PREAMBLE

PROGRAMME OVERVIEW

- NAME OF THE PROGRAMME
  Bachelor of Science (Honours) Programme in Zoology

- DURATION OF THE PROGRAMME
  4 (four) Years; 8 (eight) Semesters

- ASSESSMENT SYSTEM OF THE PROGRAMME
  Two semesters in an academic year consisting of theoretical (Major and general education) and practical examinations, field study, *viva-voce*, and dissertation

- TOTAL MINIMUM CREDIT REQUIREMENTS
  160 Credits

- GRADING SYSTEM OF THE PROGRAMME
  Cumulative Grade Point Average (CGPA), out of a scale of 4.0

- NAME AND ADDRESS OF THE DEPARTMENT OFFERING THE PROGRAMME

  Department of Zoology
  Faculty of Biological Sciences
  Sir Jagadish Chandra Bose Building
  University of Rajshahi
  Rajshahi 6205
  Bangladesh
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1. INTRODUCTION

The learning outcomes-based curriculum framework for a B. Sc. (Honours) degree in Zoology is structured to offer a broad outline within which all aspects of zoological knowledge, skills and attitudes could be incorporated and developed. The course is upgraded keeping in mind the ambitions of students, changing nature of the subject as well as learning environment. Courses within Zoology have been reconsidered to integrate recent progresses of knowledge and techniques to upgrade the skills of the learners. This framework permits the review of agreed graduate attributes, qualification descriptors, programme learning outcomes (PLOs) and course-level learning outcomes periodically. This framework provides students with an exciting and modern programme of study that integrates a range of learning and teaching techniques of relevance to both their educational developments and career ambitions. The programme covers the latest developments in Zoology, and provides theoretical knowledge plus training in the practical and intellectual skills to enable students to first understand and then help to solve some of the regional and global problems in this subject. Graduates from this programme will be critical thinkers, able to solve complex problems in Zoology and possess the personal and problem-solving skills that will enhance their employability prospects.

2. OVERVIEW OF THE UNIVERSITY OF RAJSHAHI

The University of Rajshahi, being the second largest University in Bangladesh, is the highest seat of learning in the Northern region of the country. Rajshahi University act 1953 (East Bengal Act XV of 1953) was passed by the East Pakistan Provincial Assembly on March 31, 1953. In 1961 the University moved to its present Campus situated at Matihar on 303.80 hectares of land acquired for the purpose and the construction of new buildings and structures started in 1958. The University's 59 Departments are organized into 12 Faculties: Arts, Science, Business Studies, Law, Social Sciences, Biological Sciences, Agriculture, Engineering, Fine Arts, Geosciences, Fisheries, and Veterinary and Animal Sciences. Six Institutes of the University include Bangladesh Studies, Biological Sciences, Education and Research, Environmental Science, Business Administration and English and other Languages, which are meant for higher education and research. With more than 25,000 students and around 1200 academic staff, it is one of the largest universities in Bangladesh. The University has 18 residential halls for students, six for female and twelve for male students. Degrees offered by the University include Bachelors (Honours) and Masters in different disciplines as well as MPhil, PhD, Diplomas and Certificates.

3. VISION OF THE UNIVERSITY OF RAJSHAHI

To pursue enlightenment and creativity for producing world-class human resources to cater for the needs of changing time.

4. MISSION OF THE UNIVERSITY OF RAJSHAHI

4.1 To ensure a world-class curriculum with talented academicians and conducive academic and research environment for generation and dissemination of knowledge.

4.2 To maintain international standards in education with focusing on both knowledge and skills, and humanitarian and ethical values to meet the needs of the society and state.

4.3 To develop strategic partnerships with leading national and international universities and organizations for academic as well as research collaborations.

5. CORE VALUES

5.1 Upholding the spirit of war of liberation in all aspects of life.
5.2 Maintaining honesty and integrity and showing mutual respect.
5.3 Practicing openness, accountability and transparency in all academic and administrative affairs.
5.4 Ensuring justice for all, irrespective of gender, caste, disability, belief and religion.
5.5 Inspiring innovation and youth leadership.

6. OVERVIEW OF THE PROGRAMME OFFERING DEPARTMENT

The Department of Zoology had its origin in the Department of Botany in 1969-70. With the rapid advances in the field of animal science, it was felt necessary to extend it into an independent and full-fledged department. Thus, the Department of Zoology started functioning in September 1972. Professor Dr. Mustafizur Rahman was appointed the founder Head of the Department. Since then the Department has developed at a fast rate to its present state with a view to meeting the growing demand for trained personnel in the fields of classical as well as applied Zoology. Many changes have taken place over the last five decades.

Located on the 303.80 hectare of land of the campus, the Department of Zoology occupies a working area of 2198.91 m^2 including classrooms, laboratories, office rooms, corridors, washrooms, and a magnificent Zoology Museum in the Sir Jagadish Chandra Bose Building (former Third Science Building). The building is a purpose-built facility which started functioning from 1972. The Department occupies most part of the West block on the second and third floors, the second floor of the North block and parts of the third and fourth floors of the South block. All academic staff members have their own individual office spaces, including spaces for the Deputy Curator of the Museum, Administrative Officers and the departmental store, which serves the reception point for deliveries. The Department has a strong and proud history of serving science and the society, and honouring the intellectual traditions of classical Zoology, while embracing new developments. The skills, flexibility and positive attitudes of the technical staff have contributed greatly to the development of the Department in its present teaching and research activities.

7. VISION OF THE PROGRAMME

The vision of the B.Sc. (Hons) programme in Zoology is to become one of the premier subjects/disciplines in the University of Rajshahi, Bangladesh, nationally and internationally recognized for its teaching and research activities in emerging areas of Zoology from global perspectives.

8. MISSION OF THE PROGRAMME

The Mission of the B.Sc. (Hons) Programme in Zoology is:

- To familiar the students with the Introduction to Zoology, Protista to Gnathostomula, Gastrotricha to Crustacea, Phoronida to Cephalochordata, Pisces and Amphibia, Reptilia to Mammalia; Introduction to Plant Kingdom and Lower Plant groups; Taxonomy, Economic Botany and Plant Breeding; Plant Anatomy and Plant Tissue Culture; Bangladesh Studies; Plant Physiology, Ecology and Fungal diseases; Microbiology and Plant Pathology; and English for Communication and Science;
- To introduce the learners with advanced courses ranging from Protection, Support and Nutrition, Respiration and Excretion, Nervous System and Sensory Receptors, Reproductive System and Reproduction; Chemistry I: Bio-physical; Chemistry II: Bio-organic; Chemistry III: Bio-inorganic; Feeding, Nutrition and

Digestion/Digestive System; Circulation System and Gaseous Exchange; Coordinating System II: Endocrinology System; Chemistry IV: Bio-physical and Bio-organic; and Chemistry V: Bio-inorganic;

- To offer such versatile courses as Cell Biology, Genetics and Animal Breeding; Developmental Biology, Taxonomy and Bioinformatics; Ecology, Ethology, Palaeontology; Evolution; Molecular Biology; Zoogeography; Wildlife, Biodiversity and Conservation Biology; Life Cycle and Population Biology; Health Biology and Epidemiology, Ecology and Physiology of Parasites; and Parasitic Diseases of Animals;
- To introduce the students with Pest Biology and Control; Aquaculture and Fisheries Management; Animals for Farming, Industry and Trade; Apiculture, Vermiculture and Medical Entomology; Lac Culture and Sericulture; Research Methodology; Bio-safety, Bio-security and Bio-ethics; Microbiology, Biometry, Genetic Engineering and Biotechnology, Pest Management; Fisheries and Fish Technology; Zoo-keeping, Museology and Ethnozoology; Immunology; and Environmental Pollution; and
- To enable Zoology graduates to make the best-informed career decisions in competitive job markets at home and abroad.

9. AIMS AND OBJECTIVES OF THE PROGRAMME

The principal aim of the B.Sc. (Hons) programme in Zoology is to teach and conduct research in various aspects of the subject to the highest possible standards. It aims to communicate research findings in Zoology in general, to the widest possible audience, thus contributing to the overall integration of scientific knowledge, findings and methods into the fabric of the society, in both Bangladesh and global contexts.

The aims of the offered courses are to provide a wide coverage of modern Zoology, followed by the opportunity to specialize in one or more areas reflecting the students' particular interests. Since animals cannot be studied in isolation, the course includes elements of plant science, genetics, and chemistry, with the opportunity of carrying some of these additional subjects to a more advanced level.

Graduates in Zoology will have an understanding of the key concepts of modern Zoology, and be aware of the scope and limitations of the subject. In addition, they will have sufficient specialized knowledge in selected areas to allow them to pursue a research degree in Zoology. Graduates will also acquire a general biology, biodiversity, biostatistics, research methodology and scientific background as well as gain experience in problem solving and communications, coupled with numerical and computer skills required for a wide range of careers.

10. DESCRIPTION OF THE PROGRAMME

The B.Sc. (Honours) degree will be offered by the Department. Subject to the conditions laid down and conditions as set by the Admission Committee, students passing Higher Secondary Certificate (HSC) examination or an equivalent from a recognized Education Board or Institution may be admitted to the programme of study leading to the degree of B. Sc. Honours in Zoology on recommendation of the Academic Committee of the Department. Only current students passing the HSC or equivalent examination shall be allowed for admission.

The B.Sc. (Honours) courses in Zoology shall consist of Zoology Honours (H) as Major and General Education (GEd) incorporating different courses from Zoology, Botany, Chemistry and Bangladesh Studies with a non-credit subject on English

for Communication and Science. Different courses of the honours subject as Major (H) shall altogether carry 2900 marks and the General Education (GEd) shall carry 1100 marks as follows: Botany 300 marks (theory 250 + practical 50); Bangladesh Studies 50 marks; Chemistry 300 marks (theory 250 + practical 50); Ethology 50 marks; Palaeontology 50 marks; Evolution 50 marks; Health Biology and Epidemiology 50 marks; Ecology and Physiology of Parasites 50 marks; Parasitic Diseases of Animals 50 marks; Research Methodology 50 marks; Biosafety, Biosecurity and Bioethics 50 marks; Microbiology 50 marks. Thus, the total being 160 Credits of 4000 marks (40 Units) distributed over eight semesters (duration of each semester will be 6 months in one academic year) in four academic years. The degree shall be completed within a maximum period of six academic years from the date of the student's first admission. No student shall be allowed to stay for more than two times in Semester 1 to Semester 7 of the Programme.

12. Academic schedules

The dates of the beginning and completion of courses, dates of the examinations and publication of the results etc. shall have to be declared by the concerned Department through an academic calendar at the beginning of the session. The schedule may be prepared according to the following guidelines:

Each Semester (24 weeks)	Number of weeks
Teaching	14
Preparatory Leaves	2
Examination Period	4
Result Publication	4
Total	**24**

Total marks for the B.Sc. (Honours) examination shall be 4000, consisting of 40 Units and 160 Credits for all the courses in Semester 1 to Semester 8, in which 70% marks ashall be allocated for examinations, 20% for class assessment and 10% for class attendance.

For each academic year, there shall be theoretical and practical examinations and a field work/study at the end of each semester but *viva-voce* shall be held only in the second semester. Each course (0.5 Unit; 50 marks) shall carry 2 Credits and each field work/study course shell carry 1 Credit (0.25 unit 25 marks). The duration of the theoretical and practical examinations of each course shall be of 3 hours and 6-12 hours (6 hours per day) for each 50 marks (2 Credits). Further details have been shown in Sections 17 and 18.

11. GRADUATE ATTRIBUTES

Zoology graduates will be able to demonstrate:

11.1 Understanding of the diversity of animals from evolutionary, functional and ecological perspectives;

11.2 Appreciation of the distinctiveness of Bangladesh's fauna, its place in a global setting and the need to protect diversity;

11.3 Awareness of the contribution of research to the development of the discipline of Zoology, the limits of current knowledge and that all knowledge is contestable;

11.4 Skills important for the research in the different fields of Zoology: making observations, generating and presenting data, experimental design, statistical analysis, writing reports and manuscript, publication of article etc;

11.5 Comprehensive knowledge of fundamental and applied disciplines of Zoology;.

11.6 Personal skills in written and oral communications; analysis, problem solving and decision making; gathering and presenting information; imagination, openness, curiosity and creativity; the ability to learn and to work both independently and effectively in a team; and

11.7 Obligation of the ethical and social issues relating to research on animals, and the ethical, cultural, social and economic contexts of the native and introduced animals and their harvesting.

12. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEOs of the B.Sc. (Hon's) programme in Zoology are:

12.1 To impart high quality education in Zoology;

12.2 To equip the students with communication skills and professionalism;

12.3 To establish culture of research; and

12.4 To conduct scientific meetings, conferences, workshops and seminars etc.

13. PROGRAMME LEARNING OUTCOMES (PLOs)

After successful completion of the Programme, the students will be able to:

13.1 Identify the Major groups of organisms with an emphasis on animals and be able to classify them within a phylogenetic framework;

13.2 Compare and contrast the morphological, anatomical, physiological and behavioural characteristics of animals that differentiate them from each other and other forms of life;

13.3 Use the evidence of comparative biology to explain how the theory of evolution offers the scientific explanation for the unity and diversity of life on earth. They will also be able to use specific examples to explicate how descent with modification has shaped animal morphology, physiology, life history, and behaviour;

13.4 Explain how organisms function at the level of the gene, genome, cell, tissue, organ and organ systems. Drawing upon this knowledge, they will be able to give specific examples of the physiological adaptations, development, reproduction and behaviour of different forms of life;

13.5 Explicate the ecological interconnectedness of life on earth by tracing energy and nutrient flows through the environment. They will also be able to relate the physical features of the environment to the structure of populations, communities, and ecosystems;

13.6 Compare and contrast ecological, physiological, biological and immunological relationships between organisms (hosts, parasites, predators and pests) as well as their impacts on human and animal health and economy. They will be able to design the control strategies for different life-threatening diseases;

13.7 Demonstrate skills in the experimental techniques and methods of analysis appropriate for their area of specialization in Zoology;

13.8 Apply the scientific methods to questions in Zoology by formulating testable hypotheses, gathering data that address these hypotheses, and

analyzing those data to assess the degree to which their scientific work supports their hypotheses;

13.9 Present scientific hypotheses and data both orally and written forms and formats that are used by practicing scientists;

13.10 Access the primary literature, identify relevant works for a particular topic, and evaluate the scientific content of these works;

13.11 Apply fundamental mathematical tools (statistics, biometry) and physical principles (physics, chemistry) to the analysis of relevant biological situations;

13.12 Translate zoological knowledge and methods into innovations in applied biological sciences such as ecology, fisheries science, entomology, genetics, sericulture, crop protection and apiculture etc;

13.13 Communicate scientific information effectively to express thoughts in a logical, clear, concise and precise manner; and

13.14 Uphold intellectual honesty and integrity in their conduct.

14. GENERIC SKILLS

Zoology graduates will gain and attain the highest level of professional skills in accordance with the National Skills and Framework (NSF) as mentioned in the National Wildlife Conservation Policy and the relevant sectors of the Government of the People's Republic of Bangladesh.

15. MAPPING BETWEEN UNIVERSITY'S MISSION AND PROGRAMME EDUCATION OBJECTIVES (PEOs)

UNIVERSITY'S MISSION (as in Section 4)	PEOs (as in Section 10)			
	12.1	12.2	12.3	12.4
4.1	√	√	√	√
4.2	√	√	√	√
4.3			√	√

16. MAPPING BETWEEN PEOs AND PLOs

PEOs (as in Section 10)	PLOs (as in Section 13)													
	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9	13.10	13.11	13.12	13.13	13.14
12.1	√	√	√	√	√	√	√	√	√	√	√	√	√	√
12.2									√	√		√		√
12.3							√	√	√	√	√			
12.4									√	√				√

17. COURSES AND MARKS DISTRIBUTION

a) Total marks: The Programme of study for the B. Sc. (Honours) degree in Zoology shall carry a total of 4000 marks (40 Units, 160 Credits), 25% of which are for the General Education (GEd) courses, and 30-40% for the practical, *viva-voce*, class assessment/ tutorial/ terminal/ home assignment/ field report/ excursion/ research project etc. The GEd courses shall have to be completed within the Fourth Year First Semester of the Programme.

b) Contact hours (Theoretical and practical courses)**:** There shall be two semesters in an academic year and there shall be 30 lecture hours (LH) and 30 laboratory periods (LP), each containing 45 minutes, in a semester for each theory and practical course of 0.50 Unit (2 Credits). For other fractions of a Unit, proportionality should be applied. A single LP is therefore equivalent to 3 theoretical LH, *i.e*., 1 LP = 3 LH or 3×45 = 135 minutes.

c) Marks distribution: The semester-wise distribution of marks among the theory, practical, *viva-voce*, class assessment/ tutorial/ terminal/ home assignment/ field report/ excursion/ research project/ thesis/ dissertation etc. shall be as follows:

DISTRIBUTION OF THE COURSES IN SEMESTER SYSTEM

Semester-wise distribution of total marks and units of Major and GEd courses of each academic year

Categories	First Year		Second Year		Third Year		Fourth Year		Total	Credits
Marks (Units)	Marks (Units)		Marks (Units)		Marks (Units)		Marks (Units)		Marks (Units)	
Semesters	First	Second	First	Second	First	Second	First	Second	-	-
Major	275(2.75)	325(3.25)	325(3.25)	325(3.25)	375(3.75)	375(3.75)	375(3.75)	525(5.25)	2900 (29)	116
GEd	200(2.0)	150(1.5)	150(1.5)	150(1.5)	150(1.5)	150(1.5)	150(1.5)	-	1100 (11)	44
Total	475(4.75)	475(4.75)	475(4.75)	475(4.75)	525(5.25)	525(5.25)	525(5.25)	525(5.25)	4000 (40)	160

Semester-wise distribution of total marks and units of Major subjects of each academic year

Categories	First Year		Second Year		Third Year		Fourth Year		Total	Credits
Marks (Units)	Marks (Units)		Marks (Units)		Marks (Units)		Marks (Units)		Marks (Units)	
Semesters	First	Second	First	Second	First	Second	First	Second	-	-
Theory	150(1.5)	150(1.5)	200(2)	150(1.5)	250(2.5)	200(2)	250(2.5)	350(3.5)	1700(17)	68
Practical + Dissertation	100(1)	100(1)	100(1)	100(1)	100(1)	100(1)	100(1)	100(1)	800(8)	32
Viva-voce	-	50(0.5)	-	50(0.5)	-	50(0.5)	-	50(0.5)	200 (2)	8
Field Study/ Excursion	25(0.25)	25(0.25)	25(0.25)	25(0.25)	25(0.25)	25(0.25)	25(0.25)	25(0.25)	200 (2)	8
Total	275(2.75)	325(3.25)	325(3.25)	325(3.25)	375(3.75)	375(3.75)	375(3.75)	525(5.25)	2900 (32)	116

Semester-wise distribution of total marks and units of GEd courses of each academic year

Categories	First Year		Second Year		Third Year		Fourth Year		Total	Credits
Marks (Units)	Marks (Units)		Marks (Units)		Marks (Units)		Marks (Units)		Marks (Units)	
Theory	200(2)	150(1.5)	100(1)	100(1)	150(1.5)	150(1.5)	150(1.5)	-	1000(10)	40
Practical	-	-	50(0.5)	50(0.5)				-	100(1)	4
Total	200(2)	150(1.5)	150(1.5)	150(1.5)	150(1.5)	150(1.5)	150(1.5)	-	1100(11)	44

18. DESCRIPTION OF THE COURSES IN SEMESTER SYSTEM

B. Sc. (Honours) First Year First Semester Examination, 2024

Course codes	Course titles	Units	Marks	Credits
Major Courses				
BZOOL 1101	Introduction to Zoology	0.5	50	2
BZOOL 1102	Protista to Gnathostomula	0.5	50	2
BZOOL 1103	Gastrotricha to Crustacea	0.5	50	2
BZOOL 1104	Field Study	0.25	25	1
BZOOL 1105	Zoology Practical I	0.5	50	2
BZOOL 1106	Zoology Practical II	0.5	50	2
GEd Courses				
BZOOL 1107	Botany I: Introduction to Plant Kingdom & Lower Plant groups	0.5	50	2
BZOOL 1108	Botany II: Taxonomy, Economic Botany & Plant Breeding	0.5	50	2
BZOOL 1109	Botany III: Plant Anatomy & Plant Tissue Culture	0.5	50	2
BZOOL 1110	Bangladesh Studies	0.5	50	2
Total		**4.75**	**475**	**19**

B. Sc. (Honours) First Year Second Semester Examination, 2024

Course codes	Course titles	Units	Marks	Credits
Major courses				
BZOOL 1201	Phorona to Cephalochordata	0.5	50	2
BZOOL 1202	Pisces & Amphibia	0.5	50	2
BZOOL 1203	Reptilia to Mammalia	0.5	50	2
BZOOL 1204	Field Study/ Excursion	0.25	25	1
BZOOL 1205	*Viva-voce* (Honours courses)	0.5	50	2
BZOOL 1206	Zoology Practical I	0.5	50	2
BZOOL 1207	Zoology Practical II	0.5	50	2
GEd courses				
BZOOL 1208	Botany IV: Plant Physiology, Ecology & Fungal diseases	0.5	50	2
BZOOL 1209	Botany V: Microbiology & Plant Pathology	0.5	50	2
BZOOL 1210	Botany Practical	0.5	50	2
Non-credit				
BZOOL 1211	English for Communication & Science	0.5	50	0
Total		**4.75**	**475**	**19**

B. Sc. (Honours) Second Year First Semester Examination, 2025

Course codes	Course titles	Units	Marks	Credits
Major courses				
BZOOL 2101	Protection, Support & Locomotion	0.5	50	2
BZOOL 2102	Respiration & Excretion	0.5	50	2

BZOOL 2103	Coordinating System I: Nervous System & Sensory Receptors	0.5	50	2
BZOOL 2104	Reproductive System & Reproduction	0.5	50	2
BZOOL 2105	Field Study/ Excursion	0.25	25	1
BZOOL 2106	Zoology Practical I	0.5	50	2
BZOOL 2107	Zoology Practical II	0.5	50	2
Ged courses				
BZOOL 2108	Chemistry I: Bio-physical	0.5	50	2
BZOOL 2109	Chemistry II: Bio-organic	0.5	50	2
BZOOL 2110	Chemistry III: Bio-inorganic	0.5	50	2
Total		**4.75**	**475**	**19**

B. Sc. (Honours) Second Year Second Semester Examination, 2025

Course codes	Course titles	Units	Marks	Credits
Major courses				
BZOOL 2201	Feeding, Nutrition & Digestion	0.5	50	2
BZOOL 2202	Circulatory System	0.5	50	2
BZOOL 2203	Coordinating System II: Endocrinology System	0.5	50	2
BZOOL 2204	Field Study/ Excursion	0.25	25	1
BZOOL 2205	*Viva-voce* (Honours courses)	0.5	50	2
BZOOL 2206	Zoology Practical I	0.5	50	2
BZOOL 2207	Zoology Practical II	0.5	50	2
GEd courses				
BZOOL 2208	Chemistry IV: Bio-physical & Bio-organic	0.5	50	2
BZOOL 2209	Chemistry V: Bio-inorganic	0.5	50	2
BZOOL 2210	Chemistry Practical	0.5	50	2
Total		**4.75**	**475**	**19**

B. Sc. (Honours) Third Year First Semester Examination, 2026

Course codes	Course titles	Units	Marks	Credits
Major courses				
BZOOL 3101	Cell Biology	0.5	50	2
BZOOL 3102	Genetics & Animal Breeding	0.5	50	2
BZOOL 3103	Developmental Biology	0.5	50	2
BZOOL 3104	Taxonomy & Bioinformatics	0.5	50	2
BZOOL 3105	Ecology	0.5	50	2
BZOOL 3106	Field Study/ Excursion	0.25	25	1
BZOOL 3107	Zoology Practical I	0.5	50	2
BZOOL 3108	Zoology Practical II	0.5	50	2
GEd courses				
BZOOL 3109	Ethology	0.5	50	2
BZOOL 3110	Palaeontology	0.5	50	2
BZOOL 3111	Evolution	0.5	50	2
	Total	**5.25**	**525**	**21**

B. Sc. (Honours) Third Year Second Semester Examination, 2026

Course codes	Course titles	Units	Marks	Credits
Major courses				
BZOOL 3201	Molecular Biology	0.5	50	2
BZOOL 3202	Zoogeography	0.5	50	2
BZOOL 3203	Wildlife, Biodiversity & Conservation Biology	0.5	50	2
BZOOL 3204	Life Cycle & Population Biology	0.5	50	2
BZOOL 3205	Field Study/ Excursion	0.25	25	1
BZOOL 3206	*Viva-voce*	0.5	50	2
BZOOL 3207	Zoology Practical I	0.5	50	2
BZOOL 3208	Zoology Practical II	0.5	50	2
GEd courses				
BZOOL 3209	Health Biology & Epidemiology	0.5	50	2
BZOOL 3210	Ecology & Physiology of Parasites	0.5	50	2
BZOOL 3211	Parasitic Diseases of Animals	0.5	50	2
	Total	**5.25**	**525**	**21**

B. Sc. (Honours) Fourth Year First Semester Examination, 2027

Course codes	Course titles	Units	Marks	Credits
Major courses				
BZOOL 4101	Pest Biology & Control	0.5	50	2
BZOOL 4102	Aquaculture & Fisheries Management	0.5	50	2
BZOOL 4103	Animals for Farming, Industry & Trade	0.5	50	2
BZOOL 4104	Apiculture, Vermiculture & Medical Entomology	0.5	50	2
BZOOL 4105	Lac Culture & Sericulture	0.5	50	2
BZOOL 4106	Field Study/ Excursion	0.25	25	1
BZOOL 4107	Zoology Practical I	0.5	50	2
BZOOL 4108	Zoology Practical II	0.5	50	2
GEd courses				
BZOOL 4109	Research Methodology	0.5	50	2
BZOOL 4110	Biosafety, Biosecurity & Bioethics	0.5	50	2
BZOOL 4111	Microbiology	0.5	50	2
Total		**5.25**	**525**	**21**

B. Sc. (Honours) Fourth Year Second Semester Examination, 2027

Course Codes	Course titles	Units	Marks	Credits
Major courses				
BZOOL 4201	Biometry	0.5	50	2
BZOOL 4202	Genetic Engineering & Biotechnology	0.5	50	2
BZOOL 4203	Pest Management	0.5	50	2
BZOOL 4204	Fisheries & Fish Technology	0.5	50	2
BZOOL 4205	Zoo-keeping, Museology & Ethnozoology	0.5	50	2
BZOOL 4206	Immunology	0.5	50	2
BZOOL 4207	Environmental Pollution	0.5	50	2

BZOOL 4208	Field Study/ Excursion	0.25	25	1
BZOOL 4209	*Viva-voce*	0.5	50	2
BZOOL 4210	Zoology Practical	0.5	50	2
BZOOL 4211	Thesis / Dissertation	0.5	50	2
	Total	**5.25**	**525**	**21**

19. MAPPING BETWEEN PLOs AND THE COURSES

COURSES (As in Section 18)	**PLOs (As in Section 13)**													
	13.1	**13.2**	**13.3**	**13.4**	**13.5**	**13.6**	**13.7**	**13.8**	**13.9**	**13.10**	**13.11**	**13.12**	**13.13**	**13.14**
First Year First Semester														
BZOOL 1101	√									√				√
BZOOL 1102	√	√												√
BZOOL 1103	√	√												√
BZOOL 1104	√	√												√
BZOOL 1105									√				√	√
BZOOL 1106									√				√	√
BZOOL 1107									√				√	√
BZOOL 1108	√	√					√	√	√	√	√		√	√
BZOOL 1109	√	√	√	√										√
BZOOL 1110	√	√	√	√										√
First Year Second Semester														
BZOOL 1201			√	√	√						√			√
BZOOL 1202			√	√	√	√					√			√
BZOOL 1203			√	√	√	√					√			√
BZOOL 1204									√	√			√	√
BZOOL 1205		√		√		√								√
BZOOL 1206					√						√			√
BZOOL 1207					√						√			√
BZOOL 1208		√		√		√								√
BZOOL 1209		√	√		√		√				√			√
BZOOL 1210									√				√	√
BZOOL 1211									√				√	√
Second Year First Semester														
BZOOL 2101		√	√	√	√	√	√	√	√		√		√	√
BZOOL 2102		√		√	√	√								√

BZOOL 2103	√		√			√								√
BZOOL 2104			√	√	√						√			√
BZOOL 2105			√	√	√						√			√
BZOOL 2106	√	√	√			√	√	√			√			√
BZOOL 2107			√	√	√		√	√			√			√
BZOOL 2108			√	√	√		√	√			√			√
BZOOL 2109				√								√		√
BZOOL 2110			√	√										√
Second Year Second Semester														
BZOOL 2201		√	√		√	√					√			√
BZOOL 2202	√	√	√											√
BZOOL 2203					√	√					√	√		√
BZOOL 2204		√		√	√	√						√		√
BZOOL 2205									√				√	√
BZOOL 2206									√				√	√
BZOOL 2207	√	√	√	√	√	√	√	√			√	√	√	√
BZOOL 2208							√	√	√		√			√
BZOOL 2209				√			√					√		√
BZOOL 2210														
Third Year First Semester														
BZOOL 3101		√				√	√					√		√
BZOOL 3102					√	√						√		√
BZOOL 3103		√										√		√
BZOOL 3104					√	√						√		
BZOOL 3105					√	√						√		
BZOOL 3106									√				√	√
BZOOL 3107									√				√	√
BZOOL 3108		√		√	√	√	√	√	√		√	√	√	√
BZOOL 3109							√	√	√	√	√		√	√
BZOOL 3110									√				√	√
BZOOL 3111									√				√	√
Third Year Second Semester														
BZOOL 3201	√	√				√	√					√		√
BZOOL 3202					√	√						√		√
BZOOL 3203		√										√		√

BZOOL 3204					√	√						√		
BZOOL 3205					√	√						√		
BZOOL 3206									√				√	√
BZOOL 3207		√		√	√	√						√		√
BZOOL 3208		√		√	√	√	√	√	√		√	√	√	√
BZOOL 3209							√	√	√	√	√		√	√
BZOOL 3210									√				√	√
BZOOL 3211									√				√	√
Fourth Year First Semester														
BZOOL 4101		√				√	√					√		√
BZOOL 4102					√	√						√		√
BZOOL 4103		√										√		√
BZOOL 4104					√	√						√		
BZOOL 4105					√	√						√		
BZOOL 4106									√				√	√
BZOOL 4107									√				√	√
BZOOL 4108		√		√	√	√	√	√	√		√	√	√	√
BZOOL 4109							√	√	√	√	√		√	√
BZOOL 4110									√				√	√
BZOOL 4111									√				√	√
Fourth Year Second Semester														
BZOOL 4201		√				√	√					√		√
BZOOL 4202					√	√						√		√
BZOOL 4203		√										√		√
BZOOL 4204					√	√						√		
BZOOL 4205					√	√						√		
BZOOL 4206									√				√	√
BZOOL 4207									√				√	√
BZOOL 4208		√		√	√	√	√	√	√		√	√	√	√
BZOOL 4209							√	√	√	√	√		√	√
BZOOL 4210									√				√	√
BZOOL 4211									√				√	√

20. TEACHING LEARNING PROCESSES (TLPs)

The teaching learning processes are oriented towards enabling the students to attain the defined learning outcomes relating to the courses within a Programme.

Hence, the TLPs are significantly shifted from teacher centric to learner/ student centric pedagogies and from passive to active /participatory pedagogies.

TLPs guided by such a framework, may include:

20.1 Lecture supported by group tutorial work and invited lectures;

20.2 Practical and field-based learnings;

20.3 The use of prescribed textbooks and e-learning resources and other self-study materials;

20.4 Open-ended project work, some of which may be team based;

20.5 Assignments, seminars and oral presentations;

20.6 Activities designed to promote the development of generic/transferable and subject-specific skills;

20.7 Internships and visits to field sites, factories and hospitals or other research facilities; and

20.8 Guidance by the 'mentors' and specialists in the field.

21. MAPPING BETWEEN CLOs AND TEACHING LEARNING & ASSESMENT STRATEGIES

CLOs Student will be able to:	**Teaching Learning Strategy (as in section 20)**								**Assessment Strategies***			
	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	a	b	c	d
Introduce Zoology	√		√		√				√	√	√	√
Describe Protista to Gnathostomula	√		√		√				√	√	√	√
Describe Gastrotricha to Crustacea	√		√		√				√	√	√	√
Introduce Plant Kingdom & Lower Plant groups	√		√		√				√	√	√	√
Describe Taxonomy, Economic Botany & Plant Breeding	√		√		√				√	√	√	√
Explain Plant Anatomy & Plant Tissue Culture	√		√		√				√	√	√	√
Introduce Bangladesh Studies	√				√				√	√	√	√
Describe Phorona to Cephalochordata	√		√		√				√	√	√	√
Describe Pisces & Amphibia	√		√		√				√	√	√	√
Describe Reptilia to Mammalia	√		√		√				√	√	√	√

Describe Plant physiology, Ecology & Fungal diseases	√		√		√				√	√	√	√
Describe Microbiology & Plant Pathology	√		√		√				√	√	√	√
Use English for Communication & Science	√		√		√				√	√	√	√
Explain the Protection, Support & Locomotion	√		√		√				√	√	√	√
Describe Respiration & Excretion	√		√		√				√	√	√	√
Interpret Nervous System & Sensory Receptors	√		√		√				√	√	√	√
Explain Reproductive System & Reproduction	√		√		√				√	√	√	√
Describe Chemistry I: Bio-physical	√		√		√				√	√	√	√
Describe Chemistry II: Bio-organic	√		√		√				√	√	√	√
Explain Chemistry III: Bio-inorganic	√		√		√				√	√	√	√
Explain Feeding, Nutrition & Digestion	√		√		√				√	√	√	√
Describe Circulatory System		√	√	√	√	√	√	√	√	√	√	√
Endocrinology System		√	√	√				√		√	√	√
Describe Chemistry IV: Bio-physical & Bio-organic	√		√		√				√	√	√	√
Describe Chemistry V: Bio-inorganic	√		√		√				√	√	√	√
Introduce Cell Biology	√	√	√		√				√	√	√	√

Describe Genetics & Animal Breeding	√	√	√		√				√	√	√	√
Interpret Developmental Biology	√	√	√		√				√	√	√	√
Describe Taxonomy & Bioinformatics	√	√	√		√	√			√	√	√	√
Describe Ecology	√	√	√		√				√	√	√	√
Describe Ethology	√	√	√		√				√	√	√	√
Describe Palaeontology	√	√	√		√	√			√	√	√	√
Describe Evolution	√	√	√		√				√	√	√	√
Describe Molecular Biology	√	√	√		√				√	√	√	√
Introduction to Zoogeography	√	√	√		√				√	√	√	√
Introduce Wildlife, Biodiversity & Conservation Biology	√	√	√	√	√	√	√		√	√	√	√
Describe Life Cycle & Population Biology	√	√	√	√	√	√			√	√	√	√
Describe Health Biology & Epidemiology	√	√	√		√	√	√		√	√	√	√
Interpret Ecology & Physiology of Parasites	√	√	√	√	√	√	√		√	√	√	√
Describe Parasitic diseases of Animals	√	√	√	√	√	√	√		√	√	√	√
Introduce Pest Biology & Control	√	√	√		√				√	√	√	√
Illustrate Aquaculture & Fisheries Management	√	√	√	√	√	√	√		√	√	√	√
Introduce Animals for Farming, Industry & Trade	√	√	√	√	√	√	√		√	√	√	√
Describe Apiculture, Vermiculture & Medical Entomology	√	√	√	√	√	√	√		√	√	√	√

Introduce Lac Culture & Sericulture	√	√	√	√	√	√	√		√	√	√	√
Explain Research Methodology	√	√	√		√	√			√	√	√	√
Illustrate Biosafety, Biosecurity & Bioethics	√	√	√		√	√			√	√	√	√
Study Microbiology	√	√	√		√	√			√	√	√	√
Demonstrate Biometry	√	√	√		√	√			√	√	√	√
Describe Genetic Engineering & Biotechnology	√	√	√		√	√	√		√	√	√	√
Describe Pest Management	√	√	√		√	√	√		√	√	√	√
Demonstrate Fisheries & Fish Technology	√	√	√	√	√	√	√		√	√	√	√
Demonstrate Zookeeping, Museology & Ethnozoology	√	√	√	√	√	√	√		√	√	√	√
Introduce Immunology	√	√	√		√		√		√	√	√	√
Demonstrate Environmental Pollution	√	√	√	√	√	√	√		√	√	√	√

*****a=First and Second Semester Exams; b=Continuous Assessment; c=Attendance; d=*Viva-voce*

21. EVALUATION PROCESS

Examination Committee

(a) Committee Members: There shall be separate Examination Committees for both first and second semesters of all academic years as proposed by the departmental Academic Committee. The Examination Committee shall consist of five members as follows:

- **I.** Chairman of the committee and three Members among the teachers of the concerned Department; and
- **II.** One External Member from outside of the Department or the University.

(b) Committee Members for GEd Courses: There will be one to three **(1-3)** additional members for the GEd courses from the relevant department.

Examinations

(a) **Examinations:** The B.Sc. (Honours) examination shall be held semester-wise and shall consist of the First Year, First Semester to Fourth Year, Second Semester during the Programme. For obtaining the degree, a student shall have to pass all the examinations within 6 (six) academic years from the date of his/her first admission and shall not be allowed to stay more than 2 (two) consecutive terms in the same semester/year. A candidate absenting himself/herself in a course in an examination,

in which he/she ought to have been present, will be considered "F" grade in that course. The non-credit courses shall have to be appeared and qualified, when the status of the student will be considered either as attended and passed, or not attended and failed/disqualified.

