photographs). **02**

(Identification-1 Mark, comments-1)

III. Biostatistics problem on Chapter 7 **04**

IV. Biostatistics problem on Chapter 8 **04**

V. Identify and comment on the given spotters B, C and D. **3X2=06**

(PCR/PAGE/Restriction enzyme kit/ BLAST, CLUSTALW, FASTA/Database)

(Identification - 1 Mark; comments -1 Mark)

VI. Class record **05**

Total= 25

Note: Questions must be framed as per the scheme provided.

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Open Elective Course Content

Semester: IV Zoology

Course Title: **Animal Behaviour** Course Code: **BSCZOEN401**	Course Credits:**3**
Total Contact Hours**: 42**	Duration of ESA: **2 Hours**
Formative Assessment Marks: **40**	Summative Assessment Marks: **60**

Course Outcomes (COs):

At the end of the course the students will be able to:

1. Examine and critically to evaluate the emergence of ideas that have shaped how we observe and collect data on animal behaviour.
2. Understand the main historical ideas that underpin animal behaviour theory
3. Critically review hypotheses to explain animal behaviour
4. Understand different methods for collecting data on animal behaviour
5. Have advanced their written and oral presentation skills.

Course Content

Content	**42 Hrs.**
Unit – 1	
Chapter 1. Introduction to Animal Behaviour • Contributions of Karl Von Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen. • Proximate and ultimate causes of behaviour. **Chapter 2. Patterns of Behaviour** • Stereotyped Behaviours - Orientation and Reflex. • Individual Behavioural patterns: Instinct and Learned Behaviour. • Associative learning, classical and operant conditioning, Habituation, Imprinting.	**14**
Unit – 2	**14**
Chapter 3. Social Behaviour • Social organization in termites and honey bees. • Social behaviour: Altruism. • Conflict behaviour. **Chapter 4. Sexual Behaviour** • Sexual dimorphism, Mate choice in peacock. • Intra-sexual selection (male rivalry in red deer). • Kinship theory: Relatedness & inclusive fitness. • Parental care in fishes (Nest building).	
Unit – 3	**14**
Chapter 5. Chronobiology • Brief historical developments in chronobiology. • Adaptive significance of biological clocks. **Chapter 6: Communications in animals** • Bioluminescence in deep sea fishes and insects. • Territoriality in Monkeys and Dogs.	

• Role of pheromones in animal communication- Insects and Vertebrates. • Communication in Honey bees (Waggle Dance).	

Suggested Reading:

1. D. S. Saunders , X. Vafopoulou C. G. H. Steel , R. D. Lewis . 2002. Insect Clocks, 3rd edition, Barens and Noble Inc. New York, USA.
2. Hosang S. Gundevia, Hare Govind Singh. 2001. A text book of Animal Behaviour, S Chand and Company Ltd, New Delhi.
3. Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey. 2004. Chronobiology: Biological Timekeeping, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA.
4. John Alcock, Animal Behavior: An Evolutionary Approach**,** 4th edition**,** Sinauer Associate Inc., USA.
5. Lee C Drickamer, Stephen H Vessey. 2001. Animal Behavior: Mechanisms, Ecology, Evolution.
6. Mohan P. Arora. 2000. Animal Behaviour, Himalaya Publishing house, New Delhi.
7. Paul W. Sherman and John Alcock. Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
8. Reena Mathur. 2018. Concepts of Animal Behaviour, Rastogi Publications, 1st edition, Meerut, India.
9. Vinod Kumar. 2002. Biological Rhythms, Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

Pedagogy: Chalk and Talk, PPT, Group discussion, Seminar, Interaction, virtual lab, Lab visit

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
House Examination/Test	**20**
Written Assignment / Project / Seminar	**15**
Class performance/Participation	**05**
Total	**40**

Scheme of Examination: Open elective (Semester IV)

Question No.	**PART - A**	**Marks**
I	Answer any **SIX** Questions out of **NINE** Questions (3 questions of 2 marks from each unit)	**6 x 2 = 12**
	PART - B	
	Unit - I	
II **III**	**3** Marks Questions (Answer any **THREE** out of **FOUR**) **7** Marks Questions (Answer any **ONE** out of **TWO**)	**3 x 3 = 9** **7 x 1 = 7**
	Unit - II	
IV **V**	**3** Marks Questions (Answer any **THREE** out of **FOUR**) **7** Marks Questions (Answer any **ONE** out of **TWO**)	**3 x 3 = 9** **7 x 1 = 7**
	Unit - III	
VI **VII**	**3** Marks Questions (Answer any **THREE** out of **FOUR**) **7** Marks Questions (Answer any **ONE** out of **TWO**)	**3 x 3 = 9** **7 x 1 = 7**
	Total	**60**

Program Name	**B.Sc.**		**SEMESTER**	**V**
Course Title	**NON-CHORDATES AND ECONOMIC ZOOLOGY (Theory)**			
Course Code:	**BSCZOCN501**		No. of Credits	**4**
Contact hours	**60 Hrs.**		Duration of SEA/Exam	**2 Hrs.**
Formative assessment marks		**40**	Summative assessment marks	**60**

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

- Group the animals on the basis of their morphological characteristics/ structures.
- Demonstrate comprehensive identification abilities of Non-Chordate diversity.
- Explain structural and functional diversity of Non-Chordates.
- Develop understanding on the diversity of life with regard to protists, nonchordates and chordates.
- Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.

