University of Dhaka

Department of Zoology

Outcome Based Education (OBE) Curriculum

Bachelor of Science in Zoology

Undergraduate programme in Zoology

under The Four Year Integrated Grading System
for the sessions 2024-2025, 2025-2026, 2026-2027 and 2027-2028

June, 2025 **Dhaka**

Outcome Based Education (OBE) Curriculum
Undergraduate programme in Zoology

Prepared by
Syllabus and Curriculum Committee
Department of Zoology
University of Dhaka

Faculty Approval Date: -------

Academic Council Approval Date: ----------

Contents

Outcome Based Education (OBE) Curriculum
Part- A and B

1. Title of the Academic Program: Undergraduate programme in Zoology

Degree	Bachelor of Science in Zoology
Abbreviated form of the Degree	BS in Zool.
Program Offering Entity (POE)	Department of Zoology
Acronym of the POE Faculty	Department of Zool. Faculty of Biological Sciences
Awarding Institution	University of Dhaka
Location	Dhaka, Bangladesh
Bangladesh National Qualifications Framework (BNQF) Level	8 and 9
Mode of Study	Full Time
Language of Study	English
Applicable Session	2024- 2025 and onwards

2. Name of the University: The University of Dhaka

3. Vision of the University:

- To create new areas of knowledge and disseminate this knowledge to the society and the nation as well.
- To enrich the global pool of knowledge by making notable contributions in the fields of teaching and research.
- To strive and transform the world in positive ways through advanced education, impactful research with new knowledge, and the translation of knowledge into solutions.
- To create sustained environments to advance the motto of the University and to build and maintain excellence.

4. Mission of the University:

SL. No.	Description
UM1	Generating new knowledge through a broad array of scholarly, research and UM1 creative endeavors, which provide a foundation for dealing with the immediate and long-range needs of society.
UM2	Building strength through creative innovation, entrepreneurship, research, intellectual curiosity and partnerships.
UM3	Empowering our students to fulfill their academic and professional passions in the university that is diverse, welcoming, and inclusive for all students, faculty, and staff.
UM4	Serving society through coordinated countrywide outreach programs that meet continuing educational needs in accordance with the university's designated status.
UM5	Fostering a diverse community of students, staff, and faculty. It is dedicated to access, affordability, and ensuring that the benefits of its transformative educational opportunities are not limited by financial circumstance or background.
UM6	Maintaining a level of excellence and standards in all programs that will give

	them national and international significance.
UM7	Supporting the community of alumni through imaginative programs that enrich their lifelong relationship with university and that expand the collective contributions to the world.

5. Name of the Program Offering Entity: Department of Zoology

6. Vision of the Program Offering Entity:

The vision of the department is to inhere amongst the students the highest values of life, respect for Nature and to introduce sound acquisition of knowledge of animal sciences through quality educational practices and research. The department is dedicated to disseminating its research-based findings to all relevant parties, such as scientists, policymakers, and other members of the society.

7. Mission of the Program Offering Entity:

SL. No.	Description
M1	Trained the students to become proficient academics in both academia and research in the central area of Zoology through offering advanced courses.
M2	Form partnerships with national and international universities for research collaboration and student-faculty exchange programs so that students may stay up to date with the shifting demands of the community for graduates in animal sciences.

8. **Objectives of the Program:** Bachelor of Science in Zoology.

SL. No.	Description
O1	Programmes offer the opportunity to study the aforementioned core subjects of Zoology to produce undergraduates/professionals of global competence capable of contributing to national development.
O2	The undergraduate programme in Zoology is aligned to meet the expectations of country's policy for tertiary education.
O3	The programme is designed to equipping the students with theoretical and practical knowledge and skills in major spheres of zoological studies aiming at producing graduates in zoology of global competence, capable of contributing to national development.
O4	The major focuses of the undergraduate study are animal diversity covering the entire animal kingdom, structural, functional and developmental zoology, evolution, ecology, environmental biology, paleontology, ethology, zoogeography, genetics & molecular biology and applied zoology (for example culture, farming of animals, crop protection, etc.).
O5	The programme also integrates selected courses, having relevance to zoological sciences, offered by Botany, Biochemistry and Microbiology Departments of the university to meet the needs of the zoology students.

9. Name of the Degree: Bachelor of Science in Zoology

10. Description of the Program:

The Department of Zoology, University of Dhaka, is one of the oldest departments of the university and the pioneer institute to introduce teaching and research in animal sciences in the country and, therefore, played a commendable role in promoting zoological studies in Bangladesh. Since its inception in 1954, the department has been the best learning seat for zoology in the country and producing graduates of global competence. The department has been

offering a 4-years Batchelor of Science (Honors) degree in Zoology that aligned to meet the expectations of country's policy for tertiary education.

In the first year the syllabus has been developed giving emphasis on the introductory ideas on animal sciences. For second and third years, courses emphasis has been given on more advanced courses in Zoology. In fourth year, courses have been designed to cover five main branches of Zoology, viz. Fisheries, Entomology, Wildlife Biology, Parasitology and Genetics & Molecular Biology.

The duration of the undergraduate programme is 4 (four) consecutive academic calendar years, designated as 1st, 2nd, 3rd and 4th year, based on an annual course system, in which students complete all assigned courses for a particular year. The time allocation of each academic year includes 42-44 working weeks for lecture and practical classes, 4 weeks as preparatory period for course final examinations and up to a maximum of 8 weeks for taking all course final examinations. Results are published within 6 weeks after completion of course final examinations. However, a student may complete his/her degree within 6 academic years, in case when he/she fails to be promoted in any year. This opportunity can be availed twice for completing the degree.

Eligibility for Admission: The selection of students for enrollment in the 1st year undergraduate programme Course is made through an admission test conducted under 'Science' (Ka)-unit admission, controlled centrally by the university. Student seeking admission in Zoology needs to go through the 'Science' -unit admission test.

10.1 Structure of Curriculum

10.1.1 Assignment of Credits and Credit hours: The entire undergraduate programme is covered by a set of theoretical, field studies, practical (laboratory/field) and viva courses. Each course comprises a number of credits depending on the volume of contents of each individual course, ranging from 1 to 4 credits.

(a) For theoretical courses, a single credit course will have a minimum of 15 class hours (credit hours) during an entire academic year, while there will be a minimum of 30 and 60 lecture hours of each theoretical course for 2 and 4 credit courses per year, respectively.
(b) The duration of one practical class will be equivalent to 3 (three) theory class hours.
(c) Credits assigned to seminar/project will be determined by the Academic Committee of the Department.
(d) Each credit course carries 25 marks.
(e) The total number of course credits for Zoology BS degree is 140 and a student must need to earn all the credits for the successful completion of his/her graduation programme.

10.1.2 Distribution of Credits in Zoology: A year-wise distribution of credits for a four-year undergraduate programme in Zoology under the integrated annual grading system is as follows:

Zoology Core courses	**Credit**				
	1st Year	**2nd Year**	**3rd Year**	**4th Year**	**Total**
Theory	13	17	26	30	86
Field Studies	1	1	2	2	6
Practical	4	4	8	8	24
Viva-voce	2	2	2	2	8
Extra-Departmental courses: Theory & Practical	4 (Botany-1) 4 (Biochemistry)	4 (Botany-II) 4 (Microbiology)	--	--	16
Total	**28**	**32**	**38**	**42**	**140**

10.1.3 Assessment System

Course Assessment: The assessment process for any theory course involves a 3-steps scheme: i) in-course examination to be taken by the course teacher usually at the midway of the course duration; ii) course final examination will be held after the completion of the course, conducted centrally by the university; and iii) class attendance.

(a) There will be at least 1 (one) in-course examination for a 2-credit course and at least 2 (two) in-course examinations for a 4-credit course.

(b) The distribution of marks for a theoretical course will be as follows:

Class attendance	5%
In-course examination	35%
Course final examination	60%

(c) In case of practical course, marks distribution will be as follows:

Class attendance	5%
In-course assessment	35%
Course final examination	60%

(d) The distribution of marks for an extra-departmental course will be as follows:

Class attendance	5%
In-course assessment	15%
Practical examination	20%
Course final examination	60%

(e) The course final examinations will be of 3 hours duration for a 4 credit course, 2 and a ½ hours for 3 credit course, and 2 hours for a 2 credit course.

(f) For the evaluation of the course final theoretical examination, there will be two examiners: 1st examiner (course teacher) and the 2nd examiner (anyone other than the course teacher). In case of the assessment of Seminar/Project/Internship, the examination committee of the Department will determine the mode of assessment.

(g) Assessment of the field trip will be done by the Members of concerned Examination Committee.

(h) Basis for awarding marks for class attendance will be as follows:

Attendance (% of total class held)	Marks (%)	Attendance (% of total class held)	Marks (%)
95 and above	5	80 to less than 85	2
90 to less than 95	4	75 to less than 80	1
85 to less than 90	3	Less than 75	0

(i) **In-course Assessment (theory and practical courses)**

In-course test: In-course tests will be of minimum one hour duration each, to be conducted and evaluated by the course teacher. There will be at least 2 (two) written tests for a 4 credit course and at least 1 (one) written test for a 2 credit course. Questions for in-course tests would be of the objective and short types. The course teacher will show the assessed in-course scripts to the students. Absence in any in-course test will be counted as zero for calculating the average marks for in-course test for that course.

Make-up test: Make-up test will be arranged for a student who fails to appear in in-course test/tests. A student will be able to apply to the Chairman of the department for make-up test. The Chairman will place the application before the Academic Committee of the department, only if the particular student has met with an accident or his/her parent(s) has/have expired or he/she has gone through a surgical procedure or any other such situation which the Academic Committee feels can be considered. The make-up test must be held during the course period.

(j) **The Course Final Examination (theory courses):**

i. The course final examination will be conducted centrally by the Controller of Examinations as per existing system.

ii. For evaluation of the course final examination there will be two examiners: one 1st examiner (the course teachers) and the 2nd examiner (other than the course teacher). In case of difference of more than 20% of marks between the marks given by the two examiners, there will be a 3rd examiner. Marks of nearest two examiners will be averaged to calculate the final marks for that course.

(k) **Viva-Voce/Oral Examination:** Viva-voce/Oral examination will be conducted by the respective Departmental Examination Committee, approved by the University.

(l) **The Grading System:** Marks obtained for each course will be converted to grades. A basic four point (4.00) grading scale is followed. The following letter grades and corresponding grade-points will be used to determine the student's grade point average (GPA):

Marks Obtained	Corresponding Letter Grade	Grade Point
80% or above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40% to less than 45%	D	2.00
Less than 40%	F	0.00

Note: Any fractional total marks for a course will be rounded up to next higher marks.

10.1.4 Grading Description

The explanations of letter grades are described as follows:

A: Exceptional performance, all course objectives achieved; objectives met in a consistently outstanding manner.

B: Very good performance; significantly more than the majority (at least two-thirds) of the course objectives achieved; objectives met in a consistently thorough manner.

C: Satisfactory performance; at least majority of the course objectives achieved; objectives met satisfactorily.

D: Minimally acceptable performance; less than the majority but more than the minimum required course objectives achieved; objectives achieved at a minimally acceptable level.

10.1.5 Earned Credits

A course in which a student has obtained 'D' or a higher grade will be counted as credits earned by him/her. Any course in which a student has obtained 'F' grade (failed in the course) will not be counted towards his/her earned credits.

10.1.6 Evaluation of Student's Performance

Marks obtained in in-course exam(s), class attendance and course final examination (average of

1st and 2nd examiners) of a course will be added to get total marks obtained by the students for that course and be converted to percent marks obtained for each of the individual courses. The percent marks obtained in a particular course will be converted to letter grade and GPA for each individual course. The final CGPA will be calculated as follows.

10.1.7 Calculation of GPA and CGPA

Grade Point Average (GPA) is the weighted average of the grade points obtained in all the courses passed/completed by a student in an academic year. The Grade Point Average (GPA) is computed in the following manner:

$$\text{GPA} = \frac{\sum(\text{Grade points x Credits})}{\text{Sum of Credits Attempted}}$$

The Cumulative Grade Point Average (CGPA) of 2nd year, 3rd year and 4th year results is computed by dividing the total accumulated grade points earned up to date by total credit points attempted. For the student who earned more than the required minimum of 140 credits, after successful completion of his/her 4 year graduate programme, the final CGPA will be calculated using all the credits attempted.

10.1.8 Eligibility for Appearing for Course Final Examinations

a) A student must attend **at least 75%** of the total classes held in an academic year to be eligible for appearing for the final examination of that year without paying any penalty.

b) A student attending **at least 60%** of the total classes but **less than 75%** of the total classes will be allowed to appear for the examination after paying non-collegiate fees fixed by the university.

c) A student attending **less than 60%** of the total classes will not be allowed to appear for final examination for that year/session.

10.2 Promotion

a) *Promotion from 1st year to 2nd year*

(i) A student must earn a minimum Grade Point Average (GPA) of 2.0 and must pass all the courses for promotion.

(ii) Students who failed in courses (maximum 8 credit hours), but have earned the required GPA 2.0 will be promoted on probation.

(iii) Those on probation shall appear for a retake examination as mentioned in Retake section (4) and must pass the failed courses to continue studies in the 2nd year.

b) *Promotion from 2nd year to 3rd year*

(i) A student must have earned a minimum Cumulative Grade Point Average (CGPA) of 2.25 and must have passed all the courses for promotion.

(ii) Students who failed in courses (maximum 8 credit hours) but have earned the required 2.25 CGPA will be promoted on probation.

(iii) Students who earned CGPA less than 2.25 but equal to or more than 2.0 without any 'F' grade will also be promoted on probation.

(iv) Those on probation shall appear for a retake examination as mentioned in Retake section (4) and pass the failed courses to continue studies in the 3rd year.

c) *Promotion from 3rd year to 4th year*

(i) A student must have earned a minimum Cumulative Grade Point Average (CGPA) of 2.5 and must have passed all the courses for promotion.

(ii) Students who failed in courses (maximum 8 credit hours) but have earned the required CGPA

2.5 will be promoted on probation.

(iii) Students who earned CGPA less than 2.5 but equal to or more than 2.25 without any 'F' grade will also be promoted on probation.

(iv) Those on probation shall appear in a retake examination as mentioned in Retakes section (4) and pass the failed courses to be allowed to continue studies in the 4th year.

10.3 Retake Examination (may be taken only in case of course final examination)

a) Student who has been promoted on probation for failing to earn requisite CGPA without any 'F' will be allowed to sit for retake examination for maximum 8 credits (including practical course and viva-voce), within 4-6 weeks after publication of results, conducted by the same examination committee for that year. Expenses of the retake examination (as determined by the University) must be borne by the student. After the retake examination, if the student succeeds to earn required CGPA he/she will be considered promoted, but his/her transcripts will be marked to identify the courses retaken. If any student fails to achieve the required CGPA, his/her promotion on probation will be deemed cancelled.

b) Student who failed in maximum of 8 credits of the 4th year, he/she must sit for retake examination of the failed courses, within 4-6 weeks after publication of results, conducted by the same examination committee for the year. Expenses of the retake examination (as determined by the University) must be borne by the student. After the retake examination, if a student achieves the required credits, he/she will be considered for graduation, but his/her transcript will be marked to identify the courses retaken.

10.4 Readmission

a) A Student failing to earn the requisite credits and/or GPA/CGPA (see clause 3 and 4 above) for promotion or graduation may seek readmission with the next batch. For readmission, a student will have to apply within one month after announcement of the result of the concerned year. Readmission will be allowed only after the approval of the departmental Academic Committee.

b) On readmission, a student may choose, subject to approval of the academic committee of the department, to keep grades and credits earned earlier or choose to take all or any course(s) again. Student must clearly indicate his/her choice in the application for readmission.

c) On readmission, a student may be allowed by the departmental Academic Committee to retain his/her in-course marks, earned earlier as chosen by him/her.

d) Readmission must not be allowed more than twice during the entire programme. A student will have to complete the undergraduate programme within a period of maximum six years, including readmission.

e) A student attending less than 60% classes will not be allowed to take readmission. Therefore, he/she will be dropped out of the programme forever.

10.5 Dropout

A student failing to earn the required minimum GPA/CGPA and/or to earn requisite credits after retakes, he/she may take readmission, with the approval of the academic committee of the department, to appear for the course final examinations with the next batch. If he/she fails again to earn the required minimum GPA/CGPA and/or to earn requisite credits he/she will be dropped out of the programme.

10.6 Improvement of Earned Credits

a) To improve GPA/CGPA, a student may appear in the course final examination (theory courses, practical courses and viva-voce), only once, with the following next batch in a maximum 8 credits in each year. Improved grade point will be used for GPA/CGPA calculation. For improvement of grade in a course the student shall apply to the chairman of

the department at least 8 weeks before the start date of the final examination. The transcript will carry a symbol identifying the improved courses.

b) If a student likes to improve the grade point earned in a course of 4th year, he/she must apply for such improvement examination before the award of the degree (i.e., before issuance of certificate). Improvement shall not be allowed once the degree is awarded.

10.7 Grade codes for Retakes, Readmissions and Improvements

a) If a student succeeded in a retake after promotion on probation his/her letter grade for that course will be preceded by letter **'P'**.

b) If a student succeeded after taking readmission his/her letter grade for the courses will be preceded by letter **'R'**.

c) If a student succeeded in the improvement examination for earned credits his/her letter grade for that course will be preceded by letter **'I'**.

10.8 Requirements for Graduation

a) To graduate with a Bachelor's degree, a minimum total of 140 credits with no F grade in any course must be earned by a student in the graduation programme. He/she must also have to earn the minimum required **2.5 CGPA on a 4.00 scale**.

b) A student who has fulfilled all the academic requirements for a Bachelor's degree will have to file with the Controller of Examinations, an application for graduation. Provisional degree will be awarded on completion of credit and CGPA requirements. Such provisional degree will be confirmed by the Academic Council.

10.9 Time Limits for Completion of Bachelor's Degree

A student must fulfill all the requirements for a Bachelor's degree within a maximum period of six academic years, starting from the year of registration.

10.10 Dean's Award

As a recognition of excellent performance, the names of students obtaining CGPA of 3.75 or above after successful completion of the 4 year graduation courses, will be eligible for the Dean's Award with a maximum of 05 (five) candidates from each Department. Students who have received 'F' grade/taken retakes /taken improvement/taken readmission in any course throughout the graduation programme will not be eligible for the Dean's Award. Students who failed to attend a minimum of 80% of the classes offered during his/her graduation programme will also not be eligible for the Dean's Award.

10.11 Other General Regulations

a) Respective statutory authorities of the University shall design syllabus, allocate courses for teaching, constitute examination committee and panel of examiners as per the rules of the university.

b) At the beginning of the session, a course teacher shall provide the students a course outline including: teaching approaches (e.g., labs, case studies, field work, etc.) schedule of tests and other required materials.

c) The course teacher shall announce the results of the in-course tests within two weeks of the date of holding the tests and submit the marks to the Chairman of the Examination Committee for the respective session and also a copy to the Controller of Examinations at least two weeks before start of the annual examination. He/she should also submit a statement showing the total number of classes held and the number of classes attended by each student in his/her course to the Chairman of the Examination Committee for the respective session.

d) Tabulation work will be started only after all the marks of the course final examinations for the year are received by the Chairman of Examination Committee. Marks received by the Chairman of the Examination Committee shall remain in the sealed envelope as sent by the Examiner/Examiners until tabulation work is started.

e) The present system of conducting course final examination and publication of results by the office of the Controller of Examinations shall continue.

f) For any matter not covered in these rules, the existing rule of the University of Dhaka will be applicable.

10.12. Publication of Results

The yearly and final degree results are published centrally by the Controller of Examination Office of the university. The results are published within 4-6 weeks after completion of course final examinations. The results indicate the letter grade as well as average CGPA earned by an individual student.

10.13. Relevancy of Syllabus of the Department of Zoology, University of Dhaka to the SDGs (Sustainable Development Goals) in Bangladesh

SDGs	**Relevancy of Syllabus to the SDGs**
Goal 1: No poverty 	Undergraduate Course: Zool. 304; Zool. 305.
Goal 2: Zero hunger 	Undergraduate Course: Zool. 208; Zool. 305; Zool. 306; Zool. 402; Zool. 406; Zool. 409.
Goal 3: Good health and well-being for people 	Undergraduate Course: Zool. 208; Zool. 302; Zool. 305; Zool. 4306; Zool. 402; Zool. 405; Zool. 406; Zool. 407; Zool. 408; Zool. 409.
Goal 4: Quality education 	The department has adopted Outcome Based Education. The curriculum has been updated. The program will be regularly evaluated as per OBE principles and revised, as necessary, to ensure quality education.
Goal 5: Gender equality 	Zool. 305.

SDGs	**Relevancy of Syllabus to the SDGs**
Goal 6: Clean water and sanitation 	Undergraduate Course: Zool. 102; Zool. 103; Zool. 104; Zool. 105; Zool. 106; Zool. 306; Zool. 406.
Goal 9: Industry, Innovation, and Infrastructure 	Undergraduate Course: Zool. 204; Zool. 208; Zool. 406; Zool. 407; Zool. 409.
Goal 10: Reducing inequalities 	Undergraduate Course: Zool. 208; Zool. 406.
Goal 12: Responsible consumption and production 	Undergraduate Course: Zool. 208; Zool. 302; Zool. 306; Zool. 402; Zool. 405; Zool. 406; Zool. 407; Zool. 408; Zool. 409.
Goal 13: Climate action 	Undergraduate Course: Zool. 304; Zool. 306; Zool. 402; Zool. 405; Zool. 406; Zool. 407; Zool. 408; Zool. 409.
Goal 14: Life below water 	Undergraduate Course: Zool. 102; Zool. 103; Zool. 104; Zool. 105; Zool. 106; Zool. 201; Zool. 202; Zool. 203; Zool. 204; Zool. 207; Zool. 208; Zool. 301; Zool. 302; Zool. 303; Zool. 304; Zool. 307; Zool. 402; Zool. 405; Zool. 406; Zool. 407; Zool. 408; Zool. 409.
Goal 15: Life on land 	Undergraduate Course: Zool. 101; Zool. 102; Zool. 104; Zool. 105; Zool. 106; Zool. 201; Zool. 202; Zool. 203; Zool. 204; Zool. 205; Zool. 206; Zool. 207; Zool. 208; Zool. 402; Zool. 405; Zool. 407; Zool. 408; Zool. 409.
Goal 16: Peace, justice and strong institutions 	Undergraduate Course: Zool. 208; Zool. 402
Goal 17: Partnerships for the goals 	The department has collaboration and partnership with a number foreign and national universities, research organizations and NGOs to achieve its goal.

10.14 Academic Year-Wise Distribution of Courses and Credits

FIRST YEAR

Departmental courses

Zool. 101	Introductory Zoology	3 credits
Zool. 102	Protozoology	2 credits
Zool. 103	Porifera, Cnidaria and Ctenophora	2 credits
Zool. 104	Platyhelminthes and Nematoda	2 credits
Zool. 105	Mollusca and Annelida	2 credits
Zool. 106	Arthropoda and Echinodermata	2 credits
Zool. 109	Field Study (Invertebrate Diversity)	1 Credit
Zool. 110	Practical	4 credits
Zool. 111	Viva-voce	2 credits

Extra-Departmental courses

Bot. 001	Botany- I (including practical)	4 credits
BMB. 11	Biochemistry and Molecular Biology (including practical)	4 credits
		Total: 28 credits

SECOND YEAR

Departmental courses

Zool. 201	Minor Phyla and Lower Chordates	2 credits
Zool. 202	Chondrichthyes and Osteichthyes	2 credits
Zool. 203	Amphibia and Reptilia	2 credits
Zool. 204	Aves and Mammalia	2 credits
Zool. 205	Cytology and Histology	2 credits
Zool. 206	Developmental Biology	2 credits
Zool. 207	Animal Systematics and Nomenclature	2 credits
Zool. 208	Applied and Economic Zoology	3 credits
Zool. 209	Field Study (Vertebrate Diversity)	1 credit
Zool. 210	Practical	4 credits
Zool. 211	Viva-voce	2 credits

Extra-Departmental courses

Bot. 002	Botany-II (including practical)	4 credits
Microbiol. 200	Microbiology (including practical)	4 credits
	Total:	**32 credits**

THIRD YEAR

Departmental courses

Zool. 301	Comparative Vertebrate Zoology	4 credits
Zool. 302	Animal Genetics	2 credits
Zool. 303	Animal Behavior, Welfare and Ethics	3 credits
Zool. 304	Fundamental and Advanced Ecology	4 credits
Zool. 305	Human Physiology, Reproduction & Family Planning and Population Studies	4 credits

Zool. 306	Environmental Pollution and Human Ecology	3 credits
Zool. 307	Evolution, Zoogeography and Paleontology	3 credits
Zool. 308	Neurobiology and Endocrinology	2 credits
Zool. 309	Ecological field studies in terrestrial and aquatic ecosystems	2 credits
Zool. 310	Practical	8 credits
Zool. 311	Viva-voce	2 credits
	Total:	**38 credits**

FOURTH YEAR

Departmental courses

Zool. 401	Biodiversity, Biodiversity Conservation and Bioresource Management	3 credits
Zool. 402	Radiation Biology and Biosafety Regulation	3 credits
Zool. 403	Biostatistics	2 credits
Zool. 404	Research Methodology	2 credits
Zool. 405	Entomology	4 credits
Zool. 406	Fisheries and Aquaculture	4 credits
Zool. 407	Wildlife and Wildlife Management	4 credits
Zool. 408	General Parasitology	4 credits
Zool. 409	Molecular Genetics	4 credits
Zool. 410	Ecological field studies in Mangrove ecosystems	2 credits
Zool. 411	Practical	8 credits
Zool. 412	Viva-voce	2 credits
	Total:	**42 credits**

11. Graduate Attributes (GAs)

GAs	Description
GA1	Comprehensive knowledge and understanding of the subject areas, and the ability to applying their knowledge in multidisciplinary areas.
GA2	Digital skills to compete with the different aspects of Zoology
GA3	Application of critical thinking in innovative and problem- solving aptitudes.
GA4	Creative responses and advanced thinking should be applied to combat the future challenges.
GA5	Professional development in applying the entrepreneurial and take leadership roles in their chosen occupations.
GA6	Self-awareness and reflective attitudes of the graduates.
GA7	Carries social values and ethics in society development as a responsible member of the valued society.
GA8	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

12. Program Educational Objective (PEOs):

PEOs	Description
PEO1	**Develop Expertise in Animal Sciences:** Graduates will acquire both fundamental and advanced knowledge in zoology, encompassing subjects such as taxonomy, animal physiology, genetics, evolution, ecology, and conservation.
PEO2	**Foster Research and Analytical Skills**: Graduates will be prepared to conduct, design, and analyze research in the disciplines of zoology and biology, thereby contributing to the advancement of science and the resolution of problems in related fields.
PEO3	**Develop solutions to national and international problems:** Graduates will be able to generate new ideas, concept and technologies to solve contemporary problems related to biology, food security, health, economic development, environment and climate change.
PEO4	**Promote Environmental and Conservation Awareness**: Graduates will be capable of applying zoological principles to address ecological and environmental challenges, emphasizing the value of biodiversity, conservation and sustainable practices.
PEO5	**Prepare for Professional and Ethical Practices**: Graduates will be equipped for professions in government, business, research, and academia while upholding moral principles and exhibiting strong leadership, collaboration, and communication abilities.
PEO6	**Encourage Lifelong Learning, Innovation and Entrepreneurship**: Graduates will engage in lifelong learning, adapt to advancements in biological sciences, and apply innovative and sustainable solutions to zoological and environmental challenges, fostering entrepreneurship and professional growth.

