



**Department of Higher education Karnataka State Higher  
Education Council National Education Policy -2020**

**Proposed Model Curriculum for Undergraduate Programme in  
Genetics**

**in**

**All state Universities and Colleges in Karnataka**

**For the year 2022-2023**

***Submitted by***

***Zoology / Genetics Subject***

***Committee***

***NEP2020***

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## FOREWORD

National Education Policy (NEP) 2020 seeks to transform the Higher Education system in India by introducing the exit and entry option to the students. Selecting courses of choice will improve the education quality of the students. A creative combination of disciplines like Core, Open Elective, and Elective courses with multi-disciplinary nature is one key recommendation of NEP 2020.

The multiple exit and entry options in the Higher Education System would remove rigid boundaries and create new possibilities for students to choose and learn the courses of their choice anywhere in India can pave the way for improving student progress. A formal system of credit recognition, credit accumulation, credit transfers and credit redemption is a praiseworthy recommendation in the education system. Karnataka is the first state in the country to implement NEP in higher education. The state came up with the NEP framework for all the UG-PG programmes starting from the academic year 2021.

### **The prominent features of the NEP framework are:**

1. Flexibility in choosing subjects and even disciplines for the graduate programmes.
2. Vertical and horizontal mobility across subjects throughout the programme.
3. Multiple entry and exit points.
4. Mainstreaming of skill based courses.
5. Credit based evaluation system.
6. Integration of research into IV year of the programme leading to Honors degree.
7. Post-graduate Diplomas in respective disciplines.

I am delighted to present curriculum structure and syllabus of B. Sc Degree in Zoology with multiple exit entry with skills and job opportunities in point of exit system. I hope that the curriculum structure and syllabus will pave the way for overall development of the student community. I ensure that, students community will procure the benefits at large in higher education

**Dr. K. Vijaykumar**  
Chairman Zoology/Genetics  
State Level Faculty Committee

# Syllabus for B.Sc., Hons in Genetics

Name of the Degree Program: **B. Sc., Hons**  
Discipline Core: **Genetics**  
Total Credits for the Program: **50/100/142/184/268**  
Starting year of implementation: **2021-22 (I & II sem)**  
**2022-23 (III & IV sem)**

Progressive Certificate, Diploma, Bachelor Degree or Bachelor Degree with Honours Provided at the End of Each Year of Exit of the Four-year Undergraduate Programme/ Five-year Integrated Master's Degree Programme

**Introduction** The curriculum framework for B.Sc. degree in Genetics is structured to offer a broad outline that helps in understanding genetic factors and disorders about promoting health and preventing disease. The course is upgraded keeping in mind the aspirations of students, changing nature of the subject as well as the learning environment. The core concepts within subject have been updated to incorporate the recent advancements, techniques to upgrade the skills of learners. The syllabus under NEP-2020 is expected to enhance the level of understanding among students and maintain the high standards of graduate program offered in the country. Effort has been made to integrate the use of recent technology and MOOCs to assist teaching-learning process among students. The major objective of the graduate program is to elevate the subject knowledge among students, and making them as critical thinkers thereby students can address the issues related to genetics logically and efficiently and helps in securing a career in academia, industry, pharmaceutical research and development in private as well as public sectors. In a nutshell, the course serves as plethora of opportunities in different fields right from classical to clinical Genetics.

## AIMS AND OBJECTIVES OF UG PROGRAM IN GENETICS

- The Program offers both classical as well as modern concepts of Genetics in higher education.
- It enables the students to study genetic diversity in both local and global environments.
- To update the concepts concerning genetic diversity among different traits of population, pattern of inheritance.
- To correlate contemporary and modern techniques like genomics, metagenomics, genome editing and molecular diagnostic tools.
- Bioinformatics and computational tools used in modern sciences will provide ample opportunities to explore different career avenues and provide opportunity to be an entrepreneur.

## GRADUATE ATTRIBUTES IN B.Sc. (Hons.) GENETICS

Some of the characteristic attributes a graduate in Genetics should possess are:

- Disciplinary knowledge and skills
- Skilled communication
- Critical thinker and problem solving capacity
- Logical thinking and reasoning
- Team spirit
- Leadership quality
- Digitally efficacy
- Ethical awareness/reasoning
- Lifelong learning

## Flexibility

- The program is flexible enough to allow liberty to students in designing them according to their requirements. Students may choose a single Major, one Major with a Minor, and one Major with two Minors. Teacher Education

or Vocational courses may be chosen in place of Minor/s. Below listed are the various options students may choose from.

- One Major subject/discipline, Two Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses including Extracurricular Activities.
- One Major and one Minor subject/discipline along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses including Extracurricular Activities
- Two Major subject/disciplines along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses, including Extracurricular Activities (subject to fulfilling the requirements as stated in 3. i and 3.ii).
- One Major subject/discipline and one Vocational course along with Languages, Generic Electives, Ability Enhancement and Skill Development and courses including Extracurricular Activities.
- One Major Discipline and One Education Discipline along with Languages, Generic Electives, Ability Enhancement and Skill Development Courses including Extracurricular Activities.

### Weightage for assessments

Type of Course	Formative Assessment / IA Marks	Summative Assessment Marks
<b>Theory</b>	<b>40</b>	<b>60</b>
<b>Practical</b>	<b>25</b>	<b>25</b>
<b>Projects*</b>	<b>45</b>	<b>105</b>
<b>Experiential Learning (Internships etc.)</b>		

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

### Credit distribution for the course

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

<b>IIA. Model Program Structures for the Under-Graduate Programs in Universities and Colleges in Karnataka</b>							
<b>Example: Bachelor of Science (Basic/Hons.) (with Genetics &amp; Botany as subjects with practicals) with one major and one minor</b>							
Sem.	Discipline Core (DSC) (Credits)(L+T+P)	Discipline Elective (DSE)/ Open Elective (OE) (Credits)(L+T+P)	Ability Enhancement Compulsory Courses (AECC), Languages (Credits)(L+T+P)		Skill Enhancement Courses (SEC)		Total Credits
					Skill based (Credits)(L+T+P)	Value based (Credits)(L+T+P)	
I	Genetics A1(4+2) Botany B1(4+2)	OE-1(3)	L1-1(3), L2-1(3) (4 hrs. each)		SEC-1: Digital Fluency(2)(1+0+2)	Physical Education for Health & Wellness fitness(1)(0+0+2) (1)(0+0+2)	25
II	Genetics A2(4+2) Botany B2(4+2)	OE-2(3)	L1-2(3), L2-2(3) (4 hrs. each)	Environmental Studies (2)		Physical Education - NCC/NSS/R	25
Exit option with Certificate (50 credits)							
III	Genetics A3(4+2) Botany B3(4+2)	OE-3(3)	L1-3(3), L2-3(3) (4 hrs. Each)		SEC-2: Artificial Intelligence(2)(1+0+2)	Physical Education - NCC/NSS/R	25
IV	Genetics A4(4+2) Botany B4(4+2)	OE-4(3)	L1-4(3), L2-4(3) (4 hrs. Each)	Constitution of India(2)		Physical Education - NCC/NSS/R	25
<b>Exit option with Diploma in Science (100 credits) OR Choose any one of the core subjects as Major and the other as Minor</b>							
V	Genetics A5(3+2) Genetics A6(3+2) Botany B5(3+2)	Vocational-1(3)			SEC-3: SEC such as Cyber Security (2) (1+0+2)		20
VI	Genetics A7(3+2) Genetics A8(3+2) Botany B6(3+2)	Vocational-2(3) Internship(2)			SEC-4: Professional Communication(2)		22
<b>Exit option with Bachelor of Science Degree, B.Sc. Degree in Zoology (142 credits) or continue studies with the Major in the third year</b>							
VII	Genetics A9(3+2) Genetics A10(3+2) Genetics A11(3)	Genetics E-1(3) Genetics E-2(3) Res. Methodology(3)					22
VIII	Genetics A12(3+2) Genetics A13(3) Genetics A14(3)	Zoology E-3 (3) Research Project(6)*					20
<b>Award of Bachelor of Science Honours Degree, B.Sc.(Hons.) Degree in Genetics (184 credits)</b>							
*In lieu of the research Project, two additional elective papers/Internship may be offered.							

\*BOS resolved to adopt only B1 and B2 core subjects for the year 2021-22

### SEMESTER WISE CURRICULUM STRUCTURE OF COURSES

Semester	Name of the course/credits	What all program outcomes the course addresses (not exceeding 3 /course)	Pre- requisite course(s)	Concurrent course	Pedagogy	Assessment
1 Semester A1Core	Cytology, Genetics and Infectious Diseases (4)	<ol style="list-style-type: none"> <li>The structure and functions of animal cell, cell organelles, cell- cell interactions, process of reproduction leading to new organisms.</li> <li>The principles of inheritance, Mendel's laws and the deviations.</li> <li>Inheritance of chromosomal aberrations in humans by pedigree analysis in families.</li> </ol>	Student must have studied Biology or equivalent subjects in Class 12.	Lab on Cell Biology and Genetics(2)	Lectures/Videos/ Seminars/Case study/Project/ Group discussion/Problem Solving/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of pedagogy,
1 Semester B1 Core	Biology of Non-Chordates (4)	<ol style="list-style-type: none"> <li>Learn the systematics and biology of non-chordates through their adaptive features.</li> <li>Study the functional biology of non-chordates through their body organization.</li> <li>Comprehend identification of species and their evolutionary relationships.</li> </ol>	Student must have studied Biology or equivalent subjects in Class 12.	Lab on Biology of Non- Chordates (2)	Lectures/Videos/ Seminars/Case study/Project/ Formative Assessment/ Summative	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of pedagogy,
1 Semester OE1Open Elective course	Economic Zoology (3)	<ol style="list-style-type: none"> <li>Acquaint the knowledge about basic procedure and methodology of integrated animal rearing.</li> <li>Students can start their own business i.e. self- employments.</li> <li>Get employment in different sectors of Applied Zoology</li> </ol>	Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/ Seminars/Case study/Project/ Group discussion/Problem Solving/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of pedagogy,
SEC 1 Skill Enhancement course	<b>SEC 1 Digital fluency</b> Vermiculture(2)		Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/ Seminars/Case study/Project/ Group discussion/Problem Solving/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
2 Semester A2	Biochemistry and Physiology (4)	<ol style="list-style-type: none"> <li>In depth understanding of structure of biomolecules like proteins, lipids and carbohydrates.</li> <li>The thermodynamics of enzyme catalyzed reactions.</li> <li>To know various physiological processes of animals.</li> </ol>	Student must have studied Biology or equivalent subjects in Class 12.	A2 Lab on Biochemistry, Physiology and Hematology (2)	Lectures/Videos/ Seminar/Case study/Project/ Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,