UNIT – I: **15 Hrs.**

An overview of Invertebrate classifications up to the phylum; Protozoa**:** *Paramecium* -Morphology and Reproduction: Asexual- binary fission, Sexual-conjugation (endomixis, autogamy, cytogamy); Porifera: *Sycon* – Morphology and *Canal* System; Coelenterata: *Obelia* - Morphology and life cycle; Ctenophora: Salient features with an example.

UNIT – II: **15 Hrs.**

Platyhelminthes: *Taenia solium* - Morphology and Life cycle; Nemathelminthes: *Ascaris lumbricoides* - Morphology and life cycle; Annelida: Characteristics and classification: *Hirudinaria* (Leech) - Morphology and Reproduction.

UNIT – III: **15 Hrs.**

Arthropoda: Characteristics and classification: *Palaemon* (Prawn) - Morphology, Appendages, Nervous System and Reproduction; Mollusca: Characteristics and classification: *Pila* - Morphology, Shell, Respiratory system, Nervous System and Reproduction; Echinodermata: Characteristics and classification: *Asterias* - Morphology and Water vascular system.

UNIT – IV: **15 Hrs.**

Economic Zoology: Life cycle and control of pests - Gundhi bug, Sugarcane leafhopper, Termites,Rodents; Mosquito life cycle and control; Bio-culture: Lac-culture - techniques and applications; Vermi-culture - techniques and its applications; Apiculture -Types and applications; Aquaculture – techniques and applications; Poultry-housing management and applications; Dairy farming- cattle breeds and Management of diary.

References:

1. Adam, S. 1990. A Students Text Book of Zoology, Vol. I, II & Vol. III. Low Price Publications, New Delhi.
2. Agarwal, V.K. 2017. Zoology for Degree Students: Non-Chordata, S. Chand & Company, New Delhi.
3. Ayyar, E. 1982. A Manual of Zoology Vol. I, Part I & II, S. Vishwanathan Pvt. Ltd.
4. Barnes, R.S.K, Calow P, Olive P.J.W, Golding D.W, Spicer, J.I. 2002. The Invertebrates: Synthesis, Blackwell Publishing.
5. Dhami, P.S. & Dhami, J.K. 2021. Invertebrate Zoology, 5th Edition, R. Chand & Co. New Delhi.
6. Hickman,C., Roberts,L.S., Keen,S.L., Larson, A. and Eisenhour, D. 2018. Animal Diversity, McGraw-Hill.
7. Holland, P. 2011. The Animal Kingdom: A Very Short Introduction, Oxford University Press.
8. Jordan, E.L. & Verma, P.S. 2022. Invertebrate Zoology, S. Chand & Company, New Delhi.
9. Kardong, K.V. 2006. Vertebrates: Comparative Anatomy, Function, Evolution (4th edition), McGraw-Hill.
10. Kotpal, R.L. 2017. Modem Text Book of Invertebrates, Rastogi Publications, Meerut.
11. Kotpal, R.L. 2017. Protozoa to Echinodermata (Phylum Series), Rastogi Publications, Meerut.
12. Lal, S.S. 2016. A Text book of Practical Zoology – Invertebrates, Rastogi Publications.
13. Prakash, M. & Arora, C. K. 1998. Laboratory Animals, Anmol Publications, New Delhi.
14. Shukla & Upadhya, V. B. 2008. Economic Zoology, Rastogi Publications.
15. Srivastava. 1985. A Text Book of Fishery Science and Indian fishery, Kitabmahal.
16. Theobald, F.1997. Economic Zoology, Printwell, Jaipur.
17. Uday, S. B. 1995. Vermiculture Ecotechnology, Bhawalkar Earthworm Research Institute, Pune.
18. Verma, P.S. 2013. A Manual of Practical Zoology – Invertebrates, S. Chand & Co. New Delhi.

SCHEME OF THEORY EXAMINATION
B.Sc. Zoology V Semester

Course Title/Code: BSCZOCN501: NON-CHORDATES AND ECONOMIC ZOOLOGY

Duration: 2 Hours **Max. Marks: 60**

PART - A

Q-I. Answer any **SIX** questions out of **EIGHT** questions (**2 questions from each Unit**) (**6 x2) = 12**

PART - B

Q-II. Answer any **TWO** questions out of **THREE** questions (**From Unit-I)** (**2 x 3) = 06**
Q-III. Answer any **ONE** question out of **TWO** questions (**From Unit-I**) **(1 x 6) = 06**

Q-IV. Answer any **TWO** questions out of **THREE** questions (**From Unit-II)** (**2 x 3) = 06**
Q-V. Answer any **ONE** question out of **TWO** questions (**From Unit-II**) **(1 x 6) = 06**

Q-VI. Answer any **TWO** questions out of **THREE** questions (**From Unit-III)** (**2 x 3) = 06**
Q-VII. Answer any **ONE** question out of **TWO** questions (**From Unit-III**) **(1 x 6) = 06**

Q-VIII. Answer any **TWO** questions out of **THREE** questions (**From Unit-IV)** (**2 x 3) = 06**
Q-IX. Answer any **ONE** question out of **TWO** questions (**From Unit-IV**) **(1 x 6) = 06**

