ROYAL GLOBAL UNIVERSITY
GUWAHATI

ROYAL SCHOOL OF LIFE SCIENCES

(RSLSC)

Department of Zoology

Learning Outcomes-based Curriculum Framework (LOCF) for

Undergraduate Programme

BSc- (Honours) in Zoology

AY 2022-23

Table of Contents –

1. Preamble

The Assam Royal Global University is upgrading its undergraduate programmes as per the current developments and emerging prerequisites and perspectives. Higher education plays an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution - a democratic, just, socially conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all. Higher education significantly contributes towards sustainable livelihoods and economic development of the nation.

A holistic and multidisciplinary education would aim to develop all capacities of human beings -intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner. Such an education will help develop well-rounded individuals that possess.

As India moves towards becoming a knowledge economy and society, more and more young Indians are likely to aspire for higher education which aims at making higher education multidisciplinary learning process. In other words, the curriculum will be flexible, it will allow students to take up creative subject-combinations.

The new curriculum of BSc-Honours in Zoology under The Assam Royal Global University will be– more flexible, multi-disciplinary and holistic.

1.1 Introduction:

The current syllabus aims at a new and forward-looking vision for India's 'Higher Education System'. At the societal level, higher education must enable the development of an enlightened, socially conscious, knowledgeable, and skilled nation that can find and implement robust solutions to its own problems. Higher education must form the basis for knowledge creation and innovation thereby contributing to a growing national economy. The purpose of quality higher education is, therefore, more than the creation of greater opportunities for individual employment. It represents the key to more vibrant, socially engaged, cooperative communities and a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation.

This policy envisions a complete overhaul and re-energising of the higher education system to overcome these challenges and thereby deliver high-quality higher education, with equity and inclusion, moving towards a more multidisciplinary undergraduate education, revamping curriculum, pedagogy, assessment, and student support for enhanced student experiences etc. A university will mean a multidisciplinary institution of higher learning that offers undergraduate and graduate programmes, with high quality teaching, research, and community engagement. Looking at all these new concepts and progress, the detailed syllabus of BSc-Honours in Zoology has been designed and decided to be implemented.

Zoology deals with the study of animal kingdom specially the structural diversity, biology, embryology, evolution, habits and distribution of animals, both living and extinct. As it covers a fascinating range of topics, the modern zoologists need to have insight into many disciplines. The learning outcomes-based curriculum framework for a B.Sc. degree in Zoology is designed to cater to the needs of students in view of the evolving nature of animal science as a subject. The present framework is intended to allow for flexibility and innovation in programme design and syllabi development, teaching-learning process, assessment of student learning levels.

1.2 Approach to Curriculum Planning

The fundamental premise underlying the learning outcomes-based approach to curriculum planning and development is that higher education qualifications such as a Bachelor's Degree (Hons) programmes are earned and awarded on the basis of (a) demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values) and (b) academic standards expected of graduates of a programme of study.

The expected learning outcomes are used as reference points that would help formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning

outcomes which in turn will help in curriculum planning and development, and in the design, delivery, and review of academic programmes.

Learning outcomes-based frameworks in any subject must specify what graduates completing a particular programme of study are (a) expected to know, (b) understand and (c) beable to do at the end of their programme of study. To this extent, LOCF in Zoology is committed to allowing for flexibility and innovation in (i) programme design and syllabi development by higher education institutions (HEIs), (ii) teaching-learning process, (iii) assessment of student learning levels, and (iv) periodic programme review within institutional parameters as well as LOCF guidelines, (v) generating framework(s) of agreed expected graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes.

The key outcomes that underpin curriculum planning and development at the undergraduate level include Graduate Attributes, Qualification Descriptors, Programme Learning Outcomes, and Course Learning Outcomes. The LOCF for undergraduate education is based on specific learning outcomes and academic standards expected to be attained by graduates of a programme of study. However, an outcome-based approach identifies moves way from the emphasis on what is to be taught to focus on what is learnt by way of demonstrable outcomes. This approach provides greater flexibility tothe teachers to develop—and the students to accept and adopt—different learning and teaching pedagogy in an interactive and participatory ecosystem. The idea is to integrate social needs and teaching practices in a manner that is responsive to the need of the community. HEIs, on their turn, shall address to the situations of their students by identifying relevant and common outcomes and by developing such outcomes that not only match the specific needs of the studentsbut also expands their outlook and values.

1.2.1 Nature and Extent of Bachelor's Degree Programme in Zoology (Honours)

A bachelor's degree in Zoology is a 3 years degree course which is divided into 6 semesters. The credit division is as follows-

Sl. No.	Year	Semester	Credit division
1.	1st Year	1st Semester	24
2.		2nd Semester	24
3.	2nd year	3rd Semester	24

4.		4th Semester	24
5.	3rd Year	5th Semester	26
6.		6th Semester	26
TOTAL CREDITS			148

Bachelor's Degree (Honours) is a well-recognized, structured, and specialized graduate level qualification in tertiary, collegiate education. The contents of this degree are determined interms of knowledge, understanding, qualification, skills, and values that a student intends to acquire to look for professional avenues or move to higher education at the postgraduate level.

Bachelor's Degree (Honours) programmes attract entrants from the secondary level or equivalent, often with subject knowledge that may or may not be directly relevant to the field of study/profession. Thus, BSc (Honours) Course in Zoology aims to equip students to qualify for joining a profession or to provide development opportunities in particular employment settings. Graduates are enabled to enter a variety of jobs or to continue academic study at a higher level.

1.2.2 Aims of Bachelor's Degree (Honours) Programme in Zoology:

The overall objectives of the Learning Outcomes-based Curriculum Framework (LOCF) for BSc-Honours degree in Zoology are-

- To impart the basic knowledge of zoological concepts and theories
- To provide students with the knowledge and skill base that would enable them to undertake further studies in Zoology
- To empower learners by enabling them with communication, professional and life skills
- To impart a multi-disciplinary and holistic course curriculum.
- To provide an understanding of animal behaviour, population dynamics, physiology and the way they interact with other species and their environments.
- To involve and engage students in advanced or modern biology and help develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship.

- To prepare socially responsible academicians, researchers, professionals with global vision.
- To help students adapt to recent trends of Zoology by with special focus on applied and policy issues.
- To design a curriculum needs to focus on special skills to maximize the students' employment probability

1.3 Graduate Attributes

- **Disciplinary knowledge and Understanding**: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of BSc (Hons.) Programme in Zoology. It will provide basic knowledge of Classical and Modern Zoology, use of biochemistry and biotechnology in Zoology, learning entrepreneurial skills through research and concepts and knowledge of other courses relating to core areas of study. Along with the core papers, **The Assam Royal Global University** gives much more emphasis on broader coverage of generic electives. ***A student of BSc in Zoology Programme can choose any discipline from a wide range of basket as his/her generic electives, which facilitate the student better understanding of the core courses.*** Moreover, a wide range of Skilled based papersare designed to improve the skill of the students.
- **Practical Skills**: The students of Zoology will have the opportunity to learn the animal world around them with the help of hands-on practical classes. The Zoology lab is well equipped with modern instruments to conducts experiments.
- **Communication Skills**: Ability to express thoughts and ideas effectively in writing and orally is very essential for a student. **The Assam Royal Global University** at Undergraduate and PG level has made ***Communicative English*** compulsory for all students in all semesters. A student at UG level will study six papers of Communicative English as **Ability Enhancement Compulsory Courses (AECC)** with a view to improve communication skills of the students.
- **Critical thinking**: A student will be capable of using analytic thought to a body of knowledge and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence. Faculty members organize Group Discussion, Power Point presentation, Debate, Quiz, seminars, lecture series etc regularly to develop this quality among the students.
- **Problem solving**: The course is designed to develop capacity to extrapolate from what a

student has learned and apply their competencies to solve different kinds of non-familiar problems, and apply one's learning to real life situations.

- **Analytical reasoning**: Zoology is a subject of experimentation, reasoning and evidenced based learning. This enhances a student's abilityto evaluate the reliability and relevance of evidence and can identify logical flaws in the arguments of others. Moreover, the students can analyse and synthesise data from a varietyof sources and can draw valid conclusions and support them with evidence.

- **Research-related skills**: Zoology is research-based subject with plenty of hands-on and practical opportunities. Students are asked prepare project report regularly which brings about the sense of inquiry and capability for asking relevant/appropriate questions. They can also develop the ability to recognise cause-and- effect relationships and can draw conclusions from data.

- **Cooperation/Team work**: Capable of working effectively in diverse teams in both classroom and field-based situations.

- **Information/digital literacy:** Capable of using computers in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant informationsources and use appropriate software for analysis of data.

- **Moral and ethical awareness/reasoning**: Capable of conducting their work with honesty and precision thus avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, and appreciating environmental and sustainability issues.

- **Lifelong learning**: Capable of self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/re-skilling.

1.4 Qualification Descriptors for a Bachelor's Degree programme in Zoology

The qualification descriptors for a Bachelor's Degree programme in Zoology may include the following:

1. Demonstrate a systematic or coherent understanding of the academic field of Zoology, its different learning areas and applications, and its linkageswith related disciplinary areas/subjects;

2. To be able to apply procedural knowledge that creates different types of professionals related to zoological area of study, including research and development, teaching and government and public service;

3. Demonstrate skills in areas related to specialization area relating the subfields and current developments in the academic field of Zoology.

4. Use knowledge, understanding and skills required for identifying problems and issues relating to Zoology. A keen interest in research and the study of living organisms.

5. Communicate the results of studies undertaken accurately in a range of different contexts using the main concepts, constructs and techniques of Zoology

6. Meet one's own learning needs, drawing on a range of current research and development work and professional materials;

7. Demonstrate subject-related and transferable skills that are relevant to Zoology-related job trades and employment opportunities

8. Develop analytical power and logical approach to problem-solving

9. Good oral and written communication abilities. Excellent observational skills.

10. Able to work independently or with team members

1.5 Programme learning outcomes relating to B.Sc. (Honours) degree programme in Zoology

Programme Outcomes

PO-1: Knowledge

Demonstrate (i) in-depth knowledge and understanding about the fundamental concepts, principles and processes underlying the academic field of Zoology and its different subfields (animal

diversity, principles of ecology, comparative anatomy and developmental biology of vertebrates, physiology and biochemistry, genetics and evolutionary biology, animal biotechnology, applied Zoology, aquatic biology, immunology, reproductive biology, and insect, vectors and diseases, apiculture, aquarium fish keeping, medical diagnostics, and sericulture) (ii) procedural knowledge that creates different types of professionals in the field of Zoology and related fields such as, apiculture, aquarium fish keeping, medical diagnostics, and sericulture, etc.(iii) skills related to specialization areas within Zoology as well as within subfields of Zoology, including broader interdisciplinary subfields (Chemistry, Physics and Mathematics).

PO-2: Comprehension

Use knowledge, understanding and skills required for identifying problems and issues relating to Zoology. Appreciate the complexity of life processes, their molecular, cellular and physiological processes, their genetics, evolution and behaviour and their interrelationships with the environment.

PO-3: Application

Demonstrate subject-related and transferable skills that are relevant to some of the job trades and employment opportunities. Accept the legal restrictions & ethical considerations placed for animal welfare. A thorough knowledge of fundamental aspects of animal sciences.

PO-4: Analysis

Ability to understand various social issues and economic problems. To be able to design experiments, analyze data and reach suitable conclusions.

PO-5: Creation

Develop analytical power and logical approach to problem-solving and thereby having a solid understanding of scientific principles underlying animal health, management and welfare.

Programme Specific Outcomes

PSO1: Ability to apply knowledge of Zoology to realize and explain notions and complexities of animal sciences.

PSO2: Ability to comprehend the relationship of organisms at all levels: molecular, cellular, and

organismal

PSO3: Ability to conduct empirical studies for scientific research as well as to validate, analyze and interpret them.

PSO4: Skilled in advanced biological techniques and in-depth understanding of zoological experiments. Understand good laboratory practices and safety.

PSO5: Ability to apply the knowledge of Zoology in various fields such Vermiculture, Sericulture, Wildlife Management, Aquaculture, Livestock Framing and Fisheries. To gain a multi-disciplinary understanding of classical and modern Zoology.

PSO6: Ability to perform as skilled professional in corporate sector, NGO sector, Government line departments, wildlife conservation agencies, academic institutions, pharma and biotech industry, etc.

PSO7: Maintenance of high standards of learning in animal sciences and contributes the knowledge for nation building.

1.6 Index for program learning outcome for Zoology Core Courses

Courses	Disciplinary Knowledge	Identifying problems and issues	Research related skills	Problem Solving	Employability	Critical thinking	Communication Skills	Analytical reasoning	Moral and ethical awareness/reasoning
Cell Biology and Molecular Biology	✓	✓	✓	✓		✓		✓	✓
Non-Chordates	✓	✓	✓	✓		✓		✓	✓
Practical on Cell Biology, Molecular Biology and Non-Chordates	✓	✓	✓	✓	✓	✓	✓	✓	✓
Communicative English-I	✓				✓	✓	✓		✓

Behavioural Science-I	✓				✓	✓	✓		✓
Comparative Anatomy of Animals	✓	✓	✓	✓		✓		✓	✓
Chordates	✓	✓	✓	✓		✓		✓	✓
Practical on Comparative Anatomy of Animals and Chordates	✓	✓	✓	✓		✓		✓	✓
Communicative English-II	✓				✓	✓	✓		✓
Behavioural Science-II	✓				✓	✓	✓		✓
Animal Physiology	✓	✓	✓	✓		✓		✓	✓
Biochemistry	✓	✓	✓	✓		✓		✓	✓
Practical on Animal Physiology & Biochemistry	✓	✓	✓	✓	✓	✓	✓	✓	✓
Endocrinology	✓	✓	✓	✓		✓		✓	✓
Animal Physiology	✓	✓	✓	✓		✓		✓	✓
Human Biology	✓	✓	✓	✓		✓		✓	✓
Communicative English-III	✓				✓	✓	✓		✓
Behavioural Science-III	✓				✓	✓	✓		✓
Histology and Immunology	✓	✓	✓	✓		✓		✓	✓
Practical on Histology, Immunology & Developmental Biology	✓	✓	✓	✓	✓	✓	✓	✓	✓
Developmental Biology	✓	✓	✓	✓		✓		✓	✓

Introduction to Microscopy and Histology	✓	✓	✓	✓		✓		✓	✓
Ecology	✓	✓	✓	✓		✓		✓	✓
Aquaculture	✓	✓	✓	✓		✓		✓	✓
Communicative English-IV	✓				✓	✓	✓		✓
Behavioural Science-IV	✓				✓	✓	✓		✓

1.7 Teaching Learning Process

Teaching and learning in this programme involve classroom lectures as well tutorials. It allows-

- The tutorials allow a closer interaction between the students and the teacher as each student gets individual attention.
- Written assignments and projects submitted by students
- Project-based learning
- Group discussion
- Home assignments
- Quizzes and class tests
- PPT presentations, Seminars, interactive sessions
- Socio-economic survey
- Co-curricular activity etc.
- Industrial Tour or Field visit

1.8 Assessment Methods

Methods	**Weightage**
Semester End Examination	70%
Internal Assessment	30%
Total	**100%**

Internal assessment is based on – Mid-semester Examination, Class test, Assignment, Project, Viva-voce, attendance of the student, seminar, group discussion, field work etc.

