



RANI CHANNAMMA UNIVERSITY, BELAGAVI

PROGRAM/COURSE STRUCTURE AND SYLLABUS

**As per the Choice Based Credit System (CBCS) designed in
accordance with Learning Outcomes-Based Curriculum
Framework (LOCF) of National Education Policy (NEP)
2020**

For

Bachelor of Science (Hons) Zoology

w.e.f.

Academic Year 2021-22 and onwards



RANICHANNAMMA UNIVERSITY,BELAGAVI

BSc (Hons) Zoology program-2021-22

BoS Committee-NEP- BSc (Hons) Zoology

S.No.	Name & Address	Designation
1	Prof.K.Kantharaju Chairman & Professor, Dept.of Chemistry RCUB	Chairman
2	Dr.G.M.Sajjanar Associate Professor S.V.M.Arts, Science & Commerce College,Ilkal-587125	Member
3	Shri.G.M.Karki M.M.College, Belagavi	Member

PREAMBLE

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 Zoology 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. Effort has been made to integrate use of recent technology and use of MOOCs to assist teaching-learning process among students.

This framework permits there view of graduate attributes, qualification descriptors; program learning out comes 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 field's right from classical to applied Zoology.

Zoology has been studied in an integrated and cross-disciplinary manner with a comprehensive understanding of all living systems, their relationship with the ecosystem and their application. The framework imbibes a Learning Outcome-based Curriculum Framework (LOCF) for its entire Under Graduate program in Zoology.

A comprehensive understanding and appreciation of the organism differences through ICT tools, MOOCs and well-designed hands on practical exposures along with the fieldwork 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 are to impart and assess the quality of critical thinking, analytical and scientific reasoning, reflective thinking, information and digital literacy, and problem-solving capacity.

Aim of program 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 Zoology courses designed in terms of concepts, mechanisms, biological designs & functions and evolutionary significance. The students should do the dissertation/project work under practical of different courses, wherever possible.

Program Learning Outcome

Students enrolled in B.Sc. (Hons.) degree program in Zoology will study and acquire complete knowledge of disciplinary as well as allied biological sciences. At the end of graduation, they should possess expertise which will provide them competitive advantage in pursuing higher studies from India or abroad; and seek jobs in academia, research or industries.

Students should be able to identify, classify and differentiate diverse chordates and non-chordates based on their morphological, anatomical and systemic organization. They will also be able to describe economic, ecological and medical significance of various animals in human life. This will create a curiosity and awareness among them to explore the animal diversity and take up wild life photography or wild life exploration as a career option. The procedural knowledge about identifying and classifying animals will provide students professional advantages in teaching, research and taxonomist jobs in various government organizations; including Zoological Survey of India and National Parks/Sanctuaries.

Acquired practical skills in biotechnology, biostatistics, bioinformatics and molecular biology can be used to pursue career as a scientist in drug development industry in India or abroad. Our students will be acquiring basic experimental skills in various techniques in the fields of genetics; molecular biology; biotechnology; qualitative and quantitative microscopy; enzymology and analytical biochemistry. These methodologies will provide extra edge to our students, who wish to undertake higher studies. In-depth knowledge and understanding about comparative anatomy and developmental biology of various biological systems; and learning about the

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**Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of
Biotechnology Major& One Minor Discipline Scheme for the Four Years Chemistry B.Sc.
Undergraduate Honors Programme with effect from 2021-22**

SEMESTER-I										
Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
			IA	SE E	Total	L	T	P		
L1	21BSC1L1LK1	Kannada	40	60	100	4	-	-	3	2
	21BSC1L1LFK1	Functional Kannada								
L2	21BSC1L2LEN2	English	40	60	100	4	-	-	3	2
	21BSC1L2LHI2	Hindi								
	21BSC1L2LSN2	Sanskrit								
	21BSC1L2LTE2	Telugu								
	21BSC1L2LUR2	Urdu								
DSC1	21BSC1C1ZOO1L	Cytology, Genetics and Infectious Diseases	40	60	100	4	-	-	4	2
	21BSC1C1ZOO1P	Cell Biology and Genetics	25	25	50	-	-	4	2	4
DSC1	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	3
			25	25	50	-	-	4	2	4
SEC1	21BSC1S1CS1	Digital Fluency	25	25	50	1	-	2	2	2
VBC1	21BSC1V1PE1	Physical Education- Yoga	25	-	25	-	-	2	1	-
VBC2	21BSC1V2HW1	Health& Wellness	25	-	25	-	-	2	1	-
OEC1	21BSC1O1ZOO1	Economic Zoology	40	60	100	3	-	-	3	2
Total Marks				700	Semester Credits		25			

SEMESTER-II										
Catego ry	Course code	Title of the Paper	Marks			Teaching hours/wee k			Cred it	Durati on of exams (Hrs)
			IA	SE E	Tot al	L	T	P		
L3	21BSC2L3LK2	Kannada	40	60	100	4	-	-	3	2
	21BSC2L3FKL 2	Functional Kannada								
L4	21BSC2L4EN2	English	40	60	100	4	-	-	3	2
	21BSC2L4HI2	Hindi								
	21BSC2L4SN2	Sanskrit								
	21BSC2L4TE2	Telugu								
	21BSC2L4UR2	Urdu								
DSC2	21BSC2C2ZOO 2L	Biochemistry and Physiology	40	60	100	4	-	-	4	2
	21BSC2C2ZOO 2P	Physiological, Biochemical & Hematology	25	25	50	-	-	4	2	4
DSC2	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	4
AECC 1	21BSC2AE1ES 2	Environmental Studies	25	25	50	1	-	2	2	2
VBC3	21BSC2V3PE2	Physical Education-Sports	25	-	25	-	-	2	1	-
VBC4	21BSC2V4NC1	NCC/NSS/R&R(S&G)/Cultural	25	-	25	-	-	2	1	-
OEC2	21BSC2O2ZOO 2	Parasitology	40	60	100	3	-	-	3	2
Total Marks				700	Semester Credits			25		

Note: All skill enhancement course (SEC) syllabus and title should be selected time to time notice from the university and/or NEP committee accordingly.

SECOND YEAR;SEMESTER-III										
Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
			IA	SEE	Total	L	T	P		
L5	21BSC3L5LK3	Kannada	40	60	100	4	-	-	3	2
	21BSC3L5LFK3	Functional Kannada								
L6	21BSC3L6EN3	English	40	60	100	4	-	-	3	2
	21BSC3L6HI3	Hindi								
	21BSC3L6SN3	Sanskrit								
	21BSC3L6TE3	Telugu								
	21BSC3L6UR3	Urdu								
DSC3	21BSC3C3ZOO3L	Molecular Biology, Bioinstrumentation & Biotechniques	40	60	100	4	-	-	4	2
	21BSC3C3ZOO3P	Molecular Biology, Bioinstrumentation & Biotechniques	25	25	50	-	-	4	2	4
DSC3	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	4
SEC2	21BSC3S2AI	Artificial Intelligence	25	25	50	1	-	2	2	2
VBC5	21BSC3V5PE3	Physical Education-Sports	25	-	25	-	-	2	1	-
VBC6	21BSC3V6NC2	NCC/NSS/R&R(S &G)/Cultural	25	-	25	-	-	2	1	-
OEC3	21BSC3O3ZO O3	Endocrinology	40	60	100	3	-	-	3	2
Total Marks				700	Semester Credits		25			

SEMESTER-IV										
Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
			IA	SEE	Total	L	T	P		
L7	21BSC4L7LK4	Kannada	40	60	100	4	-	-	3	2
	21BSC4L7LFK4	Functional Kannada								
L8	21BSC4L8EN4	English	40	60	100	4	-	-	3	2
	21BSC4L8HI4	Hindi								
	21BSC4L8SN4	Sanskrit								
	21BSC4L8TE4	Telugu								
	21BSC4L8UR4	Urdu								
DSC4	21BSC4C4ZOO4L	Gene Technology, Immunology and Computational Biology	40	60	100	4	-	-	4	2
	21BSC4C4ZOO4P	Gene Technology, Immunology and Computational Biology	25	25	50	-	-	4	2	4
DSC4	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	3
			25	25	50	-	-	4	2	3
AECC 2	21BSC4AE1ES2	Constitution of India	25	25	50	1	-	2	2	2
VBC7	21BSC4V5PE4	Physical Education-Sports	25	-	25	-	-	2	1	-
VBC8	21BSC4V6NC3	NCC/NSS/R &R(S&G)/ Cultural	25	-	25	-	-	2	1	-
OEC4	21BSC4O3ZOO4	Animal Behaviors	40	60	100	3	-	-	3	2
Total Marks					700	Semester Credits			25	

SEMESTER-V										
Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
			IA	SEE	Total	L	T	P		
Zoology as Major Discipline										
DSC5	21BSC5C5ZOO5L	Non-Chordates and Economic Zoology	40	60	100	3	-	-	3	2
	21BSC5C5ZOO5P	Non-Chordate and Economic Zoology	25	25	50	-	-	4	2	4
DSC6	21BSC5C6ZOO6L	Chordates and Comparative Anatomy	40	60	100	3	-	-	3	2
	21BSC5C6ZOO6P	Chordate(Virtual Dissection),Comparative Anatomy	25	25	50	-	-	4	2	4
DSC5	Another Department Code as a Minor Subject	Another Department Course Title	40	60	100	3	-	-	3	2
			25	25	50	-	-	4	2	4
VC1	21BSC5VC1ZOO		40	60	100	3	-	-	3	2
VBC 9	21BSC5V5PE5	Physical Education-Sports	25	-	25	-	-	2	1	-
VBC 10	21BSC5V6NC4	NCC/NSS/R &R(S&G)/Cultural	25	-	25	-	-	2	1	-
SEC3	21BSC5S3ZOO3		25	25	50	1	-	2	2	2
Total Marks					700	Semester Credits			22	

SEMESTER-VI										
Cate gory	Course code	Title of the Paper	Marks			Teaching hours/week			Cre dit	Durati on of exams (Hrs)
			IA	SE E	Tot al	L	T	P		
Zoology as Major Discipline										
DSC7	21BSC6C7ZOO7 L	Evolutionary and Developmental Biology	40	60	100	3	-	-	3	2
	21BSC6C7ZOO7 P	Evolutionary and Developmental Biology	25	25	50	-	-	4	2	4
DSC8	21BSC6C8ZOO8 L	Environmental Biology and Wildlife Management	40	60	100	3	-	-	3	2
	21BSC6C8ZOO8 P	Environmental Biology, Wildlfi Management and conservation	25	25	50	-	-	4	2	4
DSC6	Another Department Code as a Minor Subject	Another Department Course Title	40	60	100	3	-	-	3	2
			25	25	50	-	-	4	2	4
VC2	21BSC6VC2HT	HealthCare Technologies	40	60	100	3	-	-	3	2
	21BSC6VC2DM	Digital Marketing								
INT1	21BSC6INT1L	Internship	25	50	75	-	-	2	2	2
VBC1	21BSC6V5PE5	Physical Education -Sports	25	-	25	-	-	2	1	-
VBC2	21BSC6V6NC4	NCC/NSS /R&R(S& G) /Cultural	25	-	25	-	-	2	1	-
SEC4	21BSC6S4ZOO4	Zoology	25	25	50	1	-	2	2	2
Total Marks					700	Semester Credits			24	
Total Marks for B.Sc Program						Total Credits for B.Sc Program			146	

Zoology Subject as a Minor Discipline

SEMESTER-V										
Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams(Hrs)
			I	SE	Total	L	T	P		
DSC5 As a Minor Subject	21BSC5C5ZOO5L	Non-Chordates and Economic Zoology	40	60	100	3	-	-	3	2
	21BSC5C5ZOO5P	Non-Chordate and Economic Zoology	25	25	50	-	-	4	2	4

SEMESTER-VI										
Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams(Hrs)
			IA	SEE	Total	L	T	P		
DSC6 As a Minor Subject	21BSC6C6ZOO7L	Evolutionary and Developmental Biology	40	60	100	3	-	-	3	2
	21BSC6C6ZOO7P	Evolutionary and Developmental Biology	25	25	50	-	-	4	2	4

Concept Note, Abbreviation Explanation and Coding:

Concept Note:

1. **CBCS** is a mode of learning in higher education which facilitates a student to have some freedom in selecting his/her own choices, across various disciplines for completing a UG/PG program.
2. A credit is a unit of study of a fixed duration. For the purpose of computation of workload as per UGC norms the following is mechanism be adopted in the University:
One credit (01) = One Theory Lecture (L) period of one (1) hour.
One credit (01) = One Tutorial (T) period of one (1) hour.
One credit (01) = One practical (P) period of two (2) hours.
3. Course: paper/subject associated with AECC, DSC, DSEC, SEC, VBC, OEC, VC, IC and MIL
4. In case of B.Sc. Once a candidate chose two courses/subjects of a particular two department in the beginning, he/she shall continue the same till the end of the degree, and then there is no provision to change the course(s) and Department(s).
5. A candidate shall choose one of the Department's courses as major and other Department course as minor in fifth and sixth semester and major course will get continued in higher semester.
6. Wherever there is a practical there will be no tutorial and vice-versa
7. A major subject is the subject that's the main focus of Core degree/concerned.
8. A minor is a secondary choice of subject that complements core major/concerned.
9. Vocational course is a course that enables individual to acquire skills set that are required for a particular job.
10. Internship is a designated activity that carries some credits involving more than **25days** of working in an organization (either in same organization or outside) under the guidance of an identified mentor. Internship shall be an integral part of the curriculum.
11. **OEC: For non computer science students. Computer Science students have to opt for OEC from departments other than major and minor disciplines.**

Abbreviation Explanations:

1. AECC: Ability Enhancement Compulsory Course.
2. DSC: Discipline Specific Core Course.
3. DSEC: Discipline Specific Elective Course.
4. SEC: Skill Enhancement Course.
5. VBC: Value Based Course.
6. OEC: Open/Generic Elective Course
7. VC: Vocational Course.
8. IC: Internship Course
9. L1: Language One
10. L2: MIL
11. L= Lecture; T=Tutorial; P=Practical.
12. MIL=Modern Indian Language; English or Hindi or Telugu or Sanskrit or Urdu

Program Coding:

1. Code21: Year of Implementation
2. Code BSc: BSc Program under the faculty of Applied Science of the University
3. Code1: First Semester of the Program, (2 to 6 represent higher semesters)
4. CodeAE: AECC, (C for DSC, S for SEC, V for VBC and O for OEC)
5. Code1: First-AECC Course in semester, similarly in remaining semester for such other courses
6. Code LK: Language Kannada, similarly Language English, Language Hindi, Language Telugu, Language Sanskrit, & Language Urdu
7. Code1: Course in that semester.
8. Zoo: Zoology

Note: All skill enhancement course (SEC) syllabus and title should be selected time to time notice from the university and/or NEP committee accordingly.