2 Semester B2	Biology of Chordates (4)	<ol style="list-style-type: none"> <li>1. Learn the systematics and biology of Chordates through their adaptive features.</li> <li>2. Study the functional biology of Chordates through their body organization.</li> <li>3. Comprehend identification of Chordate species and their evolutionary relationships.</li> </ol>	Student must have studied Biology or equivalent subjects in Class 12.	Lab on Biology of Chordates (2)	Lectures/Videos/ Seminar/Case study/Project/ Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
2 Semester OE2 Open Elective course	Parasitology(3)		Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/ Seminar/Case study/Project/ Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
2 Skill Enhancement course	<b>Environmental Studies</b> Sericulture(2)	<ol style="list-style-type: none"> <li>1. Sericulture is an agro-based industry which gives economic empowerment to the students.</li> <li>2. Sericulture may be taken up as a small scale industry by the small farmers and unemployed youth.</li> <li>3. Get jobs in teaching</li> </ol>	Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/ Seminar/Case study/Project/ Formative Assessment/ Summative Assessment	Formative and Summative Assessment/ Evaluation/ Analysis of result/ Application of Heutagogy,
<b>EXIT OPTION WITH CERTIFICATE (50 CREDITS)</b>						



## 2. Course Structure

### 5.1 Credit distribution for the course

Semester	Course Opted	Course Name	Credits
I	MajorCoreCourse-1(Theory)	Cell Biology and Genetics	4
	MajorCoreCourse-1(Practical)	CellBiologyandGenetics	2
	MinorDisciplineCourse-1(Theory)	Nutritional Genetics	4
	MinorDisciplineCourse-1(practical)	Nutritional Genetics	2
	OpenElectiveCourse-1(Theory)	Principles of Genetics	3
	Skill Enhancement (Vocational) Elective Course -1(Practical)	Genetic Counselling	2
II	MajorCoreCourse-2(Theory)	Bio-Instrumentation and Animal Cell Culture	4
	MajorCoreCourse-2(Practical)	Bio-Instrumentation and Animal Cell Culture	2
	MinorDisciplineCourse-2(Theory)	Medical Genetics	4
	MinorDisciplineCourse-2(Practical)	Medical Genetics	2
	OpenElectiveCourse-2(Theory)	Genetic Counselling	3
<b>Exit option with certificate in Genetics(50credits)*</b>			
III	MajorCoreCourse-3(Theory)	Bio molecules and Molecular Genetics	4
	MajorCoreCourse-3(Practical)	Biomolecules and Molecular Genetics	2
	MinorDisciplineCourse-3(Theory)	Pharmaco-genetics	4
	MinorDisciplineCourse-3(Practical)	Pharmaco-genetics	2
	OpenElectiveCourse-3(Theory)	Eugenics, Euthenics and Society	3
	Skill Enhancement (Vocational)Elective Course - 3(Practical)	Genetic diagnostics and Public Health	2
IV	MajorCoreCourse-4(Theory)	Human Genetics sand Genetic Counselling	4
	MajorCoreCourse-4(Practical)	Human Genetics and Genetic Counselling	2
	Minor Discipline Course–4(Theory)	Medical and Environmental impact on development	4
	Minor Discipline Course–4(Practical)	Medical and Environmental impact on development	2
	OpenElectiveCourse-4(Theory)	Human Genetic Disorders	3
<b>Exit option with Diploma in Genetics(100credits)*</b>			
V	MajorCoreCourse-5(Theory)	Gene Regulation and DNA Repair	3
	MajorCoreCourse-5(Practical)	Gene Regulation and DNA Repair	2
	MajorCoreCourse-6(Theory)	Plant cell and Tissue culture Technology	3
	MajorCoreCourse-6(Practical)	Plant cell and Tissue culture Technology	2
	MinorDisciplineCourse-5 Theory)	Radiation Genetics	3
	MinorDisciplineCourse-5(Practical)	Radiation Genetics	2
	Discipline Specific Elective Course–5(Theory)	Clinical Genetics	3
	VocationalElectiveCourse-1(Practical)	Geno-toxicology	2

VI	MajorCoreCourse-7(Theory)	Genes and Development	3
	MajorCoreCourse-7(Practical)	Genes and Development	2
	MajorCoreCourse-8(Theory)	Population and Evolutionary Genetics	3
	Major Core Course –8(Practical)	Population and Evolutionary Genetics	2
	MinorDisciplineCourse-6(Theory)	Scientific Communication	3
	MinorDisciplineCourse-6(Practical)	Scientific Communication	2
	Discipline Specific Elective Course–6(Theory)	Statistical Genetics	3
	VocationalElectiveCourse-2(Practical)	Seed Science and Technology	3
	Internship	Research Centers/Industries/Hospitals	2
Exit option with B.Sc.in Genetics (142credits)*			
VII	MajorCoreCourse-9(Theory)	Immunology and Immunogenetics	3
	MajorCoreCourse-9(Practical)	Immunology and Immunogenetics	2
	MajorCoreCourse-10(Theory)	Cancer and Radiation Genetics	3
	MajorCoreCourse-10(Practical)	Cancer and Radiation Genetics	2
	MajorCoreCourse-11(Theory)	Microbial Genetics and Technology	3
	MajorCoreCourse-11(Practical)	Microbial Genetics and Technology	2
	Discipline Specific Elective Course–7(Theory)	Animal Biotechnology	3
	Discipline Specific Elective Course–7(Theory)	Forensic Genetics	3
	Open Elective	Research Methodology	3
VIII	MajorCoreCourse-12(Theory)	Neurogenetics and Neurological disorders	3
	MajorCoreCourse-12(Practical)	Neurogenetics and Neurological	2
	MajorCoreCourse-13(Theory)	Behavioural Genetics	3
	MajorCoreCourse-13(Practical)	Behavioral Genetics	2
	MajorCoreCourse-14(Theory)	Plant Breeding	3
	MajorCoreCourse-14(Practical)	Plant Breeding	2
	Discipline Specific Elective Course–8(Theory)	Plant Biotechnology	3
	Research Project	Based on student interest and teacher expertise	6
Exit option with B.Sc.(Hons)in Genetics(184credits)*			
IX	MajorCoreCourse-15(Theory)	Genetic Engineering and Stem Cell technology	4
	MajorCoreCourse-15(Practical)	Genetic Engineering and Stem Cell technology	2
	MajorCoreCourse-16(Theory)	Computational Genetics	4
	MajorCoreCourse-16(Practical)	Computational Genetics	2
	Discipline Specific Elective Course–9(Theory)	Genomics and Proteomics	3
	Skill Enhancement(Vocational)Elective Course -9	Assisted Reproductive techniques	2
X	MajorCoreCourse-17(Theory)	Advanced cellular and Molecular Genetics	4
	MajorCoreCourse-17(Practical)	Advanced cellular and Molecular Genetics	2

### 3. CURRICULUMSTRUCTURE

#### CURRICULUMSTRUCTUREFORUNDERGRADUATEDEGREEPROGRAMINGENETICS

Name of the Degree: B.Sc.(Hons) Specialization: Genetics (I & II sem) Program Articulation Matrix:

This matrix lists only the core courses. Core courses list the courses that are essential for every student to earn his degree. It includes all types of courses (theory, lab, tutorial, Project, Internships, that every student of the course).

Sem.	Name of the course (with code)	What all program outcomes the course addresses (not exceeding three per course)	Prerequisite courses	Concurrent course (with code)#	Pedagogy##	Assessment\$
I	Cell Biology And Genetics(DSCC5 GENT1)	<ol style="list-style-type: none"> <li>1. Understand the structure and function of all the cell organelles.</li> <li>2. Know about the chromatin structure and its location.</li> <li>3. Understand the Mendel's laws and its deviations.</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> standard	Cell Biology and Genetics(DSCC5 GENP1)	House Examination/Test/Seminars/ Assignment/Minor project/ Active learning/ Problem based/Review Writing/ Paper presentation/ Case studies	Formative /summative assessment, Evaluation/Result analysis/Application of Heutagogy,
I	Nutritional Genetics(MDC5 GENT1)	<ol style="list-style-type: none"> <li>1. Understand relationship between food, microbiome, genome and epigenome.</li> <li>2. Know how a plateful of meal can control metabolism, prevent diseases and improve health.</li> <li>3. Learn importance of nutritional defects of adulterants.</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> standard	Nutritional Genetics(MDC5 GENP1)	House Examination/Test/Seminars/ Assignment/Minor project/ Active learning/ Problem based/Review Writing/ Paper presentation/ Case studies	Formative/summative assessment, Evaluation/Result analysis/Application of Heutagogy,

I	Principles of Genetics (OEC5GENT1)	<ol style="list-style-type: none"> <li>1. Study historical overview and laws of Inheritance.</li> <li>2. Understand Mendel's principles and deviations.</li> <li>3. Gene interactions and their outcome through gene mapping.</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> standard		House Examination/Test/Seminars/ Assignment/ Minor project/ Active learning/Problem based/ Review Writing/ Paper presentation/Case studies	Formative /summative assessment, Evaluation/Result analysis/Application of Heutagogy,
I	Genetic Counseling(VE C5GENP1)	<ol style="list-style-type: none"> <li>1. Learning methods of genetic testing</li> <li>2. understanding pedigree construction, analysis and risk calculation</li> <li>3. intensive practical knowledge of Genetic Counseling.</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> standard		House Examination/Test/Seminars/ Assignment/ Minor project/ Active learning/Problem based/Review Writing/ Paper presentation/Case studies	Formative /summative assessment, Evaluation/Result analysis/Application of Heutagogy
II	Bio-instrumentation &Animal cell Culture(DSCC5G ENT2)	<ol style="list-style-type: none"> <li>1. Understand the basic principles of different laboratory equipments.</li> <li>2. Know the uses of the analytical equipments in various biological applications.</li> </ol> <p>Understand the cell lines and culture media and cell culture methods</p>	Life science Studied as of the options in 12 <sup>th</sup> standard	Bio-instrumentation &Animal Cell Culture(DSCC5G ENP2)	House Examination/Test/ Seminars/Assignment/ Minor project/ Active learning/Problem based/Review Writing/ Paper presentation/ Case studies	Formative /summative assessment, Evaluation/Result analysis/ Application of Heutagogy
II	Medical Genetics(MDC5 GENT2)	<ol style="list-style-type: none"> <li>1. Understand genetic basis of human diseases and disease gene identification</li> <li>2. Have insight of techniques used in medical genetics</li> <li>3. Have thorough knowledge of gene therapy and its strategies</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> standard	Medical Genetics(MDC5 GENP2)	House Examination/Test/Seminars/ Assignment/ Minor project/ Active learning/Problem based/Review Writing/ Paper presentation/ Case studies	Formative /summative assessment, Evaluation/ Result analysis/ Application of Heutagogy
II	Genetic Counselling(OE C5GENT2)	<ol style="list-style-type: none"> <li>1. Genetic counselling methods</li> <li>2. Reproductive risk calculation</li> <li>3. Ethical and legal issues of genetic counseling</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> standard		House Examination/Test/Seminars/ Assignment/ Minor project/ Active learning /Problem based/Review Writing/ Paper presentation/ Case studies	Formative /summative assessment, Evaluation/ Result analysis/ Application of Heutagogy

**III SEMESTER B.SC., GENETICS (HONS) THEORY SYLLABUS**  
**DISCIPLINE SPECIFIC CORE COURSE DSCC**  
**THEORY PAPER: BIOMOLECULES AND MOLECULAR GENETICS**

**1. Course Description**

Semester: III	Course Title: <b>Biomolecules and Molecular Genetics</b>
Course Code:	Course Type: <b>DSCC5GENT3</b>
Course Credits	4
Total hours :	56
Formative Assessment Marks: <b>40</b>	Summative Assessment Marks: <b>60</b>
Duration of DSC	<b>4Hours</b>

**2. Course Objectives:**

- Understand concepts of biomolecules and gene organization
- Comprehend the central dogma of molecular biology.
- Understand gene structure and expression.
- Appraise DNA repair mechanism.