2. Learning Outcomes of different types of courses for BSc (Honours) in Zoology

BSc (H) Zoology
Programme Structure

1st semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	ZOO142C101	Cell Biology and Molecular Biology	3	1	0	4	4
2	ZOO142C102	Non-Chordates	3	1	0	4	4
3	ZOO142C113	Cell Biology, Molecular Biology and Non-Chordates (Practical)	0	0	8	4	8
Skill Enhancement Courses (SEC)							
4	ZOO142S121	Vermiculture	0	0	2	2	2
Value Added Courses (VAC)							
5	VAC992V103	Personality Development	2	0	0	2	2
Generic Elective Courses (GEC)							
6	ZOO142G101	Animal Diversity: Non- Chordates	2	1	0	3	3
7	ZOO142G102	Human Health and Disease	2	1	0	3	3
Ability Enhancement Compulsory Courses (AECC)							
8	CEN982A101	Communicative English-I	1	0	0	1	1
9	BHS982A104	Behavioural Science-I	1	0	0	1	1
		Total credits	**24**				**28**

2nd Semester							
Sl.No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	ZOO142C201	Comparative Anatomy of Animals	3	1	0	4	4
2	ZOO142C202	Chordates	3	1	0	4	4
3	ZOO142C213	Comparative Anatomy of Animals and Chordates (Practical)	0	0	8	4	8
Skill Enhancement Courses (SEC)							

4	ZOO142S221	Sericulture	0	0	2	2	2
Value Added Courses (VAC)							
5	VAC992V203	Science and Society	2	0	0	2	2
Generic Elective							
6	ZOO142G201	Animal Diversity: Chordates	2	1	0	3	3
7	ZOO142G202	Animal Parasites	2	1	0	3	3
Ability Enhancement Compulsory Courses (AECC)							
8	CEN982A201	Communicative English-II	1	0	0	1	1
9	BHS982A204	Behavioural Science-II	1	0	0	1	1
		Total credits	**24**				**28**

3rd Semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	ZOO142C301	Animal Physiology and Biochemistry	3	1	0	4	4
2	ZOO142C313	Animal Physiology and Biochemistry (Practical)	0	0	8	4	8
Discipline Specific Elective							
3	ZOO142D301	Endocrinology	3	1	0	4	4
Generic Elective							
4	ZOO142G301	Animal Physiology	2	1	0	3	3
5	ZOO142G302	Human Biology	2	1	0	3	3
Ability Enhancement Compulsory Courses (AECC)							
6	CEN982A301	Communicative English-III	1	0	0	1	1
7	BHS982A304	Behavioural Science-III	1	0	0	1	1
Field Study/ Project							
		4-week field study/ project after completion of 2nd semester	0	0	0	0	4
		Total credits	**24**				**28**

4th Semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	ZOO142C401	Histology and Immunology	3	1	0	4	4

2	ZOO142C413	Histology, Immunology and Developmental Biology (Practical)	0	0	8	4	8
Discipline Specific Elective							
3	ZOO142D401	Developmental Biology	3	1	0	4	4
Skill Enhancement Courses (SEC)							
4	ZOO142S421	Introduction to Microscopy and Histology	0	0	2	2	2
Value Added Courses (VAC)							
5	VAC992V403	To be selected from a basket of courses	2	0	0	2	2
Generic Elective							
6	ZOO142G401	Ecology and Wildlife	2	1	0	3	3
7	ZOO142G202	Animal Parasites	2	1	0	3	3
Ability Enhancement Compulsory Courses (AECC)							
8	CEN982A401	Communicative English-IV	1	0	0	1	1
9	BHS982A404	Behavioural Science-IV	1	0	0	1	1
		Total credits	**24**				**28**
5th Semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	ZOO142C501	Genetics & Genomics	**3**	**1**	**0**	**4**	**4**
2	ZOO142C513	Genetics, Genomics (Practical)	**0**	**0**	**8**	**4**	**8**
Discipline Specific Elective (To select any 2)							
3	ZOO142D501	Parasitology	**3**	**1**	**0**	**4**	**4**
4	ZOO142D502	Aquatic Biology	**3**	**1**	**0**	**4**	**4**
5	ZOO142D503	Evolutionary Biology	**3**	**1**	**0**	**4**	**4**
6	ZOO142D504	Biostatistics	**3**	**1**	**0**	**4**	**4**
Value Added Courses (VAC)							
7		To be selected from a basket of courses	2	0	0	2	2
Ability Enhancement Compulsory Courses (AECC)							
8	CEN982A501	Communicative English- V	1	0	0	1	1
9	BHS982A504	Behavioural Science- V	1	0	0	1	1

Internship							
		Mandatory 6-week internship after 4 semester exams	0	0	12	6	6
Total Credits						26	30
6th Semester							
Sl. No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	ZOO142C601	Ecology and Wildlife Biology	**3**	**1**	**0**	**4**	**4**
2	ZOO142C613	Ecology (Practical)	**0**	**0**	**8**	**4**	**8**
Discipline Specific Elective (To select any 3)							
3	ZOO142D601	Agrochemicals and Pest Management	**3**	**1**	**0**	**4**	**4**
4	ZOO142D602	Livestock management and Animal Husbandry	**3**	**1**	**0**	**4**	**4**
5	ZOO142D603	Aqariculture	**3**	**1**	**0**	**4**	**4**
6	ZOO142D604	Biotechnology	**3**	**1**	**0**	**4**	**4**
7	ZOO142D605	Bioinformatics	**3**	**1**	**0**	**4**	**4**
8	ZOO142D606	Entomology	**3**	**1**	**0**	**4**	**4**
Skill Enhancement Course							
8	ZOO142S621	Wildlife Photography and Ecotourism	**0**	**0**	**4**	**2**	**4**
Value Added Courses (VAC)							
9		To be selected from a basket of courses	2	0	0	2	2
Ability Enhancement Compulsory Courses (AECC)							
9	CEN982A601	Communicative English- V	1	0	0	1	1
10	BHS982A604	Behavioural Science- V	1	0	0	1	1
Total credits						26	36

Semester-I
Paper I/Subject Name: Cell Biology and Molecular Biology **Course Code: C1 Subject Code: ZOO142C101** **L-T-P-C- 3-1-0-4** **Credit Units: 4** **Scheme of Evaluation: Theory**

Course Objective: The objective of the course is to help the students to learn and develop a basic understanding of a cell as a basic unit of life. This course is designed to enable them to understand the functions of cellular organelles and how a cell carries out and regulates cellular functions.

Course Outcomes:

Upon completion of the course, students should be able to:
BT1- Understand and describe the fundamental principles of cell biology.
BT2- Explain and compare the structures and functions of various cell organelles involved in diverse cellular processes.
BT3- Describe how cells grow, divide, survive, die and regulate these important processes.
BT4- Have an insight of how defects in functioning of cell organelles and regulation of cellular processes can develop into diseases.

Detailed syllabus:

Modules	Topics (if applicable) & Course content	Periods
I	**Biomolecules** **Carbohydrates:** Structure and biological importance; Classification and nomenclature; Reducing and non-reducing sugars. **Lipids:** Structure and biological importance; Saturated and un-saturated fatty acids; Tri-glycerol's, Phospholipids, Glycolipids, Steroids, and Prostaglandins. **Amino acids:** Structure, classification and properties of amino acids, Essential and non-essential amino acids. **Proteins:** Peptide bond, Simple and conjugate proteins; Protein denaturation. **The Structures of DNA and RNA / Genetic Material:** DNA Structure- Miescher to Watson and Crick model; Salient features of double helix; Types of DNA; Types of genetic material; DNA denaturation and renaturation.	**12**
II	**Cell structure and function** **Plasma membrane and Cell wall:** Structure and function, Transport of molecules across plasma membrane, Cell wall-Bacterial and eukaryotic cell wall. **Mitochondria, Chloroplast, and Peroxisomes:** Structural	**12**

	organization and function, Mitochondrial biogenesis, semiautonomous nature of mitochondria and chloroplast, Mitochondrial DNA, Chloroplast DNA, Peroxisome assembly. **Nucleus:** Nuclear envelope- structure of nuclear pore complex, nuclear lamina, transport through nuclear envelope, nucleolus and rRNA processing, nucleolus, chromatin.	
III	**Cell interaction, cytoskeleton and Cell cycle** **Extracellular matrix, and cell interaction:** Extracellular matrix; cell-matrix interaction; cell-cell interaction **Cytoskeleton:** Structure and organization of microtubule, microfilament, and intermediate filament. **Cell cycle and cell division:** Mitosis and meiosis; Cell cycle in eukaryotes; Cell cycle regulation; Apoptosis and Cancer;	**12**
IV	**Molecular Biology** **DNA Replication:** Mechanism of replication in prokaryotes and eukaryotes; Enzyme involved in DNA replication – DNA polymerases, DNA ligase, Primase, Telomerase, DNA super coiling and topoisomerase. **Transcription:** RNA Polymerase and the transcription unit; Transcription in Prokaryotes and **e**ukaryotes; lac and tryptophan operon, Post-transcriptional modifications. **Translation:** Structure and assembly of ribosome; Charging of tRNA; Aminoacyl tRNA synthetases; Proteins involved in initiation, elongation and termination of translational, Post-translational modifications.	**12**
Total		**48**

Textbooks:

1. Satyanarayana, U. and Chakrapani, U. (2021) Biochemistry (6th ed). Elsevier.
2. David, L., Nelson, D. L., & Cox, M. (2021). Lehninger principles of biochemistry (8th ed). Macmillan Learning.
3. Lodish, H., Berk, A., Kaiser, C. A., Kaiser, C., Krieger, M., Scott, M. P. and Matsudaira, P. (2021). Molecular cell biology (9th ed). Macmillan Learning.
4. Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2017). Molecular biology of the gene (7th ed). JD. Cold Spring Harbour Laboratory Press, Pearson Publishing.
5. De Robertis, E.D.P. and de Robertis, E.M.F. Cell and molecular biology (9th Ed). Lippincott Williams & Wilkins.
6. Gerald, K., Janet, I., & Wallace, M. (2020). Karp's cell and molecular biology (9th Ed). Wiley.

References:

1. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2017). The World of the Cell (9th Ed). Pearson Benjamin Cummings Publishing, San Francisco.

2. Murray, R. K., Granner, D. K., & Rodwell, V. W. (2018). Harper's illustrated biochemistry. (31st Ed). McGraw Hill / Medical.

Semester-I
Paper I/Subject Name: Non-Chordates
Course Code: C2 Subject Code: ZOO142C102
L-T-P-C- 3-1-0-4
Credit Units: 4
Scheme of Evaluation: Theory

Course Objective: This course is designed to introduce the students to the diversity of non-Chordates, their systemic classification, phylogeny, characteristics, affinities and significance.

Course Outcomes:

On completion of the course the students will be able to:

BT1- Describe and identify the diverse non-chordate life forms.

BT2- Classify and compare major phyla with respect to their general characteristics.

BT3- Evaluate the relationships between various phyla

BT4- summarise the significance of non- chordates.

Detailed syllabus:

Modules	Topics (if applicable) & Course content	Periods
I	**Introduction to Invertebrates-** diversity, general characteristics and phylogeny of invertebrates. **Protozoa:** General characters and outline classification up to class. Protozoa– nutrition, locomotion and diseases associated with Protozoans. **Metazoa:** Origin of metazoa, metamerism and coelom. **Porifera:** General characters and outline classification up to classes. Porifera- canal system and affinities.	**12**
II	**Cnidaria:** General characters and outline classification up to class. Polymorphism, alternation of generation, nematocysts and locomotion in Cnidarians. **Platyhelminthes:** General characters and outline classification up to class. General discussion on parasitic Platyhelminthes. Phylogenetic significance. **Aschelminthes:** General characters and outline classification up to class. Discussion of phylogenetic position of aschelminthes. Parasitic	**12**

	nematodes and diseases caused by them.	
III	**Ctenophora:** General characteristics and affinities **Annelida:** General characters and outline classification up to class. Metamerism and nephridia. Adaptive radiations in Annelida. **Arthropoda:** General characters and outline classification up to class. Larval forms of crustacea; social life, metamorphosis in Insecta.Onychophora: Affinities of Onychophora.	**12**
IV	**Mollusca:** General characters and outline classification up to class. Torsion in Gastropods; pearl formation. **Echinodermata:** General characters and outline classification up to class. Affinities of Echinodermata. Water-vascular system and larval forms. Brief discussion on minor phyla of non-chordates. Economic and ecological significance of non-chordates.	**12**
Total		**48**

Textbooks:

1. Ruppert, E.E., Fox R.S., and Barnes R. (2004). Invertebrate Zoology. (7th ed), Holt Saunders International Edition. Thompson- brooks/ Cole
2. Kotpal, R.L. (2015). Modern textbook of zoology: Invertebrates. (11th ed). Rastogi publications.
3. Parker, T.J. and Haswell, W.A. (2021). Textbook of Zoology: Invertebrates. (8th Ed), Vol. I. Macmillan education, U.K.
4. Royston, A. (2015). Invertebrates. Heinemann
5. Brusca,R. C., Brusca, J. G., Haver, N. J. (2003). Invertebrates. (2nd Ed). Sinauer Associates

References:

1. Solomon, E.P., Martin, E.C., Martin, D.W., Berg, L.R.(2019). Biology. (11th Ed). Cengage.

2. Miller, S.A., & Harley, J.P. (2016). Zoology. (10th ed). Mcgraw-Hill.

3. Campbell, N.A., & Reece, J.B. (2005). Biology. (7th ed). Pearson Benjamin Cummings.

Semester-I
Paper I/Subject Name: Cell Biology, Molecular Biology and Non-Chordates **Course Code: C3 Subject Code: ZOO142C103** **L-T-P-C- 0-0-8-4** **Credit Units: 4** **Scheme of Evaluation: Practical**

Course Objective: The objective of the course is to help the students to develop a basic understanding of the structural differences of various cell types and the changes that occur during mitosis and meiosis. The students will also be able to identify the invertebrate species based on their morphological and anatomical characteristics and the behavioural patterns exhibited by different invertebrate species.

Course Outcomes: After completion of the course the students will be able to:

BT1- Identify major classes of bio molecules involved in cellular metabolism.
BT2- Understand the basic structure of different cell types, their morphological differences and characterise the various stages of the cell cycle.
BT3- Describe and differentiate non-chordates based on their morphology, anatomy and special physical features.
BT4- Recognise the various behavioural patterns of invertebrates.