13. Program Learning Outcomes (PLOs):

Following program completion, students will be qualified to:

PLOs	Statements
PLO1	Demonstrate comprehensive knowledge of fundamental principles and advanced concepts in zoology, including animal biology, ecology, physiology, genetics, evolution, taxonomy, and developmental biology. (Knowledge/Remembering)
PLO2	Recognize the ecological roles of animals, analyze the interrelationships between organisms and their environments, understand conservation issues, and apply knowledge to promote biodiversity and environmental sustainability, with awareness of how these efforts support ecosystem health and services. (Comprehension/Understanding)
PLO3	Develop and apply critical thinking and analytical skills to conduct research in zoology, including designing experiments, collecting and analyzing biological data, interpreting results, and making evidence-based conclusions. (Critical thinking/Applying)
PLO4	Engage in lifelong learning to stay current in zoological sciences, demonstrating adaptability and a commitment to innovation in addressing biological challenges. (Application/Applying)
PLO5	Perform essential field and laboratory techniques with precision and safety, demonstrating skills in specimen handling, microscopy, data collection, and experimental design. (Application/Applying)
PLO6	Apply knowledge of ecological, physiological, and immunological relationships among hosts, parasites, and pests to devise strategies to mitigate their impacts on human and animal health (One Health approach). (Analysis/Analyzing)
PLO7	Integrate knowledge from related disciplines to understand complex biological systems, apply scientific reasoning, and solve real-world issues in animal biology, production, conservation, and related fields. (Synthesis/Creating)
PLO8	Effectively communicate scientific findings and ideas in written, oral, and digital forms to diverse audiences, including scientists, policymakers, and the public; collaborate productively within multidisciplinary teams. (Synthesis/Creating)
PLO9	Uphold ethical standards in research, environmental stewardship, and professional interactions, demonstrating a commitment to responsible conduct in science. (Evaluation/Evaluating)

14. Mapping mission of the university with PEOs:

PEOs	UM1	UM2	UM3	UM4	UM5	UM6	UM7
PEO1	3	2	1	1	1	2	2
PEO2	3	3	3	3	3	3	3
PEO3	3	2	2	3	3	3	2
PEO4	3	2	3	2	3	3	2
PEO5	2	3	1	2	1	2	3
PEO6	3	3	2	3	2	2	3

Level of correction: *(1) Weak; (2) Moderate; and (3) Strong.*

15. Mapping PLOs with PEOs:

PLOs	PEO 1	PEO 2	PEO 3	PEO 4	PEO 5
PLO1	√	√	√		√
PLO2	√	√		√	
PLO3	√	√	√	√	
PLO4	√	√	√	√	√
PLO5	√	√	√		
PLO6	√	√	√		√
PLO7	√	√	√	√	√
PLO8	√	√	√	√	
PLO9		√	√		√

16. Mapping courses with the PLOs:

Courses	Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
Zool. 101	Introductory Zoology	√	√	√	√	√				
Zool. 102	Protozoology	√	√	√	√		√			
Zool. 103	Porifera, Cnidaria and Ctenophora	√	√	√		√	√	√	√	
Zool. 104	Platyhelminthes and Nematoda	√	√	√	√		√			
Zool. 105	Mollusca and Annelida	√	√				√			
Zool. 106	Arthropoda and Echinodermata	√	√	√	√		√			
Zool. 109	Field Study (Invertebrate diversity)	√	√	√	√	√		√	√	√
Zool. 110	Practical	√	√	√				√	√	√
Zool. 111	Viva	√	√			√	√	√		
Zool. 1001	Animal Diversity	√	√	√	√	√	√	√	√	√
Zool. 201	Minor phyla and Lower chordates	√	√					√	√	
Zool. 202	Chondrichthyes and Osteichthyes	√	√	√	√	√	√			
Zool. 203	Animal Diversity IV: Amphibia to Reptilia	√		√	√	√	√	√		
Zool. 204	Aves and Mammalia	√	√							
Zool. 205	Cytology and Histology	√	√	√	√	√	√	√	√	
Zool. 206	Developmental Biology	√	√	√	√	√				
Zool. 207	Animal Systematics and Nomenclature	√	√	√		√			√	√
Zool. 208	Economic and Applied Zoology	√	√	√	√	√	√	√		

Courses	Title	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
Zool. 209	Field Study (Vertebrate Diversity)	√	√	√	√	√		√	√	√
Zool. 210	Practical	√	√	√		√		√	√	√
Zool. 211	Viva-voce						√	√		√
Zool. 301	Comparative Vertebrate Zoology	√	√	√			√		√	
Zool. 302	Animal Genetics	√	√	√	√	√	√	√	√	
Zool. 303	Ethology and Animal Welfare	√	√	√	√		√	√		√
Zool. 304	Fundamental and Advanced Ecology	√	√	√	√					
Zool. 305	Human Physiology, and Population Studies	√	√		√		√			
Zool. 306	Environmental Pollution and Human Ecology	√	√	√	√	√			√	√
Zool. 307	Evolution, Palaeontology and Zoogeography	√	√	√	√			√		
Zool. 308	Neurobiology and Endocrinology	√	√		√	√	√	√		√
Zool. 309	Terrestrial and Aquatic Ecosystem Visit	√	√	√		√			√	√
Zool. 310	Practical	√	√	√		√				
Zool. 311	Viva-voce			√				√		√
Zool. 401	Biodiversity, and Bioresource Management	√	√	√	√			√		
Zool. 402	Radiation biology and biosafety regulations	√	√			√	√		√	√
Zool. 403	Biostatistics	√	√	√	√			√		
Zool. 404	Research Methodology			√	√				√	√
Zool. 405	Entomology	√	√	√				√	√	
Zool. 406	Fisheries and Aquaculture	√	√	√		√	√	√		
Zool. 407	Wildlife and Wildlife Management	√	√			√			√	
Zool. 408	General Parasitology	√	√	√	√		√			
Zool. 409	Molecular Genetics	√		√	√	√	√			√
Zool. 410	Mangrove Ecosystem Visit	√	√	√		√			√	√
Zool. 411	Practical	√	√	√		√	√	√	√	√
Zool. 412	Viva-voce			√				√	√	√

First Year Undergraduate Programme in Zoology

Guidelines for the Letter Grading System for the Undergraduate Programme

Applicable for the Sessions 2024-2025, 2025-2026, 2026-2027, and 2027-2028

Outcome- Based Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 101	**Introductory Zoology**	**Core course**	**3**	**45**	**75**

Prerequisites: As per the University requirements for admission into the program.

Rationale of the course

Introductory Zoology, the opening course of the four-year Undergraduate programme, builds the conceptual scaffold for all later study. It surveys life's origins, animal diversity, and the hierarchical organisation of living systems—from molecules to biosphere—showing how energy and matter move through food chains and ecosystems. Students master essential zoological terminology, classification principles, and species concepts while gaining hands-on practice in ethical field techniques for surveying, collecting, and documenting fauna. Local case studies on Bangladesh's threatened wildlife and protected areas embed global ideas in a national context and foster a conservation ethic. By the end of the semester, learners hold a clear mental map of zoology's major sub-disciplines, recognise their interconnections, and can envision academic and professional pathways in research, education, and biodiversity management.

Specific objectives of the course

By the end of the course, students will be able to:

- Gain familiarity with major disciplines of Zoological sciences.
- Develop an understanding of the basis and scheme of animal classification and the functional and structural organizations in an animal body at different levels.
- Broaden their knowledge of key concepts such as phylogeny, evolution, animal identification, pollution, habitat, ecosystem, food chains, gene cloning, and related topics.
- Strengthen their skills in conducting animal surveys, monitoring, and conserving biodiversity.

Mapping with SDGs

This course is relevant to achieve SDG goals 4 (quality education), 14 (life below water) and 15 (life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	Define introduction to zoology as a subject (Apply).	PLO1
CLO2	Describe origin and emergence of life (Understand).	PLO1, PLO2
CLO3	Relate the organization of animal body (Analyze).	PLO1, PLO4
CLO4	State the basis of animal classification (Understand, Remember).	PLO1, PLO4, PLO5
CLO5	Describe the Functional organization and integration of animal body	PLO1,

	(Understand).	PLO5
CLO6	Levels of organization in organisms (Analyze, Understand).	PLO1, PLO5
CLO7	Discuss the concept of species (Understand).	PLO1, PLO2
CLO8	Illustrate the overview of animal classification system (Apply).	PLO1, PLO2
CLO9	Explain the methods of studying animals (Understand).	PLO1, PLO3
CLO10	Prepare a report on field observation of animal (Evaluate)	PLO1, PLO3
CLO11	Distinguish between habitat, ecosystem, biodiversity and faunal diversity (Analyze).	PLO1, PLO2
CLO12	Compare protected areas versus protected and threatened animals (Create).	PLO1, PLO2
CLO13	Express the causes and effects of environmental pollution (Understand).	PLO1, PLO2

Outcome- Based Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
4	**Introduction to Zoology:** Definition, scope, emergence of zoology as a subject. Branches of Zoology and their relation to other branches of science. History of the development of zoological studies in Bangladesh.	**CLO1**	Interactive lectures, diagrams, visuals, discussions	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
5	**Origin and emergence of life:** Early earth and the origin of life; major events in the history of life; geological time scale and emergence of various animal groups; law of recapitulation; concept of phylogeny; phylogenetic relationship and phylogenetic tree; fossils, concept of evolution.	**CLO2**		
3	**Organization in animal body:** Body constituents; biological molecules (biomolecules); cell- cytoplasm and nucleus; tissue, organs; organ systems**.**	**CLO3**		
4	**Basis of animal classification:** Cell differentiation; germ layers; coelom, symmetry, segmentation (metamerism); tagmatization, body coverings; appendages, skeleton, etc	**CLO4**		
3	**Functional organization and integration of animal body:** Gene and gene function, DNA, nervous and hormonal regulation, homeostasis.	**CLO5**		
3	**Levels of organization in organisms**: Pre-cellular level - biomolecule; sub-cellular level -	**CLO6**		

	organelle; cellular level - cell; Multi-cellular level – tissue; organ, organ system; organism. Level of organization in ecosystem - individual, population, community, ecosystem, biome, biosphere and ecosphere.			
2	**Concepts of animal species and nomenclature: Species**, sub-species, variety, sibling species, overview of naming of species.	**CLO7**		
3	**Overview of animal classification and taxonomy:** History of classification and classification system, taxonomic categories, taxonomic keys and characters and their uses	**CLO8**		
2	**Methods of studying animals:** Collection (sampling), transportation, preservation, identification, description, reference materials and publication.	**CLO9**		
2	**Field observation of animal:** Concept of survey and monitoring of animal; qualitative and quantitative observation and methods of observation of different animal groups. Beneficial and harmful organisms/animals. Animals used as food and other commercial and aesthetic values.	**CLO10**		
4	**Habitat:** Concept and types, major habitats in Bangladesh - terrestrial, freshwater, estuary and sea water. **Ecosystem:** Concept, food chain, food web, ecological niche, biomass, ecological pyramid, ecological footprints. **Biodiversity:** Concept, components, importance and values, bioresources – threats and conservation importance. **Animal diversity:** Terminology related to fauna; faunal diversity with special reference to Bangladesh.	**CLO11**		
4	**Protected areas:** Concept, types, purposes, designated protected areas of Bangladesh (national park, wildlife sanctuary, safari park, community conserved areas, ecologically critical areas, Ramsar site, World heritage site). **Protected and threatened animals:** Definitions, purposes, categories, IUCN's categories of threatened animals, protected animals of Bangladesh, Salient features of Wildlife (Conservation and Security) Act, 2012 of Bangladesh.	**CLO12**		
2	**Environmental pollution:** Air, water and noise pollution (an outline of causes and effects only).	**CLO13**		

*** Per week 2 classes**

Distribution of class lectures: Total number of lectures: 45

Class/ lecture type	Number of classes	Class/ lecture type	Number of classes
Lecture with discussion (including three classes for Students' group presentation, if required for the course)	41	In-course examination	2
		Review class	2

Outcome- Based Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 26.25 marks and 3.75 marks will be for class attendance. The course final examination, comprising 45 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (26.25 marks), Attendance: 3.75 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	6.25	
2. Understand	7	
3. Apply	7	
4. Analyze	3	
5. Evaluate	3	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 45)	Test
1.Remember	15
2.Understand	15
3.Apply	10
4.Analyze	5
5.Evaluate	
6.Create	

Outcome- Based Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. 2001. The Invertebrates: A synthesis. Blackwell Scientific Publications, Oxford, UK. Bashar, M.A. 2004. Instant Basics of Environment. Positron Publications. Dhaka. Gilbert, S.F. 2006. Developmental Biology. Sinauer Associates Inc., USA. Groombridge, B. 1992. Global Biodiversity. World Conservation Monitoring Centre. Global Biodiversity: Status of the Earth's living resources. Chapman & Hall, London. Hickman Jr., C. Keen, S. Eisenhour, D., Larson, A., I'Anson, H. 2023. Integrated Principles of Zoology. 19th edition. McGraw-Hill Co. Inc., New York, USA. Jeffries, M.J. 1997. Biodiversity and Conservation. Routledge, London and New York. Miller, G., Andrews-Brown, D., and Spoolman, S. 2024. Environmental Science. 17th edn., Cengage Learning, Pacific Grove, CA,USA. Odum, E.P. and Barrett, G.W. 2005. Fundamentals of Ecology. 5th edition. Thomson Brooks/Cole Publishing Co., USA. Storer, Tracy I., Usinger, Robert L., Stebbins, Robert C., Nybakken, James W. 1979. General Zoology, 6th Edn. McGraw-Hill Companies, New York, U.S.A. Turk, J and Turk, A, 1988. Environmental Science, Saunders College Pub., NY, USA.
Supplementary Readings	IUCN. 1994. Guidelines for Protected Area Management Categories. IUCN. 2015. Red list of Bangladesh. Vol. 1 to 7. Forest Department, MoEF&CC, GoB. Dhaka, Bangladesh. Karp, G. 2005. Cell and Molecular Biology (Concept and Experiments). 4th edition. John Wiley and Sons Inc., New York. Kolbert, Elizabeth. 2014. The Sixth Extinction: An Unnatural History. Henry Holt and Co.New York, USA.

Visiting hours: 9:00 am to 5:00 pm on the working days (if available).

Outcome- Based Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 102	**Protozoology**	**Core course**	**2**	**30**	**50**

Prerequisites: As per University's requirements for the admission into program.

Rationale of the course
Protozoa are the simplest but diverged group of unicellular sub-kingdoms of animals. This sub-kingdom is represented by a wide variety of animals distributed all over the world. Protozoa constitute a vast majority of the animal kingdom. This group has tremendous economic importance since a large number of protozoa act as disease-causing agents in both man and other animals.

Specific objectives of the course
By the end of the course, students will be able to:

- Explain the diversity and variety of protozoan species in detail.
- Identify different protozoans based on the classification system.
- Describe the biology and organelles of protozoa by a type study from each relevant group.
- Develop the ability to compare and differentiate between various protozoan groups.
- Learn about the disease-causing protozoans and their control measures in brief.

Mapping with SDGs
This course is relevant to achieving SDG3 (Good health and well-being), SDG4 (Quality education), SDG14 (Life below water), and SDG15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	Identify and classify the protozoans with distinguishing characters (Apply)	PLO1, PLO3
CLO2	Describe the different functional systems of protozoans with appropriate schematic diagrams (Understand)	PLO2, PLO4
CLO3	Describe the ecology, food and feeding, reproduction and developmental stages of that particular animal groups (Understand)	PLO1, PLO6
CLO4	Compare the organ systems in different groups of animals under this phylum (Apply)	PLO1, PLO2

Outcome- Based Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
1	**Diversity:** Introduction protozoan diversity.	**CLO1**		
5	**Classification**: Detailed classification up to orders with characteristics and examples of	**CLO2**		

	Protozoa.		Interactive lectures, diagrams, visuals, discussions	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
4	**Groups of Protozoa:** Characteristics and examples of the protozoan phyla belonging to the following categories: flagellated Protozoa; amoeboid Protozoa; spore-forming Protozoa; and ciliated Protozoa.	**CLO3**		
6	**Type study:** Systematic position, habitat, morphology, development, special features (if any) and major systems of the following protozoan species: a. *Euglena viridis,* b. *Paramecium caudatum* and c. *Entamoeba histolytica.*	**CLO4**		
4	**Short description:** Short description of habit and habitat, food and feeding, breeding and economic importance of the following protozoans: Flagellated Protozoa: *Ceratium, Trypanosoma, Leishmania, Opalina;* Amoeboid Protozoa: *Amoeba, Actinophrys, Globigerina;* Spore-forming Protozoa: *Monocystis, Gregarina, Toxoplasma, Nosema* and Ciliated Protozoa: *Vorticella.*	**CLO1**		
6	**Comparative study:** Body coverings and skeletal structures; locomotor organelles and locomotion; reproduction; nuclear apparatus; and nutrition. (Note: The four types of Protozoa, viz.: flagellated, amoeboid, spore-forming and ciliated Protozoa, are to be compared on the basis of these characteristics).	**CLO2**		

*** Per week 2 classes**

Distribution of class lectures: Total number of lecture: 30

Class/ lecture type	**Number of classes**	**Class/ lecture type**	**Number of classes**
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	28	In-course examination	1
		Review class	1

Outcome- Based Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern
There will be one in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	4	
2. Understand	4	
3. Apply	3	
4. Analyze	2.5	
5. Evaluate	2	
6. Create	2	

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	10
2.Understand	10
3.Apply	5
4.Analyze	5
5.Evaluate	
6.Create	

Outcome- Based Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Storer, T.I., Usinger, R.L., Stebbins, R.C. and Nybakken, J.W. 2001. *General Zoology*. 6th edition. Tata McGraw-Hill Co. Ltd., New Delhi, India. (Free download: https://www.goodreads.com/book /show/4452321-general-zoology). Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. 2001. *The Invertebrates: A synthesis.* Blackwell Scientific Publications, Oxford, UK. Hickman, C.P., Roberts, L.S. and Larson, A. 2001. *Integrated Principles of Zoology*. 11th edition. McGraw-Hill Co. Inc., New York, USA. (PDF available: http://www.ciens.ucv.ve).
Supplementary Reading	Roberts, L. S. and Janovy, Jr. J. Foundations of Parasitology. 6th edition. Wm. C. Brown Publishers. USA.

Visiting hours: 9:00 am to 5:00 pm on the working days (if available).

Outcome- Based Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 103	**Porifera, Cnidaria and Ctenophora**	Core course	2	30	50

Prerequisites: As per the University requirements for admission into the program.

Rationale of the course

This course provides a foundational understanding of three basal invertebrate phyla - Porifera, Cnidaria, and Ctenophora - focusing on their taxonomy, anatomy, physiology, development, ecological roles, and evolutionary relationships. Through comparative studies and type specimens, students will gain essential knowledge to classify these animals and appreciate their biological and ecological significance.

Specific objectives of the course

By the end of the course, students will be able to:

- Classify Porifera, Cnidaria, and Ctenophora up to orders with examples and diagnostic features.
- Describe the structure, systems, development, and adaptations of representative species.
- Compare structural and functional characteristics across and within phyla.
- Explain ecological roles, economic importance, and evolutionary affinities of these groups.
- Apply knowledge in identifying specimens using morphological and diagnostic features.

Mapping with SDGs

This course supports SDG 4 (Quality Education) by fostering fundamental zoological knowledge and SDG 14 (Life Below Water) by promoting an understanding of marine biodiversity, including coral reefs and ecosystem conservation.

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to		PLO covered
CLO1	Classify Porifera, Cnidaria, and Ctenophora up to orders with examples and diagnostic traits.	PLO1, PLO2, PLO3
CLO2	Describe the form, function, and development of key type species (e.g., *Scypha*, *Obelia*, *Hormiphora*).	PLO2, PLO5
CLO3	Compare body organization, reproduction, and physiology across Porifera, Cnidaria, and Ctenophora.	PLO2, PLO5, PLO6
CLO4	Discuss selected taxa's ecology, habitat, feeding, breeding, and economic aspects.	PLO1, PLO6, PLO8
CLO5	Evaluate phylogenetic relationships and affinities among basal metazoans.	PLO1, PLO7, PLO8

Outcome- Based Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
1	**Phylum Porifera:** Classification of the phylum Porifera up to orders with diagnostic and general characteristics and examples of each taxonomic category.	**CLO1**	Interactive lectures, diagrams, visuals, discussion	Assignment/ Presentation /Oral presentation, Class attendance, In-course Exam and Final theory Exam
3	**Type study**: Systematic position, habitat, morphology, development, special features (if any) and major systems of *Scypha* sp.	**CLO2**		
3	**Comparative study of Porifera**: Body wall and cell types; skeletal structures; canal systems; reproduction and development; (Note: different classes of sponges are to be compared on the basis of these characteristics).	**CLO3**		
2	**Short description**: Habit and habitat, food and feeding, breeding and economic importance of the following sponges: *Spongilla, Oscarella, Cliona, Chalina* and *Euspongia.*	**CLO4**		
1	Affinities and phylogenetic position of Porifera.	**CLO5**		
1	**Phylum Cnidaria:** Classification of the phylum Cnidaria up to orders with diagnostic and general characteristics with examples of each taxonomic category.	**CLO1**		
4	**Type study**: Systematic position, habitat, morphology, development, special features (if any) and major systems of the following Cnidaria species: a. *Obelia geniculata* and b. *Aurelia aurita*.	**CLO2**		
2	**Comparative study of Cnidaria**: Cnidarian tissues, polymorphism and metagenesis. (Note: The different classes of cnidarians are to be compared on the basis of these characteristics).	**CLO3**		
2	**Short description**: Habit and habitat, food and feeding, breeding and economic importance of the following cnidarians: *Physalia, Cyanea, Cassiopea, Tubipora, Pennatula, Renilla, Adamsia* and *Gorgonia*.	**CLO4**		
2	**Coral:** Coral reef, coral reef formation and distribution.	**CLO4**		
1	**Phylum Ctenophora:** Classification of the phylum Ctenophora up to orders with diagnostic and general characteristics with examples.	**CLO1**		
3	**Type study**: Systematic position, habitat, morphology, development, special features (if any) and major systems of *Hormiphora [=Pleurobrachia];* its affinities with other animals.	**CLO2 CLO5**		
1	**Short description**: Habit and habitat, food and feeding, breeding and economic importance of the following ctenophores: *Cestum* and *Beroe*.	**CLO4**		

***Per week 2 classes**

Distribution of class lectures: Total number of lecture: 30

Class/ lecture type	Number of classes	Class/ lecture type	Number of classes
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	28	In-course examination	1
		Review class	1

Outcome- Based Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	2.5	
2. Understand	5	
3. Apply	5	
4. Analyze	3	
5. Evaluate	2	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	5
2.Understand	10
3.Apply	7
4.Analyze	5
5.Evaluate	3
6.Create	

Outcome- Based Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Barnes, R.D. 1980. *Invertebrate Zoology*. WB Saunders Co., Philadelphia, USA. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. 2001.

	The Invertebrates: A synthesis. Blackwell Scientific Publications, Oxford, UK. Hickman, C.P., Roberts, L.S. and Larson, A. 2001. *Integrated Principles of Zoology*. 11th edition. McGraw-Hill Co. Inc., New York, USA. Ruppert, E.E. and Barnes, R.D. 1994. *Invertebrate Zoology.* 6th edition. Saunders College Publishing Co., New York. Storer, T.I., Usinger, R.L., Stebbins, R.C. and Nybakken, J.W. 2001. *General Zoology*. 6th edition. Tata McGraw-Hill Co. Ltd., New Delhi, India.
Supplementary Reading	Informed by the course teacher from time to time.

Visiting hours: 9:00 am to 5:00 pm on the working days (if available).

Outcome- Based Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 104	**Platyhelminthes and Nematoda**	**Core course**	**2**	**30**	**50**

Prerequisites: As per the University requirements for admission into the program.

Rationale of the course

The course offers learning opportunities for the students on the range of diversity of the groups through studying classification and the morphological, anatomical, and functional organization of the body by studying types of animals representing different classes under the two phyla. The course also provides a comparative account of various organ systems within each phylum. The course will also discuss adaptive radiation and the mode of life of parasitic animals, their habits and habitats, reproduction, and the importance and evolutionary significance of these two groups of animals.

Specific objectives of the course

By the end of the course, students will be able to:

- Classify the phyla Platyhelminthes and Nematoda.
- Describe morphological characters, anatomical features, and functional systems of representative animals of the two groups.
- Understand the parasitic adaptation and development, including structural forms and functions, and the pathogenic importance of the host-parasite relationship.