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

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
House Examination/Test	20
Written Assessment/ Presentation/Project/Term papers/Seminars	15
Class room Performance/Participation	05
TOTAL	**40**
Formative Assessment as per NEP guidelines are compulsory	

Course Title	**NON-CHORDATES AND ECONOMIC ZOOLOGY (Practical)**		
Course Code:	**BSCZOPN501**	Practical Credits	**2**
Contact hours	**4 Hours/Week**	Duration of Practical Exam.	**3 Hrs.**
Formative Assessment Marks	**25**	Summative Assessment Marks	**25**

Course Outcomes (COs): At the end of the course the student should be able to:

- Understand the basics of classification of non-chordates.
- Learn the diversity of habit and habitat of these species.
- Develop the skills to identify different classes and species of animals.
- Know uniqueness of a particular animal and its importance.
- Enhancement of basic laboratory skill like keen observation and drawing.

PRACTICALS **15x4=60 (4Hrs/week)**

1. Preparation and observation of protozoan culture.
2. Protozoa: Systematics of *Amoeba*, *Euglena*, *Noctiluca*, *Paramecium* and *Vorticella* (Permanent slides).
3. Porifera**:** Systematics of *Sycon, Euplectella, Hyalonema, Spongilla* and *Euspongia* (Specimens). Study of permanent slides of T.S of *Sycon*, spicules and gemmules.
4. Cnidaria: Systematics of *Aurelia* and *Metridium* (Specimens). Slides of *Hydra, Obelia*-polyp and medusa, and *Ephyra* larva, T.S. of *Metridium* passing through mesenteries.
5. Study of Corals- *Astraea, Fungia, Meandrina, Corallium, Gorgonia, Millepora* and *Pennatula.*
6. Helminthes**:** Systematics of *Planaria*, *Fasciola hepatica* and *Taenia solium*, *Ascaris*- Male and female (Specimens). Slides of T.S. of *Planaria*, T.S of male and female *Ascaris*.
7. Annelida: Systematics of *Nereis, Heteronereis, Sabella, Aphrodite* (Specimens). Slide of T.S. of Earth worm through typhlosole.
8. Arthropoda: Systematics of *Penaeus, Palaemon, Astracus,* Scorpion, Spider, *Limulus, Peripatus, Millipede, Centipede,* Praying mantis, Termite Queen, Moth, Butterfly, Dung beetle/Rhinocerous beetle (Any six specimens). Slide of Larvae- Nauplius, Zoea, Mysis.
9. Mollusca**:** Systematics of *Chiton, Mytilus, Aplysia, Pila, Octopus, Sepia* (Specimens) and Glochidium larva (Slide). Shell Pattern- *Unio, Ostrea, Cypria, Murex, Nautilus, Patella, Dentalium,* Cuttle bone.
10. Echinodermata: Systematics of Sea star, Brittle star, Sea Urchin, Sea cucumber, Sea lilly (Specimens). Slides of Bipinnaria larva, Echinopluteus larva and Pedicellaria.

11. Harmful Non chordates**:** Soil Nematodes. Agricultural, veterinary and human pests / vectors of Arachnida and Arthropoda – Mosquito, Lice, Mites.

12. Beneficial Non chordates**:** *Bombyx mori*: Life cycle - Cocoon, Raw silk. Uzi fly; Study on honey bee (any twospecies) and bee wax; Pearl Oyster and Natural Pearls.

13. Indian Poultry breeds and Cattle breeds (Any three).

14. Virtual Dissection/Cultured specimens**:** Earthworm – Nervous system, Leech- Digestive system.

15. Virtual Dissection/Cultured specimens: Prawn - Nervous system; Cockroach- Salivary apparatus and Digestive system

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SCHEME OF PRACTICAL EXAMINATION
B.Sc. Zoology: V Semester
Course Title/Code: BSCZOPN501: NON-CHORDATES AND ECONOMIC ZOOLOGY

Duration: 3 hours **Max. Marks: 25**

Q I. Dissect and display the organ system of available cultured specimens provided and comment.
(Dissection and display-4 marks, comments-2 marks) **(4+2) = 06**

OR

Virtual dissection (Two specimens) - Identify, draw labelled diagram and comment on the flagged systems (Identification of the system - ½ mark; Identification of the flagged part - ½ mark; Labelled diagram of the entire system - 1 marks; Description of flagged part -1 mark) **(3+3) = 06**

Q II. Identify with systematics, draw labelled diagram and comment (**A- C)**. (1 slide, 2 specimens). (Identification -½ mark; Systematics -½ mark; Labelled diagram -1 mark; Comments -1 mark) (**3x3) = 09**

Q III. Identify and comment on the economic importance (**D and E**). (D- Harmful Non chordates; E-Beneficial non chordates/ Breeds) (Identification-1, Economic importance-1.5 marks) (**2.5x2) = 05**

Q IV. Record and Viva voce **05**

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

Formative Assessment for Practical	
Assessment Occasion/ type	**Marks**
House Examination/Test	10
Project/Model submission	05
Class room Performance/Participation	05
Record writing & timely submission	05
Total	**25**
Formative Assessment as per NEP guidelines are compulsory	

Program Name	**B.Sc.**	**SEMESTER**	**V**
Course Title	**CHORDATES AND COMPARATIVE ANATOMY (Theory)**		
Course Code	**BSCZOCN502**	No. of Credits	**4**
Contact hours	**60 Hrs.**	Duration of SEA/Exam	**2 Hrs.**
Formative assessment marks	**40**	Summative assessment marks	**60**

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

- Demonstrate comprehensive identification abilities of chordate diversity
- Explain structural and functional diversity of chordate diversity
- Understand evolutionary relationship amongst chordates
- Take up research in biological sciences.
- Realize that very similar physiological mechanisms are used in very diverse organisms.
- Get a flavour of research by working on project besides improving their writing skills. It will further enable the students to think and interpret individually.