Detailed Course:

Modules	Topics (if applicable) & Course content	Periods
I	1. Detection of Carbohydrate by Benedict's and Fehling's test. 2. Qualitative detection of lipids and proteins. 3. Qualitative detection of protein by Biuret test 4. Staining of buccal epithelial cells and blood cell using methylene blue and leishmann stain respectively 5. Effect of hypotonic and hypertonic solution on mammalian RBC 6. Staining of nucleus and nucleolus in mammalian cell 7. Staining of mitochondria using Vital stain	**12**
II	1. Isolation of DNA and RNA from eukaryotic cell 2. To study replication, transcription, and translation using photographs. 3. Study of various stages of mitosis in onion root tip. 4. Study of different stages of meiosis using grass hopper/Sand hopper testes 5. Preparation of polytene chromosome from salivary gland of chironomous / drosophila larvae	**12**
III	1. Study of Museum Specimens 10 (Identification and classification up to order. Generic name must be known) - *Spongilla, Physalia, Metridium* (Seaanemone). *Pennatula*, (Sea-pen) Gorgonia, Fasciola. *Taenia, Echiurus, Limulus,*	**12**

	Scolopendra (Centipede) *Julus* (Millipede), Carausius (stick insect), *Lepisma*, Mantis, Termite queen, Belostoma (Giant water bug), *Peripatus, Chiton, Achatina, Pinctada* (Pearl oyster), *Loligo, Mytilus, Limax, Cucumaria* (Sea Cucumber), *Echinus* (Seaurchin). 2. Identification of prepared slides - *Polystomella,* Sponge spicules, T.S of Ascaris, Miracidium, Cercaria larvae of Liver fluke, T.S. of Leech (Through crop region). T.S. of Earth worm (through pharynx, gizzard and intestine). Mouth parts of mosquitoes, Larvae of Glochidium and Echinodermata (Bipennaria)	
IV	1. Demonstration/ dissection of the following systems of invertebrates animals (any one) a. Digestive system of Cockroach b. Nervous system of Pila c. Nervous system of Prawn d. Urogenital system of Leech 2. Mounting temporary slide of the following organ/parts- Setae of Earthworm, Salivary gland of Cockroach, Redulla of Pila, Mouthparts of Mosquito and honey bee. 3. To examine the nematode diversity from soil sample collected from different places. 4. To study the social behaviours of ants/honey bee/termites/wasp. 5. To study about two ecto and endo parasites	**12**
TOTAL		**48**

Text Book:

1. Lal, S. S. (2020). Practical Zoology Invertebrates. (12th Ed), Rastogi Publications
2. Das, D. (2017). Essential practical handbook of cell biology & genetics, biometry & microbiology: a laboratory manual. (1st Ed). Academic Publishers.
3. Gupta, A., Sati, B. K., & Lambert, L. A. P. Practical laboratory Manual- Cell Biology. Academic Publishing

Reference Book:

1. Barnes, R. S. K., Calow, P. P., Olive, P. J., Golding, D. W., & Spicer, J. I. (2009). The invertebrates: a synthesis. (3rd Ed). John Wiley & Sons.

2. Practical, Sukla, J. P., & Pandey, K. (2017). Non-Chordates (Invertebrate) Zoology. Himalay publishing House.

AECC-1 (Semester-I)
AECC-1/Subject Name: Communicative English- I: Developing Oral Communication and Listening Skills
Subject Code: CEN982A101
L-T-P-C – 1-0-0-1
Credit Units: 1
Scheme of Evaluation: Theory + Viva-Voce + Extempore Speech **Continuous Evaluation: 30 Marks** **Semester End Examination:** **Component A – Written Examination = 30 Marks** **Component B +C – Viva-Voce + Extempore speech = 40 Marks**

Course Objective:

The objective of the course is to introduce students to oral communication skills in English by engaging them to meaningful discussion and interactive activities.

Course Outcomes: On completion of this course students will be expected to -

- Have a knowledge of Communication process, verbal, and non-verbal communication
- Improve the skill of listening processes
- Develop a life skill on oral group communication- group discussion leadership skills, team management.
- Have a basic idea of language styles – oral and written communication.

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I.	**Basics of Communication- Introduction** Communication - definition – meaning – elements - basics of communication - communication process - importance of communication Components of Communication Types/forms of Communication (Oral-written, Formal-Informal (Grapevine), Interpersonal-Intrapersonal, Mass- Group, Verbal-Non Verbal External communication, Organizational Communication- Upward, Downward, horizontal, Diagonal) Non-verbal Communication - Introduction; Body language- Personal Appearance, Postures, Gestures, Eye Contact, Facial expressions Paralinguistic Features-Rate, Pause, Volume, Pitch/Intonation/	**4**

	Voice/ modulation Proxemics, Haptics, Artifactics, Chronemics	
II.	**The Listening Process** Types of Listening – Superficial, Appreciative, Focused, Evaluative, Attentive, Emphatic, Listening with a Purpose, Barriers to Communication, Barriers to Listening	**4**
III.	**Focus on Oral Group Communication** Nature of group communication, Characteristics of successful Group Communication Selection of group discussion-subject knowledge, leadership skills, team management Group Discussion Strategies	**4**
IV	**Language Styles- Oral and Written Communication** Technical Style, ABC of technical communication- accuracy, using exact words and phrases, brevity, clarity, Objectivity of Technical Writing - Impersonal language, Objectivity in professional speaking.	**4**
TOTAL		**16**

Textbooks:

Rizvi, M. Ashraf. (2008). *Effective Technical Communication* (11 reprint). New Delhi: Tata McGraw Hill.

Reference Books:

- Koneru, Aruna.(2017) *Professional Communication*. New Delhi: Tata McGraw Hill ISBN-13: 978-0070660021
- Hair, Dan O., Rubenstein, Hannah and Stewart, Rob. (2015).A *Pocket Guide to Public Speaking*. (5th edition). St. Martin's. ISBN-13:978-1457670404

AECC-2 (Semester I)
AECC-2/Subject Name: Behavioural Science - I
Subject Code: BHS982A102
L-T-P-C – 1-0-0-1
Credit Units: 1
Scheme of Evaluation: Theory + Viva-Voce + Extempore Speech **Continuous Evaluation: 30 Marks** **Semester End Examination:** **Component A – Written Examination = 30 Marks**

Component B +C – Viva-Voce + Extempore speech = 40 Marks

Course objectives: To increase one's ability to draw conclusions and develop inferences about attitudes and behaviour, when confronted with different situations that are common in modern organizations

Course Outcomes: On completion of this course students will be expected to -

- Understand self-identity and identity crisis
- Understand self-esteem.
- Have in depth knowledge of foundation of individual behaviour.
- Develop a life skill on Time management
- Have an idea on barriers of communication.

Modules	Course Contents	Periods
I	**Understanding Self** Understanding of Self ,What is self?, Components of Self-self identity, Identity crisis, Definition self confidence, self image, Johari Window, Self Esteem, High and Low Self-esteem, Erikson's model.	4
II	**Foundations of individual behavior** Personality- structure, determinants, personality traits, Perception- Perceptual Process, Attribution, Errors in perception, Stereotyping, Racial Profiling, Learning- Theories of learning.	4
III	**Managing self** Time management: Introduction-the 80:20, sense of time management, Three secrets of time management, Effective scheduling, Stress management, effects of stress, kinds of stress-sources of stress, Signs of stress, Stress management tips.	4
IV	**Behaviour and communication.** Behaviour as a barrier to Communication , ways to overcome the barriers, Non-verbal communication-body language (voluntary and involuntary body language) forms of body language, Interpreting body language	4
Total		**16**

Text books

- Soft skills by Dr.K.Alex, S.Chand.
- Organisational behaviour by S.P Robbins, Judge , Vohra 18th Ed

SEC-1/Semester I
Paper I/Subject Name: Vermiculture **Course Code: S1 Subject Code: ZOO142S101** **L-T-P-C – 0-0-2-2** **Credit Units: 2** **Scheme of Evaluation: Practical**

Course Objective: This course is designed to introduce the students to the basic processes and practice of vermiculture, its scope and economic advantages.

Course Outcomes:

On completion of the course the students will be able to:

BT1- Explain the importance of vermicompost in organic agriculture.

BT2- Recognise the benefits of vermicompost over chemical fertilizers.

BT3- Produce their own vermicompost

BT4- Experience turning their waste into black gold.

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I	**Introduction:** Definition, Choosing the right worm. Useful species of earthworms. Maintenance of soil structure.	6
II	**Scope of Vermiculture:** Advantages of vermiculture; scope of sericulture in India employment potential and income generation;	6
III	**Vermicomposting:** Method and techniques of preparing vermicompost,	6
IV	**Application and advantages of vermiculture,** Vermicomposting for Organic Farming - an Eco-Friendly	6
Total		24

Textbooks:

1. Edwards, Norman and Rhonda. (2010). Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management.
2. Sultan (2005). The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.

Reference:

1. Bhatnagar & Patla (2007). Earthworm vermiculture and vermin-composting. Kalyani Publishers, New Delhi

GE-1/Semester-I
Paper I/Subject Name: Animal Diversity: Non-Chordates **Course Code: G1 Subject Code: ZOO142G101** **L-T-P-C- 2-1-0-3** **Credit Units: 3** **Scheme of Evaluation: Theory**

Course Objective: This course is designed to introduce the students to the diversity of non-Chordates, their systemic classification, phylogeny, characteristics, affinities and significance.

Course Outcomes: On completion of the course the students will be able to:

BT1- Describe and identify the diverse non-chordate life forms.
BT2- Classify and compare major phyla with respect to their general characteristics.
BT3- Evaluate the relationships between various phyla
BT4- Summarise the significance of non- chordates.

Detailed course:

Modules	Topics (if applicable) & Course content	Periods
I	**Introduction to Invertebrates**- Diversity, general characteristics and phylogeny of invertebrates. P**rotozoa:** General characters and outline classification up to order. Protozoa – nutrition and diseases associated with Protozoans. **Metazoa**: Origin of metazoa, metamerism and coelom **Porifera:** General characters and outline classification up to order. canal system and affinities.	**12**
II	**Cnidaria:** General characters and outline classification up to order. Polymorphism and alternation of generation. **Platyhelminthes:** General characters and outline classification up to order. General discussion on parasitic Platyhelminthes. **Aschelminthes:** General characters and outline classification up to order. Parasitic nematodes and diseases caused by them.	**12**
III	**Ctenophora:** General characteristics,bioluminescence. **Annelida:** General characters and outline classification up to orders. Metamerism and nephridia. Adaptive radiations in Annelida. **Arthropoda:** General characters and basic classification up to order. Social life of bee, ants and termites.	**12**

IV	**Mollusca:** General characters and outline classification up to order. Torsion in Gastropods. **Echinodermata:** General characters and outline classification up to classes. Water-vascular system in echinoderms. **Economical and ecological significance of non-chordates**: Pearl formation, lac industry, sericulture, role of insect in pollination, biological pest control.	**12**
Total		**48**

Text Book:

1. Rastogi, V.B. (2021). Parker And Haswell Textbook Of Zoology: Invertebrates (8th Ed), Vol. I. Medtech Science Press
2. Ruppert, E.E., Fox, R.S., and Barnes, R. (2004). Invertebrate Zoology. (7th ed).Holt Saunders International Edition. Thompson- brooks/ Cole
3. Kotpal, R. L. (2015). Modern textbook of zoology: Invertebrates. (11th ed). Rastogi publications.
4. Moore, J. (2006). An introduction to the Invertebrates. (2nd ed).Cambridge press
5. Brusca, R. C, Brusca, J. G., Haver, N. J. (2003). Invertebrates. (2nd Ed). Sinauer Associates

References:

1. Solomon, E.P., Martin, E.C., Martin, D.W., Berg, L.R. (2019). Biology. (11th Ed). Cengage.
2. Miller, S.A., & Harley, J.P. (2016). Zoology. (10th ed). Mcgraw-Hill.
3. Campbell, N.A., & Reece, J.B.(2005).Biology. (7th ed). Pearson Benjamin Cummings.

GE-2/Semester-I
Paper I/Subject Name: Human health and Diseases **Course Code: G2** **Subject Code: ZOO142G102** **L-T-P-C- 2-1-0-3** **Credit Units: 3** **Scheme of Evaluation: Theory**

Course Objective: This course is designed to introduce the students to basic concepts health and diseases, how the immune system works against common communicable and non-communicable diseases.

Course Outcomes: On completion of the course the students will be able to:

BT1- Describe the basics of health, diseases and immunity.

BT2- Identify various disease-causing pathogens.

BT3- Summarise the role of immune system.

BT4- Take an informed decision on common communicable and non-communicable diseases

Detailed course:

Modules	Topics (if applicable) & Course content	Periods
I	**Basics of human health** Definition and concept of health; Dimension of wellness; Determinants and indicators of health; Health and nutrition.	**12**
II	**Basics of diseases** Concept of disease; Epidemiology of diseases; Types of diseases.	**12**
III	**Basics of immunity** Concept and types of immunity; antigens and antibodies; vaccination and immunization.	**12**
IV	**Common communicable and non-communicable diseases** Bacterial, viral, protozoan and helminthic diseases; allergy, cancer and addiction; eating disorders.	**12**
Total		**48**

Text Book:

1. Norris, T. L. (2019). Porth's pathophysiology: Concepts of Altered Health States. (10th Ed).
2. McCance., and Huether. (2018). Pathophysiology: The biologic basis for diseases in adults and children. (8th ed.).

References:

1. Scanton and Sanders (2007). Essentials of Anatomy and Physiology. 5th edition
2. Website: https://www. cdc.gov/index.htm
3. Website: https://www.who.int/

Semester-II
Paper I/Subject Name: Comparative Anatomy of Animals **Course Code: C1 Subject Code: ZOO142C201** **L-T-P-C- 3-1-0-4** **Credit Units: 4** **Scheme of Evaluation: Theory**

Course Objective: This course is designed to acquaint students on comparative anatomy of higher Chordates and provide a detailed account of the mechanisms behind different physiological processes.

Course Outcomes: On completion of the course the students will be able to:

BT1- Describe the basic anatomy of various organ systems in the higher Chordates.
BT2- Compare and summarise the physiology of various organ systems that exist in higher vertebrates.
BT3- Interpret understanding behind the mechanisms and rewrite as per understanding

Detailed course:

Modules	Topics (if applicable) & Course content	Periods
I	**Respiratory system**: Skin, Gills, Lungs, Air sacs and voice apparatus, Air bladder and accessory breathing organs in fishes. Mechanism of breathing of Vertebrate series.	**12**
II	**Circulatory System:** Evolution of heart and aortic arches in Invertebrates, Venous system and lymphatic system of Vertebrate animals. **Skeleton System:** Axial and appendicular skeleton, Jaw suspensorium and Visceral arches.	**12**
III	**Nervous System:** General organization of Central nervous system, cranial nerves, Peripheral & Autonomic Nervous System. **Sense Organs:** Classification of receptors, structure and working of Mammalian eye and ear.	**12**
IV	**Urinogenital System:** Succession of kidney- archinephros, pronephros, mesonephros and metanephros, Evolution of urinogenital ducts.	**12**
Total		**48**

Textbooks:

1. Rastogi, V.B., (2021). Parker And Haswell Textbook Of Zoology :Vertebrates. (8th Ed) Vol. II [PB]. Medtech Science Press.
2. Kardong, K.V.(2019). Vertebrates: Comparative Anatomy, Function, Evolution. (8th ed). McGraw-Hill.
3. Jordan, E.L., & Verma, P.S. (2013). *Chordate Zoology*. S. Chand Publishers.
4. Young, J. Z. (2004). The Life of Vertebrates (3rd Ed). Oxford University Press.
5. Kent, G.C. and Carr, R.K. (2000). Comparative Anatomy of the Vertebrates. (9th Ed). The McGraw-Hill Companies

References:

1. Solomon, E.P., Martin, E.C., Martin, D.W., Berg, L.R. (2019). Biology (11th Ed). Cengage.
2. Miller, S.A., & Harley, J.P. (2016). Zoology. (10th ed). Mcgraw-Hill.
3. Campbell, N.A., & Reece, J.B. (2005). Biology. (7th ed). Pearson Benjamin Cummings.
4. Leiem, C.F., Bermis, Walker, W.E, W.F., & Grande, L. (2001). Functional anatomy of the vertebrates, An evolutionary perspective. (3rd Ed). Brookes/Cole, Cengage Learning.
5. Weichert, C.K. & William, P. (1970). Elements of Chordate Anatomy (3rd ed). McGraw Hills.