(b) **Class Test/ Class Assessment/ Mid-Term/ Quiz:** The individual course teacher will evaluate 20% marks of each theory course as Class Test/ Class Assessment/ Mid-Term/ Quiz. Average of all class assessments of the theory courses with scripts and average of all laboratory assessment marks shall have to be submitted by the course teacher(s) concerned in sealed envelope to the Chairman of the relevant Examination Committee before the commencement of the final examination. A course teacher failing to submit the assessment marks before the commencement of the final examination shall not be allowed to act as an examiner of the course. In such case, the decision shall be taken by the relevant Examination Committee with the approval of the departmental Academic Committee.

(c) **Duration of Examinations:** The duration of examinations of the theory courses shall be 3 hours for 2 Credits (0.50 Unit) and 4 hours for 3-4 Credits (0.75-1.00 Unit) courses. The duration of practical examinations shall be 6-12 and 12-24 hours (6 hours per day) for 2 Credits (0.50 Unit) and 3-4 credits (0.75-1.00 Unit) practical courses, respectively. For other fractions of a Unit, proportionality shall be applied.

(d) **Submission of Marks:** Consolidated average marks of the theory courses, class assessment, *viva-voce*, laboratory assessment, practical courses etc. shall have to be converted to the letter grade (LG) by the relevant Examination Committee and to be submitted to the Controller of Examinations before finalizing the results.

Eligibility for Examinations

(a) **Percentage of Attendance:** A student with 75% class attendance (theoretical, practical, class assessment, field work/excursion etc.) will be allowed to participate in semester final examination as *regular*. But a student with 60% to less than 75% class attendance will be declared as *non-collegiate* and allowed to sit for the semester final examination with a fine of Tk. 1000/-. A student with less than 60% class attendance will be considered as *dis-collegiate*, and will not be allowed to fill up the examination form to sit for the semester final examination.

Marks on class attendance/participation: Marks on class attendance will be 10% of the total marks of the theory and practical courses. The marks will be awarded as follows:

Attendance range	% of the total marks
95% and above	10
90% to below 95%	9
85% to below 90%	8
80% to below 85%	7
75% to below 80%	6
70% to below 75%	5
65% to below 70%	4
60% to below 65%	3
Less than 60%	0

(b) **Re-admission:** A candidate, who failed to appear at the examination or failed to pass the examination, may on the approval of the relevant Department be readmitted to the same semester/year in the next academic year/session. A readmitted candidate shall have to reappear at all course examinations.

Appearing to the Examinations: For appearing at the B. Sc. (Honours) Examinations, a candidate shall have to submit his/her application in the prescribed form together with certificates of attendance and fulfill all other conditions prescribed by the University. The application shall be submitted through the Chairman of the Department and Provost of the Hall concerned so as to reach the Controller of Examinations at least 2 (two) weeks before the date fixed for the commencement of the examination.

Question Setter and Script Examiners

(a) For the B.Sc. (Honours) examination, there shall be two question setters (first and second setters) in each of the theory courses, and two script examiners (first and second examiners) in each theory course.

(b) Field Reports/Excursion Reports/Internship Reports/Research Project Reports and the like: These reports shall also be examined by two examiners (preferably other than the examination committee) as selected by the Examination Committee. A total 8 Credits shall be allocated in the entire undergraduate Programme.

Medium of Instruction and the Nature of Questions and Answers: Questions shall be made in English and /or a translated version in Bangla. The medium of answers in the examination of all courses shall be either English or Bangla. However, a mixing of English and Bangla will never be allowed in an answer script. In a theory course of 50 marks (0.5 Unit; 2 Credits), 35 marks shall be for the written questions (20 for broad questions and 15 for short questions), 5 for attendance and 10 for tutorial. In a practical course of 50 marks (0.5 Unit; 2 Credits), 30 marks shall be for practical examination (6 hours daily), 5 for attendance, 6 for practical class records and 9 for laboratory assessment. All practical questions as well as answers shall be made in English only.

Third Examinations: If the marks awarded by two script examiners differ by 20% or more, the Examination Committee will recommend a third examiner, and the arithmetic mean of the two nearest marks will be counted. In case, both the extreme marks differ from the middle marks by exactly the same margin, the arithmetic mean of the two higher marks will be taken to the advantage of the student. If, however, the number of scripts to be third examined is 50% or more of the total number of the scripts of a course, all scripts of that course will have to be re-examined by a third examiner.

Practical/ Sessional Examinations: Examiners for practical/sessional examinations shall be internal with an external from outside the Department or University from the enlisted and approved Panel of Examiners. The departmental Academic Committee will assign a teacher or a group of teachers to conduct a particular laboratory class or all the laboratory classes of a particular semester, as well as to conduct the laboratory assessment examinations of that class during the scheduled course periods. A copy of the marks of the laboratory assessment examination shall have to be sent to the Chairman of the concerned Examination Committee before the commencement of practical/sessional examinations.

***Viva-Voce*:** At the end of second semester of each academic year, *viva-voce* or oral examination will be conducted by Examination Committee, preferably in presence of the External Member from outside of the Department or University. The *viva-voce* shall be of 2 Credits (50 marks; 0.50 Unit) in each academic year.

Non-credit Course(s): Each candidate shall have to appear at the non-credit courses and shall have to pass or qualify. Candidates failing to appear or disqualify such non-credit courses shall be considered as failed or not-attended.

Award of Degree, Promotions and Improvement of Results

(a) Degree Requirements: The B. Sc. (Honours) degree in Zoology shall be awarded on the basis of the cumulative grade point average (CGPA) obtained by a student from Semester 1 to Semester 8 examinations. In order to obtain the B. Sc. (Honours) degree, a student must fulfill the following conditions:

(i) B. Sc. (Honours) degree Programme must be completed within a minimum period of 4 (four) and maximum of 6 (six) academic years from the date of admission. No student will be allowed to stay for more than two consecutive terms in the same semester/year.

(ii) The minimum CGPA for awarding B. Sc. (Honours) degree shall be 2.50 out of 4.0.

(iii) The minimum Credit Point (CP) required for awarding the degree shall be 152 out of the total Credits 160 after exemption of maximum 8 (eight) Credits.

(iv) The minimum passing letter grade (LG) shall be **'**D**'** (GP 2.00) in each course.

(b) Publications of Results: The overall results of a successful student covering all 8 semester examinations over a four-year period shall be declared on the basis of CGPA. The transcripts in English shall show the course numbers, course titles, credits, grades and grade points of individual courses, GPA of each year and CGPA for the overall B. Sc. (Honours) result.

(c) Annual/Semester Promotion: In order to be promoted to next semester/year, a student will have to fulfill the following requirements:

i). The minimum Semester Grade Point Averages **(SGPAs)** shall be 2.00, 2.25, 2.50, and 2.50 for the First Year, First and Second Semesters; Second Year, First and Second Semesters, and so on, respectively, as shown below:

Years and Semesters	Minimum SGPAs
First Year, First Semester	2.00
First Year, Second Semester	2.00
Second Year, First Semester	2.25
Second Year, Second Semester	2.25
Third Year, First Semester	2.50
Third Year, Second Semester	2.50
Fourth Year, First Semester	2.50
Fourth Year, Second Semester	2.50

Semester-wise Grade Point Average (SGPA): A semester-wise grade point average shall be computed for each semester. The SGPA will be calculated as follows:

$$\mathbf{SGPA} = \frac{\sum_{\mathbf{i=1}}^{\mathbf{n}} \mathbf{Ci\ Gi}}{\sum_{\mathbf{i=1}}^{\mathbf{n}} \mathbf{Ci}}$$

Where, n is the number of courses offered during the semester, C is the number of credits allotted to a i'th course and G is the i'th grade point corresponding to the grade awarded for that course.

The minimum **Year Grade Point Averages (YGPAs)** will be 2.00, 2.25, 2.50 and 2.50 for the First, Second, Third and the Fourth year, respectively, as follows:

Years	Minimum YGPAs
First Year	2.00
Second Year	2.25
Third Year	2.50
Fourth Year	2.50

The **Year Grade Point Averages (YGPAs)** shall be computed at the end of second semester of each year in the following way:

$$\textbf{YGPA} = \frac{\textbf{Sum of TCP x GPA of Semester 1 and Semester 2 of each year}}{\textbf{TCP of Semester 1 and Semester 2 of the respective year}}$$

Where, TCP is for Total Credit Point, and GPA is for Grade Point Average.

Cumulative Grade Point Averages (CGPAs): The cumulative grade point averages (CGPAs) shall also be computed at the end of Fourth Year, Second Semester in the following way:

$$\textbf{CGPA} = \frac{\sum_{i=1}^{m} \textbf{Ci Yi}}{\sum_{i=1}^{m} \textbf{Ci}}$$

Where, m is the total number of years being considered, Y is the YGPA of a i'th year, C is the total number of credits in i'th year. SGPA, YGPA and CGPA will be rounded off as per the Ordinance of the University.

ii) A maximum of 4 and 8 credits can be relaxed in theoretical courses for the candidates to be promoted to the next semester or year, respectively. If a student fails to be promoted to the next semester/year, he/she will have to be re-admitted in the same semester/year in the next academic year.

(d) Course Improvements

- **i)** A promoted student will only be allowed to appear at the theoretical course improvement examination in the immediate next academic year for once in order to improve a maximum of two theoretical courses up to 4 (four) Credits. To clear an F grade, the student will be allowed to appear at the examination for maximum two times in immediate consecutive similar semesters. This is applicable to the Fourth Year, First Semester for the semester result system or to the Third year, Second semester for the yearly result system.
- **ii)** Theoretical course improvements will only be allowed if the earned LG is less than B minus (B-), having a GPA <2.75.
- **iii)** For the practical courses, a student will not be allowed to clear his/her F grade as there will be no improvement examinations.
- **iv)** Students appearing at the course improvement examination(s) shall carry their previously earned marks on Continuous Assessment (CA).
- **v)** For students failing to improve their course grade at the course improvement examination(s), the previously earned grade(s) shall remain valid.

(e) Final Result (CGPA) Improvement

A student obtaining B. Sc. (Honours) degree within 4 to 5 academic years will only be allowed to improve his/her result in the immediate, next regular examination after publication of the result. A student will only be allowed to take part in result improvement examination for a maximum of two theoretical courses (maximum 6 Credits) of the final semester (Fourth year, Second semester). Result improvement in theoretical courses will only be allowed if his/her earned CGPA is <3.00.

The Grading Systems

(a) **Credit Point (CP):** The credit points achieved by an examinee for 0.50 and 0.25 unit courses shall be 2 and 1, respectively. For other fractions of a unit, proportionality should be applied. Out of a 4 scale, the grading system (Letter Grade, LG; Grade point, GP; and Credit Point, CP) shall be awarded in accordance with the provisions shown below:

Marks obtained	Letter Grades (LGs)	Grade Points (GPs)
80% or its above	A^+ (A plus)	4.00
75% to less than 80%	A (A regular)	3.75
70% to less than 75%	A^-(A minus)	3.50
65% to less than 70%	B^+ (B plus)	3.25
60% to less than 65%	B (B regular)	3.00
55% to less than 60%	B^- (B minus)	2.75
50% to less than 55%	C^+ (C plus)	2.50
45% to less than 50%	C (C regular)	2.25
40% to less than 45%	D (regular)	2.00
Less than 40%	F (Fail)	0.00

LG, GP and CP for non-credit courses:

Status	LG	GP/unit	CP
Attended/Non-Attended	Attended/Non-Attended		

22. Teaching Feedback

All students will be allowed to express their own opinions regarding course teaching performance through a prescribed form and it should be evaluated confidentially by the departmental Academic Committee or Special Evaluation Committee or by the Central Evaluation Committee of the University.

23. Class Attendance Record for Students

The class attendance records for the students shall be recorded electronically in every class and finally be handed over to the Chairman and will be preserved by the Examination Committee as examination record.

24. Examination Ethics

a) Everyone involved in the process of examinations shall ensure the security of the examinations and follow the examination rules of the University.

b) An examinee never shall be asked any questions that hurt his/her religious or ethnic backgrounds and beliefs.

c) If someone (amongst the teacher or employee) involved in examination process has the following relatives as examinee(s), he/she should inform the Chairman of relevant Examination Committee or the Controller of Examinations immediately, and he/she must then be refrained from acting as a member of the Committe: (i) husband/wife, (ii) son/daughter, (iii) brother/sister, (iv) brother-in-law/sister-in-law, (v) son-inlaw/daughter-in-law, (vi) nephew/niece, (vii) first cousins, (viii) father/mother, (ix) uncle/aunt, and (x) father-in-law/mother-in-law.

N.B.: Changes, if any, made in the Ordinance will also be applicable to the rules and regulations mentioned above.

Curriculum
For
First Year
First Semester

B.Sc. (Honours) First Year First Semester Examination, 2024

Course codes	Course titles	Units	Marks	Credits
Major Courses				
BZOOL 1101	Introduction to Zoology	0.5	50	2
BZOOL 1102	Protista to Gnathostomula	0.5	50	2
BZOOL 1103	Gastrotricha to Crustacea	0.5	50	2
BZOOL 1104	Field Study	0.25	25	1
BZOOL 1105	Zoology Practical I	0.5	50	2
BZOOL 1106	Zoology Practical II	0.5	50	2
GEd Courses				
BZOOL 1107	Botany I: Introduction to Plant Kingdom and Lower Plant groups	0.5	50	2
BZOOL 1108	Botany II: Taxonomy, Economic Botany and Plant Breeding	0.5	50	2
BZOOL 1109	Botany III: Plant Anatomy and Plant Tissue Culture	0.5	50	2
BZOOL 1110	Bangladesh Studies	0.5	50	0
	Total	**4.75**	**475**	**19**

B.Sc. (Honours) First Year First Semester Examination, 2024

Course Title: Introduction to Zoology		
Course Code: BZOOL 1101	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3

Course Description

History and milestones in Zoology:

This course will introduce the historical background of zoological studies and its gradual development; great personalities of this part of science and their contribution. This course is also designed to discuss the group animals, their identifying characters, morphological and anatomical features), so that learners can identify an unknown animal in the field and in the laboratory. Description and adaptive features of the habits of different animals; types of animal association with examples; animal habitats provided with examples from each type of habitat; distribution of animals on earth; zoogeography of Bangladesh in brief. Instruments: Introduction to instruments/ equipment used in zoological laboratories with their user manual; How to collect, culture and preserve lower animals. Bioinformatics: Introduction to bioinformatics, concepts, vocabularies and tools used in bioinformatics.

Course Learning Objectives

1. To discus the history and miles stones in Zoology
2. To describe the bases of animal taxonomy
3. To discuss on the habits, habitats and distribution of animals of Bangladesh
4. To be acquainted with the instruments/ equipment and methods used in zoological studies
5. To be familier with bioinformatics

Course Learning Outcomes (CLOs)

After completion of this course, the learners will be able to:

1. Describe the history of zoology, great personalities of zoology and their contribution in the development of zoological studies.
2. Define zoology and, make discussion on the scopes and approaches of the subject;
3. Describe origin of life from pre-life stage to cell stage; organize levels of animals (pre-biotic, cell formation, from single celled to multicellular organisms); categorize organisms into population, community, fauna, biota, ecosystem and biosphere; divisions of biodiversity;
4. Define cell, tissue, organ, organ system, organism (species/ individual); describe primitive and ideal cell with characters, functions of cell organelles, types of tissues;
5. Define taxonomy, systematics and classification; define and describe basic taxonomic divisions (taxa) and Linnaean hierarchy;
6. Explain the bases of animal classification (with examples) e.g., orientation, symmetry, planes and axes, metamerism, tagmatization, body coverings, appendages, phylogeny, define each of these terminologies;
7. Define coelom, describe types and functions of coeloms; names of germinal layers in vertebrate embryo; define embryology and embryogeny, fertilization, cleavage; egg types based on yolk cntent; state charcters of prostomia and deuterostomia; group animal phyla in these two divisions;
8. Discuss naming (nomenclature) of animals and taxa, specific characters used in nomenclature provided with examples.
9. Describe and characterize animal habits like feeding and style of living, provided with adaptive features and examples;
10. Explain different types of animal association, provided with examples from each;
11. Classify animal habitats with distinguishing characters, mention examples and distribution of animals in each of those habitats;
12. Discuss spatial and temporal distribution of animals; describe briefly zoogeography of Bangladesh; temporal distribution of animals based on Geological Time Scale (GTS) from the beginning of animal life up to recent groups; describe different eras, periods and epochs with major groups of animals of that time; describe animal world, extinct and extant animals (palaeontology and neontology).
13. Introduce instruments/ equipment used in zoological laboratories with their user;
14. Identify, collect and preserve the lower animals (specially insects);
15. Describe how to culture lower animals;
16. Describe language and tools used in bioinformatics.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
History and milestone in Zoology		
Historical background of Zoological Studies.	CLO 1	1
Great personalities of Zoology of Europe.	CLO 1	1
Great personalities of Zoology of Asia Minor and the Middle East.	CLO 1	1
Great personalities of Zoology of the Americas.	CLO 1	1

Great personalities of Zoology of India and Bangladesh.	CLO 1	1
Bases of Animal Taxonomy		
Animal world; significance of animal.	CLO 2	1
Scope and approaches of the subject.	CLO 2	2
Origin of life and organization of animals.	CLO 3-4	2
Embryology, celom and germinal layers.	CLO 7	2
Types and characteristics of different organisms.	CLO 6	2
Animal nomenclature.	CLO 8	1
Basic taxonomic divisions of animals, bases of animal classification.	CLO 5	2
Habits, Habitats and Zoogeography of Bangladesh		
Habits of animal (feeding and living)	CLO 9-10	1
Animal habitats.	CLO 11	1
Spatial and temporal distribution of animals.	CLO 12	1
Bioecological and agroecological zones of Bangladesh, Report writing on habitat and fauna.	CLO 12	2
Techniques and methods		
Methods of studying animals: collection, preservation, identification, curation, transportation.	CLO-14	1
Methods of laboratory culture of lower animals	CLO-15	1
Instruments used in zoological studies: microscopy, centrifugation, incubation, balance, collecting devices and kits, microtomes, habitat analytical kits, haemocyto-meter, sphygmomanometer, photography, camera lucida, micrometer, chemicals and their handlings.	CLO-13	2
Bioinformatics		
History, scope and importance	CLO 16	2
Tools and their uses	CLO 16	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Protista to Gnathostomula		
Course Code: BZOOL 1102	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3
Course Description The course has been designed to introduce the students with The Protozoan Phyla (Phylum Karyoblastea through Myxospora) and The Metazoan Phyla (Porifera to Gnathostomula). It will also provide knowledge about the habit, habitat, geographical distribution, morphological feature and economic importance of the representative animal of those Phyla.		

Course Learning Objectives

1. To introduce The Protozoan Phyla and The Metazoan Phyla.
2. To provide knowledge about the habit, habitat, geographical distribution, morphological feature and economic importance of the representative animal of those Phyla.

Course Learning Outcomes (CLOs)

After completion of the course the Protozoan Phyla (Phylum Karyoblastea through Myxospora) and the Metazoan Phyla (Porifera to Gnathostomula), learners will be able to:

1. Mention the salient features of Protozoan Phyla;
2. Explain the systematic position, habit, habitat, geographical distribution, morphological feature and economic importance of the representative animals under phylum Karyoblastea through Myxospora;
3. Write down the characteristics of The Metazoan Phyla (Porifera to Gnathostomula).

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
The Protozoan Phyla (The animal-like phyla of protists)		
Phylum – Karyoblastea through Myxospora: Brief Classification of Protozoa; *Entamoeba, Euglena, Trypanosoma, Leishmania, Volvox.*	CLO 1-2	4
Foraminiferans, radiolarians.	CLO 1-2	2
Paramecium, *Vorticella*, *Monocystis.*	CLO 1-2	2
Eimeria, *Plasmodium*, *Nosema.*	CLO 1-2	2
Superphylum: Parazoa		
Phylum–Porifera: Brief classification of Porifera; *Leucosolenia*, *Scypha*, *Spongilla.*	CLO 3	4
Superphylum: Phagocytellozoa		
Phylum – Placozoa: *Trichoplax.*	CLO 3	2
Eumetazoa: (Superphylum: Radiata)		
Phylum– Cnidaria: Brief Classification of Cnidaria; *Obelia*, *Physalia*, *Porpita.*	CLO 3	2
Gorgonia, Aurelia, any sea anemone.	CLO 3	2
Phylum – Ctenophora: *Pleurobrachia*, *Hormiphora.*	CLO 3	2
Superphylum: Mesozoa		
Phylum – Rhombozoa: *Dicyemennea.*	CLO 3	2
Superphylum: Bilateria (Protostomes: Acoelomates)		
Phylum – Platyhelminthes: Brief classification of Platyhelminthes, *Planaria*, *Fasciola*, *Taenia.*	CLO 3	4
Phylum – Nemertea: *Prostoma*, *Nipponnemertes* Phylum – Gnathostomula: Any gnathostomulid.	CLO 3	2

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Gastrotricha to Crustacea		
Course Code: BZOOL 1103	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3

Course Description

The course has been designed to introduce the students with The Phylum Gastrorticha to Crustacea.It will also provide knowledge about the habit, habitat, geographical distribution, morphological feature and economic importance of the representative animal of those Phyla.

The course has been designed to introduce the students with Pseudocoelomates and schizocoelous coelomates. This course provides the information on the economic importance of many unknown animals and their role in ecosystems as well as in the environments. Tardigrada to Cephalochordata has been designed to introduce the organisms with their diagnostic and special features of each phylum with recent classification, salient features and brief description of the representative animals from the following groups. Finally, it will capable the students to apply our knowledge and skill for identify of this type species and conserve the biodiversity.

Course Learning Objectives

1. To introduce the phylum Gastrorticha to Crustacea.
2. To provide knowledge on phylogenecity of animals between minor phyla and major phyla.
3. To provide information on habit, habitat, systemic position, shape and size, characteristics, morphology and economic importance of several members of minor phyla and major phyla
4 To apply knowledge and skill for identify of this type species and conserve the biodiversity.

Course Learning Outcomes (CLOs)

After completion of the course the Protozoan Phyla Gastrorticha to Crustacea, learners will be able to:

1. Define Pseudocoelomates;
2. Define schizocoeloous coelomates;
3. Define Bilateria;
4. Explain the systematic position, habit, habitat, geographical distribution, morphological feature and economic importance of the representative animals under phylum Gastrotricha to Crustacea;
5. Describe mode of development (direct or indirect);
6. Work in taxonomical research lab.;

7. Explain the affinities of the organisms.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy		
Course contents	**Alignment of topic with CLOs**	**LH**
Pseudocoelomates		
Phylum – Gastrotricha: Any gastrotrichan.	CLO 1-7	1
Phylum – Nematoda: *Wuchereria, Meloidogyne.*	CLO 1-7	2
Phylum – Kinorhyncha: *Echinoderes.*	CLO 1-7	1
Phylum – Loricifera : *Nanaloricus.*	CLO 1-7	1
Phylum – Priapula: *Priapulus.*	CLO 1-7	1
Phylum – Rotifera: Any rotifer.	CLO 1-7	1
Phylum – Acanthocephala: Macranthorhynchus and one Bangladeshi examples.	CLO 1-7	1
Schizocoelous Coelomates		
Phylum – Sipuncula: *Sipunculus.*	CLO 1-7	2
Phylum – Echiura: *Echiurus.*	CLO 1-7	1
Phylum – Pogonophora : *Lamellisabella.*	CLO 1-7	1
Phylum – Annelida: *Neanthes, Syllus, Tubifex, Hirudo.*	CLO 1-7	3
Phylum – Mollusca: *Pila, Aplysia, Dentalium,* freshwater mussel, *Sepia, Loligo, Octopus.*	CLO 1-7	4
Phylum – Tardigrada: *Macrobiotus.*	CLO 1-7	1
Phylum – Pentastoma: *Linguatula.*	CLO 1-7	1
Phylum – Onychophora: *Peripatus.*	CLO 1-7	1
Phylum – Chelicerata: *Buthus*, *Tachypleus.*	CLO 1-7	2
Phylum – Uniramia: *Scolopendra*, *Julus*, housefly, mosquito, honeybee, firefly, *Kerria*, silkmoth, *Drosophila*, dragonfly, grasshopper, ants, aphids, termites	CLO 1-7	4
Phylum – Crustacea: *Balanus*, prawn, crab, *Argulus, kingcrab.*	CLO-1-7	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	Components	Marks
	Written Examination	Questions	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course: BZOOL 1104
Field study
Full marks: 25 (0.25 unit, 1 credit)

Preparation and submission of reports on habitats of terrestrial and aquatic (fresh water) fauna; and visit to local meteorological station. Distribution of marks: Field report/ Excursion= 12.50; Presentation/ *viva-voce*= 5; Assessment= 5 and Attendance= 2.50.

Course Title: Zoology Practical I		
Course Code: BZOOL 1105	**Course Type:** Practical (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Periods:** 30	**Exam Hours:** 6 (6 hours daily)

Course Learning Objectives

To provide practical experience on the topics covered by theoretical courses so that the learner can apply their knowledge in lab, workplace and in practical life.

Course Learning Outcomes (CLOs)

After completion of this course, learners will be able to:

Display, demonstrate and draw labeled diagrams of the orientation, symmetries, planes and axes of the supplied specimens (Protista to Crustacea);

Identify cell and tissue types, grade of organization (Protista to Crustacea);

Display, demonstrate and draw labeled diagrams of the metamerism, tagmatization and appendages of the supplied specimens (Protista to Crustacea);

4. Collect morphometric/meristic data from the supplied specimen, demonstrate the measurements/counts, calculate ratios between the parameters and leave a graphical presentation of the data;

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Contents	Alignment of topic with CLOs	LP
Bases of Animal Taxonomy: **Orientation of Protista to Crustacea:** dorsal, ventral, oral, aboral, anterior, posterior, lateral, peduncular (or pedal disc), superior, inferior, subumbrellar, exumbrellar. **Symmetry of Protista to Crustacea:** asymmetry; bilateral, radial, biradial and universal or spherical symmetries; symmetry problem. **Planes and Axes of Protista to Crustacea:** longitudinal, transverse, dorso-ventral, cross section (CS/XS), transverse section (TS), sagittal, frontal.	CLO 1	8
Grades of organization of Protista to Crustacea:	CLO 2	4
Metamerism and Tagmatization of Protista to Crustacea: Pseudometamerism, metamerism; head-thorax-abdomen; cephalothorax; head-trunk-tail; prosoma, mesosoma, opisthosoma, metasoma; secondary loss of segmentation. **Appendages of Protista to Crustacea:** Structures used in locomotory, prehensile, food capturing, copulatory, defensive and/or offensive purposes: pseudopodia, flagella, cilia, tentacles, podia (parapodia and legs), antennae, antennules, pineal setae and eye stalks; mouthparts, wings, legs and prolegs, cerci, styles, sting, tentacles and arms; fins, tetrapod appendages, paddles and flippers.	CLO 3	8
Morphometrics: Earthworm: total, clitellar and girth lengths and ratios (somatic indices); Prawn: total, carapace, rostral, antennary, antennulary, telson and uropod lengths and ratios; Any insect: total,	CLO 4	10

cephalic, thoracic and abdominal lengths and widths, head-width, interocular length, wing span and their ratios. **Meristics:** Earthworm: segment numbers, position of different orifices; Prawn: rostral spines; Any insect: number of antennary, tarsal and abdominal segments. **Coelom Of Protista to Crustacea:** Diagnostic internal features of the representative animals. **Class/ Lab notebooks:** Classroom preparations and class records.		

Teaching-learning Strategy	**Assessment Strategy**		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hrs daily on the above tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Course Title: Zoology Practical II		
Course Code: BZOOL 1106	**Course Type:** Practical (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Periods:** 30	**Exam Hours:** 6 (6 hours daily)

Course Learning Objectives

To provide practical experience on the topics covered by theoretical courses so that the learner can apply their knowledge in lab, workplace and in practical life.

Course Learning Outcomes (CLOs)

After completion of this course, learners will be able to:

1. Identify the genus of selected animals and to mention their systematic position with taxon-specific diagnostic characteristics (Protista to Crustacea);
2. Identify the supplied specimens up to Order using taxonomic keys (insects);
3. Prepare and handle the different types of laboratory chemicals;
4. Identify, draw labeled diagrams and mention the use of instruments/ equipment/ apparatus;

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Contents	**Alignment of topic with CLOs**	**LP**
Animal Taxonomy: Study of preserved and representative museum specimens and their identification based on taxon-specific (PCOFGS) external morphological characters	CLO 5-6	20

(Protista to Crustacea). **Identification of supplied animals up to order using keys (insects)**		
Instrumentation: Laboratory safety; Use, caring and handling of microscopes: simple, compound, stereo, zoom of all models; Microscopy: magnifications, measurements using micrometers, graticules and camera lucida. Centrifugation (rpm): hand, electric and ultra-centrifuges. Balances: spring, pan and electronic, Scales and measuring tapes. Microtome machine, dissecting box, chromatographic and electrophoretic devices. Incubator and hot-water bath, autoclave, maximum-minimum temperature and estimation of RH. Binocular and camera: natural history photography; Distillation plant. **Methodologies:** Preparation of laboratory chemicals and their handlings: Preparation of solution with required concentration, stains, adhesive and fixatives, preservatives; Preparation of pesticide/ extractive doses, preparation of normal (N) and milli Molar (mMol) solutions. **Class/ Lab notebooks:** Classroom preparations and class records.	CLO 7-8	10

Teaching-learning Strategy	**Assessment Strategy**		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hrs daily on the above tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Learning Resources

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Course Title: Botany I: Introduction to Plant Kingdom & Lower Plant Groups		
Course Code: BZOOL 1107	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3

Course Description

Botany I: Introduction to Plant Kingdom and Lower Plant Groups course has been designed to introduce you the living world and non-living environment with examples. It also covers knowledge on plant world with its origin and distribution followed by plants in association with animals. This course deals with major plant taxas in plant kingdom including their feature, classification, and economic importance. It will also provide knowledge about the resemblances and differences among different plant groups. It includes the study of the primitive plants known as algae, fungi, bryophytes and pteridophytes including their life cycle, structure and reproduction. Altogether, you will learn about bacteria including its structure, reproduction, classification and economic importance.

Course Learning Outcomes (CLOs)

After completion of this course, learners will be able to:

1. Explain the living world and non-living environment with examples;
2. Interpret the interdependence of organisms;
3. Define plant;
4. Describe the origin and distribution of plant;
5. Interpret what is the relationship between plant and animal;
6. Describe the classification of plant kingdom;
7. Identify the major groups of plants;
8. Compare the characteristics of lower and higher plants;
9. Describe the resemblances and differences among the plant taxa;
10. Identify the flowering and non-flowering plant;
11. Compare vascular and non-vascular plant;
12. Identify the embryo bearing plants;
13. Describe morphology, anatomy and reproduction of algae, fungi, bryophytes and pteridophytes;
14. Define life cycle of different lower and higher plant;
15. Compare the homosporous and heterosporous pteridophytes;
16. Compare the sporophytic and gametophytic generation;
17. Define alternation of generation;
18. Identify the algae, fungi, bryophytes and pteridophytes according their structure, characteristics and classification;
19. State, describe and explain the economic importance of algae, fungi, bacteria, bryophytes and pteridophytes;
20. Classify bacteria based on their characteristics and structures;
21. Create the awareness and appreciation of human friendly algae, fungi, bacteria, bryophytes and pteridophytes;
22. Apply different teaching and learning strategies associated with biology when teaching the diversity of different plants through the use of ICT.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Introduction		
Living world and non-living environment.	CLO 1-2	3
Plant world: Origin and distribution and plants in association with animals.	CLO 3-5	3
Classification of plant kingdom.	CLO 6-22	2
Different major taxas of plants.	CLO 7-9, 22	2
Flowering and non-flowering plants; Vascular and Non-vascular plants.	CLO 10-11	3
Embryo bearing plants.	CLO 12, 22	2
Lower plants		
Algae: Characteristics, Classification, Economic Importance, Structure, reproduction and life cycle of *Volvox*, *Ulothrix*, *Choleochaeta*.	CLO 13-14, 7-19, 21	3
Fungi: Characteristics, Classification, Economic Importance, Structure, reproduction and life cycle of *Penicillium*, *Helminthosporium*, *Agaricus*.	CLO 13-14, 18-19, 21	3
Bacteria: Structure, Classification, Reproduction and Economic Importance.	CLO 19-21	3
Bryophytes: Characteristics, Classification, Economic Importance, Structure, reproduction and life cycle of *Riccia* and Moss.	CLO 13-14, 18-19, 21	3
Pteridophytes: Characteristics, Classification, Economic Importance, Structure, reproduction and life cycle of *Equisetum* and a fern.	CLO 13-19 CLO 21-22	3

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Questions	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Botany II: Taxonomy, Economic Botany & Plant Breeding		
Course Code: BZOOL 1108	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3
Course Description Taxonomy of Angiosperms is the science of identification, classification and diversity studies of flowering plants. This course provides knowledge of economically important plants and plant products. Introduces the systematic of diseases and pathogens, host-pathogen interactions, pathogenesis and		

disease management. Students will know the history, fundamental principles, practices and techniques of plant breeding. It includes productivity, disease resistance and breeding methodologies for pollinated and clonal crops.

Course Learning Outcomes (CLOs)

After completion of this course, learners will be able to:

1. Describe the plant classification as a foundation for plant recognition and family's identification;
2. Apply the basic knowledge on plant breeding and explore the necessary strategies and methods used in the breeding of different crop plants;
3. Apply the skill to identification and management of common weeds in the crop fields;
4. Apply the knowledge on commercial products derived from plants that provide us with consumable products such as oil, tea and materials such as fiber and practice of herbal medicine;
5. Identify the different symptoms and causal agents of some plant diseases and disease management;
6. Describe the various conventional and molecular methods or strategies for the genetic improvement of crops to achieve food and nutritional security.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Classification of Angiosperms		
Systems of classification: Bentham and Hooker's system; Englar and Prantle's system.	CLO-1	3
Study of families: Moraceae *(Morus),* Gramineae. Cruciferae, Leguminosae, Solanaceae, Nymphaceae, Labiatae, Apocynacceae, Malvaceae, Compositae, Palmae and common weeds in the crop fields (minimum 10 species name).	CLO 1 CLO 3	7
Economic Botany		
Sources, methods of cultivation, processing and uses of oil, fibre, tea and medicinal items.	CLO-4	5
Role of lower plants in maintaining the environment and their economic importance.	CLO-4	1
Plant diseases		
Plant diseases caused by fungi in rice, jute, sugarcane and potato.	CLO-5	4
Plant breeding		
Definition and importance, history and principles.	CLO-2	3
Methods of plant breeding; Breeding systems of plants.	CLO-2	4
Domestication and evolution of crops; breeding for disease resistance, basis of resistance, breeding strategies and methods.	CLO-2	3

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Questions	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Learning Resources:

Smith, G.M. 1971. Cryptogamic Botany, Algae and Fungi. Vol.1. (2nd ed) Tata Mc Graw-Hill, New Delhi.

Alexopoulos, C. J., Mims, C. W. and Blackwell, M. 2007. Introductory Mycology (4th Edition). Wiley India Pvt. Ltd.

Vashishta, B. R. 1990. Fungi, Botany for Degree Students (9th Edition). S. Chand and Company Ltd., New Delhi-110055, India.

Dube, H. C. A. 1994. Text Book of Fungi, Bacteria and Viruses. Vikas Publ. Ltd. India.

Pelczer, M. J., Chau, E. C. S. and Krieg, N. R. 1993. Microbiology (5th ed.). Tata Mc Graw-Hill Com. India.

Vanderpoorten, A. and Goffinet, B. 2009. Introduction to Bryophytes. Cambridg University Press, NY.

Vashishta, B. R. 1990. Botany for Degree Students: Part III: Bryophytes. S. Chand & Com. Ltd. New Delhi.

Vashishta, B. R. 2005. Botany for Degree Students: Pteridophytes. S. Chand & Com. Ltd. New Delhi.

Rashid, A. 1999. An Introduction to Pteridophyta (2nd ed.). Vikas Publ. House Pvt. Ltd. New Delhi,

Course Title: Botany III: Plant Anatomy & Plant Tissue Culture		
Course Code: BZOOL 1109	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3

Course Description

This course has been designed to introduce the gamete formation, pollination, fertilization and embryogenesis of plant. Plant anatomy is the general term or study of the internal structure of plants. While originally it introduced plant morphology, which is the description of the physical form and external and internal structure of plants. Plant tissue culture is the aseptic culture of cells, tissue, organs, and their components under deferent chemical and physiological condition *in vitro*.