UNIT – I: **15 Hrs.**

Hemichordata: *Balanoglossus* –Habitat and Habit; morphology; Coelom; Tornaria larva and its affinities; Affinities and systematic position of Hemichordata; Chordata: Origin of Chordates; Basic characters of chordates and classification up to classes; Urochordata: *Herdmania*- Habitat and Habit; Morphology; Ascidian tadpole- structure and retrogressive metamorphosis. Cephalochordata: *Branchiostoma* (*Amphioxus*)- Habitat and Habit; Morphology; Digestive system; Feeding mechanism; Excretory and Circulatory system; Agnatha: General characters of *Agnatha* and classification up to classes; Salient features of *Cyclostomata* and *Ostracodermi* with examples. *Ammocoete* larva and its significance.

UNIT – II: **15 Hrs.**

Vertebrates**:** General characters and Classification of different classes of Vertebrates (*Pisces*-up to classes, *Amphibia*-up to orders, *Reptilia* up to orders (living orders only), *Aves*-up to super orders, *Mammalia* up to subclass) citing examples; General characters and comparison of *Chondrichthyes* and *Osteichthyes*; Interesting features and evolutionary significance of *Dipnoi*; Salient features of *Placodermi* with examples; Interesting features of *Sphenodon*, crocodile and *Archaeopteryx*; Salient features of *Ratitae* and *Carinatae* with examples. Interesting features of mammalian orders (*Insectivora, Carnivora, Chiroptera, Cetacea, Proboscidia, Ungulata – Perissodactyla* and *Artiodactyla* and *Primates –Platyrhini* and *Catarhini*) with examples.

UNIT – III: **15 Hrs.**

General account of Chordates: Types of caudal fins, scales and swim bladder in fishes; Origin of Amphibia; Neoteny and Paedogenesis in Amphibians; Parental care in Pisces and Amphibians; Adaptive radiation in extinct reptiles with suitable examples; Temporal fossae in reptiles; Distinguishing poisonous snakes from non-poisonous snakes; Poison apparatus and biting mechanism in snakes; Flight adaptations in birds; Dentition in mammals; Evolution of molar tooth; Migration in fishes -catadromous and anadromous with suitable example; Bird migration-types with example; Echolocation in mammal.

UNIT – IV: **15 Hrs.**

Integumentary System: Structure of skin and its derivatives; Skeletal System: Comparative account of Axial Skeletal system in vertebrates- Skull- Amphibian (Frog), Reptiles (Lizard), Aves (Pigeon) and Mammals (Man); Comparative account of Appendicular skeletal system in vertebrates-Pectoral and Pelvic girdles of Amphibian (Frog), Reptiles (Lizard), Aves (Pigeon) and Mammals (Man); Respiratory system: Comparative account of respiratory system in vertebrates: Pisces (Scolidon), Amphibian (Frog), Reptiles (Lizard), Aves (Pigeon) and Mammals (Man); Circulatory System: Comparative account of heart and aortic arches in vertebrates: Pisces (Scoliodon), Amphibian (Frog), Reptiles (Lizard), Aves (Pigeon) and Mammals (Man); Excretory System: Succession of kidney in vertebrates; Nervous system: Comparative account of brain in vertebrates: Pisces (Scoliodon), Amphibian (Frog), Reptiles (Lizard), Aves (Pigeon) and Mammals (Man).

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1. Adam, S. 1990. A Students Text Book of Zoology, Low Price Publications, Delhi, Vol. I, II & Vo1.III.
2. Ayyar, E. 1982. A Manual of Zoology Vo1. II, S. Vishwanathan Pvt. Ltd.
3. Colbert, E.H. 2011. Evolution of the Vertebrates, Wiley Student Edition.
4. Dhami & Dhami. 2014. Chordate Zoology, R. Chand & Co. New Delhi.
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13. Lal, S.S. Practical Zoology Vertebrate 12/Ed, Rastogi Publications, Meerut.
14. Parker, T. J. & William A. H.. 1990. A Text Book of Zoology, Low Price Publications, Delhi, Vol. I & II.
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17. Romer and Parsons. 1986. The Vertebrate Body, 6th edition, CBS Publishing, Japan.
18. Saxena, R .K. & Sumitra, S. 2020. Comparative Anatomy of Vertebrates. 2nd edition, Viva Books Originals, New Delhi.
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SCHEME OF THEORY EXAMINATION
B.Sc. Zoology V Semester

Course Title/Code: BSCZOCN502**: CHORDATES AND COMPARATIVE ANATOMY**

Duration: 2 Hours **Max. Marks: 60**

PART - A

Q-I. Answer any **SIX** questions out of **EIGHT** questions (**2 questions from each Unit**) **(6 x2) = 12**