Semester-II
Paper I/Subject Name: Chordates
Course Code: C2 **Subject Code: ZOO142C202**
L-T-P-C- 3-1-0-4
Credit Units: 4
Scheme of Evaluation: Theory

Course Objective: This course is designed to introduce the students to the diversity of Chordates, their systemic classification, phylogeny, characteristics, affinities and significance.

Course Outcomes: On completion of the course the students will be able to:
BT1- Describe and identify the diverse Chordate life forms.
BT2- Classify and compare major phyla with respect to their general characteristics.
BT3- Evaluate the relationships between various phyla
BT4- Summarise the significance of Chordates.

Detailed course:

Modules	Topics (if applicable) & Course content	Periods
I	**Chordates:** characters and classification. **Protochordates:** General features and classification of Hemichordates, affinities of Balanoglossus, General features, classification and affinities	**12**

	of Urochordates, retrogressive metamorphosis.General features, classification and affinities of Cephalochordates, Amphioxus.	
II	**Agnatha:** General features of Agnatha and classification up to classes. **Pisces:** General characteristics and classification up to order. Osmoregulation in freshwater and marine fishes. **Amphibia:**General characteristics and classification up to order. Origin and evolution of terrestrial ectotherms. Parental care Metamorphosis	**12**
III	**Reptiles:** General characteristics and classification up to order. Distinction between Poisonous and non- poisonous snakes. Poison apparatus and biting mechanism in snakes. **Aves:** General characteristics and classification up to order.Flight adaptations. Mechanism of flight.Migration of birds.	**12**
IV	**Mammals:** General characteristics and classification up to order.Representative types. Mammalian phylogeny. **Integument:** Structure, function and derivatives of integument.Comparative anatomy of integument in vertebrates. Ecological and economic significance of chordates.	**12**
Total		**48**

Text books:

1. Rastogi, V.B.(2021). Parker And Haswell Textbook Of Zoology :Vertebrates. (8th Ed), Vol. I [PB]. Medtech Science Press.
2. Miller, S.A., & Harley, J.P. (2016). Zoology. (10th ed). Mcgraw-Hill.
3. Jordan, E.L., & Verma, P.S. (2013). *Chordate Zoology*. (14th Ed). S Chand.
4. Kardong, K.V. (2008). Vertebrates: Comparative Anatomy, Function, Evolution. (5th Ed). McGraw-Hill.
5. Pough, F. H., Janis, C. M., Heiser, J. B., (2008). Vertebrate life (8th Ed). Pearson
6. Young, J. Z. (2004). The Life of Vertebrates. (3rd Ed). Oxford University Press.

References:

1. Solomon, E.P., Martin, E.C., Martin, D.W., Berg, L.R.(2019). Biology. (11th Ed). Cengage.
2. Campbell, N.A., & Reece, J.B.(2005).Biology. (7th ed). Pearson Benjamin Cummings
3. Holland, et al. 2008. The amphioxus genome illuminates vertebrate origins and cephalochordate biology. Genome reasearch. CSH Press.

Semester-II
Paper I/Subject Name: Practical on Comparative Anatomy of Animals and Chordates **Course Code: C3 Subject Code: ZOO142C203** **L-T-P-C- 3-1-0-4** **Credit Units: 4** **Scheme of Evaluation: Practical**

Course Objective: This course is designed to acquaint students on comparative anatomy of vertebrate skeletal structures and the basic anatomy of various organ systems at the tissue level in the higher Chordates.

Course outcomes: After completion of the course the students will be able to:

BT1- Identify the vertebrate species based on their skeletal structures.

BT2- Compare the various organs of higher vertebrates based on histological slides.

BT3- Prepare temporary slides from given samples.

BT4- Formulate and categorize the disarticulated skeletons of animals

Detailed Course:

Module	Topics (if applicable) & Course content	Periods
I	**1. Protochordata:** Study of *Balanoglossus, Herdmania*, *Branchiostoma, Ciona, Salpa, Doliolum.* Balanoglossussections through Probosis, Collar, branchiogenital & hepatic region. Amphioxus- oral hood, Whole Mount sections through pharyngeal, intestinal & caudal regions. **2. Fishes:** Study of *Petromyzon, Scoliodon, Sphyrna, Pristis, Trygon, Torpedo, Chimaera, Notopterus, Labeo, Catla, Cirrihina, Heteropneustes, Mystus, Exocoetus*. Dissections: Afferent branchial system, V, VII, IX and Xth Cranial nerves of *Scoliodon.*Weberianossicles of *Mystus*. 3. Temporary mounting preparation: placoid, cycloid ctenoid, scales of fishes.	**12**
II	**Amphibia:** Study of *Uraeotyphlus, Necturus, Salamander, Bufo, Hyla, Rhacophorus.*Reptiles: Study of Chelone, Testuda, Kachuga, Hemidactytus, Varanus, Uromastix, Ophiosaurus, Chameoleon, Draco, Hydrophis, Bungarus, Viper, Krait, Coral snakes, Crocodiles.	**12**

III	1. **Aves:** Study of six common birds from different orders. Types of beaks and claws 2. **Mammals:** Study of: Sorex, Shrew, Hedgehog, Bat (Insectivorous & frugivorous). 3. Preparation of blood smears of fish, amphibian, birds and mammals.	**12**
IV	1. Articulated skeleton of Scoliodon. Axial, opercular& appendicular skeleton of Labeo. 2. Disarticulated skeleton of Varanus, Carapace & plastron of tortoise. 3. Disarticulated skeleton of Fowl 4. Disarticulated skeleton of Rabbit 5. Demonstration (through model or virtual) of arterial, venous and urinogenital system of frog 6. Demonstration (through model or virtual) of brain of pigeon and flight muscle. 7. Demonstration (through model or virtual) arterial, venous, urinogenital system of Rat. 8. Study of permanent slides of: lung of mammal, trachea of mammal.	**12**
Total		**48**

Textbooks:

1. Mali, R.P. (2015). A Practical Manual on Innovative Animal Physiology. (1st Ed), Oxford Book Company
2. Lal, S. S. (2020). Practical Zoology- Vertebrates, (12th Ed). Rastogi Publications

Reference:

1. McGowan, C. (1999). A practical guide to vertebrate mechanics. Cambridge University Press.

AECC-3 (Semester II)
AECC-3/Subject Name: Communicative English- II: Conversation and Public Speaking
Subject Code: CEN982A201
L-T-P-C – 1-0-0-1
Credit Units: 1
Scheme of Evaluation: Theory + Viva-Voce + Extempore Speech **Continuous Evaluation: 30 Marks** **Semester End Examination:**

Component A = Written Examination = 30 Marks **Component B + C = Viva-Voce + Extempore speech = 40 Marks**

Course Objective: The objective of the course is to give students a platform to enhance their speaking and conversational skills in English by engaging them in meaningful discussions and interactive activities.

Course Outcomes: On completion of this course students will be expected to -

- Improve speaking skill.
- Develop a life skill on conversation.
- Improve the skill of public speaking.

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I	**Speaking Skills** Speaking – The Art of Speaking, Goals, Speaking Styles, The Speaking Process Importance of Oral Communication, Choosing the form of Communication, Principles & Guidelines of Successful Oral Communication, Barriers to Effective Oral Communication Three aspects of Oral Communication – Conversing, Listening and Body Language Intercultural Oral Communication	**4**
II	**Conversational Skills : Listening and Persuasive Speaking** Conversation – Types of Conversation, Strategies for Effectiveness, Conversation Practice, Persuasive Functions in Conversation, Telephonic Conversation and Etiquette Dialogue Writing, Conversation Control	**4**
III	**Transactional Analysis** The Role of Intonation , Strokes, Psychological Characteristics of Ego States (The Parent, The Adult, The Child), Structure and Aspects of Human Personality Analysing Transactions – Complementary Transactions, Crossed Transactions, Duplex or Ulterior Transactions, How to Identify the Ego States of Interacting Individuals, How to Manage Conversations, Structural Analysis, Certain Habits of Ineffective Conversationalists	**4**
IV	**Public Speaking** Business Presentation and Speeches – Difference Elements of a Good Speech – Planning, Occasion, Audience, Purpose, Thesis, Material Organising and Outlining a Speech Outline, Types of Delivery	**4**

	Guidelines for Delivery – Verbal Elements, Non-Verbal Elements, Vocal Elements, Visual Elements, Controlling Nervousness and Stage Fright	
TOTAL		**16**

Text/Reference Books:

- Mehra, Payal. (2012). *Business Communication for Managers*: Dorling Kindersley (India) Pvt. Ltd. Page 75 – 83. ISBN 978-81-317-5865-6
- Raman, Meenakshi and Singh, Prakash.(2012). *Business Communication* (2nd Edition): Oxford University Press. Page 123 – 165.ISBN-13:978-0-19-807705-03
- Raman, Meenakshi and Sharma, Sangeeta. (2011). *Technical Communication: Principles and Practice* (2nd Edition): Oxford University Press. Page 137 – 148 ISBN-13:978-0-19-806529-6
- Sengupta, Sailesh.(2011) *Business and Managerial Communication.* New Delhi *: PHI Learning Pvt. Ltd*. Page 136-153.ISBN-978-81-203-4435-8

AECC-4 (Semester II)
AECC-4/Subject Name: Behavioural Science - II
Subject Code: BHS982A202
L-T-P-C – 1-0-0-1
Credit Units: 1
Scheme of Evaluation: Theory + Viva-Voce + Extempore Speech **Continuous Evaluation: 30 Marks** **Semester End Examination:** **Component A – Written Examination = 30 Marks** **Component B +C – Viva-Voce + Extempore speech = 40 Marks**

Course objectives: To increase one's ability to draw conclusions and develop inferences about attitudes and behaviour, when confronted with different situations that are common in modern organizations

Course Outcomes: On completion of this course students will be expected to -

- Understand culture and personality
- Understand Value.
- Demonstrate leadership.
- Develop a life skill on motivation

Modules	**Topics (if applicable) & Course content**	**Periods**

I	**Culture and Personality** Relation Between Culture and Personality with Relevant Examples. Cultural Iceberg, Overview of Hofstede's Framework, Discussion of the four dimensions of Hofstede's Framework.	**4**
II	**Attitudes and Values** Attitude's definition: changing our own attitudes, Process of cognitive dissonance. Types of Values, Value conflicts, Merging personal and Organisational values, changes of values with time, male & female values differences.	**4**
III	**Leadership** Definition of leadership, types of leadership, Leadership Continuum Transformational & transactional Leadership, Ethical Leadership.	**4**
IV	**Motivation** Definition of motivation with example, Theories of Motivation (Maslow & X and Y) Applications of motivation.	**4**
		16

Text books:

- Organizational Behaviour by Kavita Singh (Vikas publishers, 3rd Edition).
- Organisational behaviour by S.P Robbins, Judge , Vohra 18th Ed.

SEC-2 (Semester II)
Paper I/Subject Name: Sericulture **Course Code: S1 Subject Code: ZOO142S201** **L-T-P-C – 0-0-2-2** **Credit Units: 2** **Scheme of Evaluation: Practical**

Course Objective: The objective of the course is to introduce the students to the entrepreneurial scope, economic advantages and basic practices involved in sericulture.

Learning Outcomes: Having successfully completed this module A student will be able to learn-

BT1- Students will be able to identify silk producing insects and types of silk
BT2- They will have knowledge of mulberry food plants of silkworm and its cultivation.
BT3- Students will know how to rear and care silkworms independently.
BT4- Learners will understand the entrepreneurial scope of sericulture

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I.	**Introduction:** Insect and non-insect fauna producing silk; types of silk produced in India; host plants of mulberry and non-mulberry silkworms	6
II.	**Scope of Sericulture:** Advantages of sericulture; scope of sericulture in India employment potential and income generation; role of women in sericulture	6
III.	**Concepts of Moriculture:** Host plants of mulberry and non-mulberry silkworms. Mulberry cultivation.	6
IV.	**Concepts of Sericulture:** Life cycle of Bombyx mori; rearing houses and equipment's; disinfection and hygiene. Rearing operations and cocoon harvesting. Diseases in silkworms.	6
Total		**24**

References:

1. Charsley, S.R. (1982). Culture and Sericulture. Academic Press Inc., New York, U.S.A
2. Masood, M. A., and Kamili, A. S. (2000). Principles of Temperate Sericulture. Kalyani Publisher.
3. Devaiah, M.C et al. (2001); Advances in Mulberry Sericulture. Dept. of Sericulture, UAS, Bangalore.
4. Rao, M.M. (1999) Comprehensive Sericulture Manual. P.S Publications, Hyderabad.
5. Govindan, R.; Ramakrishna Naikaand Sannappa, B. (2004) Advances in Disease And Pest Management in Sericulture. Seri Scientific Publishers, Bangalore

GE-3/Semester-II
Paper I/Subject Name: Animal Diversity- Chordates
Course Code: G1 Subject Code: ZOO142G201
L-T-P-C- 2-1-0-3
Credit Units: 3
Scheme of Evaluation: Theory

Course Objective: This course is designed to introduce the students to the diversity of Chordates, their systemic classification, phylogeny, characteristics, affinities and significance.

Course Outcomes: On completion of the course the students will be able to:

BT1- Describe and identify the diverse Chordate life forms.

BT2- Classify and compare major phyla with respect to their general characteristics.

BT3- Evaluate the relationships between various phyla

BT4- Summarise the significance of Chordates.

Detailed course:

Modules	Topics (if applicable) & Course content	Periods
I	**Chordates:** Diversity**,** Characters and classification**;** **Protochordates:** General features and classification of Hemichordates, General features, classification, retrogressive metamorphosis. General features, classification and affinities of Cephalochordates, Amphioxus.	**12**
II	**Agnatha:** General features of Agnatha and classification up to classes. **Pisces:** General characteristics and classification up to order, Osmoregulation in freshwater and marine fishes. **Amphibia:** General characteristics and classification up to order; Parental care; Metamorphosis in amphibians.	**12**
III	**Reptiles:** General characteristics and classification up to order; Poison apparatus and biting mechanism in snakes. **Aves:** General characteristics and classification up to order, Flight adaptation, Mechanism of flight, Migration of birds.	**12**
IV	**Mammals:** General characteristics and classification up to order, nutrition, parental care, mammalian phylogeny, ecological and economic significance of chordates.	**12**
Total		**48**

Text books:

1. Rastogi, V.B. (2021). Parker And Haswell Textbook Of Zoology: Vertebrates. (8th Ed). Medtech Science Press.
2. Miller, S.A., & Harley, J.P. (2016). Zoology. (10th ed). Mcgraw-Hill.
3. Jordan, E.L., & Verma, P.S. (2013). *Chordate Zoology*. (14th Ed). S Chand.
4. Kardong, K.V. (2008). Vertebrates: Comparative Anatomy, Function, Evolution. (5th Ed). McGraw-Hill.
5. Pough, F. H., Janis, C. M., Heiser, J. B. (2008). Vertebrate life (8th Ed). Pearson
6. Young, J. Z. (2004). The Life of Vertebrates. (3rd Ed). Oxford University Press.