Course Learning Outcomes (CLOs)

After completion of this course, learners will be able to:

1. Describe cell, cell wall, tissue and tissue system, meristems, stomata, primary and secondary structure of stem and root;
2. Demonstrate a general familiarity with basic plant structure and organs; the detail structure of roots, stems and leaves of plants;
3. Explain the methods involved in tissue culture;
4. Apply skills to establish *in vitro* culture techniques in agriculture and food industry.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy		
Course contents	**Alignment of topic with CLOs**	**LH**
Plant Anatomy		
Structure and composition of plant cell Cell: definition, cellular complexity in plants, origin, development, structure shape, type and function.	CLO-1, 2	4
Organization of tissue: Tissue and tissue systems: definition, classification, origin, development, structure and function. Meristem: meristem and meristematic tissues, classification, origin, development and function. Stomata: definition, origin, development, types, structure and function.	CLO-1, 2	6
Plant body structure: Primary and secondary structures: root and stems. Anomalous secondary growth in stems and roots. Periderm: origin, development, structure, location and function. Transition: root-stem transition in plants, transition of vegetative to reproductive meristem, basic development of reproductive meristem. Stele: structure, types and evolution.	CLO-1, 2	6
Plant Tissue Culture		
Cellular totipotency: Basic concept of cell theory and Cellular differentiation, Tissue culture media and components, Differentiation, de-differentiation and re- differentiation.	CLO-3	6
Application of plant tissue culture: Micropropagation methods, axillary bud formation. Direct and indirect organogenesis, Somatic embryogenesis; Meristem culture and stages of micropropagation, hardening and acclimatization, transplantation; Advantage and disadvantage of micropropagation.	CLO-4	8

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Assessment	10

Learning Resources:

Cutter, E. G. 1969. Plant Anatomy: Part I and Part II, Edward Arnold Pub. UK.
Eames,A. J. and L. H. MacDaniels. 1947. An Introduction to Plant Anatomy MacGraw-Hill, N. Y.
Esau, K. 1953. Plant Anatomy: John Wiletsons, NY.
Fahn, A. 1967. Plant Anatomy: Pergamon Press, Oxford
Bhojwani, S.S. and Razdan, M.K. 1993. Plant Tissue Culture: Theory and Practice. Elsevier Sci.

Publ., Amsterdam, The Netherlands.
George, E.F., Hall, M.A. and DeKlerk G. 2008. Plant Propagation by Tissue Culture, 3rd Ed. Vol 1, Agritech Publ. NY, USA.
Razdan, M.K. 1993. An Introduction to Plant Tissue Culture. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi, India.
পাল, এন. কে. ২০০০. উদ্ভিদ শারীরস্থান।

Course Title: Bangladesh Studies		
Course Code: BZOOL 1110	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description:
History is the study of what happened in the past. History is an endless dialogue between the present and the past. "History reminds us of the inherent weakness in the human condition and the very real possibility that our fellow human beings are capable of horrendous things. Studying History will develop our ability to think critically about what happened in the past, and how this shapes with the lives of people around the world. The course has been designed to facilitate the students in obtaining the inclusive idea about the geography, history and culture, the economy, industrial development, and the present climate crisis. It has also focused on struggling past, culture and heritage of Bangladesh in the long life of long historical background. It will focus on the social, economic industrial and political developments that have been taken place before and since it's independence in the 20th century. As a Bangladeshi we should know the background of our Liberation War and how Bangladesh became independent. Because the story of our Liberation War is our pride and glory. By reading this course the students could see our past, background our Liberation war and how Bangladesh became independent.

Course Learning Objectives:

1. To introduce the students with geography, the economy, the industry sector of Bangladesh.
2. To provide the knowledge on Bangladesh constitution.
3. To make aware how to develop economy with agriculture and industry keeping our environment safe
4. To equip students with the knowledge about the inevitability of the emergence of Bangladesh as a sovereign state in the context of a long historical background.
5. To equip the students the events critically and deeply in the light of history which will make them the ideal citizen with patriotism towards the national integration and advancement.

Course Learning Outcomes (CLOs):
After completion of this course, learners will be able to:

1. To Identify and explain the location; boundary & border; topography; mineral resources; climate; administrative structure; culture, traditions-norms, values and social stratification in Bangladesh.
2. To explain the fundamental principles of the Constitution, Constitution of Bangladesh (18A) to protect and improve the environment.
3. To explain the role of private, agriculture, industrial sector on GDP andto be economically developed Bangladesh.
4. To identify the causes of environmental degradation and climate change.

5. To know the perspective of rural development and urbanization.
6. To Identify and explain the main events of the history of Bangladesh since the pre historic time to the emergence of Bangladesh as a sovereign state in 1971.
7. To describe historical events for multiple perspectives.
8. To trace the historical root of Bangladesh as an Independent state.
9. To Identify and explain the inevitability of the emergence of Bangladesh as a sovereign state.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
A. Culture, Development, Economy and environment		
Geography, Demography, Government, and Socio-cultural aspect of Bangladesh: Location; boundary & border; topography; mineral resources; climate; administrative structure; culture, traditions-norms, values and social stratification in Bangladesh.	CLO-01	2
Constitution of Bangladesh: Fundamental principles of the Constitution, Constitution of Bangladesh (18A) to protect and improve the environment and to preserve and safeguard the natural resources, bio-diversity, wetlands, forests and wild life for the present and future citizens.	CLO-02	2
Economy of Bangladesh: Role of private sector and agricultural sector on GDP. To be economically developed Bangladesh. The pillars of Bangladesh economy: -remittance, export, agriculture.	CLO-03	2
Industrial Sector of Bangladesh: Major industries of Bangladesh, role of industrial sector in national economy of Bangladesh, importance of industry in Bangladesh development.	CLO-03	2
Environmental Degradation & Climate Change: Bangladesh perspective: Impact of climate crisis, the major impact of climate change in Bangladesh, Bangladesh to face the problems as a result of climate change, impacts on coastal areas in Bangladesh, the main environmental degradation in Bangladesh.	CLO-04	3
Urbanization & Rural Development of Bangladesh: The key elements of rural development in Bangladesh, urbanization in Bangladesh, difference between urbanization and rural development, importance of rural development in Bangladesh, the rural development policy of Bangladesh, the government strategies for rural development, challenges facing rural development in Bangladesh, the effects of urbanization in rural areas, advantages, benefits and effect of urbanization.	CLO-05	2
Sustainable Agriculture and Green Growth in Bangladesh: Sustainable development of agriculture in Bangladesh; the	CLO-04	2

green initiatives in Bangladesh; Bangladesh to adopt the green growth policy; green economy in Bangladesh; the major sources of green energy in Bangladesh; the role of green growth for sustainable economy; importance of green economy for sustainable development; the sustainable issues in Bangladesh; the importance of green economy in Bangladesh.		
B. Emergence of Bangladesh		
Bengali Identity and Bangla Language: Movement phases of language movement: - early stages of language movement; Agitations of 1948, Events in 1952; significance of language movement and Bengali nationalism: -events after 1952.	CLOs 06-09	2
Pakistan Regime: Structure of the state and disparities structure of Pakistan state: economic disparities, trade and commerce, industrialization, economic inequality, socio-cultural disparities, education sectors, hindrance to cultural life, inequality in job sectors political disparities failure of Pakistan's political policy; political instability	CLOs 06-09	2
Six points Movements and Mass Uprising in 1969: Six points program: background, popularity impact of six points program, economic monopoly. **Agartala Conspiracy**: Background, aftermath of Six-point program, Boomerang for Sheikh Mujibur Rahman. **Influence Mass uprising**: background, killing of people, arrest of Sheikh Mujibur Rahman, fall of Ayub Khan, reasons, power handed over to Yahya Khan, 11 point program of students, formation of all party student's action committee and demands	CLOs 06-09	3
Election of 1970 and Non-cooperation movement: Election of 1970: background, participation of the parties, result non-cooperation movement, historical speech of Bangabandhu, aftermath, genocide on 25th march in the name of operation search light.	CLOs 06-09	2
Liberation war of Bangladesh: Declaration of independence, formation of provisional government, Indian involvement, Mukti Bahini and sectors, guerilla warfare, role of major powers: India, Russia, USA, China, UN, formation of allied force, surrender and aftermath, final victory of Bangladesh.	CLOs 06-09	2
Role of Sheikh Mujib and Awami League: Political activism, leader of Pakistan, his demand of autonomy, involvement in several nationalist movements, his contribution for the birth of Bangladesh.	CLOs 06-09	2
Political Actors toward the emergence of Bangladesh: Role of the following political leaders: a. Abul Kasem Fazlul Huq, b. Maulana Abdul Hamid Khan Bhashani c. Huseyn Shaheed Suhrawardy, d. National Four Leaders of Bangladesh.	CLOs 06-09	
Politics and Governance in Bangladesh: Return of the Father of the Nation Bangabandhu Sheikh Mujibur Rahman, Constitution making and Parliamentary Democracy.	CLOs 06-09	1

Politics and Governance in Bangladesh (1971-till date): (Political Development in different regimes and Vision 2021)	CLOs 06-09	1

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Curriculum
For
First Year
Second Semester

B. Sc. (Honours) First Year Second Semester Examination, 2024

Course codes	Course titles	Units	Marks	Credits
Major courses				
BZOOL 1201	Phorona to Cephalochordata	0.5	50	2
BZOOL 1202	Pisces and Amphibia	0.5	50	2
BZOOL 1203	Reptilia to Mammalia	0.5	50	2
BZOOL 1204	Field Study/ Excursion	0.25	25	1
BZOOL 1205	*Viva-voce* (Honours courses)	0.5	50	2
BZOOL 1206	Zoology Practical I	0.5	50	2
BZOOL 1207	Zoology Practical II	0.5	50	2
GEd courses				
BZOOL 1208	Botany IV: Plant physiology, Ecology and Fungal diseases	0.5	50	2
BZOOL 1209	Botany V: Microbiology and Plant Pathology	0.5	50	2
BZOOL 1210	Botany Practical	0.5	50	2
Non-credit				
BZOOL 1211	English for Communication and Science	0.5	50	0
	Total	**4.75**	**475**	**19**

B.Sc. (Honours) First Year Second Semester Examination, 2024

Course Title: Phoronida to Cephalochordata		
Course Code: BZOOL 1201	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3

Course Description

The course ZoolB201 has been designed to introduce the phylum Phoronida to Cephalochordata. The majority animals of minor phyla have neither economic importance nor ecological significance and the study of these animals has been largely neglected. The course will provide knowledge on phylogenecity of animals between minor phyla and major phyla. This course is also aimed to provide information on habit, habitat, systemic position, shape and size, characteristics, morphology of several members of the following groups. Finally, it will capable we to apply our knowledge and skill for identify of this type species and conserve the biodiversity.

Course learning Objectives

1. To introduce you the phylum Phoronida to Cephalochordata.
2. To provide knowledge on phylogenecity of animals between minor phyla and major phyla.
3. To provide information on habit, habitat, systemic position, shape and size, characteristics, morphology and economic importance of several members of minor phyla and major phyla
4. To apply knowledge and skill for identify of this type species and conserve the biodiversity.

Course learning Outcomes (CLOs)

After completion of phylum Phoronida to Cephalochordata, learners will be able to:

1. Identify the bilaterian organisms;
2. Classify the phylum Tardigrada to Chordata;

3. Describe the salient feature of the organisms;
4. Describe the habits of the organisms;
5. Describe the habitat of the organisms;
6. Describe the external morphology of the organisms;
7. Describe mode of development, whether it direct or indirect;
8. Work in taxonomical research lab.;
9. Explain the affinities of the organisms.

Course contents, subject to the lecture and alignment of topic with CLOs		
Course contents	**Alignment of topic with CLOs**	**LH**
Lophophorate Coelomate		
Phylum– Phoronida: *Phoronis.* Phylum– Brachiopoda: *Lingula.* Phylum– Bryozoa (Ectoprocta/Polyzoa): *Alcyonidium*, *Cristatella*. Phylum– Entoprocta: *Urnatella*, *Pedicellina.* Phylum– Cycliophora: *Symbion*.	CLO 1-9	10
Deuterostomes or Enterocoelous coelomates		
Phylum– Chaetognatha: *Sagitta*, *Spadella*.	CLO 1-9	2
Phylum– Echinodermata: *Asterias*, *Ophiura*, *Echinus*, *Cucumaria*, *Antedon*.	CLO 1-9	6
Phylum– Hemichoradata: *Balanoglossus*, *Cephalodiscus.*	CLO 1-9	4
Phylum– Chordata: Sub-Phylum: Urochordata: *Oikopleura*, *Ascidia*, *Salpa*. Sub-Phylum: Cephalochordata: *Branchiostoma*.	CLO 1-9	8

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	05
		Tutorial	10

Course Title: Pisces & Amphibians		
Course Code: BZOOL 1202	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3

Course Description

Pisces to Amphibia course has been designed to introduce students the phylum: Chordata, Sub-Phylum: Vertebrata, Super - Class: Pisces, Division I: Agnatha Class Myxini. Myxine, class: Cephalaspidomorphi: Petromyzon, class: Ostracodermi Division II: Gnathostomata, class: Placodermi, class Chondrichthyes, class Osteichthyes and class Amphiba and their representative animals. This course will also provide Knowledge on fundamental characteristics and major divisions of Chordate diversity,

general characteristics of vertebrates, classification of super class Pisces with characters and examples of its main groups, classification of Cyclostomata with characters and examples and affinities of Cyclostomata, characters, classification, biological importance and affinities of Ostracoderms and Placoderms. Classification of Chondrichthyes, Osteichthyes and Amphibia up to order or family with salient features and examples. Altogether students will learn about habit habitat, geographical distribution, external features labeled diagram, breeding behavior and economic importance of representative fishes of class – Chondrichthyes, Osteichthyes and Amphibia. Finally, it will capable students to apply their knowledge and skill for identifying various types of fishes and amphibians in the world.

Course Learning Objectives

1. To introduce the phylum: Chordata, Sub-Phylum: Vertebrata, Super - Class: Pisces and Tetrapoda- class Amphibia, and their representative animals.
2. To provide Knowledge on fundamental characteristics and major divisions of Chordate diversity, general characteristics of vertebrates, classification of super-classes with characters and examples.
3. To teach about habit habitat, geographical distribution, external features labeled diagram, breeding behavior and economic importance of representative classes of fishes and Tetrapoda, class- Amphibia and their representative animals.
4. To apply knowledge and skill to identifying various types of animals in the world.

Course Learning Outcomes (CLOs)

After completion of Class Myxini to Amphibia course, learners will be able to:

1. Define Chordata, vertebrata, Pisces, Agnatha, Gnathostomata cold blooded and warm-blooded animals;
2. Classify superclass-Pisces, class- Cychostomataclass- Ostracodermi, class- Placodermi, class-Chondrichthyes class-Osteichthyes and tetrapodean class Amphibia;
3. Mention the major divisions of chordate diversity;
4. Describe the general characters of phylum-Chordata, sub-phylum Vertebrata, superclass- Pisces, class- Cyclostomata, class- Ostracodermi, class-Placodermi, class-Chondrichthyes, class-Osteichthyes and tetrapodean class-Amphibia;
5. Compare and differences between Chordata and vertebrata, Protochordata and Urochordata, Chondrichthyes and Osteichthyes, *Petromyzon* and *Myxine* Skates and Rays;
6. Explain the affinities of ostracoderms and placoderms;
7. Explain the habit and habitat, food, feeding and breeding behavior, geographical distribution, external morphology, economic importance of various type of fishes and amphibians.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Phylum: Chordata Sub- Phylum: Vertebrata; Super-Class: Pisces; Division I: Agnatha Class Myxini: *Myxine.*	CLO 1-7	2

Class Cephalaspidomorphi: *Petromyzon.*	CLO 1-7	2
Class-Ostracodermi.	CLO 1-7	2
Division II: Gnathostomata. Class-Placodermi.	CLO 1-7	2
Class: Chondrichthyes: Dogfish (*Scoliodon*),	CLO 1-7	1
Class-Chondrichthyes. sawfish (*Pristis*), hammerhead (*Sphyrna*), sting ray (*Raja*).	CLO 1-7	2
Class: Chondrichthyes- electric ray (*Narcine*), tiger shark (*Stegostoma*)andrat fish (*Chimaera*).	CLO 1-7	2
Class. Osteichthyes.	CLO 1-7	1
Major carp (*Labeo*), climbing perch (*Anabas*), river shad (*Tenualosa/Hilsa*).	CLO 1-7	2
snakehead (*Channa*), catfish (*Heteropneustes*), gar *(Xenontodon*), halfbeak (*Hyporhampus).*	CLO 1-7	2
seahorse (*Hippocampus*), puffer (*Tetraodon*), eel (*Anguilia*), mullet (*Mugil*),	CLO 1-7	2
flatfish (*Cyanoglossus*), mudskipper (*Periopthalmus*), freshwater eel (*Mastacembalus*), sturgeon (*Acipenser*).	CLO 1-7	2
flying fish (*Exocoetus*), paddle fish (*Polyodon*), bowfin *(Amia),* bichir (*Polypterus*).	CLO 1-7	2
Notopterus and SIS fishes.	CLO 1-7	1
Class. Osteichthyes (Lung fishes).	CLO 1-7	1
Super-Class: Tetrapoda		
Classification of Amphibia	CLO 1-7	1
Amphibians *Necturus* and *Microhyla.*	CLO 1-7	1
Amphibians *Salamandra* and *Ambystoma*	CLO 1-7	1
Amphibian *Seymoria*	CLO 1-7	1

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	10
		Tutorial	20

Course Title: Reptilia to Mammalia		
Course Code: BZOOL 1203	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3

Course Description

Reptilia to Mammalia course has been designed to introduce the students with the Class- Reptilia, Aves and Mammalia and their representative animals. This course is also aimed to provide information salient features and classification of class Reptilia, Aves and Mammalia and you will learn about habit, habitat, geographical distribution, external structure breeding behavour, labeled diagram and economic

importance of representative animals of Reptilia, Aves and Mammalia. Finally, it will capable the students to apply their knowledge and skill for identifying various types of animals in the world.

Course Learning Objectives

1. To introduce the Class- Reptilia, Aves and Mammalia and their representative animals.
2. To provide Knowledge on fundamental characteristics and major divisions of Chordate diversity, general characteristics of vertebrates, classification of super classes with characters and examples.
3. To teach about habit habitat, geographical distribution, external features labeled diagram, breeding behavior and economic importance of representative classes Reptilia, Aves and Mammalia and their representative animals.
4. To apply knowledge and skill for identifying various types of animals in the world.

Course Learning Outcomes (CLOs)

After completion of Class- Amphibia to Mammalia course, learners will be able to:

1. Define Reptilia, Aves and Mammalia;
2. Classify class Reptilia, Aves and mammalian up to orders with diagnostic characters and examples;
3. Mention the common and scientific name of representative animals of class Reptilia, Aves and mammalian;
4. Explain the habit and habitat, food, feeding and breeding behavior, geographical distribution, external morphology, labeled diagram and economic importance of representative animals of Reptilia, Aves and Mammalia;
5. Compare the turtles, tortoises, terrapins; crocodylus, alligator and gavialis; migratory, resident and non- resident bird; Prototheria, Metatheria and eutheria; dolphin, whale and porpoise;
6. Distinguish between lizards and snakes, poisonous and non-poisonous snakes, flightless and flying birds, Indian elephant and African elephant, human beings and apes.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Reptilia		
Classification of Reptilia.	CLO 1-6	1
Reptilians *Draco*, *Sphenodon* and *Archaeopteryx*	CLO 1-6	1
Reptilians- turtles, tortoises and terrapins; local snakes	CLO 1-6	1
Gavialis, *Crocodilus* and *Alligator*	CLO 1-6	1
Mesozoic Reptiles and Causes of their extinction	CLO 1-6	1
Aves		
Classification of Aves.	CLO 1-6	1

Ratitae and carinates.	CLO 1-6	2
Carnivorous, insectivorous, residential and non-resident birds.	CLO 1-6	2
Mammalia		
Classification of Mammalia.	CLO 1-6	1
Prototheria, Metatheria and Eutheria; Marsupials; Ungulates.	CLO 1-6	1
Rodents (Hares and Rabbits).	CLO 1-6	1
Horns & Antlers (Deer and Rhinos).	CLO 1-6	1
Primates (Apes, Monkeys and *Homo*); Aquatic mammals.	CLO 1-6	1

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	10
		Tutorial	20

Course: BZOOL 1204
Field study/ Excursion
Full marks: 25 (0.25 unit, 1 credit)

Preparation and submission of reports on habitats of terrestrial and aquatic (estuarine and marine) fauna; Excursion to the National Safari Park at Dulahazara/Gazipur. Distribution of marks: Field report /Excursion= 12.50; Presentation/ *viva-voce*= 5; Assessment= 5 and Attendance= 2.50.

Course: BZOOL 1205
Viva-voce
Full marks: 50 (0.5 unit, 2 credit)

Viva-voce on theoretical courses of first year first semester and second semester.

Course Title: Zoology Practical I		
Course Code: BZOOL 1206	**Course Type:** Practical (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Periods:** 30	**Exam Hours:** 6 (6 hours daily)
Course Learning Objectives To provide practical experience on the topics covered by theoretical courses so that the learner can apply their knowledge in lab, workplace and in practical life.		
Course Learning Outcomes (CLOs) After completion of this course, learners will be able to:		

1. Display, demonstrate and draw labeled diagrams of the orientation, symmetries, planes and axes of the supplied specimens (Phoronida to Chordata);
2. Identify cell and tissue types, grade of organization (Phoronida to Chordata);
3. Display, demonstrate and draw labeled diagrams of the metamerism, tagmatization and appendages of the supplied specimens (Phoronida to Chordata);
4. Identify the genus of selected animals and to mention their systematic position with taxon-specific diagnostic characteristics (Phoronida to Chordata);
5. Identify the supplied specimens up to Order using taxonomic keys (fishess).

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Contents	Alignment of topic with CLOs	LP
Orientation Of Phoronida to Chordata: dorsal, ventral, oral, aboral, anterior, posterior, lateral, peduncular (or pedal disc), superior, inferior, subumbrellar, exumbrellar. **Symmetry Of Phoronida to Chordata:** asymmetry; bilateral, radial, biradial and universal or spherical symmetries; symmetry problem. **Planes and Axes Of Phoronida to Chordata:** longitudinal, transverse, dorso-ventral, cross section (CS/XS), transverse section (TS), sagittal, frontal.	CLO 1	10
Grades of organization Of Phoronida to Chordata:	CLO 2	4
Metamerism and Tagmatization Of Phoronida to Chordata: Pseudometamerism, metamerism; head-thorax-abdomen; cephalothorax; head-trunk-tail; prosoma, mesosoma, opisthosoma, metasoma; secondary loss of segmentation. **Appendages Of Phoronida to Chordata:** Structures used in locomotory, prehensile, food capturing, copulatory, defensive and/or offensive purposes: pseudopodia, flagella, cilia, tentacles, podia (parapodia and legs), antennae, antennules, pineal setae and eye stalks; mouthparts, wings, legs and prolegs, cerci, styles, sting, tentacles and arms; fins, tetrapod appendages, paddles and flippers.	CLO 3	10
Taxonomy Of Phoronida to Hemi-chordata: Study of preserved and representative museum specimens and their identification based on taxon-specific (PCOFGS) external morphological characters.	CLO 4-5	6
Class/Lab notebooks: Classroom preparations and class records.		

Teaching-learning Strategy	Assessment Strategy		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hrs daily on the above tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Course Title: Zoology Practical II		
Course Code: BZOOL 1207	**Course Type:** Practical (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Periods:** 30	**Exam Hours:** 6 (6 hours daily)

Course Learning Objectives

To provide practical experience on the topics covered by theoretical courses so that the learner can apply their knowledge in lab, workplace and in practical life.

Course Learning Outcomes (CLOs)

After completion of this course, learners will be able to:

1. Collect morphometric/ meristic data from the supplied specimen, demonstrate the measurements/counts, calculate ratios between the parameters and leave a graphical presentation of the data;
2. Identify the genus of selected animals and to mention their systematic position with taxon-specific diagnostic characteristics (Phoronida to Chordata;
3. Identify the supplied specimens up to Order using taxonomic keys (fishess);
4. Apply and interpret the methods of estimation of the group diversity of different habitats.

Course contents, teaching strategies and alignment of topic with CLOs

Contents	Alignment of topic with CLOs	LP
Morphometrics Of Phoronida to Chordata: Bony fishes: total, standard, anal, fin lengths and their ratios; Snakes: scale characters of poisonous and non-poisonous species; Mammals: total, head, pinnal and tail lengths and their ratios. **Meristics Of Phoronida to Chordata:** Bony fishes: number of fin rays and barbels; fin formulae; Mammals: whisker numbers and dental formulae. **Coelom Of Phoronida to Chordata:** Diagnostic internal features of the representative animals.	CLO 1	10
Taxonomy Of Chordata: Study of preserved and representative museum specimens and their identification based on taxon-specific (PCOFGS) external morphological characters.	CLO 2-3	12

Identification of supplied animals up to order using keys (fishes).		
Estimation of habitat-faunal relationships: Collection of local specimens by sweeping, beating, hand-picking, host body-researching etc. and estimation of group diversity (GD); demonstration of the collected specimens by easy conventional methods like temporary or permanent whole mounts; preparation of a field study report on habitat-faunal relationships.	CLO 4	8
Class/Lab notebooks: Classroom preparations and class records		

Teaching-learning Strategy	**Assessment Strategy**		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hrs daily on the above tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

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Course Title: Botany IV: Plant physiology, Ecology & Fungal diseases		
Course Code: BZOOL 1208	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3

Course Description

Plant physiology is a branch of biology which deals a wide range of processes and functions that plants use to live and survive. The courses discuss some basic contents including minerals and nutrients transportation, photosynthesis, respiration, metabolism, transpiration, plant hormones and enzymes.

Plant Ecology deals with the reciprocal relationship between plants and their environments. This course will introduce students to the basic ecological principles related to ecosystem, plant succession and distribution of plants with

biotic and abiotic environments.

The course will be conducted on basic concepts of zoo-pathogenic fungi and the occurrence of muscardine disease of silkworm, skin disease of human beings, fungal diseases of economically important animals.

Course Learning Outcomes (CLOs)

Upon completion of this course, the students will be able to:

1. Describe the basic physiological, ecological and fungal diseases and familiarize the subjective matters;
2. Analyze different physiological and ecological processes and functions and their interactions within plants and environment. Disease manifestation by fungi and their pathogenic behaviour to animals especially humans to be studied;
3. Apply knowledge to find out physiological processes and functions of plants to develop better crop cultivation practices. On the other hand, to apply ecological principles, to find out the present and future situation of plant distribution, succession, better adaptation of plants in Bangladesh. The knowledge of fungal diseases would be helpful to take precautions from harmful diseases;
4. Create awareness on various physiological and ecological acts and fundamental knowledge of fungal diseases which will be associated with human welfare.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Plant Physiology		
Concept, osmosis, absorption of water, minerals, nutrients, role of nutrients, transportation, types and factors affecting transpiration.	CLO 1-3	4
Photosynthesis, mechanism in C_3 and C_4 plants, factors affecting the rate of photosynthesis, respiration types, mechanism of anaerobic and aerobic respiration.	CLO 1-3	3
Phytohormone, enzymes, germination of seeds and viability of seeds.	CLO 1-3	3
Ecology		
Concept, ecosystem, components of ecosystem, ecosystem of Bangladesh.	CLO 1-3	3
Edaphic, climatic and biotic factors in relation to growth, development and distribution of plants, succession sere, xero and hydro-sere.	CLO 1-3	4
Adaptations of hydrophytes and xerophytes; distribution and floristic composition of forests in Bangladesh.	CLO 1-3	3

Fungal diseases		
Introduction, elementary knowledge of zoo-pathogenic fungi.	CLO 1-3	2
Study of the following diseases: muscardine disease of silkworm, skin diseases of human beings.	CLO 1-3	3
Mycoses, fungal diseases of economically important animals.	CLO 1-3	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Examination	Written	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Botany V: Microbiology & Plant Pathology		
Course Code: BZOOL 1209	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3

Course Description

This course is designed to help students to understand regarding the basic concept of microbiology and plant pathology. Students can explore various topics of microbiology and plant pathology including characteristics, habit, habitat, etiology, diseases and their industrial use. It also helps the students to be familiar with different characteristics to identify viruses, bacteria and plant diseases causing organisms.

Course Learning Outcomes (CLOs)

Upon completion of microbiology and plant pathology course, students will be able to:

1. Define and understand characteristics of different organisms and their biological nature;
2. Describe microbiological mode of function, pattern of environmental and nutritional factors, as well as relationship of fungi with agriculture, crop plants and human/ animals;
3. Collect, identify and use different microorganisms.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	**Alignment of topic with CLOs**	**LH**
Microbiology		
Introduction, Definition of microorganism and microbiology, A brief history of microbiology.	CLO 1	3
Viruses		
Introduction, biological status of viruses, nature, structure, chemical composition, replication and classification.	CLO 1-3	3

Bacteria		
Morphology of bacteria, structure of bacteria cells, internal structures, the cell wall and plasma membrane, staining reactions, colony morphology, classification, reproduction and special structure.	CLO 1-3	5
Actinomycetes		
Discovery, structure, classification, distribution, multiplication and economic importance.	CLO 1-2	2
Industrial uses of microorganisms		
Antibiotics, vinegar, alcohol, baker's yeast.	CLO 2-3	3
Bacterial and viral diseases		
Causal organisms, symptoms and control measures of tuberculosis, diphtheria, pneumonia, cholera, shigellosis, typhoid, tetanus, influenza, polio and dengue.	CLO 2-3	3
Plant Pathology		
Importance of plant pathology in modern agriculture.	CLO 1-2	1
Parasitism, disease development and stages in the development of disease.	CLO 2-3	2
How pathogen attack plants.	CLO 1	3
Forecasting of plant disease.	CLO 1-2	1
Plant quarantine.	CLO 1-2	1
Control of plant disease.	CLO 2-3	3

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Written	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Botany Practical		
Course Code: BZOOL 1210	**Course Type:** Practical (Core Course, Mandatory)	**Credits:**2
Full Marks: 50	**Total Lecture periods:** 30	**Exam Hours:** 6 (One day)

Course Learning Outcomes (CLOs)

After completion of this course, learners will be able to:

1. Identify the major groups of plants and lower plants;
2. Compare the characteristics of lower and higher plants;
3. Identify the cell, cell wall, tissue and tissue system, meristems, stomata, primary and secondary structure of stem and root;
4. Prepare the tissue culture processes;
5. Identify the different symptoms and causal agents of some plant diseases;
6. Identify different zoo-pathogenic fungi;
7. Collect, identify and use different microorganisms.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Contents	Alignment of topic with CLOs	LH
Laboratory and field observation and examination of major plant taxa and lower plants including their feature, classification, and economic importance in relation to topics included in the theoretical course Zool.-R-121.	CLO 1-2	6
Dissection and displaying of cell, cell wall, tissue and tissue system, meristems, stomata, primary and secondary structure of stem and root and study of tissue culture system in relation to topics included in the theoretical course Zool.-R-122.	CLO 3-4	6
Laboratory and field observation of diseases in relation to topics included in the theoretical course Zool.-R-123.	CLO 5	6
Laboratory and examination of zoo-pathogenic fungi in relation to topics included in the theoretical course Zool.-R-221.	CLO 6	6
Laboratory and examination of viruses, bacteria and plant diseases causing organisms in relation to topics included in the theoretical course Zool.-R-122.	CLO 7	6

Teaching-learning Strategy	Assessment Strategy		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hours	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Learning Resources:

Agrios, G.N. 2005. Plant Pathology.

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Sinha, A.K. 1989. Plant Pathology.

Course Title: English for Communication & Science		
Course Code: BZOOL 1211	**Course Type:** Theory (Core Course, non-credit)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description

English for communication: This part of the course is meant for communicative English where appropriate uses of articles, prepositions, verbs, tenses, gerunds, infinitives, phrase, clause, sentence, voice, prefix, suffix and biological terminologies will be discussed to enhance the students' communicative skills by giving adequate exposure in reading and writing.

English for Science: This part of the course is concerned with improving English of the students for biological science, Zoology in particular. It introduces English as the universal language of science along with its opportunities and challenges. Such pre-writing activities as describing zoological specimens, text books, tables and graphs are included, which help the students with more advanced skills like writing field reports.

Course Learning Outcomes (CLOs)

After completion of **English for Communication and Science**, learners will be able to:

1. Show overall control of English grammar;
2. Show paraphrasing and elaboration skills;
3. Perform coherent organization of information at both sentence and discourse levels
4. Develop vocabulary regarding subject matter;
5. Use terminologies specific to biology;
6. Explain English as the universal language of science. its opportunities and challenges;
7. Apply rules of pre-writing activities-1; Describing specimens and books;
8. Apply rules of pre-writing activities-2; Describing tables and graphs;
9. Write field reports, for example, on Rajshahi weather station.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topics with CLOs	LH
English for Communication		
Use of correct articles and prepositions.	CLO 1-3	2
Types of verbs and tenses with uses.	CLO 1-3	2
Verbal types and forms.	CLO 1-3	2
Phrase, clause and sentence: forms and uses.	CLO 1-3	2
Active and Passive voices and their uses in making sentences.	CLO 1-3	4
Use of prefixes and suffixes in Zoology; Basic Zoological terminologies.	CLO 4-5	4
English for Science		
English as the universal language of science: its opportunities and challenges.	CLO 6	2
Pre-writing activity-1; Describing specimens.	CLO 7	2

Pre-writing activity-2; Describing books.	CLO 7	2
Pre-writing activity-3; Describing tables.	CLO 8	2
Pre-writing activity-3; Describing graphs.	CLO 8	2
Writing field report on Rajshahi weather station.	CLO 9	4

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Questions	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Learning Resources

Ahmed, S. 2010. Learning English, The Easy Way

Dev, A. T. 1976. Student's Favourite Dictionary.

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Mazyad, S.S. 2004: English for Science. University of Durham, UK.

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Rashid, MH. 2001. English for Bengali Learners

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University of Leicester, 2009. Learning Development. www.le.ac.uk/suceedyourstudies

Vallins, GH. 1951. Good English

Zimmerman, F. 2007. English for Science. Prentice Hall, UK.

http://www.learnnc.org/lp/editions/writing-process/5812

http://www.preservearticles.com/201107149097/what-are-the-relationship-between-animals-climatic-conditions-and-vegetation-in-an-ecosystem.html

http://www.tageo.com/index-e-bg-weather-bg.htm

http://www4.caes.hku.hk/epc/presentation/

https://cft.vanderbilt.edu/guides-sub-pages/lecturing/

https://en.wikipedia.org/wiki/Ecological_relationship

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https://www.acurite.com/learn/weather-stations/what-is-a-weather-station

https://www.google.com.bd/?gws_rd=ssl#q=fauna+definition

https://www.google.com.bd/?gws_rd=ssl#q=habitat+definition

Curriculum
For
Second Year
First Semester

B. Sc. (Honours) Second Year First Semester Examination, 2025

Course codes	Course titles	Units	Marks	Credits
Major courses				
BZOOL 2101	Protection, Support & Locomotion	0.5	50	2
BZOOL 2102	Respiration & Excretion	0.5	50	2
BZOOL 2103	Coordinating System I: Nervous System and Sensory Receptors	0.5	50	2
BZOOL 2104	Reproductive System & Reproduction	0.5	50	2
BZOOL 2105	Field Study/ Excursion	0.25	25	1
BZOOL 2106	Zoology Practical I	0.5	50	2
BZOOL 2107	Zoology Practical II	0.5	50	2
GEd courses				
BZOOL 2108	Chemistry I: Bio-physical	0.5	50	2
BZOOL 2109	Chemistry II: Bio-organic	0.5	50	2
BZOOL 2110	Chemistry III: Bio-inorganic	0.5	50	2
	Total	**4.75**	**475**	**19**

B. Sc. (Honours) Second Year First Semester Examination, 2025

Course Title: Protection, Support & Locomotion		
Course Code: BZOOL 2101	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description:

This course has been designed to introduce the students about the body covering of animals which protect themselves from harmful influences of external environment. It will also provide knowledge about the skeletal system of different animals in Protozoa to Chordata. This course is also aimed to provide information on muscles and musculature. In addition, this course will describe the different locomotory organelles and mechanism of locomotion. Finally, the students will be able to apply their knowledge and skill to compare anatomy, physiology and evolutionary trends in Protozoa to Chordata.

Course Learning Objectives:

1. To introduce knowledge on protection and support in Protozoa to Chordata.
2. To provide knowledge on locomotion of different animals in Protozoa to Chordata.

