



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

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Preamble

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

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

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

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

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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 of the 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

Demonstrates subject-related skills relevant to Zoology-related jobs and employment 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-The Programme offers both classical as well as modern concepts of Zoology in higher education.

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

POs3-To make the study of animals more interesting and relevant to human studies more emphasis is given to branches like 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	30	70
Practical	15	35
Projects	45	105
Experiential Learning (Internship 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 Intelligence (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) Zoology A10(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 A1 Major course	Cytology, Genetics and Infectious Diseases (4)	1. The structure and functions of animal cell, cell organelles, cell-cell interactions, process of reproduction leading to new organisms. 2. The principles of inheritance, Mendel's laws and the deviations. 3. Inheritance of chromosomal aberrations in humans by pedigree analysis in families.	Student must have studied Biology or equivalent subjects in Class 12.	Lab on Cell Biology and Genetics (2)	Lectures/Videos/Seminars/Case study/Project/Group discussion/Problem Solving/Formative Assessment/Summative Assessment	Formative and Summative Assessment/Evaluation/Analysis of result/Application of Heutagogy,
1 Semester B1 Minor course	Biology of Non-Chordates (4)	1. Learn the systematics and biology of non-chordates through their adaptive features. 2. Study the functional biology of non-chordates through their body organization. 3. Comprehend identification of species and their evolutionary relationships.	Student must have studied Biology or equivalent subjects in Class 12.	Lab on Biology of Non-Chordates (2)	Lectures/Videos/Seminars/Case study/Project/Formative Assessment/Summative Assessment	Formative and Summative Assessment/Evaluation/Analysis of result/Application of Heutagogy,
1 Semester OE1 Open Elective course	Economic Zoology (3)	1. Acquaint the knowledge about basic procedure and methodology of integrated animal rearing. 2. Students can start their own business i.e. self employments. 3. Get	Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/Seminars/Case study/Project/Group discussion/Problem Solving/Formative Assessment/Summative Assessment	Formative and Summative Assessment/Evaluation/Analysis of result/Application of Heutagogy,

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

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

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

4 A4 Major Core course	GeneTechnology, Immunology and Computational Biology (4)		Certificate Course in Zoology	Lab on Genetic Engineering And Counselling (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to industry/Formati ve Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ 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/Formati ve Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of Heutagogy,
4 Sem OE 4 Open Elective Course	Animal Behaviour (3)		Certificate Course in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formati ve Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of Heutagogy,
4 Semester Skill Enhanseme nt course	Constitute of India (2) Poultry		Certificate Course in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formati ve Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of Heutagogy,
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/Ev aluation/ 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/Ev aluation/ Analysis of result/ Application of

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

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

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

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

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

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

	Physiology (3)		Bachelor of Science Honors		/ Seminars/Case study/Project/ Group discussion/Visit to Industry/Formati ve Assessment/ Summative Assessment	Summative Assessment/Ev aluation/ 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/Formati ve Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of Heutagogy,
10 Skill Enhanceme nt	E-3 Animal Breeding Techniques (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formati ve Assessment/ Summative Assessment	Formative and Summative Assessment/Ev aluation/ Analysis of result/ Application of Heutagogy,
EXIT OPTION WITH M. Sc. DEGREE (268 CREDITS)						

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

Core Course Content

Course Title/Code: Cytology, Genetics and Infectious Diseases	Course Credits: 4
Course Code: DSCC5Z00T1	L-T-P per week: 4-0-0
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative AssessmentMarks: 30	Summative AssessmentMarks: 70
Model SyllabusAuthors:	

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 organism and also reproduces to form new organisms.
4. How a cell communicates with its neighboring cells.
5. The principles of inheritance, Mendel's laws and the deviations.
6. How environment plays an important role by interacting with genetic factors.
7. 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)	CC T1	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 Chapter 2 Plasma membrane: chemical structure—lipids and proteins Chapter 3 Endomembrane system: protein targeting and sorting, transport, endocytosis and exocytosis	
Chapter 2. Structure and Function of Cell Organelles II in Animal Cell <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • Basic principles of heredity: Mendel's laws- monohybrid cross and hybrid cross • Complete and Incomplete Dominance • Penetrance and expressivity • Genetic Sex-Determining Systems, Environmental Sex Determination, Sex Determination and mechanism in <i>Drosophilamelanogaster</i>. • Sex-linked characteristics in humans and dosage compensation 	
Chapter 6. Extensions of Mendelism, Genes and Environment <ul style="list-style-type: none"> • Extensions of Mendelism: Multiple Alleles, Gene Interaction. • The Interaction Between Sex and Heredity: Sex-Influenced and Sex-Limited Characteristics • Cytoplasmic Inheritance, Genetic Maternal Effects. • Interaction between Genes and Environment: Environmental Effects on Gene Expression, Inheritance of Continuous Characteristics. 	
Unit IV	14
Chapter 7. Human Chromosomes and Patterns of Inheritance <ul style="list-style-type: none"> • Patterns of inheritance: autosomal dominance, autosomal recessive, X-linked recessive, X-linked dominant. • Chromosomal anomalies: Structural and numerical aberrations with examples. • Human karyotyping and Pedigree analysis. 	
Chapter 8. Infectious Diseases <ul style="list-style-type: none"> • Introduction to pathogenic organisms: viruses, bacteria, fungi, protozoa and worms. • Structure, life cycle, pathogenicity, including diseases, causes, symptoms and control of common parasites: <i>Trypanosoma, Giardia and Wuchereria</i>. 	

Suggested Readings :

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

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

Formative Assessment	
Assessment Occasion	Weightage in Marks
House Examination/Test	10
Written Assignment/Presentation/Project / Term Papers/Seminar	15
Class performance/Participation	05
Total	30

Date:Coordinator

Subject Committee Chairperson

Zoology Core Lab Course Content

Semester I

Course Title: Cell Biology &Cytogenetics Lab	Course Credits: 2
Course Code: DSCC5Z00P1	L-T-P per week: 0-0-4
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative AssessmentMarks: 15	Summative AssessmentMarks: 35
Model SyllabusAuthors:	

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 rs.
<ol style="list-style-type: none"> 1. Understanding of simple and compound microscopes. 2. To study different cell types such as buccal epithelial cells, neurons, striated muscle cells using 3. Methylene blue/any suitable stain (virtual/ slaughtered tissue). 3. To study the different stages of Mitosis in root tip of <i>Allium cepa</i>. 4. To study the different stages of Meiosis in grasshopper testis (virtual). 5. To check the permeability of cells using salt solution of different concentrations. 6. Study of parasites in humans (e.g. Protozoans, Helminthes in compliance with examples being studied in theory) permanent microslides. 7. To learn the procedures of preparation of temporary and permanent stained slides, with available mounting material. 8. Study of mutant phenotypes of <i>Drosophila</i> sp. (from Cultures or Photographs). 9. Preparation of polytene chromosomes (Chironomus larva or Drosophila larva). 10. Preparation of human karyotype and study the chromosomal structural and numerical aberrations from the pictures provided. (Virtual/optional). 11. To prepare family pedigrees. 12. https://www.vlab.co.in 13. https://zoologysan.blogspot.com 14. www.vlab.iitb.ac.in/vlab 15. www.onlinelabs.in 16. www.powershow.com 17. https://vlab.amrita.eduhttps://sites.dartmouth.edu/ 	

Suggested Readings:

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

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

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

Date:

Course Co-ordinator

Subject committee Chairperson

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)	MDC5ZOO T1	MDC5ZOO T2	MDC5ZOO T3	MDC5ZOO T4	MDC5ZOO T5	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
<p>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.</p> <p>Chapter 2. General characters and classification of major Invertebrate phyla- Protozoa,</p>	

Porifera, Coelenterata, Helminthes, Annelida, Arthropoda, Mollusca and Echinodermata up to the level of classes with suitable examples.	
Unit II	14
<p>Chapter 3. Diversity of life sustaining systems in nonchordates: (with an example for each type of system)</p> <p>Locomotion: Protozoa- amoeboid (Sol-Gel theory), Flagellar, euglenoid and ciliary movements. Hydrostatic movements in Annelida-Earthworm and Echinodermata-starfish.</p> <p>Nutrition: In Protozoa.</p> <p>Feeding apparatus and mechanism: In Annelida-filter feeding, Arthropoda-Prawn, Mollusca-Pila and Echinodermata-Sea Star.</p> <p>Respiration: In Protozoa-diffusion, Helminthes-parasitic, Annelida-cutaneous, Arthropoda (any one type), Mollusca (Gill) and Echinodermata (Dermal papillae and Tube feet).</p> <p>Circulation: In Protozoa (cyclosis), Annelida- Earthworm, Arthropoda-Prawn, Mollusca-Pila and Echinodermata- Sea Star.</p> <p>Osmoregulation and excretion: In Protozoa-Contractile vacuoles, Platyhelminthes- Flame cells, Annelida-Nephredia and Arthropoda-Green glands.</p>	
Unit III	14
<p>Chapter 4. Diversity of coordinating systems and generative systems in nonchordates: (with an example for each type of system)</p> <p>Nervous system in Coelenterata, Platyhelminthes, Annelida, Arthropoda, Mollusca and Echinodermata.</p> <p>Neuroendocrine system and pheromones in Insecta.</p> <p>Sense organs: Mechanoreceptors, Photoreceptors, Chemoreceptors, thigmoreceptors, rheoreceptors and proprioceptors.</p> <p>Reproduction: Asexual and sexual reproduction in Protozoa, Porifera, Coelenterate, Annelida and Echinodermata.</p> <p>Metamorphosis in Insecta.</p> <p>Larval forms of Coelenterata, Annelida and Echinodermata.</p>	
Unit IV	14
<p>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.</p> <p>Chapter 6. Harmful non-chordates Parasitic Platyhelminthes. Soil Nematodes. Agricultural, veterinary and human pests of Arachnida. Agricultural, veterinary and human pests of Arthropoda.</p>	07 07

Topics Suggested for Assignment/ Formative Assessment:

1. Animal connecting links. 2. Polymorphism 3. Parasitic adaptations 4. Metamorphosis 5. Freshwater sponges 6. Molluscs 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	Course 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)	MDC5ZOO P1	MDC5ZOOP 2	MDC5ZOOP 3	MDC5ZOOP 4	MDC5ZOOP 5	MDC5ZOOP 6
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
<ol style="list-style-type: none"> 1. Preparation and observation of protozoan culture. 2. Protozoa: Systematics of <i>Amoeba</i>, <i>Euglena</i>, <i>Noctiluca</i>, <i>Paramecium</i> and <i>Vorticella</i> (Permanent slides). 3. Porifera: Systematics of <i>Sycon</i>, <i>Euplectella</i>, <i>Hyalonema</i>, <i>Spongilla</i> and <i>Euspongia</i> (Specimens). Study of permanent slides of T.S of <i>Sycon</i>, spicules and gemmules. 4. Cnidaria: Systematics of <i>Aurelia</i> and <i>Metridium</i> (Specimens). Slides of <i>Hydra</i>, <i>Obelia</i>-polyp and medusa, and <i>Ephyra</i> larva, T.S. of <i>Metridium</i> passing through mesenteries. 5. Study of Corals-<i>Astraea</i>, <i>Fungia</i>, <i>Meandrina</i>, <i>Corallium</i>, <i>Gorgonia</i>, <i>Millepora</i> and <i>Pennatula</i>. 	56

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|---|--|
| <ol style="list-style-type: none"> 6. Helminthes: Systematics of <i>Planaria</i>, <i>Fasciola hepatica</i> and <i>Taeniasolium</i>, Ascaris- Male and female (Specimens). Slides of T.S. of <i>Planaria</i>, T.S of male and female Ascaris, 7. Annelida: Systematics of <i>Nereis</i>, <i>Heteronereis</i>, <i>Sabella</i>, <i>Aphrodite</i> (Specimens). Slide of T.S. of Earth worm through typhlosole. 8. Arthropoda: Systematics of <i>Panaeus</i>, <i>Palaemon</i>, <i>Astracus</i>, Scorpion, Spider, <i>Limulus</i>, <i>Peripatus</i>, Millipede, Centipede, Praying mantis, Termite Queen, Moth, Butterfly, Dung beetle/Rhinoceros beetle (Any six specimens). Slide of Larvae- Nauplius, Zoea, Mysis. 9. Mollusca: Systematics of <i>Chiton</i>, <i>Mytilus</i>, <i>Aplysia</i>, <i>Pila</i>, <i>Octopus</i>, <i>Sepia</i>, Glochidium larva (Specimens). 10. Shell Pattern-<i>Unio</i>, <i>Ostrea</i>, <i>Cypria</i>, <i>Murex</i>, <i>Nautilus</i>, <i>Patella</i>, <i>Dentalium</i>, Cuttle bone. 11. Echinodermata: Systematics of Sea star, Brittle star, Sea Urchin, Sea cucumber, Sea lily (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 <i>Bombyxmori</i>, 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. | |
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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 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 AssessmentMarks: 30	Summative AssessmentMarks: 70
Model SyllabusAuthors:	

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
<p>Chapter 1. Sericulture:</p> <ul style="list-style-type: none"> • History and present status of sericulture in India • Mulberry and non-mulberry species in Karnataka and India • Mulberry cultivation • Morphology and life cycle of <i>Bombyxmori</i> • Silkworm rearing techniques: Processing of cocoon, reeling • Silkworm diseases and pest control <p>Chapter 2. Apiculture:</p> <ul style="list-style-type: none"> • Introduction and present status of apiculture • Species of honey bees in India, life cycle of <i>Apisindica</i> • Colony organization, division of labour and communication • Bee keeping as an agro based industry; methods and equipments: indigenous methods, extraction appliances, extraction of honey from the comb and processing • Bee pasturage, honey and bees wax and their uses • Pests and diseases of bees and their management 	
Unit II	14
<p>Chapter 3. Live Stock Management:</p> <ul style="list-style-type: none"> • 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 <p>Chapter 4. Aquaculture:</p> <ul style="list-style-type: none"> • 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
<p>Chapter 5. Fish culture:</p> <ul style="list-style-type: none"> • 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 <p>Chapter 6. Prawn culture:</p> <ul style="list-style-type: none"> • Culture of fresh and marine water prawns. • Preparation of farm. • Preservation and processing of prawn, export of prawn. <p>Chapter 7. Vermiculture:</p> <ul style="list-style-type: none"> • 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. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Mahadevappa, D., Halliyal, V.G., Shankar, D.G. and Bhandiwad, R., (2000). Mulberry Silk Reeling Technology Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Roger, M (1990). The ABC and Xyz of Bee Culture: An Encyclopedia of Beekeeping, Kindle Edition.
5. Shukla and Upadhyaya (2002). Economic Zoology, Rastogi Publishers
6. YadavManju (2003). Economic Zoology, Discovery Publishing House.
7. JabdePradip V (2005). Textbook of applied Zoology, Discovery Publishing House, New Delhi.
8. Cherian & Ramachandran Bee keeping in-South Indian Govt. Press, Madras.
9. Sathe, T.V. Vermiculture and Organic farming.
10. Bard. J (1986). Handbook of Tropical Aquaculture.
11. Santhanam, R. A. Manual of Aquaculture.
12. Zuka. R.1 and Hamiyn (1971). Aquarium fishes and plants
13. Jabde, P.V. (2005) Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac culture.
14. Animal Disease- Bairagi K. N. Anmol Publications Pvt.Ltd 2014
15. Economics Of Aquaculture - Singh(R.K.P) - Danika Publishing Company 2003
16. 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	10
Written Assignment/Presentation/Project / Term Papers/Seminar	15
Class performance/Participation	05
Total	30

Date: Course Co-Ordinator

Subject Committee Chairperson

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)	VEC5ZOO P1	2	3	4	5	6	7	8	9	10	11	12
i Core competency.	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 <i>Eiseniafetida</i> and <i>Eudriluseugeniae</i> .	
4	Dissection of digestive and reproductive system.	
5	Study of vermicomposting equipments and devices.	
6	Preparation of vermibeds and their maintenance.	
7	Study of different vermicomposting methods.	
8	Harvesting, separation of worms, packaging, transport and storage of vermicompost.	
9	Vermi-wash collection and processing.	
10	Small scale earth worm farming for home gardens and studying the effect of vermicompost on garden plants.	
11	Budget and cost scenario of vermiculture (Project).	
12	Diseases and natural enemies of earth worms and their control measures.	
13	Role of vermitechnology in environmental protection.	
14	Economics and Marketing of vermicompost and vermi wash.	
15	Visit to vermiculture farm to acquaint with latest techniques.	

Text Books and references

1. Bhatt J.V. & S.R. Khambata (1959) "Role of Earthworms in Agriculture" Indian Council of Agricultural Research, New Delhi
2. Edwards, C.A. and J.R. Lofty (1977) "Biology of Earthworms" Chapman and Hall Ltd., London.
3. Lee, K.E. (1985) "Earthworms: Their ecology and Relationship with Soils and Land Use" Academic Press, Sydney.
4. Dash, M.C., B.K.Senapati, P.C. Mishra (1980) " 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 BSc
Zoology Core Course Content

Course Title: Biochemistry and Physiology	Course Credits: 4
Course Code: DSCC5Z00T2	L-T-P per week: 4-0-0
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative AssessmentMarks: 30	Summative AssessmentMarks: 70
Model SyllabusAuthors:	

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
<p>Chapter 1. Structure and Function of Biomolecules:</p> <ul style="list-style-type: none"> • Structure and Biological importance of carbohydrates (Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates). • Lipids (saturated and unsaturated Fatty acids, Tri-acylglycerols, Phospho lipids, Glycolipids and Steroids) • Structure, Classification and General Properties of α-amino acids; Essential and non-essential amino acids, Levels of organization in proteins; Simple and conjugate proteins. 	
<p>Chapter 2. Enzyme Action and Regulation</p> <ul style="list-style-type: none"> • Nomenclature and classification of enzymes; Cofactors; Specificity of enzyme action. • Isozymes; Mechanism of enzyme action • Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions ; Equation of Michaelis-Menton, Concept of K_m and V_{max}, Enzyme inhibition • Allosteric enzymes and their kinetics; Regulation of enzyme action. 	
Unit 2	14
<p>Chapter 3. Metabolism of Carbohydrates and Lipids</p> <ul style="list-style-type: none"> • 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 	

<p>Chapter 4. Metabolism of Proteins and Nucleotides</p> <ul style="list-style-type: none"> • Catabolism of amino acids: Transamination, Deamination, Ureacycle, Nucleotides and vitamins • Peptide linkages 	
Unit 3	14
<p>Chapter 5. Digestion and Respiration in humans</p> <ul style="list-style-type: none"> • Structural organization and functions of gastrointestinal tract and associated glands. • Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Physiology of trachea and Lung. • Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood, Respiratory pigments, Dissociation curves and the factors influencing it; • Control of respiration. 	
<p>Chapter 6. Circulation and Excretion in humans</p> <ul style="list-style-type: none"> • 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
<p>Chapter 7. Nervous System and Endocrinology in humans</p> <ul style="list-style-type: none"> • Structure of neuron, resting membrane potential(RMP) • Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers. Types of synapse • Endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas and adrenal; hormones secreted by them. • Classification of hormones; Mechanism of Hormone action. 	
<p>Chapter 8. Muscular System in humans</p> <ul style="list-style-type: none"> • Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus 	

Suggested Readings:

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

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	15
Class performance/Participation	05
Total	30

Date:Coordinator**Subject Committee Chairperson**

Zoology Semester II Core Course Lab Content

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

Course 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, Proteins and Lipids. 5. Qualitative analysis of Nitrogenous wastes – Ammonia, Urea and Uric acid. 6. Separation of amino acids or proteins by paper chromatography.	20
7. Determination of the activity of enzyme (Urease)-Effect of [S] and determination of Km and Vmax. 8. Determination of the activity of enzyme (Urease) - Effect of temperature and time. 9. Action of salivary amylase under 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.in www.powershow.com https://vlab.amrita.edu https://sites.dartmouth.edu	06

Text Books

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

Web References:

- Mammalian Physiology – www.biopac.com

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

TOPICS RECOMMENDED FOR SEMINAR/PROJECT REPORT

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

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

Date:Coordinator

Subject Committee Chairperson

Course Content

Semester: **II 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: 56	Duration of ESA: 3 Hrs
Formative AssessmentMarks: 30	Summative AssessmentMarks: 70
Model SyllabusAuthors:	

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)	MDC5ZO O T1	MDC5ZOO T2	MDC5ZOO T3	MDC5ZOO T4	MDC5ZOO T5	MDC5ZOO T6
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
<p>Chapter 1: Hemichordata: Type Study of <i>Balanoglossus</i> – Habit and Habitat, Morphology, Coelom. Tornaria larva and its affinities. Affinities and systematic position of Hemichordata.</p> <p>Chapter 1: Chordates: Origin of Chordates. Basic characters of chordates and classification upto classes.</p> <p>Chapter 3: Urochordata : Type Study of <i>Herdmania</i>-Habit and Habitat, Morphology, Ascidian tadpole- structure and its retrogressive metamorphosis.</p> <p>Chapter 4: Cephalochordata : Type Study of <i>Branchiostoma (Amphioxus)</i>-Habit and Habitat, Morphology, Digestive system, Feeding mechanism and circulatory system.</p> <p>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.</p>	
Unit II	14
<p>Chapter 6: Vertebrates: General characters and Classification of different classes of vertebrates (Pisces, Amphibia, Reptilia, Aves, Mammalia) up to the order with examples. 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, Proboscidea, Ungulata – Perissodactyla and Artiodactyla, and Primates –Platyrrhini and Catarrhini) with examples.</p>	
Unit III	14
<p>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.</p> <p>Chapter 8: Type study of <i>Rattus</i>: Morphology, Endoskeleton (Axial and appendicular skeleton, except hands and feet) Digestive system, circulatory system, reproductive system.</p>	
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 Dairy.

Suggested Readings:

1. Harvey et al: The Vertebrate Life (2006)
2. Colbert et al: Evolution of the Vertebrates: A history of the backbone animal through time (5th ed 2002, Wiley-Liss)
3. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)
4. Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill
5. McFarland et al: Vertebrate Life (1979, Macmillan Publishing)
6. Parker and Haswell: Text Book of Zoology, Vol. II (1978, ELBS)
7. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)
8. Young: The Life of vertebrates (3rd ed 2006, ELBS/Oxford)
9. Weichert C. K. and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills

Web Sources:

1. <https://www.khanacademy.org/science/biology/crash-course-bio-ecology/crash-course-biology-science/v/crash-course-biology-123>
2. <https://opentextbc.ca/biology2openstax/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

Subject Committee Chairperson

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: 56	Duration of ESA: 3 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 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)	MDC5ZOO P1	MDC5ZOOP 2	MDC5ZOOP 3	MDC5ZOOP 4	MDC5ZOOP 5	MDC5ZOOP 6
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.

Minor Course Lab Content

List of labs to be conducted	56 Hours
<p>1. Protochordata: Balanoglossus and its T. S through proboscis Ascidian/ <i>Herdmania</i> and <i>Amphioxus</i>, T.S. of <i>Amphioxus</i> through pharynx and intestine.</p> <p>2. Cyclostomata: -<i>Petromyzon</i>, Ammocoete larva and <i>Myxine</i>.</p> <p>3. Pisces: - Cartilaginous Fishes – <i>Narcine</i>, <i>Trygon</i>, <i>Pristis</i>, <i>Myxobatias</i> - Bony Fishes – Zebra fish, Hippocampus, Muraena, Ostracion, Tetradon, Pleuronectus, Diodon, Echeneis.</p> <p>4. Ornamental fishes: -Siamese, Koi, Oscar, Betta Sp., Neon tetra, Guppies, Gold fish, Angle fish, Rainbow fish, Mollies.</p> <p>5. Accessory respiratory organs – Saccobranchus, Clarias and Anabas.</p> <p>6. Amphibia: -Frog, Bufo, Ambystoma, Axolotl larva, Necturus and Ichthyophis.</p> <p>7. Reptilia: -Turtle, Tortoise, Mabuaya, Calotes, Chameleon, Varanus. snakes – Dryophis, Rat snake, Brahmini, Cobra, Krait, Russell’s viper and Hydrophis; Poison apparatus.</p> <p>8. Aves: Beak and feet modifications in the following examples: Duck, Crow, Sparrow, Humming bird, Parrot, King fisher, Eagle or Hawk.</p> <p>9. Mammalia: -Mongoose, Squirrel, Pangolin, Hedge Hog, Rabbit, Rat, Monkey and Loris.</p> <p>10. Virtual Dissection/Cultured specimens: -Shark/Bony fish: Afferent and efferent branchial systems, glossopharyngeal and vagus nerves.</p> <p>11. Virtual Dissection/Cultured specimens: - Frog: Origin and distribution of trigeminal nerve.</p> <p>12. Virtual Dissection/Cultured specimens: -Rat: Dissection (only demonstration) – Circulatory system (arterial and venous), urinogenital system.</p> <p>Beneficial Chordates:</p> <p>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)</p>	

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 Credits: 3
Course Code: OEC5ZOOT2	
Total Contact Hours: 42	Duration of ESA: 3 Hours
Formative Assessment Marks: 30	Summative Assessment Marks: 70
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 <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of • <i>Fasciolopsisbuski</i> • <i>Schistosomahaematobium</i> • <i>Taeniasolium</i> • <i>Hymenolepis nana</i> Chapter 3. Parasitic Protists <ul style="list-style-type: none"> • Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of • <i>Entamoebahistolytica</i> • <i>Giardia intestinalis</i> 	14

<ul style="list-style-type: none"> • <i>Trypanosomagambiense</i> • <i>Plasmodium vivax</i> 	
Unit – 2	14
<p>Chapter 4. Parasitic Nematodes</p> <ul style="list-style-type: none"> • Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of <ul style="list-style-type: none"> • <i>Ascarislumbricoides</i> • <i>Ancylostomaduodenale</i> • <i>Wuchereriabancrofti</i> • <i>Trichinellaspiralis</i> • Nematode plant interaction ; Gall formation <p>Chapter 5. Parasitic Arthropods</p> <ul style="list-style-type: none"> • Biology, importance and control of <ul style="list-style-type: none"> • Ticks (Soft tick <i>Ornithodoros</i>, Hard tick <i>Ixodes</i>) • Mites(<i>Sarcoptes</i>) • Lice (<i>Pediculus</i>) • Flea (<i>Xenopsylla</i>) • Bug (<i>Cimex</i>) • Parasitoid (Beetles) <p>Chapter 6. Parasitic Vertebrates</p> <ul style="list-style-type: none"> • Cookicutter Shark • Hood Mocking bird and Vampire bat and their parasitic behavior and effect on host 	
Unit – 3	14
<p>Chapter 7. Molecular diagnosis & clinical parasitology</p> <ul style="list-style-type: none"> • 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 <i>G.intestinalis</i>, <i>B. coli</i>, <i>E. histolytica</i>, <i>L. donovani</i>, Malarial parasite using <ul style="list-style-type: none"> • ELISA, RIA • Counter Current Immunoelectrophoresis (CCI) • Complement Fixation Test (CFT) PCR, DNA, RNA probe 	

Suggested Readings:

- Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors.
- E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea &Febiger.
- Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group.
- Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi.
- Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers.
- K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd.
- Gunn, A. and Pitt, S.J. (2012). Parasitology: an Integrated Approach. Wiley Blackwell.
- Noble, E. R. and G.A.Noble (1982) Parasitology: The biology of animal parasites. V th Edition, Lea &Febiger.
- Paniker, C.K.J., Ghosh, S. [Ed} (2013). Paniker's Text Book of Medical Parasitology. Jaypee, New Delhi.
- Parija, S.C. Textbook of medical parasitology, protozoology & helminthology (Text and color Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi.
- 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 and Sons 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 print 1990, 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 nd Edn 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	10
Written Assignment/Presentation/Project / Term Papers/Seminar	15
Class performance/Participation	05
Total	30

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

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)	VEC5ZOO P1	VEC5ZOO P2	3	4	5	6	7	8	9	10	11	12
i Core competency.		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 <i>Bombyxmori</i> .	
7	Dissection of digestive system and silk glands of <i>Bombyxmori</i> .	
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 practice sericulture .
6. FAO Manuals 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

Semester III - Zoology

Core Course Content

Course Title : Molecular Biology, Bioinstrumentation & Techniques in Biology	Course Credits: 4
Course Code: DSCC5ZOOT3	L-T-P per week: 4-0-0
Total Contact Hours: 56	Duration of ESA: 2 Hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Model Syllabus Authors:	

Course Outcomes (COs):

At the end of the course the student should be able to: <ol style="list-style-type: none"> 1. 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 skills related to the field of molecular biology. 2. Gain knowledge on principal molecular events of cell incorporating DNA Replication, Transcription and Translation in prokaryotic as well as eukaryotic organisms. 3. Acquire skills in instrumentation and techniques in biology.
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Content	Hours
Unit I	14
Chapter 1: Process of Transcription <ul style="list-style-type: none"> • Fine structure of gene (Cistron, Recon, Muton) • RNA polymerases - types and functions • Transcription in prokaryotes and eukaryotes 	8
Chapter 2: Process of Translation <ul style="list-style-type: none"> • Genetic code and its salient features • Translation in prokaryotes and eukaryotes 	6
Unit II	14
Chapter 3. Regulation of gene expression-I <ul style="list-style-type: none"> • Regulation of gene expression in prokaryotes- lac operon (inducible) and trp operon (repressible) in <i>E. coli</i> • Regulation of gene expression in eukaryotes - Role of chromatin (euchromatin and heterochromatin) in gene expression • Post-transcriptional modification: capping, splicing, polyadenylation • Concept of RNA editing (mRNA), gene silencing, and RNAi 	9
Chapter 4. Regulation of gene expression-II <ul style="list-style-type: none"> • Post-translational modifications: purpose, advantages, and significance; glycosylation, methylation, phosphorylation, and acetylation. • Intracellular protein degradation (lysosomal autophagy and ubiquitin proteasome pathway). 	5

Unit III	14
Chapter 5: Microscopy <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> Centrifugation: Principles, types, and applications (High speed and Ultracentrifugation) Chromatography : Principle and applications of: TLC, HPLC and GC 	5
Unit IV	14
Chapter 7: Biochemical Instrumentation <ul style="list-style-type: none"> Colorimetry and Spectrophotometry: Beer-Lambert's law, Absorption spectrum, UV-VL Spectrophotometer. pH meter, measurement of pH Principle, applications and safety measures of Radio-tracer techniques - Autoradiography. 	6
Chapter 8: Molecular Techniques <ul style="list-style-type: none"> 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 Readings:

- Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. Molecular Biology of the Cell, 4th edition. New York: Garland Science (2002).
- Daniel L. Hartl and Maryellen Ruvolo. Genetics: Analysis of Genes and Genomes, 8th Edition. Burlington, Mass.: Jones & Bartlett Learning (2012).
- Gerald Karp. Cell and Molecular Biology: Concepts and Experiments, 5th Edition. Wiley Publication (2008).
- Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger, Freeman. Molecular Cell Biology, 5th edition. W. H. & Company (2003).
- James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick. Molecular Biology of the Gene, 5th edition. Cold Spring Harbor Laboratory Press (2003).
- Stryer, Lubert. Biochemistry, 2nd Edition. W. H. Freeman and Company, New York (1981).