**3. Course Outcome:**

**Course Outcome (Cos): After completing this course, the student will be able to:**

- Describe the structure and function of biomolecules.
- Appreciate and illustrate the chemical composition of the genetic material and its replication.
- Describe the process of gene expression in prokaryotes and eukaryotes.
- Explain the concept of transposition, mutation and DNA repair mechanism.

**4. COURSE CONTENT**

Content	Hours 56
<b>Unit 1: Biomolecules:</b>  <b>a.</b> Carbohydrates: Structure, classification and functions of carbohydrates <b>b.</b> Lipids: Saturated and unsaturated fatty acids, Tri-acyl glycerol, phospholipids, glycolipids, steroids and omega family fatty acids <b>c.</b> Proteins: Structure, classification, and general properties of $\alpha$ -amino acids, organizations of protein-simple and conjugate protein. Peptide Linkages- <b>d.</b> Enzymes: Properties, classification and functions, Enzymes kinetics, Enzyme inhibitors, Allosteric enzymes	14

<p><b>Unit 2: Chemical basis of Heredity</b></p> <p><b>a. Introduction:</b> DNA (Hershey and Chase experiment) and RNA (Fraenkel and Singer experiment) as genetic material.</p> <p><b>b.</b> Structure and functions of DNA: Structure of DNA, Chargaff's rule, forms of DNA - A, B and Z; Functions of DNA and RNA including ribozymes.</p> <p><b>c.</b> DNA replication in Prokaryotes and Eukaryotes. Initiation, continuous and discontinuous synthesis and termination. Enzymes and proteins involved in replication, Theta model and rolling circle model.</p>	14
<p><b>Unit 3: Protein synthesis and gene regulation</b></p> <p><b>a.</b> Protein biosynthesis: Types of RNA, structure of tRNA, aminoacyl-tRNA synthetase; Transcription: initiation elongation, termination in prokaryotes and eukaryotes, Post-transcriptional modifications: Methylation, polyadenylation and RNA splicing. Gene-silencing by RNA interference; Genetic code; Translation and post translational modification of Proteins.</p> <p><b>b.</b> Regulation of gene expression in bacteria- Lac Operon and Trp Operon; Overview of regulation of gene expression in eukaryotes, regulation of galactose metabolism in yeast.</p>	14
<p><b>Unit 4: Transposons, Mutations and DNA repair mechanism</b></p> <p><b>a.</b> Transposons – Inersion sequence (IS) elements in bacteria, p elements in <i>Drosophila</i>, AC-DS in Maize;</p> <p><b>b.</b> Mutations- Types of point mutations -Transition and transversion, base substitution Mutation- missense, non-sense, neutral and silent mutation. Frame shift Mutation-Insertion and deletion Mutations., Mutagens-physical and chemical, Detection of mutation - Ames test; Beneficial and harmful effects of mutation.</p> <p><b>c.</b> DNA repair mechanism- photo reactivation, Mismatch repair, excision and SOS repair.</p>	14

## 5. Resources

### a) Reference Books:

- Becker, W.M. & Klein smith, L. J. (2017), World of the cell (9th Ed.), Benjamin Cummings, Washington DC.
- Cooper, G.M. (2013), The Cell (6th Ed.).SinauerAssociates,Sunderland.
- Griffiths, A. J. F., Miller, J. H., Suzuki, D. T., Lewontin, R. C. &Gelbart, W. M.(2007) AnIntroduction to Genetic Analysis (9th Ed.), Freeman, New York.
- Hames, B. D. & Hooper, N. M. (2011). Instant Notes in Biochemistry (4th Ed.). Viva Books.
- Hartwell, L. H., Hood, L., Goldberg, M. L., Reynolds, A. E., Silver, L. M. &Veres, R. C. (2016)
- Genetics: From Genes to Genomes,Tata–McGraw Hill, New Delhi.
- Harvey, L., Arnold, B., Lawrence, S., Zipursky, Paul, M., David, B., & James, D. (2018). Molecular Cell Biology (6th Ed.). Freeman. New York.
- Lodish, J. H & Baltimore, D. (2016). Molecular Cell Biology (8th Ed.), Scientific American Books, New York.

**III SEMESTER B.SC., GENETICS (HONS) PRACTICAL SYLLABUS  
DISCIPLINE SPECIFIC CORE COURSE DSCC  
PRACTICAL PAPER: BIOMOLECULES AND MOLECULAR GENETICS**

## 1. Course Description

Semester: III	Course Title: Biomolecules and Molecular Genetics
Course Code:	Course Type: <b>DSCC5GENP3</b>
Course Credits:	2
Total contact hours : <b>56 hrs.</b>	Duration of MD: <b>4 Hours</b>
Formative Assessment Marks: <b>25</b>	Summative Assessment Marks: <b>25</b>

## 2. Course Objectives:

- Qualitative analysis of biomolecules
- Understand the principle and working of different laboratory instruments.
- Extract genomic DNA and run the DNA in a gel through gel electrophoresis.
- Perform paper chromatography and thin layer chromatography
- Study effects of mutations and molecular markers.

## 3. Course Outcomes:

After the successful completion of the course, the student will be able to:

- Understand the working principle and handling of instruments.
- Perform the isolation of DNA from various sources.
- Characterize the eye pigments in *Drosophila* using paper chromatography.
- Demonstrate the effects of mutation and appraise the applications of molecular markers.

## 4. Course Content: 56 hours

Sl No	Experiment	Units
1	Qualitative analysis of Carbohydrates(Mohlish's test, Iodine Test , Benedict's test)	01
2	Qualitative analysis of Protein (Biuret and Ninhydrin test)	01
3	Qualitative analysis of Lipid( test for free fatty acid, saponification test)	01
4	Instrumentation–Micropipette, Glass Homogenizer, Glass bead sterilizer and PCR machine	01
5	Extraction of genomic DNA from coconut endosperm	02
6	Extraction of genomic DNA from liver tissue	02
7	Extraction of genomic DNA from bacteria	02
8	Separation of eye pigments in wild type and mutant <i>Drosophila</i> Using Chromatography.	01
9	Separation of chlorophyll from leaf pigment – Paper chromatography	01
10	Demonstration of DNA and Protein Profiling.	01
11	Study of mutations: Sickle cell anemia–Missense mutation; Thalassemia–frame shift mutation	01

\*Each Unit : 4 hours

**III SEMESTER B. Sc. GENETICS (HONS) THEORY SYLLABUS**  
**OPEN ELECTIVE COURSE- OEC**  
**THEORY PAPER: Eugenics, Euphenics and Society**

**1. Course Description**

Semester: III	Course Title: <b>Eugenics, Euphenics and Society</b>
Course Code:	<b>OEC5GENT3</b>
Course Credits:	3
Total hours :	42
Formative Assessment Marks: <b>40</b>	Summative Assessment Marks: <b>60</b>

**2. Course Objectives**

- Study the eugenics and Assisted reproductive technology
- Understand the prenatal diagnosis
- Understand genetic counselling and gene therapy

**3. Course Outcomes**

**After the successful completion of the course, the student will be able to:**

- explain the basic concepts of eugenics and Assisted reproductive technology
- appraise the concept of preimplantation and prenatal diagnosis
- interpret the importance of genetic counselling
- appraise the concept of gene therapy and its significance

**4. Course Content**

Content	Hours 42
<p><b>Unit 1: Introduction to Eugenics</b>  Eugenics - Concept, types-positive and negative Eugenics, Eugenics in United States, Nazism and decline of Eugenics; Modern Eugenics- genetic engineering and modern reproductive technologies, <i>in vitro</i> fertilization, female and male infertility, steps in IVF techniques, Sperm and Oocyte preservation; Euphenics Euthenics - environment pollution and parasitism; Ethical issues.</p>	14
<p><b>Unit 2: Prenatal diagnosis</b>  Indications for prenatal diagnosis; Methods- Non-invasive method- Ultrasonography and Foetal echocardiography, Invasive methods – Amniocentesis and Chorionic villus sampling. Introduction to pre-implantation genetic diagnosis. Genetic testing and screening.</p>	14
<p><b>Unit 3: Gene therapy</b>  Introduction, somatic and germ line gene therapy <i>Ex vivo</i> and <i>In vivo</i> gene therapy; viral vectors, delivery methods; Gene Therapy and diseases- Cystic fibrosis, haemophilia; Cancer gene therapy, Gene therapy of non-heritable disorders; Cord blood banking and stem cell banking, Stem cell therapy</p>	14



## 5. Resources

### a) Reference Books:

1. Gardner and Sutherland's chromosome abnormalities and genetic counselling, R.J. McKinlay Gardner and David J. Amor (2018).
2. Genetic counseling: ethical challenges and consequences, Dianne M. Bartels, Bonnie S. LeRoy, and Arthur L. Caplan (2011).
3. Ajay Paul (2000) Genetics- from genes to genomes, 6<sup>th</sup> edition, Books and Allied (P), Ltd
4. Foundations of perinatal genetic counseling: a guide for counselors, Amber Mathiesen and Kali Roy (2018).
5. Rimmon et al (2002) Principles and Practice of Medical Genetics, Vol I-III.
6. Martin H. Johnson & Barry Everitt. Essential reproduction.
7. Peter Snustad and Michael J Simmons (2009). Principles of Human Genetics. Fifth Edition. John Wiley & Sons, Inc.
8. Strachan T and Read A 2010 Human Molecular Genetics, Fourth Edition. Taylor and Francis
9. Ricki Lewis (2009) Human Genetics-Concepts and Application. Ninth Edition. McGraw-Hill College Publishers

**IV SEMESTER B.SC., GENETICS (HONS) THEORY SYLLABUS**  
**DISCIPLINE SPECIFIC CORE COURSE DSCC**  
**THEORY PAPER: DSCC5GENT4: HUMAN GENETICS AND GENETIC**  
**COUNSELLING**

**1. Course Description:**

Semester: IV	Course Title: <b>Human Genetics and Genetic Counselling</b>
Course Code:	Course Type: <b>DSCC5GENT4</b>
Course Credits	4
Total hours :	<b>56</b>
Formative Assessment Marks: <b>40</b>	Summative Assessment Marks: <b>60</b>
Duration of DSC	4Hours

**2. Course Objectives:**

- Study the Human chromosome and chromosomal Inheritance pattern in Human.
- Understand the components of immune system and the role of genes in immune development.
- Comprehend prenatal diagnosis method and use of cell therapy and gene therapy for genetic disease.
- Understand the objective of Genetic counseling and its steps involved.