Course Learning Outcomes (CLOs):

After completion of **Protection, Support and Locomotion** course learners will be able to:

1. Explain how invertebrates are protect themselves by their body walls or covering;
2. Describe different types of endo- and exoskeletons in phylum Protozoa to Echinodermata;
3. Describe different types of water vascular systems in Echinodermata;
4. Explain how vertebrates are protect themselves by their integuments;
5. Describe different types of derivatives of integument in vertebrates;
6. Compare different types of bones of skull found in Pisces to Mammalia;

7. Compare vertebral columns in Pisces to Mammalia;
8. Compare ribs, sternum, pectoral girdle and pelvic girdle bones found in Pisces to Mammalia.
9. Compare different types of appendicular skeletons (forelimb and hindlimb) in Pisces to Mammalia;
10. Describe the muscles and muscular systems in vertebrates;
11. Define locomotion and movement with example;
12. Compare different types of locomotory organelles and mechanism of locomotion in phylum Protozoa to Echinodermata;
13. Describe different types of locomotory organelles and mechanism of locomotion in vertebrates;
14. Mention the types of locomotion in various groups of vertebrate animals.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Protection & Support		
Body covering and skeleton in protozoa.	CLO-1,2	1
Body covering in Porifera.	CLO-1,2	1
Spicules in Porifera.	CLO-1,2	1
Body wall and nematocyst in Cnidaria.	CLO-1,2	1
Comparative account of body wall in Platyhelminthes and Nematoda.	CLO-1,2	1
Protection in Annelida.	CLO-1,2	1
Body wall in Arthropoda.	CLO-1,2	1
Shell and body covering in Mollusca.	CLO 1,2	1
Body covering and water vascular system in Echinodermata.	CLO-1,2,3	2
Integument and its derivatives in phylum Chordata.	CLO-4,5	1
Skeletal systems of Chordates (skull and vertebral column).	CLO-6,7	2
Skeletal systems of Chordates (rib, sternum, pectoral girdle and pelvic girdle).	CLO-8	2
Skeletal systems of Chordates (fore-limb and hind-limb).	CLO-9	1
Muscle and Musculature of chordates.	CLO-10	2
Locomotion		
Locomotory organelles and locomotion in Protozoa.	CLO-11,12	2
Locomotion in Cnidaria.	CLO-12	1
Locomotion in Annelida.	CLO-12	2
Locomotion in Arthropoda.	CLO-12	2
Locomotion in Mollusca.	CLO-12	2
Locomotion in Echinodermata.	CLO-12	2
Locomotion of Chordates.	CLO-13,14	2

<table>
<tr><th colspan="2">Teaching-learning Strategy</th><th colspan="3">Assessment Strategy</th></tr>
<tr><td colspan="2" rowspan="6">➢ Lectures followed by discussion
➢ Participatory question-answer
➢ Group discussion
➢ Text books
➢ Lecture notes
➢ Online resources
➢ Videos on related topics</td><td>Type of Assessment</td><td>Components</td><td>Marks</td></tr>
<tr><td>Written Examination</td><td>Written</td><td>35</td></tr>
<tr><td rowspan="3">Continuous Assessment</td><td>Attendance</td><td>5</td></tr>
<tr><td rowspan="2">Tutorial</td><td rowspan="2">10</td></tr>
<tr></tr>
</table>

<table>
<tr><th colspan="3">Course Title: Respiration & Excretion</th></tr>
<tr><td>Course Code: BZOOL 2102</td><td>Course Type: Theory
(Core Course, Mandatory)</td><td>Credits: 2</td></tr>
<tr><td>Full Marks: 50</td><td>Total Lecture hours: 30</td><td>Exam Hours: 3</td></tr>
<tr><td colspan="3">Course Description:
This course has been designed to understand the structure and functionsof the respiratory and excretory systems, and their modifications; types and methods of respiration and excretion in different animal groups. This course provide information to the students regarding the exchange of gases, removal of gaseous waste, the carbon dioxide, nitrogenous wastes i.e. urea, uric acid, amino acid, ammonia, etc., and other metabolic waste products. The respiratory system consisting of organs and tissues responsible for the exchange of gases i.e. oxygen and carbon dioxide. The respiratory system also helps the students to understand how animalsuse oxygen to convert the nutrients into energy which is used to carry out the different bodily functions. The aim of this course is also to provide knowledge on the excretory organs,their functions and significance;osmotic and ionic regulation, control of water and solutes, buoyancy, homeostasis and thermoregulation.</td></tr>
<tr><td colspan="3">Course Learning Objectives:
1. To introduce the students about the anatomy &physiology of respiratory and excretorysystems, and their modifications in the major phylum of animal kingdom.
2. To provide knowledge on the processesof respiration and excretion, waste removal & energy production, and regulation of different bodily function in different groups of animals.</td></tr>
<tr><td colspan="3">Course Learning Outcomes (CLOs):
After completion of Respiration and Excretion course, learners will be able to:
1. Describe the structure & functions of respiratory organs in different animal groups;
2. Discuss the accessory respiratory organ and its types;
3. Define respiration, and its types with examples;
4. Compare the aerobic and anaerobic respirations;
5. Mention the factorsinfluencingthe respiration in animals;
6. Explain the importance of ATP in respiration (Glycolysis and Kreb’s cycle);
7. Explain major modifications of respiratory structure in animals (due to invasion from water to land;
8. Describe excretory organs of invertebrates and vertebrates;
9. Define excretion, excretory system and mention the parts of nephron and functions of kidney;
10. Interpret osmotic and ionic regulation;</td></tr>
</table>

11. Control of water and solutes, and buoyancy;
12. Define homeostasis and mention the types of homeostasis (biological and ecological homeostasis);
13. Define thermoregulation (vertebrates and man).

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy		
Course contents	**Alignment of topic with CLOs**	**LH**
Respiratory system & modes of respiration:		
Introduction, definition, structure and functions of respiratory organs in Protozoa to Echinodermata.	CLO-1	2
Anatomy of the respiratory system in vertebrates.	CLO-1	2
Definition, types and methods of respiration in animals.	CLO-1,3	2
Definition, types, significance of aerobic and anaerobic respiration.	CLO-3,4	1
Factors influencing respiration.	CLO-5	1
Accessory respiratory organ and it's types.	CLO-2	2
Central importance of ATP in respiration.	CLO-6	2
Major modifications of respiratory structure in animals (due to invasion from water to land).	CLO-7	2
Excretory system and excretion		
Excretory system in various groups of animals.	CLO-8	2
Types and methods of excretion in various groups of animals.	CLO-9	2
Osmotic and ionic regulation.	CLO-10	2
Control of water and solutes, and buoyancy.	CLO-11	2
Homeostasis.	CLO-12	2
Thermoregulation.	CLO-13	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Written	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Coordinating System I: Nervous System & Sensory Receptors		
Course Code: BZOOL 2103	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3
Course Description: This course has been designed to introduce the students how animals maintain body's homeostasis by coordinating and regulating their external and internal environments. A variety of mechanisms in the body has played this role, the nervous system is one of these mechanisms. The nervous system together with		

the endocrine system coordinate and regulate the various activities of animals body in response to changes their external and internal environments. The aim of this course is how the nervous system evolved in lower invertebrates and higher vertebrates including human. It provides the information about the divisions and functions of the nervous system. The course also provides information to the students about the basic anatomy and functions of the nervous tissue; sensory and motor pathways; how a neuron function at rest and transmits signal through a neuron, and between neurons, or neuron to other cells. The course focuses on the chemicals i.e. neurotransmitters used in impulse transmission; sensory input and motor output. In addition, the course is aimed to fortify the student's knowledge regarding the different sensory receptors and effectors in animals; how these receptors perceive and respond to changes in animal's surroundings.

Course Learning Objectives:

1. To introduce the students regarding the development of the nervous system from lower invertebrates to higher vertebrates including human.
2. To introduce the students concerning the basic organization and importance of the nervous system in animal's body; different types of sensory receptors & effectors, and their roles.

Course Learning Outcomes (CLOs):

After completion of this course, students will be able to:

1. Define nervous system and its role in maintaining body's homeostasis;
2. Explain the development of simplest nervous system - nerve net in Cnidaria to simple brain in bilateral invertebrates; development of central and peripheral nervous system in chordates;
3. Describe the basic organization of vertebrate nervous system; The gross anatomy of the central and peripheral nervous systems, the site of information receiving, analyzing, processing and transmitting;
4. Explain how the central nervous system protects from the external injury; Understand the basic structures and functions of human brain and spinal cord;
5. Understand the location and functions of human brain lobes; Structure and roles of the limbic system and ventricular system of human brain;
6. Describe the anatomy and role of the peripheral nervous system; Names and functions of the peripheral nerves i.e., cranial and spinal nerves;
7. Describe the nervous tissue and its composition; Types of cell structure and functions of the cells;
8. Explain the properties of a neuron plasma membrane and role of ion channels and myelin sheath;
9. Explain how a neuron function at rest, how information is relayed within a neuron, and how neurons relay information to other neurons or other cells;
10. Interpret how our nervous system response to external world involuntarily and spontaneously;
11. Describe chemical compounds use to communicate between neurons, or neuron and other cells;
12. Describe the sensory receptors in invertebrate and vertebrate animals;
13. Describe the effectors where response is produced.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy		
Course contents	**Alignment of topic with CLOs**	**LH**
Introduction: General notes on nervous system, how nervous system regulates other organ systems; differences between invertebrate and vertebrate nervous systems.	CLO-1	1
Development of simplest NS, and development of cephalization in bilateral invertebrates	CLO-2	1
Development of dorsal tubular nerve cord, notochord, and central and peripheral nervous systems in chordates (Urochordata to Vertebrata).	CLO-2	2
Organization of the vertebrate nervous system: Flow chart of the basic organization of vertebrate NS; Structure & roles of the protective membranes of the Central Nervous System (CNS).	CLO-3,4	1
Central Nervous System of Vertebrates (Human): Anatomy and functions of the spinal cord; Basic parts of human brain (Forebrain, midbrain and hindbrain).	CLO-3,4	2
Central Nervous System of Vertebrates (Human): Structure and functions of each part of the human brain (midbrain & hindbrain - brain stem, cerebellum).	CLO-3,4	1
Central Nervous System of Vertebrates (Human): Structure and functions of each part of the human forebrain (cerebrum, thalamus and hypothalamus).	CLO-3,4	2
Central Nervous System of Vertebrates (Human): Structure and functions of the limbic and ventricular systems of the brain; production & flow of CSF within the brain ventricles; Role of CSF.	CLO-5	2
Peripheral Nervous System of Vertebrates (Human): Structure and functions of the peripheral nervous system; secretion of chemicals.	CLO-6	2
Peripheral Nervous System of Vertebrates (Human): Origin & distribution, and functions of the peripheral nerves (cranial & spinal).	CLO-6	1
Nerve tissue of Vertebrates Nervous System (Human): Introduction, development, structures, types and functions of glial cells.	CLO-7	1
Nerve tissue of Vertebrates Nervous System (Human): Definition of the neuron and nerve; differences between the neuron and other cells; Structure, types and functions of neuron.	CLO-7	2
Nerve tissue of Vertebrates Nervous System (Human): Types of neuron on the basis of different categories and their functions.	CLO-7	2
Properties and roles of neuron plasma membrane; membrane potential: Properties of neuron plasma membrane; membrane potential and establishment of resting membrane potential.	CLO-8,9	1

Generation & transmission of nerve impulse: Stimulus & Action potential; generation & transmission of nerve impulse within a neuron	CLO-9	2
Synapse and synaptic transmission: Types of synapse; transmission of nerve impulse across the synaptic cleft; and role of chemical transmitters.	CLO-9	2
Reflex Action and Reflex Arc (Involuntary response): Definition, Types and mechanism of reflex action; Definition, components and types of reflex arc.	CLO-10	1
Chemical compounds use to communicate between cells: Neurotransmitters: introduction, discovery, characters, mechanism and types.	CLO-11	2
Sensory system in animals: Sensory receptors: definition, general types and functions; Different types of receptors in invertebrates.	CLO-12	1
Organization of motor outputs: The effectors where response produced: definition, types and functions in invertebrates and vertebrates.	CLO-13	1

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Written	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Reproductive system & Reproduction		
Course Code: BZOOL 2104	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description:

This course is designed to strengthen the learners' knowledge and understanding of different aspects of the comparative study of reproductive system in invertebrates and vertebrates; biological processes of reproduction; including patterns of sexuality; significance of sexual and asexual reproduction. The course will also help enrich existing ideas on the basic organization of sexual reproduction and life histories; reproductive traits and functions; systems for sexual reproduction (myxis), parthenogenesis; control of reproductive processes; ultimate and proximal factors; hermaphroditism *versus* gonochorism: an investment trade-off; and synchronous reproduction of marine invertebrates. Finally, it will be helpful to comprehend diapause in terrestrial and freshwater environments; biorhythmicity (circadian rhythm); photoperiodism, and the biological clock.

Course Learning Objectives:

1. To compare and contrast reproductive systems of invertebrates and vertebrates.
2. To compare and contrast asexual and sexual reproduction.

3. To provide knowledge on biological fitness, sexual patterns, and sexual dimorphism.
4. To understand specific reproductive strategies and mode that increase biological fitness.

Course Learning Outcomes (CLOs):

After completion of Reproductive system and Reproduction course, students will be able to:

1. Define reproduction as a most important characteristics of living beings, Origin of Life/Historical Background;
2. Describe the reproductive system of invertebrates and vertebrates and their morphology and physiology;
3. Demonstrate the steps in asexual and sexual determination and differentiation at gonadal, internal and external morphology levels;
4. Describe the pattern of sexuality; explain the importance of reproduction, and their types. Discuss the asexual reproduction in invertebrates. explain the advantages and disadvantages of asexual reproduction;
5. Describe the comparative study of asexual reproduction and sexual reproduction; explain the several patterns of sexual reproduction. Discuss the different forms of sexual reproduction, explain the conditions of sexuality in invertebrates;
6. Define sexual reproduction, explain the characters of sexual reproduction, Describe the Life cycles and sexual reproduction in invertebrate, describe the process of conjugation, explain the importance, factors and conditions of conjugation;
7. Define the systems for sexual reproduction (Mysis), describe the process of exchange of genetic materials in viruses; bacteriophage viruses and their life cycle; define and types of plasmid, explain roll of plasmid in conjugation;
8. Describe the organization of sexual reproduction and life histories: reproductive trait and functions, describe a functional analysis of the life histories of Insects, explain the different instar with different function base on some principles, explain a functional analysis of the life histories of Insects, Orthoptera, Diptera, aquatic and terrestrial insect with examples, hymenopter, honey bee etc. explain reproductive strategy;
9. Describe the life cycle of some multicellular animals, explain asexual reproduction (Amixis), describe the mechanism of parthenogenesis (Automixis), and define, Arrhenotoky, thylotoky, sexual reproduction Significance of sexual and asexual reproduction. Discuss the Life cycle of Daphnia, rotifer and Aphid;
10. Describe the control of reproductive process, explain and describe the factor on reproductive cycle, explain ultimate and proximate factor, describe the difference between ultimate factors and proximate factors, describe hermaphroditism, discuss the types of hermaphroditism, describe gonochorism and comparative study of hermaphroditism *versus* gonochorism and explain an investment trade off;
11. Explain synchronous reproduction of marine invertebrates, describe the Co-variable traits in marine invertebrates, explain the non-marine invertebrates' reproductive traits, Describe the reproduction and life history of marine invertebrates, synchronous production strategies and advantages;
12. Describe the organization of sexual reproduction: reproductive trait and functions, sexual reproduction in higher animals; exchange of genetic

materials; reproductive strategies, spawning types;

13. Define dormancy, describe the types of dormancy, diapause in terrestrial and freshwater environments: Phases of insect diapause, Comparison of Diapause Periods, discuss the hibernation and aestivation;
14. Define Biorhythmicity (circadian rhythm); Define chronobiology, explain the general criteria of biological rhythm, describe the importance of biological rhythm in animal, explain the light-dark cycle;
15. Biological clock in mammals and its location, discuss biological marker, describe the Outside the “Master Clock", impact on human health and related diseases.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Introduction to reproduction.	CLO-1	2
Comparative study of reproductive system: structure and function of invertebrates.	CLO-2&3	2
Comparative study of reproductive system: structure and function of vertebrates.	CLO-2&3	2
Pattern of sexuality, significance of sexual and asexual reproduction.	CLO-4	2
Non-clonal and clonal reproduction in details with types, hermaphrodite, Organization of sexual reproduction: Control of reproductive processes.	CLO-5	2
Sexual reproduction: characters of sexual reproduction; Life cycles and sexual reproduction in invertebrate; process of conjugation; importance, factors and conditions of conjugation.	CLO-6	2
Comparative study of asexual reproduction and Sexual reproduction: basic concepts, sexual reproduction (Mysis), exchange of genetic materials in viruses; bacteriophage viruses and their life cycle; types of plasmid and role of plasmid in conjugation.	CLO-7	2
Organization of sexual reproduction and life histories: reproductive trait and functions, analysis of the life histories of Insects, reproductive strategy.	CLO-8	2
Life cycle of some multicellular animals: asexual reproduction (Amixis); parthenogenesis (Automixis): types of parthenogenesis; parthenogenesis in aphid, rotifer; advantages and disadvantages of parthenogenesis.	CLO-9	2
Control of reproductive process: Ultimate and proximal factors; their differences; hermaphroditism *versus* gonochorism: an investment trade off.	CLO-10	2
Synchronous reproduction of marine invertebrates: co-variable traits in marine invertebrates; non-marine invertebrates’ reproductive traits, reproduction and life history of marine invertebrates, synchronous production strategies and advantages.	CLO-11	2

Organization of sexual reproduction: reproductive trait and functions, sexual reproduction in higher animals; exchange of genetic materials; reproductive strategies, spawning types.	CLO-12	2
Dormancy: Diapause, hibernation, aestivation in terrestrial and freshwater environments.	CLO-13	2
Biorhythmicity (circadian rhythm); photoperiodism and biological clock.	CLO-14	2
Biological clock in mammals and its location, discuss biological marker, describe the Outside the “Master Clock", impact on human health and related diseases.	CLO-15	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Written	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Field Study/Excursion

Course Code: BZOOL 2105
Full Marks: 25 (Unit 0.25, Credit 1)

Preparationand submission of report(s) onthe Breeding Center and Fish Flesh Selling Shops withthe demonstration and illustrationof different organs and organ systems of larger animals in anatomical aspectsand on collection of integumentary derivatives and skeleton of different animal groups. Submission of any autopsy report (if available), and visit to an abattoir (if possible). (Distribution of Marks: Local field reports = 12.5, Presentation/viva-voce = 5, Assessment =5, Attendance =2.5).

Course Title: Zoology Practical I		
Course Code: BZOOL 2106	**Course Type:** Practical (Core Course, Mandatory)	**Credits:** 2
Full Marks:50	**Total Lecture periods:** 30	**Exam Hours:** 6 (6 hours daily)

Course Learning Objectives:

To provide practical experience covering topics in the theoretical courses so that the learner can apply their knowledge in their laboratories, workplaces and in practical life.

Course Learning Outcomes (CLOs):

After completion of this course, students will be able to:

1. Dissect and display the different organs and organ systems of the representative animals of different taxa;
2. Provide comparative interpretation of different organs and organ systems of the representative animals of different taxa;
3. Describe the structures of the representative organs and organ systems of the rare/endangered species;
4. Draw labeled diagrams of the dissected and/or displayed organs and

organ systems of different animals;
5. Identify special structures, integumentary derivatives, skeletal system, sound producing organs of the representative animals of different taxa.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy		
Contents	**Alignment of topic with CLOs**	**LH**
Dissection and displaying of the respiratory systems of the following animals: Earthworm, any insect (Cockroach, grasshopper), prawn, freshwater snail & mussel, starfish/sea star, available cartilaginous & bony fishes, toad/frog, lizard, commercially available birds (chicken/pigeon), and mammals (lab. mice/rats).	CLO 1-2, CLO 4	12
Study of the representative organs and organ systems of the rare/endangered specimens; displaying different organs of the dissected animals i.e. appendages & statocyst of prawn, nictitating membrane and hyoid apparatus of toad/frog, internal ear of dogfish, Weberian ossicles of any bony fish.	CLO 1-4	6
Identification of integumentary derivatives, skeletal systems and sound producing organs of insects, chordates; teeth and dentition in mammals; loreal pits in vipers.	CLO 5	12

Teaching-learning Strategy	**Assessment Strategy**		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hrs daily on the tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Course Title: Zoology Practical II		
Course Code: BZOOL 2107	**Course Type:** Practical (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture periods:** 30	**Exam Hours:** 6 (6 hours daily)

Course Learning Objectives:

To provide practical experience covering the topics in their theoretical courses so that the learners can apply their knowledge in the laboratories, workplaces and in their practical life.

Course Learning Outcomes (CLOs):

After completion of this course, students should be able to:

1. Dissect and display the different organs and organ systems of the

representative animals of different taxa;
2. Provide comparative interpretation of the different organs and organ systems of the representative animals of different taxa;
3. Describe the structures of the representative organs and organ systems of the rare/endangered species.
4. Draw labeled diagrams of the dissected and/or displayed organs and organ systems of different animals.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Contents	Alignment of topic with CLOs	LH
Dissection and displaying of the nervous and reproductive systems of the following animals: Earthworm, any insect (Cockroach, grasshopper), prawn, freshwater snail & mussel, starfish/sea star, available cartilaginous & bony fishes, toad/frog, lizard, commercially available birds (chicken/pigeon), and mammals (lab. mice/rats).	CLO 1-2, CLO 4	21
Study of the representative organs and organ systems of the rare/endangered specimens; displaying different organs of the dissected animals i.e. radula and osphradiumof snail, pectin of bird.	CLO 1-4	9

Teaching-learning Strategy	Assessment Strategy		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hours daily on the tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Learning Resources:

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Barrington, EJW. 1979. Invertebrate Structure and Function (2nd edn). John Wiley and Sons, New York

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Chapman, R.F. (1998). *Cutaneous Respiration*. In RF Chapman, The Insects: Structure and Function (p. 452). New York: Cambridge University Press.

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Colin Russell Austin. 1972. Reproductive Patterns. University Press, 156 pages

Dales, RP. 1981. Practical Invertebrate Zoology. Blackwell Scientific Publications. London.

Eckert R. and Randall D. 1978. Animal Physiology. WH Freeman and Co., New York.

Eddy, S. 1949. Atlas of Drawings for Chordate Anatomy. John Wiley and Sons Inc., New York.

ELendell Cockrum, William J. McCauley (1965). Zoology.

Fusco, G. and Minelli, A. 2019. The Biology of Reproduction 1st Edition**.**

Goodrich, ES. Comparative Anatomy of Vertebrates.

Griffin, DR and Novick, A. 1962. Animal Structure and Function. Holt, Rinehart and Winston, Inc., New York.

Guyton, AC and Hall, JE. 2000. Textbook of Medical Physiology (10th edn.). W.B. Saunders Philadelphia.

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Rugh, R. 1968. The Mouse - its reproduction and development. Burgess Publishing Co., Minneapolis, Minn.

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Stephen M. Shuster, Michael J. Wade. 2003. Mating Systems and Strategies. Princeton University Press, May 26, 2003 - Science - 533 pages

Urry, L. *et. al.,*2016. Campbell Biology (Campbell Biology Series) 11th Edition

Walker, WF Jr. 1987. Functional Anatomy of the Vertebrates: An Evolutionary Perspective. Sander's College Publishing, USA.

Walker, W.F. 1975. Vertebrate Dissection. W.B. Sander's Co., London.

Walker, W.F. 1980. Vertebrate Dissection. Sander's Co., Philadelphia.

Webster, D and Webster, M. 1974. Comparative Vertebrate Morphology. Academic Press, New York, London.

Weickert, CK. 1965. Anatomy of the Chordates (3rd edn). McGraw-Hill, New York.

Wigglesworth, VB. 1965. The Principles of Insect Physiology. ELBS and Methuen and Co.

Williams, P, Stone, G and Johnston, I. 2005. Environmental Physiology of Animals (2nd edn). Blackwell Scientific Publications, Oxford. London.

Course Title: Chemistry I: Bio-physical		
Course Code: BZOOL 2108	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3
Course Description This course describes the concept and applications of chemical thermodynamics. The course also provides the students with the knowledge of chemical calculations and data treatment, thermodynamics of solutions, ligand binding and nonequivalent ligand sites on a macromolecule, modern concepts of acids and bases, solubility product and its analytical applications. At the end of the course, students will enrich		

their knowledge about the energetics of physical and chemical changes, phase and reaction equilibria. The students can apply their achievements to predict the stabilities of reactants and products and optimize the physical and chemical processes.

Course Learning Outcomes (CLOs)

After completion of this course, students will be able to:

1. Associate physical quantities with their International System of Units (SI) and perform conversions among SI units using scientific notation;
2. Relate measurement uncertainty to significant figures and apply the rules for using significant figures in calculations;
3. Correctly create, label, and identify relationships in graphs using mathematical relationships (e.g., slope, *y*-intercept, inverse, quadratic and logarithmic);
4. Write out various numbers in scientific notation and vice versa;
5. Write out various numbers with the proper significant figures;
6. Use thermodynamic terminology appropriately;
7. Explain fundamental thermodynamic properties;
8. Derive and discuss the first and second laws of thermodynamics;
9. Solve problems using the properties and relationships of thermodynamic fluids;
10. Describe what information is obtained from the second Law of thermodynamics about speeds of chemical and physical changes;
11. Use the second law of thermodynamics to predict the spontaneity of physical and chemical changes;
12. Describe the meaning of a positive value, a negative value, and a value of zero, for ΔG (ΔG^o);
13. Explain the physical significance of entropy;
14. Relate the concept of energy change to chemical reactions that occur in the body;
15. Describe why a physical or chemical change is spontaneous only if ΔG is negative;
16. Predict whether or not a physical or chemical change is spontaneous given the temperature and the enthalpy and entropy changes;
17. Describe why do chemical reactions occur and the driving force(s) that are responsible for physical and chemical changes/reactions;
18. Describe what information is provided by the value of the equilibrium constant for a chemical reaction;
19. Describe the difference between ΔG and ΔG^o;
20. Describe the basic units of the macromolecules and the types of linkages between them;
21. Analyze ligand binding to macromolecules quantitatively for both simple and complex systems;
22. Describe the various concepts for acids and bases;
23. Describe the difference(s) between strong acids/bases and weak acids/bases;
24. Describe how the strength of either an acid or a base is indicated by the magnitude of its equilibrium constant (i.e., K_a or K_b);
25. Calculate the pH, pOH, $[H_3O^+]_{tot}$ and/or $[OH^-]_{tot}$ for a solution given one of these values

26. Describe the relationship between both equilibrium constant expressions and pH,and activities/activity coefficients;
27. Describe the two main factors that need to be considered to determine if a substance will behave as an acid, a base, or neither;
28. Describe the analytical significance of common ion effect and solubility products;
29. Explain the nature (acidity or basicity) of the salt's solution;
30. Interpret fundamental concepts of solution thermodynamics involving ideal and non-ideal systems;
31. Derive fundamental equations that govern the estimation of solution properties;
32. Explain the role of Donnan membrane equilibrium in generation of resting membrane potential.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Measurement and Units		
Dimensions and units, SI units, Uncertainties in measurements.	CLO 1-2	2
Significant figures and rounding off numbers, Slope and intercepts of a linear plot, analysis of errors and reporting data.	CLO 3-5	2
Thermodynamics		
First law: Definitions, Interactions of systems with surroundings, Applications of first law.	CLO 6-9	3
Thermochemistry, Bond energies, Second Law: Entropy, statement of the law, Reversible and irreversible processes.	CLO 10-13	3
Free energy, Standard states, and biochemical standard state, Direction of chemical and biochemical processes, Energetics of biochemical reactions.	CLO 14-17	3
Chemical equilibrium and Ligand binding to macromolecules		
Relationship between ΔG^0 and equilibrium constant, Distinction between ΔG and ΔG^0, Variation of equilibrium constant with temperature, Measurement of thermo-dynamic functions of reactions.	CLO 18-19	3
The binding equation, Treatment of binding data, Multiple binding site equilibrium.	CLO 20-21	3
Nonequivalent ligand sites on a macromolecule, Experimental methods for obtaining data.	CLO 20-21	2
Acids and Bases		
Concepts of acid and bases, pH, buffer, indicators and its dissociation, Effect of ionic strength on acid-base equilibria, Common ion effect, Solubility product principle with applications.	CLO 22-29	3

Thermodynamics of solutions		
Raoult's law, Properties of ideal and non-ideal solutions, Anomalous molecular weight, Concept of activity, Solutions of macro molecules.	CLO 30-31	3
The Donnan effect, Macro-molecules, Molecular weight, Number and weight average molecular weight, concept of chemical potentials.	CLO 32	3

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Questions	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Learning Resources:

P.W. Atkins, J. Paula: Atkin's Physical Chemistry (10th edition).
I.N. Levine: Physical Chemistry (6th edition).
R.G. Mortimer: Physical chemistry.
N. Kundu, S.K. Jain: Physical Chemistry.
R.D. Madan: Modern Inorganic Chemistry.
G.G. Hammes, S.H. Schiffer: Physical Chemistry for the Biological Sciences.

Course Title: Chemistry II: Bio-organic		
Course Code: BZOOL 2109	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3

Course Description

This course has been designed for the students to provide an understanding about the basic concepts of organic Chemistry including classification and purification of organic compounds and detection of elements in organic compounds. This course is also aimed to provide information about the study of nomenclature, classification, general methods of preparation and reactions, uses etc. of hydrocarbons, derivatives of hydrocarbons and organic compounds containing nitrogen and sulpher. The topic concentrates on biological molecules andstereoisomerism**.** The students will enrich their knowledge through this course and can apply that knowledge in different aspect in chemistry.

Course Learning Outcomes (CLOs)

After completion of this course, students will be able to:

1. Classify and purify the organic compound;'
2. Describe the detection processes of elements presence in organic compound;
3. Describe the process of making stock solution that can be used to detect elements presence in organic compound;
4. Name different alkanes and cycloalkanes, organic compounds containing oxygens and Organic compounds containing nitrogen and sulfur;
5. Classify different alkanes and cycloalkanes, organic compounds containing

oxygens and Organic compounds containing nitrogen and sulfur;

6. Describe general method of preparation of different alkanes and cycloalkanes, organic compounds containing oxygens and Organic compounds containing nitrogen and sulfur;
7. Write reaction and uses of different alkanes and cycloalkanes, organic compounds containing oxygens and Organic compounds containing nitrogen and sulfur;
8. Describe different type of amino-acid;
9. Write structure of proteins with their function;
10. Describe the optical isomerism of simple compounds having one asymmetric carbon;
11. Describe the geometrical isomerism of simple organic compounds.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Introduction		
Introduction: Classification and purification of organic compounds, detection of elements in organic compounds.	CLO 1-3	4
Hydrocarbons (Alkanes and cycloalkanes): The alkane series, alkenes and alkynes, aromatic hydrocarbons, petroleum refining.	CLO 4-7	5
Derivatives of hydrocarbons (organic compounds containing oxygens): Alcohols, and ethers, aldehydes and ketones, carboxylic acids and esters, esterification and saponification, polyesters.	CLO 4-7	5
Organic compounds containing nitrogen and sulfur: Amines and amides, thiols and disulfides.	CLO 4-7	4
Biological molecules		
Biopolymers, amino acids, protein/enzyme, protein structure, conformation and functions.	CLO 8-9	6
Stereoisomerism		
Optical isomerism of simple compounds having one asymmetric carbon	CLO 10	3
geometrical isomerism of simple organic compounds.	CLO 11	3

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Chemistry III: Bio-inorganic		
Course Code: BZOOL 2110	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3

Course Description

This course has been designed for students to provide an understanding about the basic concepts of Inorganic Chemistry including atomic structure, periodic classifications of the elements, and different types of chemical bonding. This course is also aimed to provide information about the source and effects of oxides and oxyacids of nitrogen, phosphorus, sulfur and carbon compounds such as CO, CO_2 and chlorofluorocarbon on life and environment. The students will gather knowledge through this course and can apply that knowledge in different aspect in chemistry.

Course Learning Outcomes (CLOs)

After completion of this course, students will be able to:

1. Write the fundamental particles of atom;
2. Use the rutherford's scattering experiment and the discovery of the nucleus;
3. Explain the bohr's model of the atom and somerfield's extension of bohr's atomic model;
4. Describe the atomic spectrum of hydrogen atom;
5. Calculate quantum numbers and to write the electronic configuration of elements;
6. Write the wave mechanical model of atom and orbitals;
7. Make the modern periodic table and periodic law;
8. Describe the types of elements in the periodic table on basis of electronic configuration;
9. Write the periodic properties of elements viz. ionization potential, electron affinity, electro negativity, atomic and ionic radii;
10. Describe the different types of chemical bonding: ionic, covalent, coordinate and hydrogen bond;
11. Explain the bond angle, bond energy and bond length;
12. Explain the hybridization of atomic orbital and shapes of molecules;
13. Write the elementary idea of metallic bond and vander waals forces;
14. Describe the source and toxic effects of oxides and oxyacids of nitrogen, phosphorus, and sulfur on life and environment;
15. Describe the preparation, properties and the effects of oxides and hydroxides of alkali and alkaline earth metals on life and environment;
16. Write the source and toxic effects of carbon compounds such as co, co_2 and chlorofluorocarbon on life and environment.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Atomic Structure		
Fundamental particles, discovery of electron, charge, mass, proton and neutron, Rutherford atom model, hydrogen spectra.	CLO 1-2	2
Bohr atom model, four quantum numbers, Pauli exclusion	CLO 3-5	4

principle, electronic configuration of elements.		
Elementary idea about the wave mechanical model of atom, atomic orbitals.	CLO 6	2
Periodic classification of elements		
Modern periodic table, periodic law.	CLO 7	2
Periodic system and electronic configuration of atoms.	CLO 8	2
Types of elements in the periodic table, correlation of atomic structure with periodic properties of elements, viz. ionization potential, electron affinity, electro negativity, atomic and ionic radii.	CLO 9	3
Different types of bonds		
Ionic, covalent, coordinate and hydrogen bond.	CLO 10	2
Bond angle, bond energy and bond length.	CLO 11	2
Hybridization of atomic orbital and shapes of molecules, elementary idea of metallic bond and vander Waals forces.	CLO 12	3
Chemistry of the following and their effects on life and environment		
Oxides and oxyacids of nitrogen, phosphorus and sulfur.	CLO-14	4
Oxides and hydroxides of alkali and alkaline earth metals.	CLO-15	2
Carbon compounds such as CO, CO_2 and chlorofluorocarbon.	CLO-16	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Broad Questions	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Learning Resources:

Bahl, B.S. and Bahl, A., Advanced Organic Chemistry.
Ebbing, D.D., General Chemistry.
Morrison, R.T. and Boyed, R.N., Organic Chemistry.
S.Z. Haider : Modern Inorganic Chemistry
J.E. Huheey : Inorganic Chemistry: principles of structure and reactivity
R.D. Madan : Modern Inorganic Chemistry
C.E. Housecroft & A.G. Sharpe : Inorganic Chemistry
W.U. Malik, G.D. Tuli, R.D. Madan : Selected Topics in Inorganic Chemistry

Curriculum
For
Second Year
Second Semester

B. Sc. (Honours) Second Year Second Semester Examination, 2025

Course codes	Course titles	Units	Marks	Credits
Major courses				
BZOOL 2201	Feeding, Nutrition & Digestion	0.5	50	2
BZOOL 2202	Circulatory System	0.5	50	2
BZOOL 2203	Coordinating System II: Endocrinology System	0.5	50	2
BZOOL 2204	Field Study/ Excursion	0.25	25	1
BZOOL 2205	*Viva-voce* (Honours courses)	0.5	50	2
BZOOL 2206	Zoology Practical I	0.5	50	2
BZOOL 2207	Zoology Practical II	0.5	50	2
GEd courses				
BZOOL 2208	Chemistry IV: Bio-physical & Bio-organic	0.5	50	2
BZOOL 2209	Chemistry V: Bio-inorganic	0.5	50	2
BZOOL 2210	Chemistry Practical	0.5	50	2
	Total	**4.75**	**475**	**19**

B. Sc. (Honours) Second Year Second Semester Examination, 2025

Course Title: Feeding, Nutrition & Digestion		
Course Code: BZOOL 2201	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description:

This course has been designed to introduce you with the feeding, nutrition, digestion and assimilation. This course is aimed to provide information on different aspect of feeding, nutrition and foraging theory. Furthermore, the aim of the course is to provide information regarding the types and diversity of digestive system in different Phyla. In addition, it will helpthe students to understand the process of ingestion, digestion, absorption, assimilation and egestion, and the roles of hormones and enzymes in food digestion.

Course Learning Objectives:

- To provide knowledge on the feeding, nutrition, digestion and assimilation

Course Learning Outcomes (CLOs):

After completion of **Basic organization of structures; Feeding and nutrition; Digestion and assimilation** courses, learners will be able to:

1. Describe the modes of feeding;
2. Discuss the classification of feeding mechanisms;
3. Mention the types of feeding behavior with interactions;
4. Define nutrition and nutrient and describe modes/ types of nutrition especial reference with the ways of obtaining and using nutrients;
5. Explain how a tapeworm obtains its nutrition along with structural adaptations;
6. Introduce foraging and their influencing factors, types of foraging and cost and benefits of group foraging;
7. Explain optimal foraging theory (OFT);
8. Describe the various types of digestive systems found in animals with view of evolutionary trends;
9. Describe the digestive system of Protozoa and Porifera with comparative

anatomy, physiology and evolution;
10. Describe the digestive system of Cnidaria, Nematoda and Platyhelminthes with comparative anatomy, physiology and evolution;
11. Explain the digestive system of Annelida and Mollusca with comparative anatomy, physiology and evolution.
12. Elucidate the digestive system of Arthropoda and Echinodermata with comparative anatomy, physiology and evolution;
13. Describe embryonic digestive system and its derivatives and digestive tract;
14. Compare vertebrate digestive structures with figures;
15. Compare of mouth to esophagus of vertebrates with physiology;
16. Compare of stomach to intestine of vertebrates with physiology;
17. Describe the accessory digestive organs and their roles in digestion;
18. Explain the roles of digestive hormones in digestion;
19. Describe the digestive enzymes and their roles in digestion;
20. Interpret absorption of nutrients with their absorptive mechanisms;
21. Describe the process of assimilation and egestion.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Feeding		
Modes of feeding.	CLO-1	2
Classification of feeding mechanisms.	CLO-2	2
Types of feeding behavior.	CLO-3	2
Nutrition		
Nutrition, nutrient and modes/ types of nutrition.	CLO-4, 5	2
Introduction to foraging behavior: influencing factors, types of foraging, cost and benefits of group foraging.	CLO-6	2
Optimal foraging theory (OFT)	CLO-7	2
Digestion		
Types of digestive system.	CLO-8	2
Digestive system of Protozoa, Porifera, Cnidaria, Nematoda and Platyhelminthes.	CLO-9, 10	4
Digestive system of Annelida and Mollusca.	CLO-11	2
Digestive system of Arthropoda and Echinodermata.	CLO-12	2
Embryonic digestive system and its derivatives; digestive tract; comparative of vertebrate digestive structures.	CLO-13, 14	2
Comparative of mouth to esophagus of vertebrates.	CLO-15	2
Comparative of stomach to intestine of vertebrates and accessory digestive organs.	CLO-16, 17	2
Digestive hormones and enzymes, nutrient absorption, assimilation and egestion.	CLO-18, 21	2

<table>
<tr><th colspan="2">Teaching-learning Strategy</th><th colspan="3">Assessment Strategy</th></tr>
<tr><td colspan="2" rowspan="8">➢ Lectures followed by discussion
➢ Participatory question-answer
➢ Group discussion
➢ Text books
➢ Lecture notes
➢ Online resources
➢ Videos on related topics</td><td>Type of Assessment</td><td>Components</td><td>Marks</td></tr>
<tr><td>Written Examination</td><td>Written</td><td>35</td></tr>
<tr><td rowspan="2">Continuous Assessment</td><td>Attendance</td><td>5</td></tr>
<tr><td>Tutorial</td><td>10</td></tr>
</table>

Course Title: Circulatory System		
Course Code: BZOOL 2202	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description:

This course has been designed to introduce about the physiology of blood circulation in major phyla of the animal kingdom. This course is also intended to provide information on circulatory system, lymphatic system in different animals. Furthermore, this course is aimed to compare the above mentioned physiological process and also elucidate the evolutionary significance on the basis of structure and function of heart and blood vessels; lymphatic system and its components in different animal groups.