ASSESSMENT METHODS**Evaluation Scheme for Internal Assessment:****Theory:**

Assessment Criteria	40marks
1 st Internal Assessment Test for 30 marks 1 hr after 8 weeks and 2 nd Internal Assessment Test for 30 marks 1hr after 15 weeks. Average of two tests should be considered.	30
Attendance > 75%	05
Assignment	05
Total	40

Assessment Criteria	25marks
1 st Internal Assessment Test for 20 marks 1 hr after 8 weeks and 2 nd Internal Assessment Test for 20 marks 1hr after 15 weeks. Average of two tests. Should be considered.	20
Attendance > 75%	05
Total	25

Practical:

Assessment Criteria	25 marks
1 st Internal Assessment Test for 15 marks 1/2 hr after 8 weeks and 2 nd Internal Assessment Test for 15 marks 1/2hr after 15 weeks. Average of two tests should be considered.	15
Attendance > 75%	05
Assignment	05
Total	25

Question Paper Pattern:

RANI CHANNAMMA UNIVERSITY
Department of ZOOLOGY

I Semester B.Sc (Zoology)

Duration: 2 hrs

Sub:

Code:

Maximum Marks: 60

a. Answer any six Questions from Question I

b. Answer any Three questions from each main questions numbers II, III, IV and V

Q.No.I	Answer any six Questions (Two question from Each Unit) 1. 2. 3. 4. 5. 6. 7. 8.	2X6=12
Q.No.II	(Should cover Entire Unit-I) 9. 10. 11. 12.	4X3=12
Q.No.III	(Should cover Entire Unit-II) 13. 14. 15. 16.	4X3=12
Q.No.IV	(Should cover Entire Unit-III) 17. 18. 19. 20.	4X3=12
Q.No.V	(Should cover Entire Unit-IV) 21. 22. 23. 24.	4X3=12

SYLLABUS

Semester I

Year	I	Course Code: 21BSC1C1ZOO1L	Credits	04
Sem.	1	Course Title : Cytology, Genetics and Infectious Diseases	Hours	56
Unit No.	Course Content			Hours
Unit I	Structure and Function of Cell Organelles I in Animal cell <ul style="list-style-type: none"> • Plasma membrane: chemical structure—lipids and proteins • Endomembrane system: protein targeting and sorting, transport, endocytosis and exocytosis 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			14
Unit II	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 • Structure of chromosomes • Types of DNA and RNA 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: intra cellular 11 signaling and cell surface receptors, via G-protein linked receptors • Cell-cell interaction: cell adhesion molecules, cellular junctions 			14

Unit III	<p>Mendelism and Sex Determination</p> <ul style="list-style-type: none"> • Basic principles of heredity: Mendel's laws- monohybrid cross and hybrid cross • Complete and Incomplete Dominance • Genetic Sex-Determining Systems, Environmental Sex Determination, Sex Determination and mechanism in <i>Drosophila melanogaster</i>. • Sex-linked characteristics in humans and dosage compensation <p>Extensions of Mendelism, Genes and Environment</p> <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. <p>Interaction between Genes and Environment: Environmental Effects on Gene Expression, Inheritance of Continuous Characteristics.</p>	14
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Unit IV	<p>Human Chromosomes and Patterns of Inheritance</p> <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. <p>Infectious Diseases</p> <ul style="list-style-type: none"> • Introduction to pathogenic organisms: viruses, bacteria, fungi, protozoa and worms. • Structure, lifecycle, pathogenicity, including diseases, causes, symptoms and control of common parasites: <i>Trypanosoma, Giardia and Wuchereria</i> 	14
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Suggested Readings:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Albert 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

Zoology-Lab Course Content

Semester-I

Course Title:Cell Biology & Cytogenetics	Course Credits:2
CourseCode:21BSC1C1ZOO1P	L-T-P perweek:0-0-4
Total Contact Hours: 56	Duration of ESA:4Hours
FormativeAssessmentMarks:25	SummativeAssessmentMarks:25

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	CO P1	CC	CC	CC	CC	CC	CC	CC	CC	CC	CC	CC
I Core competency	X											
II Critical thinking	X											
III Analytical reasoning	X											
IV Research skills	X											
V Team work	X											

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

Lab Course Content

List of labs to be conducted	56 hrs
1. Understanding of simple and compound microscopes.	1
2. To study different cell types such as buccal epithelial cells, neurons, striated muscle cells using Methylene blue/any suitable stain (virtual/slaughtered tissue).	1+1
3. To study the different stages of Mitosis in root tip of <i>Allium cepa</i> .	1
4. To study the different stages of Meiosis in grasshopper testis (virtual).	1
5. To check the permeability of cells using salt solution of different concentrations.	1
6. Study of parasites in humans (e.g. Protozoans, Helminthes in compliance with examples being studied in theory) permanent micro slides.	1+1
7. To learn the procedures of preparation of temporary and permanent-stained slides, with available mounting material.	1
8. Study of mutant phenotypes of <i>Drosophila</i> sp. (from Cultures or Photographs).	1
9. Preparation of polygene chromosomes (Chironomus larva or <i>Drosophila</i> larva).	1+1
10. Preparation of human karyotype and study the chromosomal structural and numerical aberrations from the pictures provided. (Virtual/optional).	1+1

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. WHF Reeman (2007).
6. Kesar, Saroj and Vasishta N. 2007 Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi.

OPEN-ELECTIVE SYLLABUS:

Year	I	Course Code: 21BSC101ZOO1	Credits	03
Sem.	1	Course Title: Economic Zoology	Hours	42
Unit No.	Course Content		Hours	
Unit I	1. Sericulture: <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>Bombyx mori</i> Silkworm rearing techniques: Processing of cocoon, reeling Silkworm diseases and pest control 2. Apiculture: <ul style="list-style-type: none"> Introduction and present status of apiculture Species of honey bees in India, lifecycle of <i>Apis indica</i> Colony organization, division of labour and communication Beekeeping as an agro based industry; methods and equipments: indigenous methods, extraction appliances, extraction of honey from the comb and processing Bee pasturage, honey and beeswax and the viruses. Pests and diseases of bees and their management 		14	
Unit II	3. Live Stock Management: <p>Dairy:</p> <ul style="list-style-type: none"> 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 Cattlefeeds, milk and milk products Cattle diseases <p>Poultry:</p> <ul style="list-style-type: none"> Types of breeds and their rearing methods Feed formulations for chicks Nutritive value of egg and meat Disease of poultry and control measures 4. Aquaculture: <ul style="list-style-type: none"> Aquaculture in India: An overview and present status and scope of aquaculture. Types of aquacultures: Pond culture: Construction, maintenance and management; carp culture, shrimp culture, shellfish culture, composite fish culture and pearl culture 		14	
Unit III	5. Fish culture: <ul style="list-style-type: none"> Common fishes used for culture. 		14	

	<ul style="list-style-type: none"> • 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>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>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. • Advantage of vermicomposting. • Diseases and pests of earthworms. <p>8. Lac Culture:</p> <ul style="list-style-type: none"> • History of lac and its organization, lac production in India. • Lifecycle, 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 	
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Textbooks: Suggested Readings:

1. Eikichi, H. (1999). Silkworm Breeding (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Ganga.G. (2003).Comprehensive Sericulture Vol-II: Silkworm Rearing and Silk Reeling.
3. Oxford & IBH Publishing Co.Pvt.Ltd. New Delhi.
4. Mahadevappa.D. Halliyal.V.G., Shankar.D.G. And Bhandiwad.R. (2000). Mulberry Silk
5. Reeling Technology Oxford& IBH Publishing Co.Pvt.Ltd. New Delhi.
6. Roger.M (1990).The ABC and Xyz of Bee Culture: An Encyclopedia of Beekeeping, Kindle Edition.

7. Shukla and Upadhyaya(2002).Economic Zoology, Rastogi Publishers
 8. Yadav Manju (2003). Economic Zoology, Discovery Publishing House.
 9. Jabbed PradipV (2005). Textbook of applied Zoology, Discovery Publishing House, New Delhi.
 10. Cherian & Ramachandran Bee keeping in-South Indian Govt.Press, Madras.
 11. Sathe, T.V. Vermiculture and Organic farming.
 12. Bard.J (1986). Handbook of Tropical Aquaculture.
 13. Santhanam, R.A. Manual of Aquaculture.
 14. Zuka.R.1 and Hamiyn (1971). Aquarium fishes and plants
 15. Jabde.P.V. (2005) Textbook of Applied Zoology: Sericulture, Apiculture, Sericulture, Lac culture.
 16. Animal Disease- Bairagi K.N. Anmol Publications Pvt. Ltd 2014
 17. Economics of Aquaculture-Singh (R.K.P)- Danika Publishing Company 2003
 18. Applied and Economic Zoology (SWAYAM)
- webhttps://swayam.gov.in/nd2_cec20_ge23/preview Course Books published in English and Kannada maybe prescribed by the Universities and College

Semester-II

Year	I	Course Code: 21BSC2C2ZOO2L	Credits	04
Sem.	2	Course Title: Biochemistry and Physiology	Hours	56
Unit No.	Course Content			Hours
Unit I	<p>Structure and Function of Biomolecules:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Structure and Biological importance of carbohydrates (Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates). <input type="checkbox"/> Lipids (saturated and unsaturated Fatty acids, Triacylglycerols, Phospho lipids, Glycolipids and Steroids) <p>Structure, Classification and General Properties of α-amino acids;</p> <p>Essential and non-essential amino acids, Levels of organization in proteins; Simple and conjugated proteins.</p> <p>Enzyme Action and Regulation</p> <ul style="list-style-type: none"> • Nomenclature and classification of enzymes; Cofactors; Specificity of enzyme action. • Isoenzymes; Mechanism of enzyme action • Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Equation of Michaelis - Menten, Concept of K_m and V_{max}, Enzyme inhibition <input type="checkbox"/> Allosteric enzymes and their kinetics; Regulation of enzyme action. 			14
Unit II	<p>Metabolism of Carbohydrates and Lipids</p> <ul style="list-style-type: none"> <input type="checkbox"/> Metabolism of Carbohydrates: glycolysis, citric acid cycle, gluconeogenesis, <input type="checkbox"/> Phosphate pentose pathway Glycogenolysis and Glycogenesis Lipids-Biosynthesis of palmitic acid; Ketogenesis, <input type="checkbox"/> β-oxidation and omega-oxidation of saturated fatty acids. <p>Metabolism of Proteins and Nucleotides</p> <ul style="list-style-type: none"> <input type="checkbox"/> Catabolism of amino acids: Transamination, Deamination, Urea cycle, Nucleotides and vitamins, Peptide linkages 			14

Unit III	<p>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.. <p>Mechanism of respiration, Physiology of trachea and Lung Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood, Respiratory pigments, Dissociation curves and the factors influencing it;</p> <p>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 out put and its regulation, Electrocardiogram, Blood pressure and its regulation. <p>Structure of kidney and its functional unit; Mechanism of urine formation</p>	14
UnitIV	<p>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 non myelinated nerve fibers. Types of synapse. • Endocrine glands- pineal,pituitary,thyroid,parathyroid,pancreas and adrenal <p>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. 	14

Suggested Readings

1. Nelson & Cox: Leiningers Principles of Biochemistry : McMillan (2000)
2. Zubayetal: Principles of Biochemistry:WCB (1995)
3. Voet &Voet: Biochemistry Vols 1 & 2: Wiley(2004)
4. Murrayetal: Harper's Illustrated Biochemistry : McGrawHill (2003) Elliott and Elliott : Biochemistry and Molecular Biology: Oxford University Press
5. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology, XL Edition, Harcourt Asia PTE Ltd. W.B. Saunders Company. (2006).
6. Tortora, G.J. & Grabowski, S. Principles of Anatomy & Physiology. XI Edition JohnWiley & sons (2006).
7. Christopher D. Mayes, Patricia M. Schulte. Principles of Animal Physiology. 3rdEdition, 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).