**3. Course Outcomes:**

After the successful completion of the course, the student will be able to:

- Understand the nomenclature of Human chromosome and chromosomal inheritance pattern.
- Understand cells of immune system, structure of immunoglobulin and role of MHC in transplantation.
- Understand Prenatal diagnosis method and gene therapy for treating Genetic disease.
- Appreciate Genetic counselling and steps involved in it.

**4. Course Content**

Content	56 Hrs
<p><b>UNIT I: Human chromosomes and chromosomal Inheritance Pattern</b></p> <p>a. Human Chromosomes: Normal and abnormal Human Karyotype: Paris Nomenclature, Flowkaryotyping, FACS - Fluorescence Activated Cell Sorter.</p> <p>b. Genetic Diseases and Inheritance Pattern: Autosomal inheritance- Dominant (Eg. Adult polycystic kidney and Neurofibromatosis) Autosomal inheritance- Recessive (Eg. Albinism, Sickle cell anemia) X-linked – Recessive: (Eg. Duchene muscular dystrophy) X-linked Dominant- (Eg. Hypophosphatemia) Y-linked inheritance- Holandric gene (E.g. Testes determining factor - TDF) Multifactorial inheritance: (Eg. Congenital malformations: Cleft lip and palate, Rheumatoid arthritis and Diabetes) Mitochondrial diseases: (Eg. Leber’s hereditary optic neuropathy).</p>	14

<p><b>Unit 2: Immunogenetics</b></p> <p><b>a. Introduction to immunology-</b> types and properties of antigens, antibodies, B and T Cells, Immunity types - Innate and acquired. Immune response - Humoral and Cell mediated,</p> <p><b>b.</b> Genetics of immune system – antibody gene rearrangement and class switching. Inherited immunodeficiency- Ex. X- linked agammaglobulinaemia.</p> <p><b>c.</b> Major Histocompatibility Complex- Types, HLA disease associations. Transplantation, graft-rejection and immunosuppressors. Concept of immunization</p>	14
<p><b>Unit 3: Prenatal diagnosis and gene therapy</b></p> <p><b>a.</b> Indications for prenatal diagnosis; Methods- Noninvasive method- Ultrasonography and Fetal echocardiography, Invasive methods - Amniocentesis, Chorionic villus sampling; Pre-conception and pre-implantation genetic diagnosis- Teratogen exposure in early pregnancy, Genetic testing and screening.</p> <p><b>b.</b> Gene therapy with reference to SCID Stem cells- Properties, types and sources. Cord blood banking and Stem cell therapy</p>	14
<p><b>Unit 4: Genetic Counseling:</b></p> <p><b>a.</b> Symbols used in pedigree studies, Pedigree construction and analysis, Pedigree analysis for the inheritance pattern of genetic diseases.</p> <p><b>b.</b> Genetic Counseling. –Introduction to Genetic counseling; Historical overview, stages of counseling, scope of genetic counselling.</p> <p><b>c.</b> Roles and responsibilities of Counselor and Consultant - needs, rights; Ethical, legal and social issues (ELSI), Acts and Amendments.</p>	14

## 5. References:

1. Basic Human Genetics by E.J. Manage and A.P. Manage (1997 India Reprint) a Rastogi Publications, Meerut.
2. Emery's Elements of Medical Genetics- Peter Turnpenny, SlanEllard 15th Edition. 2017.
3. Essentials of Human Genetics by S.M. Bhatnagaretal (1999) IV edition. Orient Longman.
4. Genetic basis of common diseases by R. A. King et al, Oxford University Press 2002.
5. Genetics in Medicine by M.W. Thompson et al, 5 Edition, W.B. Saunders Company, London 1996.
6. Human Cytogenetics. Denise Rooney Oxford University Press, 2001.
7. Human Genetics – Bruce.R.Korf. 2000
8. Human Genetics: Concepts and Applications by Lewis R (2001) McGrawHi; Boston.
9. Human Genetics by S.D. Gangane (2nd Edition-Reprint 2001), B.L Churchill Livingstone Pvt. Ltd., New Delhi.
10. Medical Genetics. Lynn Jorde John CareyMichael Bamshad. 2015.
11. Mendelian inheritance in Man by-Mc. Kusick V.A, (1998), 12 Edition, John Hopsins University Press.
12. Molecular Basis of Inherited Diseases, (6th Edition-1989) by Scriver, C.R. A.L. Beudit, W.S. Syabnd D. Valle (Eds) Mc Graw Hill, New York.

**IV SEMESTER B.SC., GENETICS (HONS) PRACTICAL SYLLABUS**  
**DISCIPLINE SPECIFIC CORE COURSE DSCC**  
**PRACTICAL PAPER: DSCC5GENP4: HUMAN GENETICS AND GENETIC COUNSELLING**

### 1. Course Description

Semester: IV	Course Title: Human Genetics and Genetic Counselling
Course Code:	Course Type: DSCC5GENP4
Course Credits:	2
Total contact hours : 56 -	Duration of MD: 4 Hours
Formative Assessment Marks: 25	Summative Assessment Marks:25

### 2. Course Objectives:

- Study of inactivated X chromosome from buccal and blood smear
- Count RBC and WBC using Heamocytometer, identify different types of WBC using Differential staining technique.
- Study the Human chromosome and chromosomal Inheritance pattern in Human.
- Construct and analyse Pedigree.
- Study different types of kit based immunological techniques.

### 3. Course Outcomes:

After the successful completion of the course, the student will be able to:

- Identify inactivated X chromosome.
- Perform and able to identify different WBC using Differential staining.
- Understand the nomenclature of chromosome and perform Karyotype of normal and Abnormal Human chromosomes.
- Construct and analyze Pedigree.
- Appreciate and understand different immunological techniques.

### 4. Course Content:

Sl No	Experiment	units
1	Study of Barr body in the Buccal epithelial cells	1
2	Study of drum sticks in Neutrophils of Blood smear	1
3	Blood Cell counting using Haemocytometer (RBC and WBC)	1
4	Differential staining of blood cells	1
5	Demonstration of short-term blood lymphocyte culture — Washing and sterilization of glassware and plastic ware, Preparation of solutions and culture medium, Harvesting the culture,	2
6	Demonstration of Preparation of metaphase spread, Staining, Banding and Scoring.	2
7	Study of Karyotypes I: Normal Karyotypes in Human Study of Karyotypes II: Abnormal Karyotypes. • Down's syndrome (autosomal). • Turner's syndrome (sex chromosomal) • Klinefelter's syndrome (sex chromosomal)	2
8	Preparation of Normal and abnormal Karyotypes	2
9	Pedigree construction and analysis.	2
10	Performance of Ouchterlony Double Diffusion (ODD) • Radial Immuno diffusion (RID) •Dot ELISA.	2

\*Each Unit: 4 hours

**IV SEMESTER B. Sc. GENETICS (HONS) THEORY SYLLABUS  
OPEN ELECTIVE COURSE OEC  
THEORY PAPER: Human Genetic Disorders**

**1. Course Description**

Semester: III	Course Title: Human Genetic Disorders
Course Code:	OEC5GENT4
Course Credits:	3
Total hours :	42
Formative Assessment Marks: 40	Summative Assessment Marks:60

**2. Course Objectives:**

- Study the Human chromosome and chromosomal Inheritance pattern in Human.
- Understand the concept of one gene one enzyme hypothesis with examples.
- Study different single gene and multifactorial diseases.

**3. Course Outcomes:**

After the successful completion of the course, the student will be able to:

- Understand the nomenclature of Human chromosome and chromosomal inheritance pattern.
- Appreciate and understand one gene one enzyme hypothesis.
- Understand the pattern of inheritance of various genetic diseases.

**4. Course Content**

Content	Hours 42
<p><b>Unit 1:</b> Human Chromosomes, study of Normal Human Karyotype and abnormal karyotypes. Pattern of inheritance: Autosomal dominant –Adult polycystic kidney disease. Autosomal recessive – Sickle cell anaemia, X-linked dominant – Fragile X syndrome, X linked recessive – Duchenne muscular dystrophy, Y linked inheritance and mitochondrial inheritance pattern.</p>	14
<p><b>Unit 2:</b> Inborn errors of metabolism–Introduction, concept of one gene one enzyme hypothesis. Disorders of :</p> <p>a. Carbohydrate metabolism–Galactosaemia; b. Amino acid metabolism – Alkaptonuria c. Lysosomal enzymes–Tay- Sachs disease d. Lipoprotein and lipid metabolism – Hyper Lipoproteinemia;</p>	14
<p><b>Unit 3: Single gene disorder, complex disorder and gene therapy</b> Introduction to single gene disorder and complex diseases, Genetics of haemophilia and Albinism. Multifactorial/ Complex disease - Diabetes. Gene Therapy, Types of gene therapy, Cancer gene therapy, Cord blood banking, stem cell banking and Stem cell therapy</p>	14

**References:**

1. Basic Human Genetics by E.J. Manage and A.P. Manage (1997 India Reprint) a Rastogi Publications, Meerut.
2. Emery's Elements of Medical Genetics- Peter Turnpenny, SlanEllard 15th Edition. 2017.
3. Essentials of Human Genetics by S.M. Bhatnagaretal (1999) IV edition. Orient Longman.
4. Genetic basis of common diseases by R. A. King et al, Oxford University Press 2002.
5. Genetics in Medicine by M.W. Thompson et al, 5 Edition, W.B. Saunders Company, London 1996.
6. Human Cytogenetics. Denise Rooney Oxford University Press, 2001.
7. Human Genetics – Bruce.R.Korf. 2000