References:

1. Solomon, E.P., Martin, E.C., Martin, D.W., Berg, L.R.(2019). Biology. (11th Ed). Cengage.
2. Campbell, N.A., & Reece, J.B.(2005).Biology. (7th ed). Pearson Benjamin Cummings
3. Holland, et al. (2008). The amphioxus genome illuminates vertebrate origins and cephalochordate biology. Genome reasearch. CSH Press.

GE-4/Semester II
Paper I/Subject Name: Animal Parasites
Course Code: G2 Subject Code: ZOO142G202
L-T-P-C – 2-1-0-3
Credit Units: 3
Scheme of Evaluation: Theory

Course Objective: This course is designed to introduce the students to common parasites affecting public health, their life cycles, control measures and the relationships between them and their hosts.

Course Outcomes: On completion of the course the students will be able to:

BT1- Describe, identify and comment on the parasites of clinical importance.
BT2- Compare life cycles of various parasites of clinical importance.
BT3- Evaluate the relationships between various parasites and their hosts.
BT4- Explain role of immune system against parasites

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I	**Introduction:** Introduction to Parasitology, types of animal associations, parasite and types of parasitism (commensalism, symbiosis, phoresis and mutualism).	12
II	**Host Parasite Relationship:** Types of Hosts (Final, intermediate, paratenic and reservoir), vector, natural and unnatural, host parasite relationship and types of parasites. Effects of parasites to their hosts. Modes of transmission of parasites.	12
III	**Host Immunity:** Immunity to parasitic infections (natural and acquired), parasite adaptations. Immune reactions and resistance of host to parasitic infections.	12
IV	**Parasites of clinical importance:** Salient morphological features, diagnosis, life cycle, transmission, pathogenesis, epidemiology of and general control measures of any two parasitic protozoans, helminths and insects affecting humans and livestock	12
Total		48

Textbooks:

1. Leventhal, R., & Cheadle, R. F. (2019). Medical parasitology. (7th Ed). FA Davis

2. Roberts, L.S., Janovy, J.J., Nadler, S. (2012). Foundations of parasitology. (9th Ed). McGraw Hill.
3. Satoskar, A.R., et al. (2009). Medical parasitology. Landes Biosciences.
4. Webster, J.P. 2009. Natural History of Host-Parasite Interactions. Academic Press.
5. Arora, D.R., and Arora, B. (2005). Medical Parasitology. CBS Publishers and Distributors.

References:

1. Gillespie, S., & Pearson, R.D. (2001). Principles and Practice of Clinical Parasitology. Wiley.
2. Chatterjee, K. D. (2009). Parasitology: Protozoology and Helminthology. (13th Ed). CBS Publishers & Distributors (P) Ltd.
3. Clerk, P. (1977). Animal Parasitism.Prentice Hall of India PTL.

SEMESTER- III
Subject Name: Animal Physiology and Biochemistry
Course Code: C1 Subject Code: ZOO142C301
L-T-P-C– 3-1-0-4
Credit Units: 4
Scheme of Evaluation: Theory

Course Objective: The course is designed to provide a detailed account of the different physiological systems and aims to give a comprehensive insight into the relationships between different physiological setups and a fundamental overview on the endocrine machinery of an animal body.

Course Outcomes: Upon completion of the course, students should to be able to:

1. Describe and compare structural aspects of various vital organs with regards to animal physiology.
2. Explain and compare the basic life processes such as digestion, respiration, excretion, etc.
3. Illustrate various regulatory mechanisms for control of physiological processes in the animal body
4. Describe basic biomolecules and their roles and distinguish between the various biochemical pathways.
5. Illustrate various regulatory mechanisms for control of biochemical processes

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I	Digestion and absorption of various nutrients Hormonal control of secretion of enzymes in Gastrointestinal tract. Respiratory system & pigments; Mechanism of respiration, Dissociation curves. Structure of kidney and its functional unit. Components of blood and their functions: Blood clotting system. Structure of mammalian heart; Origin and conduction of cardiac impulses. Blood pressure and its regulation	**12**
II	**Reproductive System:** Physiology of male and female reproduction; Puberty, Methods of contraception in male and female **Endocrine System:** Classification of hormones; Regulation of their secretion; Mode of hormone action, neuroendocrine control of anterior pituitary and endocrine system; Placental hormones.	**12**

III	**Carbohydrates:** Structure and Biological importance; Classification and nomenclature; **Lipids:** Structure and Significance: Physiologically important saturated and unsaturated fatty acids, **Amino acids:** Structure, Classification and General properties of α-amino acids. **Proteins:** Bonds stabilizing protein structure; Levels of organization in proteins; **Vitamins:** Classification and functions. Nucleic acids- Types of DNA and RNA, Complementarity of DNA, Hypo Hyperchromaticity of DNA **Enzyme:** Nomenclature and classification. Mechanism of enzyme action	**12**
IV	**Overview of Metabolism:** Catabolism *vs* Anabolism, Stages of catabolism, Shuttle systems and membrane transporters. Oxidative Phosphorylation**:** Redox systems; Review of mitochondrial respiratory chain. Overview of Carbohydrate, Lipid and Protein Metabolism, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis. Transamination, Deamination, Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids	**12**
TOTAL		**48**

Textbooks:

- Guyton, A.C. & Hall, J.E. (2015). Textbook of Medical Physiology. XIII Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S. (2017). Principles of Anatomy & Physiology. XI Edition John Wiley & Sons
- Nelson, D.L., Cox, M.M., (2017), Lehninger Principles of Biochemistry, (7th Edition), WH Freeman and Company, New York, USA
- Hurray R. K., Podwell V.W. Harper's Illustrated Biochemistry, (31st edition). McGraw Hill Medical.

References:

- Victor P. Eroschenko. (2017). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.
- Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders.
- Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, Mcgraw Hills
- Satyanarayana, U. (2021). Biochemistry, (6th Edition) Elsevier Health Sciences.

SEMESTER- III
Subject Name: Practical on Animal Physiology and Biochemistry **Course Code: C2 Subject Code: ZOO142C313** **L-T-P-C- 0-0-4-4** **Credit Units: 4** **Scheme of Evaluation: Practical**

Course Objective: The course designed to enhance the knowledge of students in physiology, biochemistry and various techniques to assess several important physiological phenomenon.

Course Outcomes: Upon completion of the course, students should to be able to:

1. Quantitatively and qualitatively estimate the amount of carbohydrate, proteins and lipids.
2. Differentiate between the various tissues in the body structurally and morphologically.
3. Assess and interpret the results of various techniques used to analyse physiological health.

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I	Determination of ABO blood group, Enumeration of Red blood cells and White blood cells using haemocytometer, Estimation of haemoglobin using Sahli's haemocytometer, Preparation of haemin and haemochromogen crystals.	**12**
II	Recording of blood pressure using a sphygmomanometer, To determine BMI ratio, Estimation of different respiratory Indices by Spirometry.Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testes, Ovary, Adrenal, Thyroid and Parathyroid,	**12**
III	Qualitative and Quantitative tests of functional groups in carbohydrates, Proteins and lipids, Paper chromatography of coloured compounds.	**12**

IV	Detection of SGOT and SGPT or GST and GSH in serum/tissue, Protein estimation- Biuret, Millon's reagent, Estimation of Ptyalin and Starch, Analysis of Gait.	**12**
Total		**48**

Textbooks:

1. Nelson, D.L., Cox, M.M. (2017). Lehninger's Principles of Biochemistry, (7th Edition), WH Freeman and Company, New York, USA

2. Hurray R. K., Podwell, V.W. (2018). Harper's Illustrated Biochemistry, (31st edition). McGraw Hill Medical.

Reference:

1. Satyanarayana, U. (2021). Biochemistry, (6th Edition) Elsevier Health Sciences.

DSE / Semester-III
Subject Name: Endocrinology
Course Code: D1 **Subject Code: ZOO142D301**
L-T-P-C- 2-1-0-3
Credit Units: 3
Scheme of Evaluation: Theory

Course Objective: The course is designed to provide a general account on endocrine system and regulation of hormone action at the molecular level.

Course Outcomes: Upon completion of the course, students should to be able to:

1. Describe and compare various hormones and their roles.
2. Elaborate the mechanism of hormone action.
3. Illustrate the structure of hypothalamus and anterior pituitary.
4. Categorize and compare different endocrine glands and their disorders.

Detailed Syllabus:

Module	Topics (if applicable) & Course Contents	Periods
I	**The chemical messengers**: Definition and classification of hormores. Endocrine, paracrine and autocrine modes of hormone delivery, Feedback mechanism.	12
II	**Hypothalamo-hypophysial Axis:** Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction; Structure of hypothalamus,	

	Hypothalamic nuclei and their functions; Structure of pituitary gland and its hormones; Hypothalamo-hypophysial portal system	12
III	**Peripheral Endocrine Glands:** Structure, Hormones, Functions and Regulation of Thyroid gland; Parathyroid & Adrenal glands; Pancreas; Ovary and Testis; Hormones in homeostasis; Disorders of endocrine glands.	12
IV	**Regulation of Hormone Action:** Hormone action at Cellular level: Hormone receptors; Transduction and regulation of Hormone action at Molecular level; Molecular mediators; Genetic control of hormone action.	12
TOTAL		**48**

Textbooks:

1. Turner, C. D. (2012) General Endocrinology, (6th Edition) Saunders Toppan.
2. Hadley, M.E. and Levine J.E. (2007) Endocrinology, (6th edition) Pearson Prentice-Hall, New Jersey.

References:

1. Norris, D. O., & Carr, J. A. (2020). Vertebrate endocrinology (6th Edition). Academic Press.
2. Nussey, S. S., & Whitehead, S. A. (2001). Endocrinology: an integrated approach (1st Edition). BIOS Scientific Publishers Limited, Oxford

GE-5/Semester-III
Subject Name: Animal Physiology
Course Code: G1 **Subject Code: ZOO142G301**
L-T-P-C- 2-1-0-3
Credit Units: 3
Scheme of Evaluation: Theory

Course Objective: The course is designed to provide a general account of the different physiological systems, aims to give a comprehensive insight into the relationships between different physiological setups and a fundamental overview on the endocrine machinery of an animal body.

Course Outcomes: Upon completion of the course, students should to be able to:

1. Describe and compare structural aspects of various vital organs with regards to animal physiology.

2. Explain and compare the basic life processes such as Digestion, Respiration, excretion, etc.
3. Outline the regulatory mechanisms for control of physiological processes in the animal body.

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I.	**Digestion and Respiration-** Structural organization and functioning of GI tract and associated glands, Mechanical and Chemical digestion, Absorption, Hormonal regulation. Structural organization of lungs, mechanism of respiration, respiratory volumes and capacities, respiratory pigments	**12**
II.	**Physiology of Heart and Renal Physiology** Structure of kidney and nephron, urine formation and osmoregulation, mode of excretion and hormonal control of excretion. Structure of heart, cardiac cycle, ECG, blood pressure and its regulation	**12**
III.	**Nervous system** Structure of neuron, Resting membrane potential, action potential and its propagation, types of synapses, neuromuscular junction, reflex action and its types, structure and organization of brain and spinal cord.	**12**
IV.	**Endocrine system** Organization of endocrine system, classification of hormone, mode of hormone action, structure and function of hypothalamus, pituitary gland, thyroid gland, para-thyroid gland, pancreas, adrenal gland, sex hormones and placental hormones.	**12**
	Total credits	**48**

TEXT BOOK:

1. Guyton, A.C. & Hall, J.E. (2015). Textbook of Medical Physiology (13th Edition). Hercourt Asia PTE Ltd. W.B. Saunders Company.

REFERENCES:

1. Suresh R. (2012). Essentials of Human Physiology. (1st Edition). Books and Allied (P) Ltd

GE-6/Semester-III
Subject Name: Human Biology
Course Code: G2 Subject Code: ZOO142G302
L-T-P-C- 2-1-0-3
Credit Units: 3
Scheme of Evaluation: Theory

Course Objective: The course is designed to provide a general account the structure of cells, life processes, nutrition, diseases and immunity.

Course Outcomes: Upon completion of the course, students should to be able to:

1. Describe and compare various aspects of human biology.
2. Elaborate the immune response and how a good diet helps in maintaining well-functioning immunity.
3. Explore concepts such as lifestyle diseases and various communicable and non-communicable diseases
4. An understanding of cell as basic working units of life. Also, a better insight of DNA and its functions.

Detailed Syllabus:

Module	Topics (if applicable) & Course Contents	Periods
I	**Introduction to Human Biology -** Cell, Chromosome, DNA; Various Systems: Respiratory, Circulatory, Digestive	12
II	**Food and Nutrition** -Balanced diet, Importance of balanced diet, components of food	12
III	**Human Diseases** Communicable and non-communicable diseases, Lifestyle diseases, Cancer	12
IV	**Immunity** Definition, types of immunoglobulins, Immune response	12
TOTAL		**48**

TEXT BOOK:

1. Starr, C., & McMillan, B. (2013). Human biology, (10th Edition) Cengage Learning.

REFERENCE BOOKS:

1. Chiras, D. D. (2013). Human biology. (5th Edition) Jones & Bartlett Publishers.

Semester IV
Subject Name: Histology & Immunology
Course Code: C1 Subject Code: ZOO142C401
L-T-P-C: 3-1-0-4
Credit Units: 4
Scheme of Evaluation: Theory

Course Objective: The objectives of the course is to introduce students to the basic concepts of immunology, the functioning of the immune system, the components of the immune system along with their structures and function and certain techniques associated with immunology

Course Outcomes: On completion of the course the students will be able to:

BT1- Describe the types of tissues and organs present in the human body connected to immune system

BT2- Explain the fundamentals of histology, especially on the structures as well the function and locations of different animal tissues and organs as well correct identification of tissues and organs when viewed under microscopes

BT3- Demonstrate an understanding of the components and their functions of immune system.

BT4- Examine and identify knowledge about the mechanisms behind several immunological diseases.

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I	**Differentiation**: Stem cells, Types of differentiation; mechanism of cellular differentiation. **Animal tissue:** Organisation of tissue, Types, structure and their functions; epithelial, muscular, connective, nervous tissues. **Histological structure of organs**: GI tract, liver, pancreas, spleen, lung, kidney of mammal.	**12**
II	**Fixation and staining of tissues:** Basic principles of fixation and staining, classification, composition and properties of dye, use of mordants and metachromatic dyes. Microtomy technique.	**12**

III	**Overview of Immune System:** Cells and organs of the immune system, Types of immune cells: lymphoid and myeloid; Primary and secondary lymphoid organs and lymphatic system; Anatomical barriers, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity.	**12**
IV	**Antigen and antibody** Immunoglobulins: Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions. Antigens: Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes. **Immune dysfunctions:** Autoimmune diseases: Rheumatoid Arthritis Immunodeficiency disorders: AIDS., **Techniques in Immunology:** Immunoassays (ELISA and RIA), Polyclonal sera, Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis	**12**
TOTAL		**48**

Text books :

1. Abbas, A. K., Lichtman, A. H., & Pillai,S. (2021). *Cellular and Molecular Immunology*. (10th ed.). Saunders.
2. Albert, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2011). *Molecular Biology of the Cell.* (6th ed.). Garland Science.
3. Delves, P.J., Martin, S.J., Burton, D.R., & Roitt I.M. (2017). *Roitt's Essential Immunology*. (13th ed.). Wiley-Blackwell.