Semester-II: Zoology Course Lab Content

Course Title/Code: Biochemistry and Physiology	Course Credits: 2
Course Code: 21BSC2C2ZOO2P	L-T-P per week: 0-0-4
Total Contact Hours: 56	Duration of ESA: 4 Hours
Formative Assessment Marks : 25	Summative Assessment Marks: 25

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	CO P1	CO P2	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO
I Corecompetency		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 attainments 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 amino acids and dipeptides. 2. Preparation of models of DNA and RNA. 3. Qualitative analysis of Carbohydrates, Proteins and Lipids. 4. Qualitative analysis of Nitrogenous wastes—Ammonia, Urea and Uric acid. 5. Separation of amino acids or proteins by paper chromatography.	20
6. Determination of the activity of enzyme (Urease)-Effect of [S] and determination of-K _m and V _{max} . 7. Determination of the activity of enzyme (Urease)- Effect of temperature and time.	15
8. Estimation of Hemoglobin in human blood using Sahli's haemoglobinometer. 9. Counting of RBC in blood using Hemocytometer. 10. Counting of WBC in blood using Hemocytometer. 11. Differential staining of human blood corpuscles using Leishman stain. 12. Recording of blood glucose level by using glucometer.	15
Virtual Labs (Suggestive sites) https://www.vlab.co.in http://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab https://vlab.amrita.edu https://sites.dartmouth.edu www.onlinelabs.in	06

Textbooks

1. Nelson & Cox: Lehninger'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: Mc Graw Hill (2003) Elliott and Elliott: Biochemistry and Molecular Biology: Oxford University Press
5. Guyton, A.C. & Hall, J.E. Text book 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 C C 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 non essential 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.

OPEN- ELECTIVE SYLLABUS:

Year	I	Course Code: 21BSC2O2ZOO2	Credits	03
Sem	II	Course Title: Parasitology	Hours	42
Unit No.	Course Content			Hours
Unit I	<p>1. General Concepts</p> <ul style="list-style-type: none"> • Introduction, Parasites, parasitoids, host, zoonosis • Origin and evolution of parasites • Basic concept of Parasitism, symbiosis, phoresis, commensalism and mutualism • Host-parasite interactions and adaptations • Life cycle of human parasites • Occurrence, mode of infection and prophylaxis <p>2. Parasitic Platyhelminthes</p> <p>Study of morphology, lifecycle, pathogenicity, prophylaxis and control measures of</p> <ul style="list-style-type: none"> • <i>Fasciolopsis buski</i> • <i>Schistosoma haematobium</i> • <i>Taenia solium</i> <p>3. Parasitic Protists</p> <p>Study of morphology, lifecycle, pathogenicity, prophylaxis and control measures of</p> <ul style="list-style-type: none"> • <i>Entamoeba histolytica</i> • <i>Giardia intestinalis</i> • <i>Plasmodium vivax</i> 			14
Unit II	<p>4. Parasitic Nematodes</p> <p>Study of morphology, lifecycle, pathogenicity, prophylaxis and control measures of</p> <ul style="list-style-type: none"> • <i>Ascaris lumbricoides</i> • <i>Ancylostoma duodenale</i> • <i>Wuchereria bancrofti</i> • Nematode plant interaction; Gall formation <p>5. Parasitic Arthropods</p> <p>Biology, importance and control of</p> <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>) • Parasitoid (Beetles) <p>6. Parasitic Vertebrates</p> <ul style="list-style-type: none"> • Cookicutter Shark • Hood Mocking bird and 			14

	Vampire bat and their parasitic behavior and effect on host	
Unit III	7.Molecular diagnosis & clinical parasitology <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 endoparasite on the basis of marker molecules like G.intestinalis, B.coli, E.histolytica, L.donovani, malarial parasite using ELISA, RIA • Counter Current Immuno electrophoresis (CCI) Complement Fixation Test (CFT) PCR, DNA, RNA probe.	14

Suggested Readings:

1. Arora, D.R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors.
2. E.R.Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea & Febiger.
3. Ahmed,N., Dawson,M.,Smith,C. and Wood,Ed .(2007) Biology of Disease.Taylor and Francis Group.
4. Parija,S.C. Textbook of medical parasitology, protozoology & helminthology (Text and colour atlas), II Edition, All India Publishers & Distributors, Medical Books Publishers, Chennai, Delhi.
5. Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D.Dailey, W.C.Brown Publishers.
6. K.D.Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd.
7. Gunn, A. and Pitt, S.J. (2012). Parasitology: an Integrated Approach.Wiley Blackwell.
8. Noble,E.R. and G.A.Noble (1982) Parasitology:
9. The biology of animal parasites.Vth Edition,Lea & Febiger.
10. Paniker, C.K.J., Ghosh, S. [Ed} (2013). Paniker's TextBook of Medical Parasitology. Jaypee, NewDelhi.
11. Parija, S.C.Textbook of medical parasitology, protozoology & helminthology (Text and color Atlas), II Edition, All India Publishers & Distributors, Medical Books Publishers, Chennai, Delhi.
12. Roberts, L. Sand Janovy, J. (2009). Smith & Robert's Foundation of Parasitology. 8th. Edn. McGraw Bogitsh, B. J. and Cheng, T. C. (2000). Human Parasitology. 2nd Ed. Academic Press, New York.
13. Chandler, A. C.andRead.C. P. (1961).Introduction to Parasitology, 10th ed. John Wiley and Sons Inc.
14. Cheng T.C. (1986). General Parasitology. 2nd ed. Academic Press, Inc.Orlando.U.S.A.
15. Schmidt, G.D. (1989). Essentials of Parasitology.Wm.C.Brown Publishers (Indian print1990, Universal Book Stall).
16. John Hyde (1996) Molecular Parasitology Open University Press.

III Semester BSc Zoology Core Course Content

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

Course Outcomes (COs):

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

1. After successful accomplishment of the course, the learners will be able to acquire better understanding and comprehensive knowledge regarding most of the essential aspects of Molecular Biology subject which in turn will provide a fantastic opportunity to develop professional skill related to the field of molecular biology.
2. The course will mainly focus on the study of principal molecular events of cell incorporating DNA Replication, Transcription and Translation in prokaryotic as well as eukaryotic organisms.
3. Acquiring knowledge on instrumentation and techniques in biology.

Semester III-Zoology Core Course III Content:

Content	Hours
Unit I	14
Chapter1: 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
Chapter2: Process of Translation <ul style="list-style-type: none"> • Genetic code and its salient features • Translation in prokaryotes and eukaryotes 	6
Unit II	14
Chapter3: 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
Chapter4: 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

Chapter5: 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
Chapter6: 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 measure 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 Dideoxymethod) , PCR, DNA Fingerprinting, ELISA, Southern Blotting and Western Blotting. 	8

Semester III (Practical III)**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: 4Hours
Formative Assessment Marks: 25	Summative Assessment Marks: 25

Course Outcomes (COs):

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

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

Lab Course Content

List of 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 airflow, Incubator, shaker, Waterbath and centrifuge.	2
3.To prepare 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.	2
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

Suggested Readings:

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

Open Elective Course Content

Course Title: ENDOCRINOLOGY Course Code: OEC5ZOOT3	Course Credits: 3
Total Contact Hours: 42	Duration of ESA: 3Hours
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:

Differentiate among endocrine, paracrine and autocrine systems.

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

Course Content

Content	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>Chapter7: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>Chapter8:Gastro-intestinal hormones–</p> <ul style="list-style-type: none"> • Functions and regulation of secretion of the hormones. <p>Chapter9:Differenttypesof 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-lagand shift work. 	
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Text Books & Suggested Readings:

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

IV Semester, B.Sc, (Hons) Zoology

Course Title: 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: 2Hrs.
Formative Assessment Marks: 40	Summative Assessment Marks: 60

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

1. Acquaint knowledge on versatile tools and techniques employed in genetic engineering and recombinant DNA technology.
2. An understanding on application of genetic engineering techniques in basic and applied experimental biology.
3. To acquire a fundamental working knowledge of the basic principles of immunology.
4. To understand how these principles, apply to the process of immune function.
5. Use, and interpret results of, the principal methods of statistical inference and design; helps to communicate the results of statistical analyses accurately and effectively; helps in usage of appropriate tool of statistical software.

Course Content	Hrs.
Unit I	14
Chapter 1: Principles of Gene Manipulation <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, Lamdaphage vectors, cosmids ● Gene transfer techniques (Direct and indirect). ● Screening and selection of recombinant colonies 	07
Chapter 2: Applications of Genetic Engineering <ul style="list-style-type: none"> ● Transgenic animals (Transgenic cow, Transgenic Fish); Transgenic plants (cryprotein); Gene silencing (Knockout 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 	07
Unit II	14

Chapter3:IntroductiontotheImmuneSystem <ul style="list-style-type: none"> Defense against diseases: Introduction, First and second line of defense, Innate and acquired immunity; Antigen presenting cells (APC's), Role of Band 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). Band T cellepitopes. Structure of Ig Gandfunctions of different classes of immune globulins. Major histo compatibility complex –Structure of MHCI&II. 	07
Unit III	14
Chapter5: 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
Chapter6:Bioinformatics <ul style="list-style-type: none"> Databases:Sequence and structural Sequence analysis (homology):Pair wise and Multiple Sequence alignment-BLAST, CLUSTALW, Sequence alignment-FASTA. Scope and applications of Bioinformatics. 	07
Unit-IV	14
Chapter7:BiostatisticsI <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
Chapter8:BiostatisticsII <ul style="list-style-type: none"> Measures of dispersion: Range, Standard Deviation, Variance. Correlation and Regression. Tests of significance-test,ANOVA,t-test and Chisquare 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&AnalysisoGenes&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.ClinicalGenetics-AShort 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. Snedecor 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. VivaBooks (2003)
14. Genetic engineering: Sandhya Mitra BITS, Pilani
15. Principles of Biostatistics Khan and Khan
16. Transgenic animals: Ranga

Web Sources:

Course Lab Content

Course Title: Gene Technology, Immunology and Computational Biology	CourseCredits: 02
Course Type: Minor Discipline Core Practical, L-T-P:0-0-4	CorseCode:DSCC5ZOOP4
Total Contact Hours: 56	DurationofESA: 4Hours
Formative Assessment Marks: 25	Summative Assessment Marks: 25

Course Outcomes (COs):

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

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

Lab IV Course Content

List of labs to be conducted	Hours 56
1. Calculate the mean, median, mode and standard deviation (Measurement of pre and post clitellar lengths (with suitable examples).	2 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).	2
5. To detect genetic mutations by Polymerase Chain Reaction (PCR) using teaching kits (Demonstration only).	2
6. Demonstration of agarose gel electrophoresis for detection of DNA.	
7. Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for detection of proteins.	1
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

Open Elective Course Content

Semester: IV Zoology

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 behavior.
2. Understand the main historical ideas that underpin animal behaviour theory
3. Critically review hypotheses to explain animal behavior
4. Understand different methods for collecting data on animal behaviour
5. Have advanced their written and oral presentation skills.

Course Content

Content	42Hrs
Unit– 1	
Chapter 1.: Introduction to Animal Behaviour <ul style="list-style-type: none"> Brief contributions of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen. Proximate and ultimate causes of behaviour. Chapter 2. Patterns of Behaviour <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–2	14
Chapter 3. Social Behaviour: <ul style="list-style-type: none"> Social organization in termites and honeybees. Social behaviour: Altruism. Conflict behaviour. Chapter 4. Sexual Behaviour <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) 	
Unit– 3	14

Chapter5.Chronobiology	
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|--|--|
| <ul style="list-style-type: none">• Brief historical developments in chronobiology.• Adaptive significance of biological clocks.• Biological Rhythms | |
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Chapter6:Communicationsinanimals	
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|--|--|
| <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 Honeybees (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 Behavior, 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 Barends and Noble Inc. New York, USA
6. Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/Springer-Verlag, Germany.