PART - B

Q-II. Answer any **TWO** questions out of **THREE** questions (**From Unit-I)** **(2 x 3) = 06**
Q-III. Answer any **ONE** question out of **TWO** questions (**From Unit-I**) **(1 x 6) = 06**

Q-IV. Answer any **TWO** questions out of **THREE** questions (**From Unit-II)** **(2 x 3) = 06**
Q-V. Answer any **ONE** question out of **TWO** questions (**From Unit-II**) **(1 x 6) = 06**

Q-VI. Answer any **TWO** questions out of **THREE** questions (**From Unit-III)** **(2 x 3) = 06**
Q-VII. Answer any **ONE** question out of **TWO** questions (**From Unit-III**) **(1 x 6) = 06**

Q-VIII. Answer any **TWO** questions out of **THREE** questions (**From Unit-IV)** **(2 x 3) = 06**
Q-IX. Answer any **ONE** question out of **TWO** questions (**From Unit-IV**) **(1 x 6) = 06**

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

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
House Examination/Test	20
Written Assessment/ Presentation/Project/Term papers/Seminars	15
Class room Performance/Participation	05
TOTAL	**40**
Formative Assessment as per NEP guidelines are compulsory	

Course Title	**CHORDATES AND COMPARATIVE ANATOMY (Practical)**		
Course Code:	**BSCZOPN502**	Practical Credits	**2**
Contact hours	**4 Hours/Week**	Duration of Practical Exam.	**3 Hrs.**
Formative Assessment Marks	**25**	Summative Assessment Marks	**25**

Course Outcomes (COs): At the end of the course the student should be able to:

- Understand the basics of classification of chordates.
- Learn the diversity of habit and habitat of types species of each groups.
- Know uniqueness of a particular animal and their evolutionary modifications and its importance.
- Handling of few animals as a laboratory skill to understand their anatomy and to identify different classes and species of animals.

PRACTICALS (15x4) = 60 (4Hrs/ Week)

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, Myolobaties*; Bony Fishes –*Zebra fish, Hippocampus, Muraena, Ostracion, Tetradon, Pleuronectus, Diodon, Echeneis*. (Any six). Ornamental fishes: *Siamese, Koi, Oscar, Betta* sp., *Neon tetra, Guppies, Gold fish, Angle fish, Rainbow fish, Mollies* (Any four).

4. Accessory respiratory organs: *Saccobranchus, Clarias* and *Anabas.*

5. Amphibia: *Haplobatrachus, Bufo, Ambystoma, Axolotl larva, Necturus* and *Ichthyophis.*

6. Reptilia: *Turtle, Tortoise, Mabuya, Calotes, Chameleon, Varanus*. snakes –*Dryophis, Rat snake, Brahmini, Cobra, Krait, Russell 's viper* and *Hydrophis*.

7. Aves: Beak and feet modifications in the following examples: *Duck, Crow, Sparrow, Parrot, King fisher, Eagle* or *Hawk.*

8. Mammalia: *Mongoose, Squirrel, Pangolin, Hedge Hog, Rat, Loris* and *Bats.*

9. Virtual Dissection/Cultured specimens: Shark/Bony fish: Afferent and efferent branchial systems; glossopharyngeal and vagus nerves.

10. Virtual Dissection/Cultured specimens: Rat: Dissection (only demonstration) – Circulatory system (arterial and venous); Urinogenital system.

11. Skeletal System in man: Skull, Vertebrae, Girdles and Limb bones (Except hands and feet).

12. Comparative account of skin in *shark, frog, calotes, pigeon* and *Man*.

13. Comparative account of heart in *shark, frog, calotes, pigeon* and *Man.*

14. Comparative account of brain in *shark, frog, calotes, pigeon* and *Man.*

SCHEME OF PRACTICAL EXAMINATION
B.Sc. Zoology: V Semester

Course Title/Code: BSCZOPN502:CHORDATES AND COMPARATIVE ANATOMY

Duration: 3 hours **Max. Marks: 25**

Q I. Dissect and display the organ system of available cultured specimens provided and comment.
(Dissection and display-4 marks, comments-2 marks) **(4+2) = 06**

OR

Virtual Dissection (Two Specimen) - Identify, draw labelled diagram and comment on the flagged Systems (Identification of the system - ½ mark; Identification of the flagged part - ½ mark; Labelled diagram of the entire system - 1 marks; Description of flagged part -1mark) **(3+3) = 06**

Q II. Identify with systematics, draw labelled diagram and comment (**A&B)**. (1 slide/ 1 specimen).
(Identification - ½ mark; Systematics -½ mark; Labelled diagram -1 mark; Comments -1 mark) (**3x2) = 06**

Q III. Identify the human endoskeleton '**C**' with neat labelled diagram and comment. **03**
(Identification -1 mark, diagram -1 mark, comment-1 marks)

Q IV. Identify and give the comparative account of skin / heart / brain of two vertebrates (**D)** **05**
(Identification -1 mark, diagram -2 mark, comment-2 marks)

Q IV. Record and Viva voce **05**

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

Formative Assessment for Practical	
Assessment Occasion/ type	**Marks**
House Examination/Test	10
Project/Model submission	05
Class room Performance/Participation	05
Record writing & timely submission	05
Total	**25**
Formative Assessment as per NEP guidelines are compulsory	

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark -X in the intersection cell if a course outcome addresses a particular program outcome.