Reference books:

1. Kindt, T.J., Goldsby, R.A., Osborne. B.A., & Kuby, J. (2006). *Immunology*. (6th ed.). W. H. Freeman.
2. Mescher, A. (2013). *Junqueira's Basic Histology: Text and Atlas*. (13th ed.). McGraw-Hill Education
3. Dey. P. (2018). *Basic and Advanced Laboratory Techniques in Histopathology and Cytology*. Springer Singapore.

Semester IV
Subject Name: Practical's on Immunology, Histology and Developmental Biology **Course Code: C2 Subject Code: ZOO142C** **Credit Units: 0-0-4-4**

Scheme of evaluation: Practical

Course Objective: The paper aims to equip students with the practical skills in the field of immunology and histology and developmental biology.

Course outcome:

BT1- Students will be able to identify the fundamental ideas on immunology, histology and developmental biology.

BT2- Students will be able to explain the processes/techniques involved in the preparation of histological slides the completion of the course.

BT3- Preparation of histological slides and blood film to study various tissues and blood cells

BT4- Draw the various developmental stages of whole mount of chick

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I	1. Study of histological slides- Histological study of spleen, thymus, lymph node, Sub-lingual, parotid, sub-maxillary, skin, stomach, intestine, etc. 2. Histological identification of primary and secondary lymphoid organs,	**12**
II	1. Preparation of blood film to study various blood cells. 2. Demonstration of ELISA.	**12**
III	1. Study of whole mount of frog- Blastula, Gastrula, etc. 2. Preparation of developmental stages of chick embryo in fertilized eggs upon incubation at different time periods like 24, 48, 72 and 96 h of incubation 3. Study of splenocytes from spleen	**12**
IV	1. Study of frog development models. 2. Histological slide preparation. 3. Project report on developmental stages of frog/chick.	**12**
Total		**48**

Text books:

1. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2021). *Cellular and Molecular Immunology*. (10th ed.). Saunders.
2. Albert, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2011). *Molecular Biology of the Cell*. (6th ed.). Garland Science.

Reference books:

1. Delves, P.J., Martin, S.J., Burton, D.R., & Roitt I.M. (2017). *Roitt's Essential Immunology*. (13th ed.). Wiley-Blackwell.
2. Kindt, T.J., Goldsby, R.A., Osborne. B.A., & Kuby, J. (2006). *Immunology*. (6th ed.). W. H. Freeman.
3. Mescher, A. (2013). *Junqueira's Basic Histology: Text and Atlas*. (13th ed.). McGraw-Hill Education
4. Dey. P. (2018). *Basic and Advanced Laboratory Techniques in Histopathology and Cytology*. Springer Singapore.

Semester IV
Subject Name: Developmental Biology
Course Code: D1 **Subject Code: ZOO142D402**
L-T-P-C: 3-1-0-4
Credit Units: 4
Scheme of Evaluation: Theory

Course Objectives: The objectives of the course is to introduce students to the basic understanding of the development and structure of gametes, events occurring in early embryonic life, late embryonic life as well as post embryonic development.

Course Outcomes: On completion of this course students will be expected to

BT1- Outline the sequence and events in development in Aves and Mammals using model organisms
BT2- Discuss the structural and functional aspects of different developmental stages in animals.
BT3- Interpret the different phenomenon and structures regarding developmental biology like teratogenesis, regeneration, parthenogenesis, etc. and mechanisms behind them
BT4- Differentiate the different anomalies related to development of an organism as well as infer relations between these anomalies and diseases caused due to them.

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I.	**Basic concepts:** Potency, commiment, specification, induction and organisers, competence, determination and differentiation, morphogenetic gradients, Cell-Cell interaction, Pattern formation, Differential gene expression, equivalence and Cytoplasmic determinants.	**12**

II.	**Gametogenesis, fertilisation and early development:** Spermatogenesis, Oogenesis; Types of eggs, Egg membranes, cell surface molecules in sperm-egg recognition in animals; Fertilization (External and Internal), Blocks to polyspermy; Cleavage: Planes and patterns and types of cleavage; Blastulation, Gastrulation and neurulation: Types of Blastulas, Fate maps- methods of preparation and examples, morphogenetic movements, Fate of Germ Layers and neural crest cells.	**12**
III.	**Extra-embryonic membranes and placenta**: Types and functions of extra embryonic membranes; Structure, types and functions of placenta. **Overview of early development** in frog/chick. **Organogenesis:** Vulva formation in C. elegans, induction of eye lens, tetrapod limb development.	**12**
IV	**Metamorphosis:** hormonal regulation of metamorphosis in amphibians and insects, Retrogressive metamorphosis; regeneration: modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration. Parthenogenesis, Teratogenesis, ageing and senescence.	**12**
TOTAL		**48**

TEXTBOOKS

1. Barresi, M.J.F., & Gilbert, S.F. (2019). *Developmental Biology*. (12th ed.). Sinauer Associates Inc.
2. Girish, E. (2021). *A Textbook of Clinical Embryology*. Cambridge University Press
3. Twyman, R. (2000). *Developmental Biology*. Taylor & Francis

REFERENCE BOOKS

1. Moore, K. L. (2019). *The Developing Human*. (11th ed.). Saunders
2. Schoenwolf, G.C., Bleyl, S. B., Brauer, P.R., & Francis, P.H. (2022). *Larsen's Human Embryology*. (6th ed.). Elsevier.

SEC/Semester IV
Subject Name: Introduction to Microscopy and Histology **Course Code: S1 Subject Code: ZOO142S** **L-T-P-C – 0-0-2-2** **Credit Units: 2**

Scheme of Evaluation: Practical

Course Objectives: The course will introduce the students to microscopy and on the preparation of histological slides.

Learning Outcomes: Having successfully completed this course, learners will be able to-

BT1- Will be able to recognize a light microscope and understand the working of microscopes
BT2- Distinguish and recognize the various cell and tissue structures under the microscope.
BT3- Can relate and employ the basic principles involved in histological methods in the preparation of histological slides
BT4- Students will now be able to prepare and produce histological slides independently.

Detailed Syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I	**Introduction to Microscopy:** Various types of microscopes, their working principles and uses. Important parameters in microscopy (magnification, resolution and contrast).	6
II	Handling and maintenence of light microscope. Study of microscopic structure of cells and tissues using permanent slides.	6
III	Basics principles and methods in histology**:** preparation of chemicals required, Fixation, dehydration, clearing, embedding, sectioning, mounting and staining.	6
IV	Preparation of permanent slides using vertebrate tissues (brain, heart, kidney, muscles, adrenal, testis and ovary).	6
Total		**24**

Textbooks:

1. Dey. P. (2018). *Basic and Advanced Laboratory Techniques in Histopathology and Cytology*. Springer Singapore
2. Mescher, A. (2013). *Junqueira's Basic Histology: Text and Atlas*. (13th ed.). McGraw-Hill Education

References

1. Lindberg, M. R. (2022). Diagnostic Pathology: Normal Histology, 3rd ed, 560 pages, $263, Elsevier
2. Murphy, D. B. (2001). Fundamentals of Light Microscopy and Electronic Imaging 1st Edition, Wiley-Liss

GE/Semester IV
Subject Name: Ecology
Course Code: G1 **Subject Code: ZOO142G401**
L-T-P-C – 2-1-0-3
Credit Units: 3
Scheme of Evaluation: Theory

COURSE OBJECTIVE: To educate the students with basic knowledge of ecology and wildlife

COURSE OUTCOMES:

BT1- To describe and impart a clear knowledge about the concept of ecosystem.

BT2- Discuss and recognize the endangered species and the need for their conservation

BT3- Demonstrate and apply the knowledge while interpreting the threats to biodiversity

BT4- Examine the various IUCN rating and analysing the application of IUCN in categorizing species and to critically evaluate work published in both the primary literature and internet

MODULE	TOPICS AND COURSE CONTENT	PERIODS
I	Fundamentals of Ecology- Definition of ecology, branches of ecology, concept of ecosystem, ecological succession- process and types, niche and types	12
II	Population and Community- Properties of population, population growth- exponential and logistic, population regulation- interspecific and intraspecific factors, community characteristics.	12
III	Biodiversity and Conservation- Value, types, hotspots and threats of biodiversity and aims of conservation, conservation strategies, categories of conservation	12
IV	IUCN rating, threatened species of Northeast India, Need for protected areas. Human- wildlife conflict and management	12
	TOTAL	48

Textbook:

1. Barrick, Barrett and Odum: Fundamentals of Ecology (Cengage Publication, 5th Edition, 2005)
2. P. D. Sharma : Ecology and Environment (Rastogi Publication, Edition: 13, 2017)
3. E. J. Kormondy Edward J: Concepts of Ecology (Pearson Education, 4th edition2017)

References:

1. Turk and Turk: Environmental Science (4rth ed. Saunders, 1993)
2. S. V. S. Rana: Essentials of Ecology and Environmental Science (5th Edition, 2013)
3. Elizabeth Kolbert: The Sixth Extinction: An Unnatural History (Publisher: Henry Holt and Co., 2014)
4. Pranay Lal: Indica- A Deep Natural History of the Indian Subcontinent (Penguin Random House India; Latest edition, 2016)

GEC/Semester IV
Subject Name: Aquaculture **Course Code: G2** **Subject Code: ZOO142G402** **L-T-P-C – 2-1-0-3** **Credit Units: 3** **Scheme of Evaluation: Theory**

COURSE OBJECTIVE: The learners will have a holistic understanding of the fundamentals and techniques used in aquaculture

COURSE OUTCOME:

BT1- The learner will be able to recall and relate to different fundamentals and concepts relevant to aquaculture

BT2- Describe and review the culturable aquatic species and integrated fish farming

BT3- Employ knowledge of health and safety issues in aquaculture ventures

BT4- Interpret the understanding of aquarium culture and ornamental fishes

DETAILED SYLLABUS:

MODULE	**TOPIC AND COURSE CONTENTS**	**HOURS**
I	Introduction to Aquaculture- Salient characters of Aquaculture, Qualities of Culturable of Aquatic	12

	species, Types of Aquaculture practices- pen culture and cage culture	
II	Types of Fish Culture- Composite Fish Farming- meaning, principle, objectives, management Integrated Fish Farming- meaning, objectives, types	12
III	Types of non-Fish Culture- Prawn culture and Pearl Culture	12
IV	Aquarium culture- Types of aquariums, Setting of an aquarium, requirements. Ornamental Fishes	12
	TOTAL	48

Textbooks

1. Chakraborty, C & Sadhu, A. K. (2000). Biology Hatchery and Culture Technology of Tiger Prawn and Giant Freshwater Prawn. Daya Publ. House.
2. Jhingran, V. G. (2009). Fish and Fisheries of India. Hindusthan Publishing Corporation, New Delhi
3. Hertrampf JW & Pascual FP. 2000. Handbook on Ingredients for Aquaculture Feeds. Kluwer.

REFERENCES:

1. Pillay TVR, 1996. Aquaculture Principles and Practices, Fishing News Books Ltd., London
2. ICAR. 2006. Hand Book of Fisheries and Aquaculture. ICAR.
3. Elena M. 2003. Nutrition, Physiology and Metabolism in Crustaceans. Science Publishers.

SEMESTER-V
Subject Name: Genetics and Genomics
Course C ode: C1 **Subject Code:** ZOO142C501
L-T-P-C: 3-1-0-4
Credit Units: 4
Scheme of Evaluation: Theory (As outlined in Point 8)

Course Objective:
This course is an introduction of the basic genetics concepts that permeate several other fields in the biological sciences from biochemistry to cell biology.

Course Outcomes: On completion of this course students will be able to:

CO1- Identify and summarize the concept of gene & gene interaction, and sex- linked inheritance.
C03- Interpret the understanding of topics like mutations, eugenics, genetic counselling, euthenics, euphenics and gene regulation, cytoplasmic inheritance in animals.
CO4- Develop the knowledge of how the genome is transcriptionally regulated (genetically and epigenetically) to yield genetic variation at the level of the phenotype.

Detailed Syllabus:

Modules	Course Contents	Periods
I	**Mendelian Genetics and its Extension:** Principles of inheritance, Incomplete dominance and co-dominance, Epistasis, Multiple alleles, Isoallele (White eye mutations), Pseudoallele (Lozenge Locus) & Cis-trans test for allelism, Lethal alleles, Pleiotropy, Penetrance & Expressivity	**12**
II	**Linkage, Crossing Over and Linkage Mapping**: Linkage and Crossing, Complete & Incomplete Linkage, Measuring Recombination frequency and linkage map construction using three factor crosses, Interference and coincidence Sex linkage in Drosophila (White eye locus) & Human (Haemophilia), Sex chromosome systems: XX/XO, XX/XY, ZZ/ZW and haploidy/diploidy types, Genetic disorders, Genetic counselling	**12**
III	**Mutations:** Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one suitable example from Drosophila and Human of each), variation in chromosome number; Nondisjunction of X chromosome in Drosophila; Non-disjunction of	**12**

	Human Chromosome 21. Molecular basis of mutations in relation to UV light and chemical mutagens. Mutation detection in Drosophila by attached X method. Biochemical mutation detection in Neurospora.	
\IV	**Sex Determination & Extrachromosomal Inheritance** Mechanisms of sex determination in Drosophila and in man; Dosage compensation in Drosophila & Human, Kappa particle in Paramoecium, Shell spiralling in snail. Quantitative and multifactor inheritance, Transgressive variations, Heterosis.	**12**
TOTAL		**48**

Textbooks:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2017). IX ed. Principles of Genetics. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2019). Principles of Genetics. VIII Edition. John Wiley and Sons Inc.

Reference Books:

1. Russell, P. J. (2018). Genetics- A Molecular Approach. VIII Edition. Benjamin Cummings.
2. Glick, B.R., Pasternak, J.J. (2017). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

SEMESTER-V

Subject Name: Genetics and Genomics (Practical)

Course Code: C2 **Subject Code:** ZOO142C513

L-T-P-C: 0-0-8-4

Credit Units: 4

Scheme of Evaluation: Lab. Work/ Practical (As outlined in Point 8)

Course Objective: The primary course objectives of the paper is to help students develop practical skills on Genetics, Genomics and Ecology

Course Outcomes: On completion of this course students will be expected to:

CO1- List the normal and aberrant metaphase plate of eukaryotes.
CO2- Compare and summarize the different aspects of genotype combination in dihybrid cross
C03- Identify the genetic distance between two loci in a chromosome.