Course Learning Objectives:

1. To introduce about the physiology of blood circulation in major phylum of the animal kingdom.
2. To provide knowledge on nutrient transport and regulation of homeostasis.

Course Learning Outcomes (CLOs):

After completion of **Circulatory System** course, learners will be able to-

1. Explain the basic/unified themes of animal physiology in the animal kingdom;
2. Describe how all animals are following a basic set of physical and chemical laws to survive and adapt;
3. Demonstrate and compare the structure and types of circulatory systems (CS) found in different groups of animals;
4. Describe different components of CS and their functions in different animal phyla;
5. Illustrate the structure, comparative anatomy and physiology of hearts found in different vertebrate classes;
6. Interpret the evolutionary significance of hearts from Protozoa to Chordata;
7. Describe the composition and function of blood and its corpuscles, blood vessels and its structure;
8. Elucidate blood clotting process and capillary filtration of blood;
9. Describe the hemodynamics of arterial system in different vertebrate classes;
10. Interpret the evolutionary significance of aortic arches from Pisces to Mammalia;
11. Compare the structure and function of venous system found different vertebrate classes;

12. Describe major electrolytes and their function in an animal;
13. Elucidate different circulatory fluid (except blood) compartment and their composition in an animal;
14. Explain Sodium-Potassium pump and their function in homeostasis;
15. Describe different cardiovascular diseases; their risk factors, symptoms, diagnosis and treatment options;
16. Illustrate the structure and function of advanced lymphatic system (LS) found in mammals.
17. Explain the presence or absence of LS or homologous to LS in other animal phyla with evolutionary significance.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Introduction to the circulatory system and gaseous exchange.	CLO-1, 2	2
Circulatory System (CS): Definition, functions, components of CS, types of CS.	CLO-3, 4	2
Heart: Structure of heart; Comparative anatomy & physiology of heart; Evolution of Heart.	CLO-5, 6	4
Blood and Blood Vessels: Comparative anatomy and function; Blood clotting process.	CLO-7, 8	2
Arterial system and evolution of aortic arches.	CLO-9, 10	2
Comparative account of venous system in different vertebrate classes.	CLO-11	2
Circulatory fluid (CF) compartments: Composition of extracellular fluid (ECF) and Intracellular fluid (ICF); Major electrolytes of ECF and ICF.	CLO-12, 14	2
Cardiovascular diseases in human.	CLO-15	2
Lymphatic system (LS): Structure and function of lymph, lymphatic vessels and lymphatic organs.	CLO-16, 17	2

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Written	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Coordinating System II: Endocrine system		
Course Code: BZOOL 2203	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description:

This course covers the glands and hormones of the endocrine system in vertebrate and invertebrate animals. Furthermore, the synthesis, structure, secretion, function and mode of action of hormones are discussed in details. In addition, the integration between endocrine glands and other body systems in regulating homeostasis and the factors that affect hormonal balance are discussed. Finally, this course covers the clinical aspects of hormonal disturbances including causes, diagnosis and treatment.

Course Learning Objectives:

To introduce the students regarding the evolutionary trends of the endocrine system from lower invertebrates to higher vertebrates including human.

Course Learning Outcomes (CLOs):

After completion of **Coordinating System II: Endocrinology** course, learners will be able to:

1. Define endocrinology and exocrinology and hormone; types of hormones; mode of action relating to homeostasis in vertebrate and invertebrate animals;
2. Describe the synthesis and function of different hormones and mechanism of secretion in endocrine glands;
3. Determine the chemical structure and mode of action including the hormonal imbalance;
4. Gather knowledge regarding the binding mechanism of steroid and non-steroid hormones in target cells; hormonal target cell and receptor;
5. Discuss the different types of hormonal pathway and its role in vertebrate and invertebrate animals;
6. Learn the different types of hormonal chemical messengers and their mechanism in vertebrate and invertebrate animals; different types of hormonal cell signals; mechanism of different feedback occurs in different endocrine system;
7. Gather knowledge on the thyroid and pituitary glands including their role and major function in vertebrate animal;
8. Describe of role of reproductive glands including their secretion as well as function in vertebrate animal;
9. Illustrate the role of pancreas gland and their secretion of hormones including the function; mechanism of homeostasis in insulin and glucagon;
10. Interpret the body function including the major endocrine disorders;
11. Describe the practical application of hormones in animals;
12. Discuss the endocrine systems in invertebrates' animals;
13. Explain the mechanism of endocrine systems in occur in advanced phyla including mollusc and annelids;
14. Illustrate the function of endocrine systems in arthropods including the role of different types of hormones in insects;
15. Compare the function as well as role of hormone secreting in different glands of vertebrate and invertebrate animals.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy		
Course contents	**Alignment of topic with CLOs**	**LH**
Endocrine system.	CLO–1	2
Bindings of hormones.	CLO–2	2
Hormonal pathways.	CLO–3	2
Hormonal cell signal.	CLO–4	1
Mechanisms of hormone.	CLO–5	2
Role of endocrine system.	CLO–5	1
Feedback systems.	CLO–6	2
Hormonal chemical messengers.	CLO–6	2
Major glands.	CLO–7	2
Reproductive glands including their secretion.	CLO–8	2
Hormonal disorders.	CLO-9	2
Mechanism of homeostasis.	CLO–10	1
Body function.	CLO–11	2
Practical application of hormones.	CLO–12	2
Invertebrate endocrine system.	CLO–13	1
Mechanism of Invertebrate endocrine systems.	CLO–14	2
Comparative studies of hormonal mechanism in vertebrates and invertebrates.	CLO–15	2

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Written	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Field Study/Excursion

Course Code: BZOOL 2204

Full Marks: 25 (Unit 0.25, Credit 1)

Preparation and submission of report(s) on Slaughtering and Meat Selling Shops with the demonstration and illustration of different organs and organ systems of larger animals in anatomical aspects. Submission of any autopsy report (if available), and visit to an abattoir (if possible). (Distribution of Marks: Local field reports = 12.50, Presentation/viva-voce = 5, Assessment =5, Attendance =2.50).

Course Title: *Viva-voce*
Course Code: BZOOL 2205
Full Marks: 50 (Unit 0.5, Credit 2)

Viva-voce on theoretical courses of second year first and second semester.

Course Title: Zoology Practical I		
Course Code: BZOOL 2206	**Course Type:** Practical (Core Course, Mandatory)	**Credits:** 3
Full Marks: 50	**Total Lecture Hours:** 45	**Exam Hours:**6 (6 hours daily)

Course Learning Objectives:
To provide practical experience on the topics covered by theoretical courses so that the learner can apply their knowledge in lab, workplace and in practical life.

Course Learning Outcomes (CLOs):
After completion of this course, students should be able to:

1. Dissect and display the different organs and organ systems of the representative animals of different taxa;
2. Provide comparative interpretation of the different organs and organ systems of the representative animals of different taxa;
3. Describe the structures of the representative organs and organ systems of the rare/endangered specimens;
4. Draw labeled diagram of the dissected and/or displayed organs and organ systems of different animals;
5. Identify special structures and photographs of different organs and organ systems.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	**Alignment of topic with CLOs**	**LH**
Dissection and displaying of the digestive and endocrine systems of the following animals: Earthworm, any insect (Cockroach, grasshopper), prawn, freshwater snail& mussel, starfish/sea star, available cartilaginous & bony fishes, toad/frog, lizard, commercially available birds (chicken/pigeon), and mammals (lab. mice/rats).	CLO 1, 2, 4	18
Identify the supplied organs and photographs of organ and organ systems of animals.	CLO-5	12

Teaching-learning Strategy	**Assessment Strategy**		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hours daily on the tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Course Title: Zoology Practical II		
Course Code: BZOOL 2207	**Course Type:** Practical (Core Course, Mandatory)	**Credits:** 3
Full Marks: 50	**Total Lecture Hours:** 45	**Exam Hours:**6 (6 hours daily)

Course Learning Objectives:

To provide practical experience on the topics covered by theoretical courses so that the learner can apply their knowledge in lab, workplace and in practical life.

Course Learning Outcomes (CLOs):

After completion of this course, students should be able to:

1. Dissect and display the different organs and organ systems of the representative animals of different taxa;
2. Provide comparative interpretation of the different organs and organ systems of the representative animals of different taxa;
3. Describe the structures of the representative organs and organ systems of the rare/endangered specimens;
4. Draw labeled diagram of the dissected and/or displayed organs and organ systems of different animals;
5. Demonstrate and describe the procedure(s) for detection of urea, albumen and glucose in given samples as well as for measurement of blood pressure;

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Dissection and displaying of the circulatory of the following animals: Earthworm, any insect (Cockroach, grasshopper), prawn, freshwater snail& mussel, starfish/sea star, available cartilaginous &bony fishes, toad/frog, lizard, commercially available birds (chicken/pigeon), and mammals (lab. mice/rats).	CLO 1, 2, 4	18
Detection of urea, albumen and glucose in given samples; measurement of blood pressure.	CLO-5	12

Teaching-learning Strategy	Assessment Strategy		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hours daily on the tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Learning Resources:

Barnes, R.S.K. *et.al.,* 2001. The Invertebrates: A Synthesis 3rd Edition.

Barrington, EJW. 1979. Invertebrate Structure and Function (2nd edn). John Wiley and Sons, New York

Beklemishev. Comparative Anatomy of Invertebrates. Vol. I Promorphology; Vol. II Organology

Chapman, R.F. (1998). *Cutaneous Respiration*. In RF Chapman, The Insects: Structure and Function (p. 452). New York: Cambridge University Press.

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Dales, RP. 1981. Practical Invertebrate Zoology. Blackwell Scientific Publications. London.

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ELendell Cockrum, William J. McCauley (1965). Zoology.

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Goodrich, ES. Comparative Anatomy of Vertebrates.

Griffin, DR and Novick, A. 1962. Animal Structure and Function. Holt, Rinehart and Winston, Inc., New York.

Guyton, AC and Hall, JE. 2000. Textbook of Medical Physiology (10th edn.). W.B. Saunders Philadelphia.

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Reece, Urry, Cain Wasserman, Minorsky, Jackson. 2011, Campbell Biology.

Regina Macedo, Glauco Machado.2013. Sexual Selection: **Perspectives and Models from the Neotropics.** Academic Press, 466 pages

Rugh, R. 1968. The Mouse - its reproduction and development. Burgess Publishing Co., Minneapolis, Minn.

Schilman, PE (2007). *The respiration of arthropods with tracheas*. Science Today, 17, 22-26.

Stephen M. Shuster, Michael J. Wade. 2003. Mating Systems and Strategies. Princeton University Press, May 26, 2003 - Science - 533 pages

Urry, L. *et. al.,*2016. Campbell Biology (Campbell Biology Series) 11th Edition

Walker, WF Jr. 1987. Functional Anatomy of the Vertebrates: An Evolutionary Perspective. Sander's College Publishing, USA.

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Walker, WF. 1975. Vertebrate Dissection. W.B. Sander's Co., Philadelphia.

Walker, WF. 1980. Vertebrate Dissection. Sanders Co., Philadelphia.

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Webster, D and Webster, M. 1974. Comparative Vertebrate Morphology. Academic Press, New York, London.

Weickert, CK. 1965. Anatomy of the Chordates (3rd edn). McGraw-Hill, New York.

Wigglesworth, VB. 1965. The Principles of Insect Physiology. ELBS and Methuen and Co.

Williams, P, Stone, G and Johnston, I. 2005. Environmental Physiology of Animals (2nd edn). Blackwell Scientific Publications, Oxford. London.

Course Title: Chemistry IV: Bio-physical and Bio-organic		
Course Code: BZOOL 2208	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3

Course Description

This course has been designed to introduce students to electrochemical cells, chemical and enzyme kinetics, spectrophotometry, carbohydrates and Lipids of chemical and biochemical processes. It will also provide knowledge on electrode potentials, the order and molecularity of reactions, the effect of pH and ionic strength, the kinetics of enzyme-catalyzed reactions, Spectrophotometric analysis, Nucleic acids, lipids and different aspect of biological membranes. Finally, it will capable students to apply their knowledge and skill for diagnosis of chemical and enzyme reactions, the effective control of those reactions and basic knowledge of bio-organic chemistry.

Course Learning Outcomes (CLOs)

After completion of this course, learners will be able to:

1. Define electrochemical cells, chemical and enzyme kinetics reactions with examples;
2. Compare the Red-Ox processes, thermodynamics of reversible cells, half cells, electrode potentials, electrochemical cells, sign conventions, the Nernst equation, biochemical standard states, coupled red-ox processes;
3. Describe the pathway of reaction, order and molecularity of reaction, type of rate processes, determination of the order of reaction, rate expression for first and second order reaction, effect of temperature on the rate of reaction, Arrhenius equation, significance of parameters, simple treatment of transition state theory of reactions, effect of pH and ionic strength on the rate of reaction in solution, kinetics of enzyme catalyzed reactions, treatment of kinetic data, enzyme inhibition, effect of pH and temperature on enzyme reaction;
4. Explain the electromagnetic spectrum, Beer-Lambert law and determination of unknown concentration based on the Beer-Lambert law, appropriate concentration range, two absorbing compounds and isosbestic points;
5. Synthesize and give structures of different kinds of carbohydrates;
6. Convert one carbohydrate to another and know their uses;
7. Write RNA/DNA conformation and their functions;
8. Discuss about genetic code;
9. Write structures and functions of different kinds of lipids;
10. Describe the component and functions of biological membranes.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy		
Course contents	**Alignment of topic with CLOs**	**LH**
Electrochemical cells (Red-Ox Processes):		
Red-Ox processes, thermodynamics of reversible cells, half cells, electrode potentials, electrochemical cells, sign conventions, the Nernst equation, biochemical standard states, coupled red-ox processes	CLO 1-2	6
Chemical and enzyme kinetics:		
The pathway of reaction, order and molecularity of reaction, type of rate processes, determination of the order of reaction, rate expression for first and second order reaction, effect of temperature on the rate of reaction, Arrhenius equation, significance of parameters, simple treatment of transition state theory of reactions, effect of pH and ionic strength on the rate of reaction in solution, kinetics of enzyme catalyzed reactions, treatment of kinetic data, enzyme inhibition, effect of pH and temperature on enzyme reaction.	CLO 1-3	8
Spectrophotometry:		
The electromagnetic spectrum, Beer-Lambert law and determination of unknown concentration based on the Beer-Lambert law, appropriate.	CLO 4	6
Carbohydrates:		
Monosaccharides, oligosaccharides and polysaccharides.	CLO 5-6	3
Nucleic acids		
Nucleotides/Polynucleotide, their conformations, DNA/RNA, genetic code.	CLO 7-8	3
Lipids		
Fats and oils, biological membranes.	CLO 9-10	4

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Written	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Chemistry V: Bio-inorganic		
Course Code: BZOOL 2209	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Hours:** 30	**Exam Hours:** 3

Course Description

This course describes the concept of fundamental particles and radioactivity. The course also provides the students with the knowledge of group displacement law and laws of radioactive disintegration as well as the methods for the separation and identification of isotomes. This course is also aimed to provide information about the sources, requirements and functions of alkali alkaline metal. At the end of the course, students will enrich their knowledge about the structure and functions of different protein. The students can apply their achievements to keep healthy the living systems.

Course Learning Outcomes (CLOs)

After completing this course, the students will be able to:

1. Write fundamental particles and their nature;
2. Write radioactive elements and its' units;
3. Explain the terms decay constant, half-life period, average life period and their relationship;
4. State and explain the "group displacement law";
5. Explain the laws of radioactive disintegration;
6. Describe the methods for the separation and identification of isotopes;
7. Discuss the sources, requirements and functions of alkali and alkaline earth metals in living systems;
8. Write structure and functions of chlorophyll;
9. Write structure and functions of heme protein;
10. Write structure and functions of iron Sulphur protein;
11. Describe the source and functions of zinc and copper metalloenzymes.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Nuclear Chemistry		
Fundamental particles, natural and artificial radioactivity, unit of radioactivity,	CLO-1, 2	3
Group displacement law.	CLO-3, 4	3
Laws of radioactive disintegration, radioactive equilibrium.	CLO-5	2
Isotopes: definition, separation and application.	CLO-6	2
Bio-Metal Chemistry		
Overview, the role of alkali and alkaline earth metals in living systems.	CLO-7	4
Metalloporphyrin		
Introduction, structure and functions of chlorophyll.	CLO-8	4
Heme proteins, haemoglobin and myoglobin, haemoglobin	CLO-9	4

modeling, other heme proteins (cytochromes, cytochrome P-450, enzyme, catalase, peroxidases).		
Iron sulphur proteins, rubredoxines, ferredoxines and high potential iron proteins, hemerythrin, iron supply and transport, bio-inorganic chemistry of cobalt, vitamin B_{12}.	CLO-10	4
Metalloenzymes: Zinc and copper metalloenzymes.	CLO-11	4

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Written	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Learning Resources:

Clarke H.T. and Haynes, B. 1975. A Handbook of Organic Analysis: Qualitative and Quantitative, 5th edn.

Cotton, F.A. *et al*., Advanced Inorganic chemistry.

Madon,R.D. Modern Inorganic chemistry.

Shriner, Fuson and Curtin. 1999. The systematic identification of organic compounds, 7th edn.

Vogel, A.I. 1957. Elementary practical chemistry (Part-I, Part-II, Part-III), 2nd edn.

Vogel, A.I. 1989. A text book of organic chemistry, 5th edn.

Course Title: Chemistry Practical		
Course Code: BZOOL 2210	**Course Type:** Practical (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture Periods:** 30	**Exam Hours:** 6 (One day)

Course Description

The organic section of the practical course provides the students to understand the determination of the melting and boiling points, detection of elements and functional groups present in organic compounds through some simple reactions. These ideas help the students to flameout the structure of a simple organic molecule.

The inorganic practical section of this course is aimed at providing information on the preparation of standard solutions, estimation of carbonate and volumetric estimation ofdifferent metals.

Course Learning Outcomes (CLOs):

After completion of this course, students should be able to:

1. Detect the melting and boiling points of organic compounds;
2. Detect the presence of elements i.e., N, S and X in organic compounds;
3. Detect the various functional groups in organic molecules;
4. Evaluate the molecular structure of organic molecules;
5. Identify the organic compounds through systematic analysis;
6. Prepare the different standard solution and standardization of supplied solutions;
7. Estimate of carbonate in a caustic soda solution;
8. Assess the volumetric estimation of chemical compound(s) by complexometric titration with EDTA.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Section A (Bio-organic, 50% of the total marks)		
Measure the physical constants such as melting and boiling points of pure organic compounds.	CLO-1	2
Reveal the elements like N, S, and X present in pure organic molecules.	CLO-2	2
Detect various functional groups present in organic samples.	CLO-3	2
Synthesize different derivatives related to the various functional groups of organic compounds.	CLO-3	2
Evaluate the real molecular structure of organic molecules by utilizing obtained data.	CLO-4	2
Identification of Organic Compounds by Systematic Analysis: (a) Determination of melting point of solid and boiling point of liquid organic compounds. (b) Detection of N, S and halogens in organic compounds. (c) Solubility test and classification of the compound. (d) Identification of Functional Groups Using Chemical Method: primary amine, secondary amine, substituted amide, simple amide and imide, carboxylic, phenolic, carbonyl, aromatic hydrocarbon etc.; Preparation of derivative, conclusion, naming and structure of compound. **N.B. Identification of the compound under investigation should be systematic**	CLO-5	5
Section B (Volumetric analysis, 50% of the total marks)		
Preparation of standard sodium carbonate solution and standardization of supplied HCl and NaOH solutions.	CLO-6	3
Preparation of standard potassium dichromate solution and standardization of supplied sodium thiosulphate solution.	CLO-6	3
Preparation of standard sodium oxalate solution and standardization of supplied permanganate solution.	CLO-6	3
Estimation of carbonate in a caustic soda solution.	CLO-7	3
Volumetric estimation of (a) copper (iodometric), (b) Iron with permanganate and dichromate, (c) Iron, copper, nickel, zinc, calcium and magnesium by complexometric titration with EDTA.	CLO-8	3

Teaching-learning Strategy	Assessment Strategy		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hours daily on the tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Curriculum
For
Third Year
First Semester

B. Sc. (Honours) Third Year First Semester Examination, 2026

Course codes	Course titles	Units	Marks	Credits
Major courses				
BZOOL 3101	Cell Biology	0.5	50	2
BZOOL 3102	Genetics & Animal Breeding	0.5	50	2
BZOOL 3103	Developmental Biology	0.5	50	2
BZOOL 3104	Taxonomy & Bioinformatics	0.5	50	2
BZOOL 3105	Ecology	0.5	50	2
BZOOL 3106	Field Study/ Excursion	0.25	25	1
BZOOL 3107	Zoology Practical I	0.5	50	2
BZOOL 3108	Zoology Practical II	0.5	50	2
GEd courses				
BZOOL 3109	Ethology	0.5	50	2
BZOOL 3110	Palaeontology	0.5	50	2
BZOOL 3111	Evolution	0.5	50	2
	Total	**5.25**	**525**	**21**

B.Sc. (Honours) Third Year First Semester Examination, 2026

Course Title: Cell Biology		
Course Code: BZOOL 3101	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description:

Cell Biology: The cell biology course is intended to introduce the students to cell structure and function, and it revolves around the concept that the cell is the fundamental unit of life. Concentrating on cell biology allows for a thorough understanding of the cell, cell theory, stem cells, cell division, cell organelles, growth and aging, differentiation, radiation effects, pathological aspects, and histology. It also includes cell ultrastructure and function, energy transfer, reproduction, migration, DNA replication, and genetics. By understanding how cells work in healthy and diseased states, cell biologists working in animal and medical science will be able to develop new vaccines, more effective medicines, animals with improved qualities, and, through increased knowledge, a better understanding of how all living things live.

Course Learning Objectives:

1. To introduce the learners to cell structure and function, and it revolves around the concept that the cell is the fundamental unit of life.
2. To learn about the structures and purposes of the basic components of prokaryotic and eukaryotic cells.
3. To learn the macromolecules, membranes, and organelles.
4. To understand the cell cycle, consider cell division.
5. To understand cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation as well as histopathology.

Course Learning Outcomes (CLOs):

After completion of **Cell Biology** course, learners will be able to**:**

1. Define cell, cell theory, cell cycle and cell processes;
2. Define stem cell, Describe the history of stem cells, types; characters;

3. Describe the culture and importance of stem cells in research;
4. Define cell cycle and types of cell division: amitosis, mitosis, meiosis and explain the mechanism of cytokinesis;
5. Discuss the structure, origin and function of cell organelles: internal membranes, compartmentalize the functions of a eukaryotic cell, endoplasmic reticulum, Golgi bodies, lysosomes and mitochondria;
6. Describe the structure, types and function of endomembrane system: nucleus, ribosomes and vacuoles; Define peroxisomes with their structures and functions
7. Describe morphology, structure and function of cytoskeleton: microtubules, microfilaments and intermediate filaments;
8. Describe the basic concept of chromosomes with detail structure, morphology, types and functions;
9. Describe the structure and cytogenetic functions, polytene and lampbrush chromosomes;
10. Define cell growth and explain how it is not to be confused with growth in the context of cell division, referred to as proliferation. Define aging and explain the factors that influence aging, describe genetic and environmental factors on aging;
11. Explain the basic mechanism of sub-cellular changes due to aging as well as describe various theories of aging;
12. Define cell differentiation in unicellular and multicellular animals; explain differentiation results from the interaction of the nucleus and cytoplasm, describe the influence of the nucleus on the cytoplasm and *vice versa*;
13. Explain the differential gene action, describe the mechanism of cell differentiation process, explain the role of DNA and RNA, control of gene expression as well as describe the environmental factors which affect cellular differentiation;
14. Define radiation, types and sources; describe the effects of UV and ionizing radiations on cells and unicellular organisms;
15. Define pathology and pathological aspects of cells, describe different types of cellular adaptation, cell infiltration, degeneration and degenerative diseases, types of cell injury. Describe necrosis, apoptosis. Describe the stages of decomposition of corpse and explain the mechanism of post mortem changes due to *rigor mortis*;
16. Define histology, describe the detail procedure of histotechniques; describe the histological structure of different organs of vertebrates: such as esophagus, intestine, stomach, heart, liver, lungs, pancreas and kidney.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of the topic with CLOs	LH
Cell		
Introduction to cell; cell theories; cell cycle and cell processes.	CLO 1	2
Stem cell: history; characters and types, Stem cell culture and stem cell in research.	CLO 2-3	2

Cell Division		
Cell division; types; amitosis; mitosis; meiosis and cytokinesis.	CLO-4	2
Cell organelles		
Structure, origin and functions: Plasma membrane; Structure, model and physiology: Endoplasmic reticulum; Golgi complex; lysosomes, mitochondria.	CLO-5	2
Structure, model and physiology: Mitochondria; Nucleus, ribosomes.	CLO-6	2
Cytoskeleton: Morphology, structure and functions of microfilaments, microtubules and intermediate filaments.	CLO-7	2
Chromosome: Morphology, structure and cytogenetic functions.	CLO-8	2
Chromosome: Polytene and lampbrush chromosomes.	CLO-9	2
Cell growth and aging		
Process of aging; Sub-cellular changes due to aging; Causes and theories of aging.	CLO-10	2
Process of aging; Sub-cellular changes due to aging; Causes and theories of aging.	CLO-11	2
Cell differentiation		
Differentiation in unicellular and multicellular organisms; mechanism of differentiation.	CLO-12	2
Effects of radiation on cells: Sources of radiation; effects of ultraviolet (UV) and ionizing radiations on cells.	CLO-14	2
Pathological aspects of cell: Cellular infiltration and degeneration; Necrosis and post mortem changes.	CLO-15	2
Histology: Histotechniques; Study of histological structure of different organs of vertebrates: Oesophagus, intestine, stomach, heart, liver, lungs, pancreas and kidney.	CLO-16	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Learning Resources:

1 Cooper, M.G., 2000. The Cell **(**A Molecular Approach**)**, 2nd edition
2. Alberts, B., et. al. 2014. Molecular Biology of the Cell Sixth Edition
3. Barnes, R.S.K. et.al., 2001. The Invertebrates: A Synthesis 3rd Edition.
4. ELendell Cockrum, William J. McCauley (1965). Zoology.
5. Fusco, G. and Minelli, A. 2019. The Biology of Reproduction 1st Edition.
6. Verma, P.S., V.K. Agarwal (1974). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology.
7.George Plopper, Diana Bebek Ivankovic. 2020. Principles of Cell Biology. Jones & Bartlett Learning, **Science** - 744 pages.
8.Thomas Dean Pollard, William C. Earnshaw, Jennifer Lippincott-Schwartz, Graham T. Johnson. 2017. Cell Biology. Elsevier, 882 pages

9. John K. Young. 2010. Introduction to Cell Biology. World Scientific. Science. 219 pages
10. Urry, L. et. al., 2016. Campbell Biology (Campbell Biology Series) 11th Edition
11. **Harvey Lodish**, **Arnold Berk**, **Chris A. Kaiser**, **Monty Krieger**, **Matthew P. Scott**, **Anthony Bretscher**, **Hidde Ploegh**, **Paul Matsudaira**. 2007. Molecular Cell Biology 6th Edition. W.H. Freeman.
12. Leslie P. Gartner.2018. BRS Cell Biology and Histology (Board Review Series) 8th Edition. LWW.

Course Title: Genetics & Animal Breeding		
Course Code: BZOOL 3102	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description:

Genetics and Animal Breeding: The course is designed to enrich the knowledge and understanding of the learners about various aspects of Genetics and Animal Breeding. The course will also help enrich the existing ideas of the students on the basic work of Mendel, his laws of inheritance and their deviations. In addition, types and mechanisms of linkage and crossing-over, sex-linked inheritance in man and *Drosophila*, gene and chromosomal mutations, ABO blood groups and their inheritance, various mechanisms of sex determination in animals, Hardy-Weinberg law and its uses in population genetic studies, extra-nuclear inheritance and types and applications of animal breeding for farm animals.

Course Learning Objectives:

1. To strengthen the knowledge and understanding of the learners about various aspects of Genetics and Animal Breeding, ranging from the basic laws of Genetics to the applications of breeding principles to domesticated and farm animals.

Course Learning Outcomes (CLOs):

After completion of **Genetics and Animal Breeding** course, learners will be able to**:**

1. Describe the work of Johann Mendel, the father of Genetics, explain Mendelism, and define the common terminologies used in Genetics;
2. Describe and explain with examples the Mendelian crosses and ratios in garden peas and animals;
3. Explain allelic and non-allelic interactions, and deviations from Mendel's laws;
4. Explain with examples deviations from Mendelian monohybrid and dihybrid ratios;
5. Classify, explain and compare linkage and crossing-over along with their significance;
6. Describe and compare sex-linked, sex-limited and sex-influenced traits particularly in man and *Drosophila;*
7. Define, compare and explain multiple and pseudo-alleles with special reference to the inheritance of ABO blood groups in man and their medico-legal applications;
8. Describe and understand various mechanisms of sex determination in animals and their abnormalities;
9. Describe types, mechanisms and detection of gene mutations;
10. Describe types of chromosomal mutations along with their practical

applications;

11. Classify and explain chromosomal aberrations, their origin and frequencies in man;
12. Interpret extra-nuclear inheritance in animals and compare it with nuclear inheritance;
13. Define population genetics and describe Hardy-Weinberg law and its derivation;
14. Describe inbreeding, outbreeding and cross breeding and their genetic effects; and
15. Apply animal breeding principles for improving farm and domesticated animals

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of the topic with CLOs	LHs
Genetics		
A short life-sketch of Mendel; Common terminologies used in Genetics.	CLO-1	2
Mendel's laws of inheritance.	CLO-2	2
Deviations from monohybrid and dihybrid cross ratios.	CLO-3	2
Linkage and crossing-over.	CLO-5	2
Sex-linked inheritance in *Drosophila* and man; Sex-limited and sex-influenced traits.	CLO-6	2
Multiple alleles and inheritance of ABO blood groups in man; Pseudoalleles and Rh antigen.	CLO-7	2
Mechanisms and chromosomal mutations		
Determination of sex in animals.	CLO-8	2
Gene *versus* chromosomal mutations; Classification of gene mutations; Detection of mutations by ClB and Muller-5 methods.	CLO-9	2
Variations in chromosome number and structure.	CLO-10	2
Chromosomal abnormalities in man.	CLO-11	2
Extra-chromosomal inheritance in *Paramecium* and *Drosophila*.	CLO-12	2
Hardy-Weinberg law and its limiting factors.	CLO-13	2
Animal Breeding		
Types of breeding and their genetic effects.	CLO-14	2
Practical applications of breeding principles.	CLO-15	2

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Learning Resources:

Altenburg, E. 1965. *Genetics*. Oxford & IBH Publish Co., Calcutta, India.

Ayala, FJ & Kiger Jr. JA. 1980. *Modern Genetics*. Benjamin/Cummings Pub. Co., Inc. USA.

Burns, WG. 1981. *The Science of Genetics* (5th edn). MacMillan Publ. Co. Inc., NY, USA.

Burnett, L. 1986. *Essential Genetics*. Cambridge University Press, UK.

Dunn, LC. 1965. *A Short History of Genetics*. McGraw-Hill Book Co., NY, USA.

Gardner, EJ, Simmons, MJ. and Snustad, DP. 1991. *Principles of Genetics* (8th edn). John Wiley & Sons Inc., NY, USA.

Griffiths, AJF et al. 2000. *An Introduction to Genetic Analysis*. (7th edn). WH Freeman & Co., NY, USA.

Islam, AS.1973. *Fundamentals of Genetics*. AKM Abdul Hai Asiatic Press, Dhaka.

Islam, MS. 2018. *Selected Lectures in Genetics*. LAP Lambert Academic Publishing, Germany.

Jenkins, JB 1975. *Genetics*. Houghton Mifflin Co., Boston, USA.

King, RC. 1962. *Genetics*. Oxford University Press, NY, USA.

Novitski, E. 1977. *Human Genetics*. MacMillan Pub. Co. Inc., NY, USA.

Pai, AC. 1974. *Foundations of Genetics*. McGraw-Hill Book Co., NY, USA.

Serra, JA 1968. *Modern Genetics* (3 Vols). Academic Press, London, UK.

Singh, CV. 1986. *Animal Breeding and Genetics*. Tata McGraw-Hill Publ. Co. Ltd. New Delhi, India.

Sinnot, EW, Dunn, LC. and Dobzhansky, T. 1967. Principles of Genetics (5th edn). Tata McGraw-Hill Publ. Co. Ltd. New Delhi, India.

Srb, AM, Owen, RD & Edgar, RS. 1968. *General Genetics*. WH Freeman & Co., San Francisco, USA.

Standsfield, WD., Colome, JS. and Cano, RJ. 1996. *Theory and Problems of Molecular and Cellular Biology*. Schaum's Outline Series. McGraw-Hill Inc., Singapore.

Stansfield, WD. 1991. *Theory and Problems f Genetics* (3rd edn). Schaum's Outline Series. McGraw-Hill Inc., Singapore.

Strickberger, MW. 1968. *Genetics*. MacMillan Co., NY, USA.

Suzuki DT & Griffiths, AJF. 1976. *An Introduction to Genetic Analysis*. WH Freeman & Co., San Francisco, USA.

Verma, PS & Agarwal, VK. 1999. *Genetics*. S. Chand & Co. Ltd. New Delhi, India.

Verma, PS & Agarwal, VK. 2001. *Concept of Genetics, Human Genetics and Eugenics*. S. Chand & Co. Ltd. New Delhi, India.

Winchester, AM. 1966. *Genetics: A survey of the Principles of Heredity* (3rd edn). Oxford & IBH Publ. Co. New Delhi.

ইসলাম, এম.সা, খান, হা.সা. ও রানা, মো. হা.তা. ২০১৭: জেনেটিক্স ঃ মিল ও অমিলেরবিজ্ঞান। অন্যপ্রকাশ, বাংলাবাজার, ঢাকা।

খান, হা.সা. ও ইসলাম, এম.সা. ২০১৩ : জৈবপ্রযুক্তি ও জীনপ্রকৌশল।

গুহ, সু.: জীন, বংশধারা ও বিবর্তন।

পাল, এন.কে. : বংশগতিবিদ্যা।

Course Title: Developmental Biology		
Course Code: BZOOL 3103	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description:

The course has been designed to understand the processes of gamete formation and that lead from the fertilization of an egg cell to the formation of a well-structured and functional multicellular organism. It will also provide knowledge to investigate how fertilized egg cells divide in regulated manners to grow into full-size bodies, how the cells formed in this process communicate in meaningful ways to become different from each other, migrate, change shape and attach to each other, thus assembling into tissues and complex organs.

Finally, it will capable the students to apply their knowledge and skill for biomedical research.

Course Learning Objectives:

1. To introduce the students with the embryonic development, developmental theory, developmental events.
2. To provide knowledge on the processes that lead from the fertilization of an egg cell to the formation of a well-structured and functional multicellular organism.
3. To apply knowledge and skill for biomedical research.

Course Learning Outcomes (CLOs):

After completion of **developmental Biology** course, learners will be able to:

1. Define embryonic development, embryology, developmental Biology;
2. Compare the embryology, developmental Biology, embryogenesis, blastogenesis;
3. Describe the types of development and their control mechanisms;
4. Describe different theories of development;
5. Compare among different theories of development;
6. Name and discuss the events of development;
7. Define gametogenesis as well spermatogenesis along with sperm or acrosome development;
8. Compare the spermatogenesis and spermiogenesis;
9. Describe oogenesis and comparison spermatogenesis & oogenesis;
10. Define egg and egg types with examples;
11. Mention the types of cleavage and explain cleavage pattern;
12. Interpret the influence of yolk on cleavage;
13. Describe the fertilization types and the process;
14. Define gastrulation and mention types of gastrulation with explanation;
15. Define coelom, discuss different types of coeloms and their significance;
16. Discuss Speaman's organizer;
17. Name the organizer in different chordate and discuss the theories of organizer;
18. Discuss determination of cell fate, fate map and cytoplasmic localization;
19. Describe different methods of fate map construction;
20. Describe fate map of an animal as example;
21. Describe the events of embryonic development of*Neanthes*and chick as examples;
22. Name the extra-embryonic membranes of chick and discuss their development;
23. Discuss the comparison of embryonic development of the above animals;
24. Define placenta and describe their types with significance and mention their evolutionary sequence.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Embryonic development:		
Types of development and their control mechanism	CLO 1-4	2

Theories of development	CLO-5	2
Mosaic versus regulative development	CLO-6	2
Event of development:		
Gametogenesis**:** spermatogenesis and Oogenesis	CLO 6-9	4
Egg types and cleavage patterns.	CLO 10-12	2
Fertilization: External and internal fertilization; Fertilizin and antifertilizin; Process of fertilization; Significance of fertilization	CLO 13	4
Types of gastrulation, coelom and their significance	CLO 14-15	2
Spemann's organizer	CLO-16	2
organizer in different chordates, Theories of organizer	CLO-17	2
Determination of cell fate, fate map and cytoplasmic localization	CLO 18-20	2
Examples of development:		
Embryonic development of *Neanthes*	CLO-21	2
Embryonic development of chick	CLO 22-23	2
Placentation types, significance and evolutionary sequence	CLO-24	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Taxonomy and Bioinformatics		
Course code: BZOOL 3104	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description: Taxonomy course has been designed aims to understand the processes that lead from the define taxonomy and their related terms. It will also provide knowledge to the scope of taxonomy, the historical development of taxonomy, differentiate between taxonomy and systematics, Describe the approaches in taxonomy, the types of classification, "species concept"., the activities and regulations of ICZN. Finally, it will capable you to apply your knowledge and skill for taxonomical and conservation biology.
Introduction of the bioinformatics concepts, vocabularies, and application, familiarize with various bioinformatics tools, databases and resources and provide an understanding of web-accessible bioinformatics applications.