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

Formative Assessment	
Assessment Occasion	Weightage in Marks
House Examination/Test	15
Written Assignment/Presentation/Project / Term	15
Class performance/Participation	10
Total	40

Core Course Lab Content

Course Title: Molecular Biology, Bioinstrumentation and Techniques in Biology	Course Credits: 2
Course Code: DSCC5ZOOP3	L-T-P per week: 0-0-4
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative Assessment Marks: 25	Summative Assessment Marks: 25

Course Outcomes (COs):

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

1. Understand the applications of biophysics and principle involved in bio-instruments.
2. Understand the methodology involved in bio techniques.
3. Acquire knowledge and practical skills of using instruments in biology and medical field.
4. Perform techniques involved in molecular biology and diagnosis of diseases.

Lab Course Content

List of experiments	14 units (1unit- 4hrs)
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- pH meter, Electronic balance, Vortex mixer, use of glass and micropipettes, Laminar air flow, Incubator, shaker, Water bath and centrifuge.	2
3. To prepare fixatives, stains and Buffer solutions (Phosphate, Citrate, Tris-HCl buffer)	1
4. To estimate amount of RNA by Orcinol method.	2
5. Demonstration of differential centrifugation to fractionate components in a given mixture.	1
6. To estimate amount of protein by Lowry's method.	1
7. To identify different unknown amino acids using ascending paper chromatography.	1
8. Extraction of DNA from the given animal tissue sample.	2
9. To estimate amount of DNA by di-phenyl amine (DPA) method.	2
10. Micrometry of different cell types	1

Suggested Readings:

7. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. Molecular Biology of the Cell, 4th edition. New York: Garland Science (2002).
8. Daniel L. Hartl and Maryellen Ruvolo. Genetics: Analysis of Genes and Genomes, 8th Edition. Burlington, Mass.: Jones & Bartlett Learning (2012).
9. Gerald Karp. Cell and Molecular Biology: Concepts and Experiments, 5th Edition. Wiley Publication (2008).
10. Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger, Freeman. Molecular Cell Biology, 5th edition. W. H. & Company (2003).
11. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick. Molecular Biology of the Gene, 5th edition. Cold Spring Harbor Laboratory Press (2003).
12. Stryer, Lubert. Biochemistry, 2nd Edition. W. H. Freeman and Company, New York (1981).

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

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

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

Course Title: Core Course Content: Gene Technology Immunology and Computational Biology	Course Code: DSCC5ZOOT4
Course Type: Discipline Core Theory, L-T-P: 4-0-0	Course Credits: 4
Total Contact Hours: 56	Duration of ESA: 2 Hrs.
Formative Assessment Marks: 40	Summative Assessment Marks: 60

Course Outcomes (COs):

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

1. Acquire knowledge on versatile tools and techniques employed in genetic engineering and recombinant DNA technology.
2. Apply knowledge on genetic engineering techniques in basic and applied experimental biology.
3. Acquire a fundamental working knowledge of the basic principles of immunology.
4. Understand the mechanisms and significance of immune functions.
5. Design experiments and perform data interpretation by applying the principal statistical methods and infer the significance of experimental results.
6. Learn use of statistical software and its applications in biology.

Course Content	Hrs.
Unit I	14
Chapter 1: Principles of Gene Manipulation	07
<ul style="list-style-type: none"> ● Recombinant DNA Technology: Introduction, steps involved. ● Restriction Enzymes and Ligases and Nucleic acid modifying enzyme. ● Gene cloning Vector: Concept of plasmids-pBR322, Lamda phage vectors, cosmids ● Gene transfer techniques (Direct and indirect). ● Screening and selection of recombinant colonies 	
Chapter 2: Applications of Genetic Engineering	07
<ul style="list-style-type: none"> ● 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 (SCID) ● Biosensors and its applications 	

Unit II	14
Chapter 3: Introduction to the Immune System <ul style="list-style-type: none"> • Defence against diseases: Introduction, First and second line of defence, Innate and acquired immunity; Antigen presenting cells (APC's), Role of B and T-lymphocytes (Humoral immunity and cell mediated immunity), primary and secondary immune response. • Types of Immunity • Functional aspects of organs of the Immune system - Thymus and bone marrow, spleen, Lymph Node, Small intestine and Liver (Peyer's patches and Von Kupffer cells). 	07
Chapter 4: Antigens and Antibodies <ul style="list-style-type: none"> • Antigens and haptens: Properties (foreignness, molecular size, heterogeneity). • B and T cell epitopes. • Structure of IgG and functions of different classes of immunoglobulins. • Major histocompatibility complex - Structure of MHC I & II. 	07
Unit III	14
Chapter 5: Clinical Immunology <ul style="list-style-type: none"> • Immunity against diseases of viral, bacterial and protozoan infections. • Vaccines: Types and Uses - Immunization schedule for children. • Transplantation immunology: Transplantation of organ- Types, graft rejection and Immuno-suppressors. 	07
Chapter 6: Bioinformatics <ul style="list-style-type: none"> • Databases: Sequence and structural • Sequence analysis (homology): Pairwise and Multiple Sequence alignment- BLAST, CLUSTALW, Sequence alignment- FASTA. • Scope and applications of Bioinformatics. 	07
Unit IV	14
Chapter 7: Biostatistics I <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • Measures of dispersion: Range, Standard Deviation, Variance. • Correlation and Regression. • Tests of significance: F-test, ANOVA, t-test and Chi square test. 	07

Topics Suggested for Assignment/ Formative Assessment:

1. Q/A, Short Question, Quiz, MCQ, Assignment etc.

Recommended Books:

1. Primrose & Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).
2. Hartl & Jones. Genetics: principles & Analysis of Genes & Genomes. Jones & Bartlett (1998).
3. Sambrook et al. Molecular Cloning Vols I, II, III. CSHL (2001).
4. Primrose. Molecular Biotechnology. Panima (2001).
5. Clark & Switzer. Experimental Biochemistry. Freeman (2000)
6. Sudbery. Human Molecular Genetics. Prentice-Hall (2002).

7. Wilson. Clinical Genetics-A Short Course, Wiley (2000).
8. Pasternak. An Introduction to Molecular Human Genetics. Fritzgerald (2000).
9. Biostatistical Analysis (Fourth Edition) by Jerrold H. Zarr, Pearson Education Inc., Delhi.
10. Statistical Methods (Eighth Edition) by G. W. Snecdecor and W. G. Cochran, Willey Blackwell
11. Biostatistics (Tenth Edition) by W.W. Daniel and C. L. Cross, Wiley
12. Introductory Biological Statistics (Fourth Edition) by John E. Havel, Raymond E. Hampton and Scott J. Meiners
13. Westhead et al. Bioinformatics: Instant Notes. Viva Books (2003)
14. Genetic engineering: Sandhya Mitra BITS, Pilani
15. Principles of Biostatistics Khan and Khanam
16. Transgenic animals: Ranga

Web Source: Suitable web sources may referred

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

Formative Assessment	
Assessment Occasion	Weightage in Marks
Assignment/ Field Report/ Project	15 Marks
Test	20 Marks
Participation in class	05 marks
Total	40 Marks

Course Title: Gene Technology, Immunology and Computational Biology	Course Credits: 02
Course Type: Minor Discipline Core Practical, L-T-P: 0-0-4	Course Code: DSCC5ZOOP4
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative Assessment Marks: 25	Summative Assessment Marks: 25
Model Syllabus Authors:	

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 techniques.