Detailed Syllabus:

Modules	Course contents	Periods

I	1. Calculation of genetic distance between two loci in a chromosome. 2. To study of karyotype of normal and aberrant metaphase plate of eukaryotes	**12**
II	3. Detection of polytene chromosome in Chironomus larvae. 4. Calculation of genotype combination in dihybrid cross based on Mendelian genetics.	**12**
III	5. Meiotic chromosome preparation from rat/ grasshopper/ sandhopper testis 6. Preparation of human karyotype from two normal and 2 abnormal metaphase plates	**12**
IV	7. Chromosomal aberration assay from bone marrow of rat 8. Study of G- banding and C- banding of mitotic chromosome prepared from mouse/ rat bone marrow cells	**12**
Total		**48**

Textbooks:

1. Rani and Kumar (2022). Fundamentals of Genetics (A practical Approach). Publisher: Kalyani Publication. ISBN: 978-9389900637
2. Trigunayat & Trigunayat (2019). A Manual of Practical Zoology: Biodiversity, Cell Biology, Genetics & Developmental Biology. Scientific Publishers. ISBN9789388449076

Reference:

1. Panigrahi, K. K. (2019). Practical Manual on "Fundamentals of Genetics" (PBG-121). Edition: First Publisher: Odisha University of Agriculture & Technology.

SEMESTER-V

Subject Name: Parasitology

Course C ode: D1 **Subject Code:** ZOO142D501

L-T-P-C: 3-1-0-4

Credit Units: 4

Scheme of Evaluation: Theory (As outlined in Point 8)

Course Objective: The primary course objectives of the paper is to provide students with knowledge concerning biological, epidemiological, and ecological aspects of parasites causing diseases to humans.

Course Outcomes: On completion of this course students will be expected to:

CO1- Identify the pathogenesis, clinical presentations, and complications of parasitic diseases.

CO2- Compare and summarize the treatment, prevention, and control of parasitic infections.

C03- Interpret the genetic distance between two loci in a chromosome.

Detailed Syllabus:

Module	Course Contents	Periods
I	Introduction to Parasitology, Types of parasites; Type of hosts. Zoonosis. Global warming and impact on parasites	12
II	Protozoan Parasites: Life cycles, mode of infection of *Entamoeba, Plasmodium, Leishmania*	12
III	Helmintic Parasites: Morphology, biology, life cycles, mode of infection of *Giardia, Schistosoma, Wuchereria* and *Taenia*	12
IV	Immune Response: Immune response of body towards parasite; adaptations of parasites. Parasites of veterinary importance	12
	Total	48

Textbooks

1. Foundations of Parasitology, Roberts L.S. and Janovy J., McGraw-Hill Publishers
2. Modern Parasitology: A Textbook of Parasitology, FEG Cox., Wiley-Blackwell

References

1. Chandler & Read: Introduction to Parasitology, Wiley, 1970.

SEMESTER-V
Subject Name: Aquatic Biology
Course C ode: D2 **Subject Code:** ZOO142D502
L-T-P-C: 3-1-0-4
Credit Units: 4
Scheme of Evaluation: Theory (As outlined in Point 8)

Course Objective: The primary course objectives of the paper is to provide students with a broad-based foundation in science together with extensive subject knowledge in the discipline of aquatic biology.

Course Outcomes: On completion of this course students will be expected to:

CO1- Identify the relevant scientific principles in aquatic biology.

CO2- Compare and summarize the unique environmental problems dealing with aquatic environments.
C03- Interpret and evaluate information relevant to aquatic biology.

Detailed Syllabus:

Module	Course Contents	Hours
I	Introduction to Aquatic biology: Salient characters of Aquaculture, Qualities of Culturable of Aquatic species (Fish, Prawn and Pearl), Types of Aquaculture practices- pen culture and cage culture. Co-breeding of exotic and local fishes.	12
II	Aquatic Organisms: Feeding in aquatic fishes; respiration in aquatic organisms; Locomotion in water. Adaptation of hill-stream fishes. Adaptation of deep sea fishes. Migration of fishes. Biofloc culture.	12
III	Abiotic conditions of Freshwater ecosystems: Brief introduction of the aquatic ecosystems; Freshwater ecosystems (lakes, wetlands, streams and rivers). Physico-chemical Characteristics of fresh water bodies: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity: dissolved gases (Oxygen, Carbon dioxide).	12
IV	Brief knowledge of marine ecosystems: Lentic and lotic ecosystem Estuaries, intertidal zones, Oceanic pelagic zone, marine benthic zone. Physico-chemical nature of marine water.	12
	Total	48

Textbooks:

1. Goldman, C. (1994) Limnology (2nd edition).
2. Ananthakrishnan, T.N. (1989) Bioresources Ecology (3rd edition).

References

1. Odum, E.P. and Barrett, G.W. (2004) Fundamentals of Ecology (5th edition).
2. Pawlowski, L. (1980) Physicochemical Methods for water and Wastewater Treatment.
3. Wetzel, R. (2001) Limnology (3rd edition) Elsevier

SEMESTER-V
Subject Name: Evolutionary Biology **Course C ode: D3** **Subject Code:** ZOO142D503 **L-T-P-C**: 3-1-0-4 **Credit Units:** 4 **Scheme of Evaluation:** Theory

Course Objective: The aim of the course is to provide comprehensive overview of concept of evolution and origin of life.

Course Outcome: After successful accomplishment of the course, the students will be able to-

CO1- Describe the essential aspects of Evolutionary Biology in detail which will help them in acquiring better understanding regarding the subject.

C02- Classify the various forces that shapes evolution.

CO3- Explain the process of speciation and macro-evolutionary processes.

Detailed Syllabus:

MODULE	COURSE CONTENTS	PERIODS
I	**Origin of Life:** An overview of pre-biotic conditions and events in the origin of earth. Chemogeny: RNA world hypothesis. Biogeny: Cellular evolution based on proto-cell models (coacervates and proteinoid micro-spheres). Origin of photosynthesis: Evolution of oxygen and ozone build-up. Endosymbiotic theory: Evolution of Eukaryotes from Prokaryotes. **Historical review of Evolution:** Lamarkism, Darwinism, Neo-Darwinism, Modern Synthetic theory. **Evidence of evolution:** Fossil study, vestigial, homologous and analogous organs.	12
II	**Forces of Evolution (Qualitative Studies):** Natural selection, Modes of natural selection, Industrial melanism, Mutation, Meiotic drive, Genetic drift; bottleneck effect, founder effect. **Forces of Evolution (Quantitative Studies):** Population Genetics; Gene pool, gene/allele frequency, genotypic frequency, phenotypic frequency, Hardy-Weinberg's Law of Genetic Equilibrium.	12
III	**Speciation:** Concept of species, Mechanism of reproductive	12

	isolation, Modes of speciation; allopatric, sympatric, parapatric & peripatric speciation, Patterns of speciation; anagenesis & cladogenesis, Macroevolution and Microevolution.	
IV	**Macro-evolutionary Phenomena:** Geological time scale, Phylogenetic study in macro-evolutionary process; tree of life, techniques in phylogenetic analysis (morphological and molecular), Overview of Hominin Evolution.	12
	Total	48

Textbooks-

1. Veer Bala Rastogi (2018). Organic Evolution, 13th Edition, Medtech.
2. Dr. B.S. Tomar, Dr. S.P. Singh (). Evolutionary Biology, 9th Edition, Rastogi Publications.
3. Minkoff, E. C. (1983). Evolutionary biology. Reading, MA: Addison-Wesley Publishing Company.

References-

1. Douglas J. Futuyma and Mark Kirkpatrick (2017). Evolution, 4th Edition, Sinauer Associates.
2. Geoffrey Zubay (2000). Origins of Life on the Earth and in the Cosmos, 2nd Edition, Academic Press.
3. Mark Ridley (2004). Evolution, 3rd Edition, Blackwell Publishing.
4. Monroe W. Strickberger (2000). Evolution, Jones & Bartlett Publishers.
5. Theodosius Dobzhansky (1959). Evolution, Genetics and Man, John Wiley & Sons.

SEMESTER-V
Paper/Subject Name: Basic Biostatistics **Course C ode: D4** **Subject Code:** ZOO142D504 **L-T-P-C**: 3-1-0-4 **Credit Units:** 4 **Scheme of Evaluation:** Theory

Course Objectives:

To impart knowledge to students on the basics of biostatistics as an important skill which is required for data collection, data representation and its analysis on a daily basis. The course also aims to familiarise the students with application of computer programs and softwares in biological data analysis for the daily design of experiments as well as hands on practical exercises.

Course Outcomes: After completion of this paper, the students will be able to-

CO1: Define the basic concepts of biostatistics and its various applications in different fields of biological sciences.

CO2: Demonstrate understanding of descriptive statistics & graphical tools and apply hypothesis testing to the available data.

CO3: Application of various computer programs and softwares that are employed to retrieve/ analyze various biological data.

Course Outline:

Module	Course Content	Periods
I	**Data handling:** population, sample, variable, parameter, primary and secondary data, screening and representation of data, frequency distribution, tabulation, bar diagram, histograms, pie diagram.	12
II	**Descriptive statistics:** Measures of Central Tendency and their uses- Arithmatic Mean, Median, mode. **Measure of variability:** Standard Deviation in data analysis and Standard error and their calculation; standard deviation, coefficient of variation.	12
III	**Probability-** Definition of probability (frequency approach), independent events. Addition and multiplication rules, conditional probability, examples- poisson and normal distributions.	12
IV	**Hypothesis testing:** Z-test, t –Test, chi-square test Application of statistics in biology.	12
	Total	48

Textbooks:

1. Le C.T and Eberly L.E (2016). Introductory Biostatistics. 2nd Ed, John Wiley & Sons.
2. Pagano M and Gauvreau K (2000). Principles of Biostatistics. 2nd Ed, CRC Press.

References:

1. Mount D.W (2001). Bioinformatics: Sequence and Genome Analysis. 2nd Ed, ColdSpring Harbor Laboratory Press, New York, USA.

2. Krane D.E and Raymer M.L (2003). Fundamental concepts of bioinformatics. Benjamin Cummings.
3. Claverie J.M and Notredame C (2007). Bioinformatics for Dummies. 2nd Ed, WileyPublishing, Inc., New York, US.

SEMESTER-VI
Subject Name: Ecology and Wildlife Biology **Course C ode: C1** **Subject Code:** ZOO142C601 **L-T-P-C**: 3-1-0-4 **Credit Units:** 4 **Scheme of Evaluation:** Theory (As outlined in Point 8)

Course Objective: The primary course objective of the paper is to understand patterns in ecosystem and knowledge across dimensions of ecological organization.

Course Outcome: After successful accomplishment of the course, the students will be able to learn most of the essential aspects of ecology.

CO1: Describe the different aspects of community ecology and dynamics of population.

CO2: Summarize the importance of biodiversity conservation, flagship species in current backdrop of ecological loss and the aspect of human wildlife conflict, wildlife trade and related pandemics.

CO3: Interpret the understanding of how biotic and abiotic factors affect the abundance and distribution of organisms in natural communities.

CO4: Take an informed decision regarding the best environmental practices followed around the world.

Detailed Syllabus:

Module	Course Contents	Periods
I	**Introduction to ecology:** Historical outline, Elements of ecology; Biotic and abiotic factors and their interactions. Levels of organization, Laws of limiting factors, Ecotone and Edge effect, Ecological niche; Fundamental & Realized.	12
II	**Population ecology (Autoecology):** Population characteristics & dynamics, Population growth; exponential & logistic, Population regulation; density-dependent and independent, Population interactions; negative and positive interactions. **Community ecology (Synecology):** Characteristics of community, Community structure and composition, Intra & Inter specific competition, Lotka-voltera equation for prey-predator relationship.	12
III	**Ecosystem:** Overview, Ecological balance; Ecological succession; concepts of ecological succession, general process of succession, types of succession. **Ecosystem productivity:** Food chains & food web, Ecological	12

	pyramids. Productivity and energy flow in an ecosystem.	
IV	**Biodiversity and its conservation:** Hotspots of biodiversity, endemic species, strategies for biodiversity conservation, Protected areas and sacred groves, Endangered flagship species (with special reference to Assam); human wildlife conflict and management, wildlife trade and ecology of diseases outbreaks,	12
TOTAL		48

Textbooks-

1. Barrick, Barrett and Odum: Fundamentals of Ecology (Cengage Publication, 5th Edition, 2005)
2. P. D. Sharma: Ecology and Environment (Rastogi Publication, Edition: 13, 2017)
3. E. J. Kormondy Edward J: Concepts of Ecology (Pearson Education, 4th edition2017)
4. Chapman & Reiss: Ecology: Principles and applications (Cambridge Univ. Press, 1992)
5. A.R. Conklin: Field Sampling: Principles and Practices in Environmental Analysis (CRC Press, 2004)

References:

1. Turk and Turk: Environmental Science (4rth ed. Saunders, 1993)
2. S. V. S. Rana: Essentials of Ecology and Environmental Science (5th Edition, 2013)
3. Rachel Carson: Silent Spring, (Penguin UK; New Ed edition, 2000)
4. Elizabeth Kolbert: The Sixth Extinction: An Unnatural History (Publisher: Henry Holt and Co., 2014)

SEMESTER-VI
Subject Name: Ecology (Practical)
Subject Code: ZOO142C613
L-T-P-C: 0-0-8-4
Credit Units: 4
Scheme of Evaluation: Lab. Work/ Practical (As outlined in Point 8)

Course Objective: The primary course objectives of the paper is to help students develop practical skills on ecology.

Course Outcomes: On completion of this course students will be expected to:
CO1- Identify the biotic and abiotic factors and their impact on the abundance and distribution of organisms in natural communities.
CO2- Compare and summarize the different aspects of community ecology and dynamics of population.
C03-. Summarize the various citizen science tools used to study different species.

Detailed Syllabus:

Modules	Course Contents	Periods
I	Estimation of different parameters (pH, DO) of pond ecosystem. To study the distribution of insects in RGU campus	**12**
II	Study of population density by Quadrant method in RGU campus Study of life tables of different types from hypothetical/real data provided.	**12**
III	Population estimation using Mark-recapture method- Using a suitable insect model, (e.g., rice weevil using - marker pen) Identification of birds and butterflies in and around RGU campus	**12**
IV	Introduction to handheld GPS and recording of location data. Using citizen science tools- India Biodiversity Portal, ifoundbutterflies and iNat	**12**
Total		**48**

Textbooks:

1. Vodopich, D. (2010). Ecology Lab Manual, 1st Edition. ISBN10: 007338318X | ISBN13: 9780073383187
2. Rao (2003). Practical Ecology. Anmol Publications Pvt Ltd. ISBN- 9788170417248

References:

1. Mumjadar (2019). Practical Manual of Ecology and Environment Science. Prestige Books

SEMESTER-VI

Subject Name: Agrochemicals and Pest Management

Course C ode: D1 **Subject Code:** ZOO142D601

L-T-P-C: 3-1-0-4

Credit Units: 4

Scheme of Evaluation: Theory (As outlined in Point 8)

Course Objective: The primary course objectives of the paper is to understand agrochemicals and their mode of action.

Course Outcomes: On completion of this course students will be expected to:

CO1- Identify the difference various kinds of agrochemicals.
CO2- Compare and summarize the knowledge of specific modes of pesticide activity

C03-. To summarize and develop awareness of the laws and regulations governing the proper use of pesticides.