Course pattern and scheme of examination for B.Sc. / B.Sc. (Hons.)
As per NEP (2021-22 onwards)
Subject: ZOOLOGY

SL No.	Semester	Title of the paper	Teaching hours	Hours /week		Examination Pattern Max. & Min. Marks / Paper						Duration of Exam(hours)		Total Marks/paper	Credits	
				Theory	Practical	Theory			Practical			Theory	Practical		Theory	Practical
						Max.	MIN.	I A	Max.	MIN.	I A					
1	I	CORE subject	56	4	4	60	21	40	25	9	25	2	4	150	2	4
		Open elective	42	3	-	60	21	40	-	-	-	2	-	100	2	-
		Skill Enhancement Course	56	-	4	-	-	-	25	9	25	3	3	50	-	2
2	II	CORE subject	56	4	4	60	21	40	25	9	25	2	4	150	2	4
		Open elective	42	3	-	60	21	40	-	-	-	2	-	100	2	-
		Skill Enhancement Course	56	-	4	-	-	-	25	9	25	3	3	50	-	2



RANI CHANNAMMA UNIVERSITY, BELAGAVI

PROGRAM/COURSE STRUCTURE AND SYLLABUS

**As per the Choice Based Credit System (CBCS) designed in
accordance with Learning Outcomes-Based Curriculum
Framework (LOCF) of National Education Policy (NEP) 2020**

For

Bachelor of Science

Zoology – V and VI Semester

w.e.f.

Academic Year 2023-24 and onwards

RANI CHANNAMMA UNIVERSITY,BELAGAVI

B.Sc. in Zoology Effective from 2023-24

Sem.	Type of Course	Theory/ Practical	Course Code	CourseTitle	Instruc tion hour/ week	Total hours /sem	Duratio nof Exam	Marks			Credits
								Format ive	Sum m ative	Total	
V	DSCC-9	Theory	21BSC5C5ZOO 5L	Non-Chordates and Economic Zoology	04hrs	56	02 hrs	40	60	100	04
	DSCC-10	Practical	21BSC5C5ZO O5P	Non-Chordates and Economic Zoology	04 hrs	56	03 hrs	25	25	50	02
	DSCC-11	Theory	21BSC5C6ZO O6L	Chordates and Comparative Anatomy	04hrs	56	02 hrs	40	60	100	04
	DSCC-12	Practical	21BSC5C6ZO O6P	Chordates and Comparative Anatomy	04 hrs	56	03 hrs	25	25	50	02
	Other subject										04
	Other subject										02
	Other subject										04
	Other subject										02
	SEC-3	Practical		The Bee Keeping	04hrs	56	03 hrs	25	25	50	02
	Total										26
VI	DSCC-13	Theory	21BSC6C7ZO O7L	Evolutionary and Developmental Biology	04hrs	56	02 hrs	40	60	100	04
	DSCC-4	Practical	21BSC6C7ZO O7P	Evolutionary and Developmental Biology	04 hrs	56	03 hrs	25	25	50	02
	DSCC-15	Theory	21BSC6C8ZO O8L	Environmental Biology, Wildlife Management and Conservation	04hrs	56	02 hrs	40	60	100	04
	DSCC-16	Practical	21BSC6C8ZO O8P	Environmental Biology, Wildlife Management and Conservation	04 hrs	56	03 hrs	25	25	50	02
	Other subject										04
	Other subject										02
	Other subject										04
	Other subject										02
	Internship-1	Practical		Internship				50	0	50	02
	Total										26

B.Sc. Semester – V
Discipline Specific Course (DSC)-9

Course Title: Non-Chordates and Economic Zoology (Theory)Course
Code: 21BSC5C5ZOO5L

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-9	Theory	04	04	56 hrs	2hrs	40	60	100

Course Outcomes (COs):At the end of the course students will be able to:

CO1: Understand the evolutionary history and diversity of non-chordates

CO2: Study the external and internal characters of non-chordates

CO3: Expose type, structural and functional organization of non-chordates

CO4: Group the animals on the basis of their morphological characteristics.

CO 5: Understand the economic importance of non-chordates

Units	DSCC-9: Course Title: Non-Chordates and Economic Zoology –Theory (Code: 035 ZOO 011)	56.hrs/ sem
Unit- I	Phylum Protozoa: General characters and classification up to classes; Locomotory organelles and locomotion in Protozoa. Type study: Paramecium (Morphology and Reproduction) Phylum Porifera: General characters and classification upto classes; Canal System in poriferans. Type study: Sycon (Morphology and Reproduction) Phylum Cnidaria: General characters and classification upto classes; Polymorphism in Physalia. Type study: Obelia (Morphology and Reproduction) Ctenophora: Salient features	14
Unit- II	Phylum Platyhelminthes: General characters and classification upto classes; Parasitic adaptations (morphological and physiological). Type study: Taenia (Tape worm)- (Morphology and Reproduction) Phylum Nemathelminthes: General characters and classification upto classes; Transmission, pathogenicity and preventive measures of Ascariasis. Type study: Ascaris (Round worm)- (Morphology and Reproduction) Phylum Annelida General characters and classification upto classes; Metamerism in Annelida and external morphology of Leech. Type study: Hirudinaria (Leech) - (Morphology and Reproduction)	14

Unit- III	Phylum Arthropoda General characters and classification upto classes; Metamorphosis in Insects and economic importance insects. Type study: Palaemon (Prawn) - (Morphology, Appendages, Nervous system and Reproduction). Phylum Mollusca General characters and classification upto classes; Torsion in gastropods, Pearl	14
	formation. Type study: Pila (morphology, shell, respiration, nervous system and Reproduction) Phylum Echinodermata General characters and classification upto classes; Water-vascular system in Asteroidea. Type study: Pentacerous (Morphology and Reproduction)	
Unit- IV	Economic Zoology: Pests: Life cycle and their control of following pests: Gundhi bug, Leaf hopper. Vectors: Prevention and control of Termites and Mosquitoes Economic Zoology: Economic importance of Lac Culture, Vermiculture and Sericulture.	14

References:

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

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Internal Assessment Test 1	10
Internal Assessment Test 2	10
Quiz/ Assignment/ Small Project	10
Seminar	10
Total	40 Marks
<i>Formative Assessment as per guidelines.</i>	

B.Sc. Semester – V
Discipline Specific Course (DSCC)-10
Course Title: Non-Chordates and Economic Zoology (Practical)
CourseCode: 21BSC5C5ZOO5P

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-10	Practical	02	04	56 hrs	3hrs	25	25	50

Course Outcomes (COs):At the end of the course, students will be able to:**CO 1:**

Understand basics of classification of non-chordates.

CO 2: Learn and understand the internal systems of non-chordates.

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

CO 4: Know uniqueness of a particular animal and economic importance of non-chordates.

CO 5: Enhancement of basic laboratory skill like keen observation and drawing.

CO 6: Study the useful and harmful non-chordates

Expt. No.	DSCC-10: Course Title: Non-Chordates and Economic Zoology –Practical (Code: 035 ZOO 012)	56.hrs/sem
1	Preparation and observation of protozoan culture. Protozoa: Systematics of <i>Amoeba</i> , <i>Euglena</i> , <i>Noctiluca</i> , <i>Paramecium</i> and <i>Vorticella</i> (Permanent slides/ Charts).	4
2	Porifera: Systematics of <i>Sycon</i> , <i>Euplectella</i> , <i>Hyalonema</i> , <i>Spongilla</i> and <i>Euspongia</i> T.S of <i>Sycon</i> , Spicules and Gemmules (Specimens/ Permanent slides/ Charts)	4
3	Cnidaria: Systematics of <i>Aurelia</i> and <i>Metridium</i> (Specimens). Slides/Charts of <i>Hydra</i> , <i>Obelia</i> - polyp and medusa, and <i>Ephyra</i> larva, T.S. of <i>Metridium</i> passing through mesenteries. Study of Corals- <i>Astraea</i> , <i>Fungia</i> , <i>Meandrina</i> , <i>Corallium</i> , <i>Gorgonia</i> , <i>Millepora</i> and <i>Pennatula</i> .	4
4	Helminthes: Systematics of <i>Planaria</i> , <i>Fasciola hepatica</i> and <i>Taenia solium</i> , <i>Ascaris</i> - Male and female (Specimens/Charts). Slides/Charts of T.S. of <i>Planaria</i> , T.S. of male and female <i>Ascaris</i> .	4
5	Annelida: Systematics of <i>Nereis</i> , <i>Heteronereis</i> , <i>Sabella</i> , <i>Aphrodite</i> (Specimens/Charts). Slide/Chart of T.S. of earthworm through typhlosole.	4
6	Arthropoda: Systematics of <i>Panaeus</i> , <i>Palaemon</i> , <i>Astracus</i> , Scorpion, Spider, <i>Limulus</i> , <i>Peripatus</i> , <i>Millipede</i> , <i>Centipede</i> , Praying mantis, Termite Queen, Moth, Butterfly, Dung beetle /Rhinceros beetle (Any six specimens). Slide/Chart of Larvae- Nauplius, Zoea, Mysis.	6

7	Mollusca: Systematics of <i>Chiton</i> , <i>Mytilus</i> , <i>Aplysia</i> , <i>Pila</i> , <i>Octopus</i> , <i>Sepia</i> (Specimens) and Glochidium larva (Slide/Chart). 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	4
8	Echinodermata: Systematics of Sea star, Brittle star, Sea Urchin, Sea Cucumber, Sea lilly (Specimens/Charts). Slides/Charts of Bipinnaria larva, Echinopluteus larva and Pedicellaria.	4
9	Harmful Non-chordates: Soil Nematodes, Agricultural, Veterinary and Human pests (Ticks, Mites and Bugs).	4
10	Beneficial Non-chordates: Sericulture: Life cycle of <i>Bombyx mori</i> , Types of silk Vermiculture: Earthworm species used in Vermiculture and Vermicomposting, Vermi products	6
11	Virtual Dissection/Cultured specimens: Earthworm –Nervous system, Leech-Digestive system	6
12	Virtual Dissection/Cultured specimens: Prawn-Nervous system. Cockroach-Salivary apparatus and Digestive system.	6
13	Any other practical's related to this paper may be added based on the feasibility	

Scheme of Practical Examination (distribution of marks): 25 Marks for Semester end Examination

1. Perform all the experiments as per the instructions in each question

Semester end Examination for Practical	
Assessment	Distribution of Marks
1. Major Experiments	08
2. Minor Experiments	05
3. Identifications (A-D)	08
4. Viva	02
5. Journal	02
Total	25 Marks

Note: Same Scheme may be used for IA (Formative Assessment) examination for 25 marks

B.Sc. Semester – V
Discipline Specific Course (DSCC)-11
Course Title: Chordates and Comparative Anatomy (Theory)
Course Code: 21BSC5C6ZOO6L

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-11	Theory	04	04	56 hrs	2hrs	40	60	100

Course Outcomes (COs): At the end of the course, students will be able to: CO1:

Understand the basic concept, diversity and classification of Chordates CO2:

Demonstrate comprehensive identification abilities of chordate diversity CO3:

Understand evolutionary relationship amongst all chordates

CO4: Understand the external morphology and sexual dimorphism in chordates.

CO5: Understand arrangement of endoskeleton of vertebrates.

CO6: Know the comparative anatomy of various systems, adaptations, physiological mechanisms of vertebrates.

Units	DSCC-11: Course Title: Chordates and Comparative Anatomy-Theory (Code:035 ZOO 013)	56.hrs/sem
Unit-I	Chordates: Origin of Chordates; Basic characters of chordates and classification upto classes. Protochordates: General features and phylogeny of Protochordata, Classification of Protochordates: Hemichordata: Type Study: <i>Balanoglossus</i> - Habit and Habitat, Morphology, Coelom. Tornaria larva and its affinities. Urochordata: Type Study: <i>Herdmania</i> - Habit and Habitat, Morphology, Ascidian tadpole-structure and its retrogressive metamorphosis. Cephalochordata: Type Study: <i>Branchiostoma (Amphioxus)</i> -Habit and habitat, Morphology, Digestive system, Feeding mechanism, excretory and circulatory system. Agnatha: General characters of Agnatha and classification upto classes. Salient features of Cyclostomata and Ostracodermi with examples. Ammocoete larva and its significance.	14
Unit-II	Vertebrates: General characters and Classification of different classes of vertebrates (Pisces - Chondrichthyes and Osteichthyes, Amphibia, Reptilia, Aves, Mammalia) upto the orders with five characters for each order citing examples.	14

Unit-III	<p>Pisces: Osmoregulation, migration and swim bladder in fishes. Types of caudal fins, scales in fishes.</p> <p>Amphibia: Origin of Amphibia, Parental care and Neoteny in Amphibia,</p> <p>Reptilia: Adaptive radiation in extinct reptiles with suitable examples. Temporal fossae in reptiles. Poisonous and non-poisonous snakes, biting mechanism in snakes, types of venom.</p> <p>Aves: Flightless birds and their distribution, Major types of beaks. Kinds of migration in birds. Flight adaptations in birds.</p> <p>Mammals: Distribution of Prototheria and Metatheria with examples. Dentition in mammals and evolution of molar tooth. Adaptive radiation in mammals.</p>	14
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Unit-IV	<p>Comparative Anatomy of Vertebrates:</p> <p>Integumentary System: Structure of skin and its derivatives.</p> <p>Skeletal System: Comparative account of Axial (Skull) and Appendicular (girdles) Skeletal system in Amphibians (Frog), Reptiles (Calotes), Aves (Pigeon) and Mammals (Rabbit).</p> <p>Comparative account of Digestive system (digestive glands and alimentary canal), Respiratory System (gills, lungs, air sacs, swim bladder) Circulatory System (heart and aortic arches) and Nervous system (brain) in Pisces (Scoliodon), Amphibians (Frog), Reptiles (Calotes), Aves (Pigeon) and Mammals (Man).</p> <p>Excretory System: Succession of vertebrate kidney and Evolution of urino-genital ducts in vertebrates</p>	14
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References:

1. Colbert *et al*: Colbert's Evolution of the Vertebrates: A history of the back boned animals through time. (5th ed 2002, Wiley-Liss).
2. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)
3. Kenneth V. Kardong (20015) Vertebrates: Comparative Anatomy, Function, Evolution Mc Graw Hill
4. Mc Farland *et al.*: Vertebrate Life (1979, Macmillan publishing)
5. Parker and Haswell: Text Book of Zoology, Vol. II (1978, ELBS)
6. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing, Japan)
7. Young: The Life of Vertebrates (3rd ed 2006, ELBS/Oxford)
8. Weichert C.K. and William Presch (1970). Elements of Chordate Anatomy, Tata Mc Graw Hills

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Internal Assessment Test 1	10
Internal Assessment Test 2	10
Quiz/ Assignment/ Small Project	10
Seminar	10
Total	40 Marks
<i>Formative Assessment as per guidelines.</i>	

B.Sc. Semester – V

Discipline Specific Course (DSCC)-12

Course Title: Chordates and Comparative Anatomy (Practical)

Course Code: 21BSC5C6ZOO6P

Type of Course	Theory / Practical	Credits		Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-12	Practical	02		04	56 hrs	3hrs	25	25	50

Course Outcomes (COs): At the end of the course, students will be able to: CO

1: Understand the external morphology of proto-chordates and chordates CO

2: Study the cartilaginous, bony and ornamental fishes

CO 3: Understand the systematic position and classification of Chordates

CO 4: Study the comparative anatomy and internal systems of vertebrates

CO 5: Understand the beak and foot modifications in birds.

Expt. No.	DSCC-12: Course Title: Chordates and Comparative Anatomy –Practical (Code:035 ZOO 014)	56.hrs/sem
1	Protochordata: Balanoglossus and T. S through proboscis Ascidian/ <i>Herdmania</i> and <i>Amphioxus</i> , T.S. of <i>Amphioxus</i> through pharynx and intestine. Cyclostomata: <i>Petromyzon</i> , <i>Myxine</i> . Ammocoete larva	04
2	Pisces: Cartilaginous fishes – <i>Narcine</i> , <i>Trygon</i> , <i>Pristis</i> , <i>Myxobatias</i> , <i>Scoliodon</i> . (Any four) Bony fishes– Zebrafish, Hippocampus, Muraena, Ostracion, Tetradon, Pleuronectes, Diodon, Echeneis. (Any six).	05
3	Ornamental fishes: Siamese, Koi, Oscar, Betta Sp., Neon tetra, Guppies, Goldfish, Angle fish, Rainbow fish, Mollies (Any four). Accessory respiratory organs – <i>Saccobranchius</i> , <i>Clarias</i> and <i>Anabas</i> .	04
4	Amphibia: <i>Rana</i> , <i>Bufo</i> , <i>Ambystoma</i> , <i>Axolotl</i> larva, <i>Necturus</i> and <i>Ichthyophis</i> .	04
5	Reptilia: Turtle, Tortoise, <i>Mabuya</i> , <i>Calotes</i> , Chameleon, <i>Varanus</i> . Snakes –Dryophis, Ratsnake, Brahmini, Cobra, Krait, Russell's viper and Hydrophis.	04
6	Aves: Beak and feet modifications in the following examples: Duck, Crow, Sparrow, Parrot, Kingfisher, Eagle or Hawk. Mammalia: Mongoose, Squirrel, Pangolin, Hedge Hog, Rat and Loris, Platypus, Echidna.	05
7	Virtual Dissection/Cultured specimens: Shark/Bony fish: Afferent and efferent branchial systems, glosso-pharyngeal and vagus nerves.	05
8	Virtual Dissection/Cultured specimens: Rat: Dissection (only demonstration)– Circulatory system (Arterial and Venous), Urinogenital system.	05
9	Comparative account of skeletal system: Skull, vertebrae, girdles and limb bones of Shark, Frog, <i>Calotes</i> , Pigeon and Rabbit	05
10	Comparative account of skin in Shark, Frog, <i>Calotes</i> , Pigeon and Man.	05

11	Comparative account of heart in Shark, Frog, Calotes, Pigeon and Man.	05
12	Comparative account of brain in Shark, Frog, Calotes, Pigeon and Man.	05
13	Any other practical's related to this paper may be added based on the feasibility	

Scheme of Practical Examination (distribution of marks): 25 Marks for Semester end Examination

1. Perform all the experiments as per the instructions in each question

Semester end Examination for Practical	
Assessment	Distribution of Marks
1. Major Experiments	08
2. Minor Experiments	05
3. Identifications (A-D)	08
4. Viva	02
5. Journal	02
Total	25 Marks

Note: Same Scheme may be used for IA (Formative Assessment) examination for 25 marks

B.Sc. Semester – V
Skill Enhancement Course: SEC-3
Course Title: The Bee Keeping (Practical) Course Code:

Type of Course	Theory / Practical	Credits	Instruction hour/ week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
SEC-3	Practical	02	04	56 hrs	3hrs	25	25	50

Course Outcomes (COs): At the end of the course students will be able to:

CO 1: Explain what the prerequisite to get started in beekeeping

CO 2: Discuss the responsibilities of urban beekeepers.

CO 3: Identify where to purchase equipment and demonstrate how to assemble it.

CO 4: Name and identify major parts of the honeybee such as mouth parts, sting apparatus and mandibular parts.

CO5: Describe bee biology and anatomy from the perspective of managing bees.

CO 6: Describe the importance and usage of honey and bee wax.

Expt. No.	SEC-3: Course Title: The Bee Keeping-Practical (Code:035 ZOO 061)	56.hrs/ sem
1	Study of general characters and anatomy of honey bee	6
2	Systematic position and classification of honey bee	2
3	Study of life cycle of honey bee	4
4	Mounting of mouth parts/sting apparatus of honey bee	4
5	Study of castes in honey bees	4
6	Identification of honey bee species	4
7	Study of social organization in honey bees	4
8	Requirements of bee keeping: Hive, Protective gear, smoker, hive tool and other equipments (Charts)	4
9	Study of honey bee by-products and their uses (Charts)	4
10	Study of diseases of honeybees (Charts)	4
11	Study of pests of honeybees (Charts)	4
12	Field study/Project report on nearby Apiary/bee keeping unit and submit a report	12
13	Any other practical's related to this paper may be added based on the feasibility	

References:

1. Abrol , D. P. (1997) Bees and Beekeeping. Kalyani Publisher, New Delhi. 173
2. Abrol, D. P. (2010) A Comprehensive guide to Bees and Beekeeping. Scientific Publisher, New Delhi.
3. Withhead, S. B. (2010) Honey bees and their management Axis books Publisher, Jodhpur.
4. Nagaraja, N. and Rajagopal, D. (2013) Honey bees: Diseases, Parasites, Pests, Predator and their management. M.J.P Publisher, Chennai.
5. Dharamsing and Singh, D. P. A Handbook of Beekeeping, Agrobios India (Publisher), Jodhpur.
6. Prost, P. J. Apiculture. Oxford and IBH, New Delhi.
7. Bisht D.S. Apiculture, ICAR Publication.
8. Bisht, D.S. Agricultural Development in India, Anmol Pub. Pvt. Ltd.
9. Singh S. Beekeeping in India, Indian council of Agricultural Research, New Delhi
10. Mehrotra, K.N. Bisht, D.S. Twenty-five years of apiculture research at IARI.

**Scheme of Practical Examination (distribution of marks): 25 Marks
for Semester end Examination**

1. Perform all the experiments as per the instructions in each question

Semester end Examination for Practical	
Assessment	Distribution of Marks
1. Major Experiments	06
2. Minor Experiments	04
3. Identifications (A-C)	06
4. Viva	02
5. Journal	02
6. Field visit report	05
Total	25 Marks

Note: Same Scheme may be used for IA (Formative Assessment) examination for 25 marks

B.Sc. Semester – VI
Discipline Specific Course (DSCC)-13
Course Title: Evolutionary and Developmental Biology (Theory)
CourseCode: 21BSC6C7ZO07L

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-13	Theory	04	04	56 hrs	2hrs	40	60	100

Course Outcomes (COs):At the end of the course students will be able to:

- CO 1:** Understand that by biological evolution we mean that many of the organisms that inhabit the earth today are different from those that inhabited it in the past.
- CO 2:** Understand that natural selection is one of several processes that can bring about evolution, although it can also promote stability rather than change.
- CO 3:** Understand how the single cell formed at fertilization forms an embryo and then a full adult organism.
- CO 4:** Integrate genetics, molecular biology, biochemistry, cell biology, anatomy and physiology during embryonic development.
- CO 5:** Understand a variety of interacting processes, which generate an organism's heterogeneous shapes, size, and structural features.

Units	DSCC-13: Course Title: Evolutionary and Developmental Biology-Theory (Code:036ZOO 011)	56.hrs/sem
Unit- I	Origin of Life and theories; Historical review of evolutionary concept. Theories of Evolution: Lamarckism, Darwinism (Natural, Sexual and Artificial selection), Mutation Theory of Evolution (Hugo de Vries) and Neo- Darwinism (Synthetic theory of evolution, gene mutation, gene flow, genetic drift, Hardy-Weinberg equilibrium). Adaptive radiations: Patterns of evolution (Divergence, Convergence, Parallel, Co-evolution).	14

Unit- II	<p>Evidences of Evolution: Relationship among organisms, Morphological and Anatomical evidences, Embryological evidences, Paleontological evidences, Bio-geographical evidences, Biochemical/Physiological evidences, Cytological evidences, Taxonomical evidences and Current evidences.</p> <p>Geological Time Scale/ Stratigraphic Scale.</p> <p>Species Concept and Extinction: Concept of species; Modes of speciation: Allopatric and Sympatric species; Mass extinction (Causes, Names of five major extinctions)</p> <p>Origin and evolution of Human and Horse.</p>	14
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Unit- III	Introduction to Developmental Biology: Scope and theories of development biology Early Embryonic Development: Gametogenesis: Spermatogenesis and oogenesis in mammals. Fertilization: external (amphibians), internal (mammals), monospermy and polyspermy; Early development of frog and humans (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula); types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.	14
Unit- IV	Embryonic membranes and early development of Chick: Development, structure and functions of yolk sac, amnion, chorion and allantois, structure of hen's egg, cleavage, blastula, gastrulation, origin and structure of primitive streak, structure of 18, 24, 36 and 48 hrs chick embryos. Placenta: Classification of placenta (morphological and histological) with examples, and functions of placenta. Modern trends in human reproduction: In-vitro fertilization, sperm and egg banks, sexually transmitted diseases (AIDS, syphilis and gonorrhea).	14

References:

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

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Internal Assessment Test 1	10
Internal Assessment Test 2	10
Quiz/ Assignment/ Small Project	10
Seminar	10
Total	40 Marks
<i>Formative Assessment as per guidelines.</i>	

B.Sc. Semester – VI
Discipline Specific Course (DSCC)-14
Course Title: Evolutionary and Developmental Biology (Practical)
Course Code: 21BSC6C7ZOO7P

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-14	Practical	02	04	56 hrs	3hrs	25	25	50

Course Outcomes (COs): At the end of the course, students will be able to:

- CO 1: Explain core features of evolutionary theory and their applications to biological systems.
- CO 2: Explain how evolutionary patterns and processes can be inferred using sequence data, the biology of extant organisms, and fossils.
- CO 3: Study the process by which organisms grow and develop.
- CO 4: Understand the development of multicellular organisms from a single cell zygote.
- CO 5: Learn interesting and unique post-embryonic development in other animals.
- CO 6: Understand the concept of aging and the relevance of this knowledge in several medical applications.