Lab IV Course Content

List of labs to be conducted	Hours
1. Calculate the mean, median, mode and standard deviation (with suitable examples).	2
2. Measure the height and weight of all students in the class and apply statistical measures.	1
3. Determination of ABO Blood group and Rh factor.	1
4. To study Restriction enzyme digestion using teaching kits (Demonstration only).	1
5. To detect genetic mutations by Polymerase Chain Reaction (PCR) using teaching kits (Demonstration only).	1
6. Demonstration of agarose gel electrophoresis for detection of DNA.	1
7. Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for detection of proteins.	2
8. To calculate molecular weight of unknown DNA and protein fragments from gel pictures. (https://youtube/mCiCiO0cfbg)	1
9. To learn nucleotide sequence database.	1
10. To learn sequence alignment: Pairwise alignment (Protein/ DNA).	1
11. Study of immune techniques- ELISA and RIA	1
12. Study of lymphoid organs- Bone marrow, thymus, spleen, lymph node, tonsils.	1
13. One day field visit pertaining to practicals	

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

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

Open Elective Course Content

Course Title: ENDOCRINOLOGY Course Code: OEC5ZOOT3	Course Credits:3
Total Contact Hours: 42	Duration of ESA: 2 Hours
Formative Assessment Marks: 40	Summative Assessment Marks:60
Model Syllabus Authors:	

Course Outcomes (Cos):

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

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

Course Content

Content	Hrs.
Unit I	14
Chapter 1. About Endocrine glands <ul style="list-style-type: none"> • Endocrine glands and classifications of hormones. • Characteristics and Transport of Hormones. Chapter 2. Hypothalamus-Hypophysis <ul style="list-style-type: none"> • Hypothalamus as a neuroendocrine organ • Pituitary – Structure and functions • Chemical nature, mode of action, and functions. • Pituitary disorders Chapter 3. Pineal gland <ul style="list-style-type: none"> • Structure and functions of Pineal gland. • Hypo- and hyperactive states of the gland. 	
Unit II	14
Chapter 4. Thyroid and parathyroid <ul style="list-style-type: none"> • Histological structure of the glands. • Chemical nature, mode of action, and functions of the hormones. • Hypo- and hyperactive states of the glands. Chapter 5. Adrenal cortex and medulla – <ul style="list-style-type: none"> • Histological structure of the gland. Chemical nature, and functions • Hypo- and hyperactive states of the gland. Chapter 6. Prostaglandins	

Unit – III	14
<p>Chapter 7: Pancreas:</p> <ul style="list-style-type: none"> • Pancreatic islets - histological structure. Chemical nature, and function. Hormonal control of blood sugar. • Hyperinsulinism and diabetes mellitus. <p>Chapter 8: Gastro-intestinal hormones –</p> <ul style="list-style-type: none"> • Functions and regulation of secretion of the hormones. <p>Chapter 9: Different types of Rhythms –</p> <ul style="list-style-type: none"> • Ultradian, circadian, infradian. Different zeitgebers and their relation with circadian clock • Neural basis of biological clock and role of suprachiasmatic nuclei. Sleep- wakefulness cycle. Time keeping genes. Jet-lag and shift work. 	

Text Books & Suggested Readings:

1. William's Text Book of Endocrinology
2. Larsen et al.: An Imprint of Elsevier.
3. Endocrinology, Mac E. Hadley, Pearson Education.
4. The Kidney-An outline of Normal and Abnormal Functions, by H.E. Dewardener, ELBS.
5. Vander's Human Physiology, E.P. Widmaier et al., McGraw-Hill, Higher Education.
6. Concise Medical Physiology by S.K. Chaudhuri, New Central Book Agency.
7. Endocrinology. Vols. I, II and III by L.O. DeGroot. W.B. Saunders Co.
8. The Physiology of Reproduction, Vols. I & II, by E. Knobil and J.D. Neil. Raven Press.
9. Guyton and Hall. Textbook of Medical Physiology. 13th Edition.
10. Histology: A Text and Atlas. Sixth Edition. Ross & Pawlina. Lippincott Williams & Wilkins.
11. Vertebrate Endocrinology by D. O. Norris.

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

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

Open Elective Course Content

Course Title: Animal Behaviour Course Code: OEC5ZOOT4	Course Credits: 3
Total Contact Hours: 42	Duration of ESA: 2 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:

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 behavior
5. Understand the methods and significance of different types of communications.

Course Content

Content	42Hrs
Unit – I	
<p>Chapter 1.: Introduction to Animal Behaviour</p> <ul style="list-style-type: none"> • Brief contributions of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen. • Proximate and ultimate causes of behaviour. <p>Chapter 2. Patterns of Behaviour</p> <ul style="list-style-type: none"> • Stereotyped Behaviors - Orientation and Reflex. • Individual Behavioural patterns: Instinct and Learned Behaviour • Associative learning, classical and operant conditioning, Habituation, Imprinting. 	14
Unit – II	
<p>Chapter 3. Social Behaviour:</p> <ul style="list-style-type: none"> • Social organization in termites and honey bees. • Social behaviour: Altruism. • Conflict behaviour. <p>Chapter 4. Sexual Behaviour</p> <ul style="list-style-type: none"> • 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 & cost benefit) 	14

Unit – III	14
<p>Chapter 5. Chronobiology</p> <ul style="list-style-type: none"> • Brief historical developments in chronobiology. • Adaptive significance of biological clocks. • Biological Rhythms <p>Chapter 6: Communications in animals</p> <ul style="list-style-type: none"> • 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 Readings:

1. Animal Behaviour by Drickamar.
2. John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
3. Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
4. Chronobiology: Biological Timekeeping - Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
5. Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.) R.D. Lewis. (3rdEd) 2002 Baren and Noble Inc. New York, USA
6. Biological Rhythms: Vinod Kumar (2002) 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
House Examination/Test	15
Written Assignment / Case Presentation / Project / Seminar	20
Class performance/Participation	05
Total	40



GULBARGA UNIVERSITY
KALABURAGI

B.Sc. Zoology Syllabus for V SEM

To be implemented from 2023 – 2024 Academic year

for

UNDERGRADUATE PROGRAMME

Colleges Affiliated to

Gulbarga University, Kalaburagi

CHAIRMAN

Department of Studies and Research in Zoology

2023 Onwards



GOVERNMENT OF KARNATAKA

**Curriculum Framework for Undergraduate Program
in Colleges and Universities of Karnataka State.**



5th Semester
Model Syllabus
for B.Sc. in
Zoology

Chairman (BOS)
Department of Studies and Research in
Zoology
Gulbarga University
Kalaburagi

**COMPOSITION OF STATE SUBJECT EXPERT
COMMITTEE MEMBERS**

S.No	Name and Organization	Designation
1	Prof. K. Vijaykumar, Department of Zoology, Gulbarga University, Kalaburagi. 9480060508, katepaga63@gmail.com	Chairman
2	Prof. P M Basha, Department of Zoology, Bangalore University, Bengaluru. 9448701652, pmbashabub@rediffmail.com	Member
3	Prof. Vijaykumar B Malashetty, Department of Zoology, VSK University, Ballari. 9343011567, vijaymalashetty@gmail.com	Member
4	Prof. Dr.S.Basavarajappa, Mysore University, Mysuru. 9449203241 ornithoraj11@gmail.com	Member
5	Prof. Nagaraj, Department of Zoology, KuvempuUniversity, Shivamogga. 9620485338	Member
6	Prof. Kareemunnisa Syed, Nrupathunga University, Bengaluru 9964300991 kareemunnisa66@gmail.com	Member
7	Prof. B.Vasanthkumar, Department of Zoology, Sir MV Govt. College, Bhadravathi, Shimoga. 9448573105	Member
8	Prof. B. K. Meera, Professor, Maharani Cluster University, Bengaluru (9886409382)	Member
9	Dr. Gangadhara Rao, Professor, Govt. Women's College, Kolar. 9448984956	Member
10	Prof. Shankarappa S. Hatti, Govt. College, Dept. of Zoology, SedamRoad, Kalaburagi. 9980391964	Member
11	Dr. Zeba Parveen Dept. of Zoology, Bi Bi Raza Women's DegreeCollege, Kalaburagi. 9448092786	Member
12	Dr. Asiya Nuzhath F.B, Associate Professor, Dept. of Zoology, Tumkur University, Tumakuru. 9844029441	Member
13	Akshatha Chandra G R, Special Officer, KSHEC, Bengaluru. 9535487108	Member Convener

Gulbarga University, Kalaburagi
Board of Studies in Zoology

SN	Name and Organization	Designation
1	Dr. K. Vijaykumar , Senior Professor Department of Zoology, Gulbarga University, Kalaburagi. 9480060508, katepaga63@gmail.com	Chairman
2	Dr. Neelakanth S. Wali , Asst. Professor Department of Zoology MSI Degree College, Kalaburagi	Member
3	Dr. B. Ramakrishnareddy , Asso Professor Department of Zoology, Sharanabasaveshwar College of Science, Kalaburagi	Member
4	Dr. S. Basavarajappa , Professor Department of Zoology, University of Mysore, Mysuru	External Member
5	Dr. Shashikant H. Majagi , Professor Department of Zoology, VSK University, Ballari	External Member
6	Dr. Renuka Khaple , Asst. Professor Department of Zoology, Davanagere University, Davanagere.	External Member

Guidelines For Model Curriculum

1. The Universities shall promote Double Major model as prescribed in the Model Curriculum Table.
2. For Arts/Humanities/Social Science - V & VI sem, three core papers (DSC) to be selected in each semester.
 For Science – Ensure two core papers (DSC) should get minimum of 12 credits/or 2 major subjects of 24 credits (4+2 patterns)(1 hour of Lecture or 2 hours of practical/field work per week in a semester is assigned one credit and core subject theory courses/papers will have 4 credits, while practical are assigned 2 credits)
3. Formative assessment and summative assessment to be followed in the ratio of 40:60.
4. Selection of Open electives: The university shall follow curriculum and credit frame work for Undergraduate program of published by UGC.
Open Electives – Courses from other Disciplines (9 Credits)
 - Students are not allowed to choose or repeat courses as open electives already undergone at the higher secondary level(12th class)
 - All UG students are required to undergo 3 introductory-level courses relating to any of the broad disciplines given below.