Mapping with SDGs

This course is relevant to achieving SDG3 (Good health and wellbeing), SDG4 (Quality education), SDG6 (Clean water and sanitation), SDG14 (Life below water), and SDG15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	Identify and classify the platyhelminthes and nematoda with distinguishing characters (Apply)	PLO1, PLO3
CLO2	Describe the different functional systems of platyhelminthes and nematoda with appropriate schematic diagrams (Understand)	PLO2, PLO4
CLO3	Describe the ecology, food and feeding, reproduction, and transmission of developmental stages of that particular animal groups (Understand)	PLO1, PLO6
CLO4	Compare the organ systems and pathological effects in different groups of animals under this phylum (Apply)	PLO1, PLO2

Outcome- Based Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
3	**Phylum Platyhelminthes:** Classification of the phylum Platyhelminthes up to orders with diagnostic and general characteristics with examples.	**CLO1**	Interactive lectures, diagrams, visuals, discussions	Class attendance, Oral Presentation, In-course Exam and Final Theory Exam
7	**Type study:** Systematic position, habitat, morphology, special features (if any) development, and major systems of the following Platyhelminthes species: *Dugesia sp., Fasciola hepatica* and *Taenia solium.*	**CLO2**		
4	**Short description**: Habit and habitat, food and feeding, breeding and economic importance of the 15 following Platyhelminthes: *Convoluta, Polystomum, Aspidogaster, Schistosoma, Gyrocotyle, Diphyllobothrium and Hymenolopis*.	**CLO3**		
4	**Comparative study of Arthropoda**: Parasitic adaptations, holdfast organs; life-cycle patterns and larval forms. (Note: Different classes of Platyhelminthes are to be compared on the basis of these characteristics).	**CLO4**		
3	**Phylum Nematoda:** Classification of the phylum Nematoda up to orders with diagnostic and general characteristics and examples.	**CLO1**		
2	**Type study:** Systematic position, habitat, morphology, development, special features (if any) and major systems of *Ascaris lumbricoides.*	**CLO2**		
3	**Short description**: Habit and habitat, food and feeding, breeding and economic importance of the following nematodes: *Ancylostoma, Enterobius, Wuchereria, Trichinella, Meloidogyne, Dracunculus, Loa* and *Trichuris.*	**CLO3**		

*** Per week 2 classes**

Distribution of class lectures: Total number of lecture: 30

Class/ lecture type	Number of classes	Class/ lecture type	Number of classes
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	28	In-course examination	1
		Review class	1

Outcome- Based Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	5	
2. Understand	5	
3. Apply	7.5	
4. Analyze		
5. Evaluate		
6. Create		

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	5
2.Understand	10
3.Apply	15
4.Analyze	
5.Evaluate	
6.Create	

Outcome- Based Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Cheng, T.C. 1997. General Parasitology. Academic Press, New York. Schmidt, G.D. and Roberts, L.S. 1996. Foundations of Parasitology. W. C. Brown Publishers, USA. Chatterjee, K.D. 2009. Parasitology, protozoology and helminthology. CBS Publishers and Distributors Pvt. Ltd. New Delhi, India.
Supplementary Reading	Storer, T.I., Usinger, R.L., Stebbins, R.C. and Nybakken, J.W. 2001. *General Zoology*. 6th edition. Tata McGraw-Hill Co. Ltd., New Delhi, India. (Free download: https://www.goodreads.com/book /show/4452321-general-zoology).

Visiting hours: 9:00 am to 5:00 pm on the working days (if available).

Outcome- Based Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 105	**Mollusca and Annelida**	**Core course**	**2**	**30**	**50**

Prerequisites: As per the University requirements for admission into the program.

Rationale of the course

The phylum Mollusca is a diverse and economically important amazing group of animals, comprising more than 100,000 species. The annelids are also a diverse and ecologically important group of animals with different schemes of organization of the body and functional peculiarities. The course will expose the students to these two fascinating groups of animals and offer learning opportunities on the diversity and biology of these two groups. In particular, the major focuses of the course include detailed classification of each of the groups, study of the structural and functional systems based on the study of the types of animals, and aspects of their habitat, food and feeding, reproduction, adaptation, and economic importance.

Specific objectives of the course

By the end of the course, students will be able to:

- Describe the mollusks and annelids, including their classifications, habits, habitats, and distributions;
- Compare the morphological and anatomical details of different functional systems of a molluscan and an annelid;
- Explain the ecological, biological, and economic importance of the representative animals of mollusks and annelids.

Mapping with SDGs

This course is relevant to achieving SDG4 (Quality education), SDG14 (Life below water), and SDG15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	Recall the position and status of molluscan and annelid fauna in the animal kingdom. (Remember)	PLO1
CLO2	Understand and state the general characters of molluscan and annelid animals. (Understand)	PLO1
CLO3	Classify the phylum Mollusca and Annelida with taxonomic characteristics and examples. (Understand)	PLO1
CLO4	Describe the organ structures of different body systems of representative molluscan (*Pila globosa*) and annelid (*Neries*) organisms. (Analyze)	PLO1
CLO5	Compare the morphological structures of some organ and organ systems among different molluscan animals.	PLO1, PLO2
CLO6	Compare the morphological structures of major organ and organ systems among annelids animals. (Analyze)	PLO1, PLO2
CLO7	Assess the habit, habitat, morphological peculiarities, economic importances of different molluscs and annelids. (Apply)	PLO2, PLO6

Outcome- Based Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
5	**Phylum Mollusca:** Classification of the phylum Mollusca up to orders with diagnostic and general characteristics and examples. **Phylum Mollusca**: Classification of the phylum Annelida up to orders with diagnostic and general characteristics with examples of each taxonomic category.	**CLO1, CLO2, CLO3**	Interactive lectures, diagrams, visuals, discussions	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
12	**Type study**: Systematic position, habitat, development, morphological features and major physiological systems of *Pila globosa*. **Type study**: Systematic position, habitat, development, special features (if any) and major systems of *Nereis* sp.	**CLO4**		
6	**Comparative study of Mollusca**: Adaptive diversity, molluscan shells, torsion and detorsion, ctenidia, foot and its modifications. **Comparative study of Annelida:** Segmental organs, development and larval forms.	**CLO5 CLO6**		
5	**Short description**: Habit and habitat, basic structure and economic importance of the following molluscs: *Neopilina, Chiton, Aplysia, Dentalium, Lamellidens, Mytillus, Loligo, Sepia, Octopus* and *Nautilus*. **Short description:** Habit and habitat, basic structure and economic importance of the following annelids: *Metaphere, Tubifex, Chaetopterus, Glycera, Spirorbis, Arenocola, Tomopteris, Amphitrite, Lumbricus, Hirudo, Piscicola* and *Myzostoma.*	**CLO7**		

*** Per week 2 classes**

Distribution of class lectures: Total number of lecture: 30

Class/ lecture type	Number of classes	Class/ lecture type	Number of classes
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	28	In-course examination	1
		Review class	1

Outcome- Based Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	3	
2. Understand	8	
3. Apply	2	
4. Analyze	2	
5. Evaluate	2.5	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	5
2.Understand	15
3.Apply	5
4.Analyze	2.5
5.Evaluate	2.5
6.Create	

Outcome- Based Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Barnes, R.D. 1980. Invertebrate Zoology. WB Saunders Co., Philadelphia, USA. Hyman, L.H. 1959. The Invertebrates. Vols. 1-6. MacGraw Hill Co., New York. Ruppert, E.E. and Barnes, R.D. 1994. Invertebrate Zoology. 6th edition. Saunders College Publishing Co., New York. Kotpal, R.L., 2010. *Modern text book of zoology: vertebrates*. Rastogi Publications.
Supplementary Reading	Siddiqui, K.U., Islam, M.A., Kabir, S.M.H., Ahmed, M., Ahmed, A.T.A., Rahman, A.K.A., Haque, E.U., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., Khondker, M. and Rahman, M.M. (ed.). 2007. Encyclopedia of Flora and Fauna of Bangladesh, Vol. 17. Molluscs. Asiatic Society of Bangladesh, Dhaka. Kabir, S.M.H., Ahmed, M., Ahmed, A.T.A., Rahman, A.K.A., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., and Khondker, M. (ed.) 2009. Encyclopedia of Flora and Fauna of Bangladesh, Vol. 16. Annelida, Echinodermata, Acanthocephala and Minor Phyla. Asiatic Society of Bangladesh, Dhaka.

Visiting hours: 9:00 am to 5:00 pm on the working days (if available).

Outcome- Based Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 106	**Arthropoda and Echinodermata**	**Core course**	**2**	**30**	**50**

Prerequisites: As per the University requirements for the admission into program.

Rationale of the course

The course is intended to enhance students' learning about the diversity of Arthropods and Echinoderms, which are highly evolved animals. The major focus is on the detailed classification of both phyla and the morphological and anatomical features of each functional system, with their comparative accounts. The students will also touch on the habit and habitat, food and feeding, ecology, reproduction, and development of these animals.

Specific objectives of the course

By the end of the course, students will be able to:

- Understand the diversity of arthropods and echinoderms.
- Explain how higher invertebrate animals are organized, how they work, how they reproduce, etc.
- Apply the taxonomic identification.
- Describe on the biology and ecological aspects of the phyla arthropods and echinoderms.

Mapping with SDGs

This course is relevant to achieving SDG4 (Quality education), SDG14 (Life below water), and SDG15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	Identify and classify the arthtropods and echinoderms with distinguishing characters (Apply)	PLO1, PLO3
CLO2	Describe the different functional systems of arthtropods and echinoderms with appropriate schematic diagrams (Understand)	PLO2, PLO4
CLO3	Describe the ecology, food and feeding, reproduction and developmental stages of that particular animal groups (Understand)	PLO1, PLO6
CLO4	Compare the organ systems in different groups of animals under this phylum (Apply)	PLO1, PLO2

Outcome- Based Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
5	**Phylum Arthropoda:** Classification of the phylum Arthropoda up to orders with diagnostic and general characteristics and examples.	**CLO1**	Interactive lectures, diagrams, visuals, discussions	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
3	**Type study**: Systematic position, habitat, morphology, development, special features (if any) and major systems of *Macrobrachium rosenbergii* and *Oxya velox*.	**CLO2**		
4	**Short description**: Habit and habitat, food and feeding, breeding and economic importance of the following arthropods: *Limulus, Eupagurus*, *Sacculina, Squilla, Scolopendra,* beetles & weevils, moths & butterflies, termite, bug and bees.	**CLO3**		
3	**Comparative study of Arthropoda**: Appendages, respiratory organs and crustacean larvae. (Note: Different classes of Arthropoda are to be compared on the basis of these characteristics)	**CLO4**		
3	**Phylum Echinodermata:** Classification of the phylum Echinodermata up to orders with diagnostic and general characteristics and examples.	**CLO1**		
3	**Type study**: Systematic position, habitat, morphology, development and major systems of *Asterias* sp.	**CLO2**		
2	**Short description**: Habit and habitat, food and feeding, breeding and economic importance of the following echinoderms: *Astropecten, Ophiura, Echinus, Cucumaria* and *Antedon.*	**CLO3**		
3	**Comparative study of Echinodermata**: Skeletal structures; water vascular system; larval forms. (Note: Different classes of Echinodermata are to be compared on the basis of these characteristics).	**CLO4**		

*** Per week 2 classes**

Distribution of class lectures: Total number of lecture: 30

Class/ lecture type	Number of classes	Class/ lecture type	Number of classes
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	28	In-course examination	1
		Review class	1

Outcome- Based Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	5	
2. Understand	5	
3. Apply	7.5	
4. Analyze		
5. Evaluate		
6. Create		

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	5
2.Understand	10
3.Apply	20
4.Analyze	5
5.Evaluate	
6.Create	

Outcome- Based Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. 2001. *The Invertebrates: A synthesis.* Blackwell Scientific Publications, Oxford, UK. Hickman, C.P., Roberts, L.S. and Larson, A. 2001. *Integrated Principles of Zoology*. 11th edition. McGraw-Hill Co. Inc., New York, USA. (PDF available: http://www.ciens.ucv.ve).
Supplementary Reading	Storer, T.I., Usinger, R.L., Stebbins, R.C. and Nybakken, J.W. 2001. *General Zoology*. 6th edition. Tata McGraw-Hill Co. Ltd., New Delhi, India. (Free download: https://www.goodreads.com/book /show/4452321-general-zoology).

Visiting hours: 09:00 am to 5:00pm on the working days (if available).

Outcome- Based Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 109	**Field Studies for Animal Diversity (Invertebrate)**	**Core course**	**1**	**15**	**25**

Prerequisites: As per the University requirements for admission into the program.

Rationale of the course
A field trip should be organized for the students during the academic year to study and observe the ecosystems, habitats, community structure, and organisms (particularly the invertebrates in the field conditions) in the visited area.

Specific objectives of the course
By the end of the course, students will be able to:

- Provide students with a foundational understanding of invertebrate diversity and their ecology.
- Develop skills in identifying, classifying, and analyzing invertebrate specimens from the field.
- Foster critical thinking through comparative studies of morphological adaptations and functional roles of invertebrates.

Mapping with SDGs
This course is relevant to achieving SDG 4: Quality Education, SDG 14: Life Below Water, and SDG 15: Life on Land.

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to		PLO covered
CLO1	Learn about invertebrates across different phyla with their ecological adaptations according to their respective habitat (Understand)	PLO1, PLO2
CLO2	Apply knowledge of invertebrate biodiversity to real-world contexts, such as public health, agriculture, and conservation biology (Apply)	PLO7
CLO3	Synthesize observations from practical knowledge to contribute to ecology and related sciences (Apply)	PLO7, PLO9

Outcome- Based Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class hour	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
2	Pre-field lectures: introducing field based invertebrate fauna; observation techniques; identification; classification; ecological perspectives; data collection and analysis.	**CLO1, CLO2**	Visual, Auditory, Practical	On-field assessment, report writing and

No. of Class hour	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
2	Preparation of field studies; field safety measures; on-site activities; and demonstration	**CLO1, CLO2**		presentation
1	Briefing on report writing and presentation	**CLO3**		
9	Visit the assigned field area, particularly invertebrate-rich sites	**CLO1-CLO3**	Field demonstrati on and observation	

Outcome- Based Curriculum
Part- C

Instructional strategies of the course

The course will be delivered through pre-field lectures and field visits to the assigned area, particularly invertebrate-rich sites. Lectures will be aided by powerpoint presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. All students must participate in the program. Students will be guided in the field to study the invertebrate fauna.

Assessment

Assessment will be done by the Members of the concerned Examination Committee. Three-step assessments will be followed, including onsite assessment (written examination), presentation and report writing. Onsite assessment, presentation and report writing will carry 10, 7.5 and 7.5 marks, respectively.

Outcome- Based Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Ahmed, A.T.A., Kabir, S.M.H., Ahmed, M., Rahman, A.K.A., Haque, E.U., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., and Khondker, M. (ed.). 2008. *Encyclopedia of Flora and Fauna of Bangladesh*. Vol. 18. Part 11. Arthropoda: Crustacea. Asiatic Society of Bangladesh, Dhaka. Barnes, R.D. 1980. *Invertebrate Zoology.* WB Saunders Co., Philadelphia, USA. Barrington, E.J.W. 1979. *Invertebrate structure and function.* Willy and Sons, New York, USA. Kabir, S.M.H., Ahmed, M., Ahmed, A.T.A., Rahman, A.K.A., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., and Khondker, M. (ed.) 2009. *Encyclopedia of Flora and Fauna of Bangladesh,* Vol. 16. Annelida Echinodermata Acanthocephala and Minor Phyla. Asiatic Society of Bangladesh, Dhaka. Lal, S. S. (ed.) 2009. *Practical Zoology Invertebrate.* Rajpal and Sons Publishing, India. Ruppert, E.E. and Barnes, R.D. 1994. *Invertebrate Zoology*. 6th edition. Saunders College Publishing Co., New York. Verma, P. S. (ed.) 1982. *A Manual of Practical Zoology: Invertebrates.* S. Chand & Company, India.

Supplementary Reading	Storer, T.I., Usinger, R.L., Stebbins, R.C. and Nybakken, J.W. 2001. *General Zoology*. 6th edition. Tata McGraw-Hill Co. Ltd., New Delhi, India. (Free download: https://www.goodreads.com/book /show/4452321-general-zoology). Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. 2001. *The Invertebrates: A synthesis.* Blackwell Scientific Publications, Oxford, UK.

Outcome- Based Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 110	**Practical**	**Core course**	**4**	**60**	**100**

Prerequisites: As per the University requirements for admission into the program.

Rationale of the course

This course offers a comprehensive and practical exploration of invertebrate diversity, morphology, and life history through hands-on study of museum specimens, permanent slides, dissections, and models. By examining preserved representatives from Protozoa to Echinodermata, students gain insights into key adaptations, evolutionary trends, and the functional significance of body structures. The study of permanent slides facilitates detailed observation of tissues, organs, and parasitic adaptations, while anatomical models enhance spatial understanding of complex systems and larval forms. Emphasis is placed on identifying common invertebrates through morphological characteristics, including parasites such as those from Platyhelminthes and Nematoda. This fosters understanding of life strategies and host-parasite interactions relevant to public health and agriculture. Students receive hands-on training on dissection and anatomical investigation to develop technical skills in comparative anatomy and internal organ identification. Field tours around Dhaka enrich the learning experience by exposing students to invertebrates in their natural habitats. The integrated approach of this course nurtures critical thinking, ecological awareness, research application, and ethical scientific practices, preparing students for careers in zoology, marine biology, conservation, and ecological monitoring while fostering an appreciation for the complexity and ecological roles of invertebrates.

Specific objectives of the course

By the end of the course, students will be able to:

- Demonstrate a foundational understanding of invertebrate diversity, morphology, anatomy, and evolutionary trends across major phyla, from protozoans to echinoderms.
- Identify, classify, and analyze invertebrate specimens using both external and internal morphological features.
- Perform dissections of representative invertebrates to study and distinguish internal organs and systems.
- Gain proficiency in laboratory techniques, including specimen handling, microscopic observation, and the use of anatomical models.
- Analyze structural and functional adaptations of invertebrates, fostering critical thinking through comparative studies.
- Understand the ecological significance of invertebrates, including parasitic relationships and developmental biology, and their relevance to public health, agriculture, and conservation.
- Prepare and present detailed scientific reports that reflect critical analysis, data interpretation, and effective communication.
- Conduct fieldwork to identify, collect, and record invertebrate specimens in natural habitats.
- Practice ethical behavior and maintain safety standards in both laboratory and fieldwork environments.

- Develop an appreciation for invertebrate biodiversity and their vital roles in global ecosystems, supporting future careers in zoology, marine biology, taxonomy, and ecological research.

Mapping with SDGs
This course is relevant to achieve SDG 4: Quality Education, SDG 14: Life Below Water, SDG 15: Life on Land, SDG 13: Climate Action, SDG 3: Good Health and Well-being, and SDG 12: Responsible Consumption and Production.

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		**PLO covered**
CLO1	Based on their distinguishing features, identify and classify invertebrate specimens, from protozoans to echinoderms (Understand)	PLO1, PLO2, PLO3
CLO2	Explain adaptations and ecological significance of invertebrates across different phyla (Understand)	PLO1, PLO2
CLO3	Understand the roles of invertebrates in ecological systems, including parasitic relationships and their developmental stages (Understand)	PLO1, PLO2, PLO8
CLO4	Demonstrate proficiency in handling and observing museum specimens, permanent slides, and models (Apply)	PLO7
CLO5	Analyze and compare morphological adaptations of invertebrates using hands-on techniques and microscopy (Apply)	PLO7
CLO6	Apply knowledge of invertebrate biodiversity to real-world contexts, such as public health, agriculture, and conservation biology (Apply)	PLO7
CLO7	Synthesize observations from practical knowledge to contribute to ecology and related sciences (Apply)	PLO7
CLO 8	Demonstrate proficiency in preparing Morphometrics and meristic study of Earthworm, Prawn and insects using ethical and scientific protocols, while accurately documenting observations, measurements of different body parts and integrating findings into practical reports. (Apply/ Understand)	PLO1, PLO5, PLO3
CLO9	Analyze and interpret the appendages of different phylum, identifying key adaptations and their ecological and evolutionary significance. (Analyze/Understand)	PLO1, PLO4
CLO10	Perform dissections to explore and demonstrate the structural and functional organization of invertebrate organ systems (e.g., digestive, circulatory, respiratory, nervous, and reproductive systems), while adhering to ethical standards and safety protocols. (Apply/Analyze/ Understand)	PLO1, PLO5
CLO11	Conduct field studies, maintain organized notebooks, and synthesize observations into comprehensive scientific reports, demonstrating effective documentation and communication skills. (Apply/Analyze Create)	PLO2, PLO4, PLO8, PLO9

Outcome- Based Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
24	**Study of museum specimens-** Invertebrates representing protozoan phyla to the phylum Echinodermata	**CLO 1- CLO 7**	Visual, Auditory, Practical	Class attendance, Class participation, Group work, Oral Presentation, In-course Exam and Final practical Exam
5	**Study of permanent slides and models-** Invertebrates and their body parts: a. whole mounts; b. appendages; c. parasites (mainly representing Platyhelminthes and Nematoda); and d. different larval forms.	**CLO 1- CLO 7**		
3	**Morphometrics and meristic study** a. Earthworm: morphometrics- total, cliteller and girth lengths, and ratios (somatic indices); meristics- segment numbers, position of different orifices; b. Prawn: total, rostral, carapace, antennary, antenullary, uropod, telson lengths and their ratios; c. Insect: total, cephalic, thoracic, abdominal lengths and widths and their ratios.	**CLO1, CLO2**		
2	**Study of the appendages** Dissecting and displaying of appendages of a typical insect and a prawn (Note. Students will detach organs used for locomotion, flying, food capturing, copulation and defense or offense from the supplied specimens of these two arthropods)	**CLO7, CLO8, CLO9**		
	Dissection			
20	Pila - digestive and nervous systems; Earthworm - digestive, circulatory and nervous systems; Cockroach - digestive and nervous systems; and Prawn - circulatory and nervous systems.	**CLO8, CLO9, CLO10**		
2	Local study tour and preparation of a report on the tour Preparation of practical notebooks and field reports	**CLO11**		

*** Per week 2 classes**

Distribution of class lectures: Total number of lecture: 60

Class/ lecture type	Number of classes	Class/ lecture type	Number of classes
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	56	In-course examination	2
		Review class	2

Outcome- Based Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will employ a combination of lectures, multimedia aids, and hands-on group activities to create an engaging and participatory learning environment. Theoretical content will be delivered through lectures supported by PowerPoint presentations, video clips, and animations to visually illustrate complex invertebrate anatomy and life cycles. Students will work in groups to observe specimens from museum collections, enhancing their practical skills and collaborative learning. Group work will also include analyzing specimens, preparing weekly reports, and participating in discussions to consolidate their understanding. These reports will be reviewed weekly to provide timely feedback and ensure consistent progress. Class discussions, interactive Q&A sessions, and group exercises will foster critical thinking and engagement. Additionally, students' feedback on each session and the overall course will be collected through structured methods to improve course delivery and content.

Assessment Pattern

There will be two in-course examinations, each consisting of 17.5, and 5 marks for class attendance. A course final examination, comprising of 60 marks will be held, which will also include marks for practical note books and study tour reports.

CIE- Continuous Internal Evaluation (8.75 marks), Attendance: 1.25 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember		
2. Understand	15	
3. Apply	10	
4. Analyze	10	
5. Evaluate		
6. Create		

Year-end Examination

Bloom's Category Marks (out of 60)	Test
1.Remember	
2.Understand	20
3.Apply	15
4.Analyze	15
5.Evaluate	10
6.Create	

Outcome- Based Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Ahmed, A.T.A., Kabir, S.M.H., Ahmed, M., Rahman, A.K.A., Haque, E.U., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., and Khondker, M. (ed.). 2008. *Encyclopedia of Flora and Fauna of Bangladesh*. Vol. 18. Part 11. Arthropoda: Crustacea. Asiatic Society of Bangladesh, Dhaka. Barnes, R.D. 1980. *Invertebrate Zoology.* WB Saunders Co., Philadelphia, USA. Barrington, E.J.W. 1979. *Invertebrate structure and function.* Willy and Sons, New York, USA. Kabir, S.M.H., Ahmed, M., Ahmed, A.T.A., Rahman, A.K.A., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., and Khondker, M. (ed.) 2009. *Encyclopedia of Flora and Fauna of Bangladesh,* Vol. 16. Annelida Echinodermata Acanthocephala and Minor Phyla. Asiatic Society of Bangladesh, Dhaka. Lal, S. S. (ed.) 2009. *Practical Zoology Invertebrate.* Rajpal and Sons Publishing, India. Ruppert, E.E. and Barnes, R.D. 1994. *Invertebrate Zoology*. 6th edition. Saunders College Publishing Co., New York. Verma, P. S. (ed.) 1982. *A Manual of Practical Zoology: Invertebrates.* S. Chand & Company, India.
Supplementary Reading	Storer, T.I., Usinger, R.L., Stebbins, R.C. and Nybakken, J.W. 2001. *General Zoology*. 6th edition. Tata McGraw-Hill Co. Ltd., New Delhi, India. (Free download: https://www.goodreads.com/book /show/4452321-general-zoology). Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. 2001. *The Invertebrates: A synthesis.* Blackwell Scientific Publications, Oxford, UK. Hickman, C.P., Roberts, L.S. and Larson, A. 2001. *Integrated Principles of Zoology*. 11th edition. McGraw-Hill Co. Inc., New York, USA. (PDF available: http://www.ciens.ucv.ve).

Visiting hours: 9:00 am to 5:00 pm on the working days (if available).

Outcome- Based Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 111	**Viva voce**	**Core course**	**2**	**30**	**50**

Prerequisites: As per the University requirements for admission into the program.

Rationale of the course

Viva voce, or oral examination, is integral to the undergraduate Zoology programme. It is a mandatory course in which students demonstrate their knowledge, expertise, and understanding of theoretical and practical courses. It's also an opportunity for the examiners to evaluate students' academic abilities and ultimately determine whether they have met the requirements for promotion to the upper class.