## Course pattern and scheme of examination for B.Sc./ B.Sc. (Hons.) as per NEP (2021-22 onwards)

### Subject: GENETICS

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.	IA	Max.	MIN.	IA					
1	I	<b>CORE subject</b>	56	4	4	60	21	40	25	9	25	3	3	150	4	2
		<b>Open elective</b>	42	3	-	60	21	40	-	-	-	2.5	-	100	3	-
		<b>Skill Enhancement Course</b>	56	-	4	-	-	-	25	9	25	3	3	50	-	2
2	II	<b>CORE subject</b>	56	4	4	60	21	40	25	9	25	3	3	150	4	2
		<b>Open elective</b>	42	3	-	60	21	40	-	-	-	2.5	-	100	3	-
		<b>Skill Enhancement Course</b>	56	-	4	-	-	-	25	9	25	3	3	50	-	2

### Scheme of Internal Assessment Marks: Theory

Sl. No.	Particulars	IA Marks
1	Attendance	05
2	Internal Tests (Minimum of Two)	20
3	Assignments /Seminar / Case Study / Project work / Reports on - Field visits made for observation and collection of data etc.,	15
	<b>TOTAL Theory IA Marks</b>	<b>40</b>

### Practicals:

Sl. No.	Particulars	IA Marks
1	Practical Test	10
2	Report / Seminar on practical experiments, etc.	10
3	Active participation in practical classes (Attendance)	05
	<b>TOTAL Theory IA Marks</b>	<b>25</b>



**Scheme of Practical Examination**  
**BSc. Genetics III Semester**  
**Core Subject: DSCC5GENP3; BIOMOLECULES AND MOLECULAR GENETICS**

**Duration: 3 hours**

**Max. marks: 25**

- |  |      |
|--|------|
| 1. Isolation of DNA from coconut endosperm/ Bacteria/liver   | 10 M |
| 2. Separate the chlorophyll from leaf pigment / <i>Drosophila</i> eye pigments by using ascending paper Chromatography | 07M  |
| 3. Perform and comment on the qualitative test for carbohydrate/protein/lipid (any two)                                | 06M  |
| 4. Identify and comment on Spotter A ( Sickle cell anemia/ thalassemia).   | 03M  |

TOTAL Marks 25M

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**Scheme of Practical Examination**  
**BSc. Genetics IV Semester**  
**Genetics Core Subject: DSCC5GENP4: HUMAN GENETICS AND GENETIC COUNSELLING**

**Duration: 3 hours**

**Max. marks: 25**

- |  |     |
|--|-----|
| 1. Prepare a Buccal smear / Blood smear for sex chromatin and comment        | 06M |
| 2. Count the RBC / WBC in the blood sample. Calculate and report the results | 06M |
| Or   |     |
| Prepare Differential staining of Blood smear and comment on the result       |     |
| 3. Construct pedigree for the given data / analyze the given Pedigree        | 05M |
| 4. 4) Identify and comment on the given Karyotype                            | 04M |
| 5. Identify and comment on the given spotters A and B<br>(ODD/RID/Dot ELISA) | 04M |

TOTAL Marks 25M



**Department of Higher education Karnataka State Higher  
Education Council National Education Policy -2020**

**Proposed Model Curriculum for Undergraduate Programme in  
Zoology**

**in**

**All state Universities and Colleges in Karnataka**

**For the year 2022-2023**

***Submitted by***

***Zoology / Genetics Subject***

***Committee***

***NEP2020***

## **COMMITTEE**

1	<b>Dr. K.Vijaykumar</b> , (9480060508) Professor, Dept. of Zoology, Gulbarga University, Kalaburagi.	Chairman
2	<b>Dr. Lakshmi Inamdar</b> , (9449972767) Professor, Dept. of Zoology, Karnataka University, Dharwad.	Member
3	<b>Dr. Bhaskar Shenoy</b> , Professor (Applied Zoology), Mangalore University, Konaje.	Member
4	<b>Dr. Venkateswaralu M.</b> (96861571680) Professor (Applied Zoology), Kuvempu University, Shankaraghatta.	
5	<b>Dr. Asiya Nuzhath F.B.</b> , (9844029441) Associate Professor, Dept. of Zoology, Tumkur University, Tumakuru.	Member
6	<b>Dr. Vijaykumar B. Malashetty</b> , (9343011567) Professor, Dept. of Zoology, VSK University, Ballari.	Member
7	<b>Dr. B. K. Meera</b> , (9886409382) Associate Professor, Maharani Cluster University, Bengaluru.	Member
8	<b>Smt. Kareemunnisa Syed</b> , (9964300991) Associate professor, Dept. of Zoology, Nrupathunga University, Bengaluru.	Member
9	<b>Dr. Gangadhara Rao</b> , (9448984956) Associate Professor, Govt. Women's College, Kolar.	Member
10	<b>Shri. GanapathiK. Naik</b> , (9482029035) Sir M. V. Govt. Science College, Bhadravathi.	Member
11	<b>Dr. Vasanthakumar. B.</b> (9448573105) Sir M. V. Govt. Science College, Bhommanakatte, Bhadravathi-577322	Member
12	<b>Dr.Shankarappa S. Hatti</b> (9980391964) Govt.College, Dept. of Zoology, SedamRoad,Kalaburgi.	Member
13	<b>Dr. Zeba Parveen</b> (9448092786) Dept. of Zoology, BiBi Raza Women's Degree College, Kalaburagi.	Special Invitee
14	<b>Prof. P. M. Basha</b> (9448701652) Professor, Dept. of Zoology, Bangalore University Bengaluru.	Special Invitee

## **FOREWORD**

National Education Policy (NEP) 2020 seeks to transform the Higher Education system in India by introducing the exit and entry option to the students. Selecting courses of choice will improve the education quality of the students. A creative combination of disciplines like Core, Open Elective, and Elective courses with multi-disciplinary nature is one key recommendation of NEP 2020.

The multiple exit and entry options in the Higher Education System would remove rigid boundaries and create new possibilities for students to choose and learn the courses of their choice anywhere in India can pave the way for improving student progress. A formal system of credit recognition, credit accumulation, credit transfers and credit redemption is a praiseworthy recommendation in the education system. Karnataka is the first state in the country to implement NEP in higher education. The state came up with the NEP framework for all the UG-PG programmes starting from the academic year 2021.

**The prominent features of the NEP framework are:**

1. Flexibility in choosing subjects and even disciplines for the graduate programmes.
2. Vertical and horizontal mobility across subjects throughout the programme.
3. Multiple entry and exit points.
4. Mainstreaming of skill based courses.
5. Credit based evaluation system.
6. Integration of research into IV year of the programme leading to Honors degree.
7. Post-graduate Diplomas in respective disciplines.

I am delighted to present curriculum structure and syllabus of B. Sc Degree in Zoology with multiple exit entry with skills and job opportunities in point of exit system. I hope that the curriculum structure and syllabus will pave the way for overall development of the student community. I ensure that, students community will procure the benefits at large in higher education

**Dr. K. Vijaykumar**  
Chairman Zoology/Genetics  
State Level Faculty Committee

## Syllabus for B.Sc., Hons in Zoology

Name of the Degree Program: **B. Sc., Hons**  
Discipline Core: **Zoology**  
Total Credits for the Program: **50/100/142/184/268**  
Starting year of implementation: **2021-22 (I & II sem)**  
**2022-23 (III & IV sem)**

Progressive Certificate, Diploma, Bachelor Degree or Bachelor Degree with Honours Provided at the End of Each Year of Exit of the Four-year Undergraduate Programme/ Five-year Integrated Master's Degree Programme

### Introduction

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

### AIMS AND OBJECTIVES OF UG PROGRAM IN ZOOLOGY

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

### Weightage for assessments

Type of Course	Formative Assessment / IA Marks	Summative Assessment Marks
Theory	40	60
Practical	25	25
Projects*	45	105
Experiential Learning (Internships etc.)		

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

### Credit distribution for the course



## IIA. Model Structure of the Under-Graduate Program(s) in Universities and Colleges in Karnataka

Semester	Discipline Core (DSC) (Credits) (L+T+P)	Discipline Elective(DSE) / Open Elective (OE) (Credits) (L+T+P)	Ability Enhancement Compulsory Courses (AECC), Languages (Credits) (L+T+P)		Skill Enhancement Courses (SEC)			Total Credits
					Skill based (Credits) (L+T+P)	Value based (Credits) (L+T+P)		
I	Discipline A1-(4+2) Discipline B1-(4+2)*	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs. each)		SEC-1: Digital Fluency (2) (1+0+2)	Physical Education for Health & Wellness fitness(1)(0+0+2)(1) (0+0+2)		25
II	Discipline A2- (4+2) Discipline B2- (4+2)*	OE-2 (3)	L1-2(3), L2-2(3) (4 hrs. each)	Environmental Studies (2)		Physical Education - NCC/NSS/R&R(S&		25
Exit option with Certificate (50 credits)								
III	Discipline A3- (4+2) Discipline B3- (4+2) (One Core to be chosen)	OE-3 (3)	L1-3(3), L2-3(3) (4 hrs. each)		SEC-2: Artificial Intelligence (2)(1+0+2)	Physical Education- NCC/NSS/R&R(S&		25
IV	Discipline A4- (4+2) Discipline B4- (4+2)	OE-4 (3)	L1-4(3), L2-4(3) (4 hrs. each)	Constitution of India (2)		Physical Education - NCC/NSS/R&R(S&		25
Exit option with Diploma in Science (100 credits) OR Choose any one of the core subjects as Major and the other as Minor								
V	Discipline A5-(3+2) Discipline A6-3+2) Discipline B5-(3+2)	Vocational-1 (3)			SEC-3: SEC such as Cyber Security (2) (1+0+2)			20
VI	Discipline A7-(3+2) Discipline A8-(3+2) Discipline B6-(3+2)	Vocational-2 (3) Internship (2)			SEC-4: Professional Communication (2)			22
Exit option with Bachelor of Science Degree, B. Sc. Degree in Zoology (142 credits) or continue studies with the Major in the third year								
VII	Discipline A9-(3+2) Discipline A10-(3+2) Discipline A11-(3)	Zoology E-1 (3) Zoology E-2 (3) Res. Methodology (3)						22
VIII	Discipline A12-(3+2) Discipline A13-(3) Discipline A14-(3)	Zoology E-3 (3) Research Project (6)*						20
Award of Bachelor of Science Honours Degree, B.Sc.(Hons.) Degree in Zoology (184 credits)								