Course Outcomes (COs) / Program Outcomes (POs)	**BSCZOCN501**	**BSCZOPN501**	**BSCZOCN502**	**BSCZOPN502**
Core competency				
Critical thinking				
Analytical reasoning				
Research skills				
Team work				

Program Name	B.Sc.		SEMESTER	VI
Course Title	EVOLUTIONARY & DEVELOPMENTAL BIOLOGY (Theory)			
Course Code	BSCZOCN601		No. of Credits	4
Contact hours	60 Hours		Duration of SEA/Exam	2 hours
Formative assessment marks		40	Summative assessment marks	60

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

- 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.
- Understand that natural selection is one of several processes that can bring about evolution although it can also promote stability rather than change.
- 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.
- Understand a variety of interacting processes, which generate an organism's heterogeneous shapes, size, and structural features.
- Understand how a cell behaves in response to an autonomous determinant or an external signal, and the scientific reasoning exhibited in experimental Life sciences.

UNIT – I: **15 Hrs.**

Theories of Evolution**:** Origin of Life; 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). Population Genetics**:** Microevolution and Macroevolution; allele frequencies; genotype frequencies; Hardy- Weinberg equilibrium and conditions for its maintenance; Forces of evolution- mutation, selection, migration, genetic drift.

UNIT – II: **15 Hrs.**

Direct evidences of evolution**:** Types of fossils; Incompleteness of fossil record; Dating of fossils; Evolution of horse- *Eohippus, Mesohippus, Merychippus* and *Equus;* Species concept - Biological species concept; Advantages and Limitations; Modes of speciation –Allopatric and Sympatric; Speciesextinction: Mass extinction - Causes and names of five major extinctions.

UNIT – III: **15 Hrs.**

Gamete Fertilization and Early Development**:** Gametogenesis; Fertilization; Cleavage pattern; Gastrulation; Fate maps and Morphogenesis; Developmental Genes: General concepts of organogenesis; Introduction to the genetic basis of embryonic development and Developmental control genes in *Drosophila* (*Homeo- box* genes).

UNIT – IV: **15 Hrs.**

Vertebrate Development: Early developmental process: Metamorphosis in amphibians; Placentation in mammals; Environmental regulation of development. Late developmental processes: Development of eye, kidney, limb in amphibians; Mammalian female reproductive cycles - estrous and menstrual cycle; Regeneration in mammals; Aging- Biology of senescence.

References:

1. Armugam, N. 2005. A Text Book of Embryology, Saras Publication, Nagercoil.
2. Arora, M.P. and Chaudar, K. 2000. Evolution, 2nd edition, Himalaya Publishing House, New Delhi.
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SCHEME OF THEORY EXAMINATION
B.Sc. Zoology VI Semester

Course Title/Code: BSCZOCN601: EVOLUTIONARY & DEVELOPMENTAL BIOLOGY

Duration: 2 Hours **Max. Marks: 60**

PART - A

Q-I. Answer any **SIX** questions out of **EIGHT** questions (**2 questions from each Unit**) (**6 x2) = 12**

PART - B

Q-II. Answer any **TWO** questions out of **THREE** questions (**From Unit-I)** (**2 x 3) = 06**

Q-III. Answer any **ONE** question out of **TWO** questions (**From Unit-I**) **(1 x 6) = 06**

Q-IV. Answer any **TWO** questions out of **THREE** questions (**From Unit-II)** (**2 x 3) = 06**

Q-V. Answer any **ONE** question out of **TWO** questions (**From Unit-II**) **(1 x 6) = 06**

Q-VI. Answer any **TWO** questions out of **THREE** questions (**From Unit-III)** (**2 x 3) = 06**

Q-VII. Answer any **ONE** question out of **TWO** questions (**From Unit-III**) **(1 x 6) = 06**

Q-VIII. Answer any **TWO** questions out of **THREE** questions (**From Unit-IV)** (**2 x 3) = 06**

Q-IX. Answer any **ONE** question out of **TWO** questions (**From Unit-IV**) **(1 x 6) = 06**

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

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
House Examination/Test	20
Written Assessment/ Presentation/Project/Term papers/Seminars	15
Class room Performance/Participation	05
TOTAL	**40**
Formative Assessment as per NEP guidelines are compulsory	

Course Title	**EVOLUTIONARY & DEVELOPMENTAL BIOLOGY (Practical)**		
Course Code:	**BSCZOPN601**	Practical Credits	**2**
Contact hours	**4 Hours/Week**	Duration of Practical Exam.	**3 Hrs.**
Formative Assessment Marks	**25**	Summative Assessment Marks	**25**

Course Outcomes (Cos) :

- The foundation in other courses further makes the student to understand the basis of classification of different taxa .
- Species characteristics and their evolutionary modifications are studied by closely observing unique characteristics .
- Adaptive modifications for varied eco-regions and climatic conditions in certain important groups will be understood .
- Developmental process through egg to adult stages are studied in the selected invertebrates and vertebrates
- Few statistical tools will also be applied to understand the evolutionary divergences of adaptive characters.