Specific objectives of the course

By the end of the course, students will be able to:

- Demonstrate comprehensive knowledge in their broader field of study.
- Enhance their ability to effectively communicate scientific information with confidence, skills, and expertise.
- Evaluate and reflect on their understanding and mastery of the programme's content.

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course, the students will be able to -		PLO covered
CLO1	Demonstrate how their acquired knowledge, expertise, and skills from the courses contribute to their field of study.	PL1, PL2, PL7
CLO2	Recognise and explain the current state of knowledge on a particular issue or topic of the programme.	PL5, PL6, PL7,
CLO3	Demonstrate and assess their academic feats with critical analysis and interpretation of various aspects of the courses.	PL6, PL7

Outcome- Based Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
No specific classes will be assigned	The contents will cover all theoretical and practical courses.	**All CLOs**	N/A	Oral examination will be conducted by examination committee

Outcome- Based Curriculum
Part- C

Assessment and Evaluation:

The course will follow interactive lectures of all theoretical and practical courses of the BS programme. Besides, regular class discussions and individual or group mentoring sessions will also provide instructions for viva voce. All faculty members will instruct the students in this regard.

Assessment

This is a two-credit course that carries 50 marks. The respective Examination Committee including external members will assess overall student's knowledge asking questions from the contents of respective syllabus of the BS programme and student will answer questions accordingly.

Outcome- Based Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	References mentioned for the theory course
Supplementary Reading	References mentioned for the theory course

Second Year BS Programme in Zoology

Applicable for the Sessions 2024-2025, 2025-2026, 2026-2027 and 2027-2028

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 201	**Minor phyla and Lower chordates**	**Core course**	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

Animals of minor phyla often do not draw our attention as because these are less diversified groups in terms of species number. However, they are specialized and have great evolutionary significance. Animals of lower chordates are fascinating as they represent a transitional group between the invertebrates and vertebrate groups. The course focuses on classification, morphological characteristics, affinities and evolutionary significance of these animal groups.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Understand the structural and functional organization of animals of representative species from the various minor phyla.
- Explore life activities of invertebrate animals and the adaptations of invertebrates to particular environment.
- Provide the classification scheme of lower chordates.
- Discuss the anatomical and functional organization of the lower chordates and their larval forms.

Mapping with SDGs

This course is relevant to achieving SDG 4 (Quality education), SDG 14 (Life below water) and SDG 15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course, the students will be able to		PLO covered
CLO1	Analyze characteristics, habitat distribution, affinities and morphological description of different minor phyla (Apply, Analyze).	PLO1, PLO2, PLO7
CLO2	Identify, classify and describe affinities of different orders of lower chordates (Remember, Analyze).	PLO1, PLO2, PLO7
CLO3	Describe different functional systems, morphology and development of Urochordates, Cephalochordates and Cyclostomatous animals (Understand, Analyze).	PLO1, PLO2, PLO7, PLO8

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
14	Minor phyla: Introduction, general characteristics, habitat, distribution, affinities and brief morphological descriptions of the following minor phyla: Mesozoa: *Dicyema* Gastrotricha: *Chaetonotus* Acanthocephala: *Macrocanthorhynchus* Onycophora: *Peripatus capensis* Ectoprocta: *Plumatella* Brachiopoda: a common lampshell Rotifera: Any typical rotifer Nematomorpha: *Gordius* Phoronida: *Phoronis* Chaetognatha: *Sagitta*	**CLO1**	Visual and Auditory	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
5	Lower chordates: Introduction, classification of the phylum lower Chordates up to orders with diagnostic and general characteristics of each taxonomic category with examples, affinities, etc.	**CLO2**		
9	Type study: Systematic position, habitat, morphology, development, special features and major systems of the following chordates: Urochordata: *Ascidia* Cephalochordata: *Branchiostoma* (Amphioxus) Cyclostomata: (a) Lamprey, *Petromyzon* and (b) Hagfish, *Myxine*. Hemichordata: *Balanoglossus*	**CLO3**		

*** Per week 2 classes**

Distribution of class lectures: Total number of lectures: 30

Class/ lecture type	Number of classes	Class/ lecture type	Number of classes
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	28	In-course examination	1
		Review class	1

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by PowerPoint presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class, students' feedback on the previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	5	
2. Understand	5	
3. Apply	5	
4. Analyze	2.5	
5. Evaluate		
6. Create		

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	10
2.Understand	10
3.Apply	5
4.Analyze	5
5.Evaluate	
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Barnes, R.D. 1980. Invertebrate Zoology. 5th edition, WB Saunders College publishing HBJC Publisher, Philadelphia, USA. Ruppert, E.E. and Barnes, R.D. 1994. Invertebrate Zoology. 6th edition. Saunders College Publishing Co., New York, USA.
Recommended Reading	Hickman, C.P., Roberts, L.S. and Larson, A. 2001. Integrated Principles of Zoology. 11th edition. McGraw-Hill Co. Inc., New York, USA. McGraw-Hill Co. Inc., New York, USA. Parker, T.J. and Haswell, W.A.. 1959. A Textbook of Zoology. Vol. 2. Macmillan, & Co., London.

Visiting hours: 9:00 am to 5:00 pm on working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 202	**Chondrichthyes and Osteichthyes**	**Core course**	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

Chondrichthyes (cartilaginous fishes) and Osteichthyes (bony fishes) represent two significant evolutionary groups within the class Pisces. This course is designed to explore their diversity, unique characteristics, ecological roles, and significance in both marine and freshwater ecosystems. Understanding the systematics, morphological diversity, habitat preferences, and the developmental aspects of these groups is crucial for students aiming to pursue careers in marine biology, aquaculture, ichthyology, or environmental conservation. This course also provides insight into extinct and archaic fish groups, adding a historical dimension to the study of modern fish species.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Provide a detailed understanding of the classification, characteristics, and evolutionary significance of Chondrichthyes and Osteichthyes.
- Facilitate an in-depth study of morphometric and meristic characters for both groups.
- Examine the systematic position, habitat, morphology, and development of selected species (*Scoliodon* and *Labeo rohita*).
- Explore the feeding, breeding, and behavioral patterns of sharks, skates, rays, and selected bony fish species.
- Understand the ecological roles of various fish species, including the extinct and archaic groups.
- Discuss the special features and distribution of various fish species, including lungfishes, catfishes, snakeheads, and others.

Mapping with SDGs

This course is relevant to achieving SDG 4 (Quality education), SDG 13 (Climate Action), SDG 14 (Life Below Water) and SDG 15 (Life on Land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course, the students will be able to		PLO covered
CLO1	Define and describe the basic characteristics and classification of Chondrichthyes and Osteichthyes (Understand).	PLO1
CLO2	Recognize and explain the morphometric and meristic features of these fish groups (Understand)	PLO5
CLO3	Explain the systematic position, habitat, and development of *Scoliodon* (shark) and *Labeo rohita* (carp) (Understand).	PLO1
CLO4	Analyze the evolutionary trends and affinities of extinct and archaic fish groups (Analyze).	PLO6
CLO5	Analyze the feeding, breeding, and ecological roles of various species, including sharks, skates, rays, and bony fishes (Analyze).	PLO1, PLO2
CLO6	Critically examine the special features and adaptations of various fish species, including lungfishes, catfishes, and exotic fish species (Analyze).	PLO1, PLO4, PLO6

CLO7	Apply knowledge of fish classification to identify and categorize various species of Chondrichthyes and Osteichthyes (Apply).	PLO1, PLO3
CLO8	Apply morphometric and meristic data to assess the health, biodiversity, and evolutionary development of fish populations (Apply).	PLO3, PLO5

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
6	**Chondrichthyes:** Definition and characteristics, morphometric and meristics characters of Chondrichthyes; Classification up to orders with diagnostic and general characters and examples and affinities; Extinct and archaic fishes.	**CLO1, CLO2, CLO4, CLO7, CLO8**	Visual and Auditory	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
5	**Type study:** Systematic position, habitat, morphology, development, special features (if any) and major systems of *Scoliodon*.	**CLO3, CLO6**		
3	**Short description:** Habit, habitat, food and feeding, breeding of sharks, skates and rays.	**CLO5, CLO**		
6	**Osteichthyes:** Definition and characteristics, morphometric and meristics of Osteichthyes; classification up to orders with examples; extinct and archaic fishes.	**CLO1, CLO2, CLO4, CLO7, CLO8**		
5	**Type study:** Systematic position, habitat, morphology, development, special features and major systems of *Labeo rohita*.	**CLO3**		
3	**Short description:** Habit, habitat, food and feeding, breeding, special features and distribution of lung fishes, carps, catfishes, snakeheads, paddle fish, SIS fishes, perch, shad fish, sea horse, mullets, and exotic fishes.	**CLO5, CLO6,**		

*** Per week 2 classes**

Distribution of class lectures: Total number of lectures: 30

Class/ lecture type	Number of classes	Class/ lecture type	Number of classes
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	28	In-course examination	1
		Review class	1

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by PowerPoint presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class, students' feedback on the previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	2.5	
2. Understand	5	
3. Apply	3	
4. Analyze	5	
5. Evaluate	2	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	5
2.Understand	10
3.Apply	5
4.Analyze	8
5.Evaluate	2
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Bone, Q., Marshall, N.B. and Blaxter, J.H.S. 1995. Biology of fishes. 2nd Edition, London: Chapman and Hall. Breder, C.M. and Rosen, D.E. 1966. Mode of Reproduction in Fishes. T.F.H. Publications, New Jersey, USA. Compagno, L.J.V. 1984. FAO Species Catalogue, Vol. 4, Sharks of the World. An annotated and illustrated catalogue of sharks known to date. FAO Fisheries Synopsis No. 125 FAO. 2014. On Board Guide for the Identification of Pelagic Sharks and Rays of the Western Indian Ocean. Nelson, J.S. 1994. Fishes of the World. 3rd edition. John Wiley & Sons, Inc., New York, USA.

	Rahman, A.K.A. 2005. Freshwater Fishes of Bangladesh. 2nd edition. Zoological Society of Bangladesh, Dhaka. Siddiqui, K.U., Islam, M.A., Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A., Haque, E.U., Ahmed, Z.U., Begum, Z.N.T., Hasan, M.A., Khondker, M. and Rahman, M.M. (ed.). Encyclopedia of Flora and Fauna of Bangladesh. Vol.23 & 24. Freshwater Fishes and Marine Fishes. Asiatic Society of Bangladesh, Dhaka. Young, J.Z. 1974. The Life of Vertebrates. Oxford University Press, London. Nelson, J.S. 1994. Fishes of the World. 3rd edition. John Wiley & Sons, Inc., New York, USA.

Visiting hours: 9:00 am to 5:00 pm on working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 203	**Amphibia and Reptilia**	**Core course**	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

The rationale for this course lies in its focus on understanding the overview of the two vertebrate groups - Amphibia and Reptilia. Topics include animal classification and general characteristics, diversity, anatomical structure and function, and roles in the environment. The course will encourage students to observe amphibians and reptiles in their natural environments, identify them and to raise awareness among them for the conservation of these two particular groups, finally the course will create a bonding with the living world.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Understand the brief details about the groups Amphibia and Reptilia.
- Learn on classification, characteristics and diversity by discussing different morphological as well as anatomical features.
- Discuss the importance of these two groups for the people and ecosystems.
- Understand the probable threats to these two vertebrate groups highlighting local and global perspectives.
- Provide the conservation measures of these two groups.

Mapping with SDGs

This course is relevant to achieving SDG 4 (Quality education), SDG 14 (Life Below Water) and SDG 15 (Life on Land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course, the students will be able to		PLO covered
CLO1	Explain the brief details on two vertebrate groups - amphibian and reptiles (Understand).	PLO1, PLO4
CLO2	Discuss the classification of the two vertebrate groups - amphibian and reptiles (Understand).	PLO1, PLO3
CLO3	Identify different morphological features of different animals under the phylum Amphibia and Reptilia (Remember).	PLO1, PLO6
CLO4	Describe different key anatomical features highlighting the functions of physiological processes (Understand).	PLO1, PLO7
CLO5	Understand the ecological and economical importance of these two groups (Understand).	PLO5, PLO6
CLO6	Identify and aware of different planetary threats that impact these two groups and probable conservation measures (Analyze).	PLO1, PLO6

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

Required No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
2	**Amphibia:** Classification up to orders (living and nonliving) with characteristics and examples.	**CLO1, CLO2**	Visual and Auditory	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
6	**Type study**: Systematic position, habitat, morphology, development, special features (if any) and major systems of toad/frog.	**CLO1, CLO2, CLO4**		
3	**Short description** of the habit, habitat, food and feeding, breeding, special features (if any) and distribution of caecilians, *Necturus, Salamander, Ambystoma*, *Typhlops*, *Seymouria* and extinct amphibians.	**CLO2, CLO3, CLO4, CLO5**		
2	**Ecological and economical importance of amphibians; Adaptive radiation**, secondary sex characters and parental care.	**CLO1, CLO2, CLO5**		
2	**Reptilia:** Classification of living (up to sub-orders) and extinct (up to orders) reptiles with characteristics and examples.	**CLO1, CLO2**		
6	**Type study of *Hemidactylus:*** External morphology; internal anatomy including skeletal; digestive, respiratory, circulatory, excretory, nervous and reproductive systems; food and feeding habits.	**CLO1, CLO2, CLO4**		
2	**Short description** of the habit, habitat, food and feeding, breeding, special features (if any) and distribution of lizards, tortoise, turtles, terrapins, *Sphenodon*, alligator and crocodile with special references to Bangladesh fauna.	**CLO2, CLO3, CLO4, CLO5**		
2	**Ecological and economical importance of reptiles.** Snake venom, venomous and non-venomous snakes, poison apparatus and biting mechanism in snakes; key for identification of poisonous and non-poisonous snakes	**CLO1, CLO2, CLO5**		
1	**Adaptive radiation** and difference between lizards-snake, tortoise-turtles-terrapins, alligator-crocodile	**CLO1, CLO2, CLO3, CLO4**		
2	Planetary threats to the amphibians and reptiles of Bangladesh and conservation measures.	**CLO5, CLO6**		

*** Per week 2 classes**

Distribution of class lectures: Total number of lectures: 30

Class/ lecture type	Number of classes	Class/ lecture type	Number of classes
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	28	In-course examination	1
		Review class	1

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by PowerPoint presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class, students' feedback on the previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	2.5	
2. Understand	4	
3. Apply	4	
4. Analyze	3	
5. Evaluate	2	
6. Create (Innovation in presenting answer)	2	

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	5
2.Understand	8
3.Apply	8
4.Analyze	4
5.Evaluate	2
6.Create (Innovation in presenting answer)	3

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Hickman, C.P., Roberts, L.S. and Larson, A. 2001. *Integrated Principles of Zoology.* 11th edition. McGraw-Hill Co. Inc., New York, USA. Kabir, S.M.H., Ahmed, M., Ahmed, A.T.A., Rahman, A.K.A., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., and Khondker, M. (ed.). 2009. *Encyclopedia of Flora and Fauna of Bangladesh, Vol. 25. Amphibians and Reptiles.* Asiatic Society of Bangladesh. Dhaka. Parker, T.J. and W.A. Haswell. 1959. *A Textbook of Zoology.* Vol. 2. Macmillan, & Co., London. Trevor JCB. 2013. *Amphibians and Reptilians.* Naturalists' handbook. Vol. 31. Pelagic publishing. ISBN: 9781907807459. London. Weichart, C.K. 1959. *Element of Chordate Anatomy*. McGraw-Hill Book Company Inc. New York, USA. Young, J.Z. 1974. *The Life of Vertebrates.* Oxford University Press, London. Zug, G.R. 1993. *Herpetology: An Introduction to Biology of Amphibians and Reptiles.* Academic Press. Inc., San Diego, USA. Zug. G.R., Vitt, L., and Caldwell, J.P. 2001.*Herpetology: An Introductory Biology of Amphibians and Reptiles.* Academic Press, USA.
Supplementary Reading	

Visiting hours: 9:00 am to 5:00 pm on working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 204	**Aves and Mammalia**	**Core course**	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

The course is intended to enhance students' learning of the range of higher vertebrate diversity, such as Aves and Mammalia. The major focus is on the detailed classification of vertebrate classes, the morphological and anatomical features of each physiological system, and their comparative accounts. The students will also touch on the basic ecology and special features of some groups of birds and mammals.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Provide a detailed understanding of the diversity of birds and mammals.
- Explain how the physiological systems of higher vertebrate animals are organized, how they work, etc.
- Learn the biology and ecological aspects of the higher vertebrate animals.

Mapping with SDGs

This course is relevant to achieving SDG4 (Quality education), SDG14 (Life Below Water) and SDG 15 (Life on Land)

Upon completion of this topic, the students will be able to		PLO covered
CLO1	Identify and classify each group of birds with their identifying characters (Apply).	PLO1
CLO2	Describe the different major physiological systems of birds with appropriate schematic diagrams (Understand).	PLO2
CLO3	Describe the ecology, breeding, dispersal, migration and social behaviours of some major bird groups (Understand).	PLO2
CLO4	Identify and classify each group of mammals with identifying characters (Apply).	PLO1
CLO5	Describe the different major physiological systems of mammals with appropriate schematic diagrams (Understand).	PLO2
CLO6	Describe the ecology, food and feeding, breeding and distribution of some special mammalian groups (Understand).	PLO2

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
5	**Aves:** Classification of the class Aves up to orders with characteristics and examples.	**CLO1**	Visual and Auditory	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
6	**Type study of pigeon:** Morphology, skeletal, digestive, respiratory, circulatory, excretory, nervous, muscular, and reproductive systems; air sacs, feathers and flight adaptation.	**CLO2**		
4	**Short description** of the habit, habitat, food and feeding, breeding, dispersal and migration and social behaviour; migratory birds, flightless birds, carnivorous birds, waders, pheasants, game birds (with special emphasis on Bangladesh fauna).	**CLO3, CLO4**		
3	**Mammalia:** Classification of the class Mammalia up to orders with diagnostic characters and examples.	**CLO1**		
6	**Type study of Guinea-pig:** External morphology, skeletal, digestive, respiratory, circulatory, excretory, nervous, reproductive, and endocrine systems.	**CLO2**		
4	**Short description** of the habit, habitat, food and feeding, breeding and distribution of egg laying mammals, marsupials, aquatic mammals, flying mammals, nonhuman primates, rodents.	**CLO3, CLO4**		

*** Per week 2 classes**

Distribution of class lectures: Total number of lectures: 30

Class/ lecture type	Number of classes	Class/ lecture type	Number of classes
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	28	In-course examination	1
		Review class	1

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by PowerPoint presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class, students' feedback on the

previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	5	
2. Understand	5	
3. Apply	7.5	
4. Analyze		
5. Evaluate		
6. Create		

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	5
2.Understand	10
3.Apply	15
4.Analyze	
5.Evaluate	
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Kotpal, R.L. 1992. *Modern Textbook of Zoology: Vertebrates.* Rastogi Publications, Meerut. Sinha, A.K., Adhikari, S. and Ganguly, B.B. 1988. *Biology of Animals*, *Vol. II.* New Central Book Agency, Calcutta, India. Starr, C. and Taggart, R. 1981. *Biology: The Unity and Diversity of Life.* Wadsworth Publishers. Co., California, USA. Welty, J. C. & Baptista, L. 1988. *The Life of Birds*. (4th ed). W.B. Saunders Co., Philadelphia. Young, J.Z. 1974. *The life of vertebrates*. Oxford University Press, London, UK.
Supplementary Reading	Storer, T.I., Usinger, R.L., Stebbins, R.C. and Nybakken, J.W. 2001. *General Zoology*. 6th edition. Tata McGraw-Hill Co. Ltd., New Delhi, India. (Free download: https://www.goodreads.com/book /show/4452321-general-zoology).

Visiting hours: 9:00 am to 5:00 pm on working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 205	**Cytology and Histology**	**Core course**	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

This course on Cytology and Histology is designed to provide a foundational understanding of the structure, function, and organization of cells and tissues, which are the basic building blocks of life. It is essential for students pursuing careers in biology, medicine, genetics, and related fields, as it enables them to connect the microscopic organization of cells and tissues to their roles in physiology, pathology, and molecular biology. The course builds a foundation for advanced topics in genetics, cell biology, histopathology, and biotechnology while equipping students with analytical skills to study cellular processes, tissue functions, and their implications in health and disease. Additionally, it emphasizes the interdisciplinary nature of cytology and histology, highlighting their connections to biochemistry, genetics, and pharmacology, thus fostering a comprehensive understanding of these critical biological sciences.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Provide a thorough understanding of the structure, function, and organization of cells and tissues, forming the basis for advanced studies in biology and medical sciences.
- Analyze cellular processes, tissue structures, and their physiological and pathological implications, bridging theoretical concepts with practical applications.
- Build a strong foundation for exploring complex topics in genetics, cell biology, histopathology, and biotechnology, supporting future research and professional development.

Mapping with SDGs

This course is relevant to achieving SDG 3 (Good health and well-being for people), SDG 4 (Quality education), Goal 12 (Responsible consumption and production) and Goal 15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course, the students will be able to		PLO covered
CLO1	Grasp fundamental knowledge of cell biology, including the structural and chemical composition of the major macromolecules (proteins, nucleic acids), cell organelles and their roles in cellular processes (Remember, Understand).	PLO1, PLO3
CLO2	Explain the properties of stem cells and their role in development and tissue repair as well as cell growth, differentiation, and aging (Understand).	PLO1, PLO4
CLO3	Acquire knowledge about the cell membrane structure and mechanisms of transport across membranes, such as diffusion and active transport Understand).	PLO1, PLO6
CLO4	Compare the intracellular structures of ER, Golgi, lysosome, vacuoles, peroxisomes, like the endoplasmic reticulum, Golgi complex and mitochondria and their roles in cellular metabolism (Analyze).	PLO1, PLO7
CLO 5	Analyze the structure of genetic material, and mechanisms of DNA packing (Analyze).	PLO1, PLO4

CLO 6	Understand the functions of microtubules, microfilaments, and intermediate filaments in cellular structure and transport (Understand).	PLO1, PLO6, PLO7
CLO 7	Comparative analysis of the histological features and functions of different tissues and their specific roles in various organs (Analyze).	PLO1, PLO2, PLO7
CLO 8	Gain expertise in identifying cell organelles and tissues under a microscope (Apply).	PLO5, PLO8
CLO 9	Apply knowledge of cell biology and histology to advanced topics in medicine, genetics, toxicology, and developmental biology (Apply).	PLO3

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
4	**Introduction to Nuclear Structure:** Nucleus, nucleolus, chromosome, nucleic acid; DNA as the genetic material; structure and function of DNA; DNA packing, nucleosome	**CLO5**	Visual and Auditory	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
4	**Basis of cell chemistry:** Macromolecules (lipids, proteins, carbohydrates)	**CLO1, CLO9**		
4	**Intracellular Compartments structure and function:** Eukaryotic cell organelles; endoplasmic reticulum and Golgi complex-lysosomes, vacuoles, peroxisomes, Redox reactions and glycolysis; mitochondria and aerobic respiration., ECM	**CLO4, CLO5**		
4	**Bioenergetics and Membrane transport:** Cell membrane structure and functions; cell membrane models; transport across membranes (diffusion), active transport.	**CLO3**		
2	**Cytoskeletal Systems:** microtubules, microfilaments and intermediate filaments.	**CLO6**		
2	**Stem Cells and Cellular Differentiation:** stem cell; cell differentiation- cell growth and aging, causes of aging and theories of aging.	**CLO2**		
4	**Tissue Structure and Function:** Tissue structure and functions; types of tissues-epithelial, connective, muscular and nervous, tissue with locations and functions.	**CLO7**		
4	**Organ and gland Specific Histology:**	**CLO8,**		

	Histology of alimentary canal- esophagus, stomach, duodenum, intestine and rectum. Histology of pancreas, liver, lung, kidney, and gonad, ovary and testis	**CLO9**		

*** Per week 2 classes**

Distribution of class lectures: Total number of lectures: 30

Class/ lecture type	Number of classes	Class/ lecture type	Number of classes
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	28	In-course examination	1
		Review class	1

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by PowerPoint presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class, students' feedback on the previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	2.5	
2. Understand	5	
3. Apply	3	
4. Analyze	5	
5. Evaluate	2	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	5
2.Understand	10
3.Apply	5
4.Analyze	8
5.Evaluate	2
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Readin`g	Nelson, D. L., & Cox, M. M. (2017). Lehninger principles of biochemistry (7th ed.). W.H. Freeman. Alberts, B. (2015) Molecular Biology of the Cell. 6th Edition, Garland Science, Taylor and Francis Group, New York. Klug, W.S. and Cummings, M.R. 2017. *Concepts of Genetics*. 11th edition. Pearson Education, Inc., New Jersey, USA. (e-Book available: https://smtebooks.com/book/7787/concepts-genetics-11th-edition-pdf) Snustad D. P., M. J. Simmons. 2015. *Principles of Genetics*. 7th Ed. John Willey and Sons. Inc. New York, USA. (PDF available: https://www.slideshare.net/hijobaba/principles-of-genetics-6-e-isbn-978-0470903599-snustad-simmons) Pierce, Benjamin A. 2012. Genetics: a conceptual approach, 4th edition. W. H. Freeman and Company, New York. (https://generalgenetics.wordpress.com/wp-content/uploads/2015/09/pierce-genetics-conceptual-approach-4th-txtbk.pdf)

Visiting hours: 9:00 am to 5:00 pm on working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 206	**Developmental Biology**	**Core course**	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

The course is intended to enhance students' learning on the three important and inter-linked disciplines of modern zoology embryonic development process, embryological studies of model animals and applied aspects of developmental biology. Developmental biology is a fascinating aspect of biological study that focuses on the embryological development of animals within an egg or in mother's body. The embryonic development process passes through a number of distinct, but continuous stages displaying the ancestral history. This course specifically highlights the theories of embryonic development, and developmental stages, including cleavages, germ layer formation, cell differentiation and organogenesis until formation of a complete or incomplete life form. The course also offers the embryological studies of three model animals- *Neries*, chick and zebrafish. The course will also discuss about some recent innovations and applied aspects of developmental biology, including cryopreservation, embryonic stem cell, infertility and its treatments.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Give a detailed understanding and learning of developmental biology
- Gain a comprehensive understanding of the concepts and processes of reproduction and embryonic development
- Explain the events in the different stages of embryonic development
- Become familiar with the developmental science, with the cryopreservation process, infertility, stem cell and farming of experimental animals.