Expt. No.	DSCC-14: Course Title: Evolutionary and Developmental Biology-Practical (Code:036 ZOO 012)	56.hrs/sem
1	Study and verification of Hardy-Weinberg Law by chi-square analysis.	3
2	Graphical representation and interpretation of data of height/weight of a sample of 100 humans in relation to their age and sex	3
3	Study of connecting links and fossils (models/pictures); Connecting links/ Living fossils: Neopilina, Peripatus, Limulus, Latimeria, Sphenodon, Archeopteryx and Duck Billed Platypus	3
4	Study of homology and analogy from suitable examples.	3
5	Study of aquatic, arboreal and volant adaptations with suitable examples: Shark, Turtle, Chameleon, Loris, Exocoetus, Bat, Pigeon and Draco	4
6	Vestigial organs: Vermiform appendix, Wisdom teeth, Coccyx (tail bone), Tonsils, Body hairs, Nipples on males, Nictitating membranes of eye (Any three)	4
7	Types of eggs based on quantity and distribution of yolk: Sea urchin, Insect, Frog, Chick.	5
8	Study of development of chick embryo through incubated chick eggs upto 96hrs	6
9	Study of stages of development of Frog: Cleavage stages, Blastula, Gastrula, Neurula stages (whole mount) and various stages of tadpole	6
10	Study of permanent slides of Chick embryo -18 hrs, 24 hrs, 36 hrs, 48 hrs (whole mount and T.S of 18 hrs and 24 hrs chick embryo)	6
11	Evolution of Man and Horse (Charts and models)	6
12	Study of Mesozoic Reptiles (Charts or models);	7

	Study of adaptive radiations in feet of birds and mouth parts in insects with example	
13	Any other practical related to this paper may be added based on the feasibility	

Scheme of Practical Examination (distribution of marks): 25 Marks for Semester end Examination

1. Perform all the experiments as per the instructions in each question

Semester end Examination for Practical	
Assessment	Distribution of Marks
1. Major Experiments	08
2. Minor Experiments	05
3. Identifications (A-D)	08
4. Viva	02
5. Journal	02
Total	25 Marks

Note: Same Scheme may be used for IA (Formative Assessment) examination for 25 marks

B.Sc. Semester – VI
Discipline Specific Course (DSCC)-15
Course Title: Environmental Biology, Wildlife Management and Conservation (Theory)
CourseCode: 21BSC6C8ZOO8L

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-15	Theory	04	04	56 hrs	2hrs	40	60	100

Course Outcomes (COs): At the end of the course, students will be able to:

- CO 1:** Develop an understanding of how animals interact with each other and their natural environment.
- CO 2:** Get knowledge about all types of ecosystems, food chains, webs and energy models.
- CO 3:** Study various types of environmental pollutions
- CO 4:** Develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues.
- CO 5:** Gain an appreciation for the modern scope of scientific inquiry in the field of wildlife conservation management.
- CO 6:** Develop an ability to analyze, present and interpret wildlife conservation management information.

Units	DSCC-15: Course Title: Environmental Biology, Wildlife Management and Conservation-Theory (Code:036 ZOO 013)	56.hrs/sem
Unit I	Ecology: Introduction to ecology, Definition, Ecosystem, Types of ecosystem, Food chain and Food web, Trophic levels. Environment: Definition, Types of environment, Terrestrial, Aquatic, Desert, Grassland and Aerial environment. Marine habitat: Zonation of the sea and ecological classification of marine biota, coastal ecology, estuarine ecology and mangroves. Freshwater habitat: Lentic and Lotic systems. Ecological classification of fresh water animals Terrestrial habitat: A brief account of biomes Ecological adaptations to marine, freshwater and terrestrial habitats.	14
Unit II	Environmental 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. Toxicants – Natural and synthetic toxicants and toxicity measurements. Global warming, Acid rain, Bio-accumulation, Bio-magnification, Eutrophication-Types and its impact.	14

Unit III	Distribution of Wildlife in India: The Himalayan ranges, The peninsular India sub-region, Deccan plateau, Western ghats, Eastern hill chain, Aravali ranges, Indian desert, Tropical rain forests, Wildlife in Andaman and Nicobar Islands. Wild life problems: Hunting, overharvesting, habitat destruction & degradation, over population, and possibilities of climatic changes.	14
Unit IV	Wildlife Management and Conservation: In-situ and ex-situ conservation methods; Wildlife sanctuaries, National parks, Biosphere reserves, Project Tiger, Project Elephant, Project Lion, Zoological Gardens, Habitat preservation and Captive breeding. Wildlife Protection Act, 1972, Causes and depletion of Wildlife, General strategies and issues, Concept of home range and territory, Animal census, Tracing movement and Remote sensing and GIS.	14

References:

1. Colinvau, P.A. (1993) Ecology (2nd edition) Wiley, John and Sons, Inc.
2. Krebs, C.J. (2001) Ecology (6th edition) Benjamin Cummings.
3. Odum, E.P. (2008) Fundamentals of Ecology. Indian Edition. Brooks/Cole. (3rd 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 (5th edition) The Wildlife Society, Allen Press.
8. Sutherland, W.J. (2000) The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
9. Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008) Problem solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Internal Assessment Test 1	10
Internal Assessment Test 2	10
Quiz/ Assignment/ Small Project	10
Seminar	10
Total	40 Marks
<i>Formative Assessment as per guidelines.</i>	

B.Sc. Semester – VI
Discipline Specific Course (DSCC)-16
Course Title: Environmental Biology, Wildlife Management and Conservation (Practical)
CourseCode: 21BSC6C8ZOO8P

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-16	Practical	02	04	56 hrs	3hrs	25	25	50

Course Outcomes (COs): At the end of the course, students will be able to:

CO 1: Understand the basic concepts of environmental sciences, ecosystems, natural resources, population, environment and society

CO 2: Understand the basic concepts of toxicology, their impact on human health and remedial measures

CO 3: Provide understanding and knowledge on modern concepts in wildlife management and relevant conservation policies and legislation and their enforcement mechanism at Global and Local Level,

CO 4: Understand the scientific approach to wildlife management and planning.

CO 5: Develop scientific skills for resolving human wildlife conflict including capture, handling, care and management of wild animals.

Expt. No.	DSCC-16: Course Title: Environmental Biology, Wildlife Management and Conservation-Practical (Code: 036 ZOO 014)	56.hrs/ sem
1	Collection of water sample and analysis of physical parameters of water: Temperature, pH, Electrical Conductivity.	4
2	Estimation of chemical parameters of water: Dissolved Oxygen (O ₂), Carbon Dioxide (CO ₂), Hardness, Chloride, Alkalinity, Total dissolved solids (TDS).	6
3	Analysis of physical parameters of soil: pH, EC, Soil moisture, Soil temperature	2
4	Determination of organic matter in the soil sample	4
5	Study of tropical pond as an ecosystem: Study of flora and fauna and interaction between the various constituents using charts.	4
6	Analysis of air pollution: Air monitoring for particulate matter	4
7	Collection, preservation and estimation of zooplanktons	4
8	Study of threatened animals of India (charts/models/pictures): Tiger, Lion, one horned Rhinoceros, Golden langur, Lion tailed monkey, Musk deer, Kashmir stag, Great Indian horn bill and Indian rock python.	4
9	Location of Tiger reserves, National parks, Biosphere reserves, Wildlife sanctuaries of India on Map.	4

10	Demonstration of field equipments used in Wildlife census: Compass, Binoculars, Spotting scope, Range finders, Global Positioning System, Various types of cameras and lenses.	4
11	Identification wild animals: Wild animal's pugmarks, hoof marks scats, pellet groups, nest, antlers. Demonstration of field techniques for wild flora and fauna.	4
12	Visit to Zoo/ Sanctuaries/ National parks/ Biosphere reserves	12
13	Any other practical's related to this paper may be added based on the feasibility	

Scheme of Practical Examination (distribution of marks): 25 Marks for Semester end Examination

1. Perform all the experiments as per the instructions in each question

Semester end Examination for Practical	
Assessment	Distribution of Marks
1. Major Experiments	08
2. Minor Experiments	05
3. Identifications (A-D)	08
4. Viva	02
5. Journal	02
Total	25 Marks

Note: Same Scheme may be used for IA (Formative Assessment) examination for 25 marks

**B.Sc. Semester – VI
INTERNSHIP**

Course Title: Internship (Practical) Course Code:

Type of Course	Theory / Practical	Credits	Instruction hour/ week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
Internship	Practical	02	04	56 hrs.	-	50	0	50

Course Outcomes (COs): At the end of the course students will be able to:

- CO 1:** Explore career alternatives prior to graduation and Integrate theory and practice
- CO 2:** Assess interests and abilities in their field of study/ research.
- CO 3:** Develop work habits and attitudes necessary for job success
- CO 4:** Build a record of work experience
- CO 5:** Identify, write down, and carry out performance objectives related to the job assignment

Expt. No.	Internship: Course Title: Internship-Practical (Code: 036 ZOO 091)	56.hrs/sem
1	Small Laboratory Research Projects related to Zoology OR	56
2	Field Study Report: Survey of animal biodiversity nearby villages/ ecosystem OR	
3	Survey of insect vectors/ animal diseases/human diseases/blood groups etc. OR	
4	Any other work related to this paper may be added based on the feasibility	

Formative Assessment for Practical	
Assessment	Distribution of Marks
Project / Survey work / Field Study Report submission	25
Internal marks based on the performance of work by mentor	10
Presentation of work	15
Total	50 Marks
<i>Formative Assessment as per guidelines.</i>	

Internship:

A course requiring students to participate in a professional activity or work experience, or cooperative education activity with an entity external to the education institution, normally under the supervision of an expert of the given external entity. A key aspect of the internship is induction into actual work situations for 2 credits. Internships involve working with local industry, local governments (such as panchayats, municipalities) or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning.

Note:

1. 1 credit internship is equal to 30hrs on field experience.
2. Internship shall be Discipline Specific of 45-60 hours (2 credits) with duration 1-2 weeks.
3. Internship may be full-time/part-time (full-time during last 1-2 weeks before closure of the semester or weekly 4 hrs in the academic session for 13-14 weeks).
4. College shall decide the suitable method for programme wise but not subject wise.
5. Internship mentor/supervisor shall avail work allotment during 6th semester for a maximum of 20 hours.
6. The student should submit the final internship report (45-60 hours of Internship) to the mentor for completion of the internship.
7. Method of evaluation: Presentations/Report submission/Activity etc.

UG programme: 2023-24

GENERAL PATTERN OF THEORY QUESTION COURSE FOR DSCC/ OEC

(60 Marks for Semester End Examination with 2 Hrs duration)

- a. Answer any six Questions from Question I
- b. Answer any Three questions from II, III, IV and V

Q.No.I	Answer any six Questions (Two question from Each Unit) 1. 2. 3. 4. 5. 6. 7. 8.	2X6=12
Q.No.II	(Should cover Entire Unit-I) 9. 10. 11. 12.	4X3=12
Q.No.III	(Should cover Entire Unit-II) 13. 14. 15. 16.	4X3=12
Q.No.IV	(Should cover Entire Unit-III) 17. 18. 19. 20.	4X3=12
Q.No.V	(Should cover Entire Unit-IV) 21. 22. 23. 24.	4X3=12



RANI CHANNAMMA UNIVERSITY, BELAGAVI

PROGRAM /COURSE STRUCTURE AND SYLLABUS

**As per the Choice Based Credit System (CBCS) designed in
accordance with Learning Outcomes-Based Curriculum
Framework (LOCF) of National Education Policy (NEP)
2020**

For

Bachelor of Science (Basic/Hons) Zoology

w.e.f.

Academic Year 2021-22 and onwards



RANI CHANNAMMA UNIVERSITY, BELAGAVI

BSc (Basic/Hons) Zoology program-2021-22

BoS Committee-NEP-BSc (Hons) Zoology

S.No.	Name & Address	Designation
1	Prof. K. Kantharaju Chairman & Professor, Dept. of Chemistry RCUB	Chairman
2	Shri. J. M. Meti, KPS College Vijayapur .	Member
3	Dr. M. A. Ghodesawar, Anjuman College Vijayapur .	Member
4	Dr. N. Birsal, KLES-BKASC College, Chikkodi.	Co-opted Members
5	Dr. D.M. Patil, GPPorwal AC&VVSS college, Sindagi-28	Co-opted Members

PREAMBLE

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 Zoology 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. 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 field's right from classical to applied Zoology.

Zoology has been studied in an integrated and cross-disciplinary manner with a comprehensive understanding of all living systems, their relationship with the ecosystem and their application. The framework imbibes a Learning Outcome-based Curriculum Framework (LOCF) for its entire Under Graduate program in Zoology.

A comprehensive understanding and appreciation of the organism 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 are to impart and assess the quality of critical thinking, analytical and scientific reasoning, reflective thinking, information and digital literacy, and problem-solving capacity.

Aim of program 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 Zoology courses designed in terms of concepts, mechanisms, biological designs & functions and evolutionary significance. The students should do the dissertation/ project work under practical of different courses, wherever possible.

Program Learning Outcome

Students enrolled in B.Sc. (Hons.) degree program in Zoology will study and acquire complete knowledge of disciplinary as well as allied biological sciences. At the end of graduation, they should possess expertise which will provide them competitive advantage in pursuing higher studies from India or abroad; and seek jobs in academia, research or industries.

Students should be able to identify, classify and differentiate diverse chordates and non-chordates based on their morphological, anatomical and systemic organization. They will also be able to describe economic, ecological and medical significance of various animals in human life. This will create a curiosity and awareness among them to explore the animal diversity and take up wild life photography or wild life exploration as a career option. The procedural knowledge about identifying and classifying animals will provide students professional advantages in teaching, research and taxonomist jobs in various government organizations; including Zoological Survey of India and National Parks/Sanctuaries.