PRACTICALS **15x4=60 (4Hrs/week)**

1. Study of fossils from models/pictures. - *Archaeopteryx, Dinosaurs, Horse* and *Human.*
2. Study of homology and analogy from suitable specimens- Forelimbs of vertebrates; wings inanimals; Prawn appendages - serial homology.
3. Study and verification of Hardy-Weinberg equilibrium by Chi-square analysis.
4. Graphical representation and interpretation of data of height/ weight of sample of 100 humans inrelation to their age and sex.
5. Study the types of eggs based on quantity and distribution of yolk: *Sea urchin, insect, frog* and *Chick.*
6. Study the early developmental stages in frog - cleavage, blastula, gastrula, neurula.
7. Study the metamorphosis in frog (tadpole to adult).
8. Study the development of chick embryo using the incubated chick eggs (up to 96h).
9. Study of adaptive radiations in feet of birds and mouth parts of insects.
10. Study the placental structure and classification.

SCHEME OF PRACTICAL EXAMINATION
B.Sc. Zoology VI Semester

Course Title/Code: BSCZOPN601: EVOLUTIONARY & DEVELOPMENTAL BIOLOGY

Duration: 3 hours **Max. Marks: 25**

Q I. Identify and comment on the given model **A** and comment (**Expt.- 1**) **03**
(Identification - 1 mark; comments - 2 marks)

Q II. Identify and comment on the spotter **B** (**Expt.- 2**) **03**
(Identification- 1 mark; comments- 2 marks)

Q III. Problem / Graphical representation of data (**Expt.-3/4**) **04**

Q IV. Identify and comment on the given chart / specimen with a labeled diagram- **C (Expt.-5/6)** **03**
(Identification-1 mark; diagram –1 mark; comments-1 mark)

Q V. Identify and comment on the given specimen/slide with a labeled diagram - **D** (**Expt.-7/8**) **03**
(Identification-1 mark; diagram – 1 mark; comments-1 mark)

Q VI. Identify and comment on the given spotter- **E** (**Expt.-9/10)** **04**
(Identification- 1 mark; diagram- 1 mark; comments - 2 marks)

Q VII. Record and Viva-voce **05**

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

Formative Assessment for Practical	
Assessment Occasion/ type	**Marks**
House Examination/Test	10
Project/Model submission	05
Class room Performance/Participation	05
Record writing & timely submission	05
Total	**25**
Formative Assessment as per NEP guidelines are compulsory	

Program Name	**B.Sc.**		**SEMESTER**	**VI**
Course Title	**ENVIRONMENTAL BIOLOGY, WILDLIFE MANAGEMENT & CONSERVATIONS (Theory)**			
Course Code:	**BSCZOCN602**		No. of Credits	**4**
Contact hours	**60 Hrs.**		Duration of Exam.	**2 Hrs.**
Formative assessment marks		**40**	Summative assessment marks	**60**

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

- Develop an understanding of how animals interact with each other and their natural environment.
- Develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues.
- Develop the ability to work collaborative team-based projects.
- Gain an appreciation for the modern scope of scientific inquiry in the field of Wildlife conservation andmanagement
- Develop an ability to analyze, present and interpret Wildlife conservation and management practices.

UNIT – I **15 Hrs.**

Ecology**:** Introduction to ecology; food chain and food web, trophic levels-ecological pyramids; Ecological succession –Ecotone and edge effect; Ecosystem: types of ecosystem- terrestrial; aquatic; desert; grassland; cave; mangrove; Man-made ecosystems- cropland; garden; aquarium. Ecological factors- weather, climate, ozone layer. Adaptive features of plants and animals to different environmental conditions (Light, Temperature).

UNIT – II **15 Hrs.**

Pollution: Types of pollutions - air, soil, water and thermal pollution- causes, effect and control measures; ozone layer depletion; bio-accumulation, bio-magnifications, and bio-remediation; Effects of pollution on plants and animals; Pollution monitoring; Waste management – Types and sources of wastes; Degradable and non-degradable wastes management.

UNIT – III **15 Hrs.**

Wildlife Management: Taxonomy in biodiversity assessment; Biodiversity – levels of biodiversity- Ecosystem, Genetic and Species (Alpha, Beta, Gamma); Zoological realms; Unique Indian animals- Endemic species; Niche, Home range and Territory; Biodiversity hot spots –Western Ghats biodiversity; Biodiversity assessment - monitoring biodiversity –WCMC, IGCMC, Animal census; Remote sensing and GIS techniques in Wildlife studies; Threats to wildlife; IUCN Red list categories with examples in Indian context.

UNIT – IV **15 Hrs.**

Wildlife Conservation: *In-situ* conservation: Wildlife National Parks, sanctuaries & biosphere reserves; *ex-situ* conservation: Zoological gardens and Captive breeding program; Legal aspects- Wildlife (Protection) Act, 1972; Biodiversity Act (2002); Ramsar convention; Special projects: Project Tiger; Project Elephant; Project Lion; Crocodile breeding project; Project Rhino. Organizations working on wildlife conservation.

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1. Agarwal. K.C. 2008. Environmental Biology, II edition, Nidhi Publishers.
2. Arora M.P. 2001. Ecology, Himalaya Publishing House, New Delhi.
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17. Saharia. V.B. 1982. Wildlife in India, Natraj publications, Dehradun.
18. Verma, P.S. and Agarwal, K.C. 2004. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Co. New Delhi.