Mapping with SDGs

This course is relevant to achieving SDG 3 (Good health and wellbeing for people) and SDG 15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course, the students will be able to		PLO covered
CLO1	Define developmental Biology, reproduction, fertilization, gametogenesis, Spermatogenesis, Spermeogenesis, fertilization, cleavage blastula, gastrula, morula and organogenesis (Remember). Identify different organs of a germ layers in human body. Classify the reproduction, Identify different parts of human sperm (Remember).	PLO1
CLO2	Describe the reproductive peculiarities, ultra-structure of a typical sperm and an egg. Describe the reproductive process (Understand). Describe the embryonic development of zebrafish (*Danio rerio*). (Understand)	PLO1, PLO3, PLO4
CLO3	Compare the different mode of reproduction and fertilization (Apply). Illustrate the process of fertilization and sequence of each event (Apply).	PLO1, PLO4

CLO4	Compare and differentiate between the structure and functions of placenta; the epigenesis, pangenesis developmental methods; Spermatogenesis and Oogenesis; monogamy and polygamy; the types of eggs; the types of cleavage; protostomes and deuterostomes development (Apply). and Discuss theories of developmental Biology and make criticism among theories (Analyze).	PLO1, PLO4, PLO5
CLO5	Explain how use the Fruit fly in developmental research (Apply, Analyze).	PLO2
CLO6	Explain the importance of placenta formation in mammals; the importance of significance of fertilization; the importance of Animal farming and transgenic animals (Apply). Evaluate the importance of Stem cell for human welfare (Analyze).	PLO4, PLO5

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
4	**Introduction:** Theories of developmental biology (epigenesis, pangenesis and germplasm).	**CLO1 CLO2 CLO4**	Visual and Auditory	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
2	**Reproductive process**: Asexual, sexual and parthenogenesis reproduction; reproductive peculiarities; monogamy and polygamy.	**CLO1 CLO2 CLO3 CLO4**		
5	**Gametes and gametogenesis:** Ultra-structure of a typical sperm, Spermatogenesis; Ultra structure of an egg, types of eggs, oogenesis.	**CLO1 CLO2 CLO4**		
4	**Fertilization:** Types and significance of fertilization; sperm-egg interactions; fate of sperm mitochondria.	**CLO1 CLO4**		
4	**Major events in fertilization**: Cleavage, cleavage patterns and types; formation of morula and blastula, gastrula, process of gastrulation and sequence of events; basic differences between protostomes and deuterostomes development.	**CLO1 CLO2 CLO3 CLO6**		
3	**Organogenesis**: Fate of germ layers, early embryology of Nereis and chicks; embryonic development of zebrafish (*Danio rerio*).	**CLO2**		
2	**Embryological derivatives of mammals**: Placentation, types and functions of placenta in mammals.	**CLO1 CLO2 CLO4**		
4	Applied embryology: Fruit fly in research. Cryopreservation. Infertility and its treatment in human. Embryonic stem cell for human welfare. Animal farming and transgenic animals.	**CLO2 CLO6**		

*** Per week 2 classes**

Distribution of class lectures: Total number of lectures: 30

Class/ lecture type	Number of classes	Class/ lecture type	Number of classes
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	28	In-course examination	1
		Review class	1

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by PowerPoint presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class, students' feedback on the previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	5	
2. Understand	5	
3. Apply	7.5	
4. Analyze		
5. Evaluate		
6. Create		

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	5
2.Understand	10
3.Apply	15
4.Analyze	
5.Evaluate	
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Balinsky, B.L. 1981. An Introduction to Embryology, 5thedn.W B Saunders Co., Philadelphia, USA. Gilbert, S.F., 1985. Developmental Biology, Sinauer Associates Inc, Massachusetts, USA. Oppenheimer, S.B., 1980. Introduction to Embryonic Development. Allyn and Bacon Inc. Boston, USA. Raven, H. and Johnson, B. Biology, 4thedn. WBC McGraw-Hill Book Co. Inc. Boston, USA.
Supplementary Reading	Winton and Bayliss. Human Physiology. 5th Edition Sheeler, P. Essential of Human Physiology. 2nd Edition. Sylvia S.M. Human Biology. 3rd Edition.

Visiting hours: 9:00 am to 5:00 pm on working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 207	**Animal Systematics and Nomenclature**	**Core course**	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

Animal Systematics is one of the essential basic branches of Zoology, which deals with taxonomy, classification and nomenclature of all the existing living animals based on multidimensional characters. Systematics additionally provides an idea of animal's position in the phylogenetic tree of organisms showing their evolutionary relationship. Therefore, Animal Systematics has been a fundamental study for species identification, biodiversity assessment and conservation. This course introduces the students to the basic and fundamental principles, schemes and rules of animal systematics, taxonomy, classification, and nomenclature including animal collections and preservation steps in animal identification, typification of specimens, describing of new species, and taxonomic publications. In essence, the course is intended for developing students' professionalism in taxonomic study of animals.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Build conceptual understanding for Animal Systematics including the basics and principles of taxonomy, classifications and nomenclature.
- Become familiar with taxonomic studies for animal identification and description using taxonomic keys, type specimens and taxonomic literatures.
- Gain knowledge and skills for collection, preservation and identification of animal specimens.
- Provide comprehensive knowledge on animal nomenclature's rules and regulations including generic and species name formation.

Mapping with SDGs

This course is relevant to achieving SDG 4 (Quality education), SDG 13 (Climate action), SDG 14 (Life below water) and SDG 15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course, the students will be able to		PLO covered
CLO1	Underline the concept of taxonomy, classification, systematics and nomenclature with their importance in zoological studies (Remember).	PLO1, PLO2
CLO2	Recall the history of taxonomy and classification understanding the animal kingdom (Remember).	PLO1, PLO2
CLO3	Describe and recognize taxonomic categories of animal classification including Linnaean hierarchies (Understand).	PLO1, PLO2
CLO4	Understand and compare different species concepts with speciation process (Analyse).	PLO1, PLO2
CLO5	Operate taxonomic collections and describe the preservation and curation techniques for taxonomic specimens (Apply).	PLO3, PLO5
CLO6	Compose taxonomic articles understanding various types of publications (Apply).	PLO8

CLO7	State the concept of cladistics and DNA barcoding in taxonomy (Understand).	PLO1, PLO2,
CLO8	Depicts and prepare the taxonomic keys for identifying different taxonomic categories of animal taxa (Apply).	PLO1, PLO2,
CLO9	State and interpret the rules and regulation of animal nomenclature (Understand).	PLO8, PLO9
CLO10	Identify and organize the type specimens used in taxonomic study (Understand).	PLO8, PLO9
CLO11	Identify and describe a new species with the procedures of species and generic names formation (Analyse).	PLO8

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
2	**Taxonomy and systematics:** Definition, and differences between taxonomy and systematics; importance of taxonomy; role of taxonomy.	**CLO1**	Visual and Auditory	Class attendance, In-course Exam, Oral test, and Final theory Exam
2	**History of taxonomy:** Old and new systematics; levels of taxonomy.	**CLO2**		
6	**Zoological classification:** Definition; kinds of classification; Linnaean hierarchy. **Taxonomic categories:** a. Species category - concepts of species; polytypic species and its significance; b. Higher categories - genus, family, order, class and phylum; superspecies; c. Lower categories (infra specific categories) - variety, subspecies, race, cline, deme, morph.	**CLO3 CLO4**		
4	Taxonomic collection, preservation, curating, identification (different methods of identification including taxonomic keys)	**CLO5 CLO8**		
3	Types of taxonomic publications; reference works in taxonomy.	**CLO6**		
2	**Cladistics:** Concepts; cladogram. DNA Barcoding in taxonomy.	**CLO7**		
3	**International Code of Zoological Nomenclature (ICZN):** Origin of ICZN; the International Zoological Commission and the International Zoological Congress, and their roles in nomenclature. **Rules of nomenclature:** Essential rules including law of priority (not more than 15 rules).	**CLO9**		
2	**Type method:** Definition of type and typification; kind of types; significance.	**CLO10**		
4	**Formation of names:** Generic and specific	**CLO11**		

	names. **Description of a new species:** Objectives, procedure, type depository, naming.			

*** Per week 2 classes**

Distribution of class lectures: Total number of lectures: 30

Class/ lecture type	Number of classes	Class/ lecture type	Number of classes
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	28	In-course examination	1
		Review class	1

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	3	
2. Understand	8	
3. Apply	2	
4. Analyze	2	
5. Evaluate	2.5	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	5
2.Understand	15
3.Apply	5
4.Analyze	2.5
5.Evaluate	2.5
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Blackwelder RE. 1967. *Taxonomy - A Text and Reference Book*. JohnWiley & Sons, New York. Kapoor, V.C. 2017. *Theory and Practice of Animal Taxonomy*. 8th edition. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, India. Mayr, E. and Ashlock, P.D. 1969. *Principles of Systematic Zoology*. 2nd edition. McGraw Hill Education Pvt. Ltd. (Reprinted in 2014), India. Quicke, D.L.J. 1993. *Principles and Techniques of Contemporary Taxonomy*. BlackWell, London. Simpson, G.G., 1961. Principles of animal taxonomy. Columbia University Press. New York.
Supplementary Reading	International Code OF Zoological Nomenclature (ICZN), Fourth Edition.1999. The International Trust for Zoological Nomenclature 1999. Winston, J. E., and Disney, H. 2000. Describing species: practical taxonomic procedure for biologists. *Nature*, 405(6787), 619.

Visiting hours: 9:00 am to 5:00 pm on working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course type	No of Credits	Credit Hour	Total marks
Zool. 208	**Economic and Applied Zoology**	**Core Course**	**3**	**45**	**75**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

The course has been designed for undergraduate students of Zoology to highlight the importance of animals to human life. The course emphasises that animals not only contribute to the ecosystem and environment, but they also have monetary benefits for human society. The course also focuses on the harmful effects animals have on humans, as well as the beneficial effects. As a graduate of Zoology, students need to know how animals can be a part of job prospects and the socio-economic development of the country. It is not just important for improving our economic condition but also for providing food security and employment opportunities.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Explore the fascinating world of economic zoology and its profound implications for agriculture, medicine and conservation.
- Know different agricultural methods like culture, cropping, cultivation, ranching, rearing and capture with emphasis on Bangladesh.
- Learn about briefing monitory influences of selected invertebrates and vertebrate animals of Bangladesh.
- Explain different kinds of culture methods like apiculture, sericulture, aquaculture, poultry, dairy farming so that they can establish their own business and also be a part of employment opportunity for youth population of the country.
- Understand the harmful effect of poisonous animals and their virulent effect on human life.
- Solve problems related to harmful parasites and pests with a vast knowledge about their transmission process and control measures including vector and pest management and life-threatening zoonotic diseases.

Mapping with SDGs

This course is relevant to achieving SDG 1 (No poverty), SDG 2 (Zero hunger), SDG 3 (Good health and well-being for people), SDG 9 (Industry, Innovation and Infrastructure), SDG 14 (Life below water) and SDG 15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course, the students will be able to		PLO covered
CLO1	Define different terms related to economic and applied zoology like culture, cropping, cultivation, capture, rearing, ranging, pests, parasites, vectors and zoonosis. (Remember)	PLO1, PLO3,
CLO2	Interpret different methods related with farming and agriculture. (Apply)	PLO2, PLO3, PLO5
CLO3	Describe different types of animal husbandry and animal culture methods and discuss about their prospects in national economy and job sector. (Understand)	PLO2, PLO3, PLO5

CLO4	Recognize economically important animals and discuss their beneficial and harmful roles in human life. (Understand)	PLO2, PLO3, PLO, PLO5
CLO5	Compare different methods of pest control (Apply)	PLO2, PLO3, PLO4, PLO5
CLO6	Name and identify different types of venomous animals, parasites, vectors and pests of human and domestic animals and discuss their zoonotic importance (Remember)	PLO6, PLO7

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
6	**Economic Zoology:** Ways of animal cultivation and cropping: culture, ranching, rearing and capture	**CLO1**	Visual and Auditory	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
19	Different types of animal culture aquaculture (fish, prawn and shrimp, oyster and pearl), apiculture, lac culture, sericulture, poultry keeping, dairy farming, integrated fish farming, crocodile and deer farming.	**CLO2, CLO3**		
5	Economic zoology: Definition, economic importance of major animal groups: Protozoa, Cnidaria, Annelids, Arthropods (beneficial and harmful insects and crustacean), Mollusca, fishes, amphibian, reptilia and mammals. Poisonous and venomous animals.	**CLO4, CLO6**		
3	Introduction to invertebrate and vertebrate pests, method of damage caused by major pests, integrated pest management.	**CLO1, CLO4, CLO5, CLO6**		
10	Vectors and parasites of major animal diseases, Zoonosis and antroponosis.	**CLO1, CLO4, CLO6**		

*** Per week 2 classes**

Distribution of class lectures: Total number of lectures: 45

Class/ lecture type	Number of classes	Class/ lecture type	Number of classes
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	43	In-course examination	1
		Review class	1

Outcome Based Education (OBE) Curriculum

Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered using a combination of lectures, discussions, and multimedia tools such as PowerPoint presentations and video clips. Interactive and participatory learning will be encouraged through question-and-answer sessions, as well as group activities conducted during class. At the start of each session, students will provide feedback on the previous lecture. A comprehensive feedback survey on course delivery and content will be conducted during the final class.

Assessment pattern

The assessment structure consists of one in-course examination (26.25 marks) and class attendance (3.75 marks). The final examination, accounting for 45 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (26.25 marks), Attendance: 3.75 marks

Bloom's Category Marks (out of 26.25)	In-course	Assignment
1. Remember	10	
2. Understand	6.25	
3. Apply	10	
4. Analyze		
5. Evaluate		
6. Create		

Year-end Examination

Bloom's Category Marks (out of 45)	Test
1.Remember	18
2.Understand	18
3.Apply	9
4.Analyze	
5.Evaluate	
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Ahmed, Z.U., Begum, Z.T., Hassan, M.A., Khondker, M., Kabir, S.M.H., Ahmad, M. and Haque, E. U. (eds.). 2008. *Encyclopedia of flora and fauna of Bangladesh*. Vol. 27. *Mammals.* Asiatic Society of Bangladesh, Dhaka. Goin, C.J. and Goin, O.B. 1971. *Introduction to Herpetology*. W.H. Freeman & Co., San Francisco, USA. Hickman, C.P., Roberts, L.S. and Larson, A. 2001. *Integrated Principles of Zoology*. 11th edition. McGraw-Hill Co. Inc., New York, USA. Shukla, G.S. and Upadhayay, V.P. 2008. *Economic Zoology*. Rastogi Publications, Meerut, India.
Supplementary Reading	Barnes, R.D. 1980. *Invertebrate Zoology*. 5th edition, WB Saunders College publishing HBJC Publisher, Philadelphia, USA.

	Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. 2001. *The Invertebrates: A synthesis*. Blackwell Scientific Publications, Oxford, UK.

Visiting hours: 9:00 am to 5:00 pm on working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 209	**Field Studies for Animal Diversity (Vertebrate)**	**Core course**	**1**	**15**	**25**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course
A Field trip should be organized for the students during the academic year to study and observe the ecosystems, habitats, community structure and organisms (particularly the vertebrates in the field conditions) found in the visited area.

Specific objectives of the course
Upon completion of this course, the student will be able to-

- Provide a foundational understanding of vertebrate diversity and their ecology.
- Gain skills in identifying, classifying, and analyzing vertebrate specimens from the field.
- Foster critical thinking through comparative studies of morphological adaptations and functional roles of vertebrates.

Mapping with SDGs
This course is relevant to achieving SDG 4 (Quality Education), SDG 14 (Life Below Water) and SDG 15 (Life on Land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to		PLO covered
CLO1	Learn about vertebrates across different phyla with their ecological adaptations according to their respective habitat (Understand).	PLO1, PLO2
CLO2	Apply knowledge of vertebrate biodiversity to real-world contexts, such as public health, agriculture, and conservation biology (Apply).	PLO7
CLO3	Synthesize observations from practical knowledge to contribute to ecology and related sciences (Apply).	PLO7, PLO9

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Credit Hours	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
2	Pre-field lectures: introducing field based vertebrate fauna; observation techniques; identification; classification; ecological perspectives; data collection and analysis.	**CLO1, CLO2**	Visual, Auditory, Practical	On-field assessment, report writing and presentation
2	Preparation of field studies; field safety measures; on-site activities; and demonstration	**CLO1, CLO2**		

1	Briefing on report writing and presentation	**CLO3**		
9	Visit the assigned field area, particularly vertebrate-rich sites	**CLO1-CLO3**	Field demonstration and observation	

Outcome Based Education (OBE) Curriculum
Part- C

Instructional strategies of the course

The course will be delivered through pre-field lectures and field visits to the assigned area, particularly vertebrate-rich sites. Lectures will be aided by PowerPoint presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. All students must participate in the program. Students will be guided in the field to study the vertebrate fauna.

Assessment

Assessment will be done by the Members of the concerned Examination Committee. Three-step assessments will be followed, including onsite assessment (written examination), presentation and report writing. Onsite assessment, presentation and report writing will carry 10, 7.5 and 7.5 marks, respectively.

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Balinsky, B.L. 1981. An Introduction to Embryology. 5th edition. WB Saunders Co., Philadelphia, USA. Kabir, S.M.H., Ahmed, M., Ahmed, A.T.A., Rahman, A.K.A., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., and Khondker, M. (ed.). 2009. Encyclopedia of Flora and Fauna of Bangladesh, Vol. 25. Amphibians and Reptiles. Asiatic Society of Bangladesh. Dhaka. Kent, G.C. 1965. Comparative Anatomy of the Vertebrates. The C.V. Mosby Company and Toppan Company Ltd. Tokyo, Japan. Oppenheimer, S.B. 1980. Introduction to Embryonic Development. Allyn and Bacon Inc., Boston, USA. Rahman, A.K.A. 2005. Freshwater Fishes of Bangladesh. 2nd edition. Zoological Society of Bangladesh, Dhaka. Siddiqui, K.U., Islam, M.A., Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A., Haque, E.U., Ahmed, Z.U., Begum, Z.N.T., Hasan, M.A., Khondker, M. and Rahman, M.M. (ed.). 2007. Encyclopedia of Flora and Fauna of Bangladesh. Vol.23. Freshwater Fishes. Asiatic Society of Bangladesh, Dhaka. Siddiqui, K.U., Islam, M.A., Kabir, S.M.H., Ahmed, M., Ahmed, A.T.A., Rahman, A.K.A., Haque, E.U., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., Khondker, M. and Rahman, M.M. (ed.). 2008. Encyclopedia of Flora and Fauna of Bangladesh, Vol. 26. Birds. Asiatic Society of Bangladesh, Dhaka. Siddiqui, K.U., Islam, M.A., Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A., Haque, E.U., Ahmed, Z.U., Begum, Z.N.T., Hasan,

	M.A., Khondker, M. and Rahman, M.M. (ed.). 2009. Encyclopedia of Flora and Fauna of Bangladesh. Vol. 24. Marine Fishes. Asiatic Society of Bangladesh, Dhaka. Wolff, R.G. 1994. Functional Chordate Anatomy. CBS Publishers and Distributors. New Delhi, India. Chatterjee, C.C. 1985. Human Physiology. Medical Allied agency, Calcutta, India. 35 Zug, G.R. 1993. Herpetology: An Introduction to Biology of Amphibians and Reptiles. Academic Press Inc., San Diego, USA.
Supplementary Reading	Storer, T.I., Usinger, R.L., Stebbins, R.C. and Nybakken, J.W. 2001. *General Zoology*. 6th edition. Tata McGraw-Hill Co. Ltd., New Delhi, India. (Free download: https://www.goodreads.com/book/show/4452321-general-zoology).

Visiting hours: 9:00 am to 5:00 pm on working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 210	**Practical**	Core course	4	60	100

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

This course is designed to provide students with practical exposure to the anatomy, morphology, embryology, and ecological significance of vertebrates. By engaging in museum studies, dissections, skeletal analyses, and embryological investigations, students gain hands-on experience and an understanding of vertebrate diversity, anatomy, and evolutionary adaptations. The course encourages critical thinking, technical skills, and ecological awareness while promoting ethical practices and collaborative learning.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Develop a comprehensive understanding of vertebrate morphology and anatomy across diverse taxa.
- Gain proficiency in laboratory techniques, including specimen handling, dissections, and skeletal preparation.
- Enhance their ability to analyze and interpret the structural and functional adaptations of vertebrates.
- Cultivate skills to observe and document embryonic development stages, linking theoretical and practical knowledge.
- Learn to prepare detailed scientific reports, emphasizing critical thinking and communication skills.
- Encourage ethical practices and safety in laboratory and fieldwork settings.

Mapping with SDGs

This course is relevant to achieving SDG 4 (Quality education), SDG 14 (Life below water), and SDG 15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to		PLO covered
CLO1	Analyze the distinguishing features and adaptive characteristics of higher vertebrate groups, including Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, and Mammalia, through museum specimen studies (Analyze).	PLO1, PLO2
CLO2	Explore and relate embryological development to vertebrate biology (Evaluate).	PLO1, PLO3
CLO3	Perform dissections to explore and demonstrate the structural and functional organization of vertebrate organ systems (e.g., digestive, circulatory, respiratory, nervous, and reproductive systems), including specialized features such as bird air sacs and sensory structures in dogfish, while adhering to ethical standards and safety protocols (Apply/Analyze).	PLO3, PLO5, PLO7
CLO4	Analyze and interpret the skeletal structures of fishes, amphibians, reptiles, birds, and mammals, identifying key adaptations and their ecological and evolutionary significance (Analyze/Understand).	PLO1, PLO5

CLO5	Demonstrate proficiency in preparing vertebrate skeletons using ethical and scientific protocols, while accurately documenting observations and integrating findings into practical reports (Apply/Create).	PLO5, PLO9
CLO6	Conduct field studies, maintain organized notebooks, and synthesize observations into comprehensive scientific reports, demonstrating effective documentation and communication skills (Create).	PLO2, PLO8, PLO9

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*week)	**Topic**	**Corres-ponding (CLOs)**	**Teaching-Learning Strategy**	**Assessment Strategy**
	Museum Study and Embryology:		Visual and Auditory	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
8	Museum study of higher vertebrates: Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves and Mammalia.	**CLO1**		
2	Embryological studies: Study of prepared embryological slides/mounts representing embryonic development of frog/toad and chick; Observation of different stages of embryonic development of chick.	**CLO2**		
	Dissection-Bones:			
4	Study of bones: Skeletal structures of fishes, amphibians, reptiles, birds and mammals; preparation of a skeleton of any cultured/largely available vertebrate.	**CLO3, CLO4**		
5	Dissection: Dissection and display of the digestive, circulatory, respiratory, nervous and reproductive systems of lata (snakehead) fish, lizard and guinea pig; Air sacs of birds; Brain, cranial nerves, eye muscles and internal ear of dogfish.	**CLO5**		
	Local study tour and preparation of a report on the tour Preparation of practical notebooks and field reports	**CLO6**		

*** Per week 2 classes**

Distribution of class lectures: Total number of lectures: 20 (each has three credit hours)

Class/ lecture type	**Number of classes**	**Class/ lecture type**	**Number of classes**
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	17	In-course examination	2
		Review class	1

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course
The course will be delivered through lectures and discussions, aided by hands-on techniques, power-point presentations, flip charts, video films, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classroom.

Assessment Pattern
There will be two in-course examinations, each consisting of 17.5, and 5 marks for class attendance. A
course final examination, comprising of 60 marks will be held, which will also include marks for practical
note books and study tour reports.

CIE- Continuous Internal Evaluation (35 marks), Attendance: 5 marks

Bloom's Category Marks (out of 35)	In-course	Assignment
1. Remember		
2. Understand	15	
3. Apply	10	
4. Analyze	10	
5. Evaluate		
6. Create		

Year-end Examination

Bloom's Category Marks (out of 60)	Test
1.Remember	
2.Understand	20
3.Apply	15
4.Analyze	15
5.Evaluate	10
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Balinsky, B.L. 1981. An Introduction to Embryology. 5th edition. WB Saunders Co., Philadelphia, USA. Kabir, S.M.H., Ahmed, M., Ahmed, A.T.A., Rahman, A.K.A., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., and Khondker, M. (ed.). 2009. Encyclopedia of Flora and Fauna of Bangladesh, Vol. 25. Amphibians and Reptiles. Asiatic Society of Bangladesh. Dhaka. Kent, G.C. 1965. Comparative Anatomy of the Vertebrates. The C.V. Mosby Company and Toppan Company Ltd. Tokyo, Japan.

	Oppenheimer, S.B. 1980. Introduction to Embryonic Development. Allyn and Bacon Inc., Boston, USA. Rahman, A.K.A. 2005. Freshwater Fishes of Bangladesh. 2nd edition. Zoological Society of Bangladesh, Dhaka. Siddiqui, K.U., Islam, M.A., Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A., Haque, E.U., Ahmed, Z.U., Begum, Z.N.T., Hasan, M.A., Khondker, M. and Rahman, M.M. (ed.). 2007. Encyclopedia of Flora and Fauna of Bangladesh. Vol.23. Freshwater Fishes. Asiatic Society of Bangladesh, Dhaka. Siddiqui, K.U., Islam, M.A., Kabir, S.M.H., Ahmed, M., Ahmed, A.T.A., Rahman, A.K.A., Haque, E.U., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., Khondker, M. and Rahman, M.M. (ed.). 2008. Encyclopedia of Flora and Fauna of Bangladesh, Vol. 26. Birds. Asiatic Society of Bangladesh, Dhaka. Siddiqui, K.U., Islam, M.A., Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A., Haque, E.U., Ahmed, Z.U., Begum, Z.N.T., Hasan, M.A., Khondker, M. and Rahman, M.M. (ed.). 2009. Encyclopedia of Flora and Fauna of Bangladesh. Vol. 24. Marine Fishes. Asiatic Society of Bangladesh, Dhaka. Wolff, R.G. 1994. Functional Chordate Anatomy. CBS Publishers and Distributors. New Delhi, India. Chatterjee, C.C. 1985. Human Physiology. Medical Allied agency, Calcutta, India. 35 Zug, G.R. 1993. Herpetology: An Introduction to Biology of Amphibians and Reptiles. Academic Press Inc., San Diego, USA.
Supplementary Reading	N/A

Visiting hours: 9:00 am to 5:00 pm on working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 211	**Viva voce**	**Core course**	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

Viva voce or oral examination is an integral component of the undergraduate programme in Zoology. This is a mandatory course for the students by which students demonstrate their secured knowledge, expertise, and understanding of theoretical and practical courses. It's also an opportunity for the examiners to evaluate the academic abilities of students, and ultimately for determining whether they have met the requirements of promoting to the upper class.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Presenting their in-depth knowledge of the broader field of study programme.
- Improve the ability of students to communicate to scientific world with secured skills and expertise
- Make a deeper understanding of the programme.