Course Learning Objectives:

1. To give the learners a broad introduction to taxonomy.
2. To fortify the knowledge and understanding of the learners about their related terms of taxonomy.
3. To apply knowledge and skill for biomedical research.
4. Acquire knowledge on different aspects of bioinformatics.

5. To discuss on Bioinformatics.

Course Learning Outcomes (CLOs):

After completion of this course, the students will be able to:

1. Define taxonomy and their related terms;
2. Describe the scope of taxonomy;
3. Mention the historical development of taxonomy;
4. Differentiate between taxonomy and systematics;
5. Describe the approaches in taxonomy;
6. Mention the types of classification;
7. Explain “species concept”;
8. Illustrate the idea on new type specimens;
9. Mention the kinds of taxonomic publications;
10. Describe the activities and regulations of ICZN;
11. Different major type of taxonomy;
12. Describe the history and scope of bioinformatics;
13. Describe different components of computers including programming languages;
14. Describe the biological data and biological information;
15. Identify appropriate biological data bases for specific analyses;
16. Manage bioinformatics tools;
17. Describe the applications bioinformatics.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Taxonomy		
Introduction and concept of taxonomy and their related terms scope and importance.	CLO 1-2	1
Historical development of taxonomy.	CLO 3	1
Difference between Taxonomy & Systematics.	CLO 4	2
Different kinds of classification**:** phenetic, natural and phylogenetic.	CLO 5	1
Trends in Taxonomy**:** morphological. Immature stages and embryological, ecological, cytological, cytogenetical, biochemical and numerical.	CLO 6	2
Species concept, Cladogram.	CLO 7	1
Illustrate the idea on new type specimens.	CLO 8	1
Describe International Commission on Zoological Nomenclature and international code of zoological nomenclature.	CLO 9	2
ICZN history and purpose, principles of priority (synonym) and activates.	CLO 10	2
Major types: Holotype,paratype, syntypes neotypes, lectotype and allotype.	CLO 11	2
Bioinformatics		15
History, scope and importance.	CLO 12	2
Computers, internet, WWW and NCBI.	CLO 13	3
DNA, RNA and proteins.	CLO 14	4

Biological data bases.	CLO 15	2
Bioinformatics tools and their uses.	CLO 16-17	2
DNA and protein sequencing and analyses.	CLO 17	2
History, scope and importance.	CLO 12	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Ecology		
Course Code: BZOOL 3105	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description:

Ecology course has been designed to introduce the students with the historical background of ecology, Environmental factors, Ecosystem, Biogeochemical cycles, Population and community, habitat ecology, ecological aspects of the Sundarbans.

Wildlife conservation and management activities in Bangladesh Finally, it will capable the students to apply their knowledge and skill for the development of the development of various aspects of the environment.

Course Learning Objectives:

1. To introduce the students with the history of ecology, environmental factors, ecosystem, biogeochemical cycles, population and community, habitat ecology.
2. To provide knowledge on the ecological aspects of the Sundarbans and its management.
3. To apply knowledge and skill for the development of better ecosystem and conservation of the Sundarbans.

Course Learning Outcomes (CLOs):

After completion of this course, learners will be able to:

1. define historical background of ecology;
2. define component and function of ecosystem;
3. energy flow in the ecosystem, concept of productivity; food chain, food web and food pyramid;
4. nitrogen, carbon, and phosphorus cycles;
5. concepts of population and community, properties of a population and classification of communities;
6. describe different habitats of aquatic ecosystem: freshwater, marine, estuary;
7. describe terrestrial ecosystem;
8. know and be aware of our mangrove forest Sundarbans.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy		
Course contents	**Alignment of topic with CLOs**	**LH**
Introduction to Ecology		
Definition of ecology, historical background, modern concepts. branches and scope of ecology, relationships of ecology with other disciplines. different types of **e**nvironmental factors and their impacts.	CLO-01	**6**
Ecosystem		
Component and function of ecosystem; food chain, food web and food pyramid; energy flow in the ecosystem, concept of productivity.	CLO-02 and 03	**6**
Biogeo-chemical cycles		
Types of biogeochemical cycle, Description of Nitrogen cycle, carbon cycle, and phosphorus cycles;	CLO-04	**4**
Population and community		
Concepts of population and community, properties of a population and classification of communities.	CLO-05	**4**
Habitat ecology- Aquatic		
Freshwater ecology; limiting factors in freshwater environment; ecological classification of freshwater habitat; lotic and lentic communities; ecosystems of ponds and lakes; marine biota; zonation of the sea; communities in the marine environment; definition and types of estuaries; biota and productivity of estuary.	CLO-06	**6**
Habitat ecology- terrestrial		
General structure of terrestrial communities; distribution of major biomes.	CLO-07	**2**
Habitat ecology- mangrove		
Ecological aspects of the Sundarbans.	CLO-08	**2**

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Final Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

References:

Fundamentals of Ecology (Paperback) by E P ODUM
Wildlife Habitats: Ecology, Environment and Conservation by Kason Hurst (Editor)
Habitat Ecology and Analysis Hardcover – March 18, 2021 ; by Joseph A. Veech
The Field Guide to Wildlife Habitats of the Eastern United States; by Janine M Benyus

Course: BZOOL 3106
Field study/Excursion
Full Marks 25 (0.25 unit, 1 credits)

Preparation and submission of a report on the animals of any one bioecological/agroecological zones of Bangladesh other than that studied earlier; acquaintance with zoogeography/biological realms of Bangladesh. Distribution of marks: Field report/ Excursion= 12.50; Presentation/ *viva-voce*= 5; Assessment= 5 and Attendance= 2.50.

Course Title: Zoology Practical I		
Course Code: BZOOL 3107	**Course Type:** Practical (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 6 (6 hours daily)
Course Learning Objectives To provide practical experience on the topics covered by theoretical courses so that the learner can apply their knowledge in lab, workplace and in practical life.		
Course Learning Outcomes (CLOs) After completion of this course, learners will be able to: 1. Prepare and identify the permanent histological slides of chordates (Pisces-Mammalia); 2. Classify (with diagnostic characteristic) *Drosophila* mutants, sex-linked inheritance, linkage and crossing-over, human karyotypes, heterosis and inbreeding depression 3. Identify developmental stages in different groups of animals. 4. Determine the taxonomic ranks (PCOFGS) for collected specimens following standard keys for vertebrates and invertebrates; 5. Prepare cladogram, hypothetical descriptions and type designation, reviews, monographs, catalogues and checklists		

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy		
Contents	**Alignment of topic with CLOs**	**LH**
Cell Biology,: Preparation and identification of permanent histological slides of chordates (Pisces-Mammalia);	CLO 1	12
Genetics and Animal Breeding: Identification of *Drosophila* mutants, and human karyotypes (with special reference to chromosomal abnormalities); Study of sex-linked inheritance in *Drosophila*. Estimates of linkage and crossing-over in *Drosophila*; Observation of heterosis and inbreeding depression on different quantitative traits.	CLO 2	6
Developmental Biology: Identification of developmental stages in different groups of animals.	CLO 3	6
Taxonomy and Bioinformatics: Determination of taxonomic ranks (PCOFGS) for collected specimens following standard keys for vertebrates and invertebrates; Construction of keys	CLO 4-5	6

based on field collections; Preparation of cladogram based on supplied specimens; Preparation of hypothetical descriptions and type designation, reviews, monographs, catalogues and checklists; Morphological, cytogenetical and biochemical systematic of the anthropoid apes, manuscript preparation for new species;		

Teaching-learning Strategy	**Assessment Strategy**		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hrs daily on the tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Course Title: Zoology Practical II		
Course Code: BZOOL 3108	**Course Type:** Practical (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture periods:** 30	**Exam Hours:** 6 (6 hours daily)

Course Learning Objectives

To provide practical experience on the topics covered by theoretical courses so that the learner can apply their knowledge in lab, workplace and in practical life.

Course Learning Outcomes (CLOs)

After completion of this course, learners will be able to:

1. Demonstrate and explain the procedure of ecological samplings, estimation of biodiversity from a variety of habitats, and exploration of food chain in communities.
2. Prepare ethograms for representative group of animals
3. Evaluate positive versus negative taxes in *Tribolium castaneum*, and T-maze learning in laboratory mouse, *Mus* sp.
4. Identify fossil fauna
5. Recognize and demonstrate the evidence and evolutionary sequences

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy		
Contents	**Alignment of topic with CLOs**	**LH**
Ecology: Ecological samplings from a variety of habitats, *e.g.* crop fields, grasslands, hedgerows and ponds; Ecosystem of ponds; Study of the food chain in communities;	CLO 1	9
Ethology: Preparation of ethograms for representative group of animals with respect to irritability, stimulus, response, taxis and tropism; Estimates of positive versus negative taxes in *Tribolium castaneum*.; Evaluation of T-maze learning in laboratory mouse, *Mus* sp.	CLO 2-3	12

Paleontology and Evolution: Palaeontology: Identification of fossil fauna. Evolution: evidence and evolutionary sequences: Homology, analogy and homoplasty; Vestigial organs: Hind limbs of python; nictitating membrane of human (diagrammatic); Secondary loses; atavism; Adaptive radiation in vertebrates; Evolutionary sequences of different organs/systems from preserved materials-models and drawings..	CLO 4-5	9

Teaching-learning Strategy	**Assessment Strategy**		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hrs daily on the above tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Course Title: Ethology		
Course Code: BZOOL 3109	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description:

Ethology: The ethology course has been designed to study the terminology, classification, patterns and basic ethological concepts. This course describes the social behaviors, territoriality, altruism, caste systems and communication in animals. This course deals with the process of memorization and the role of hormones and pheromones in behavior. The course also depicts migratory behaviors in fish and birds.

Course Learning Objectives:

1. To fortify the knowledge and understanding of the learners about ethology.

Course Learning Outcomes (CLOs):

After completion of **Ethology** course, learners will be able to:

1. Outline of different terminologies used in the ethological study with examples;
2. Mention the history and questions about animal behavior;
3. Discuss the classification/ types of animal behavior;
4. Describe the patterns of animal behavior;
5. Explain the basic ethological concepts: irritability, stimulus, response and releaser;
6. Distinguish between types of orientation, *viz.*,taxes, kinesis, tropisms and with suitable examples;
7. Define and characterize different types of animal aggregation: social aggregation and animal grouping with their merits and demerits;
8. Interpret all about territoriality and altruism;
9. Describe different types of colony insects and caste systems, characterize

types of socialization in animals providing examples;
10. Define and discuss animal communication with examples;
11. Explain the courtship behavior with functions and types;
12. Illustrate the species-specific behavior: instinctive reproductive behavior (three-spine stickleback, Mason fly);
13. Mention parental care in animals;
14. Mention the process of memorization;
15. Discuss the role of hormones and pheromones in behavior;
16. Discuss migratory behaviors in fish and birds.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Introduction, classification and concepts		
Introduction to ethology, history and questions about animal behavior.	CLO 1-2	2
Classification/ types of animal behavior and patterns of animal behavior.	CLO 3-4	2
Basic ethological concepts: irritability, stimulus, response and releaser; Types of orientation: taxes, kinesis and tropism.	CLO 5-6	4
Social behavior		
Different types of animal aggregation: social aggregation and animal grouping with their merits and demerits.	CLO 7	2
Territoriality and altruism.	CLO 8	2
Colony insects and caste systems: honey bee, ants, termites.	CLO 9	4
Communication in animals.	CLO 10	2
Reproductive behavior		
Courtship behavior with functions and types.	CLO 11	2
Species-specific behavior: instinctive reproductive behavior (three-spine stickleback, Mason fly)and parental care.	CLO 12-13	2
Physiology of behavior		
Process of memorization.	CLO 14	2
Role of hormones and pheromones in behavior.	CLO 15	2
Animal migration		
Migratory behaviors in fish and bird.	CLO 16	4

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Palaeontology		
Course Code: BZOOL 3110	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Overview:

Palaeontology course has been designed to introduce you the palaeontology. It will provide knowledge on formation and different types of fossils, geological time scales, fossil dating methods, palaeontological history of major invertebrate and vertebrate groups. This course is also aimed to provide information on different types of fossils found in different animal groups and their age determination resulting to estimate the geological time scale. Altogether, you will learn about interesting history of ancient faunal and floral appearance and disappearance resulting from environmental changes. Finally, it will make capable you to apply your knowledge and skill for how the earth has been formed, how the animals were spread after division of total landmass Pangaea, how they have been extinct.

Course Learning Outcomes (CLO)

After completion of **Palaeontology** course, learners will be able to:

1. Describe palaeontology, fossil, living fossil, divisions of palaeontology, pangaea, tethys sea and future world shape.
2. Describe fossil materials and classify different types of fossils, interpret importance of fossils and conditions fossilization
3. Describe the different processes of fossilization
4. Understand the relative and absolute/radioactive fossil dating methods, half-life and isotopes; sedimentation, uranium-lead ratio fossil dating methods.
5. Explain different types of fossil dating methods i.e., radio-carbon ratio, potassium-argon ratio and thermo-luminescence fossil dating methods and criticisms.
6. Define geological time scale, era, period, epoch and to describe palaeozoic era.
7. Describe different periods of mesozoic and coenozoic era.
8. Describe fossils found in protozoa, mollusca, arthropoda and amphibia.
9. Describe ostracoderm, placoderm (fish) and *Archaeopteryx* (bird).
10. Describe evolution of elephant with phylogeny and evolution of man.
11. Describe siwalik hills, siwalik rivers and siwalic fossil park.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strateg

Course contents	**Alignment of topic with CLO**	**LH**
Palaeontology		
Palaeontology, fossils, divisions of palaeontology, living fossils, pangaea, tethys sea and future shape of the world.	CLO-1	2
Fossil, fossil materials, different types of fossils, importance of fossils and conditions of fossilization.	CLO-2	4

Process of fossilization, five fossilization processes.	CLO-3	3
Fossil dating method, relative and absolute fossil dating methods, half-life and isotopes; sedimentation, uranium-lead ratio fossil dating methods.	CLO-4	2
Radio-carbon ratio, potassium-argon ratio and thermo-luminescence fossil dating methods with their criticisms.	CLO-5	2
Geological time scale with its divisions, era, period, epochs and palaeozoic era.	CLO-6	2
Mesozoic and coenozoic era.	CLO-7	3
Fossil protozoa (foraminifera and radiolarian orders), Mollusca (cephalopoda), Arthropoda (trilobite) and Amphibia (*Seymouria*).	CLO-8	2
Ostracoderm and placodermi (fish) fossil, *Archaeopteryx* (bird).	CLO-9	2
Evolution of elephant & man	CLO-10	4
Siwalic hill, river and fossil park	CLO-11	4

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Learning Resources:

1. Vertebrate Palaeontology. A.S. Romer. 1965. Chicago Univ. Press. Texas.
2. Introduction to Palaeontology. A.P. Tyagi. 1976.
3. Evolution, Palaeontology, Zoogeography, Embryology and Ethology. 2009. Dr. Md. Jalal Uddin Molla,
4. Dr. Md. Ataur Rahman Khan, Prof. S.M. Rafiqul Islam.

Course Title: Evolution		
Course Code: BZOOL 3111	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3 hours

Course Overview:

Evolution is the unifying concept and a significant tenet of modern biological theory. In 1973, evolutionary biologist Theodosius Dobzhansky penned, "Nothing in biology makes sense except in the light of evolution." The evolutionary ideas draw on the information gained to ascertain links between apparently contrasting fields of biology. This course introduces the learners to evolutionary biology, including phylogeny, natural selection, microevolution, macroevolution,and fossil records. Students will be presented with both short-term and long-term

evolutionary processes and explore the patterns resulting from those processes. It will cover topics like the origin of life, evidence of evolution, evolutionary theories,mechanism of evolution, species concept, and speciation.
Course Learning Outcomes (CLO) After completion of the Evolution course, learners will be able to: 1. Understand how organisms' forms, functions, and life histories have evolved. 2. Comprehend the processes of evolution and how they work in different circumstances. 3. Analyze and explain the information on evidence of evolution. 4. Understand and describe different theories of evolution. 5. Evaluate the concept of microevolution and macroevolution 6. Acquire knowledge about the major modes of speciation, species concepts, and speciation patterns.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy,and Assessment Strategy		
Course contents	**Alignment of the topic with CLO**	**LH**
Origin of Lifeand Introduction to Evolution		
An Historical account	CLO 1	1
Theories of Origin of Life	CLO 1	1
The family tree: Understanding phylogenies and buildingof the tree	CLO 1	2
Homologies and analogies; Using the tree for classification; Adding time to the tree; How we know what happened when? Significant events in the history of life	CLO 1	2
Mechanisms: the processes of evolution		
Mutations (The effects and causes of mutations),	CLO 2	2
Gene flow, Sex and genetic shuffling, Development, and Genetic drift	CLO 2	2
Natural Selection, Sexual selection, Artificial selection and Adaptation	CLO 2	2
Coevolution: A case study of coevolution: squirrels, birds, and the pinecones they love	CLO 2	1
Evidence of Evolution		
Evidence from Comparative Anatomy	CLO 3	1
Evidence from Embryology	CLO 3	1
Evidence from Paleontology	CLO 3	1
Evidence from Physiology and Biochemistry	CLO 3	1

Theories of Evolution		
Lamarckism and Neo-Lamarckism	CLO 4	1
Darwinism- Artificial Selection	CLO 4	1
Darwinism- Natural Selection	CLO 4	1
Darwinism- Sexual Selection	CLO 4	1
Synthetic Theory	CLO 4	1
Phyletic Gradualism vs. Punctuated equilibrium	CLO 4	1
Neutral Theory of Molecular Evolution	CLO 4	2
Microevolution and macroevolution		
Defining microevolution and macroevolution, Detecting microevolutionary change, Mechanisms of microevolution, Patterns in macroevolution	CLO 5	3
Speciation and Pattern of Speciation		
Defining a species and speciation, Causes of speciation	CLO 6	1
Reproductive isolation, Evidence for speciation and Cospeciation	CLO 6	1

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Learning Resources:

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ইসলাম, এম.সা., খান, হা.সা. ও রানা, মো. হা.তা. ২০১৭। জেনেটিক্স: মিল ও অমিলের বিজ্ঞান। অন্যপ্রকাশ, বাংলাবাজার, ঢাকা

Curriculum
For
Third Year
Second Semester

B. Sc. (Honours) Third Year: Second Semester Examination, 2026

Course codes	Course titles	Units	Marks	Credits
Major courses				
BZOOL 3201	Molecular Biology	0.5	50	2
BZOOL 3202	Zoogeography	0.5	50	2
BZOOL 3203	Wildlife, Biodiversity & Conservation Biology	0.5	50	2
BZOOL 3204	Population Biology	0.5	50	2
BZOOL 3205	Field Study/ Excursion	0.25	25	1
BZOOL 3206	*Viva-voce*	0.5	50	2
BZOOL 3207	Zoology Practical I	0.5	50	2
BZOOL 3208	Zoology Practical II	0.5	50	2
GEd courses				
BZOOL 3209	Health Biology & Epidemiology	0.5	50	2
BZOOL 3210	Ecology & Physiology of Parasites	0.5	50	2
BZOOL 3211	Parasitic diseases of Animals	0.5	50	2
	Total	**5.25**	**525**	**21**

B.Sc. (Honours) Third Year Second Semester Examination, 2026

Course Title: Molecular Biology		
Course Code: BZOOL 3201	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description:

Molecular Biology course has been designed to introduce the students to basic molecular biological concepts and the molecular basis of structure and function in living organisms. Molecular biology is an interdisciplinary approach to understanding biological functions and regulation at the level of molecules such as nucleic acids (DNA and RNA), proteins, and carbohydrates. It will also provide knowledge to fulfill the requirement for jobsto conduct experiments to investigate the structure, function, processing, regulation, and evolution of biological molecules and their interactions with one another, essentially providing micro-level insights into how life works. Finally, it will capable the students to apply their knowledge and skill for Molecular Biology research.

Course Learning Objectives:

1. To introduce the students with nucleic acids and proteins and how these molecules interact within the cell to promote proper growth, division, and development.
2. Molecular biology chiefly concerns itself with understanding the interactions between the various systems of a cell, including the interactions between DNA, RNA and protein biosynthesis, the transcription factor as well as learning how these interactions are regulated.
3. To provide with the core principles of molecular biology.
4. To gain higher level thinking skills that is necessary for scientists.
5. This course should excite about basic science and its applications.

Course Learning Outcomes (CLOs):

After completion of **Molecular Biology** course, learners will be able to:

1. describe nucleic acids with example;

2. explain the historical background and chemistry of nucleic acids;
3. describe the forms of DNA, their structure and examples;
4. describe the steps of DNA replication;
5. explain the types of DNA replication and their molecular mechanisms;
6. explain the role of polymerase enzymes in DNA replication and their types with example and functions;
7. Describe the mechanisms of DNA damage and repair;
8. describe the properties of RNA, their structure and examples;
9. describe types, mechanisms and functions of mRNA, rRNA and tRNA;
10. explain the role of RNA polymerase enzymes in DNA replication and their types with example and functions;
11. explain properties, classical and modern concept of gene;
12. describe the characteristics of genetic code and their evolution;
13. explain central dogma and central dogma reverse;
14. explain the fidelity of transcription and the mechanisms of transcription;
15. describe the main steps of translation and post translational modification;
16. describe the types, characterization of the cancer cells;
17. explain the historical background, concept of oncogene and their types and characterization.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Nucleic acids: definition; explain the historical background and chemistry of nucleic acids.	CLO 1-2	2
DNA: structure and functions; DNA replications; forms of DNA; palindromic DNA; DNA polymerase enzymes.	CLO 3-6	5
DNA damage and repair: mechanisms of DNA damage and repair.	CLO 7	2
RNA: RNA molecules, their structure and functions; RNA polymerase enzymes.	CLO 8-10	4
Gene: properties, classical and modern concept of gene.	CLO 11	3
Genetic code: characteristics of genetic code and their evolution.	CLO 12	3
Protein synthesis: central dogma and central dogma reverse; the fidelity of transcription and the mechanisms of transcription; steps of translation and post translational modification.	CLO 13-15	5
Cancer: types; characterization of the cancer cells.	CLO 16	3
Oncogenes: historical background, concept of oncogene and their types and characterization.	CLO 17	3

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

List of Book References:

Adams, R.L. *et al*. : The biochemistry of nucleic acids
Ahlusalia, K.B. : Genetics
C.B. Power : Cell Biology
Crick, F.H.C. : Nucleic acids
Darke, J.W. : The molecular basis of mutation
Davidson, J.F. : The biochemistry of the nucleic acids
Freifelder, D. : Molecular Biology

Course Title: Zoogeography		
Course Code: BZOOL 3202	**Course Type:** Theory (Core Course, Mandatory)	**Credits:**2
Full Marks: 50	**Total Lecture hours:**30	**Exam Hours:** 3

Course Description:

Zoogeography is a specialized field within biogeography that investigates the spatial and temporal distribution patterns of animal biodiversity.The main goal of the course is to examine the spatial distribution patterns of animals, their origins, and their ecological and evolutionary importance. This course utilizes data and models from several disciplines, such as zoology, ecology, evolutionary biology, paleontology, and geology. It enables learners to analyze the impacts of isolation, elevation, and latitude on animal biodiversity, focusing on spatial patterns. The course will primarily include studying the ecological aspects of zoogeography and the practical use of zoogeography theory in species conservation and biodiversity preservation.

Course Learning Objectives:

1. The Zoogeography course aims to provide students with knowledge related to the models of space-time distribution of animal biodiversity and the ability to critically evaluate the causes and the historical and ecological processes that have determined them.
2. To fortify the knowledge and understanding of the learners about the geographic distribution patterns of animals, their origins, and their significance for ecology and evolution.
3. Students will also acquire awareness of the problems related to managing and conserving wildlife in relation to climate change and human impact.

Course Learning Outcomes (CLOs)

After completion of **Zoogeography** course, learners will be able to -

1. Apply the scientific method in Zoogeography.
2. Demonstrate an understanding of evolution, environmental, and zoogeographic patterns.
3. Describe climatic processes that changed animal distribution.
4. Understand the internal and external factors governing and limiting a species' distribution.
5. Develop an understanding of speciation, dispersal, isolation, and extinction processes as they affect a taxon's distribution.
6. Examine, in detail, ecological zoogeography, including the theory of island

biogeography and the application of the idea to terrestrial islands and conservation.

7. Locate, characterize, and differentiate the major biomes of the planet.
8. Develop an understanding of the influence of Earth history and basic zoogeographic processes on animals.
9. Explore the application of zoogeography to conservation, which in turn prevents extinctions.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of the topic with CLOs	LH
History and Concept of Zoogeography		
History of Zoogeography	CLO 1-5	2
Zoogeographical Definitions	CLO 1-5	2
Concept and Principles of Zoogeography	CLO 1-5	6
Continental drift and Plate tectonics	CLO 5-6	2
Introduction to the Ice Age, Glaciation, Glacier formation, and Types of glaciers	CLO 5-6	
Zoogeographical Regions		
Palearctic Region (Physiography, climate, vegetation, and faunal distribution)	CLO 5-8	2
Nearctic Region (Physiography, climate, vegetation, and faunal distribution)	CLO 5-8	2
Neotropical Region (Physiography, climate, vegetation, and faunal distribution)	CLO 5-8	2
Australian Region (Physiography, climate, vegetation, and faunal distribution)	CLO 5-8	2
Ethiopian Regions (Physiography, climate, vegetation, and faunal distribution)	CLO 5-8	2
Oriental Region (Physiography, climate, vegetation, and faunal distribution)	CLO 5-8	2
Transitional zones (Physical features and faunal distribution)	CLO 5-8	2
Island biogeography (Physical features and faunal distribution)	CLO 5-8	2
Zoogeographical aspects of Bangladesh	CLO 8-9	2

Learning Resources:

1. Philip J. Darlington, Jr. 1957. Zoogeography: The Geographical Distribution of Animals. New York, John Wiley & Sons, Inc. London, Chapman & Hall Limited. pp. 675.
2. Dr. Md. Jalal Uddin Molla, Dr. Md. Ataur Rahman Khan, Prof. S.M. Rafiqul Islam. 2009. Evolution, Palaeontology, Zoogeography, Embryology and Ethology.
3. প্রফেসর কে. এম. আওরঙ্গজেব। ২০১৭। বিবর্তন, প্রত্নজীববিজ্ঞান ও প্রাণিভূগোল। কবিরপাবলিকেশন। ৩৭৬ পাতা।

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Tile: Wild Life, Biodiversity and Conservation Biology		
Course Code: BZOOL 3203	**Course Type:** Theory (Core Course, Mandatory)	**Credits**: 2
Full Marks:50	Total Lecture Hours: 30	Exam Hours: 3

Course Description:

Wildlife course is aimed to focus on wildlife concepts and management activities in Bangladesh, in light of Wildlife (Conservation and security) Act 1973 of Bangladesh amended in 2012; list of important wildlife of world. Finally it will capable the student to apply their knowledge and skill for the development various aspect of the nature.

Biodiversity has been designed to introduce the introduction, Etymology, definition, basic concept, components, types and levels biodiversity, importance of biodiversity, growth forms, life forms, stratification of species, methods of diversity study, indices, and biodiversity calculation and causes of depletion of biodiversity. This course is also aimed to provide information on invertebrate and vertebrate taxonomic division, assessment of biodiversity, inventories, ecosystem services and also threats to biodiversity. Finally, it will capable we to apply our knowledge and skill for biodiversity study, management and conservation of biodiversity.

Conservation biology course has been designed aims to understand the processes that lead from the define their related terms. This course is also aimed to provide information o of conservation biology, ethical aspects of natural resource conservation, scope of conservation biology, ecosystem services of natural resources, approaches of conservation, LEK and TEK. Sundarbans. Finally, it will capable you to apply your knowledge and skill for taxonomical and conservation biology.

Course Learning Objectives:

1. To provide knowledge and skill on wildlife
2. To introduce biodiversity.
3. To understand the level of biodiversity.
4. Able to know the measuring the methods and calculation of biodiversity.
5. To explore risk of biodiversity.
6. To able make suggestion for necessity steps foe save the biodiversity**.**
7. To give the learners a broad introduction to and conservation biology.
8. To fortify the knowledge and understanding of the learners about the conservation biology.
9. To apply knowledge and skill for biomedical research.

Course Learning Outcomes(CLOs):

Upon completion of the Wild Life, Biodiversity, and Conservation Biology course, the students will be able to-

1. Define wildlife, provide scope and status of wildlife in Bangladesh.
2. Describe the present status and role of wildlife and distribution of important wildlife species and their habitat in Bangladesh.
3. Mention the key points provided in Bangladesh "Wildlife Act ".
4. Define and categorize threatened and endangered species in Bangladesh, consulting current IUCN Red Data List.
5. Describe methods for wildlife conservation of nature and natural resources.
6. Describe *in situ* and *ex situ* conservation.
7. To define biodiversity;
8. To define Etymology of biodiversity;
9. Concept of biodiversity;
10. To study levels of biodiversity;
11. To learn importance of biodiversity;
12. To describe growth forms and life forms of biodiversity;
13. To describe stratification of species its indices;
14. Able to study the effect of biodiversity on ecosystem processes;
15. To study the depletion of biodiversity;
16. Study the methods of diversity;
17. Calculation of biodiversity study;
18. To study threats to biodiversity;
19. Define conservation biology and their related term;
20. Explain the ethical aspects of natural resource conservation;
21. Describe the scope of conservation biology;
22. Mention the historical development of conservation biology;
23. Instrumental value of conservation;
24. Explain the anthropocentrism and biocentrism with types;
25. Illustrate the ecosystem services of natural resources;
26. Apply idea on the approaches of conservation;
27. Compare LEK and TEK;
28. Describe the Sundarbans

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Wildlife scope, present status and distribution in	CLO 1-2	2

Bangladesh; brief discussion on world wildlife		
Threatened wildlife species of world and Bangladesh	CLO 4-5	2
Wildlife Act, Amended Act 2012	CLO 3	2
Threatened and endangered species	CLO 4	2
Methods for wildlife conservation of nature and natural resources, describe *in situ* and *ex situ* conservation	CLO 5-6	2
To define biodiversity, To define Etymology of biodiversity, Concept of biodiversity.	CLO 7-8	2
Levels of biodiversity, Importance of biodiversity, growth forms and life forms of biodiversity, stratification of species its indices.	CLO 9-13	2
Effect of biodiversity on ecosystem processes Depletion of biodiversity. Methods of diversity.	CLO 14-16	2
Calculation of biodiversity study.	CLO 17	2
Depletion of biodiversity	CLO 18	2
Conservation Biology		
Introduction: concept, definition, scope, importance, brief Historical development	CLO 19-22	2
Describe conservation values and ethics: Instrumental value (Goods, services , information and psycho spiritual)	CLO23	2
Describe Anthropocentrism and biocentrism with types	CLO 24	2
Describe Ecosystem approaches to conservation: key elements, examples ecosystem management.	CLO 25	2
Approaches of conservation	CLO 26	2
Describe local ecological knowledge (LEK) and Traditional ecological knowledge (TEK)	CLO-27	2
Describe natural resource management conservation	CLO-28	2
Case Study: Bangladesh Sundarbans	CLO-28	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Questions	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Life Cycle & Population Biology		
Course Code: BZOOL 3204	Course Type: Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3
Course Description: **Life cycles & Population**: This course has been designed to introduce you the reproductive biology, life cycles and population biology. It will also provide		

knowledge on larval development followed by different types of metamorphosis and their control. This course is also aimed to provide information on different types of regeneration found in different animal groups. Altogether, you will learn about individual, population, population group properties, population dynamics, different types of regulating processes and how to construct a life table. Finally, it will make capable you to apply your knowledge and skill for identification of organisms' life cycle, indirect development of larva, regeneration processes found in animal kingdom and different parameters on population.

Course Learning Objectives:

1. To provide knowledge on different life cycles and different larval forms of organisms.
2. To provide knowledge on population biology

Course Learning Outcomes (CLOs):

After completion of **Life cycles & Population** course, learners will be able to:

1. Define life cycle
2. Compare the haplontic, diplontic and haplodiplontic biological life cycles with examples
3. Describe the types zygotic and gametic meiosis
4. Define larva and knowing different forms of larvae found in different animal phyla
5. Compare different types of metamorphosis in animal keeping efficiency on insect metamorphosis
6. Interpret what is molting and ecdysis
7. Describe factors (physical & physiological) responsible for regulation of metamorphosis
8. Define regeneration and description of different types of regeneration found in animals
9. Define population, deme, mono and polyspecific populations
10. Explain basic characteristics of population keeping role in increase or decline density
11. Define and compare different types of group properties of population
12. Explain different types of density
13. Define immigration, emigration and migration in a population
14. Compare different types population dispersion
15. Define mortality with its different forms
16. Explain survivorship curves
17. Define biotic potential and its effect on population
18. Define and compare J-shaped and S-shaped growth forms in population
19. Describe different age structures and age pyramids
20. Interpret natality with its different types, fecundity and fertility
21. Describe different types of life table and how to construct a life table.
22. Explain biotic and abiotic factors
23. Define population dynamics, gain and loss which can cause a great change in population
24. Explain different equations stating population status
25. Define population regulation, carrying capacity and types of factors regulate population size
26. Define population ecology and different views on population regulation
27. Describe the theories on population regulation

Course contents, subject to the lecture and alignment of topic with CLOs:		
Course contents	**Alignment of topic with CLOs**	**LH**
Life cycles		
Biological life cycle	CLO 1-3	2
Larval development	CLO-4	2
Metamorphosis	CLO 5-7	2
Regeneration	CLO-8	2
Population biology		
Population	CLO 9-11	2
Population density	CLO 12-14	2
Population mortality and biotic potential	CLO 15-17	2
Growth forms	CLO-18	2
Age structure	CLO 19-20	2
Life table	CLO-21	2
Abiotic and biotic factors	CLO-22	2
Population dynamics	CLO 23-24	4
Population regulation	CLO 25-27	4

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Written	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Learning Resources:

Barnes, R.S.K. et.al., 2001. The Invertebrates: A Synthesis 3rd Edition**.**

ELendell Cockrum, William J. McCauley (1965). Zoology.

Eugene.P. Odum, Gary W. Barrett. (5th Edn.) (2005). Fundamentals of Ecology.

J.L. Chapman, M.J. Reiss (1992). Ecology. Principles and Applications.

P.S. Verma, V.K. Agarwal (1974). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology.

Course: BZOOL 3205
Field study/Excursion
Full Marks 25 (0.25 unit, 1 credits)

Preparation and submission of a report on the animals of any one bioecological/agroecological zones of Bangladesh other than that studied earlier; acquaintance with zoogeography/biological realms of Bangladesh. Distribution of marks: Field report/ Excursion= 12.50; Presentation/ *viva-voce*= 5; Assessment= 5 and Attendance= 2.50.

Course: BZOOL 3206
Viva-voce
Full marks: 50 (0.5 unit, 2 credits)

Viva-voce on theoretical courses of third year first and second semester

Course Title: Zoology Practical I		
Course Code: BZOOL 3207	**Course Type:** Practical (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 6 (6 hours daily)
Course Learning Objectives To provide practical experience on the topics covered by theoretical courses so that the learner can apply their knowledge in lab, workplace and in practical life.		
Course Learning Outcomes (CLOs) After completion of this course, learners will be able to: 1. Extract, characterize and identify the protein and amino acids by using different technique 2. Explain and demonstrate zoogeographical realms, distribution of endemic and insular fauna of the world, and distribution of endemic fauna of Bangladesh 3. Identify the footprint of wild animals 4. estimation of biodiversity from a variety of habitats, 5. Prepare questionnaires and manuscript regarding the biodiversity. 6. Display the procedure of mapping biodiversity. 7. Prepare a report on current issues regarding environmental and population		

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy		
Contents	**Alignment of topic with CLOs**	**LH**
Molecular Biology: Identify amino acids by using paper chromatographic technique; Extraction and characterization of protein by using PAGE.	CLO 1	10
Zoogeography: Demonstration and dynamics of zoogeographical realms; Identification and distribution of endemic and insular fauna of the world; Distribution of endemic fauna of Bangladesh	CLO 2	7
Wildlife, Biodiversity and Conservation Biology: Identification of footprint of wild animals. Estimation of different biodiversity, manuscript preparation for new species; Mapping biodiversity, Shannon-Wiener and Simpson diversity calculations. Preparation of questionnaires for collecting local peoples' knowledge on various issues of conservation.	CLO 3-6	6
Life Cycle & Population Biology: Estimation of the number of individuals in a population	CLO 7	7

Teaching-learning Strategy	Assessment Strategy		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hrs daily on the tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Course Title: Zoology Practical II		
Course Code: BZOOL 3208	**Course Type:** Practical (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 6 (6 hours daily)

Course Learning Objectives

To provide practical experience on the topics covered by theoretical courses so that the learner can apply their knowledge in lab, workplace and in practical life.