Detailed Syllabus:

Modules	Course Contents	Periods
I	**Concept of pest:** Definition, classification- weeds, bacteria, fungi, Viruses, nematodes, molluscs, Arthropods, birds, mammals etc.; Causes of outbreak of pest; Public health pests, Agricultural pests, Domestic pests	**12**
II	**Agrochemicals/ nutrients for increasing the health of plants.** Manures, Compost, Vermicomposting; Biogas plant slurry. Chemical fertilizers: N- fertilizers & P- fertilizers. Biofertilizers: Rhizobium, Azolla, Blue Green Algae	**12**
III	**Agrochemicals for pest management**: Coventional chemicals/ pesticides based on target species: Acaricides, Fungicides, Rodenticides, Nematicides, Molluscicides, Fumigants and Repellents. Organophosphates; Organochlorines, Carbamates: structure, chemical name, physical and chemical properties, Mode of action, uses, toxicity;	**12**
IV	**Botanicals and other biopesticides:** Role in pest control; Other biopesticides: Pyrethrins, Pyrethroids, Rotenone, Nicotine and Nicotinoids. Growth inhibitors, pheromones and attractants; Insect growth regulators, juvenile hormones, moulting hormones; genetically modified and transgenic plants	**12**
Total		**48**

Textbooks:

1. Sathe, T. V. (2003). Agrochemicals and Pest Management. Daya Publishing House
2. Vasantharaj, D. B. (2016). Elements of Economic Entomology 8th Ed. Brillion Publishing, Paperback

References:

1. Dent, D. (2000) Insect pest management (2nd edition) CAB International.
2. Roberts, D.A. (1978) Fundamentals of Plant Pest Control.
3. Hill, D.S. (1983) Agricultural insect pests of the tropics and their control- Cambridge Univ. Press.
4. Atwal, A. S. (1986) Agricultural pests of India and Southeast Asia.

SEMESTER-VI
Subject Name: Livestock Management and Animal Husbandry **Course C ode: D2** **Subject Code: ZOO142D602** **L-T-P-C** –3-1-0-4 **Scheme of Evaluation: Theory** (As outlined in Point 8)

Course Objectives: The course provides intensive study in livestock production, management, marketing, nutrition, breeding, production records, selection, animal health, waste management, and conservation practices.

Course Outcomes:

CO1- State the breeding systems for a livestock enterprise.
CO2- Associate the importance of genetic improvement in animal production.
CO3- Show and relate current and future issues relating to animal husbandry.

Detailed syllabus:

MODULE	Course Contents	PERIODS
I	**Animal products and breeding systems** 1. Scope of Livestock Industry; Livestock Enterprises; Issues in Animal Agriculture. 2. Animal Products and Importance, Common Breeding Systems: cattle, swine, goat, Reproductive Technologies.	12
II	**Animal products and breeding systems:** 1. Nutritional requirements: Energy requirements for maintenance, growth, milk, egg, wool, and meat production. 2. Common Feedstuffs Systems, Advanced Ration Formulations	12
III	**Maintenance of breeds** Common Breeds of Livestock; Management of breeding stocks: housing, maintenance, healthcare- vaccination programmes and de-worming programmes	12
IV	**Marketing and related issues** Planning and Marketing; Quality control; Future prospects; Genetic improvement of breeds. Current issues affecting the livestock industry	12

	Total	48

Textbooks-

1. Taylor, R.E and Field, T.G. (2004).Scientific Farm Animal Production: An Induction to Animal Science. Prentice-Hall
2. Acker, D. and Cunningham, M. (1998). Animal Science & Industry. Prentice-Hall.

References

1. Blakely, J. and Bade, D. (1985). The Science of Animal Husbandry. Prentice-Hall.
2. Cooper, E. L. (1990). Agriscience: Fundamentals & Applications Delmer: Albany.

SEMESTER-VI

Subject Name: Aquariculture
Course C ode: D3 Subject Code: ZOO142D603
L-T-P-C – 3-1-0-4
Scheme of Evaluation: Theory (As outlined in Point 8)

Course Objectives: The course envisages information on the industry of Aquariculture and to equip the students with the associated techniques and other important aspects would be addressed.

Course Outcomes:

1. To describe the ornamental fish morphology.
2. Classify and compare the basic accessories of an aquarium.
3. Evaluate the importance of the industry both economically and ecologically.

Detailed syllabus:

MODULE	COURSE CONTENTS	PERIODS
I	**Basics of Aquariculture:** Aquarium and its types, Aquatic plants used in aquarium and their care, types of substrates used and its significance, drift woods, types of aquarium filters, fish feed	12
II	**Aquarium:** Construction of an aquarium, selection of aquarium dimensions, calculation of volume of water in aquarium, cleaning of a tank.	12
III	**Ornamental fishes and their Breeding:** Characteristic features of common aquarium fishes, Role of snails and Shrimps in an aquarium, identification of the sex of fish, breeding accessories, techniques of fish breeding, care of fish lings.	12

IV	**Importance of Aquariculture:** Economic importance of aquariculture, Ecological importance of aquariculture, Negative impacts of the aquariculture industry, recent advancements in aquariculture.	12
	Total	48

Textbooks:

1. Ahilan, Felix and Santhnam, R. (2008) Textbook of Aquariculture, Pub- Daya Publishing House.
2. Slathia, I. and Rana, R. S. (2020) Aquariculture, U.F. Publishers.

References:

1. Handbook of Fisheries and Aquaculture (2014). Indian Council For Cultural Relations New Delhi

SEMESTER-VI
Subject Name: Biotechnology **Course Code: D4** **Subject Code: ZOO142D604** **L-T-P-C – 3-1-0-4** **Scheme of Evaluation: Theory** (As outlined in Point 8)

Course Objectives: The course envisages to acquaint students with basic molecular biological concepts and techniques used in the fields of biotechnology including genetic engineering.

Course Outcomes:

1. Improve the basic concepts in genetic engineering
2. Develop understanding of industrial biotechnology.
3. Evaluate and understand the techniques of proteomics and genomics

Detailed Syllabus

UNIT	COURSE CONTENTS	HOURS
1	Introduction to Genetic engineering and Biotechnology: Definition, history and scope. Molecular Genetic Tools: Restriction enzymes and their types (I, II, III), mode of action, cohesive and blunt end restriction, isoschizomers. Ligases, T4 kinase, Dnase-I, RNase H, Transformation in bacteria, animal and plant cells. Gene cloning vestors: Plasmid vectors- nature and properties, pUC18, pBR322, M13 and high capacity vectors (BAC, YAC), marker genes. Gene transfer techniques.	12

2	Industrial Biotechnology: Basic principle of Bioprocess engineering, Up-stream, Mid-stream and Downstream processing. Basic design of fermenter/bioreactor, tower and photo bioreactor. Microbial growth curve and its significance. Application of microbes in food process operations and production: Beer, wine, curd and cheese production. Applications of enzymes in food processing: enzymatic bioconversions *e.g*., starch and sugar conversion processes, High-Fructose Corn Syrup, and their downstream processing.	12
3	Genomics and its techniques: Introduction of genomics, Southern, Northern, Western blotting and hybridization, Gel Retardation Assay (GRA); DNA finger printing techniques: RFLP, RAPD, AFLP, SNP etc. Primer design; DNA polymerases; Types of PCR: multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR.	12
4	Proteomics and its techniques: Introduction to proteins to proteomes; Basics of proteomics and its applications; Types of proteomics; Approaches and techniques for proteomics study: Chromatography, 1-D & 2-D gel electrophoresis, in gel digestion, Protein sequencing, Mass spectrometry and analysis (ESI, MALDI), Functional proteomics: Yeast Two-Hybrid (YTH), Immunoprecipitation, Microarray technology	12
	Total	**48**

Textbooks:

1. Molecular Biotechnology (4th Edition) ©2010 by Bernard R. Glick, Jack J. Pasternak and Cheryl L. Patten

2**.** Recombinant DNA: A Short Course by JD Watson, J. Tooze and DT Kurtz.

3. Victor Rodwell, David Bender, P. Anthony Weil, Peter Kennelly. *Harpers Illustrated Biochemistry* 31th Edition, 2018

4. From Genes to Genomes: Concepts and Applications of DNA Technology by JW Dale and M Schantz

5. Molecular Biotechnology: Principles & Applications of Recombinant DNA Glick BR and Pasternak JJ

References:

1. J.M. Berg, J.L. Tymoczko, L. Stryer. . Biochemistry,9th Edn.(2019) WH Freeman and Company, New York and England.

2. R. Verna.. Membrane Technology, Raven Press, New York., USA.

3. H. Lodish, A. Berk, S.L. Zipursky, P. Matsudaira, D. Baltimore, J. Darnell.. Molecular Cell Biology,8th Edn. WH Freeman and Company, NY and England

4. H.R. Petty.. Molecular Biology of Membranes Structure and Function, Plenum Press, New York, USA and London.
5. D.F.H. Wallach.. Membrane Molecular Biology of Neoplastic Cells, (1975) Elsevier Scientific Publishing Company, Amsterdam, Oxford and New York., USA.
6. R.R.C. New. Liposomes a Practical Approach, IRL Press, Oxford, New York., USA. and Tokyo.
7. A. Azzi, L. Masotti, A. Vecli.. Membrane Proteins Isolation and Characterization, (1986) Spriger-Verlag, New York, USA.

SEMESTER-VI
Subject Name: Basics of Bioinformatics
Course Code: D5 **Subject Code:** ZOO142D605
L-T-P-C: 3-1-0-4
Credit Units: 4
Scheme of Evaluation: Theory

Course Objectives:

To impart knowledge to students on the most important skill which is required to use computer programs for the daily design of experiments, data collection, and analysis of results as well as hands on practical exercises on various computer programming.

Course Outcomes:

CO1: State various computer applications that are employed to retrieve various biological data.

CO2: Describe various biological database namely EMBL, SWISS-PROT, Pub-Med etc. that are useful in the field of bioinformatics.

CO3: Apply knowledge to evaluate various sequence analysis and alignment techniques.

Course Outline:

MODULE	COURSE CONTENT	PERIODS
I	**Basics of bioinformatics:** Definition, Scope and Goal, Application in Computational Biology, Limitations. **Biological Database:** Types of database, biological database: GenBank, EMBL, DDBJ, Uniprot-KB: SWISS-PROT, PDB, literature databases PubMed; Webtools: ExPASy server	12
II	**Sequence Analysis and Sequence Alignment**: Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues and xenologues, Basic concepts of sequence alignment, Uses of Sequence Alignment, Pairwise, multiple, Database Similarity search.	12

III	**Scoring matrices:** Basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, Sequence similarity search: BLAST and FASTA. **Molecular Phylogenetics:** Basic concepts, Methods in evaluation of phylogeny and steps in constructing alignments and phylogenetic Trees, Types of phylogenetic tree.	12
IV	**Structural bioinformatics:** proteins and its structure, Determination of protein 3-Dimensional structure, Protein structure visualization, comparison, Secondary and tertiary structure prediction. Application of computer in biology and data processing in computer	12
	TOTAL	48

Textbooks:

1. Mount, D.W. (2001). Bioinformatics: Sequence and Genome Analysis. 2nd Ed, ColdSpring Harbor Laboratory Press, New York, USA.
2. Krane, D.E and Raymer, M.L. (2003). Fundamental concepts of bioinformatics. Benjamin Cummings.

References:

1. Claverie, J.M and Notredame, C. (2007). Bioinformatics for Dummies. 2nd Ed, Wiley Publishing, Inc., New York, US.
2. Ghosh, Z and Bibekananda, M. (2008). Bio informatics: Principles and Applications, Oxford University Press.
3. Pevsner, S. (2015). Bio-informatics and Functional genomics, Wiley-Blackwell

SEMESTER-VI
Subject Name: Entomology **Course Code: D6** **Subject Code:** ZOO142D606 **L-T-P-C**: 3-1-0-4 **Credit Units:** 4 **Scheme of Evaluation:** Theory

Course Objective: The students will gain knowledge of detailed insect structure, pest of forest and agriculture and their economic importance.

Course Outcome: Post learning this course, students will be able to-

CO1- Observe insect body, shape, wing venation and eye.

CO2- Associate the various components of insect physiology.

CO3- Interpret and analyse the insect control measures.

Detailed Syllabus:

Module	Topics (if applicable) & Course Contents	Periods
I	**Insect Structure:** Structure of insect head, thorax and abdomen, insect integument, Type of mouthparts, antennae, legs and their modifications & function, Wings, wing structure, venations and wing coupling, Insect eye: structure & function	12
II	**Insect Physiology:** Digestive system, Respiratory system, Circulatory system, Nervous System, Reproductive system, Excretory system.	12
III	**Agricultural and Forest Entomology:** Stored grain pests: *Sitophilus oryzae*, *Tribolium castaneum*, *Callobruchus chinensis*- Life history. Forest insects: defoliators, borers and suckers of Teak, Sal, Gamari.	12
IV	**Pest Control:** Primary control measures: Physical, Mechanical, Chemical, Cultural and Legislative measures. Integrated Pest Management	12
	Total	48

Textbooks:

1. Chapman, R. F. (2012). The Insects: Structure and Function, 4th Edition, Cambridge University Press
2. Tembhare, D.B. (2009). Modern Entomology, 2nd Edition, Himalaya Publishing House

References:

1. Prasad, T.V. (2019). Handbook of Entomology (4th Edition) Paperback. New Vishal Publications
2. Madhavan, S. A. (2020), Agriculture Entomology Collection and Preservation of Insects: Equiment and insects Collection methods. Notion Press

SEMESTER-VI
Subject Name: Wildlife Photography and Ecotourism **Course Code: S1** **Subject Code:** ZOO142S621 **L-T-P-C**: 3-1-0-4 **Credit Units:** 4 **Scheme of Evaluation:** Practical

Course Objective: The idea is to spark an entrepreneurial side in our final year students. To introduce photography and nature tourism as a skill

Course Outcome: Post learning this course, we can expect following outcomes-

CO1- Have a knowledge of basics of photography and settings of camera.

CO2- Compare the various tools and technique of photography.

CO3- To analyse the scope of ecotourism in India.

CO4- Summarise and evaluate the available career options in wildlife photography and ecotourism.

Detailed Syllabus:

Module	Topics (if applicable) & Course Contents	Periods
I	**Introduction To Photography:** Introduction of Photography; A brief history. Revaluation of Cameras. Basic settings of Camera	12
II	**Tools and Technique of Photography:** Still & Video Photography. To develop expertise in Photography. Photography in different periods (Light and Dark), seasons and places (Wetlands, Wildlife sanctuaries, National parks, Industrial sites etc.)	12
III	**Eco-tourism:** Introduction of Eco-tourism. Scope of Eco-tourism with special reference to Northeast region of India. Management of Eco-tourism & hospitality	12
IV	**Wildlife Photography and Ecotourism as a career**: Nature guides as a profession. Development of Eco-tourism with innovative Eco-restoration ideas. Submission of a photography and report.	12
	Total	48

Textbooks:

1. Ken Milburn & Ron Rockwell (2002). Digital photography bible (2nd Ed), Wiley.
2. Julie Adair King (2003). Shoot Like a Pro! Digital Photography Techniques (1st Ed), McGraw-Hill Osborne Media.

References

1. Ballantyne R. & Packer J (2013). International Handbook on Ecotourism. Edward Elgar Publishing Limited, UK.
2. Fennell DA (2014). Ecotourism. An Introduction. Routledge, London, UK.