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	Demonstrate how their acquired knowledge, expertise and skills from the courses contribute to their field of study.	PLO6, PLO7
CLO2	Recognise and explain the current state of knowledge on a particular issue or topic of the programme.	PLO7, PLO9
CLO3	Demonstrate and assess their academic feats with critical analysis and interpretation of various aspects of the courses.	PLO6, PLO9

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
No specific classes will be assigned	The contents will cover all theoretical and practical courses.	**All CLOs**	N/A	Oral examination will be conducted by the examination committee

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

The course will follow interactive lectures of all theoretical and practical courses of the undergraduate programme. Besides, regular class discussions and individual or group mentoring sessions will also provide instructions for viva voce. All faculty members will instruct the students in this regard.

Assessment
This is a two-credit course that carries 50 marks. The respective Examination Committee including external members will assess overall student's knowledge asking questions from the contents of respective syllabus of the undergraduate programme and student will answer questions accordingly.

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	References mentioned for the theory courses
Supplementary Reading	References mentioned for the theory courses

Visiting hours: 9:00 am to 5:00 pm on working days (if available).

Third Year Bachelor of Science in Zoology

Applicable for the Sessions 2024-2025, 2025-2026, 2026-2027 and 2027-2028

Outcome Based Education (OBE) Curriculum
Part- A

	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 301	**Comparative Vertebrate Zoology**	**Core course**	**4**	**60**	**100**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

This course aims to provide students with a comprehensive understanding of the comparative anatomy of the vertebrates, focusing on their adaptive changes and function of the physiological and anatomical systems. The study of adaptive radiation in different vertebrate allows students to explore how environmental pressures drive diversification and specialization in each lineage. This course bridges comparative anatomy and evolutionary biology, fostering a deeper understanding of various organ systems viz. integumentary, skeleton, digestive, circulatory, excretory, endocrine and nervous systems of fishes, amphibians, reptiles, birds and mammals. Overall, the course emphasizes the interconnectedness of anatomical systems and their role in adaptation. The comparative approach of this course will enhance the critical thinking and analytical skills of the students for advanced anatomy, physiology and evolutionary studies.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Provide themselves with a comprehensive understanding of adaptive radiation in various vertebrate groups, including fishes, amphibians, reptiles, birds, and mammals.
- Study the integumentary system and derivatives of vertebrates highlighting their functional adaptations.
- Carry out comparative study of anatomical systems of various vertebrate groups, emphasizing their general structures and functional modifications related to physiological, behavioural, evolutionary and ecological adaptations to different environment.
- Prepare themselves for higher studies in comparative anatomy and evolutionary biology providing them with a strong foundation in vertebrate diversity and adaptation.

Mapping with the SDGs

This course is relevant to achieve SDG 4 (Quality Education), SDG 14 (Life Below Water, SDG 15 (Life on Land) and SDG 3 (Good Health and Well-being).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	Recognise and describe the concept of adaptive radiation and comparative anatomy of different vertebrate groups (fishes, amphibians, reptiles, birds, and mammals). (Remember and understand)	PLO1, PLO2, PLO3
CLO2	Identify and compare the structural and functional differences of the integumentary systems across vertebrate groups, including the role of	PLO1, PLO2,

	integumentary derivatives. (Understand and Evaluate)	PLO3
CLO3	Examine and compare the comparative anatomy of the skeleton, digestive, circulatory, excretory, endocrine, respiratory and nervous systems of fishes, amphibians, reptiles, birds and mammals understanding the link between structural changes and function in relation to needs (Understand and Evaluate).	PLO1, PLO2, PLO3
CLO4	Demonstrate and apply knowledge of vertebrate anatomical systems to real-world scenarios, including understanding how these systems enable them to survive in various environments. (Apply)	PLO1, PLO2, PLO3, PLO6
CLO5	Communicate scientific concepts of various comparative vertebrate zoology through written reports and oral presentations, demonstrating a deep understanding of vertebrate anatomy and adaptive radiations (Apply and Create)	PLO8, PLO9

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class	**Topic**	**Corres-ponding CLOs**	**Teaching-Learning Strategy**	**Assessment Strategy**
03	**Adaptive radiation in different groups of vertebrates:** Introduction and concepts**.**	**CLO1, CLO4 CLO5**	Visual and Auditory: Lectures, Group work, Oral Presentation	Class attendance, In-course Exam and Final theory Exam
03	**Integumentary system:** Definition, structure and comparative anatomy of integument proper in different vertebrate groups.	**CLO2, CLO4 CLO5**		
03	**Integumentary derivatives:** glands, scales, feathers, hair, beaks, claws, nails, hoops, horns and antlers. **Teeth:** function, structure, types and comparative anatomy in different groups; dentition in mammals.	**CLO2, CLO4 CLO5**		
03	**Digestive system:** General structure and modification of alimentary canal in different vertebrate groups; associated glands in the digestive system	**CLO3, CLO4 CLO5**		
03	**Skeletal system:** Endoskeleton, axial and appendicular skeletons; jaw suspension and visceral arches. Excretory system: Pro-, meso- and meta-nephric kidneys; succession of kidney; evolution of urino-genital ducts.	**CLO3, CLO4, CLO5**		
03	**Circulatory system:** Modification of aortic arches in reptiles, birds and mammals. **Nervous system:** Brain, spinal cord and cranial nerves of vertebrates.	**CLO3, CLO4, CLO5**		

03	**Respiratory system** and accessory respiratory system of vertebrates; mechanism of breathing among vertebrates. **Muscular system:** Different types of muscles, ultra structure of skeletal muscle; endocrine system. **Sense organs:** Classification of receptors; structure and working of mammalian eye and ear.	**CLO3, CLO4, CLO5**		

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will use interactive and participatory teaching methods to foster deeper understanding and engagement. Lectures will incorporate visual aids such as diagrams, video clips, and slide-based illustrations to effectively explain anatomical structures and evolutionary concepts. Group work will be emphasized, where students collaborate to analyse specimens and discuss adaptive features, encouraging peer learning and teamwork. Weekly feedback sessions will ensure continuous improvement and alignment with learning goals, while discussions and problem-solving activities will promote critical thinking and application of concepts. This multifaceted approach aims to create an engaging, hands-on learning environment that prepares students for future scientific endeavours.

Assessment Pattern

There will be at least two one in-course examinations, consisting of 35.0 marks and 5.0 marks will be for class attendance. The course final examination, comprising 60 marks, will be conducted centrally by the university.

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CIE- Continuous Internal Evaluation (35 marks), Attendance: 5 marks

Bloom's Category Marks (out of 17.5)	**In-course**	**Assignment**
1. Remember	6	
2. Understand	16	
3. Apply	4	
4. Analyze	4	
5. Evaluate	5.0	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 60)	**Test**
1.Remember	10
2.Understand	30
3.Apply	10
4.Analyze	5.0
5.Evaluate	5.0
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

Recommended Reading	Kardong, K.V. 2005. *Vertebrates Comparative Anatomy, Function and Evolution.* McGraw Hill Higher Education, London. Kent, G.C. and Carr, R.K. 2000. *Comparative Anatomy of Vertebrates.* McGraw Hill Company, London. Weichert, C.K. 1970. *Anatomy of Chordates.* McGraw Hill Co., London. Weichert, C.K. 1970. Anatomy of Chordates. McGraw Hill Co., London. Young, J.Z. 1962. *Life of Vertebrates*. 2nd edition. Oxford at the Clarendon Press, London. Verma, P. S. 2010. *Chordate Zoology*. S. Chand Publishing. India
Supplementary Reading	Kardong, K. V., & Zalisko, E. J. *Comparative Vertebrate Anatomy: A Laboratory Dissection Guide*. McGraw-Hill. Freeman, S., & Herron, J. C. *Evolutionary Analysis*. Pearson. Losos, J. B. (2010). *Adaptive Radiation, Ecological Opportunity, and Evolutionary Determinants*. Annual Review of Ecology, Evolution, and Systematics, 41, 507-532. Schluter, D. (1996). *Ecological Causes of Adaptive Radiation*. *The American Naturalist*, 148(S1), S40-S64. Grant, P. R., & Grant, B. R. (2002). *Adaptive Radiation of Darwin's Finches: Recent Data Help Explain How This Process Occurs*. *BioScience*, 52(2), 101-109. Foote, M. (1997). *Evolutionary Patterns in the Fossil Record of Mammals*. *Science*, 278(5339), 1271-1277. Moen, D. S., & Wiens, J. J. (2009). *Adaptive Radiation in Amphibians*. *Systematic Biology*, 58(4), 596-619. Harmon, L. J., et al. (2008). *Tempo and Mode of Evolution in Iguanas and Other Lizards and Snakes*. *Evolution: International Journal of Organic Evolution*, 62(5), 1608-1626.

Visiting hours: 9:00 am to 5:00pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 302	**Animal Genetics**	**Core course**	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

The rationale for this course lies in its focus on equipping students with a thorough understanding of the principles and concepts of genetics, particularly as they relate to animals. Genetics serves as a foundation for understanding life processes by centering on genes and their roles in inheritance, variation, and evolution. Advances in this field have enabled the control of diseases, enhancement of animal functions, and innovative industrial applications. By exploring mechanisms of trait inheritance, chromosome structure, population genetics, and genetic anomalies, the course bridges theoretical knowledge with practical applications for human welfare. It aims to inspire and prepare students to become proficient geneticists capable of addressing challenges in health, agriculture, and biotechnology.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Enhance conceptual understanding of the Mendel's laws and its modifications, inheritance, chromosomal structure and Hardy-Weinberg's law related genetic issues.
- Increase their knowledge on the phenomenon of crossing over, gene mutations and chromosomal aberrations with reference to animal health and development.
- Promote practical applications of Genetics and make them familiar with the applications for human welfare.

Mapping with SDGs

This course is relevant to achieves Goal 3 (Good health and well-being for people)*, SDG4 (Quality education),* Goal 12 (Responsible consumption and production), and Goal 14 (Life below water).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to		PLO covered
CLO1	Define cytogenetics and describe its significance in genetics and biology. (Remember)	PLO1, PLO4
CLO2	Explain the types and theories of genetic linkage and describe the mechanisms and types of crossing over. (Understand)	PLO1, PLO3
CLO3	Analyze various sex determination systems and theories in animals, including the implications of sex-linked inheritance. (Analyze)	PLO1, PLO6
CLO4	Identify the different types of mutations with their significance in genetic variation and evolution. (Understand)	PLO1, PLO7
CLO5	Describe the general structure of chromosomes, including nucleosomes, and compare the mitotic karyotypes of different vertebrates and invertebrates. (Analyze)	PLO5, PLO6
CLO6	Compare animal chromosomal diseases caused by chromosomal aberrations. (Analyze)	PLO1, PLO6

CLO7	Explain the mechanisms and types of gynandromorphism and their implications for understanding sex differentiation. (Understand)	PLO1
CLO8	Examine cytogenetic analysis of animal chromosomal anomalies, particularly in polytene and lampbrush chromosomes. (Analyze)	PLO1, PLO8
CLO9	Explain the principles of Mendelian inheritance, including Mendel's laws and their modifications and analyze genetic phenomena such as epistasis, penetrance, expressivity, reversion, and pleiotropism in various contexts. (Analyze)	PLO1, PLO6
CLO10	Understand the significance of animal genetics in biological research and breeding and utilize pedigree analysis for understanding inheritance patterns in animals. (Understand)	PLO6, PLO7
CLO11	Explain the concept and ethical implications of eugenics and apply breeding systems, including inbreeding, outbreeding, and pure line selection. (Apply)	PLO1, PLO6
CLO12	Explain the Hardy-Weinberg equilibrium and analyze factors causing changes in allelic frequencies, such as mutation, migration, selection, and genetic drift. (Analyze)	PLO2, PLO6
CLO13	Develop strategies for improving genetic traits in animals and assess the impact of genetic changes on populations over time. (Apply)	PLO1, PLO2

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	**Topic**	**Corres-pondin g CLOs**	**Teaching-Learning Strategy**	**Assessment Strategy**
1	Concept of cytogenetics;	**CLO1**	Visual and digital learning, Problem-solving sessions, Interactive discussion, and Feedback	Class attendance, Oral Presentation, Assignment, In-course Exam and Final theory Exam
1	Types and theories of linkage; mechanism, types and theories of crossing over;	**CLO2**		
1	sex determination systems and theories in animal; sex-linked inheritance;	**CLO3**		
1	Types and significance of mutations.	**CLO4**		
2	General outline of chromosome structure, mitotic karyotypes of fruit fly, carp fish and human;	**CLO5**		
1	Nucleosome and its structural organization in eukaryotic chromosomes;	**CLO5**		
1	Types and significance of chromosomal aberrations with special reference to *animals*;	**CLO6**		
1	Types and mechanism of gynandromorphism;	**CLO7**		
2	Cytogenetic analysis of animal chromosomal anomalies with reference to polytene and lampbrush chromosomes.	**CLO8**		
6	Mendelian Genetics: Introduction, history, development and scope of animal genetics; Mendel's laws and modification of Mendelian ratios, Mendelian applications; pedigree;	**CLO9**		

	epistasis, penetrance and expressivity, reversion, pleiotropism;			
4	Breeding Genetics: Concept of eugenics; Introduction, application of breeding system, viz. inbreeding and out-breeding, pure line selection; application of breeding systems to economically important animals.	**CLO10 CLO11**		
4	Population Genetics: Gene pool and gene frequency; equilibrium of gene frequencies and Hardy-Weinberg's Law; changes in allelic frequencies mutation, migration, selection and genetic drift.	**CLO12 CLO13**		

*** Per week 2 classes**

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	**In-course**	**Assignment**
1. Remember	2.5	
2. Understand	5	
3. Apply	5	
4. Analyze	3	
5. Evaluate	2	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 30)	**Test**
1.Remember	5
2.Understand	10
3.Apply	7
4.Analyze	5
5.Evaluate	2
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Brooker, R.J. 2016. *Concepts of genetics*. 2nd Ed. McGraw-Hill Company, London. (free copy available: https://www.mheducation.com/ highered/product/concepts-genetics brooker/ M0073525359.html) Lewin, B., Krebs, J., Stephen, T. K. and Elliott, S.G. 2016. *Genes*. 11th Ed. Pearson Education, Inc., New Jersey, USA. (PDF available: https://ms2016asab.files.wordpress.com/2016/09/lewins-genes-xi.pdf) Klug, W.S. and Cummings, M.R. 2017. *Concepts of Genetics*. 11th edition. Pearson Education, Inc., New Jersey, USA. (e-Book available: https://smtebooks.com/book/7787/concepts-genetics-11th-edition-pdf) Snustad D. P., M. J. Simmons. 2015. *Principles of Genetics*. 7th Ed. John Willey and Sons. Inc. New York, USA. (PDF available: https://www.slideshare.net/hijobaba/principles-of-genetics-6-e-isbn-978-0470903599-snustad-simmons) Pierce, Benjamin A. 2012. Genetics: a conceptual approach, 4th edition. W. H. Freeman and Company, New York. (https://generalgenetics.wordpress.com/wp-content/uploads/2015/09/pierce-genetics-conceptual-approach-4th-txtbk.pdf)
Supplementary Reading	Strickberger, M.W. 1970. *Genetics*. Mac Graw-Hill Company, London. Weaver, R. and Hedrick, P.W. 1995. *Basic Genetics.* 2nd edition. Wm. C. Brown Publishers, St. Louis, USA.

Visiting hours: 09:00 am to 5:00 pm on working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 303	**Ethology and Animal Welfare**	**Core course**	**3**	**45**	**75**

Prerequisites: As per University requirements for the admission into program.

Rationale of course

Ethology is the scientific and objective study of animal behaviour. This course will emphasis on the role of animal behaviour under an eco-evolutionary perspective, knowledge of the appropriate scientific terminology of the discipline, the ability to understand and critically discuss the main topics of the behavioural ecology. Develop knowledge about concepts and all aspects of animal behaviour. Examine various types of communication used in animals, different types of orientation and social organizations. The course will focus on different types of instinct and learning behaviour, influence of environment on behavioral development, patterns and forms of behaviour. The course also highlights the influence of genes on behavioral patterns and performances. The course will focus also on animal welfare and ethical importance of handling animals that people interact with.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Provide with basic conceptual understanding on animal behaviour and its importance.
- Enhance knowledge about the type and forms of behavioural patterns in animals and the mechanism of behavioural expressions.
- Understand the evolutionary significance of behaviour.
- Explain students the importance of animal welfare and ethical importance of animals that we interact with.

Mapping with SDGs

This course is relevant to achieves, SDG 3 (Good health and well-being for people), SDG 9 (Industry, Innovation and Infrastructure), SDG14 (Life below water), and SDG15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	Define and explain relevant terms related to ethology. (Remember) and understand)	PLO1, PLO2
CLO2	Interpret history of ethology and how environment and gene effect animal behaviour (Apply)	PLO1, PLO6
CLO3	Discuss Ecological and evolutionary significance of behaviour (understand)	PLO1, PLO2
CLO4	Describe different forms of behaviour like feeding, locomotory, play, antipredatory behaviour of animals. (understand)	PLO1, PLO2, PLO3
CLO5	Differentiate between learning and instinct behaviour (Analyze)	PLO1, PLO2, PLO3
CLO6	Explain how animals communicate and interact with each other. (understand)	PLO3, PLO4
CLO7	Compare different kinds of social behaviours of animals in different species. (Apply)	PLO1, PLO2, PLO3

CLO8	Explains the importance of animal welfare and legal regulations and ethical issues in animal husbandry, slaughter houses and laboratory. (understand)	PLO2, PLO7, PLO9

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
4	**Introduction to animal behaviour:** definition, historical background, environmental influence and natural selections, population breeding potentials (BP)- environmental resistance (ER)	**CLO1, CLO2, CLO3**	Visual and Auditory	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
4	Evolution and development of behaviour	**CLO2, CLO3**		
5	Instinct versus learning: different kinds of learning, sensitive period, use of tools, intelligence and cognition	**CLO1 CLO5, CLO6**		
8	Patterns of behaviour: tropism, taxes, reflexes, thermoregulation, play, biological clocks, body maintenance, peck orders and its types, photoperiodism and its influence, scent markings and its kinds, hoarding and its types.	**CLO1, CLO2, CLO6, CLO7**		
10	**Different forms of behaviour:** feeding behaviour, locomotory behaviour, antipredatory behaviour, locomotory behaviour, conflict behaviour, communication behaviour, social behaviour, breeding behaviour, parental care and sexual behaviour in different groups of animals, breeding behaviour of sea horse, 3 spinned stickle back, and sea gull	**CLO1, CLO6 CLO7**		
3	**Behavioural genetics:** influence of genes in behavioural patterns and influences	**CLO2**		
10	**Introduction to animal welfare:** history, concepts and cultures of animal welfare and ethics, animal and moral concern, welfare assessment and 5 freedoms, physiological indicators of welfare, scientific approaches to welfare: abnormal behaviour, diseases, stress and production , natural living and stress, human animal interaction, traditional husbandary ethics, ethical issues in slaughter houses, laboratory and animal welfare issues,animal welfare organizations and protection legislation, human animal interactions, effect of biotechnology in animal welfare	**CLO8**		

*** Per week 2 classes**

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered using a combination of lectures, discussions, and multimedia tools such as PowerPoint presentations and video clips. Interactive and participatory learning will be encouraged through question-and-answer sessions, as well as group activities conducted during class. At the start of each session, students will provide feedback on the previous lecture. A comprehensive feedback survey on course delivery and content will be conducted during the final class.

Assessment pattern

The assessment structure consists of one in-course examination (26.25 marks) and class attendance (3.75 marks). The final examination, accounting for 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (26.25 marks), Attendance: 3.75 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	11.25	
2. Understand	10	
3. Apply	5	
4. Analyze		
5. Evaluate		
6. Create		

Year-end Examination

Bloom's Category Marks (out of 45)	Test
1.Remember	8
2.Understand	15
3.Apply	8
4.Analyze	8
5.Evaluate	6
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Alcock, J. 2005. *Animal Behaviour. An Evolutionary Approach*. 8th Edition. Sinauer Associates Inc. Publishers, Sunderland, Massachusetts, USA. Arora, M.P., Kanta, C., Eds. 2003. *Animal Behaviour*. 6th Edition. Himalaya Publishing House. Mumbai, India. Krebs, J. R. and N. B. Davies (eds.). 1980. *An introduction to behavioural ecology*. Sinauer Associates, Sunderland, Massachusetts, USA. McFarland, David. 1999. *Animal Behaviour: Psychobiology, Ethology and Evolution*. 3rd Edition. Pearson Education Limited. England. Singh, H. 2003. *A textbook of Animal Behaviour*. Arora, C.K. 3rd edition.

	Anmol Publications Pvt. Ltd. New Delhi, India.
Supplementary Reading	N/A

Visiting hours: 9:00 am to 5:00 pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 304	**Fundamental and Advanced Ecology**	**Core course**	**4**	**60**	**100**

Prerequisites: As per University requirement for the admission into program.

Rationale of the course

Knowing the diverse range of animals and the ecosystems has been a fascination to mankind. This course offers a comprehensive package of learning opportunities for under graduate students. Ecology is the study of the diverse and unique habitats or surroundings. Ecological knowledge is essential for the students of biological sciences. Concept of fundamental as well as the advanced ecology and its scopes in the Zoology will allow the students to understand nature more closely and to take proper decision and action regarding conservation of nature and ecosystems. Understanding ecological processes will provide information to better understand the living world around us. This knowledge ultimately helps to improve the environment and to manage natural resources and protect human health.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Enhance conceptual understanding of students on the ecology and its importance.
- Increase their knowledge on the different unique ecosystems, ecosystem engineering and special relation with development.
- Make them familiar with the interaction between biotic and abiotic factors and different ecosystem processes (e.g. how energy transfer through food chains, how biogeochemical cycles operate in ecosystems, etc.);
- Promote practical applications of ecological knowledge with applications for human welfare.

Mapping with SDGs

This course is relevant to achieves SDG1 (No poverty), SDG4 (Quality education), SDG13 (Climate action), SDG14 (Life below water) and SDG15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	the basic principles of ecology, different ecological processes with special relation with development and conservation. (Understand)	PLO1, PLO2, PLO3, PLO4
CLO2	the conceptual ecological models, unique ecosystems and ecosystems engineering with the importance. (Apply)	PLO2, PLO4
CLO3	trophic levels and transfer of energy through food chain. (Understand)	PLO1, PLO4
CLO4	how to promote practical applications of ecological knowledge for human welfare and also for the protection of ecosystems (Apply)	PLO1, PLO2, PLO4

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
1	Concepts, types and scopes of ecology.	CLO1, CLO2	Visual and Auditory	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
5	Concept of ecosystem, energy flow in ecosystem; food chains; food webs and trophic levels; trophic structure and ecological pyramids; transfer of food energy; ecological efficiencies.	CLO1, CLO2, CLO3, CLO4		
1	Ecological principles and Ecological factors - biotic and abiotic.	CLO1, CLO2, CLO3		
2	Development of ecosystem; concept of the climax; co-evolution, group selection.	CLO1, CLO2, CLO4		
3	Biogeochemical cycles: Nitrogen, water and carbon cycles.	CLO1, CLO2, CLO3		
2	Principle of limiting factors: Liebig's law of the minimum; Shelfod's law of tolerance.	CLO1, CLO2		
3	Concepts of habitat and ecological niche: Ecological equivalent; character displacement; allopatry and sympatry; biological clock.	CLO1, CLO2, CLO3		
4	Terrestrial ecology: Tundra, forest, desert and grassland biomes including their physical characters, climatic conditions, vegetation and animal adaptations.	CLO1, CLO2, CLO3		
3	Freshwater ecology: Lotic and lentic habitats and their characteristics, major fauna, pond, lake and river ecosystems.	CLO1, CLO2, CLO3		
1	Estuarine ecology: Characteristics, major fauna.	CLO1, CLO2, CLO3		
3	Marine ecology: Marine environment, zonation of the sea, communities of the marine environment.	CLO1, CLO2, CLO3		
06	Systems ecology: concepts; Population ecology: Definition of population; principles and concepts of organization at population level; group properties - density, natality, mortality, biotic potential, population age distribution; population growth forms - J and S shaped, dispersion, isolation and territoriality.	CLO1, CLO2, CLO3		
	Concept of carrying capacity; concept of	CLO1,		

02	population regulation and stability; concept of density dependent and density independent action.	CLO2		
04	Interactive ecology: impacts of climate change on the life of animals; different types of interactions-competition, prey-predator interaction, herbivory. Host-parasite interaction, coexistence, mutualism, proto-cooperation, and commensalism.	CLO1, CLO2, CLO3		
02	**Community ecology**: Biotic community concept; concept of ecological dominance; community structure; composition and stratification.	CLO1, CLO2, CLO3		
03	Community analysis; species diversity in community; pattern in communities; ecotones and concept of edge effect; ecological corridor, Life table: concept, types and construction.	CLO1, CLO2, CLO3		
06	**Introduction to landscape ecology:** landscape structure (patches, corridors, matrix, network), concept of ecotope, landscape change (geomorphology, disturbances, plant and animal invasions), landscape function, landscape management, effects of animals in landscapes.	CLO1, CLO2, CLO3		
02	Pollution ecology: Transformation patterns of organic and inorganic pollutants in the terrestrial and aquatic ecosystems	CLO1, CLO2, CLO3, CLO4		
02	Ecological models and sustainable management of ecosystems: Concept, types and significance.	CLO1, CLO2, CLO3, CLO4		

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be two in-course examinations, consisting of 17.5 marks for each and 5.0 marks will be for class attendance. The course final examination, comprising 60 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks for both the in-course exams.), Attendance: 5.0 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	4	
2. Understand	4	
3. Apply	3	
4. Analyze	2.5	
5. Evaluate	2	
6. Create	2	

Year-end Examination

Bloom's Category Marks (out of 60)	Test
1.Remember	10
2.Understand	20
3.Apply	15
4.Analyze	5
5.Evaluate	5
6.Create	5

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Adams, G., 2015. Birdscaping Australian Gardens, 1st edition. Melbourne, Vic.: Penguin Group, 2015. Filippi, O., 2019. Dry Gardening Handbook: Plants and Practices for a Changing Climate. 2nd ed. edition. Filbert Press. Frey, K. and G. LeBuhn, 2016. The Bee-Friendly Garden: Design an Abundant, Flower-Filled Yard That Nurtures Bees and Supports Biodiversity. Berkeley: Clarkson Potter, Ten Speed. Jeffries, M.J. 1997. *Biodiversity and Conservation.* Routledge, London and New York. Odum, E.P. and Barrett, G.W. 2005. *Fundamentals of Ecology.* 5th edition.Thomson Brooks/Cole Publishing Co., USA. Turk, A., Wittes, J.J., Turk, J. and Wittes, R.E. 1978. Environmental Science. W.B. Saunders Company, Philadelphia, USA. Hickman, C.P., Roberts, L.S. and Larson, A. 2001. *Integrated Principles of Zoology*. 11th edition. McGraw-Hill Co. Inc., New York, USA.
Supplementary Reading	Primack, R.B. 1998. *Essential of Conservation Biology*. 2nd edition. Sinauer Associates, Inc. Pub., Sunderland, Massachusetts, USA.