\*BOS resolved to adopt only B1 and B2 core subjects for the year 2021-22

### SEMESTER WISE CURRICULUM STRUCTURE OF COURSES

Semester	Name of the course/credits	What all program outcomes the course addresses (not exceeding 3 /course)	Pre- requisite course(s)	Concurrent course	Pedagogy	Assessment
1 Semester A1 Core	Cytology, Genetics and Infectious Diseases (4)	<ol style="list-style-type: none"> <li>The structure and functions of animal cell, cell organelles, cell- cell interactions, process of reproduction leading to new organisms.</li> <li>The principles of inheritance, Mendel's laws and the deviations.</li> <li>Inheritance of chromosomal aberrations in humans by pedigree analysis in families.</li> </ol>	Student must have studied Biology or equivalent subjects in Class 12.	Lab on Cell Biology and Genetics (2)	Lectures/Videos/ Seminars/Case study/Project/ Group discussion/Problem Solving/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/ Evaluation/ Analysis of result/ Application of pedagogy,
1 Semester B1 Core	Biology of Non-Chordates (4)	<ol style="list-style-type: none"> <li>Learn the systematics and biology of non-chordates through their adaptive features.</li> <li>Study the functional biology of non-chordates through their body organization.</li> <li>Comprehend identification of species and their evolutionary relationships.</li> </ol>	Student must have studied Biology or equivalent subjects in Class 12.	Lab on Biology of Non-Chordates (2)	Lectures/Videos/ Seminars/Case study/Project/ Formative Assessment/ Summative	Formative and Summative Assessment/ Evaluation/ Analysis of result/ Application of pedagogy,
1 Semester OE1 Open Elective course	Economic Zoology (3)	<ol style="list-style-type: none"> <li>Acquaint the knowledge about basic procedure and methodology of integrated animal rearing.</li> <li>Students can start their own business i.e. self- employments.</li> <li>Get employment in different sectors of Applied Zoology</li> </ol>	Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/ Seminars/Case study/Project/ Group discussion/Problem Solving/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/ Evaluation/ Analysis of result/ Application of pedagogy,
SEC 1 Skill Enhancement course	<b>SEC 1 Digital fluency</b> Vermiculture (2)		Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/ Seminars/Case study/Project/ Group discussion/Problem Solving/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
2 Semester A2	Biochemistry and Physiology (4)	<ol style="list-style-type: none"> <li>In depth understanding of structure of biomolecules like proteins, lipids and carbohydrates.</li> <li>The thermodynamics of enzyme catalyzed reactions.</li> <li>To know various physiological processes of animals.</li> </ol>	Student must have studied Biology or equivalent subjects in Class 12.	A2 Lab on Biochemistry, Physiology and Hematology (2)	Lectures/Videos/ Seminar/Case study/Project/ Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,



2 Semester B2	Biology of Chordates (4)	<ol style="list-style-type: none"> <li>1. Learn the systematics and biology of Chordates through their adaptive features.</li> <li>2. Study the functional biology of Chordates through their body organization.</li> <li>3. Comprehend identification of Chordate species and their evolutionary relationships.</li> </ol>	Student must have studied Biology or equivalent subjects in Class 12.	Lab on Biology of Chordates (2)	Lectures/Videos/ Seminar/Case study/Project/ Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
2 Semester OE2 Open Elective course	Parasitology(3)		Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/ Seminar/Case study/Project/ Formative Assessment/ Summative Assessment	Formative and Summative Assessment/ Evaluation/ Analysis of result/ Application of Heutagogy,
2 Skill Enhancement course	<b>Environmental Studies</b> Sericulture (2)	<ol style="list-style-type: none"> <li>1. Sericulture is an agro-based industry which gives economic empowerment to the students.</li> <li>2. Sericulture may be taken up as a small scale industry by the small farmers and unemployed youth.</li> <li>3. Get jobs in teaching</li> </ol>	Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/ Seminar/Case study/Project/ Formative Assessment/ Summative Assessment	Formative and Summative Assessment/ Evaluation/ Analysis of result/ Application of Heutagogy,
<b>EXIT OPTION WITH CERTIFICATE (50 CREDITS)</b>						

3. A3 Core Course	Molecular Biology Bioinstrumentation & Techniques in Biology (4)		Certificate Course in Zoology	Lab on Molecular Biology, Bioinstrumentation & Techniques in Biology (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/ Formative Assessment/ Summative Assessment	Formative and Summative Assessment/ Evaluation/ Analysis of result/ Application of Heutagogy,
3B3 Core Course	Comparative Anatomy and Microanatomy (4)		Certificate Course in Zoology	Lab on Comparative Anatomy and Microanatomy (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
3OE-3 Open Elective course	Endocrinology (3)		Certificate Course in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
3 Semester Skill Enhancement course	<b>SEC 3 Artificial Intelligence Apiculture (2)</b>		Certificate Course in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
4 A4 Core course	Gene Technology, Immunology and Computational Biology (4)		Certificate Course in Zoology	Lab on Genetic Engineering And Counselling (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
4 B4 Core Course	Cell Biology and Genetics (4)		Certificate Course in Zoology	Lab on Cell Biology and Genetics (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
4 Sem OE 4 Open Elective Course	Animal Behavior (3)		Certificate Course in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
4 Semester Skill Enhancement course	<b>Constitution of India (2) Poultry</b>		Certificate Course in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
<b>EXIT OPTION WITH DIPLOMA (100 CREDITS)</b>						

5 A5 Major Core Course	Non-Chordates and Economic Zoology (4)		Diploma in Zoology	Lab on Non- Chordates and Economic Zoology (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Zoo/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
5 A6 Major Core Course	Chordates and Comparative Anatomy (3)		Diploma in Zoology	Lab on Chordates (Virtual Dissection) and Comparative Anatomy (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Zoo/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
5 B5 Minor Core Course	Animal Physiology and Animal Biotechnology (3)		Diploma in Zoology	Lab on Animal Physiology and Animal Biotechnology (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Zoo/Formative Assessment/ Summative Assessment.	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy.
5 DSEC1	Vocational -1 Aquatic Biology (3)		Diploma in Zoology		Lectures/Videos/ Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy.
5 SEC 3 Skill Enhancement course	Cyber Security Integrated Animal Rearing (2)		Diploma in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
6 A7 Major Core Course	Evolutionary and Developmental Biology (3)		Diploma in Zoology	Lab on Evolutionary and Developmental Biology (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Institute/Formative Assessment/ Summative Assessment.	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy.
6 A8 Major Core Course	Environmental Biology, Wildlife management and Conservation (3)		Diploma in Zoology	Lab on Environmental Biology, Wildlife management and Conservation (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Zoo/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
6 B6 Minor Core Course	Animal Behavior (3)		Diploma in Zoology	Lab on Animal Behaviour (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Zoo/Formative Assessment/ Summative Assessment.	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy.
DSEC	Vocational-2 Entomology-3 Internship (2)		Diploma in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,

6 Skill Enhancement Course	SEC 4 <b>Professional Communication</b> Fish Culture (2)		Diploma in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
<b>EXIT OPTION WITH B. Sc. DEGREE (142 CREDITS)</b>						
7 A9 Major Core Course	Ethology (3)		Degree in Bachelor Of Science in Zoology	Lab on Ethology (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Zoo/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
7 A8 Major Core Course	Evolution and Zoogeography (3)		Degree in Bachelor Of Science in Zoology	Lab on Evolution and Zoogeography (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Zoo/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
7A9 Major Core Course	Genetics and Computational Biology (3)		Degree in Bachelor Of Science in Zoology	Lab on Advanced Genetics and Computational Biology (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
7	Research methodology (3)		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to research lab/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
7 DSEC	<b>Zoology E-1 (3)</b> Radiation Biology		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative	Formative and Summative Assessment/ Evaluation/ Analysis of result/ Application of Heutagogy,
7DSEC	Zoo Management <b>Zoology E-2 (3)</b>		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative	Formative and Summative Assessment/ Evaluation/ Analysis of result/ Application of Heutagogy,
8 A12 Major Core Course	Immunology and Stem Cell Biology (3)		Degree in Bachelor Of Science in Zoology	Lab on Immunology and Stem Cell Biology (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative	Formative and Summative Assessment/ Evaluation/ Analysis of result/ Application of Heutagogy,
8A13 Major Core Course	Advanced Molecular Biology and Biostatistics (3)		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/ Evaluation/ Analysis of result/ Application of Heutagogy,

8A 14 Major Core Course	Genomics and Proteomics (3)		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative	Formative and Summative Assessment/ Evaluation/ Analysis of result/ Application of Heutagogy,
8	<b>RESEARCH PROJECT (6)</b>		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
8DSEC1	<i>Any one of the below 4 choice</i> E-3 Neurosciences		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
8DSEC2	E-3 Parasitology(3)		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
8DSEC3	E-3 Animal Experimentation and Ethics(3)		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
8DSEC4	E-3 Behavioral Biology(3)		Degree in Bachelor Of Science in Zoology		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
<b>EXIT OPTION WITH B. Sc. HONOURS DEGREE (184 CREDITS)</b>						
9 A15 Major Core Course	Animal Biotechnology and Genetic Engineering (3)		Degree in Bachelor of Science Honors	Lab on Animal Biotechnology and Genetic Engineering (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
9 A 16 Major Core Course	Microanatomy Histochemistry and Histopathology (3)		Degree in Bachelor of Science Honors	Lab on Microanatomy, Histochemistry and Histopathology (2)	Lectures/Videos/ Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
9 A 17 Major Core course	Molecular Endocrinology (3)		Degree in Bachelor of Science Honors	Lab on Molecular Endocrinology (2)	Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Lab/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,

9 A18	Research methodology (3) of 7 <sup>th</sup> sem) Applied Zoology (In Place of		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
9DSEC1	E-1 Animal Biotechnology (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
9DSEC2	E-1 Toxicology (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/ Evaluation/ Analysis of result/ Application of Heutagogy,
9 Skill Enhancement Course	Cattle Farming (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/ Evaluation/ Analysis of result/ Application of Heutagogy,
10 A 19 Major	Physiology of Reproduction (3)		Degree in Bachelor of Science Honors	Lab on Reproductive Physiology (2)	Lectures/Videos/ Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment /Evaluation/ Analysis of result/ Application of Heutagogy.
10 A 20 Major	Developmental Biology (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
10 A 21 Major	Chronobiology (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Lab/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
10 A 22	Nano Biotechnology (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,

10 DSEC 1	<b>RESEARCH PROJECT Or Any two DSEC Or INTERNSHIP (6)</b>		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
10 DSEC 2	E-3 Insect Vector & Diseases (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
10 DSEC 3	E-3 Human Physiology (3)		Degree in Bachelor of Science Honors		Lectures/Videos/ Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy
10 DSEC 4	E-3 Food, Nutrition & Health (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
10 Skill Enhancement	E-3 Animal Breeding Techniques (3)		Degree in Bachelor of Science Honors		Lectures/Videos / Seminars/Case study/Project/ Group discussion/Visit to Industry/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
<b>EXIT OPTION WITH M. Sc. DEGREE (268 CREDITS)</b>						