Acquired practical skills in biotechnology, biostatistics, bioinformatics and molecular biology can be used to pursue career as a scientist in drug development industry in India or abroad. Our students will be acquiring basic experimental skills in various techniques in the fields of genetics; molecular biology; biotechnology; qualitative and quantitative microscopy; enzymology and analytical biochemistry. These methodologies will provide an extra edge to our students, who wish to undertake higher studies. In-depth knowledge and understanding about comparative anatomy and developmental biology of various biological systems; and learning about the

RANI CHANNAMMA UNIVERSITY
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**Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of
 Biotechnology Major& One Minor Discipline Scheme for the Four Years Chemistry B.Sc.
 Undergraduate Honors Programme with effect from 2021-22**

SEMESTER-I										
Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
			IA	SE E	Total	L	T	P		
L1	21BSC1L1LK1	Kannada	40	60	100	4	-	-	3	2
	21BSC1L1LFK1	Functional Kannada								
L2	21BSC1L2LEN2	English	40	60	100	4	-	-	3	2
	21BSC1L2LHI2	Hindi								
	21BSC1L2LSN2	Sanskrit								
	21BSC1L2LTE2	Telugu								
	21BSC1L2LUR2	Urdu								
DSC1	21BSC1C1ZOO1L	Cytology, Genetics and Infectious Diseases	40	60	100	4	-	-	4	2
	21BSC1C1ZOO1P	Cell Biology and Genetics	25	25	50	-	-	4	2	4
DSC1	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	4
SEC1	21BSC1S1CS1	Digital Fluency	25	25	50	0/2	-	4/0	2	4/2
VBC1	21BSC1V1PE1	Physical Education- Yoga	25	-	25	-	-	2	1	-
VBC2	21BSC1V2HW1	Health & Wellness	25	-	25	-	-	2	1	-
OEC1	21BSC1O1ZOO1	Economic Zoology	40	60	100	3	-	-	3	2
Total Marks				700	Semester Credits		25			

SEMESTER-II										
Catego ry	Course code	Title of the Paper	Marks			Teaching hours/wee k			Cred it	Durati on of exams (Hrs)
			IA	SE E	Tot al	L	T	P		
L3	21BSC2L3LK2	Kannada	40	60	100	4	-	-	3	2
	21BSC2L3FKL 2	Functional Kannada								
L4	21BSC2L4EN2	English	40	60	100	4	-	-	3	2
	21BSC2L4HI2	Hindi								
	21BSC2L4SN2	Sanskrit								
	21BSC2L4TE2	Telugu								
	21BSC2L4UR2	Urdu								
DSC2	21BSC2C2ZOO 2L	Biochemistry and Physiology	40	60	100	4	-	-	4	2
	21BSC2C2ZOO 2P	Physiological, Biochemical & Hematology	25	25	50	-	-	4	2	4
DSC2	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	4
AECC 1	21BSC2AE1ES 2	Environmental Studies	20	30	50	1	-	2	2	2
VBC3	21BSC2V3PE2	Physical Education- Sports	25	-	25	-	-	2	1	-
VBC4	21BSC2V4NC1	NCC/NSS/R&R(S&G) / Cultural	25	-	25	-	-	2	1	-
OEC2	21BSC2O2ZOO 2	Parasitology	40	60	100	3	-	-	3	2
Total Marks				700	Semester Credits			25		

Note: All skill enhancement course (SEC) syllabus and title should be selected time to time notice from the university and/ or NEP committee accordingly.

SECOND YEAR; SEMESTER-III										
Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
			IA	SEE	Total	L	T	P		
L5	21BSC3L5LK3	Kannada	40	60	100	4	-	-	3	2
	21BSC3L5LFK3	Functional Kannada								
L6	21BSC3L6EN3	English	40	60	100	4	-	-	3	2
	21BSC3L6HI3	Hindi								
	21BSC3L6SN3	Sanskrit								
	21BSC3L6TE3	Telugu								
	21BSC3L6UR3	Urdu								
DSC3	21BSC3C3ZOO3L	Molecular Biology, Bioinstrumentation & Biotechniques	40	60	100	4	-	-	4	2
	21BSC3C3ZOO3P	Bioinstrumentation & Molecular Biology	25	25	50	-	-	4	2	4
DSC3	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	4
SEC2	21BSC3S2AI	Artificial Intelligence	25	25	50	1	-	2	2	2
VBC5	21BSC3V5PE3	Physical Education- Sports	25	25	50	-	-	2	1	-
VBC6	21BSC3V6NC2	NCC/NSS/R&R(S &G) / Cultural	25	25	50	-	-	2	1	-
OEC3	21BSC3O3ZO O3		40	60	100	3	-	-	3	2
Total Marks				700	Semester Credits			25		

SEMESTER-IV										
Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
			IA	SEE	Total	L	T	P		
L7	21BSC4L7LK4	Kannada	40	60	100	4	-	-	3	2
	21BSC4L7LFK4	Functional Kannada								
L8	21BSC4L8EN4	English	40	60	100	4	-	-	3	-
	21BSC4L8HI4	Hindi								
	21BSC4L8SN4	Sanskrit								
	21BSC4L8TE4	Telugu								
	21BSC4L8UR4	Urdu								
DSC4	21BSC4C4ZOO4L	Gene Technology, Immunology and Computational Biology	40	60	100	4	-	-	4	2
	21BSC4C4ZOO4P	Genetic Engineering and Counseling	25	25	50	-	-	4	2	2
DSC4	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	2
AECC 2	21BSC4AE1ES2	Constitution of India	20	30	50	1	-	2	2	2
VBC7	21BSC4V5PE4	Physical Education-Sports	25	-	25	-	-	2	1	-
VBC8	21BSC4V6NC3	NCC/NSS/R &R(S&G) / Cultural	25	-	25	-	-	2	1	-
OEC4	21BSC4O3ZOO4	Multimedia & Animation	40	60	100	3	-	-	3	2
Total Marks				700	Semester Credits			25		

SEMESTER-V										
Catego ry	Course code	Title of the Paper	Marks			Teaching hours/we ek			Cred it	Durati on of exams (Hrs)
			IA	SEE	Tot al	L	T	P		
Zoology as Major Discipline										
DSC5	21BSC5C5ZOO5L	Non-Chordates and Economic Zoology	40	60	100	3	-	-	3	2
	21BSC5C5ZOO5P	Non-Chordate and Economic Zoology	25	25	50	-	-	4	2	4
DSC6	21BSC5C6ZOO6L	Chordates and Comparative Anatomy	40	60	100	3	-	-	3	2
	21BSC5C6ZOO6P	Chordate(Virtual Dissection), Comparative Anatomy	25	25	50	-	-	4	2	4
DSC5	Another Department Code as a Minor Subject	Another Department Course Title	40	60	100	3	-	-	3	2
			25	25	50	-	-	4	2	4
VC1	21BSC5VC1ZOO		40	60	100	3	-	-	3	2
VBC 9	21BSC5V5PE5	Physical Education-Sports	25	-	25	-	-	2	1	-
VBC 10	21BSC5V6NC4	NCC/NSS/R &R(S&G) / Cultural	25	-	25	-	-	2	1	-
SEC3	21BSC5S3CS	Cyber security	25	25	50	1	-	2	2	2
Total Marks					650	Semester Credits			22	

SEMESTER-VI										
Cate gory	Course code	Title of the Paper	Marks			Teaching hours/wee			Cre dit	Durati on of exams (Hrs)
			IA	SE E	Tot al	L	T	P		
Zoology as Major Discipline										
DSC7	21BSC6C7ZOO7 L	Evolutionary and Developmental Biology	40	60	100	3	-	-	3	2
	21BSC6C7ZOO7 P	Evolutionary and Developmental Biology	25	25	50	-	-	4	2	4
DSC8	21BSC6C8ZOO8 L	Environmental Biology and Wildlife Management	40	60	100	3	-	-	3	2
	21BSC6C8ZOO8 P	Environmental Biology, Wildlife Management and conservation	25	25	50	-	-	4	2	4
DSC6	Another Department Code as a Minor Subject	Another Department Course Title	40	60	100	3	-	-	3	2
			25	25	50	-	-	4	2	4
VC2	21BSC6VC2HT	Health Care Technologies	40	60	100	3	-	-	3	2
	21BSC6VC2DM	Digital Marketing								
INT1	21BSC6 INT1L	Internship	25	50	75	-	-	2	2	2
VBC1	21BSC6V5PE5	Physical Education - Sports	25	-	25	-	-	2	1	-
VBC2	21BSC6V6NC4	NCC/NSS /R&R(S& G) / Cultural	25	-	25	-	-	2	1	-
SEC4	21BSC6S4PC	Profession Communicatio n	25	25	50	1	-	2	2	2
Total Marks					700	Semester Credits			24	
Total Marks for BSC Program					4450	Total Credits for			146	

		BSC Program	
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- Internship between 5th and 6th semester with 3-4 weeks

Zoology Subject as a Minor Discipline

SEMESTER-V										
Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
			I	SE	Total	L	T	P		
DSC5 As a Minor Subject	21BSC5C5ZOO5L	Non-Chordates and Economic Zoology	40	60	100	3	-	-	3	2
	21BSC5C5ZOO5P	Non-Chordate and Economic Zoology	25	25	50	-	-	4	2	4

SEMESTER-VI										
Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
			IA	SEE	Total	L	T	P		
DSC6 As a Minor Subject	21BSC6C6ZOO7L	Evolutionary and Developmental Biology	40	60	100	3	-	-	3	2
	21BSC6C6ZOO7P	Evolutionary and Developmental Biology	25	25	50	-	-	4	2	4

Concept Note, Abbreviation Explanation and Coding:

Concept Note:

1. **CBCS** is a mode of learning in higher education which facilitates a student to have some freedom in selecting his/her own choices, across various disciplines for completing a UG/PG program.
2. A credit is a unit of study of a fixed duration. For the purpose of computation of workload as per UGC norms the following is mechanism be adopted in the University:
One credit (01) = One Theory Lecture (L) period of one (1) hour.
One credit (01) = One Tutorial (T) period of one (1) hour.
One credit (01) = One practical (P) period of two (2) hours.
3. Course: paper/subject associated with AECC, DSC, DSEC, SEC, VBC, OEC, VC, IC and MIL
4. In case of B.Sc. Once a candidate chose two courses/subjects of a particular two department in the beginning, he/she shall continue the same till the end of the degree, then there is no provision to change the course(s) and Department(s).
5. A candidate shall choose one of the Department's courses as major and other Department course as minor in fifth and sixth semester and major course will get continued in higher semester.
6. Wherever there is a practical there will be no tutorial and vice-versa
7. A major subject is the subject that's the main focus of Core degree/concerned.
8. A minor is a secondary choice of subject that complements core major/ concerned.
9. Vocational course is a course that enables individual to acquire skills set that are required for a particular job.
10. Internship is a designated activity that carries some credits involving more than **25 days** of
working in an organization (either in same organization or outside) under the guidance of an
identified mentor. Internship shall be an integral part of the curriculum.
11. **OEC: For non- computer science students. Computer Science students have to opt for OEC from departments other than major and minor disciplines.**

Abbreviation Explanations:

1. AECC: Ability Enhancement Compulsory Course.
2. DSC: Discipline Specific Core Course.
3. DSEC: Discipline Specific Elective Course.
4. SEC: Skill Enhancement Course.
5. VBC: Value Based Course.
6. OEC: Open/Generic Elective Course
7. VC: Vocational Course.

8. IC: Internship Course
9. L1: Language One
10. L2: MIL
11. L= Lecture; T= Tutorial; P=Practical.
12. MIL= Modern Indian Language; English or Hindi or Telugu or Sanskrit or Urdu

Program Coding:

1. Code 21: Year of Implementation
2. Code BSC: BSC Program under the faculty of Applied Science of the University
3. Code 1: First Semester of the Program, (2 to 6 represent higher semesters)
4. Code AE: AECC, (C for DSC, S for SEC, V for VBC and O for OEC)
5. Code 1: First "AECC" Course in semester, similarly in remaining semester for such other courses
6. Code LK: Language Kannada, similarly Language English, Language Hindi, Language Telugu, Language Sanskrit, & Language Urdu
7. Code 1: Course in that semester.
8. Zoo: Zoology

Note: All skill enhancement course (SEC) syllabus and title should be selected time to time notice from the university and/ or NEP committee accordingly.