Visiting hours: 9:00 am to 5:00pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 305	**Human Physiology, Reproduction and Family Planning, and Population Studies**	**Core course**	**4**	**60**	**100**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

The course is intended to enhance students' learning on the three important and inter-linked disciplines of modern zoology - human physiology, reproduction and family planning, and population studies. The major focuses are on the physiological study of human (digestion, excretion, respiration, circulation and maintaining homeostatis, muscle contraction) neural and hormonal regulation of body functions. Knowledge on physiology is crucial to study as it relates to body functions and provides the basis knowledge for diagnosis and treatment of illness.

The reproduction and family planning also is a part of the course. The students will touch on the basis of human reproduction and related diseases, methods and techniques of family planning. The course will also introduce the students to basic techniques of demographic analysis, measures of mortality, fertility and migration levels and patterns. Life table, standardization and population projection techniques will also be explored. Understanding of this course will precede everyone to learn about reproduction and family planning. There is a mutual and strong relationship between the development and composition of a society's population and changes in the economy, cultural values and institutions this course is very productive.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Give the students a detailed understanding and learning on the different organ systems and physiology of major body functions, and hormonal and neural regulations of physiological functions of human body.
- Introduce the physiology of human reproduction, related diseases, hormonal regulation for reproduction and pregnancy, how they work.
- Make students familiar to the methods and techniques of birth control.
- Introduce students to the different measures of demography and its uses in demographic projections and enhance students learning on the demographic analysis.

Mapping with SDGs

This course is relevant to achieves SDG 1(No poverty), SDG 2 (Zero hunger), SDG 3 (Good health and wellbeing for people) and SDG 5 (Gender equality).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	Define physiology, Identify different organs of a functional system in human body. Define population, population growth, fertility, migration. Classify the human migration (Remember)	PLO1
CLO2	Describe the physiology of different functional systems in human body. Describe the metabolism of carbohydrates, glycolysis, citric acid cycle and electron transport system. Explain the neuromuscular actions.	PLO1, PLO2, PLO4

	Explain the process of ossification and bone growth. Explain the physiology of different types of nervous system. Discuss the reproductive hormonal system Discuss the population structure. Describe the pre-modern population doctrines and population changes. Describe the trends and levels in mortality among social class. Explain the causes of migration (Understand)	
CLO3	Illustrate the functions of different functional systems in human body. Describe the roles of blood (plasma and blood cells). Write down the role / functions of different cranial nerves of human. Identify and classify different human diseases related with reproduction Discuss the role of sex hormones in human reproduction Illustrate the population growth and development	PLO1, PLO2, PLO4
CLO4	Compare different functional system of human with diagram and their functions. Compare the phases of respiration and its regulation. Compare the functions of hormones and enzymes. Differentiate the permanent and temporary birth control methods. Differentiate migration and movement. Compare the types of population growth. Discuss population theories and make criticism among Malthus and modern theories (Analyze)	PLO1, PLO4, PLO6
CLO5	Explain the importance of sex hormone and placenta formation in human reproduction. Discuss the importance of family planning Discuss the importance of migration and population growth Evaluate the importance of age and sex ratio Discuss the measurement of population growth, birth and death rate Explain how to measure the fertility Construct the life table and population pyramid	PLO1, PLO2, PLO6

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
3	**Human Physiology**: Digestion: Definitions of food, nutrition and digestion, digestion of carbohydrates, proteins and lipids; role of liver and pancreas in digestion.	**CLO1 CLO2**		
3	**Circulation**: Pulmonary and systemic circulation, portal circulation; physiology of circulation; composition of blood and other body fluids; their functions; formation of blood cells; blood groups; coagulation of blood and blood pressure.	**CLO1 CLO2 CLO3 CLO4**		

4	**Respiration**: Definition and phases; respiratory movement of breathing; physiology of respiration and regulation of respiration.	**CLO1 CLO2 CLO3**	Visual and Auditory	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
2	**Excretion**: Definition; physiology of excretion and urine formation; regulation of excretion.	**CLO1 CLO2**		
3	**Muscle contraction**: Chemistry and theories of muscle contraction; neuromuscular action; characteristics of muscle twitch; motor unit; summation; tetanus and muscle dystrophies.	**CLO1 CLO2**		
2	**Bone**: Structure and types; ossification; bone growth; reabsorption and bone disorder.	**CLO2**		
3	**Hormone**: Types, sources and functions; regulation of hormone secretion; mode of action of hormone; effects of abnormal secretions of hormones.	**CLO1 CLO2 CLO4**		
4	**Metabolism**: Carbohydrates, glycolysis and citric acid cycle, electron transport system.	**CLO2**		
3	**Nervous system**: Neurons, physiology of different types of nervous system; role of cranial nerves; physiology of hearing; equilibrium and balance of vision.	**CLO1 CLO2 CLO5**		
5	**Human reproductive system** and accessory glands; sex hormones; regulation of menstrual cycle and pregnancy. Disorders of reproductive system.	**CLO1 CLO2 CLO4**		
5	**Fertilization**; pregnancy and placenta, and faetal development. Importance of family planning; birth control principles and methods.	**CLO1 CLO3 CLO5**		
3	**Demographic perspective**: Introduction; population and its growth; nature of population; population changes; pre-modern population doctrines.	**CLO1 CLO2 CLO3**		
3	**The Malthusian perspective**; the Marxist perspective; revised Malthus and modern population theories; theory of the demographic transition.	**CLO2 CLO4**		
3	**An overview of world population**. Population processes. Components of mortality, measuring mortality; social class differential in mortality; trends and levels in mortality.	**CLO2 CLO4 CLO5**		
3	**Fertility concepts and measurements**; fertility trends; levels and explanations. Population structures and characteristics; age and sex structure.	**CLO1 CLO2 CLO3 CLO5**		
3	**Human migration**: definition, types and explanations of migration and measuring migration. Population growth and development.	**CLO1 CLO2 CLO5**		

*** Per week 3 classes**

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be two in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 60 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	5	
2. Understand	5	
3. Apply	7.5	
4. Analyze		
5. Evaluate		
6. Create		

Year-end Examination

Bloom's Category Marks (out of 60)	Test
1.Remember	15
2.Understand	20
3.Apply	10
4.Analyze	10
5.Evaluate	05
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Chatterjee, C.C. 1977. Human Physiology. Medical Allied Agency, Kolkata, India. Weeks, J.R. 2016. Population: An Introduction to Concepts and Issues. 12th edition.
Supplementary Reading	Winton and Bayliss. Human Physiology. 5th Edition Sheeler, P. Essential of Human Physiology. 2nd Edition. Sylvia S.M. Human Biology. 3rd Edition.

Visiting hours: 9:00 am to 5:00pm on the working days (if available).

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 306	**Environmental Pollution and Human Ecology**	**Core course**	**3**	**45**	**75**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

The course is designed to equip students with a comprehensive understanding of the complex interactions between human activities and the environment. It introduces key concepts, terminologies, and types of pollution, helping students grasp the foundational knowledge necessary to address environmental challenges. Students will learn to assess environmental impacts critically through modules on Environmental Impact Assessment (EIA), covering its definition, stages, clearance processes, and assessment techniques. Additionally, they will develop skills for sustainable development planning through an understanding of the Environmental Management Plan (EMP), focusing on mitigation, enhancement, monitoring strategies, and community participation. The Human Ecology section deepens the understanding of how human populations have evolved and distributed geographically over time, exploring the ecological influences on physical, social, and cultural aspects of human life. Overall, the course aims to create environmentally literate graduates who can analyze ecological impacts, contribute to sustainable management solutions, and advocate for responsible human-environment interactions.

Specific objectives of the course

Upon completion of the course, the student will be able to-

- Be Introduced with the fundamental concepts, definitions, terminologies, and types of environmental pollution.
- Provide detailed knowledge about air, noise, water, and soil pollution, including their sources, types, effects on ecosystems and human health, and various control and prevention measures.
- Familiarize with the process and importance of Environmental Impact Assessment (EIA), including its stages, clearance categories, procedural steps, and assessment methods.
- Develop understanding of Environmental Management Plans (EMP), emphasizing the planning of mitigation, enhancement, and monitoring strategies, and the role of public participation in environmental management.
- Explore the concept and history of Human Ecology, focusing on the distribution of human types and the ecological impacts on physical, social, and cultural aspects of human life.
- Analyze the consequences of population expansion and developmental activities on environmental degradation and ecological balance.
- Prepare them for assessing, mitigating, and managing environmental and human ecological impacts, contributing to sustainable development and responsible environmental stewardship.

Mapping with SDGs

This course is relevant to achieve SDG goals 2(Zero hunger), 3 (Good health & well), 4 (quality education), 6 (Clean water and sanitation), 12 (Responsible consumption and production), 13 (Climate action), 14 (life below water) and 15 (life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	Define and introduction to environmental pollution (Apply).	PLO1

CLO2	Describe origin, source and impact of air pollution (Understand).	PLO1, PLO2
CLO3	Describe origin, source and impact of noise pollution (Understand).	PLO1, PLO4
CLO4	Describe origin, source and impact of water pollution (Understand).	PLO1, PLO4, PLO5
CLO5	Describe origin, source and impact of soil pollution (Understand).	PLO1, PLO5
CLO6	Illustrate the overview of Environmental Impact Assessment (Analyze, Understand).	PLO1, PLO5
CLO7	Illustrate the overview of Environmental Management Plan (Apply, Analyze, Understand).	PLO1, PLO2
CLO8	Define and introduction to human ecology (Apply).	PLO1, PLO2
CLO9	Explain the human race types and their distribution (Understand).	PLO1, PLO3
CLO10	Illustrate environmental impact on man's physical features, social and cultural life (Understand).	PLO1, PLO3
CLO11	Explain the impact of human population expansion on environment (Understand)	PLO1, PLO2
CLO12	Explain anthropogenic developmental activities and their impacts on environment (Understand)	PLO1, PLO2

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
2	**Introduction to Environmental Pollution:** Introduction, Concept, terminologies, definitions and types of pollution.	**CLO1**	Visual and Auditory	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
4	**Air pollution**: Definition, major types, sources, effects on biosphere and control measures.	**CLO2**		
4	**Noise pollution**: Definition, sources, effects on human and animals and prevention methods.	**CLO3**		
4	**Water pollution**: Definition, sources, types, effects on ecosystem and treatment methods.	**CLO4**		
4	**Soil pollution:** Definition, sources, effects on ecosystem and prevention.	**CLO5**		
4	**Environmental Impact Assessment (EIA):** Introduction, definition, stages/levels, clearance categories; procedural steps; assessment methods and report structure.	**CLO6**		
4	**Environmental Management Plan (EMP):** Purpose, definitions, components including	**CLO7**		

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
	mitigation; enhancement and monitoring plans; implementation and people's participation.			
2	**Human ecology:** Introduction; Early history of human distribution.	**CLO8**		
2	Human races types and their distribution.	**CLO9**		
3	Environmental impact on man's physical features, social and cultural life.	**CLO10**		
3	Impact of human population expansion on environment.	**CLO11**		
4	Anthropogenic developmental activities and their impacts on environment.	**CLO12**		

*** Per week 1 classes**

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 26.25 marks and 3.75 marks will be for class attendance. The course final examination, comprising 45 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (26.25 marks), Attendance: 3.75 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	6.25	
2. Understand	7	
3. Apply	7	
4. Analyze	3	
5. Evaluate	3	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 45)	Test
1.Remember	15
2.Understand	15
3.Apply	10
4.Analyze	5
5.Evaluate	
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Readings	Bennett, J. W. 1976. *The Human Ecosystem: A Model for studying the Human-Environment interaction*, University of California Press, USA. DOE. 1997. *EIA Guidelines for Industries.* Department of Environment, Ministry of Environment and Forest. Govt. of the People's Republic of Bangladesh, Dhaka, Bangladesh. FPCO. 1992. *Guidelines for Environmental Impact Assessment (EIA).* Flood Plan Coordination Organization, GoB, Dhaka, Bangladesh. Miller, G.T. 1985. *Living in the Environment*. Woodsworth Publishing Company, Belmont, California, USA. Odum, E.P. 1971. *Fundamentals of Ecology*. W.B. Saunders Company, Philadelphia, USA. Sutton, Mark Q. and Anderson, E. N. 2010. *Introduction to cultural ecology.* 2nd ed. AltaMira Press, USA. Townsley, P. 1993. *A manual on Rapid Appraisal Methods for Coastal Communities*. BOBP, Dhaka, Bangladesh. Turk, A., Wittes, J.J., Turk, J. and Wittes, R.E. 1978. *Environmental Science*. W.B. Saunders Company, Philadelphia, USA.
Supplementary Readings	IUCN. 1994. Guidelines for Protected Area Management Categories. IUCN. 2025. Red list of Bangladesh. Vol. 1 to 7. Forest Department, MoEF&CC, GoB. Dhaka, Bangladesh. Kolbert, Elizabeth. 2014. The Sixth Extinction: An Unnatural History. Henry Holt and Co.New York, USA.

Visiting hours: 09:00 am to 5:00 pm on working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 307	**Evolution, Palaeontology and Zoogeography**	**Core course**	**4**	**60**	**100**

Prerequisites: As per University requirements for the admission into program.

The rationale of the course

Evolution, Zoogeography and Palaeontology are three fascinating inter-linked disciplines of biological sciences as these help us to explore how the diversity of the animals on earth evolved, how individual species formed with time and their past and present distribution pattern on the planet. The course will introduce the students to these fundamental natural processes, theories of natural selections that shape and govern the diversity in animal kingdom, changes in species and their distribution. The study of evolution includes the ideas, concepts and processes of evolution, species formation and the driving forces that dictate the formation of new species. The paleontological part focuses on the processes of fossilization, paleontological evidences in support of the past history of evolving of some selected animals. The Zoogeography part highlights the past and present distribution patterns of important animal groups on earth, factors and barriers that dictate this distribution pattern and also highlights the glaciation and continental drift, and their impacts on the distribution pattern of animals.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Introduce them with different theories of evolution, underlying facts and processes of species formation.
- Enhance students' knowledge on the distribution pattern of higher animals and factors affecting animal distribution, causes for glaciation and continental drift and its impacts on animal distribution.
- Increase their knowledge and understanding of fossils and their formation, the history and natural evolution of selected animals and their paleogeography.

Mapping with SDGs

This course is relevant to achieving SDG4 (Quality education), SDG14 (Life below water), and SDG14 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	Explain and critically evaluate various theories of evolution, their evidence, and the causes of variations in animal species (Understand & Evaluation)	PLO1, PLO4
CLO2	Describe the processes of species formation, including natural selection, adaptation, and isolation (Understand & Apply)	PLO1, PLO3
CLO3	Identify and analyze fossil types, processes of fossilization, and historical evolution patterns of specific animals like humans, horses, and camels. (Understand & Analyze)	PLO1, PLO7
CLO4	Outline the zoogeographical regions, their animal distribution patterns, and the effects of factors such as glaciation and continental drift (Understand)	PLO1, PLO3
CLO5	Critically examine the geological time scale in relation to the emergence and extinction of species. (Understand & Evaluate)	PLO1, PLO2

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class	Topic	Corres-ponding (CLOs)	Teaching Learning Strategy	Assessment Strategy
19	**EVOLUTION**			
4	**Origin of life:** theories, main lines of animal evolution. History of evolutionary thoughts of Lamarck, Darwin and Wallace	**CLO1**	Visual and Auditory	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
4	**Evidences of organic evolution**- biogeography, comparative anatomy, embryology, comparative physiology, biochemistry, paleontology and genetics.	**CLO1**		
3	**Origin of variation**: gene mutation, chromosomal mutation, continuous versus discontinuous variations.	**CLO1**		
4	**Origin of species**: natural selection, isolation, and species formation. Polyploidy, convergent, divergent and parallel evolution. Adaptation, adaptive radiation and animal variation and distribution of species.	**CLO2**		
1	**Process of evolution**: Macro-and micro-evolution, *Archaeopteryx*.	**CLO2**		
3	**Speciation**: Concept, factors and process of evolution. Modern trends in evolutionary thoughts.	**CLO2**		
10	**PALAEONTOLOGY**			
2	**Introduction**: Concept, history and scope of paleontology.	**CLO1**		
2	**Fossils**: types and significance of fossils; fossilization processes.	**CLO3**		
2	Geological time scale with characteristic fauna.	**CLO5**		
4	History of evolution of horse, camel, elephant and man.	**CLO3**		
15	**ZOOGEOGRAPHY**			
4	**Introduction**: definition, scopes, history of emergence of zoogeography. Determinants and barriers of animal distribution; Past history of land water distribution; Pangea and Gondwana land.	**CLO1, CLO4**		
2	**Continental drift**: theories, evidences and impacts on animal distribution.	**CLO1, CLO4**		
2	**Pleistocene glaciation**: causes, facts and impacts on animal distribution.	**CLO4**		
6	**Zoogeographical Regions:** definition, boundary, land mass, sub-regions, climatic and vegetation conditions of each recognized region; animal distribution pattern in each region; endemic, major common, endemic and shared animal groups in each region.	**CLO4**		

	Faunal relationship among different zoogeographical regions.			
1	Insular and transitional and Siwalik Fauna.	**CLO2**		

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by powerpoint presentations, flip charts, video films, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classroom.

Assessment Pattern

There will be two in-course examinations, each consisting of 17.5 marks; 5 marks are reserved for the class attendance. Questions for in-course examination will be of short and objective types. The course final examination will be of 60.

CIE- Continuous Internal Evaluation (35 marks), Attendance: 5 marks

Bloom's Category Marks (out of 35)	**In-course**	**Assignment**
1. Remember		
2. Understand	15	
3. Apply	10	
4. Analyze	5	
5. Evaluate	5	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 60)	**Test**
1.Remember	10
2.Understand	20
3.Apply	12
4.Analyze	10
5.Evaluate	8
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Darlington, P.L. 1957. *Zoogeography*. John Wiley and Sons Inc., USA. Dobzhansky, T., Ayala, F.J., Stebbins, G.L. and Valentine, J.W. 1977. *Evolution*. W.H. Freeman and Company, San Francisco, USA. Romer, A.S. 1956. *Vertebrate Paleontology*. Univ. of Chicago Press, USA. Michael, J. B. and David A. T. H. 2009. *Introduction to Paleobiology and the*

	Fossil Record. 1st edition. Wiley-Blackwell, New Jersey, USA. Villee, C.A., Walker, W.F. and Barnes, R.D. 1973. *General Zoology*. Fourth Edition. W.B. Saunders Company, USA.
Supplementary Reading	N/A

Visiting hours: 1 9:00 am to 5:00pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 308	**Neurobiology and Endocrinology**	**Core course**	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into the program.

Rationale of the course

This course introduces students to the foundations of neurobiology with a focus on cellular, molecular, and systemic mechanisms of the nervous system. Key topics include neuronal signaling, membrane physiology, sensory integration, behavioral neurobiology, and neurological disorders. Students will explore the structural and functional basis of nervous system processes in both invertebrates and vertebrates. Endocrinology related topics are designed to identify the key endocrine glands in the body and the hormones that they release. Description of a basic hormone cascade and explain how the hypothalamus-pituitary-adrenal (HPA) axis works and to identify microscopic features of endocrine glands as well as identify the major endocrine disorders and their treatments.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Describe the structure and function of neurons and glial cells in the nervous system.
- Explain the ionic mechanisms of resting membrane potential and action potentials.
- Understand synaptic transmission, neurotransmitters, and ion channel functions.
- Analyze sensory processing and neural integration in behavior and cognition.
- Identify major neurological disorders and outline basic treatment approaches.
- Identify the key endocrine glands in the body and the hormones they release.
- Describe a basic hormone cascade and explain how the hypothalamus-pituitary-advanced (HPA) axis works.
- Identify the microscopic features of the endocrine glands of vertebrates and invertebrates.
- Identify the major endocrine disorders and their treatments.

Mapping with SDGs

This course, Neurobiology and Endocrinology, directly supports SDG 3 (Good Health and Well-being) and SDG 4 (Quality Education) by fostering advanced understanding of the nervous and endocrine systems, their disorders, and treatments, while also aligning with SDG 9 (Industry, Innovation and Infrastructure) and SDG 13 (Climate Action) through topics like neural bio-robotics and endocrine-disrupting chemicals.

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to		PLO covered
CLO1	Describe the structure and function of neurons and glial cells, and explain the history and scope of neurobiology. (Understand)	PLO1, PLO5
CLO2	Analyze the ionic basis of resting and action potentials, including the role of voltage- and ligand-gated ion channels. (Analyze)	PLO2, PLO5
CLO3	Explain synaptic transmission, neurotransmitter systems (e.g., cholinergic, dopaminergic), and synaptic integration. (Understand / Analyze)	PLO2, PLO5

CLO4	Summarize the organization of sensory systems and central information processing from perception to behavior.	PLO2, PLO5
CLO5	Discuss behavioral neurobiology including motivation, sleep, learning, and the biological basis of neurological diseases and treatment approaches.	PLO2, PLO5, PLO6
CLO6	Review general concepts and branches of endocrinology (Understand).	PLO1, PLO7
CLO7	State the overview of vertebrate endocrine system (Remember).	PLO1, PLO7
CLO8	Describe the general classes of hormone (Understand).	PLO1, PLO7
CLO9	Discuss the hormones of endocrine glands (understand).	PLO1, PLO7
CLO10	Describe the pathophysiology of hypothalamic, pituitary, pineal, thyroid, parathyroid, GI tract, pancreatic islets, adrenal and gonadal hormones (Understand)	PLO5, PLO7
CLO11	Describe endocrine disorders and treatment methods (understand)	
CLO12	State the principles of imaging and nuclear medicine in endocrine disease and hormone-replacement therapies (Remember).	PLO1, PLO7
CLO13	Assess human health consequences of endocrine-disrupting chemicals	PLO1, PLO7

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

Neurobiology Part –

No. of Class/ (*Week)	**Topic**	**Corres-ponding CLOs**	**Teaching-Learning Strategy**	**Assessment Strategy**
1	Overview of course; History of neurobiology	**CLO1**	Visual and Auditory	Class attendance, In-course Exam and Final theory Exam
2	Cells of the nervous system: Neurons and glia; structure and function	**CLO1**		
2	Neuronal membranes: membrane structure, movement of ions, and ionic basis of resting membrane potential	**CLO2**		
1	Action potentials; voltage-gated and ligand-gated ion channels	**CLO2**		
2	Synapse structure, neurotransmitters, synaptic transmission, principles of synaptic integration, ion channels, and receptors (cholinergic, dopaminergic, serotonergic, etc.)	**CLO3**		
1	Sensory systems. Physical events turned into information. Central processing of information: reception to perception	**CLO4**		
3	Neural processing in a behavioral context: Flight controls in insects; Electric fish and bio-robotics Motivation, Emotion, Sleep,	**CLO5**		

	Language; Attention. Development, Neural Plasticity, and Aging of the Brain. Learning and Memory.			
2	Neurological disorders: Epilepsy and Seizures; Alzheimer's disease and Dementia; Parkinson's disease. Treatment of neurological diseases	**CLO5**		
1	Wrap-up discussion, presentations, or review test	**CLO1-CLO5**		

Endocrinology part -

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
1	General concepts and branches of endocrinology.	**CLO1**	Visual and digital learning, Problem-solving sessions, Interactive discussion, and Feedback.	Class attendance, Oral Presentation, Assignment, In-course Exam and Final theory Exam.
2	An overview of vertebrate endocrine system. Structural features and hormones of endocrine glands- hypothalamus, pituitary, pineal, thyroid, parathyroids, GI tract, pancreatic islets, adrenals and gonads.	**CLO2**		
3	General classes of hormones: peptide, thyroid, steroid, neuro-transmitters, neuropeptides, chalones, peptide-growth stimulating factors, eicosanoids and pheromones.	**CLO3**		
2	Hormones of endocrine glands: synthesis and control of synthesis, storage, metabolism and functions.	**CLO4**		
2	Endocrinology of pregnancy, parturition and lactation.	**CLO4**		
3	Pathophysiology of hypothalamic, pituitary, pineal, thyroid, parathyroid, GI tract, pancreatic islets, adrenal and gonadal hormones.	**CLO5**		
2	Endocrine disorder and treatment: Adrenal insufficiency; Cushing's disease; Hyperthyroidism and Gigantism (acromegaly) and other growth hormone problems. Imaging and nuclear medicine and hormone-replacement therapies.	**CLO6**		
1	Human Health Consequences of Endocrine-Disrupting Chemicals	**CLO7**		

*** Per week 1 class**

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous

class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern
There will be one in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	2.5	
2. Understand	5	
3. Apply	5	
4. Analyze	3	
5. Evaluate	2	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	5
2.Understand	10
3.Apply	7
4.Analyze	5
5.Evaluate	2
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Neuroscience 5th Edition (2011); Sinauer Associates is an imprint of Oxford University Press Kandel, E. R., Schwartz, J. H., Jessell, T. M., Siegelbaum, S., Hudspeth, A. J., & Mack, S. (Eds.). (2000). Principles of Neural science (Vol. 4, pp. 1227-1246). New York: McGraw-hill. Dan Sanes, Thomas Reh, William Harri (2011) Development of the Nervous System 3rd Edition Imprint: Academic Press Franklyn F. Bolander. Molecular Endocrinology Elsevier- Academic Press. J. Darnell, H. Lodish and D. Baltimore, Norris, D. O. Vertebrate Endocrinology: Academic Press, New York D Groot. L. J. (ed.), W. B. Saunder Philadelphia. Endocrinology, Vol. I, II, III: Brook, C.G.D. and Marshall, N.J. Essential Endocrinology: Blackwell Publishing.
Supplementary Reading	Biochemical Actions of Hormones: Litwack, G. Academic Press.