### III Semester BSc Zoology Core Course Content

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

#### Course Outcomes (COs):

At the end of the course the student should be able to understand: <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>3. Acquiring knowledge on instrumentation and techniques in biology.</li> </ol>
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#### Semester III- Zoology Core Course III Content:

Content	Hours
<b>Unit I</b>	<b>14</b>
<b>Chapter 1: Process of Transcription</b> <ul style="list-style-type: none"> <li>• Fine structure of gene (Cistron, Recon, Muton)</li> <li>• RNA polymerases - types and functions</li> <li>• Transcription in prokaryotes and eukaryotes</li> </ul>	8
<b>Chapter 2: Process of Translation</b> <ul style="list-style-type: none"> <li>• Genetic code and its salient features</li> <li>• Translation in prokaryotes and eukaryotes</li> </ul>	6
<b>Unit II</b>	<b>14</b>
<b>Chapter 3. Regulation of gene expression-I</b> <ul style="list-style-type: none"> <li>• Regulation of gene expression in prokaryotes- lac operon (inducible) and trp operon (repressible) in <i>E. coli</i></li> <li>• Regulation of gene expression in eukaryotes - Role of chromatin (euchromatin and heterochromatin) in gene expression</li> <li>• Post-transcriptional modification: capping, splicing, polyadenylation</li> <li>• Concept of RNA editing (mRNA), gene silencing, and, RNAi</li> <li>•</li> </ul>	9
<b>Chapter 4. Regulation of gene expression-II</b> <ul style="list-style-type: none"> <li>• Post-translational modifications: purpose, advantages, and significance; glycosylation, methylation, phosphorylation, and acetylation.</li> <li>• Intracellular protein degradation (lysosomal autophagy and ubiquitin proteasome pathway).</li> </ul>	5



<b>Unit III</b>	<b>14</b>
<b>Chapter 5: Microscopy</b> <ul style="list-style-type: none"> <li>Principles and applications of Light microscopy, Dark field microscopy, Phase contrast microscopy, Fluorescence microscopy, Confocal microscopy and Electron microscopy (SEM and TEM).</li> </ul>	9
<b>Chapter 6: Centrifugation and Chromatography</b> <ul style="list-style-type: none"> <li>Centrifugation: Principles, types, and applications (High speed and Ultracentrifugation)</li> <li>Chromatography : Principle and applications of: TLC, HPLC and GC</li> </ul>	5
<b>Unit IV</b>	<b>14</b>
<b>Chapter 7: Biochemical Instrumentation</b> <ul style="list-style-type: none"> <li>Colorimetry and Spectrophotometry: Beer-Lambert's law, Absorption spectrum, UV-VL Spectrophotometer.</li> <li>pH meter, measurement of pH</li> <li>Principle, applications and safety measures of Radio-tracer techniques - Autoradiography.</li> </ul>	6
<b>Chapter 8: Molecular Techniques</b> <ul style="list-style-type: none"> <li>Principle and applications of Agarose gel-electrophoresis, SDS-PAGE, DNA Sequencing (Sanger's Dideoxy method)</li> <li>,PCR, DNA Fingerprinting, ELISA, Southern Blotting and Western Blotting.</li> </ul>	8

**Suggested Readings:**

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

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

## Zoology

### Core Course Lab Content

#### Semester III (Practical III)

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

#### Course Outcomes (COs):

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

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

#### Lab Course Content

List of experiments	14 units (1unit- 4hrs)
1. To study the principle and applications of simple, compound and binocular microscopes.	1
2. To study the principle and applications of various lab equipments- pH meter, Electronic balance, Vortex mixer, use of glass and micropipettes, Laminar air flow, Incubator, shaker, Water bath and centrifuge.	2
3. To prepare 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).

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

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

**Semester IV- Zoology Core Course IV Content:**

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

Course Title: <b>Core Course Content: Gene Technology Immunology and Computational Biology</b>	Course Code: <b>DSCC5ZOOT4</b>
Course Type: <b>Discipline Core Theory, L-T-P: 4-0-0</b>	Course Credits: <b>4</b>
Total Contact Hours: <b>56</b>	Duration of ESA: <b>3 Hrs.</b>
Formative Assessment Marks: <b>40</b>	Summative Assessment Marks: <b>60</b>

**Course Outcomes (COs):**

<p><b>At the end of the course the student should be able to:</b></p> <ol style="list-style-type: none"> <li>1. Acquaint knowledge on versatile tools and techniques employed in genetic engineering and recombinant DNA technology.</li> <li>2. An understanding on application of genetic engineering techniques in basic and applied experimental biology.</li> <li>3. To acquire a fundamental working knowledge of the basic principles of immunology.</li> <li>4. To understand how these principles, apply to the process of immune function.</li> <li>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.</li> </ol>
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Course Content	Hrs.
<b>Unit I</b>	<b>14</b>
<p><b>Chapter 1: Principles of Gene Manipulation</b></p> <ul style="list-style-type: none"> <li>● Recombinant DNA Technology: Introduction, steps involved.</li> <li>● Restriction Enzymes and Ligases and Nucleic acid modifying enzyme.</li> <li>● Gene cloning Vector: Concept of plasmids-pBR322, Lamda phage vectors, cosmids</li> <li>● Gene transfer techniques (Direct and indirect).</li> <li>● Screening and selection of recombinant colonies</li> </ul>	07
<p><b>Chapter 2: Applications of Genetic Engineering</b></p> <ul style="list-style-type: none"> <li>● Transgenic animals (Transgenic cow, Transgenic Fish); Transgenic plants (cry protein); Gene silencing (Knock out and Knock in mouse).</li> <li>● Production of Human Recombinant insulin and</li> <li>● Hybridoma technology: Synthesis and applications of Monoclonal antibodies</li> <li>● Gene Therapy (SCID)</li> <li>● Biosensors and its applications</li> </ul>	07
<b>Unit II</b>	<b>14</b>

<b>Chapter 3: Introduction to the Immune System</b> <ul style="list-style-type: none"> <li>Defence against diseases: Introduction, First and second line of defence, Innate and acquired immunity; Antigen presenting cells (APC's), Role of B and T-lymphocytes (Humoral immunity and cell mediated immunity), primary and secondary immune response.</li> <li>Types of Ummunity</li> <li>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).</li> </ul>	07
<b>Chapter 4: Antigens and Antibodies</b> <ul style="list-style-type: none"> <li>Antigens and haptens: Properties (foreignness, molecular size, heterogeneity).</li> <li>B and T cell epitopes.</li> <li>Structure of IgG and functions of different classes of immunoglobulins.</li> <li>Major histocompatibility complex - Structure of MHC I &amp; II.</li> </ul>	07
<b>Unit III</b>	<b>14</b>
<b>Chapter 5: Clinical Immunology</b> <ul style="list-style-type: none"> <li>Immunity against diseases of viral, bacterial and protozoan infections.</li> <li>Vaccines: Types and Uses - Immunization schedule for children.</li> <li>Transplantation immunology: Transplantation of organ- Types, graft rejection and Immuno-suppressors.</li> </ul>	07
<b>Chapter 6: Bioinformatics</b> <ul style="list-style-type: none"> <li>Databases: Sequence and structural</li> <li>Sequence analysis (homology): Pairwise and Multiple Sequence alignment- BLAST, CLUSTALW, Sequence alignment- FASTA.</li> <li>Scope and applications of Bioinformatics.</li> </ul>	07
<b>Unit IV</b>	<b>14</b>
<b>Chapter 7: Biostatistics I</b> <ul style="list-style-type: none"> <li>Measures of central tendency: Mean, Median, Mode.</li> <li>Data summarizing: Frequency distribution, Graphical presentation - bar diagram, pie diagram, histogram.</li> <li>Elementary idea of probability and its applications.</li> </ul>	07
<b>Chapter 8: Biostatistics II</b> <ul style="list-style-type: none"> <li>Measures of dispersion: Range, Standard Deviation, Variance.</li> <li>Correlation and Regression.</li> <li>Tests of significance: F-test, ANOVA, t-test and Chi square test.</li> </ul>	07

**Topics Suggested for Assignment/ Formative Assessment:**

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

**Recommended Books:**

- Primrose & Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).
- Hartl & Jones. Genetics: principles & Analysis of Genes & Genomes. Jones & Bartlett (1998).
- Sambrook *et al.* Molecular Cloning Vols I, II, III. CSHL (2001).
- Primrose. Molecular Biotechnology. Panima (2001).
- Clark & Switzer. Experimental Biochemistry. Freeman (2000)
- Sudbery. Human Molecular Genetics. Prentice-Hall (2002).
- Wilson. Clinical Genetics-A Short Course, Wiley (2000).
- Pasternak. An Introduction to Molecular Human Genetics. Fitzgerald (2000).
- 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. Viva Books (2003)
14. Genetic engineering: Sandhya Mitra BITS, Pilani
15. Principles of Biostatistics Khan and Khanam
16. Transgenic animals: Ranga

**Web Sources:**

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

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

Semester: IV

### Course Lab Content

Course Title: <b>Gene Technology, Immunology and Computational Biology</b>	Course Credits: <b>02</b>
Course Type: <b>Minor Discipline Core Practical, L-T-P: 0-0-4</b>	Course Code: <b>DSCC5ZOO4</b>
Total Contact Hours: <b>56</b>	Duration of ESA: <b>3 Hours</b>
Formative Assessment Marks: <b>25</b>	Summative Assessment Marks: <b>25</b>
Model Syllabus Authors:	

#### Course Outcomes (COs):

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

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

#### Lab IV Course Content

List of labs to be conducted	Hours
<ol style="list-style-type: none"><li>1. Calculate the mean, median, mode and standard deviation (Measurement of pre and post clitellar lengths (with suitable examples).</li><li>2. Measure the height and weight of all students in the class and apply statistical measures.</li><li>3. Determination of ABO Blood group and Rh factor.</li><li>4. To study Restriction enzyme digestion using teaching kits (Demonstration only).</li><li>5. To detect genetic mutations by Polymerase Chain Reaction (PCR) using teaching kits (Demonstration only).</li><li>6. Demonstration of agarose gel electrophoresis for detection of DNA.</li><li>7. Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for detection of proteins.</li><li>8. To calculate molecular weight of unknown DNA and protein fragments from gel pictures. (<a href="https://youtube/mCiCiO0cfbg">https://youtube/mCiCiO0cfbg</a>)</li><li>9. To learn nucleotide sequence database.</li><li>10. To learn sequence alignment: Pairwise alignment (Protein/ DNA).</li></ol>	