Natural and Physical Sciences	Mathematics, Statistics, & Computer Applications	Library, Information, and Media Sciences	Commerce and Management	Humanities and Social Sciences:
Students can choose basic courses from disciplines such as Natural Science, for example, Biology, Botany, Zoology, Biotechnology, Biochemistry, Chemistry,	Courses under this category will facilitate the students to use and apply tools and techniques in their major and minor disciplines. The course may include training in programming software like Python among others and applications software	Courses from this category will help the students to understand the recent developments in information and media science (journalism, mass media, and communication)	Courses include business management, accountancy, finance, financial institutions, fintech, etc.,	The courses relating to Social Sciences, for example, Anthropology, Communication and Media, Economics, History, Linguistics, Political Science, Psychology, Social Work, Sociology, etc. will enable students to understand the individuals and their social behavior, society, and nation. Students be introduced to survey methodology and available large-scale databases

<p>Physics, Biophysics, Astronomy and Astrophysics, Earth and Environmental Sciences, etc.</p>	<p>like STATA, SPSS, Tally, etc. Basic courses under this category will be helpful for science and social science in data analysis and the application of quantitative tools</p>			<p>for India. The courses under humanities include, for example, Archaeology, History, Comparative Literature, Arts & Creative expressions, Creative Writing and Literature, language(s), Philosophy, etc., and interdisciplinary courses relating to humanities. The list of Courses that can include interdisciplinary subjects such as Cognitive Science, Environmental Science, Gender Studies, Global Environment & Health, International Relations, Political Economy and Development, Sustainable Development, Women's and Gender Studies, etc. will be useful to understand society.</p>
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B. Sc.-Science: Curriculum and Credit Framework for Undergraduate Programme

Sem.	Discipline Specific Courses - Core (DSC), Elective (DSE)(Credits) (L+T+P)	Minor/ Multidisciplinary/ Open Elective (OE) Courses(Credits) (L+T+P)	Ability Enhancement Courses (AEC)(Credits)(L+T+P) (Languages)	Skills Enhancement Courses (SEC) (Credits) (L+T+P)/ Value Added Courses (Credits) (L+T+P) (common for all UG Programs)/ Summer Internship.		Total Credits
I	DSC-A1(4), A2(2) DSC-B1(4), B2(2)	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs each)	SEC-1: Digital Fluency (2) (1+0+2)/ Env. Studies (3)	Health, Wellness & Yoga (2) (1+0+2)	25/26
II	DSC-A3(4), A4(2), DSC-B3(4), B4(2)	OE-2 (3)	L1-2(3), L2-2(3) (4 hrs each)	Env. Studies (3)/ SEC-1: Digital Fluency (2)(1+0+2)	Sports/NCC/NSS/R&R(S&G) / Cultural (2) (0+0+4)	26/25
Students exiting the programme after securing 46 credits will be awarded UG Certificate in Disciplines A and B provided they secure 4 credits in work based vocational courses during summer term or internship/Apprenticeship in addition to 6 credits from skill-based courses earned during the first year.						
III	DSC-A5(4), A6(2), DSC-B5(4), B6(2)	OE-3 (3)/ India and Indian Constitution (3)	L1-3(3), L2-3(3) (4 hrs. each)	SEC-2:AI/Cyber Security/Financial Edu. & Inv. Aw. (2)(1+0+2)	Sports/NCC/NSS/R&R(S&G) /Cultural (2) (0+0+4)/ SEC (2)	25
IV	DSC-A7(4), A8(2), DSC-B7(4), B8(2)	India and Indian Constitution (3) / OE-3(3)	L1-4(3), L2-4(3) (4 hrs. each)	SEC-3: Financial Edu. &Inv. Aw. /AI/Cyber Security (2) (1+0+2)	Sports/NCC/NSS/R&R(S&G) / Cultural (2) (0+0+4)/ SEC (2)	25
Students exiting the programme after securing 92 credits will be awarded UG Diploma in Disciplines A and B provided they secure additional 4 credits in skill based vocational courses offered during first- or second-year summer term.						
V	DSC-A9 (4), A10 (2), A11(4), A12 (2)	DSC-B9(4), B10(2), B11(4), B12(2)		SEC-4: Employability/ Skills/Cyber Security (3) (2+0+2)		27
VI	DSC-A13(4), A14(2), A15(4), A16(2);	DSC-B13(4), B14(2), B15(4), B16(2)		Internship (2)		26
Students exiting the programme after 3-years will be awarded UG Degree in Disciplines A and B as double majors upon securing 136 credits and satisfying the minimum credit requirements under each category of courses prescribed.						

Gulbarga University, Kalaburagi
B.Sc. in Zoology
Effective from 2023-24

Sem.	Type of Course	Theory/ Practical	Course Code	Course Title	Instruct ion hour/ week	Total hours /sem	Duration of Exam	Marks			Credits
								Formative	Summative	To tal	
V	DSCC-9	Theory	ZOO C9T	Non-Chordates and Economic Zoology	04hrs	60	02 hrs	40	60	100	04
	DSCC-10	Practical	ZOO C10P	Non-Chordates and Economic Zoology	04 hrs	60	03 hrs	25	25	50	02
	DSCC-11	Theory	ZOO C11T	Chordates and Comparative Anatomy	04hrs	60	02 hrs	40	60	100	04
	DSCC-12	Practical	ZOO C12P	Chordates and Comparative Anatomy	04 hrs	60	03 hrs	25	25	50	02
	Other subject										04
	Other subject										02
	Other subject										04
	Other subject										02
	SEC-3	Practical	ZOO SE C03T	Employability	04hrs	60	03 hrs	40	60	100	03
Total										27	
VI	DSCC-13	Theory	ZOO C-13T	Evolutionary and Developmental Biology	04hrs	60	02 hrs	40	60	100	04
	DSCC-4	Practical	ZOO C-14P	Evolutionary and Developmental Biology	04 hrs	60	03 hrs	25	25	50	02
	DSCC-15	Theory	ZOO C-15T	Environmental Biology, Wildlife Management and Conservation	04hrs	60	02 hrs	40	60	100	04
	DSCC-16	Practical	ZOO C-16P	Environmental Biology, Wildlife Management and Conservation	04 hrs	60	03 hrs	25	25	50	02
	Other subject										04
	Other subject										02
	Other subject										04
	Other subject										02
	Internship-1	Practical		Internship				25	25	50	02
Total										26	

Government of Karnataka



Model Curriculum

Program Name	B.Sc.	V Semester	
Course Title	Non-Chordates and Economic Zoology (Theory)		
Course Code:	ZOO C-9 T	No. of Credits	4
Contact hours	60 Hours (4 hrs/week)	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

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

Course Outcomes (COs) / (POs)	ZOO C9T	ZOO C10P	ZOO C11T	ZOO C12P	ZOO C13T	ZOO C14P	ZOO C15T	ZOO C16P	ZOO C17T	ZOO C18P
I Core competency	X									
II Critical thinking	X									
III Analytical reasoning	X									
IV Research skills	X									
V Team work	X									

Course Pre-requisite(s):

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

CO1. Group animals on the basis of their morphological characteristics/ structures.

CO2. Demonstrate comprehensive identification abilities of Non-Chordate diversity.

CO3. Explain structural and functional diversity of Non-Chordates

CO4. Develop understanding on the diversity of life with regard to protists, non-chordates and chordates.

CO 5. Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.

Contents	60 Hrs
Unit-I	15
1. Protozoa to Coelenterate - General Characters and Classification up to classes with examples. <ul style="list-style-type: none"> • Protozoa-<i>Paramecium</i> (Morphology and Reproduction) • Porifera - <i>Sycon</i> (Canal System) • Coelenterata – <i>Obelia</i> (Morphology and Reproduction), Coral reefs in brief. 	
2. Ctenophora to Nematelminthes - General Characters and Classification up to classes with examples. <ul style="list-style-type: none"> • Ctenophora – Salient feature • Platyhelminthes- <i>Taenia</i> (Tape worm) (Morphology and Reproduction) • Nematelminthes-<i>Ascaris lumbricoides</i> (Morphology and Reproduction) 	
Unit-II	15
3. Annelida - General Characters and Classification upto classes with examples. <ul style="list-style-type: none"> • Annelida – <i>Hirudinaria</i> (Leech) (Morphology and Reproduction) 	
4. Arthropoda - General Characters and Classification up to classes with examples. <ul style="list-style-type: none"> • Arthropoda – <i>Palaemon</i> (Prawn) Morphology, Appendages, Nervous System and Reproduction) 	
Unit-III	15
5. Mollusca to Echinodermata - General Characters and Classification up to classes with examples. <ul style="list-style-type: none"> • Mollusca – <i>Pila</i> (Morphology, Shell, Respiration, Nervous System and Reproduction) • Echinodermata – <i>Pentaceros</i> (Morphology and Water Vascular System) 	
Unit-IV	15
6. Economic Zoology : Vectors and Pests <ul style="list-style-type: none"> • Life cycle and their control of following pests: Gundhi bug, Sugarcane leafhopper, Rodents. Termites and Mosquitoes and their control • Lac-culture, Vermiculture and Poultry. 	

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Attendance	10
House Examination/Test	10
Written Assessment/Presentation/Project/Term Papers/Seminars	10
Class room Performance/Participation	10
Total	40 Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

Course Title	Non-Chordates and Economic Zoology (Practical)	Practical Credits	2
Course Code	ZOO C10-P	Contact Hours	4 hrs/week
Formative Assessment	25 Marks	Summative Assessment	25 Marks

Course 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)/(POs)	ZOO C9T	ZOO C10P	ZOO C11T	ZOO C12 P	ZOO C13T	ZOO C14P	ZOO C15T	ZOO C16P	ZOO C17T	ZOO C18P
I Core competency		X								
II Critical thinking		X								
III Analytical reasoning		X								
IV Research skills		X								
V Team work		X								

Practical Content

1. Preparation and observation of protozoan culture.
2. **Protozoa:** Systematics of *Amoeba*, *Euglena*, *Noctiluca*, *Paramecium* and *Vorticella*, *Plasmodium* (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 *Panaeus*, *Palaemon*, *Astracus*, Scorpion, Spider, *Limulus*, *Peripatus*, *Millipede*, *Centipede*, Praying mantis, Termite Queen, Moth, Butterfly, Dung beetle/Rhinoceros beetle (Any six specimens). Slide of Larvae- Nauplius, Zoa, Mysis.
9. **Mollusca:** Systematics of *Chiton*, *Mytilus*, *Aplysia*, *Pila*, *Octopus*, *Sepia* (Specimens) and Glochidium larva (Slide).
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 lily (Specimens). Slides of Bipinnaria larva, Echinopluteus larva and Pedicellaria.
12. **Harmful Nonchordates:** Soil Nematodes. Agricultural, veterinary and human pests of Arachnida and Arthropoda.
13. **Beneficial Nonchordates:**
 - **Sericulture:** Life cycle of *Bombyx mori*, Uzi fly, Cocoon, Raw silk.
 - **Apiculture:** Any 2 Species of honey bee and bee wax.
 - **VermiCulture:** Earthworm & Vermicompost.
14. **Virtual Dissection/Cultured specimens: Earthworm**-Digestive system & Nervous system.
15. **Virtual Dissection/Cultured specimens: Cockroach**- Salivary Apparatus, Digestive system & Nervous system.