ASSESSMENT METHODS

Evaluation Scheme for Internal Assessment:

Theory:

Assessment Criteria	40 marks
1 st Internal Assessment Test for 30 marks 1 hr after 8 weeks and 2 nd Internal Assessment Test for 30 marks 1 hr after 15 weeks. Average of two tests should be considered.	30
Assignment	10
Total	40

Assessment Criteria	25 marks
1 st Internal Assessment Test for 20 marks 1 hr after 8 weeks and 2 nd Internal Assessment Test for 20 marks 1 hr after 15 weeks. Average of two tests should be considered.	20
Assignment	05
Total	15

Practical:

Assessment Criteria	25 marks
Semester End Internal Assessment Test for 20 marks 2 hrs	20
Journal (Practical Record)	05

Total	25
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Question Paper Pattern:

RANI CHANNAMMA UNIVERSITY
Department of ZOOLOGY

Duration: 2hr

I Semester B.Sc (Zooogy)

Sub:

Code:

Maximum Marks: 60

- a. Answer any SIX Questions from Question 1 b. Answer any Three each Questions from Question 2, 3, 4 and 5**

Q.No.1.	Answer any SIX Questions (Two question from Each Unit) a. b. c. d, e. f. g. h.	2X6=12
Q.No.2.	(Should cover Entire Unit-I) a. b. c. d.	4X3=12
Q.No.3.	(Should cover Entire Unit-II) a. b. c. d.	4X3=12
Q.No.4.	(Should cover Entire Unit-III) a. b. c. d.	4X3=12
Q.No.5.	(Should cover Entire Unit-IV) a. b. c. d.	4X3=12

SYLLABUS

Semester I

Year	I	Course Code: 21BSC1C1ZOO1L	Credits	04
Sem.	1	Course Title: Cytology, Genetics and Infectious Diseases	Hours	56
Unit No.	Course Content		Hours	
Unit I	Structure and Function of Cell Organelles I in Animal cell <ul style="list-style-type: none"> Plasma membrane: chemical structure—lipids and proteins Endomembrane system: protein targeting and sorting, transport, endocytosis and exocytosis 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		14	
Unit II	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 Structure of chromosomes Types of DNA and RNA 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 		14	
Unit III	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 Genetic Sex-Determining Systems, Environmental Sex Determination, Sex Determination and mechanism in <i>Drosophilamelanogaster</i>. Sex-linked characteristics in humans and dosage compensation 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.		14	

Unit IV	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 .. 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</i> , <i>Giardia</i> and <i>Wuchereria</i>	14
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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

Zoology -Lab Course Content

Semester - I

Course Title: Cell Biology &Cytogenetics	Course Credits:2
Course Code: 21BSC1C1ZOO1P	L-T-P per week: 0-0-4
Total Contact Hours: 56	Duration of ESA:4 Hours
Formative Assessment Marks: 15	Summative AssessmentMarks:35

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	CC P1	CC	CC	CC	CC	CC	CC	CC	CC	CC	CC
I Core competency	X										
II Critical thinking	X										
III Analytical reasoning	X										
IV Research skills	X										
V Team work	X										

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

Lab Course Content

List of labs to be conducted	56 hrs
<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 <i>Drosophila</i> larva). 10. Preparation of human karyotype and study the chromosomal structural and numerical aberrations from the pictures provided. (Virtual/optional). 	

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: Practical Examination format

Question	content	Marks
I	Preparation	05
II	Karyotype	06
III	Identification	14
IV	Vivo	05
V	Record Book	05
	Total	35

OPEN-ELECTIVE SYLLABUS :

Year	I	Course Code: 21BSC1O1ZOO1 Course Title: Economic Zoology	Credits	03
Sem.	1		Hours	42
Unit No.		Course Content	Hours	
Unit I		1. Sericulture: <ul style="list-style-type: none">History and present status of sericulture in IndiaMulberry and non-mulberry species in Karnataka and IndiaMulberry cultivationMorphology and life cycle of <i>Bombyxmori</i>Silkworm rearing techniques: Processing of cocoon, reelingSilkworm diseases and pest control 2. Apiculture: <ul style="list-style-type: none">Introduction and present status of apicultureSpecies of honey bees in India, life cycle of <i>Apisindica</i>Colony organization, division of labour and communicationBee keeping as an agro based industry; methods and equipments: indigenous methods, extraction appliances, extraction of honey from the comb and processingBee pasturage, honey and bees wax and their uses Pests and diseases of bees and their management	14	
Unit II		3. Live Stock Management: Dairy: <ul style="list-style-type: none">Introduction to common dairy animals and techniques of dairy managementTypes, loose housing system and conventional barn system; advantages and limitations of dairy farmingEstablishment of dairy farm and choosing suitable dairy animals-cattleCattle feeds, milk and milk productsCattle diseases Poultry: <ul style="list-style-type: none">Types of breeds and their rearing methodsFeed formulations for chicksNutritive value of egg and meatDisease of poultry and control measures 4. Aquaculture: <ul style="list-style-type: none">Aquaculture in India: An overview and present status and scope of aquaculture Types of aquacultures: Pond culture: Construction, maintenance and management; carp culture, shrimp culture, shellfish culture, composite fish culture and pearl culture	14	
Unit III		5. Fish culture: <ul style="list-style-type: none">Common fishes used for culture.	14	

	<ul style="list-style-type: none"> • 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>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>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. <p>8. Lac Culture:</p> <ul style="list-style-type: none"> • 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. <p>Lac composition, processing, products, uses</p>	
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Text Books: Suggested Readings:

1. Eikichi, H. (1999). Silkworm Breeding (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Ganga, G. (2003). Comprehensive Sericulture Vol-II: Silkworm Rearing and Silk Reeling.
3. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Mahadevappa, D., Halliyal, V.G., Shankar, D.G. and Bhandiwad, R., (2000). Mulberry Silk
5. Reeling Technology Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Roger, M (1990). The ABC and Xyz of Bee Culture: An Encyclopedia of Beekeeping, Kindle Edition.

7. Shukla and Upadhyaya (2002). Economic Zoology, Rastogi Publishers
8. YadavManju (2003). Economic Zoology, Discovery Publishing House.
9. JabdePradip V (2005). Textbook of applied Zoology, Discovery Publishing House, New Delhi.
10. Cherian & Ramachandran Bee keeping in-South Indian Govt. Press, Madras.
11. Sathe, T.V. Vermiculture and Organic farming.
12. Bard. J (1986). Handbook of Tropical Aquaculture.
13. Santhanam, R. A. Manual of Aquaculture.
14. Zuka. R.1 and Hamiyn (1971). Aquarium fishes and plants
15. Jabde, P.V. (2005) Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac culture.
16. Animal Disease- Bairagi K. N. Anmol Publications Pvt.Ltd 2014
17. Economics of Aquaculture - Singh (R.K.P) - Danika Publishing Company 2003
18. Applied and Economic Zoology (SWAYAM) web
https://swayam.gov.in/nd2_cec20_ge23/preview Course Books published in English and Kannada may be prescribed by the Universities and College

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

SKILL ENHANCEMENT COURSE IN CHEMISTRY

Title of the Course: SEC: Course code: 21BSC1E1CS1

Paper name: Digital Fluency

Courses	Credits	No. of Classes/Week	Total No. of Lectures/Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	02	01	11	---	---	10	10
Practical		02	22	2	25	15	40
				Total	25	25	50

Semester: II

Year	I	Course Code: 21BSC2C2ZOO2L	Credits	04
Sem.	2	Course Title: Biochemistry and Physiology	Hours	56
Unit No.	Course Content		Hours	
Unit I	<p>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) <p>Structure, Classification and General Properties of α-amino acids;</p> <p>Essential and non-essential amino acids, Levels of organization in proteins; Simple and conjugate proteins.</p> <p>Metabolism of Carbohydrates and Lipids</p> <ul style="list-style-type: none"> • Metabolism of Carbohydrates: glycolysis, citricacid cycle, gluconeogenesis, • phosphate pentose pathway Glycogenolysis and Glycogenesis Lipids- Biosynthesis of palmiticacid; Ketogenesis, • β-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbonatoms 		14	
Unit II	<p>Metabolism of Carbohydrates and Lipids</p> <ul style="list-style-type: none"> • Metabolism of Carbohydrates: glycolysis, citricacid cycle, gluconeogenesis, • phosphate pentose pathway Glycogenolysis and Glycogenesis Lipids- Biosynthesis of palmiticacid; Ketogenesis, • β-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbonatoms <p>Metabolism of Proteins and Nucleotides</p> <ul style="list-style-type: none"> • Catabolism of amino acids: Transamination, Deamination, Ureacycle, Nucleotides and vitamins <p>Peptide linkages</p>		14	
Unit III	<p>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 		14	

	<p>ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood, Respiratory pigments, Dissociation curves and the factors influencing it;</p> <p>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 <p>Structure of kidney and its functional unit; Mechanism of urine formation</p>	
Unit IV	<p>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 <p>Endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas and adrenal</p> <p>Muscular System in humans</p> <p>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.</p>	14

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).

Semester II: Zoology Course Lab Content

Course Title/Code: Biochemistry and Physiology	Course Credits: 2
Course Code: 21BSC2C2ZOO2P	L-T-P per week: 0-0-4
Total Contact Hours: 56	Duration of ESA: 4 Hours
Formative AssessmentMarks: 15	Summative AssessmentMarks: 35

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	CC P1	CC P2	CC	CC	CC	CC	CC	CC	CC	CC	CC
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	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.	15
10. Estimation of Hemoglobin in human blood using Sahli's haemoglobinometer. 11. Counting of RBC in blood using Hemocytometer. 12. Counting of WBC in blood using Hemocytometer. 13. Differential staining of human blood corpuscles using Leishman stain. 14. Recording of blood glucose level by using glucometer.	15
Virtual Labs (Suggestive sites) https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab https://vlab.amrita.edu https://sites.dartmouth.edu www.onlinelabs.in	06

Text Books

1. Nelson & Cox: Lehninger'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.

Pedagogy: Practical Examination format

Question	content	Marks
I	Qualitative test/Separation	09
II	Quantitative test/Differential count	09
III	Estimation/Counting	09
IV	Vivo	03
V	Record Book	05
	Total	35

OPEN-ELECTIVE SYLLABUS:

Year	I	Course Code: 21BSC202ZOO2	Credits	03
Sem	II	Course Title: Parasitology	Hours	42
Unit No.	Course Content			Hours
Unit I	<p>1. General Concepts</p> <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 <p>2. Parasitic Platyhelminthes Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of</p> <ul style="list-style-type: none"> • <i>Fasciolopsisbuski</i> • <i>Schistosomahaematobium</i> • <i>Taeniasolium</i> • <i>Hymenolepis nana</i> <p>3. Parasitic Protists Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of</p> <ul style="list-style-type: none"> • <i>Entamoeba histolytica</i> • <i>Giardia intestinalis</i> • <i>Trypanosomagambiense</i> <p><i>Plasmodium vivax</i></p>			14
Unit II	<p>4.Parasitic Nematodes Study of morphology, life cycle, pathogenicity, prophylaxis and control measures of</p> <ul style="list-style-type: none"> • <i>Ascarislumbricoides</i> • <i>Ancylostomaduodenale</i> • <i>Wuchereriabancrofti</i> • <i>Trichinellaspinalis</i> • Nematode plant interaction ; Gall formation <p>5. Parasitic Arthropods Biology, importance and control of</p> <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>6. Parasitic Vertebrates</p> <ul style="list-style-type: none"> • Cookicutter Shark • Hood Mocking bird and 			14

	Vampire bat and their parasitic behavior and effect on host	
Unit III	7.Molecular diagnosis & clinical parasitology <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 G.intestinalis, B. coli, E. histolytica, L. donovani, Malarial parasite using • ELISA, RIA • Counter Current Immunoelectrophoresis (CCI) Complement Fixation Test (CFT) PCR, DNA, RNA probe	14

Suggested Readings:

1. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors.
2. E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea&Febiger.
3. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group.
4. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributors, Medical Books Publishers, Chennai, Delhi.
5. Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers.
5. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd.
6. Gunn, A. and Pitt, S.J. (2012). Parasitology: an Integrated Approach. Wiley Blackwell.
7. Noble, E. R. and G.A.Noble (1982) Parasitology: The biology of animal parasites. V th Edition, Lea &Febiger.
8. Paniker, C.K.J., Ghosh, S. [Ed} (2013). Paniker's Text Book of Medical Parasitology. Jaypee, New Delhi.
9. Parija,S.C. Text book of medical parasitology,protozoology&helminthology (Textand color Atlas),II Edition, All India Publishers & Distributors, Medical Books Publishers, Chennai, Delhi.
10. Roberts, L.S and Janovy, J. (2009). Smith & Robert's Foundation of Parasitology. 8th. Edn. McGraw Bogitsh, B. J. and Cheng, T. C. (2000). Human Parasitology. 2nd Ed. Academic Press, New York.
11. Chandler, A. C. and Read. C. P. (1961). Introduction to Parasitology, 10th ed. John Wiley and Sons Inc.
12. Cheng, T. C. (1986). General Parasitology. 2nd ed. Academic Press, Inc. Orlando.U.S.A.
13. Schmidt, G. D. (1989). Essentials of Parasitology. Wm. C. Brown Publishers (Indian print1990, Universal Book Stall).
14. John Hyde (1996) Molecular Parasitology Open University Press.

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