Course Learning Outcomes (CLOs)

After completion of this course, learners will be able to:

1. Find out the significance of incidence of a disease between two groups of students/people of a specific area.
2. Find out the relationship between age of specific group of people and incidence of a disease.
3. Find out the relationship between age and weight in response to obesity
4. Collect and identify the parasites of different animal.
5. Identify the parasitic diseases of animals on the basis of symptoms.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Contents	Alignment of topic with CLOs	LH
Health Biology and Epidemiology: The significance of incidence of a disease between two groups of students/people of a specific area. The relationship between age of specific group of people and incidence of a disease. The relationship between age and weight in response to obesity	CLO 1-3	10
Biology and Physiology of Parasites: Collection and identification of parasites of different animal.	CLO 4	10
Parasitic diseases of Animals: Symptoms and identification of parasitic diseases of animal	CLO 5	10

Teaching-learning Strategy	Assessment Strategy		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hrs daily on the tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Course Title: Health Biology and Epidemiology		
Course Code: BZOOL 3209	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description

Health Biology and Epidemiology Course is designed to introduce the first aid kits for human health. It will help the students to concern about the smoking hazards on human health including lung diseases and cancer. This course introduces the artificial kidney and familiarize with human neurological disorders; drugs and their effects on human health. This course will also help to enrich the knowledge of epidemiology and epidemiological diseases and apply the knowledge and skills in managing and planning health and environmental systems.

Course Learning Objectives:

1. To give the learners a broad introduction to healthbiology
2. To fortify the knowledge and understanding of the learners about epidemiology

Course Learning Outcomes (CLOs)

After completion of **Health Biology and Epidemiology** course, learners will be able to:

1. Discuss the human health hazards;
2. Write the respiratory disorder and smoking hazards on human health;
3. Identify the important health problems including Lung, Kidney and Heart problems;
4. Describe the important neurological disorders of human;
5. Describe different drugs and their effects on human health;
6. Describe the First Aid Kits and its application;
7. Write the diagnostic procedures of health problems and tools used;
8. Describe circumstances under which disease occurs or health prevails in human populations;
9. Identify environmental health issues in local communities, society at large and in the world;
10. Apply experimental procedures to solve epidemiological problems.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy		
Course contents	**Alignment of the topic with CLOs**	**LH**
Health Biology		
Health hazards.	CLO 1	2
Smoking and respiratory system.	CLO 2	2
Respiratory disorders: bronchitis, emphysema and lung cancer.	CLO 2	3
Circulatory and blood disorders; Haemodialysis (the artificial kidney) thalassemia and leukemia.	CLO 3	3
Effects of drugs on nervous system and sense organs.	CLO 4-5	2
Selected disorders of nervous system.	CLO 5	6
First-aid kit and its applications.	CLO 6	2
Epidemiology		
Introduction, definition, objectives, development of epidemiology, elements influencing epidemiological diseases, Environment: physical, biological and socio-cultural.	CLO 7	2
Methods in epidemiology; Investigation of epidemics: field investigation, verification of disease by clinical and laboratory tests.	CLO 8	2
Data analysis, calculation of rates, surveys and screening.	CLO 9	2
Agents of diseases, reservoir of infection, host factors; Principles of control measures.	CLO 10	2
Epidemiological diseases: diarrhoea, hepatitis B, AIDS, Dengue fever, leishmaniasis, amoebiasis, elephantiasis and SARS.	CLO-10	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Ecology & Physiology of Parasites		
Course Code: BZOOL 3210	**Course Type:** Theory (Core Course, Mandatory)	**Credits:**2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description

Ecology and Physiology of Parasites course has been designed to introduce the student to the ecology and physiologyof animal parasites. It will also provide knowledge on parasites, host-parasite interaction, parasites transmission, infection, infestation, and their biochemistry and immunology. Finally, it will enable them to apply their knowledge and skill for diagnosis and prevention of parasitic diseases, planning for the effective control of parasites.

Course Learning Objectives:

1. To give the learners a broad introduction to ecology of parasites,
2. To provide knowledge on biochemistry and immunology of animal parasites,

Course Learning Outcomes (CLOs)

After completion of theBiology and Physiology of Parasitescourse, learners will be able to:

1. Define parasite and host with example;
2. Compare the parasite, parasitoid, commensal, mutualistic organism and predator;
3. Describe the types of parasites and host with their characteristics and example;
4. Explain how a host act as an environment of a parasite;
5. Mention the types of host specificity;
6. Interpret the role of ecological, ethological and physiological factors on host specificity of parasites;
7. Describe types, mechanisms and routs of transmission of parasites;
8. Define infestation, hyperinfestation, pathogenesis and diseases;
9. Classify parasites depending on oxygen requirements;
10. Explain underlying mechanism of differential Oxygen sensitivity to growth and survival of parasites;
11. Define and compare different terms related to metabolism of carbohydrates, proteins and lipids;
12. Compare the aerobic and anaerobic respiration;
13. Explain as well as to illustrate flowchart of following catabolic pathways and chemical reaction: Glycolysis, Krebs cycle, Electron transport chain, Beta-Oxidation, Glycerol catabolism, Transamination and Oxidative deamination;
14. Interpret and locate nucleic acid distribution in cells;
15. Explain the types and basic mechanism of disturbances in hosts nucleic acid metabolism by parasites with example;
16. Define molting and osmoregulation as well as to compare their types;
17. Explain basic physiology of host-parasite relationships;
18. Compare vitamin types and their roles in host-parasite relationships;
19. Define and compare following terms: immunity, immunology, immune system, innate immunity, adaptive or acquired immunity, active immunity, passive immunity, cellular immunity and humeral immunity;
20. Describe basic components of immune system of parasite;
21. Interpret the different active and passive defense mechanisms mounted by parasites to evade hosts' immune system.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy		
Course contents	**Alignment of topic with CLOs**	**LH**
Ecology of parasites		
Range and characteristics of parasitic forms.	CLO 1-3	2
Host as an environment for parasites.	CLO 4	2
Host specificity.	CLO 5-6	2
Transmission, hyper-infestation and diseases.	CLO 7-8	2
Biochemistry and immunology of animal parasites		
Oxygen requirements.	CLO 9-10	2
Metabolism of carbohydrates, proteins and lipids.	CLO 11-13	6
Nucleic acid distribution.	CLO 14	2
Types and disturbances in hosts nucleic acid metabolism by parasites.	CLO 15	2
Osmoregulation and molting.	CLO 16	2
Physiology of host-parasite relationships.	CLO 17	2
Vitamin types and their roles in host-parasite relationships.	CLO 18	2
Basic concepts of immunology.	CLO 19	2
Defense mechanisms mounted by parasites to evade hosts' immune system.	CLO 20-21	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Final Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Parasitic Diseases of Animals		
Course Code: BZOOL 3211	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3
Course Description Parasitology course will also provide knowledge on causes of parasitic infections and their sign and symptom, control and treatment. This course is also aimed to provide information on different aspects of Zoonotic diseases. Altogether, students will learn about animal parasites, the factors and mechanisms involved in		

interaction host-parasite interaction, and about different parasitic diseases in fish, livestock, and human. Finally, it will capable them to apply their knowledge and skill for the diagnosis of parasitic diseases, planning for the effective control of parasites and basic treatment of parasitic diseases.

Course Learning Objectives:

1. To fortify the knowledge and understanding of the learners about fish, livestock and human parasitic diseases, zoonotic diseases and their control.

Course Learning Outcomes (CLOs)

After completion of Parasitic Diseases of Animalscourse, learners would be able to:

1. Classify parasitic disease of fish;
2. Explain the causative agent as well as its morphological feature life cycle, mode of infestation, treatment of *Ichthyophthiriasis*, *Dactylogyrosis*, *Argulosis* and *Dibothriocephalopsis;*
3. Define livestock and its example;
4. Mention the causative agent, morphological feature, host, lifecycle, mode of infestation, controlling measures of *Emeriasis*, *Babeasis*, *Coccidiasis*, *Taeniarhynchosis* and *Capillariasis;*
5. Explain type of human disease;
6. Mention the causative agent, historical background of the diseases, habitat of the treatment of Trichomoniasis, Giardiasis, Leishmaniasis, Schistosomiasis, Clonorchiasis and Filariasis;
7. Describe zoonotic diseases, mode of its transmission, who are at the risk of transmission and how its control;
8. Define pathogen, parasite, host, carrier, pathogenic nonpathogenic parasite to man;
9. Describe viral zoonotic diseases of man e.g. Rabies, Chikungunia, etc.;
10. Describe bacterial zoonotic diseases of man e.g. Anthrax, Plague etc.;
11. Describe fungal zoonotic diseases of man e.g. Dermatophytosis, Coccidioidomycosis etc.
12. Explain Arthropodan diseases of man eg. Scabies, Acariasis etc.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Fish, livestock and human parasitic diseases		
Fish diseases.	CLO 1-2	2
Fish parasitic diseases.	CLO 2	4
Livestock parasitic diseases.	CLO 3	2
Babesiasis and Coccidiasis.	CLO 4	2
Taeniarhychus and Capillariasis.	CLO 4	2
Human parasitic diseases.	CLO 5-6	2
Zoonotic diseases and their control		
Zoonotic diseases and their control.	CLO 7	2
Bacterial zoonotic diseases.	CLO 10	2
Viral zoonotic diseases.	CLO 9	2

Fungal zoonotic diseases.	CLO 11	2
Protozoan zoonotic diseases.	CLO 6-7	2
Nematodes zoonotic diseases.	CLO 4, 7	2
Helminthic zoonotic diseases.	CLO 7	2
Arthropodan Zoonotic diseases.	CLO 12	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

References:

1. Integrated principles of Zoology. Clevland P.Hickman,Jr.Larry S.Roberts,Allen Larson,Helen I' Anson,Twelfth Edition, June 2003
2. Fish parasitology, Dr.Kirtunia Juran Chandra, October 2004
3. Parasitology by K.D.Chatterjee,Twelfth edition 1940.
4. পরজীবীবিদ্যা, ড.মো.জসিবর রহমান,২০১১
5. বাংলাদেশের জুনোটিক রোগ ও মেরুদনডীপ্রাণী, শিরিনআক্তার

Curriculum
For
Fourth Year
First Semester

B. Sc. (Honours) Fourth Year First Semester Examination, 2027

Course codes	Course titles	Units	Marks	Credits
Major courses				
BZOOL 4101	Pest Biology & Control	0.5	50	2
BZOOL 4102	Aquaculture & Fisheries Management	0.5	50	2
BZOOL 4103	Animals for Farming, Industry & Trade	0.5	50	2
BZOOL 4104	Apiculture, Vermiculture & Medical Entomology	0.5	50	2
BZOOL 4105	Lac Culture & Sericulture	0.5	50	2
BZOOL 4106	Field Study/ Excursion	0.25	25	1
BZOOL 4107	Zoology Practical I	0.5	50	2
BZOOL 4108	Zoology Practical II	0.5	50	2
GEd courses				
BZOOL 4109	Research Methodology	0.5	50	2
BZOOL 4110	Biosafety, Biosecurity & Bioethics	0.5	50	2
BZOOL 4111	Microbiology	0.5	50	2
	Total	**5.25**	**525**	**21**

B.Sc. (Honours) Fourth Year First Semester Examination, 2027

Course Title: Pest Biology & Control		
Course Code: BZOOL 4101	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours: 03**

Course Description

Pest Biology and control: Pest biology course has been designed to introduce students with the pest, their biology, nature of damage, sign and symptom, and their control. It will also provide knowledge on economic crops and causes of their losses. This course is also aimed to provide information on different aspect of insect pests of stored products and their control. Altogether, students will learn about the nematode pests of economic crops such as rice, cereal, banana, potato, sugarcane, vegetables. Finally, it will capable the students to apply their knowledge and skill for control the pests through physical, cultural, chemical and biological management.

Course Learning Objectives:

1. To introduce the students with the different aspects of Pest biology, Nematology and their control.
2. To strengthen knowledge, skills and experience of learners for different approaches of pest control.

Course Learning Outcomes (CLOs)

After completion of **Pest Biology and Control** course, learners will be able to:

1. Define pest and host with example;
2. Recite the pests' scientific name, common name, order name, family name of specific crop;
3. Describe the types of pests and host with their characteristics and example on different crop;
4. Classify pest depending on order, family, genus and sp;

5. Explain when a pest attack as an environment or seasonal pest on crop;
6. Mention the total life cycle of pest;
7. Interpret the role of ecological and physiological factors on host specificity of pest;
8. Describe biology, nature of damage of insect pest of economic crops;
9. Define management, damage, treatment of stored products pest and their control;
10. Explain damage, symptom, treatment underlying mechanism of differential growth and survival of pest;
11. Describe historical background of plant parasitic namatodes with their characterstics;.
12. Mention the types of nematodes depending on their feeding strategy;
13. Describe nematode pests of crops and plants;
14. Describe the biology, distribution economic importance and control of root-knot nematode (*Meloidogyne*), cyst nematode (*Heterodera*), gall forming nematode(*Ditylenchus*);
15. Define physical, cultural, chemical and biological control of plant parasite nematodes;
16. Explain different types control measure of pest control;
17. Compare the nematode pests of crop rice, cereal, banana, potato, sugercane vegetables and fruits.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Pest biology		
Biology of specific crop pests (Paddy, jute, Sugarcane, Tea).	CLO 1-4	8
Vegetable pests (Potato, Brinjal).	CLO-5	4
Biology and nature of damage of Fruit pest (Mango, citrus).	CLO 5-7	4
Stored product pest and their control (coleopteran, lepidopteron).	CLO 8-9,10	4
Plant Parasite Nematode		
Historical background and General structure of PPN.	CLO 11-12	2
Brief descriptions of nematode pest of crop and plants.	CLO-12	2
Biology, distribution, economic importance and control of root-knot nematode, cyst nematode, gall forming nematode.	CLO 13-14	4
Control of plant parasitic nematodes: (Physical, cultural, chemical, biological).	CLO15- 17	2

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Questions	35
	Continuous Assessment	Attendance	05
		Tutorial	10

Course title: Aquaculture & Fisheries Management		
Course Code: BZOOL 4102	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 03

Course Description

Management of different types of water body like lakes, reservoirs, rivers and other waterbody. It will also provide knowledge about river and different fisheries item of river. This course is also aimed to provide information about fishing regulation. You will learn about different types of fish hatcheries and their management. Also, you will learn about different types of bacterial, viral, fungal diseases of fishes and their control Aquaculture topics has been designed to provide knowledge about different types of aquacultures, construction of fish farm, culture techniques for carp and cat fishes; different types of aquatic weeds and their control. The scope and approach of aquaculture can also be achieved.

Course Learning Objectives:

1. To introduce the students to fisheries management and aquaculture.
2. To fortify skills and experience of learners on fisheries management and aquaculture

Course Learning Outcomes (CLOs)

After completion of A**quaculture and Fisheries Management**course, learners will be able to:

1. Define different types of aquacultures;
2. Explain the scope and approach of aquaculture;
3. Explain how to construction of a fish farm;
4. Explain fish culture technique;
5. Identify aquatic weeds and explain how to control aquatic weeds;
6. Define induce breeding;
7. Explain induce breeding techniques for carp and cat fishes;
8. Explain the management measure of lake, reservoir and other water body;
9. Define riverine fisheries;
10. Explain the fishing regulation;
11. Explain different types of fish hatcheries and their management;
12. Explain fish parasite and parasitic diseases of fish and their control measure;
13. Explain bacterial, fungal, viral diseases of fish and their control.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Aquaculture		
Definition, scope and approach; Types of aquacultures.	CLO 1-2	2
construction of Fish Farm.	CLO 3	2
Selection of sites for fish culture.	CLO 4	2
Culture techniques of carps and catfishes.	CLO 4	4
Weed control.	CLO 5	2
Induced breeding techniques for carps and catfishes.	CLO 6-7	2

Fisheries Management		
Management measures and approaches.	CLO 8	2
Management of lakes and reservoirs; River fisheries.	CLO9	2
Fishing regulations.	CLO10	2
Hatcheries and their management.	CLO 11	4
Fish parasites.	CLO12	2
diseases and their control	CLO13	4

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	05
		Tutorial	10

Course Title: Animals for Farming, Industry & Trade		
Course Code: BZOOL 4103	**Course Type:** Theory (Core Course, Mandatory)	**Credits:**2
Full Marks: 50	**Total Lecture hours:**30	**Exam Hours:** 3

Course Description

The course Animals for Farming, Industry and Trade has been designed to introduce the students with the animal for farming and industry, animal husbandry, pet and ornamental animals. It will also provide knowledge on variety of fowl and duck and different system of poultry farming with their diseases and control. This course is also aimed to provide information on different aspect of farming of domesticated animals (cattle and goat) with their diseases and control. Altogether, students will learn about the pet and ornamental animals. Finally, it will capable them to understand about the present status ofdifferent types of pet and ornamental animals.

Course Learning Objectives:

1. To introduce the students with the animal for Farming, Industry and Trade

Course Learning Outcomes (CLOs)

After completion of **Animals for Farming, Industry and Trade** course, learners will be able to:

1. Describe the economic importance of poultry farming;
2. Compare the varieties/ breeds of fowl;
3. Compare the varieties/ breeds of duck;
4. Discuss the management of the hatching and brooding system in poultry farming;
5. Illustrate the different systems of poultry farming;
6. Differentiate between the broiler and layer poultry;
7. Describe different poultry farming systems of broiler and layer with advantages and disadvantages;
8. Interpret the diseases of poultry and their control;
9. Mention the varieties/ breeds of duck;
10. Explain the duck farming in Bangladesh;
11. Explain the economic importance of farm animals with examples;
12. Explain the farming of domesticated animals especially cattle;

13. Compare the various types of breeds of cattle;
14. Discuss the farming system of cattle/ cows;
15. Interpret the diseases of cattle/ cows with their control;
16. Discuss the management of goat farming;
17. Compare the pet and ornamental animals;
18. Deliberate some pet animals;
19. Recognize the ornamental animals of some groups.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy		
Course contents	**Alignment of topic with CLOs**	**LH**
Poultry		
Economic importance of poultry farming.	CLO 1	2
Varieties/ breeds of fowl.	CLO 2	2
System of poultry farming: hatching and brooding.	CLO 4	2
System of poultry farming: broiler and layer farming.	CLO 5-7	2
Diseases of poultry and their control.	CLO 8	2
Varieties/ breeds of duck.	CLO 9	2
Duck farming in Bangladesh.	CLO 10	2
Animal husbandry		
Economic importance of farm animals.	CLO11	2
Farming of domesticated animals: breed of cattle (cows); the farming system of cattle.	CLO13-14	4
Common cattle diseases and their control.	CLO15	2
Goatary: importance, goat breeds; basics of goat farming.	CLO16	2
Pet and ornamental animals		
Pet animals.	CLO 17-18	4
Ornamental animals.	CLO 19	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	05
		Tutorial	10

Course Title: Apiculture, Vermiculture & Medical Entomology		
Course Code: BZOOL 4104	**Course Type:** Theory (Core Course, Mandatory)	**Credits:**2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 03
Course Description **Apiculture; Vermiculture; Medical Entomology**: The overall objective of the course Apiculture is for the learner to understand the basic science of the honey		

bee and its environment and transform this knowledge in beekeeping practices with improved performance.

The course vermiculture has been designed to introduce students with some useful local and exotic species of earthworms suitable for vermiculture, their biology and limiting factors. It will also provide knowledge on the role of vermiculture on soil structure maintenance, humus recycling and biotransformation of residues produced by human activities. This course is also aimed to provide information on vermicompost technology at both small scale and commercial scale. Finally, it will enable the students to apply their knowledge and skill to get employment opportunities.

Medical entomology course is aimed to provide information on different aspects of Medical entomology with special reference to Myiasis, Yellow fever and African sleeping sickness.

Course Learning Objectives:

1. To introduce the students to basic concepts and techniques of apiculture, vermiculture and medical entomology.
2. To strengthen skill and experience of learners on apiculture, vermiculture and medical entomology.

Course Learning Outcomes (CLOs)

After completion of **Apiculture, Vermiculture & Medical entomology** course, the learners will be able to:

1. Define Apiculture and Beekeeping with example;
2. Describe the history of beekeeping;
3. Assess the economic importance of bees;
4. Describe the systems of beekeeping;
5. Assess the role of pollination in ecosystem;
6. Identify the races of economic importance;
7. Distinguish African bee races;
8. Relate species diversity of bee with honey production;
9. Recognize distinctive morphological features of bees;
10. Distinguish between sexual and parthenogenetically reproduction of bees;
11. Explain sociality in organisms;
12. Trace caste development in bees;
13. Indicate age polytheism or temporal division of labour in bees;
14. Describe physical and pheromonal communication in honey bees;
15. Interpret bee dancing;
16. Prepare bee floral calendar of a locality;
17. Demonstrate various bee keeping tools;
18. Describe handling and maintenance of bee keeping equipment;
19. Describe traditional and improved hives;
20. Select Apiary site;
21. Familiarize with the process of sighting and baiting swarms;
22. Manage routine apiary activities;
23. Distinguish between flow and lean season management strategies;
24. Identify bee pests, diseases and predators with prevention and control measures;
25. Identify honey, beeswax, propolis, ambrosia, slum gum and apitoxin;
26. Determine honey quality parameters;

27. Control the quality of bee products;
28. Identify prospective local and foreign markets;
29. Explore opportunities and address challenges towards sustainable bee keeping throughout Bangladesh.
30. Define vermiculture.
31. Trace the history of vermiculture.
32. Explain the life cycles of some useful local and exotic species of earthworms along with their limiting factors.
33. Explain the role of worms in four r's of recycling: reduce, reuse, recycle and restore.
34. Develop technology for vermiculture, vermicomposting, vermiwash and vermifeed industries as a part of sustainable development concerning waste management, resource recovery and environmental conservation.
35. Describe the preparation of vermibeds, harvesting, packaging, transport and storage of vermicompost
36. Explain the role of insects in human health;
37. Identify the transmission cycles of some important vector- borne disease;
38. Identify specific medically important insects and explain their morphology, biology, ecology, behaviour, epidemiology, diagnosis, prevention, control measures and treatment strategies;
39. Describe arthropod morphology, physiology and systematics;
40. Explain epidemiological fundamentals;
41. Interpret arthropod transmission of pathogens.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Apiculture		
Scope (Notes on Pollination)	CLO 1-5	2
Species diversity in relation to honey production	CLO 6-9	2
Life cycle of honey bee	CLO10-13	2
Communication in bees	CLO14-15	2
Bee keeping equipment	CLO 16-19	2
Apiary management	CLO 20-24	2
Bee/Hive products/ Byproducts	CLO 25-27	2
Marketing of bee and bee products	CLO 28-29	1
Vermiculture		
Introduction, history and economic importance of vermiculture	CLO 31-33	2
Life cycle of earthworms	CLO-32	1
Limiting factors for earthworms	CLO-32	1
Useful local and exotic earthworm species	CLO-32	1
Enemies and diseases of earthworms	CLO-32	2
Vermicompost technology	CLO-32	1
Medical Entomology	CLO 34-35	2
Biology and nature of damage of insect vectors and carriers of human disease such as yellow fever, sleeping sickness and myiasis along with their control measures.	CLO 36-41	5

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Questions	35
	Continuous Assessment	Attendance	05
		Tutorial	10

Course Title: Lac culture & Sericulture		
Course Code: BZOOL 4105	**Course Type:** Theory (Core Course, Mandatory)	**Credits:**2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 03

Course Description

Lac culture and Sericulture course has been designed to introduce the students with the systematic position, geographical distribution, host plants, life cycle of different varieties and their salient features, techniques of rearing. It will also provide knowledge on diseases, parasites, predators and pests, their singe and symptoms, control and treatment. This course is also aimed to provide information on different aspect of economic of lac culture and significance of sericulture under the socio-economic condition of Bangladesh. Altogether students will learn about how to produces various type of lac and silk product and their uses. Finally, it will capable the students to apply their knowledge and skill for generate employment opportunity in the rural area, lac and silk industry and its related fields.

Course Learning Objectives:

1. To introduce the students to basic concepts and techniques of lac culture, sericulture.
2. To strengthen skill and experience of learners on lac culture, sericulture.

Course Learning Outcomes (CLOs)

After completion of **Lac culture and Sericulture** course, learners will be able to:

1. Define lac culture;
2. Classify lac insect and their host plants;
3. Explains the life cycle of lac insect and their diseases, parasites, predators, pests and their control and management;
4. Compare the techniques of lac insect rearing;
5. Describe basic differences of egg, larva, pupa and adult moth of lac insect;
6. Describe basic components of lac insect rearing;
7. Define sericulture;
8. Classify silkworm and their host plants;
9. Explains the life cycle of silkworm, their diseases, parasites, predators, pests and their control and management;
10. Compare the techniques of silkworm rearing;
11. Describe basic differences of egg, larva, pupa and adult moth of silkworm;
12. Describe basic components of silkworm rearing.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy		
Course contents	**Alignment of topic with CLOs**	**LH**
Lac culture		
Economic importance of lac culture; Systematic position and geographical distribution of lac insect, Life-cycle of lac, Crop schedule of lac insect, External morphology of lac insect.	CLO 1-6	2
Host plants of lac insect, Lac culture in Bangladesh.	CLO 1-6	2
Lac crops, Processing of lac.	CLO 1-6	2
Enemies of lac and their control.	CLO 1-6	4
Sericulture		
Significance of sericulture under the socio-economic conditions of Bangladesh.	CLO 7-12	2
Systematic position of mulberry and non-mulberry silkworms in the Animal Kingdom with salient features, External morphology of silkworm larva, pupa and moth.	CLO 7-12	2
Different varieties of silkworms and their host plants, Structure of silk glands and their secretions.	CLO 7-12	2
Life cycle of mulberry silkworm, Distinguish between mulberry and non-mulberry silkworm. Comparative account of the life cycle of eri, muga and tasar silkworm.	CLO 7-12	8
Silkworm diseases and pests and their management practices	CLO 7-12	6

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	05
		Tutorial	10

Course: BZOOL 4106
Field study/Excursion
Full Marks 25 (0.25 unit)

Preparation and submission of reports on industry, farm, nursery and local study tours. Distribution of marks: Field report/Excursion =12.5; Presentation/*viva-voce*=5; Assessment=5; Attendance=2.5.

Course Title: Zoology Practical I		
Course Code: BZOOL 4107	**Course Type:** Practical (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture periods:** 30	**Exam Hours: 6** (6 hours daily)

Course Learning Objectives

To provide practical experience on the topics covered by theoretical courses so that the learner can apply their knowledge in lab, workplace and in practical life.

1. Write bibliographies by searching literature on specified field.
2. Make an experimental design on crop field on assigned field of experiment.
3. Collect data from the assigned field and comment on your observation.
4. Make a research proposal on assigned field.
5. Prepare a presentation oral/poster on assigned field.
6. Make an outline of a research article on selected field.
7. The practices, equipment and facilities for the safe and secure handling of dangerous pathogens in a laboratory setting
8. Identification and characterization of pests of different crops.
9. Identification and characterization of nematode pests of crops
10. Study of parasites of fishes.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Contents	Alignment of topic with CLOs	LH
Research Methodology: Write bibliographies by searching literature on specified field. Make an experimental design on crop field on assigned field of experiment. Collect data from the assigned field and comment on your observation. Make a research proposal on assigned field. Prepare a presentation oral / poster on assigned field. Make an outline of a research article on selected field.	CLO 1-6	16
Biosafety, Bio-security and Bio-ethics Handling and use of different personal protective equipment (PPE); Handling and use of biosafety cabinet and fume hood; Safety, precaution and ethical considerations in animal house, rearing house and insect culture cabinets.	CLO 7	5
Biology and control of pests: Identification and characterization of pests of different crops. Identification and characterization of nematode pests of crops	CLO 8-9	5
Aquaculture and Fisheries: Study of parasites of fishes.	CLO 10	4

Teaching-learning Strategy	Assessment Strategy		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hrs daily on the tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Course Title: Zoology Practical		
Course Code: BZOOL 4108	**Course Type:** Practical (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 6 (6 hours daily)

Course Learning Objectives

To provide practical experience on the topics covered by theoretical courses so that the learner can apply their knowledge in lab, workplace and in practical life.

1. Identify and characterize the breeds of animals and mention their origin.
2. Identification of different races, strains and varieties of economically important animals.
3. Identification and characterization of specimens from cattle and poultry feed/ food products/ bi-products/ medicines and to mention their uses/ economic importance.
4. Describe and demonstrate following techniques; (a) Cage fish culture; (b) Poultry farming; and (c) Dairy farming.
5. Isolation of bacteria and its gram staining tests.
6. Isolate the bacteria from the supplied discrete colony by streaking method.
7. Perform a sensitivity test of the supplied antibiotic discs and make a comment on it.
8. Describe and demonstrate the following zoo techniques: (a) Lac culture; and (b) Sericulture.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Contents	Alignment of topic with CLOs	LH
Animals for farming, industry and trade: Identification of different races, strains and varieties of economically important animals. Identification and characterization of specimens from cattle and poultry feed/ food products/ bi-products/ medicines and to mention their uses/ economic importance. Describe and demonstrate following techniques; (a) Poultry farming; and (b) Dairy farming.	CLO 10-13	15
Microbiology: Isolation of bacteria and its gram staining	CLO 14-16	10

tests; Isolate the bacteria from the supplied discrete colony by streaking method; Determination of the bacterial growth kinetics; Perform a sensitivity test of the supplied antibiotic discs and make a comment on it.		
Lac culture and Sericulture: Describe and demonstrate the following zoo techniques: (a) Lac culture; and (b) Sericulture.	CLO 17	5

Teaching-learning Strategy	**Assessment Strategy**		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6 hrs daily on the tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Course Title: Research Methodology		
Course Code: BZOOL 4109	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 03

Course Description

The course Research Methodology has been designed to prepare a data sheet from any experiments, calculations, and prepare a power point to presentation research findings in a scientific community. It will also provide knowledge on experiments set up and its methodology. It is aimed to teach learners to provide accurate ideas for written a complete research proposal. Finally, the course will help the learners to make them competent for a scientific research, assistant particularly on data arrangements, calculations and to write a scientific paper for a scientific journal. The students will earn the skill to be an expert for power point preparatory, thesis writing and compilation of research output data.

Course Learning Objectives:

1. To design the research method.
2. To strengthen knowledge and experience on types of proposal, experimental designing, writing, presentation and other aspects of research.

Course Learning Outcomes (CLOs)

After completion **Research methodology** course, the learners will be able to:

1. Define Hypothesis;
2. Describe different types of hypothesis;
3. Describe theory, law and fact, different error types and level of significance;
4. Describe basic principle of experimental design;
5. Define experiment;
6. Formulate design in biological science;
7. Describe the criteria of a good research methodology;

8. Explain the types of research methodology;
9. Evaluate the problems of research to solve the problems;
10. Interpret the problems and bottlenecks faced by researchers of Bangladesh;
11. Use a proper method of scientific citation procedure;
12. Apply the procedures to find research problems;
13. Use the processes to solve the problems or errors in methodology;
14. Write a research proposal;
15. Write a scientific article for a journal;
16. Write a report or a thesis paper;
17. Evaluate good report writing;
18. Explain the types of presentation;
19. Demonstrate good oral presentation;
20. Illustrate research findings in poster presentation;
21. Communicate other researcher for research needs.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Research methodology		
Hypothesis: Significance of hypothesis in research: Characters of a good hypothesis; Differences between hypothesis, theory, law and fact; Null hypothesis and alternative hypothesis; Types of errors: Type I and Type II Errors; Levels of significance; Controls in scientific experiments.	CLO 1-3	**8**
Experimental design: Criteria for a good research design; Basic principles of experimental design; Formulation of experimental design in biological sciences.	CLO 4-6	**4**
Research methodology: Introduction to research; Objectives, types and processes of research; Criteria for good research; Problems and bottlenecks faced by researchers of Bangladesh; Methods of scientific citations.	CLO 7-10	**6**
Research topic: What is a research problem; How to find a research problem; Selection of a research topic.	CLO-11-13	**4**
Preparation of research project (RP) proposals: Preparation of RP proposals; Scientific writings; Scientific papers; Preparation of scientific reports or papers for publication and preparation of a thesis.	CLO 14-17	**4**
Presentation: Principles and methods of oral and poster presentations of scientific findings; personal communication.	CLO 18-21	**4**

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Questions	35
	Continuous Assessment	Attendance	05
		Tutorial	10

Course Title: Biosafety, Biosecurity & Bioethics		
Course Code: BZOOL 4110	**Course Type:** Theory (Core Course, Mandatory)	**Credits:**2
Full Marks: 50	**Total Lecture hours:**30	**Exam Hours:** 3

Course Description:

Biosafety and Biosecurity covers all aspects of modern biological issues in the frame of ethics. This course deals with do's and don'ts of biology/life sciences in clinical and/or laboratory setting as well as wider communities, about handling biological issues and making rational decisions. Biosafety is now one of the concerns of current era for the lab biologists and all health-related professionals. Similarly, biosecurity is one of another major challenge which will be discussed here very efficiently and in a productive manner.

Bioethics inspects the ethical considerations and implications of biomedical and biological science research and technology. As it is a biology course (not a philosophy one), it approaches bioethics from an applied viewpoint and places ethical discussions in the context of the science being discussed. A brief overview of the historical development on bioethics with its major principles, will guide students throughout the course. The topics are designed to explore a wide range of ethical issues faced during the experimental and clinical sciences of biology and biomedical disciplines. The ethical implications of various biotechnologies will also be considered. Students will have the opportunity to construct and consider bioethical arguments on a range of topics and case studies and from a diversity of perspectives.

Course Learning Objectives:

1. Overview of biosafety, biosecurity and bioethics.
2. The practices, equipment and facilities for the safe and secure handling of dangerous pathogens in a laboratory setting.
3. Understanding concepts such as dual use of science and regulatory structure of Biotechnology.
4. Provide information on the issues of medical ethics, research ethics, environmental ethics, and animal ethics.
5. Produce sound, logical, coherent, and consistent bioethical arguments.

Course Learning Outcomes (CLOs)

After completion of **the** course, students will be able to -

1. Learn the importance of biosafety and biosecurity practices in order to better communicate risk management to the public;
2. Describe how to apply the concepts of biosafety andincrease the behavioral compliance with biosafety procedures;
3. Define and develop an integrated and comprehensive biosafety management program;
4. Describe the biosecurity challenges facing the 21st century, especially as the revolution in life sciences continues;
5. Discuss how biosecurity policies, practices and guidelines are developed at international and national levels and how to contribute to these processes;
6. Understand and explain the need for laboratory biosafety and biosecurity, and what these entails;
7. List the routes of exposure for a pathogen to a human being;
8. Demonstrate and assess the proper use of PPE, best practices, biological containment, and be prepared to safely conduct research;
9. Identify the role of the biosafety professional in biomedical research laboratories, medical and clinical setting;

10. Understand the need of a regulatory structure and issues;
11. Identify areas of security and ethical concern within the life sciences and reflect on strategies and approaches to deal with them as they arise;
12. Summarize what it means to be safe in the lab, how to apply these principles and what to expect from others to keep you and the community safe from accidental and deliberate actions;
13. Develop an understanding of the basic principles and approaches of bioethics;
14. Recognize that compliance with ethical principles may contribute to the long-term trust and acceptance in scientific research from the general public;
15. Appreciate the bioethical consequences and implications of the major biomedical fields including scientific research, healthcare and medicine, use of humans and animals in research, ecology and the environmental, and biotechnology;
16. Critically consider multiple sides of a bioethical argument and from different perspectives;
17. Identify and promote ethical and animal welfare issues in their own work and be aware and able to reflect on the consequences of their own actions;
18. Describe and discuss the importance of the 3Rs as a guiding principle in the use of animals in scientific procedures;
19. Explain the Five Freedoms and how these apply to laboratory species;
20. Describe the concept of harms to animals including avoidable and unavoidable suffering, direct, contingent and cumulative suffering;
21. Describe the severity classification system, and the effect of cumulative severity on the severity classification with examples;
22. Describe how the law is based on an ethical framework which requires the weighing of harms and benefits of a project (the harm/benefit assessment);
23. Describe the regulations regarding re-use of animals.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Biosafety and Biosecurity		
History and Development of Biosafety and Biosecurity practices.	CLO 1	1
Biosafety Principles and Practices: Hazard Identification, Hazard Assessment, Hazard Control, Administrative Control, Special Consideration for Biosafety.	CLO 2-5, 9, 12	4
Biosecurity Principles and Practices: Biosecurity Measures, Bioterrorism, Biodefense.	CLO 2-5, 9, 12	3
Bio-risk Assessment and Management	CLO 6-9, 12	3
Responsible Conduct of Research	CLO 5, 10-11	2
Biological Waste Management	CLO 1, 4, 7, 9, 12	2
Bioethics		
Brief history and scope of bioethics: Past and current approaches to bioethics; What makes a good bioethics argument?	CLO 13-14	1

The 4 Principles Approach to Bioethics: Autonomy, Justice, Beneficence, and Non-maleficence.	CLO 13-14	1
Humans as Moral Agents: What makes Homo sapiens unique? Where do morals come from? Concepts of 'person'.	CLO 13-14	1
Medical Ethics: Patient-Physician relationship; Allocation of scarce resources.	CLO 15-16, 22	2
End of Life Issues: Defining death; Proxies and advanced directives; Assisted dying.	CLO 15-16, 22	1
Reproductive Issues: The right to reproduce; When does life begin? Rights of the mother and the fetus.	CLO 15-16, 22	1
Biomedical Research Ethics: Honesty and peer review; Equipoise; Placebo.	CLO 15-16, 22	2
Ecology and Environmental Ethics: Accountability to protect the environment.	CLO 15-16, 22	2
Animal ethics: Legislation relevant to the keeping of laboratory animals; Prevention of cruelty to animals; Governing principles for the care and use of animals for scientific purposes.	CLO 17-23	4

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Microbiology		
Course Code: BZOOL 4111	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description

The course Microbiology is the study of microorganisms or microbes, a diverse group which are unicellular or cell cluster organisms that include bacteria, viruses, archaea, algae, fungi and protozoa. The populations in microbial communities interact our life in various ways by both harmful and beneficial activities. We can use them for agriculture, industry and preparation of vaccine, antibiotic and many more. They are also harmful for human health. In many cases microbial populations interact and cooperate. Ecosystems are controlled to a significant extent by microbial activities. Therefore, study of microbiology is very important to impart knowledge about history, sources, nature of pathogenic and beneficial microbes, pathogenesis, laboratory diagnosis, transmission, prevention, spread and control of diseases common in the living and non-living organisms in the earth. The course will provide the information how to use and control the microbes for comfortable human life,

Course Learning Objectives:

1. To introduce the students with the different aspects of Microbiology and Animal pathology.
2. To strengthen knowledge, skills and experience of learners for application of different methods of Microbiology and Animal pathology.