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

Formative Assessment for Practical	
Assessment Occasion/ type	Marks
Attendance	05
House Examination/Test	10
Written Assessment/Presentation/Project/Term Papers/Seminars	05
Class room Performance/Participation	05
Total	25 Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

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

Government of Karnataka



Model Curriculum

Program Name	B.Sc.	Semester	V
Course Title	Chordates and Comparative Anatomy (Theory)		
Course Code:	ZOO C-11-T	No. of Credits	4
Contact hours	60 Hours (4 hrs/week)	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s):

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

CO1. To demonstrate comprehensive identification abilities of chordate diversity

CO2. Able to explain structural and functional diversity of chordate diversity

CO3. To understand evolutionary relationship amongst chordates

CO4. To take up research in biological sciences.

CO5. To realize that very similar physiological mechanisms are used in very diverse organisms.

CO6. To Get a flavor of research by working on project besides improving their writing skills. It will further enable the students to think and interpret individually.

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

Course Outcomes (COs)/(POs)	ZOO C9T	ZOO C10P	ZOO C11T	ZOO C12 P	ZOO C13T	ZOO C14P	ZOO C15T	ZOO C16P	ZOO C17T	ZOO C18P
I Core competency			X							
II Critical thinking			X							
III Analytical reasoning			X							
IV Research skills			X							
V Team work			X							

Contents	60 Hrs
Unit-I	15 hrs
<p>Chapter 1: Chordates: Origin of Chordates. Basic characters of chordates and classification up to classes.</p> <p>Chapter 2: Hemichordata: Type Study of <i>Balanoglossus</i> – Habit and Habitat, Morphology, Coelom. Tornaria larva and its affinities. Affinities and systematic position of Hemichordata.</p> <p>Chapter 3: Urochordata : Type Study of <i>Herdmania</i>-Habit and Habitat, Morphology, Ascidian tadpole- structure and its retrogressive metamorphosis.</p> <p>Chapter 4: Cephalochordata : Type Study of <i>Branchiostoma (Amphioxus)</i>-Habit and Habitat, Morphology, Digestive system, Feeding mechanism, excretory and circulatory system.</p> <p>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.</p>	
Unit-II	15
<p>6. Chapter 6: Vertebrates: General characters and Classification of different classes of vertebrates (Pisces, Amphibia, Reptilia, Aves, Mammalia) up to the order with five characters for each order citing examples. General characters of Chondrichthyes and Osteichthyes. Interesting features and evolutionary significance of Dipnoi. Salient features of Placodermi with examples. Interesting features of <i>Sphenodon</i>, and Archaeopteryx. Salient features of Class Aves with examples. Interesting features of mammalian orders (Insectivora, Carnivora, Chiroptera, Cetacea, Proboscidea, Ungulata – Perissodactyla and Artiodactyla, and Primates –Platyrrhini and Catarrhini) with examples.</p>	
Unit-III	15
<p>Chapter 7. General account of Chordates: Types of caudal fins, scales 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 and Amphibians. Flight adaptations in birds. Dentition in mammals. Evolution of Molar tooth. Migration in Pisces, Birds. Mammals.</p>	

Unit-IV	14
<p>Comparative Anatomy of Vertebrates:</p> <p>Chapter 8. Integumentary System: Structure of skin and its derivatives.</p> <p>Chapter 9. Skeletal System</p> <ul style="list-style-type: none"> • Comparative account of Axial Skeletal system in vertebrates; Skull - Amphibian (Frog), Reptiles (Lizard). • Comparative account of appendicular skeletal system in vertebrates; Pectoral and Pelvic girdles of Aves (Pigeon) and Mammals (Man). <p>Chapter-10 Respiratory system</p> <ul style="list-style-type: none"> • Comparative account of respiratory system in vertebrates: Pisces (Scoliodon), Amphibian (Frog). <p>Chapter-11 Circulatory System</p> <ul style="list-style-type: none"> • Comparative account of heart and aortic arches in vertebrates: Pisces (Scoliodon), Amphibian(Frog) <p>Chapter-12 Excretory System</p> <ul style="list-style-type: none"> • Succession of kidney in vertebrates. <p>Chapter-13 Nervous system</p> <ul style="list-style-type: none"> • Comparative account of brain in vertebrates: Aves (Pigeon) and Mammals (Man). 	

Course Title	Chordates and Comparative Anatomy Zoology (Practical)	Practical Credits	2
Course Code	ZOO C12-P	Contact Hours	4 hrs/week
Formative Assessment	25 Marks	Summative Assessment	25 Marks

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

Course Outcomes (COs)/(POs)	ZOO C9T	ZOO C10P	ZOO C11T	ZOO C12 P	ZOO C13T	ZOO C14P	ZOO C15T	ZOO C16P	ZOO C17T	ZOO C18P
I Core competency				X						
II Critical thinking				X						
III Analytical reasoning				X						
IV Research skills				X						
V Team work				X						

Practical Content

1. **Protochordata:**
Balanoglossus and its T. S through proboscis
Ascidian/ *Herdmania* and *Amphioxus*, T.S. of *Amphioxus* through pharynx and intestine.
2. **Cyclostomata:**
-*Petromyzon*, Ammocoete larva and *Myxine*.
3. **Pisces:**
4. Cartilaginous Fishes – *Narcine*, *Trygon*, *Pristis*, *Myxobatias*
5. Bony Fishes – Zebra fish, Hippocampus, Muraena, Ostracion, Tetradon, Pleuronectus, Diodon, Echeneis. (Any six).
6. **Ornamental fishes:**
Siamese, Koi, Oscar, Betta Sp., Neon tetra, Guppies, Gold fish, Angle fish, Rainbow fish, Mollies (Any four).
7. **Accessory respiratory organs** – *Saccobranchus*, *Clarias* and *Anabas*.
8. **Amphibia:** -*Rana*, *Bufo*, *Ambystoma*, *Axolotl* larva, *Necturus* and *Ichthyophis*.
9. **Reptilia:** -Turtle, Tortoise, *Mabuya*, *Calotes*, Chameleon, *Varanus*.
snakes – Dryophis, Rat snake, Brahmini, Cobra, Krait, Russell’s viper and Hydrophis;
10. **Aves:** Beak and feet modifications in the following examples: Duck, Crow, Sparrow, Parrot, Kingfisher, Eagle or Hawk.
11. **Mammalia:**
Mongoose, Squirrel, Pangolin, Hedge Hog, Rat and Loris.
12. **Virtual Dissection/Cultured specimens:**
Shark/Bony fish: Afferent and efferent branchial systems, Glossopharyngeal and Vagus nerves.
13. **Virtual Dissection/Cultured specimens:**
Rat: Dissection (only demonstration) – Circulatory system (arterial and venous), urinogenital system.
14. **Skeletal System in man:** Skull, vertebrae, girdles and limb bones (Except hands and feet)
15. **Comparative account** of Skin in shark, frog, Calotes, Pigeon and Man.
16. **Comparative account** of Heart in Calotes, Pigeon and Man.
17. **Comparative account** of Brain in Shark, Frog and Calotes.

Formative Assessment for Theory

Assessment Occasion/ type	Marks
Attendance	10
House Examination/Test	10
Written Assessment/Presentation/Project/Term Papers/Seminars	10
Classroom Performance/Participation	10
Total	40 Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

Formative Assessment for Practical	
Assessment Occasion/ type	Marks
Attendance	05
House Examination/Test	10
Written Assessment/Presentation/Project/Term Papers/Seminars	05
Class room Performance/Participation	05
Total	25 Marks
<i>Formative Assessment as per guidelines are compulsory</i>	

References	
1	Colbert <i>et al</i> : Colbert's Evolution of the Vertebrates: A history of the backboned animals through time. (5 th Ed 2002, Wiley – Liss).
2	Hildebrand: Analysis of Vertebrate Structure (4 th ed 1995, John Wiley)
3	Kenneth V. Kardong (20015) Vertebrates: Comparative Anatomy, Function, Evolution McGrawHill
4	McFarland <i>et al.</i> ,: Vertebrate Life (1979, Macmillan publishing)
5	Parker and Haswell: Text Book of Zoology, Vol. II (1978, ELBS)
6	Romer and Parsons: The Vertebrate Body (6 th ed 1986, CBS Publishing Japan)
7	Young: The Life of Vertebrates (3 rd ed 2006, ELBS/Oxford)
8	Weichert C.K. and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills
9	R.L Kotpal Rastogi Publication.
10	P.S. Dhami & J.K. Dhami Chand Publication
11	Jordan & Verma S.Chand Publication

Internship for graduate Programme (As Per UGC & AICTE)

Course title	Internship Discipline specific
No of contact hours	90
No credits	2
Method of evaluation	Presentations/Report submission/Activity etc.,

- ❖ Internship shall be Discipline Specific of 90 hours (2 credits) with duration 4-6 weeks.
- ❖ Internship may be full-time/part-time (full-time during semester holidays and part-time in the academic session)
- ❖ Internship mentor/supervisor shall avail work allotment during 6th semester for a maximum of 20 hours.
- ❖ The student should submit the final internship report (90 hours of Internship) to the mentor for completion of the internship.
- ❖ The detailed guidelines and formats shall be formulated by the universities separately as Prescribed in accordance to UGC and AICTE guidelines.

DSC Question Paper Pattern for UG V & VI Semester DSC

Paper Code:	Paper Title:		
Duration of Exam	2 Hours	Max Marks	60
Instruction:	Answer all the sections (Equal distribution of marks for all the Units.)		

Section-A

Instructions: 1) Answer all the sections 2) Draw diagrams wherever necessary.	10 Marks
I. Answer any Five of the following questions (5x2=10)	
1. 2. 3. 4. 5. 6. 7.	

Section-B

.....	20 Marks
II. Answer any FIVE of the following questions (4X5=20)	
8. 9. 10. 11. 12. 13.	

Section-C

.....	30 Marks
III. Answer any TWO of the following questions (3X10=30)	
14. 15. 16. 17. 18.	



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No:GUK/ZOOL/BOS/2023-24/

Date:

Proceedings of the meeting of Board of Studies in Zoology (Under Graduate) were held on 26.09.2023 for the academic year 2023-24.