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

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

## Semester: III Zoology

### Open Elective Course Content

Course Title: <b>ENDOCRINOLOGY</b> Course Code: <b>OEC5ZOOT3</b>	Course Credits: <b>3</b>
Total Contact Hours: <b>42</b>	Duration of ESA: 3 Hours
Formative Assessment Marks: <b>40</b>	Summative Assessment Marks: <b>60</b>
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.
<b>Unit I</b>	<b>14</b>
<b>Chapter 1. About Endocrine glands</b> <ul style="list-style-type: none"> <li>• Endocrine glands and classifications of hormones.</li> <li>• Characteristics and Transport of Hormones.</li> <li>•</li> </ul> <b>Chapter 2. Hypothalamus-Hypophysis</b> <ul style="list-style-type: none"> <li>• Hypothalamus as a neuroendocrine organ</li> <li>• Pituitary – Structure and functions</li> <li>• Chemical nature, mode of action, and functions.</li> <li>• Pituitary disorders</li> </ul> <b>Chapter 3. Pineal gland</b> <ul style="list-style-type: none"> <li>• Structure and functions of Pineal gland.</li> <li>• Hypo- and hyperactive states of the gland.</li> </ul>	
<b>Unit II</b>	<b>14</b>
<b>Chapter 4. Thyroid and parathyroid</b> <ul style="list-style-type: none"> <li>• Histological structure of the glands.</li> <li>• Chemical nature, mode of action, and functions of the hormones.</li> <li>• Hypo-and hyperactive states of the glands.</li> </ul> <b>Chapter 5.: Adrenal cortex and medulla –</b> <ul style="list-style-type: none"> <li>• Histological structure of the gland. Chemical nature, and functions</li> <li>• Hypo- and hyperactive states of the gland.</li> </ul> <b>Chapter 6. Prostaglandins</b>	
<b>Unit – III</b>	<b>14</b>



**Chapter 7: Pancreas:**

- Pancreatic islets - histological structure. Chemical nature, and function. Hormonal control of blood sugar.
- Hyperinsulinism and diabetes mellitus.

**Chapter 8: Gastro-intestinal hormones –**

- Functions and regulation of secretion of the hormones.

**Chapter 9: Different types of Rhythms –**

- Ultradian, circadian, infradian. Different zeitgebers and their relation with circadian clock
- Neural basis of biological clock and role of suprachiasmatic nuclei. Sleep-wakefulness cycle. Time keeping genes. Jet-lag and shift work.

**Text Books & Suggested Readings:**

1. William's Text Book of Endocrinology 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 Physiology of Reproduction, Vols.I & II, by E. Knobil and J.D. Neil. Raven Press.
8. Guyton and Hall. Textbook of Medical Physiology. 13th Edition.
9. Histology: A Text and Atlas. Sixth Edition. Ross & Pawlina. Lippincott Williams & Wilkins.
10. Vertebrate Endocrinology by David O. Norris.

**Course Books published in English and Kannada may be prescribed by the Universities and Colleges.**

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

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

1. Demonstrate comprehensive understanding of the structure, function and development of the human body as related to endocrinology physiology.
2. Demonstrate elementary understanding of the clinical applications of physiology.
3. Critically evaluate the impact of the recent information on the genesis of current concepts related to various topics of physiology

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

### Open Elective Course Content

#### Semester: IV Zoology

Course Title: <b>Animal Behaviour</b> Course Code: <b>OEC5ZOOT4</b>	Course Credits: <b>3</b>
Total Contact Hours: <b>42</b>	Duration of ESA: 3 Hours
Formative Assessment Marks: <b>40</b>	Summative Assessment Marks: <b>60</b>
Model Syllabus Authors:	

#### Course Outcomes (COs):

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

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

## Course Content

Content	42Hrs
<b>Unit – 1</b>	
<b>Chapter 1.: Introduction to Animal Behaviour</b> <ul style="list-style-type: none"> <li>• Brief contributions of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen.</li> <li>• Proximate and ultimate causes of behaviour.</li> </ul> <b>Chapter 2. Patterns of Behaviour</b> <ul style="list-style-type: none"> <li>• Stereotyped Behaviors - Orientation and Reflex.</li> <li>• Individual Behavioural patterns: Instinct and Learned Behaviour</li> <li>• Associative learning, classical and operant conditioning, Habituation, Imprinting.</li> </ul>	<b>14</b>
<b>Unit – 2</b>	
<b>Chapter 3. Social Behaviour:</b> <ul style="list-style-type: none"> <li>• Social organization in termites and honey bees.</li> <li>• Social behaviour: Altruism.</li> <li>• Conflict behaviour.</li> </ul> <b>Chapter 4. Sexual Behaviour</b> <ul style="list-style-type: none"> <li>• Sexual dimorphism, Mate choice in peacock.</li> <li>• Intra-sexual selection (male rivalry in red deer).</li> <li>• Kinship theory: Relatedness &amp; inclusive fitness.</li> <li>• Parental care in fishes (Nest Building &amp; cost benefit)</li> </ul>	<b>14</b>
<b>Unit – 3</b>	
<b>Chapter 5. Chronobiology</b> <ul style="list-style-type: none"> <li>• Brief historical developments in chronobiology.</li> <li>• Adaptive significance of biological clocks.</li> <li>• Biological Rhythms</li> </ul> <b>Chapter 6: Communications in animals</b> <ul style="list-style-type: none"> <li>• Bioluminescence in deep sea fishes and insects</li> <li>• Territoriality in Monkeys and Dogs</li> <li>• Role of pheromones in animal communication- Insects and Vertebrates,</li> <li>• Communication in Honey bees (Waggle Dance)</li> </ul>	<b>14</b>

### Suggested Readings:

1. Animal Behaviour by Drickamar.
2. John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
3. Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
4. Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
5. Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.) R.D. Lewis. (3rdEd) 2002 Barends and Noble Inc. New York, USA
6. Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

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

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

## 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.	IA	Max.	MIN.	IA					
1	I	CORE subject	56	4	4	60	21	40	25	9	25	3	3	150	4	2
		Open elective	42	3	-	60	21	40	-	-	-	2.5	-	100	3	-
		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	3	3	150	4	2
		Open elective	42	3	-	60	21	40	-	-	-	2.5	-	100	3	-
		Skill Enhancement Course	56	-	4	-	-	-	25	9	25	3	3	50	-	2

### Scheme of Internal Assessment Marks: Theory

<b>Sl. No.</b>	<b>Particulars</b>	<b>IA Marks</b>
1	Attendance	05
2	Internal Tests (Minimum of Two)	20
3	Assignments /Seminar / Case Study / Project work / Reports on - Field visits made for observation and collection of data etc.,	15
	<b>TOTAL Theory IA Marks</b>	<b>40</b>

### Practicals:

<b>Sl. No.</b>	<b>Particulars</b>	<b>IA Marks</b>
1	Practical Test	10
2	Report / Seminar on practical experiments, etc.	10
3	Active participation in practical classes (Attendance)	05
	<b>TOTAL Theory IA Marks</b>	<b>25</b>

**Scheme of Practical Examination**  
**BSc. Zoology III Semester**  
**Core Subject: Molecular Biology, Bioinstrumentation and Techniques in Biology**

**Duration: 3 hours**

**Max. marks: 25**

- |   |        |
|---|--------|
| 1. Extraction of DNA from the given animal tissue<br>OR<br>Estimation of DNA / RNA / Proteins     | 10M    |
| 2. Separate and Identify the given unknown amino acids by using ascending paper<br>Chromatography | 07M    |
| 3. Identify and give the working principle of the spotters A and B                                | 4X2-8M |

TOTAL Marks    25M

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**Scheme of Practical Examination**  
**BSc. Zoology IV Semester**  
**Zoology Core Subject: Gene Technology**

**Duration: 3 hours**

**Max. marks: 25**

- |   |     |
|---|-----|
| 1. Determine the blood group of the given sample and comment  | 05M |
| 2. Problem on Chapter 7   | 06M |
| 3. Problem on Chapter 8   | 06M |
| 4. Identify and comment on the given spotters A and B<br>(PCR/PAGE/Restriction enzyme kit/FASTA/BLAST/Database) | 08M |

TOTAL Marks    25M

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**Model Question Paper**  
**BSC III Semester Zoology Open Elective (OE)**

**ENDOCRINOLOGY**

**Time: 2.5hours**

**Max.Marks:60**

**Instructions to Candidates:**

1. All Sections/parts are compulsory.
2. Draw neat labelled diagrams wherever necessary.

**PART A**

I. **Answer any five of the following** (5X2=10)

1. Mention four examples for endocrine glands
2. What are the neuroendocrine cells of hypothalamus?
3. List out any four functions of melatonin
4. What are the different types of biological rhythms?
5. Mention the 3 hormones of adrenal cortex.
6. What are the types of cells found in parathyroid gland? Mention one function.
7. How does jet lag and shift work contribute to sleep deprivation?

**PART- B**

II. **Answer any five of the following** (5X4=20)

1. Explain the functions and regulations of cholecystokinin.
2. What are time keeping genes? How does it influence sleep?
3. Explain the histological structure of islets of Langerhans.
4. Write a note on prostaglandins.
5. Mention the different types of cells of adenohypophysis with its secretions.
6. Write a note on hypersecretion of parathyroid gland.

**PART- C**

III. **Answer any three of the following** (3X10=30)

1. What are hormones? Classify the hormones based on chemical nature.
2. Explain the hormonal control of blood sugar.
3. Discuss the functions of thyroid gland. Add a note on its hypersecretion.
4. Explain how zeitgebers affect time signals and reset sleep.

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**Model Question Paper**  
**BSC IV Semester Zoology Open Elective (OE)**  
**ANIMAL BEHAVIOUR**

**Time: 2.5 hrs**

**Max.Marks:60**

**Instructions to Candidates:**

1. All Sections/parts are compulsory.
2. Draw neat labelled diagrams wherever necessary.

**PART A**

**I. Answer any five of the following** **(5X2=10)**

1. Define habituation with example.
2. Mention the two dances of honey bees.
3. What is bioluminescent organism? Give example
4. Mention the four types of altruism.
5. List any two difference between classical & Operant conditioning.
6. List any four contribution of Ivan Pavlov.
7. What is meant by stereotyped behavior? Name any two types.

**PART- B**

**II. Answer any five of the following** **(5X4=20)**

1. " Termites are social insects". Justify.
2. Explain imprinting with an example of geese.
3. Write a note on mate choice in Peacock.
4. Explain kinship theory with reference inclusive fitness.
5. Explain territoriality in monkeys.
6. Write a note on parental offspring conflict.

**PART- C**

**III. Answer any three of the following** **(3X10=30)**

1. What are Pheromones? Explain its role in animal communication example.
2. Explain Social organization in termites.
3. Explain parental care in fishes.
4. Briefly explain the historical development in Chronobiology.