SCHEME OF THEORY EXAMINATION
B.Sc. Zoology VI Semester

Course Title/Code: BSCZOCN602: ENVIRONMENTAL BIOLOGY, WILDLIFE MANAGEMENT & CONSERVATIONS

Duration: 2 Hours **Max. Marks: 60**

PART - A

Q-I. Answer any **SIX** questions out of **EIGHT** questions (**2 questions from each Unit**) (**6 x2) = 12**

PART - B

Q-II. Answer any **TWO** questions out of **THREE** questions (**From Unit-I)** (**2 x 3) = 06**

Q-III. Answer any **ONE** question out of **TWO** questions (**From Unit-I**) **(1 x 6) = 06**

Q-IV. Answer any **TWO** questions out of **THREE** questions (**From Unit-II)** (**2 x 3) = 06**

Q-V. Answer any **ONE** question out of **TWO** questions (**From Unit-II**) **(1 x 6) = 06**

Q-VI. Answer any **TWO** questions out of **THREE** questions (**From Unit-III)** (**2 x 3) = 06**

Q-VII. Answer any **ONE** question out of **TWO** questions (**From Unit-III**) **(1 x 6) = 06**

Q-VIII. Answer any **TWO** questions out of **THREE** questions (**From Unit-IV)** (**2 x 3) = 06**

Q-IX. Answer any **ONE** question out of **TWO** questions (**From Unit-IV**) **(1 x 6) = 06**

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

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
House Examination/Test	20
Written Assessment/ Presentation/Project/Term papers/Seminars	15
Class room Performance/Participation	05
TOTAL	**40**
Formative Assessment as per NEP guidelines are compulsory	

Course Title	**ENVIRONMENTAL BIOLOGY, WILDLIFE MANAGEMENT & CONSERVATION (Practical)**			
Course Code:	**BSCZOPN602**		Practical Credits	**2**
Contact hours	**4 Hours/Week**		Duration of Practical Exam.	**3 Hrs.**
Formative assessment marks		**25**	Summative assessment marks	**25**

Course Outcomes (COs):

The students will be trained on various methods of assessment animals in the field and laboratory by ;

- The estimation of various pollutions in the habitats
- The impact of various pollutions on biotic community will be assessed through biological samples collected from polluted and unpolluted habitats
- The collection, preservation and identification of important groups of regional fauna.

- The identification of wild vertebrate animals by indirect methods without collecting the animals .
- The handling of various equipments used in wildlife studies.
- The assessment of animal population using field based techniques .
- The students also will be trained in degradable Solid waste management techniques
- Different ecosystems will be visited by the students to record the faunal diversity in the form of a report.

PRACTICALS **15x4=60 (4Hrs/ Week)**

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1. Water quality parameters assessment:
   - Estimation of Dissolved Oxygen (O_2);
   - Estimation of Carbon dioxide (CO_2);
   - Estimation of Biological Oxygen Demand (BOD);
   - Estimation of Chemical Oxygen Demand (COD);
   - Estimation of Chlorides, hardness and salinity of water.

2. Analysis of physico-chemical parameters of soil: pH, moisture, temperature, organic matter.

3. Analysis of air pollution: Air monitoring for particulate matter.

4. Collection, preservation and estimation of zooplanktons (Ponds & Lakes).

5. Identification of wild animals**:** Pugmarks & hoof marks; scats & pellet counts; nest; antlers.Feathers.

6. Studies on field equipments and their applications in wildlife census- Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System(GPS), Photography & Videography.

7. Demonstration of field techniques for assessment of animals (Line transect, quadrate methods)

8. Demonstration of waste management techniques: Vermitechnology / Hermitechnology

9. Collection, identification and recordings of fauna of selected ecosystems & submission of report.

10. Visit to protected areas/ ex-situ conservation facilities/ industries and submission of report.

SCHEME OF PRACTICAL EXAMINATION
B.Sc. Zoology VI Semester

Course Title/Code: BSCZOPN602: ENVIRONMENTAL BIOLOGY, WILDLIFE MANAGEMENT & CONSERVATION

Duration: 3 hours **Max. Marks: 25**

Q I. Analyses of the quality of the given water sample (O_2/ CO_2/Chloride/ Hardness/Salinity**).** **05**
(Procedure- 2 marks; readings- 2 marks; results – 1 mark)

Q II. Analysis of physico-chemical parameters of soil sample (pH,Temp, Moisture,Organic matter). **04**
(Procedure- 2 marks; results- 2 marks)

Q III. Identify and comment on the given spotters- **A** and **B** (**Expt.-5 & 6)** (**2x3)= 06**
(Identification- 1 mark; comments - 2 marks)

Q IV. Submission of report (**Expt.-9 / 10**) **05**

Q V. Record and Viva-voce **05**

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

Formative Assessment for Practical	
Assessment Occasion/ type	**Marks**
House Examination/Test	10
Project/Model submission	05
Class room Performance/Participation	05
Record writing & timely submission	05
Total	**25**
Formative Assessment as per NEP guidelines are compulsory	

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark -X in the intersection cell if a course outcome addresses a particular program outcome.

Course Outcomes (COs) / Program Outcomes (POs)	**BSCZOCN601**	**BSCZOPN601**	**BSCZOCN602**	**BSCZOPN602**
Core competency				
Critical thinking				
Analytical reasoning				
Research skills				
Team work				