Members Present

- | | | |
|-----------------------------|---|-----------------|
| 1. Prof. K. Vijaykumar | - | Chairman |
| 2. Dr. Neelakanth S. Wali | - | Member |
| 3. Dr. B. Ramkrishna Reddy | - | Member |
| 4. Prof. S. Basavarajappa | - | External member |
| 5. Prof. Shashikanth Majagi | - | External Member |
| 6. Prof. Renuka Khaple | - | External member |

Proceedings:

1. Reviewed the UG Model curriculum for Zoology Syllabus as per the KSHEC, Bangalore.
2. Reviewed the performance of the Zoology students in the proceeding examinations. Members were satisfied about the performance of the students in the examination.
3. Question papers were reviewed suggested to concern about typographical errors.
4. Finalized and approved the panel of Examiners for the academic year 2023-24.
5. Chairman thanked all the members for smooth conduct of BOS meeting.

Dr. K. Vijaykumar
Senior Professor and Chairman (BOS)
Department of Studies and Research in Zoology
Gulbarga University, Kalaburagi.



Government of Karnataka

**Curriculum Framework for Four-Year Undergraduate Multidisciplinary
Programme (Honours) & Master Programme in Colleges and
Universities of Karnataka State.**



Model Syllabus for B.Sc

6th Semester GENETICS

Submitted to Vice-Chairman

Karnataka State Higher Educational Council

30, Prasanna Kumar, Bangalore City University Campus,

Bangalore, Karnataka- 560009



Government of Karnataka

Composition of Subject Expert Committee Members

SN	Name & Organization	Designation
1	Prof. K Vijaykumar, Department of Zoology, Gulbarga University, Kalaburagi. 9480060508, katepaga63@gmail.com	Chairman
2	Prof. P M Basha, Department of Zoology, Bangalore University, Bengaluru. 9448701652, pmbashabub@rediffmail.com	Member
3	Prof. Vijaykumar B Malashetty, Department of Zoology, VSK University, Ballari. 9343011567, vijaymalashetty@gmail.com	Member
4	Dr.S.Basavarajappa, Mysore University, Mysuru. 9449203241 ornithoraj11@gmail.com	Member
5	Prof. Nagaraj, Department of Zoology, Kuvempu University, Shivamogga. 9620485338 REPEATED	Member
6	Prof. B.Vasanthkumar, Department of Zoology, Sir M V Govt College, Bhadravathi, Shimoga	Member
7	Prof. B. K. Meera, Associate Professor, Maharani Cluster University, Bengaluru (9886409382)	Member
8	Smt. Kareemunnisa Syed, Associate professor, Dept. of Zoology, Nrupathunga University, Bengaluru (9964300991) REPEATED	Member
9	Dr. GangadharaRao, Associate Professor, Govt. Women's College, Kolar. 9448984956	Member
10	Prof. Shankarappa S. Hatti, Govt. College, Dept. of Zoology, Sedam Road, Kalaburgi. 9980391964	Member
11	Dr. Zeba Parveen Dept. of Zoology, BiBiRaza Women's Degree College, Kalaburagi. 9448092786	Member
12	Dr. AsiyaNuzhath F.B, Associate Professor, Dept. of Zoology, Tumkurn Unversity, Tumakuru. 9844029441	Member
13	Dr. Akshatha, Special Officer, KSHEC, Bengaluru. 9535487108	Member Convener



Government of Karnataka

Model Curriculum

Program Name	B.Sc.	Semester	VI
Course Title	Evolutionary & Developmental Biology (Theory)		
Course Code:	ZOOC15-T	No. of Credits	4
Contact hours	45 Hours	Duration of SEA/Exam	3 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s):

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 science.

Contents	45 Hrs
Unit-I	12
1. 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).	
2. Population Genetics: Microevolution and Macroevolution: allele frequencies, genotype frequencies, Hardy- Weinberg equilibrium and conditions for its maintenance, Forces of evolution: mutation, selection, genetic drift	
Unit-II	11
3. Direct Evidences of Evolution: Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse.	7

4. Species Concept and Extinction: Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric), Mass extinction (Causes, Names of five major extinctions).	7
Unit-III	12
5. Gamete Fertilization and Early Development: Gametogenesis, Fertilization, Cleavage pattern, Gastrulation, fate maps and Morphogenesis.	6
6. Developmental Genes: General concepts of organogenesis, Introduction to genetic basis of embryonic development and Developmental control genes (Homeobox genes)	8
Unit-IV	10
7. Early Vertebrate Development: Early development of mammals including placentation, Metamorphosis, regeneration, Environmental regulation of development	
8. Late Developmental Processes, Development of eye, kidney, limb in amphibian, Mammalian female reproductive cycles estrous cycle and menstruation, Aging: the biology of senescence	

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-15)

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
						X									
						X									
						X									
						X									
						X									

Pedagogy:

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
House Examination/Test	15
Written Assessment/Presentation/Project/Term Papers/Seminars	15
Class room Performance/Participation	10
Total	40 Marks
<i>Formative Assessment as per NEP guidelines are compulsory</i>	

Course Title	Evolutionary & Developmental Biology (Practical)	Practical Credits	2
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Course Code	ZOO C16-P	Contact Hours	4 Hours
Formative Assessment	25 Marks	Summative Assessment	25 Marks
Practical Content			
1. Study of fossils from models/pictures.			
2. Study of homology and analogy from suitable specimens			
3. Study and verification of Hardy-Weinberg Law by chi square analysis.			
4. Graphical representation and interpretation of data of height/ weight of a sample. of 100 humans in relation to their age and sex.			
5. Types of eggs based on quantity and distribution of yolk: Sea urchin, insect, frog, Chick.			
6. Study of development of chick embryo through incubated chick eggs upto 96h.			
7. Study of adaptive radiations in feet of birds and mouth parts of insects.			

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

Formative Assessment for Practical	
Assessment Occasion/ type	Marks
House Examination/Test	05
Written Assessment/Presentation/Project/Term Papers/Seminars	10
Class room Performance/Participation	10
Total	25 Marks
<i>Formative Assessment as per NEP guidelines are compulsory</i>	

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



Government of Karnataka

Model Curriculum

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

Course Pre-requisite(s):

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

- CO1. Develop an understanding of how animals interact with each other and their natural environment.
- CO2. Develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues.
- CO3. Develop the ability to work collaborative team-based projects.
- CO4. Gain an appreciation for the modern scope of scientific inquiry in the field of wildlife conservation management.
- CO5. Develop an ability to analyze, present and interpret wildlife conservation management information.

Contents		60 Hrs
Unit-I		15
1	<p>Ecology: Introduction to ecology, Definition, ecosystem, types of ecosystem, food chain and food web, trophic levels.</p> <p>Environment: Definition, types of environment, terrestrial, aquatic, desert, grassland and aerial environment.</p> <p>Environmental Biology: Adaptive features of plants and animals to different environment. Ecological factors, weather, climate, ozone layer.</p>	
Unit-II		15
2.	<p>Pollution: Definition, types of pollutants, air, soil, water and thermal pollution, ozone layer depletion, biomagnifications, bioaccumulation and bioremediation. Effects of pollution on plants and animals.</p>	
Unit-III		15
3.	<p>Wildlife Conservation: National parks, Wildlife sanctuaries, biosphere reserve. Project tiger. Project Elephant. Habitat preservation, breeding in captivity. Ex-situ and in-situ conservation. Wildlife Protection Act 1972</p>	
Unit-IV		15

4. Wildlife Management and Conservation: In-situ and ex-situ conservation: Wildlife sanctuaries, National parks, Biosphere reserves, Project Tiger, Project Elephant, Project Lion, Zoological Gardens and Captive breeding. Wildlife Protection Act, 1972, causes and depletion of wildlife, inventory and classification of wetlands and their biotic components, general strategies and issues, concept of home range and territory, animal census, tracing movement and remote sensing and GIS.	
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Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-15)

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
						X									
						X									
						X									
						X									
						X									

Pedagogy:

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
House Examination/Test	15
Written Assessment/Presentation/Project/Term Papers/Seminars	15
Class room Performance/Participation	10
Total	40 Marks
<i>Formative Assessment as per NEP guidelines are compulsory</i>	

Course Title	Environmental Biology, Wildlife Management & Conservation (Practicals)	Practical Credits	2
Course Code	ZOO C-18-P	Contact Hours	4 Hours
Formative Assessment	25 Marks	Summative Assessment	25 Marks
Practical Content			
1. Water quality parameters assessment: Collection of water sample, Dissolved Oxygen (O ₂), Carbon dioxide (CO ₂), Biological Oxygen Demand (BOD) Chemical Oxygen Demand (COD), chlorides and salinity estimation in water.			
2. Analysis of physico-chemical parameters of soil: pH, soil moisture, soil temperature, organic matter in soil.			

3. Analysis of air pollution: Air monitoring for particulate matter
4. Visit of pond and lakes: Collection and identification of flora and fauna of selected ecosystems. Collection, preservation and estimation of zooplanktons..
5. Demonstration of field equipments used in wildlife census: Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of cameras and lenses.
6. Identification wild animals: Wild animal's pugmarks, hoof marks scats, pellet groups, nest, antlers. Demonstration of field techniques for wild flora and fauna.

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

Formative Assessment for Practical	
Assessment Occasion/ type	Marks
House Examination/Test	05
Written Assessment/Presentation/Project/Term Papers/Seminars	10
Class room Performance/Participation	10
Total	25 Marks
<i>Formative Assessment as per NEP guidelines are compulsory</i>	

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

CBCS Question Paper Pattern for UG Semester DSC

Paper Code:	Paper Title:	
Duration of Exam	2 Hours	Max Marks
Instruction:	Answer all the sections	

Section-A

	15 Marks
I. Answer any Five of the following questions (5x3=15)	
1.	
2.	
3.	
4.	
5.	
6.	
7.	

Section-B

	25 Marks
II. Answer any FIVE of the following questions (5X5=25)	
8.	
9.	
10.	
11.	
12.	
13.	
14.	

Section-C

	20 Marks
III. Answer any TWO of the following questions (2X10=20)	
15.	
16.	
17.	
18.	