Course Learning Outcomes (CLOs)

After completion of **Microbiology** course, learners will be able to:

1. Describe the microbial world, history and development of microscope;
2. Explain the scope of microbiology;
3. Classify the microbes;
4. Define the characteristics of various microbes;
5. Describe the morphology and characteristics of various bacteria;
6. Use the culture media and culture techniques of bacteria;
7. Apply the techniques for isolation, identification and preservation of bacteria;
8. Describe bacterial reproduction and growth, bacterial growth curve;
9. Explain the bacterial enumeration from various sources (e.g. water, soil, fish, etc.);
10. Describe the bacteria in natural environment and common bacterial diseases in human;
11. Define virus and describe their properties, morphology, classification, etc.;
12. Describe common viral diseases in human;
13. Control the microbes by physical and chemical agents;
14. Explain the microbiota (microfauna and microflora) in human body as well as their origin, nature and distribution;
15. Interpret the effects of microbiota on host body;
16. Describe the significance of the study of microbiota;
17. Explain the host-microbe relationships (commensalism, mutualism opportunistic pathogen and pathogen and their transmission;
18. Define the pathogen, pathogenicity and virulence factors;
19. Describe the bacterial, viral, protozoan, fungal and helminth diseases in animals and their mode of transmission;
20. Explain the principles and mechanisms of chemotherapeutic drug actions and their clinical uses (antibacterial, antiviral, antifungal etc.).

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Microbiology		
Introduction to microbial world; progressive development of microscopes, advancement and scope of microbiology; Classification and salient features of microbes, prokaryotes VS eukaryotes.	CLO 1-4	4
Bacteria		
Morphology, classification and characteristics: Culture media and methods; Preservation of cultures; Reproduction and growth; Bacterial growth curve; Bacterial enumeration method; Bacteria in natural environment; Common bacterial diseases.	CLO 5-10	8

Viruses		
Properties, morphology and classification; Viroid and prions; Common viral diseases.	CLO 11-12	4
Control of microbes		
Physical agents-heat, filtration, radiations and ultrasonic vibrations; Chemical agents-halogens, phenolics, heavy metals, alcohols, soaps and detergents, miscellaneous chemicals, dyes and acids.	CLO 13	2
Normal microbiota		
Microfauna and microflora of human body; Effects of microbiota on host body, Significance of the study of microbiota.	CLO 14-16	2
Host-microbe relationships		
Commensals, mutualists, opportunists and pathogens; sources and transmission of pathogens; pathogenicity and virulence factors; host factors affecting pathogenicity and virulence.	CLO 17-18	4
Animal pathology		
Bacterial, viral, protozoan, fungal and helminth diseases in animals and their mode of transmission; Antimicrobial therapy; principles and mechanisms of chemotherapeutic drug actions; Antiviral, antibacterial, antifungal, anti-protozoan and antihelminth drugs and their clinical uses.	CLO 19-20	6

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Examination	Written	35
	Continuous Assessment	Attendance	05
		Tutorial	10

Curriculum
For
Fourth Year
Second Semester

B. Sc. (Honours) Fourth Year Second Semester Examination, 2027

Course Codes	Course titles	Units	Marks	Credits
Major courses				
BZOOL 4201	Biometry	0.5	50	2
BZOOL 4202	Genetic Engineering & Biotechnology	0.5	50	2
BZOOL 4203	Pest Management	0.5	50	2
BZOOL 4204	Fisheries & Fish Technology	0.5	50	2
BZOOL 4205	Zoo-keeping, Museology & Ethnozoology	0.5	50	2
BZOOL 4206	Immunology	0.5	50	2
BZOOL 4207	Environmental Pollution	0.5	50	2
BZOOL 4208	Field Study/ Excursion	0.25	25	1
BZOOL 4209	*Viva-voce*	0.5	50	2
BZOOL 4210	Zoology Practical	0.5	50	2
BZOOL 4211	Thesis / Dissertation	0.5	50	2
	Total	**5.25**	**525**	**21**

B.Sc. (Honours) Fourth Year Second Semester Examination, 2027

Course Title: Biometry		
Course Code: BZOOL 4201	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description

Biometry course has been designed to introduce the students with the introduction, definition and scope of biometry; to study sample, sampling and data analysis. This will enable the students to describe and measure the central tendency and dispersion, probabilities, hypothesis, tests of significance, correlation & regression and to analysis of variance. The students will be able to analysis the data collected from the experiment. They will acquire the skill to present the research findings in various ways.

Course Learning Objectives:

1. To introduce the students with the sample, sampling, tests, analysis and other aspects of biometry.
2. To present the experimental output in various ways.

Course Learning Outcomes (CLOs)

After completion of **Biometry** course, learners will be able to:

1. Define the concept and scope of biometry;
2. Study population and sample: Populations, census and sample survey;
3. Describe selection of sampling procedures; Characteristics for good sampling design;
4. Describe different types of sampling design, their merits and demerits; Sampling and non-sampling errors;
5. Describe the procedure of collection of data; Discrete and continuous variables; Frequency distribution and graphical presentation of data;
6. Describe arithmetic mean, median, mode and other measures of central

tendency;
7. measure dispersion and variability: range; mean deviation; variance and standard deviation;
8. Have basic concepts, definition and meaning of probability; counting possible outcomes, permutations and combinations, sets, and laws of probability;
9. Describe the t-test, the chi-square test and test for goodness of fit and contingency tables; simple, rank, partial and multiple correlation; linear regression; relationship between co-efficient of correlation and regression co-efficient;
10. One way analysis of variance and two analysis of variance.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Biometry		
Introduction, definition and scope.	CLO 1	2
Population and sample		
Populations, census and sample survey; Selection of sampling procedures; Characteristics for good sampling design; Different types of sampling design, their merits and demerits; Sampling and non-sampling errors; Collection of data; Discrete and continuous variables; Frequency distribution and graphical presentation of data.	CLO 2-5	6
Measures of central tendency		
Arithmetic mean, median, mode and other measures of central tendency.	CLO 6	4
Measures of dispersion and variability		
Range; mean deviation; variance and standard deviation.	CLO 7	4
Probabilities		
Basic concepts, definition and meaning of probability; Terms used in probability counting possible outcomes, permutations and combinations, sets, and laws of probability.	CLO 8	2
Tests of significance		
The student's t-test.	CLO 9	2
The chi-square test and test for goodness of fit and contingency tables.	CLO 9	2
Correlation and Regression		
Simple and rank correlation, co-efficient of correlation and regression co-efficient.	CLO 9	4
Linear regression; Relationship between co-efficient of correlation and regression co-efficient and regression line.	CLO 9	2
Analysis of variance (one way ANOVA and two- way ANOVA).	CLO 10	2

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination	Questions	35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Genetic Engineering and Biotechnology		
Course Code: BZOOL 4202	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description

The concept of biotechnology encompasses a wide range of procedures for modifying living organisms according to human purposes, going back to domesticationof animals, cultivation of the plants, and "improvements" to these through breeding programs that employ artificial selection and hybridization. Biotechnology course has been designed to introduce the students to basic molecular biological concepts and techniques used in the fields of biotechnology and genetic engineering. It will also provide knowledge to fulfill the requirement for jobs in public sectors and private enterprises involved in different biotechnology efforts and to face the challenges of new developments in this field. Finally, it will capable them to apply their knowledge and skill for Genetic Engineering & Biotechnology research.

Course Learning Objectives:

1. To introduce the students to basic concepts and techniques of biotechnology and genetic engineering.
2. To fortify knowledge and experience of learners to apply their skills for Biotechnology research.

Course Learning Outcomes (CLOs)

After completion of **Biotechnology** course, learners will be able to:

1. Explain the historical background and scope of genetic engineering and biotechnology;
2. Describe principles and techniques of gene cloning with example and explain recombinant DNA technology;
3. Describe restriction enzymes and their mode of action and uses;
4. Describe the different types of plasmids and their characteristics;
5. Mention role of plasmids in biotechnology;
6. Explain agarose gel electrophoresis of DNA;
7. Describe the production of herbicide, virus and insects resistant plants through gene technology with example;
8. Describe the production of enzymes and vaccines using biotechnology;
9. Describe production of human growth hormones and interferon with functions;
10. Describe the production of alcohol and alcoholic beverages, vinegar, lactic acid, wine, enzymes and amino acids with example;

11. Describe the techniques and production of transgenic animals and their advantages and disadvantages;
12. Explain the historical background, milestone and target of Human Genome Project;
13. Explain the methods of genome sequencing and comparison of human genome with other model organisms;
14. Describe the main steps of production of Genetic modified organisms (GMOs);
15. Describe the merits and demerits and use of GMOs;
16. Mention the controversy regarding GMOs and potential risks associated with GMOs.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Biotechnology		
Definition, historical background and scope of biotechnology and genetic engineering.	CLO -1	2
Principles and techniques of gene cloning with example.	CLO -2	2
Restriction enzymes and their mode of action and uses.	CLO-3	2
Different types of Plasmids and their role in biotechnology.	CLO 4 -5	4
Gel electrophoresis	CLO-6	2
Application of biotechnology: In agriculture	CLO-7	2
Application of biotechnology: In medical science	CLO 8-9	4
Application of biotechnology: In industry	CLO-10	2
Transgenic animal	CLO-12	2
Human Genome Project	CLO 12-13	4
Main steps of production of GMOs,	CLO 14	2
Merits - demerits and potential risk of GMOs	CLO-15-16	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Final Written Examination		35
	Continuous Assessment	Attendance	05
		Tutorial	10

Course Title: Pest Management		
Course Code: BZOOL 4203	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3
Course Description: The Pest Management is a core course for honours students has been designed to		

focus on the concept and principles of pest management. The importance of pest management as an environmentally-friendly practice will be emphasized based on economic, ecological and sociological consequences. This course is an introduction to the development and application of multi-faceted approach, incorporating the use of cultural, physical, mechanical, ecological, biological, behavioural, genetic, chemical and other control tactics to suppress pest populations below damaging levels, and the issues related to pesticides and the environment. This course is to provide a holistic view of pest management with effective and cost-efficient integrated pest management to improve the agricultural and environmental quality and sustainability for human well-being. The concept of pest and major factors that influence the pest populations will be discussed.

Course Learning Objectives:

1. To prepare and strengthen knowledge, skills and experience of students to work independently or as a team member.
2. To enhance and improve the lives of those around them (students) and to better understand the concepts and principles of pest management, as well as apply it effectively considering economics, ecology, and societal influences.

Course Learning Outcomes (CLOs):
After completing this course, students will be able to:

1. Describe the concept and factors influence the pest status and types of pests; Concepts involved in pest population regulation:
2. Define the terminology related to pest management; Describe the principles of pest; management, and pest management strategies and tactics;
3. Describe Non-Chemical Control Methods: Physical & Mechanical Control Methods, Ecological Management (Cultural Control Methods), Management with Biopesticides (Plants & Animals origin), Use of Resistant Plant Varieties (Varietal Control Methods), Management by modifying insect behaviour and development; Chemical Control Method; Integrated Pest Management (IPM);
4. Define and describe the historical development, principles and components of IPM; benefits, requirements and steps of IPM.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Introduction to pest		
Definition of pest, factors for determining the status of pest and categories of pest.	CLO-1	2
Concepts involved in pest pouplation regulation.		
Introduction, Description of factors- reproduction, fecundity & fertility, generation time, cycles per season, longevity & mortality, Quiescence & dormancy, Temperature & humidity, Molting & metamorphosis, Dissemination, invasion & colonization process.	CLO-2	2
Introduction to pest management and terminology		
Definition and historical development of pest management,	CLO-3	1

Terms related to pest management.		
Introduction to Principles of pest management		
Concept, Decision, and Pest management strategies and tactics.	CLO-4	2
Pest Management Techniques: Non-Chemical Control Methods.		
Physical and Mechanical control methods: Definition, basis of management, categories of management procedures, advantages and disadvantages of these methods.	CLO-5	2
Ecological management (Cultural control methods) Definition, basis of ecological management, categories of ecological management procedures, advantages and disadvantages of ecological management.	CLO-6	1
Definition, History, principles and scope of biological control; basis of biological control, types of biological control.	CLO-7	2
Agents of biological control, practice of biological control, advantages and disadvantages of biological control.	CLO-8	2
Managing Insects with Resistant Plants (Varietal control methods)- Definition, Insect and Host-Plant Relationships, Mechanisms of host plant resistance, genetic nature of host plant resistance, factors mediating the expression of resistance, biotechnology and resistance development, advantages and disadvantages of host plant resistance.	CLO-9	2
Management by modifying insect behavior and development using pheromones and IGRs: Modifying behavior patterns, disrupting normal growth and development, advantages and disadvantages of using Pheromones and IGRs in pest management.	CLO-10	2
Pest Management Techniques: Chemical Control Method		
Definition, pesticide development history; nomenclature; drawbacks and benefits of pesticides; Classification of pesticides based on target pest and effect on pest.	CLO-11	2
Classification of Pesticides based on mode of entry and mode of action.	CLO-12	2
Classification of Pesticides based on chemical nature: Organic - natural organics and synthetic organics. Natural organics - Oils and Plant origin (Botanicals).	CLO-13	2
Synthetic Organics: Introduction, Organochlorins and Organophosphates - Structure, Physico-Chemical characteristics and uses, Mode of action.	CLO-14	2
Synthetic Organics: Carbamates and Synthetic Pyrethroids - Introduction, Structure, Physico-Chemical Characteristics and Uses, Mode of action. Biopesticides - Introduction and types of biopesticides.	CLO15	2
Integrated Pest Management		
Definition, Historical development of IPM; Practicing IPM; Principles, objectives & benefits of IPM; Essential requirments and steps of IPM implementation.	CLO-16	2

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Fisheries & Fish technology		
Course Code: BZOOL 4204	**Course Type:** Theory	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 03

Course Description

Fisheries course has been designed to introduce students the fisheries resources, fish technology, biological limnology, fisheries management and aquaculture. It will also provide knowledge on all sector of fish fin fish, shell fish, fisheries and their technology and management. This course is also aimed to provide information on different aspect of fisheries sector. Altogether they will learn about fish, fisheries, fisheries resources fisheries items of Bangladesh, fishing gear and crofts, fish handling, processing, preservation and quality control. Finally, it will capable them to apply their knowledge and skill for fisheries resources, aquaculture practices and water qualities of fish culture method and their management and plankton and benthos their type distribution and role of plankton.

Course Learning Objectives:

1. To introduce the students to fisheries resources, fish technology and biological limnology.
2. To fortify skills and experience of learners on fish technology.

Course Learning Outcomes (CLOs)

After completion of **Fisheries & fish technology** course, learners will be able to:

1. Define fish, fishery, fisheries and aquaculture with example;
2. Describe the types of fishes with example;
3. Define fresh water and marine water fishes;
4. Compare fin fish, shell fish, fresh water fish and marine water fish;
5. Describe fisheries resources and types of fisheries resource and types of fisheries resources;
6. Compare freshwater, brackish water and marine water characters and their significance.
7. Explain phylum wise enlisted fisheries resource;
8. Describe present status of fin fish and shell fish of Bangladesh;
9. Define fishing gear and crofts;
10. Describe the types of fishing gear and crafts and their uses;
11. Explain how done fish handling processing preservation and quality control;
12. Mention the principles of fish processing;
13. Describe types and mechanism of fish processing;
14. Explain P^H, DO and CO_2;
15. Describe the P^H, DO and CO_2 and their requirements importance of pond water;

16. Explain advantage and disadvantage of P^H, DO and CO_2 ;
17. Define the plankton and benthos;
18. Clarify types of plankton with example;
19. Interpret the distribution and role of plankton in fish culture;
20. Classify the types of benthos with example;
21. Explain the distribution and role of benthos in the production of fisheries items;
22. Mention the production of fisheries item in plankton and benthos;

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Fisheries Resource		
Open and Close water fisheries resources of Bangladesh.	CLO 1-7	8
Fin fish and shell fish of Bangladesh.	CLO-8	2
Fish Technology		
Fishing gears and crafts.	CLO 9-10	4
Fish handling, processing, preservation and quality control.	CLO 11-13	6
Biological limnology		
Dynamics of physical and chemical factors of inland waters. sediments and their influences.	CLO 14-15	2
Factors affecting growth, distribution and abundance of biota of inland waters.	CLO 16	2
Composition, Classification distribution and role of plankton.	CLO 17-22	6

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	5
		Tutorial	10

Course Title: Zoo-keeping, Museology & Ethnozoology		
Course Code: BZOOL 4205	**Course Type:** Theory (Core Course, Mandatory)	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3

Course Description

The course **Zoo-keeping, Museology and Ethnozoology** has been designed to introduce the students with the animal for Zoo or Zoological Garden, Museology and Ethnozoology. It will provide knowledge on historical background of the

Zoo/Zoological Garden, Objectives and establishment of a new zoo, Type of Zoo and modern Zoo keeping & management, Zoo environment and education, Collecting animal for a Zoo with considering their original habited, In-situ and Ex-situ conservation of a critical/threatened/endangered wildlife, Red listed animals of the world, Zoo keeping technique and management, Feeding and medication, Captivity and captive breeding, Principles and ethics for zoo animal, Procedure of export-import or exchange of zoo animals, Conservation of red listed animal for their existence and ecofriendly coexistence. This course is also aimed to provide information on different aspect of Act, Ordinance and Legislation for the wildlife and its implements, awareness building of the mass people is also known to the student.

Museology is an important issues for providing knowledge regarding the zoological museum. This part of the course will be focused on biodiversity, staffed and non-staffed animals, technique of Taxidermy and also provide knowledge about preserved and live animals in a modern museum to know their systematics, evolution and palaeontology,

Ethnozoology will be focused as our cultural heritage and practices of our community people that was the historical and anthropological knowledge of our ancient civilization. The student will capable to understand about the present status of Zoo, Museology and Ethnozoological study and research in our country in relation to the world perspectives and raise the awareness, knowledge and respect to the wild animals among the people.

Course Learning Objectives

1. To introduce the students with the domestic, pet and wild animals.
2. To provide information on Zoo-keeping, Museology and Ethnozoology.
3. To strengthen skills and experience of learners on Zoo-keeping with captive breeding and Museology specially on Taxidermy.

Course Learning Outcomes (CLOs)

After completion of **Zoo-keeping, Museology & Ethnozoology** course, learners will be able to:

1. Describe zoos in relation to society and environments;
2. Describe the differing views, within society, relating to the scientific uses of zoo animals and recognize the need to respect these;
3. Describe the responsibility of humans when working with research animals and recognize the importance of having a respectful and humane attitude towards working with zoo animals in research;
4. Identify ethical and animal welfare issues in their own work and be aware and able to reflect on the consequences of their own actions;
5. Recognize that compliance with ethical principles may contribute to the long-term trust and acceptance in scientific research from the general public;
6. Describe and discuss the importance of the zoo animal in the use of animals in scientific procedures;
7. Describe the concept of modern zoos;
8. Describe the regulations regarding to the re-introduce of zoo animals after successful captive breeding;
9. Describe the importance of good animal welfare including its effect on scientific outcomes as well as for societal and moral reasons;
10. Describe relevant sources of information relating to ethics, animal welfare and the implementation of the successful captivity;
11. Synthesize the wide-ranging relationships between humans, other

animals, Plants and whole ecosystem;

12. Describe the effect of plants and other animals on human history and the contribution to the structure of contemporary societies around the world;
13. Describe the symbolic, mythological and religious perspectives of animals and plants;
14. Describe the development of legal, political and social institutions that manage plants and animals.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Zoo-keeping History and types of zoos; general principles and objectives of modern Zoos;	CLOs-1-2	4
Principles of new zoo establishment-construction and equipment of animal houses, outdoor enclosures; Importation and Exportation of Zoo animals;	CLOs-3-4	4
Captivity and captive breeding, success and conservation of the wild animals;	CLO-5	2
Feeding and nutrition of zoo animals; medication, hygiene and parasitic control of zoo animals;	CLO-6	2
Importance of zoos: environmental education and awareness; in-situ, *ex-situ* conservation of wild animals, capital investment and income generation;	CLO-7	2
Museology (The science of Museum) Definition, collection, documentation and research	CLO-8	2
Taxidermy: Procedure and handling	CLO-9	2
Museum education; exhibition, conservation and preservation	CLO-10	2
Museum architecture, marketing, publication, security and administration	CLO-11	2
Ethnozoology		
Ethnozoology- History, definition and commercialization practices	CLO-12	2
Animal sources of oil, fibre, drugs, medicines and perfumes	CLO-13	2
Animal-based folk-cottage industries; productions and local markets	CLO-14	2
Conventions on biodiversity (CBD) and ethnozoology	CLO-15	2

Teaching-learning Strategy	Assessment Strategy		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	Type of Assessment	**Components**	**Marks**
	Written Examination		35
	Continuous Assessment	Attendance	05
		Tutorial	10

Course Title: Immunology		
Course Code: BZOOL 4206	**Course Type:** Theory	**Credits:** 2
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 03

Course Description

Immunology course has been designed to introduce the students the history of immunology by which, small pox, a dreadful disease is eliminated from the face of the earth. It will provide knowledge about Expanded Program on Immunization (EPI) in Bangladesh by which a person can be prevented from six infectious diseases by vaccines. It will also give knowledge about antigen, antibody and their structures. This course is also aimed to provide information about different immune disorders. Altogether, you will learn about successful transplantation of kidney and many other organs. Finally, it will capable you to apply your knowledge and skill for diagnosis of diseases by different serological reactions in the laboratory conditions.

Course Learning Objectives:

1. To introduce the students with the different aspects of Immunology
2. To strengthen knowledge, skills and experience of learners for application of different branches of Immunology.

Course Learning Outcomes (CLOs)

After completion of **Immunology** course, learners will be able to:

1. Define immunology and immunity;
2. Explain the history and major milestone in immunology;
3. Interpret the application and branches of immunology;
4. Classify immunity according to different criteria;
5. Classify the antigen according to their different criteria;
6. Describe the structure and types of antibodies, CMI and AMI;
7. Diversity of antibody and antigen-antibody reactions;
8. Describe the mechanism of complement pathways and complement Components deficiency diseases;
9. Explain the serological reactions to diagnosis diseases;
10. Explain about the Major histocompatibility complex (MHC) / Human leucocyte antigen (HLA);
11. Compare the different types of hypersensitivities;
12. Describe the synthesis of monoclonal antibodies;
13. Describe the vaccines and vaccination;
14. Explain transplantation and graft rejection.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Course contents	Alignment of topic with CLOs	LH
Immunology		
Differences between Immunity and Immunology, Major milestone in Immunology, Application and branches of immunology.	CLO 1-3	2
Immunity		
Classify immunity according to different criteria. Specific and Non-specific immunity.	CLO-4	2
Antigen		

Classify antigen according to different criteria.	CLO-5	2
Antibody		
Describe the structure and types of antibodies, Cell- mediated immunity (CMI) and Antibody -mediated immunity (AMI).	CLO-6	4
Diversity of antibody and antigen-antibody reactions.	CLO-7	2
Complement		
Describe the mechanism of complement pathways and complement Components deficiency diseases.	CLO-8	2
Serological reaction		
Serological reactions in the laboratory condition to diagnosis diseases.	CLO-9	4
MHC/HLA		
The Major histocompatibility complex (MHC) / Human leucocyte antigen (HLA).	CLO-10	2
Hypersensitivities		
What is hypersensitivity? Mechanism of Type- I, II, III, IV and V hypersensitivities.	CLO-9	4
Monoclonal antibodies		
Synthesis Monoclonal antibodies and their applications.	CLO-10	2
Vaccine and Vaccination		
Types of vaccines, mechanism of vaccination, adjuvants and possible causes of vaccine failure.	CLO-11	2
Transplantation and Graft rejection		
Differentiate the transplantation and transfusion with example. Different types of transplantation barriers, graft rejection, the role of T- lymphocytes in graft rejection, tempo of rejection and the prevention of rejection.	CLO-12	2

Teaching-learning Strategy	**Assessment Strategy**		
➢ Lectures followed by discussion ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Final Examination	Questions	35
	Continuous Assessment	Attendance	05
		Tutorial	10

Course Title: Environmental Pollution		
Course Code: BZOOL 4207	**Course Type:** Theory (Core Course, Mandatory)	**Credits:**0.5
Full Marks: 50	**Total Lecture hours:** 30	**Exam Hours:** 3
Course Description: The course has been designed to understand how the biosphere is being contaminated and how it could be mitigated. It will also provide knowledge to investigate how the pollutants are being produced by human activities and how they even get into the metabolic processes of living organisms to create calamity in the trophic levels giving a concern over how it could be reduced.Finally, it will make the students capable of applying their knowledge and skill combat against environmental pollution.		

Course Learning Objectives:

1. To introduce the students with the steady state of the natural biological systems and the interaction of the biotic factors with the abiotic factors in the ecosystem;
2. To provide knowledge on the biogeochemical cycles in nature and the events that disarray them yielding environmental hazards;
3. To apply knowledge and skill to fight against the factors causing environmental pollution and affecting the ecosystem.

Course Learning Outcomes (CLOs):

After completion of **developmental Biology** course, learners will be able to:

1. define pollution, polluter, recalcitrant and notify factors involved in these topics;
2. know the types of pollution, causes of pollution and will understand costs of pollution;
3. how the greenhouse effect, different forms of contaminations are taking place and what is the aftermath of this only planet suitable for living organisms;
4. how biological magnification appears as ecological backlash or boomerang is taking place in different trophic levels;
5. understand the energy flow in the ecosystem along with the energy drain and other obstacles that cause problem in the harmony of living among biotic communities;
6. how the air, water, soil and seawater are contaminated;
7. how the industrial effluents and urban sewage are contaminating the environment;
8. how the air and water pollution could be monitored;
9. what are the natural indicators of water pollution, and what is BOD or COD;
10. how the waste water could be treated, and how the air, water and soil pollution could be reduced;

Course contents, subject to the lecture and alignment of topic with CLOs.

	Course contents	**Alignment of topic with CLOs**	**LH**
01	Concept of pollution		2
02	Sources, types and costs of pollution		2
03	Greenhouse effect and biological magnification		2
04	Some problem areas: physical wastes (air, water)		2
05	Some problem areas: physical wastes (soil, solid waste, liquid waste)		2
06	Some problem areas: wastes without weight (radioactive, thermal and noise)		2
07	Chemical and biological pollution		2
08	Social and electronic pollution		2
09	Pollution monitoring and strategy of waste management		2
10	Phases of waste water treatment		2

11	Environmental laws and legislation	2
12	Toxicology: Introduction and classification of toxic substances	2
13	Sources of toxic substances	2
14	Pathways of toxic substances into ecosystem	2
15	Effect of toxic substances and mitigation mechanisms	2

<table>
<tr><th colspan="2">Teaching-learning Strategy</th><th colspan="3">Assessment Strategy</th></tr>
<tr><td colspan="2" rowspan="4">➢ Lectures followed by discussion
➢ Participatory question-answer
➢ Group discussion
➢ Text books
➢ Lecture notes
➢ Online resources
➢ Videos on related topics</td><td>Type of Assessment</td><td>Components</td><td>Marks</td></tr>
<tr><td>Written Examination</td><td></td><td>35</td></tr>
<tr><td rowspan="2">Continuous Assessment</td><td>Attendance</td><td>5</td></tr>
<tr><td>Tutorial</td><td>10</td></tr>
</table>

Course: BZOOL 4208
Field study/Excursion
Full Marks 25 (0.25 unit)

Preparation and submission of reports on industry, zoo, museum and local study tours. Distribution of marks: Field report/Excursion =12.5; Presentation/*viva-voce*=5; Assessment=5; Attendance=2.5.

Course : BZOOL 4209
Viva-voce
Full Marks 50 (0.5 unit)

Viva-voce on theoretical courses of fourth year first and second semester

<table>
<tr><th colspan="3">Course Title: Zoology Practical</th></tr>
<tr><td>Course Code: BZOOL 4210</td><td>Course Type: Practical
(Core Course, Mandatory)</td><td>Credits: 2</td></tr>
<tr><td>Full Marks: 50</td><td>Total Lecture periods: 30</td><td>Exam Hours: 6
(6 hours daily)</td></tr>
<tr><td colspan="3">Course Learning Objectives
To provide practical experience on the topics covered by theoretical courses so that the learner can apply their knowledge in lab, workplace and in practical life.</td></tr>
<tr><td colspan="3">Course Learning Outcomes (CLOs)
After completion of this course, learners will be able to:
1 Calculate the Mean ± SE from the supplied materials and comment on your findings and draw a graph;
2 Calculate the Student’s t-value from supplied samples and to justify if the two samples differ significantly;</td></tr>
</table>

3	Calculate the chi- value from supplied samples and to justify if the two samples differ significantly;
4	Calculate, comment and draw a graph on the Coefficient of correlation (r) from the supplied materials;
5	Calculate and comment on the F-value from the number of insects caught from your common habitats (in three replicates each);
6	Isolation of plasmid DNA from *E. Coli* bacteria and detection of plasmid DNA bands by agarose gel electrophoresis;
7	Extraction of genomic DNA from bacteria and detection of DNA bands by agarose gel electrophoresis;
8	Identification of pesticide application tools and their uses;
9	Management of pests through integrated pest management (IPM);
10	Analysis of lethal dose;
11	Study and identification of freshwater planktons;
12	Cultural and farming methodologies of fishes (Carp and Cat);
13	Collection and Identification of fishing gears and crafts;
14	Identification of the developmental stages of prawn and carp fishes with their diagnostic characters;
15	Describe and demonstrate the following zoo techniques: (a) Apiculture and (b) Vermiculture;
16	Blood group testing;
17	Determination of blood components.

Course contents, alignment of topic with CLOs, lecture hours, Teaching-learning Strategy and Assessment Strategy

Contents	Alignment of topic with CLOs	LH
Biometry Calculation of Mean ± SE with graph. Calculation of the Student's t-value from supplied samples and to justify if the two samples differ significantly. Calculation of the chi- value from supplied samples and to justify if the two samples differ significantly. Calculation of the Coefficient of correlation (r) with graph. Calculation of the F-value.	CLO 1-5	12
Genetic Engineering and Biotechnology: Isolation of plasmid DNA from *E. Coli* bacteria and detection of plasmid DNA bands by agarose gel electrophoresis. Extraction of genomic DNA from bacteria and detection of DNA bands by agarose gel electrophoresis. Amplification of a specific segment of DNA with Polymerase chain reaction (PCR).	CLO 6-7	9
Pest Management: Identification of pesticide application tools and their uses. Management of pests through integrated pest management (IPM). Analysis of lethal dose.	CLO 8-10	6
Fisheries and Fish technology: Study and identification of freshwater planktons. Cultural and farming methodologies of fishes (Carp and Cat). Collection and Identification of fishing gears and crafts.	CLO 11-14	6

Identification of the developmental stages of prawn and carp fishes with their diagnostic characters.		
Apiculture; Vermiculture; Medical Entomology Study of zoo techniques: (a) Apiculture and (b) Vermiculture.	CLO 15	6
Immunology: Blood group testing, Determination of blood components.	CLO 16-17	6
Environmental Pollution		

Teaching-learning Strategy	**Assessment Strategy**		
➢ Practice class ➢ Participatory question-answer ➢ Group discussion ➢ Text books ➢ Lecture notes ➢ Online resources ➢ Videos on related topics	**Type of Assessment**	**Components**	**Marks**
	Practical Examination	6hrs daily on the above tropics	30
	Continuous Assessment	Attendance	5
		Practical class records	6
		Laboratory assessment	9

Course: BZOOL 4211
Thesis/Dissertation
Full Marks 50 (0.5 unit)

Each student will be attached to a teacher(s) for conducting research work. At the end of theoretical examination, he/she is required to submit his/her research work in the form of a thesis/dissertation, the format of which will be designed by the Academic Committee of the Department. Two (5) copies of the thesis/ dissertation (type-written/printed and bound) duly signed by the concerned supervisor(s) shall have to be submitted to the Chairman of the relevant examination committee within the schedule date of submission [Distribution of marks: Thesis/Dissertation=35; Assessment=10; Attendance=5].

Learning Resources:

Barth, FG. 1985. *Insects and Flowers: The Biology of a Partnership*. Princeton University Press, New Jersey.

Clark, BFC. 1984. *The Genetic Code and Protein Biosynthesis* (2nd edn). Edward Arnold Ltd. London.

Foin, TC Jr. 1976. *Ecological Systems and the Environment*. Houghton Mifflin Co.,

Freifelder, D. 1999. *Essentials of Molecular Biology*. (574.8 FRE).

Geddws, AMW and Ilez, M. 1991. The Relative Importance of Crop Pests in South Asia. NRI Bull. No. 39.

Gillott, C. 2005. *Entomology* (3rd edn). Springer, Germany.

Heinz-Georgklos and Lang, EM. 1976. *Handbook of Zoo Medicine*. Van Nortrand Reinhold Co., London, New York.

Hume, CW. 1976. The UFAW *Handbook on the Care and Management of Laboratory Animals*. Churchill Livingstone, Edinburgh, London and New York.

Islam, MA. 1988. A Textbook on Parasitology (in Bengali). Bangla Academy, Dhaka.

Molles, MC Jr. 2002. Ecology: Concepts and Applications. McGraw-Hill, NY.

Mukhopadhyaya, B. and Muhthana, MS. 1962. A Monograph of Lac. Indian Lac Research Institute.

Nicholl, DST. 1996. An Introduction to Genetic Engineering. Cambridge Univ. Press, UK.

Rao VP., Ghani MA., Sankaran T. and Mathur KC. 1971. A Review of the Biological Control of Insects of other pests in South East Asia of the Pacific Region. Commonwealth Agricultural Bureaux, England.

Smith, JE. 1996. *Biotechnology* (3rd edn). Cambridge Univ. Press, UK.

Zethner, O.; Koustrup, R.; Reza, A.M.S.; Subba, D.K.; Barooah, D.; Barooah, N.; Win, M.M.; Tiwari, S.; Dhoj, Y.; Bajwa, G.A.; Bajwa, R.A.; Ahangama, D. 2015. *South Asian Ways of Silk: A Patchwork of Biology, Manufacture, Culture and History.*Bookbell, Guahati, Asam, India.

Abrose*et al*. *Museum Basics*.

Edson *et al*. *The handbook of Museum*.

Elizabeth, O. *Information Handlings of Museum*.

Gairola, T.R. *Handbook of Chemical Conservation of Museum Objects*.

Harper et al. *Museums of the shaping of knowledge*.

Light et al. *Museum Documentation System*.

Nigam, M.L. *Fundamentals of Museology*.

UNESCO. *Organization of Museums*: Practical Advice.

Zethner *et al*. 2015. *South Asian Ways of Silk: A Patchwork of Biology, Manufacture, Culture and History.*Bookbell, Guahati, Asam, India. 251pp.

খান, হা.সা. ও ইসলাম, এম.সা. ২০১১। জৈবপ্রযুক্তি এবং জীন প্রকৌশল। আগামী প্রকাশনী, বাংলাবাজার, ঢাকা।

Chairman: Prof. Dr. Md. Mahbub Hasan (From 30/06/2022-)

Professors

M. Saiful Islam (Since 1983): BSc (Hons) and MSc (RU), MSc (Newcastle upon Tyne, UK), PhD (Reading, UK), Commonwealth Academic Staff Fellow (Oxford, UK), Visiting Fellow (Kentucky, USA); former Chairman (2018-2021); Genetics and molecular biology, microbiology, biostatistics, genetic control of pest insects, quantitative traits of farm animals and human genetics.
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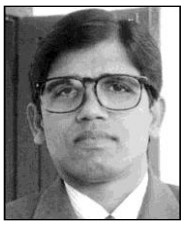

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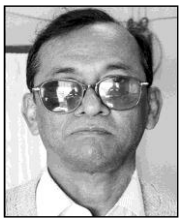
Part-time teachers



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