Visiting hours: 9:00 am to 5:00pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	No. of Credits	Credit hours	Total Marks
Zool. 309	**Ecological field studies in terrestrial and aquatic ecosystems**	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

Field study is an integral subject for undergraduate students of Zoology that provides practical and hands-on experience in studying fauna and flora and their environments. Field based courses expand the knowledge of field research methods, identifying species, collecting and analyzing data for ecological investigations, animal behavior, and conservation of animals in the natural environment. Therefore, this course is designed for students during the academic year focusing on terrestrial and aquatic ecosystems to study and observe the faunal diversity, habitats, community structure, population characteristics of species and their interaction to biotic and abiotic factors. Students will be able to put their knowledge and skills to practice by designing and conducting a small ecological investigation under this field course.

Specific objectives of the course

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

- Identify and apply the methods to study the populations of species including their habitat preferences, distributions and home ranges and other aspects of ecology.
- Assess the diversity of fauna and flora (identification and estimation) and investigate ecology of populations, species and communities in their environment.
- Develop the skills to gather reliable data in the field and to keep the record information for future use.
- Design and conducting field-based research studies to generate original biological knowledge.
- Work in a team to develop and carry out a field research project.

Mapping with SDGs

This course is relevant to achieve SDG4 (Quality education), SDG 13 (Climate action), SDG14 (Life below water), and SDG15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		**PLO covered**
CLO 1	State, recognize and use various sampling techniques for animals and plants in terrestrial and aquatic environment. (Remember, Understand and Apply)	PLO1, PLO2
CLO 2	Identify, describe and criticize the analysis methods for ecological data. (Remember, Understand and Analyze)	PLO2, PLO3
CLO 3	Describe and assess the species and ecosystems diversity of a particular area. (Understand and Evaluate)	PLO2, PLO3
CLO 4	Apply the knowledge gained from aquatic and terrestrial and aquatic ecosystems for biodiversity conservation and environmental management (Apply)	PLO3, PLO5

CLO 5	Communicate, discuss and justify the outputs of ecological field work to a scientific community via report, meeting, seminar and group presentation. (Understand, Evaluate and Create)	PLO8, PLO9

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
8	Pre-field lectures: Preparation and planning of field studies; field safety measures; Defining the aim of the field study; field site selection; Introducing faunal diversity of selected ecosystems including their identification. Ecological aspects of field investigations. Faunal observation/survey techniques; Data and sample collection and analysis. Briefing on report writing and presentation	**CLO 1 CLO 2 CLO 3 CLO 4 CLO 5**	Visual, Auditory and Visual, Auditory, Practical demonstration	On-field assessment, report writing and presentation
22	Field visit: Visit the assigned field area, particularly the marine, island and hilly area; On-site Assessment.		Field demonstration and observation	

*** Per week 2 classes**

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be taught using a blended approach, including pre-field lectures, visiting particular field sites, group meeting and presentation. Lectures for the preparation and planning of field, contents of studies and safety measures will be provided by faculties (preferably members of examination committees or other teachers assigned by academic committee) with power point presentations, online resources, printed information and video clips. All events will be made participatory and interactive through Q & A (questions and answers) sessions, group meeting and discussions. In the field, the students will be guided by the teachers to carry out the specific project of ecological investigations in small groups for approximately 3 to 5 days. Students' feedback on the overall course contents, way of delivery and field activities will be taken through an open discission in the field

Assessment Pattern

Assessment will be done by the Members of the concerned Examination Committee. Three-step assessments will be followed, including onsite assessment (written examination), presentation and report writing. Onsite assessment, presentation and report writing will carry 40%, 30 % and 30 % marks, respectively.

CIE- Continuous Internal Evaluation (out of 20 marks)

Bloom's Category	In-course	Assignment
1. Remember	3	
2. Understand	5	
3. Apply	5	
4. Analyze	5	
5. Evaluate	2	
6. Create		

Year-end Examination (out of 30 Marks)

Bloom's Category Marks	Test
1.Remember	5
2.Understand	15
3.Apply	5
4.Analyze	2.5
5.Evaluate	2.5
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	**Water analysis, Freshwater studies, Laboratory culture/rearing, Ecology:** i) Odum, E.P. and Barrett, G.W. 2005. Fundamentals of Ecology. 5th edition. Thomson Brooks/Cole Publishing Co., USA. ii) Mellanby, H. 1963. Animal Life in Freshwater-A guide to freshwater invertebrates. 6th edition. Methuen & Co. Ltd., London. iii) Henderson, P. A. 2003. Practical methods in Ecology. John Wiley & Sons. iv) Sokal, R.R. and Rohlf, F.J. 1981. Biometry - The Principles and Practice of Statistics in Biological Research. W.H. Freeman and Company, New York. v) Magurran, A.E., 2013. *Ecological diversity and its measurement*. Springer Science & Business Media.

Visiting hours: 9:00 am to 5:00pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 310	**Practical**	**Core course**	**8**	**120**	**200**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

Practical courses are integral parts of zoological education as they bridge theoretical courses fostering deeper understanding, skill development, critical thinking and ultimately preparing students for solving real-world problems. Therefore, this practical course based on hands-on demonstration has been designed aligning with the major theoretical courses taught in the third year of the BS program. This course is outlined to provide a comprehensive interdisciplinary understanding of zoological science, integrating water quality monitoring, diversity of freshwater organisms, ecology of terrestrial and freshwater ecosystems, animal genetics, animal behabiour with theoretical knowledge and practical demonstrations. This course will enable the students to carry out various practical activities viz. histological analyses with microtomy techniques, water analysis, identification of zooplankton and benthos organisms, ecological studies, measuring of blood parameters, activities on classical genetics, observing animal behavior and application of statistical tools and tests. Practical knowledge and hands-on experiences of this course will enhance the skills of the students to address the relevant real-world problems in higher studies and professional careers.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Provide insights into how the mentioned areas of science can be used in solving real problems.
- Develop their ability to carry out histological examinations of animal tissues using microtome machines.
- Enhance skills to assess the health of aquatic ecosystem through water quality parameters analyses and identification and diversity estimation of freshwater organisms.
- Provide hands-on experience in identifying human blood groups and preparing blood smears for cellular observation and other selected contents of animal genetics.
- Develop observational and experimental skills by studying the behaviour, lifecycle, and reproduction of model organisms.
- Train them to observe, document and analyze behaviours in animals, linking observations to ecological and evolutionary theories.
- Conduct a standard ecological studies of a model terrestrial and freshwater ecosystems.
- Foster statistical knowledge of the students for analyzing the biological data.
- Promote critical thinking and problem-solving skills through data collection, analysis, and interpretation

Mapping with SDGs

This course is relevant to achieving SDG4 (Quality education), SDG14 (Life below water), and SDG15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course, the students will be able to		PLO covered
CLO1	Understand and apply the microtomic techniques for histological analyses of animal tissues. (Understand & Apply)	PLO1, PLO3, PLO5
CLO2	Identify and assess the diversity of freshwater organisms including plankton and benthos. (Remember, Understand & Evaluate)	PLO1, PLO3, PLO5
CLO3	Describe and examine the techniques for water quality measurement of aquatic ecosystems. (Understand & Evaluate)	PLO3, PLO5
CLO4	Observe and describe the culture techniques of different invertebrate organisms in laboratory or captive condition. (Remember, Understand)	PLO2, PLO5
CLO5	Describe and assess the ecological status of terrestrial and aquatic ecosystems. (Understand & Evaluate)	PLO2, PLO3, PLO5
CLO6	Observe, and assess the animal behaviour scientifically (Understand & Apply).	PLO2, PLO3, PLO5
CLO7	Recognise and observe Mendelian pattern of inheritance in Drosophila sp ((Understand & Apply)	PLO3, PLO5
CLO8	Examine blood to determine the different blood group of humans. (Apply)	PLO2, PLO5

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class	Topic	Corres-ponding (CLOs)	Teaching-Learning Strategy	Assessment Strategy
5	**Microtomy:** Technique of histological slide/whole-mount preparation	**CLO1**	Visual and auditory approaches for lectures, discussion, Group works, hands-on demonstrations	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
2	**Water quality analysis:** Measurement of dissolved oxygen, carbon dioxide, ammonia, nitrite, pH, turbidity, salinity, alkalinity and hardness of water.	**CLO3**		
5	**Freshwater organisms:** Identification of planktonic and benthic macro- and micro-fauna.	**CLO2**		
5	**Ecology:** a) Sampling and data collection methods/techniques for ecological studies in aquatic (kick nets, fishing nets, plankton nets, grab samplers etc.) and terrestrial (hand nets, bottle traps, and different visual observations approach) b) Study of an aquatic (Pond/Lake) and terrestrial (Zoological or Botanical Garden/Park/Zoo) ecosystem focusing on	**CLO4 CLO5**		

	faunal and floral diversity (species richness, evenness and other alpha and beta diversity indexes), composition and abundance and their interaction/responses to biotic and abiotic factors. c) Study of the population dynamics of any cultured/reared species (*Paramecium* sp., *Euglena* sp.), Rotifers/*Hydra*/Earthworm/*Drosophila*, cockroach or any stored product insect pest) in the laboratory and investigating their growth rate, calculation of the intrinsic rate of natural increase; carrying capacity; population growth forms (J-shaped or logistic/S-shaped)			
6	**Blood grouping:** Blood grouping and preparation of human blood smear. Animal Genetics: Activity on Mendelian pattern of inheritance in Drosophila sp.	**CLO7, CLO8**		
5	**Animal behaviour:** Observation and analysis of animal behaviour.	**CLO6**		

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional Strategies

The course will be delivered through practical demonstration classes, hands-on trainings and lectures. A number of teachers will be present in the classroom to guide the individual students on how to proceed with their practical works in the laboratory. The classes will be aided with audio-visual materials, video clips relating to different topics. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classroom Necessary study materials, logistics and equipment will be provided to students, as required. The students will prepare practical note books on each practical work performed in the laboratory. Study tours will be organized and guided by the course teachers. Students are also required to prepare and submit study tour reports which will be evaluated.

Assessment Pattern

There will be five in-course examinations, consisting of 14.0 marks a portion of which will be allocated for practical note books and field report (if any); 10 marks are reserved for class attendance. The course final examination will be of 120 marks.

CIE- Continuous Internal Evaluation (70 marks), Attendance: 10 marks

Bloom's Category Marks (out of 70)	**In-course**	**Assignment**
1. Remember	5	
2. Understand	5	
3. Apply	10	
4. Analyze	40	
5. Evaluate	10	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 120)	Test
1.Remember	10
2.Understand	10
3.Apply	50
4.Analyze	30
5.Evaluate	10
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	**Microtomy:** Carson, F.L., and Hladik. C. 2009. Histotechnology: A Self-Instructional Text. 3rd edition. American Society of Clinical Pathologists, Chicago, IL, USA. Gray, P. 1952. Handbook of basic microtechnique. Blakiston Company. New York, USA. Humason, G.L. (1972) Animal tissue techniques. 3rd Edition, W.H. Freeman and Company, San Francisco. USA. Sheehan, D.C. and Barbara, B.H. 1980. Theory and Practice of Histotechnology. 2nd ed., C.V. Mosby Co., India. Reza, S. 2007. Gross Anatomy, Cell Biology and Histology. Essence Publications, Dhaka. **Water analysis, Freshwater studies, Laboratory culture/rearing, Ecology:** Odum, E.P. and Barrett, G.W. 2005. Fundamentals of Ecology. 5th edition. Thomson Brooks/Cole Publishing Co., USA. Mellanby, H. 1963. Animal Life in Freshwater-A guide to freshwater invertebrates. 6th edition. Methuen & Co. Ltd., London. **Animal Genetics:** Snustad D. P., M. J. Simmons. 2015. Principles of Genetics. 7th Ed. John Willey and Sons. Inc. New York, USA. **Animal behavior:** Arora, M.P. 2003. Animal Behaviour. Kanta, C. Eds. 6th Edition. Himalaya Publishing House. Mumbai, India. **Research Methodology:** Sokal, R.R. and Rohlf, F.J. 1981. Biometry - The Principles and Practice of Statistics in Biological Research. W.H. Freeman and Company, New York. **Biostatistics:** Parker, R.E. 1983. *Introductory Statistics for Biology.* The Institute of Biology's Studies in Biology. 43, Edward Arnold, UK. Sokal, R.R. and Rohlf, F.J. 1981. *Biometry - The Principles and Practice of Statistics in Biological Research.* W.H. Freeman and Company, New York. Bateson, M., and P. Martin. 2021. Measuring behaviour: an introductory guide. 4th edition. Cambridge University Press.
Supplementary Reading	**NA**

Visiting hours: 9:00 am to 5:00pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 311	**Viva voce**	**Core course**	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

Viva voce or oral examination is an integral component of the BS programme in Zoology. This is a mandatory course for the students by which students demonstrate their secured knowledge, expertise, and understanding of theoretical and practical courses. It's also an opportunity for the examiners to evaluate the academic abilities of students, and ultimately for determining whether they have met the requirements of promoting to the upper class.

Specific objectives of the course

By the end of the course, students will be able to:

- Prepare them for presenting their in-depth knowledge of the broader field of study programme.
- Improve their ability to communicate to scientific world with secured skills and expertise
- Assess their understanding of the programme.

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	Identify and describe the core concepts of all courses assigned to this year, and apply these concepts, and their communication skills. (Remember and understand)	PLO3, PLO7, PLO8, PLO9
CLO2	Demonstrate knowledge of animal anatomy, physiology, behavior, ecology and evolution and genetics, and explain their understanding in a verbal, interactive setting. (Understand and Assess)	
CLO3	Recognise and assess the current state of knowledge on a particular issue or topics of the programme. (Remember and Evaluate)	
CLO4	Demonstrate and assess their academic feats with critical analysis and interpretation of various aspects of the courses. (Understand, Evaluate and Crate)	

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
No specific classes will be assigned	The contents will cover all theoretical and practical courses.	**All CLOs**	N/A	Oral examination will be conducted by examination committee

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

The course will follow interactive lectures of all theoretical and practical courses of the BS programme. Besides, regular class discussions and individual or group mentoring sessions will also provide instructions for viva voce. All faculty members will instruct the students in this regard.

Assessment
This is a two-credit course that carries 50 marks. The respective Examination Committee including external members will assess overall student's knowledge asking questions from the contents of respective syllabus of the BS programme and student will answer questions accordingly.

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	References mentioned for the theory courses
Supplementary Reading	References mentioned for the theory courses

Visiting hours: 9:00 am to 5:00pm on the working days (if available).

Fourt Year Bachelor of Science in Zoology

Applicable for the Sessions 2024-2025, 2025-2026, 2026-2027 and 2027-2028

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 401	**Biodiversity, Biodiversity Conservation and Bioresource Management**	**Core course**	**4**	**60**	**100**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

The rationale for studying this course is rooted in the understanding that biodiversity is a cornerstone of human survival and well-being. By learning about biodiversity, its value, threats, and management strategies, students will be equipped to contribute to environmental conservation efforts, sustainable development, and global biodiversity goals, ensuring that ecosystems continue to function, species thrive, and future generations can enjoy the benefits of a healthy planet.

Specific objectives of the course

Upon completion of the course, the student will be able to-

- Understand and assess the global and national state of biodiversity.
- Identify the threats to biodiversity and evaluate the effectiveness of conservation strategies.
- Conduct biodiversity surveys and monitor biodiversity health using a range of tools and techniques.
- Develop biodiversity management plans that integrate conservation strategies, policy frameworks, and local community involvement.
- Gain the skills and knowledge necessary to contribute to biodiversity conservation efforts at both local and global levels, especially in the context of Bangladesh's unique biodiversity challenges and opportunities.

Mapping with SDGs

This course is relevant to achieving SDG4 (Quality education), SDG14 (Life below water), and SDG14 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to		PLO covered
CLO1	Have a solid understanding of biodiversity—its types, components, and the status of biodiversity at national and global levels (Understand).	PLO1, PLO4
CLO2	Be able to evaluate biodiversity threats and propose conservation strategies (Evaluate).	PLO2, PLO3
CLO3	Explain theoretical knowledge and demonstrate practical skills to contribute to biodiversity conservation (Understand & Apply).	PLO1, PLO7,
CLO4	Understand biodiversity challenges, use various conservation strategies, and align efforts with international policies and sustainable development goals (Understand & Evaluate).	PLO3

CLO5	Develop and implement biodiversity management plans to address the challenges facing protected areas and species conservation in the country (Understand & Apply).	PLO4
CLO6	Contribute to future conservation efforts through informed decision-making, based on scientific knowledge, legal frameworks, and local community involvement (Understand & Annalyse).	PLO7

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No of class	Course topic	Corres-ponding CLOs	Teaching Learning Strategy	Assessment Strategy
18	**Biodiversity**: Introduction to biodiversity: Definition, concept, types and components of biodiversity. National and global biodiversity status and trend. Importance and value of biodiversity: Use value, non-value, intrinsic, optional, bequest and cultural values of biodiversity; ecosystems services provisioning, regulating, supportive and recreational services. Valuing biodiversity: Concept, definitions, purposes, types and methods of economic valuation; TEVB. Biodiversity survey and monitoring: Purposes and types; methods and tools; preparation of animal inventories and its matrices. Biodiversity hotspots, mega biodiversity and other terminologies related to biodiversity studies.	**CLO1**	Visual and Auditory	Class attendance, Oral Presentation, In-course Exam and Final theory Examination
20	**Biodiversity Conservation**: Threats to biodiversity: Issues and types of threat; threat analysis and mapping; consequences of biodiversity loss. Conservation: types- ex-situ and in-situ conservation; setting conservation priorities Conservation strategies: Major strategies for biodiversity conservation. Conservation approaches: Habitat-, ecosystem-, landscape and co-management and community-based management approaches. Legal regime in biodiversity conservation in Bangladesh: Acts, policies and rules related to biodiversity and wildlife conservation in Bangladesh. International conventions: Protocol and treaties related to biodiversity conservation in Bangladesh (CBD, CITES, RAMSAR convention. Nagoya/Cartegena Protocol, etc.), SDG targets related to biodiversity and ecosystem conservation.	**CLO2** **CLO3** **CLO4**		
15	**Bioresource management**: Introduction to bioresource management: Definition, scopes, classification of bioresources;	**CLO5** **CLO6**		

	conservation vs management. Protected area: Definition, IUCN categories; Protected Areas (PAs) in Bangladesh. Protected animals: categories and stratus in Bangladesh. Threatened animals: Categories and status in Bangladesh. Species and ecosystem management: types-manipulative and management; methods and tools; forest and wetland management. PA management in Bangladesh; Development of Biodiversity Management Plan and Action Plan; Major conservation/management initiatives in Bangladesh and its impacts.			

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by powerpoint presentations, flip charts, video films, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classroom.

Assessment Pattern

There will be two in-course examinations, each consisting of 17.5 marks; 5 marks are reserved for the class attendance. Questions for in-course examination will be of short and objective types. The course final examination will be of 60.

CIE- Continuous Internal Evaluation (35 marks), Attendance: 5 marks

Bloom's Category Marks (out of 35)	In-course	Assignment
1. Remember		
2. Understand	15	
3. Apply	10	
4. Analyze	5	
5. Evaluate	5	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 60)	Test
1.Remember	10
2.Understand	20
3.Apply	12
4.Analyze	10
5.Evaluate	8
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Arms, K. 1990. *Environmental Science.* Saunders College Publishing, a division of Holt, Rinehart and Wrinston, Inc., New York. Bashar, M.A. 2004. *Instant Basics of Environment*. Positron Publications. Dhaka, Bangladesh. Dudley, N. (Editor). 2008. Guidelines for Applying Protected Area Management Categories. Gland, Switzerland: IUCN. x + 86pp. WITH Stolton, S., P. Shadie and N. Dudley (2013). IUCN WCPA Best Practice Guidance on Recognising Protected Areas and Assigning Management Categories and Governance Types, Best Practice Protected Area Guidelines Series No. 21, Gland, Switzerland: IUCN. xxpp. Groombridge, B. 1992. *Global Biodiversity.* World Conservation Monitoring Centre. Global Biodiversity: Status of the Earth's living resources. Chapman & Hall, London. Jeffries, M.J. 1997. *Biodiversity and Conservation.* Routledge, London. Myers, N., Mittermeier, R.A., Mittermeier, C.G., Fonseca, G.A. and Kent, J. 2000. *Biodiversity hotspots for conservation priorities.* Nature 403 (6772): 853-858. Park, C. 2001. *The Environment.* Routledge an imprint of Taylor and Francis Group 11 New Fetter Lane, London. Primack, R.B. 2014. *Essentials of Conservation Biology*. 6th Edition. Sinauer Associates, Inc., USA.
Supplementary Reading	**NA**

Visiting hours: 9:00 am to 5:00 pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 402	**Radiation biology and biosafety regulations**	**Core course**	**3**	**45**	**75**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

The increased use of radioisotopes has led to increased concern over the effects of these materials on biological systems including humans. This material causes serious biological damage of living cells during radioactive emission fragments or ionizing molecules. Not only potential health hazard material radioisotopes also been used in disease identification, cancer treatment as well as food preservation and agricultural pest control. Risk of biological, chemical and radiological hazard must be taken in consideration before designing a laboratory. Biological laboratories must be designed, constructed, operated and maintained to fulfill their intended role and to keep laboratory personnel, the environment and the wider community safe from the risks associated with handling biological agents. The course focuses on uses and abuses of ionizing radiations, specifically on the effects of ionizing radiations on biological systems, human health and safe handling of radiations, and its beneficial applications in agricultural, biological, food and medical sciences. This course also focuses on the concept of biosafety and its importance in laboratories; recognize protection of workers from biological risk factors. This course will also explain biosafety legislation in Bangladesh.

Specific objectives of the course

Upon completion of the course, the student will be able to-

- Promote their knowledge on the sources, impacts, uses and abuses of radioisotopes and ionizing radiations.
- Make them aware of biological hazards, permissible doses, safe handling of radiation and personal monitoring
- Understand the concept and status of biosafety regulations in the developed and developing countries including Bangladesh.

Mapping with SDGs

This course is relevant to achieves *Goal 3 (Good health and well-being for people)*, **SDG3 (Quality education), SDG6 (Clean water and sanitation) and** *Goal 12 (Responsible consumption and production).*

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to		**PLO covered**
CLO1	Describe introduction to radiobiology and its status; illustrate atomic structure and radiation phenomenon. (Remember and Apply)	PLO1, PLO5
CLO2	Describe the types of radiation, its characteristics and explain units of measurement of radiation. (Understand)	PLO2
CLO3	State the sources of radiations. (Remember)	PLO1

CLO4	Describe the biological hazards of radiation and effects of radiation on human. (Understand)	PLO1, PLO2
CLO5	Explain permissible doses of radiation, safe handling and evaluate personal monitoring. (Understand and Create)	PLO2, PLO9
CLO6	Define radioisotopes and describe their use in biological, medical and agricultural researches. (Remember and understand)	PLO1, PLO2
CLO7	Describe use of radiation in food preservation and protection. (Remember)	PLO1
CLO8	State the concepts and facts of biosafety regulation. (Remember)	PLO1, PLO8
CLO9	Discuss the status of biosafety regulations in the developed and developing countries including the United Nation Environment Programme (UNEP/FDA).(Understand)	PLO1, PLO8
CLO10	Define biological hazard and categorize the microbes. (Remember and Analyze)	PLO1, PLO6
CLO11	Categorize infectious/biohazardous substance and non-biohazardous waste; Measure thetTreatment and disposal of biohazardous waste. (Analyze and Create)	PLO1, PLO6, PLO8
CLO12	Discuss Bangladesh biosafety and biosecurity guidelines with scope and objectives. (Understand)	PLO2, PLO8

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
4	Introduction to radiobiology and its status; atomic structure and radiation phenomenon.	**CLO1**	Visual and digital learning, Problem-solving sessions, Interactive discussion, and Feedback	Class attendance, Oral Presentatio, Assignment, In-course Exam and Final theory Exam
4	Types of radiation and its characteristics; units of measurement of radiation.	**CLO2**		
3	Sources of radiations-natural and artificial sources.	**CLO3**		
4	Biological hazards of radiation and effects of radiation on human.	**CLO4**		
5	Permissible doses, safe handling and personal monitoring; detectors.	**CLO5**		
4	Radioisotopes and their use in biological, medical and agricultural researches.	**CLO6**		
3	Use of radiation in food preservation and protection.	**CLO7**		
2	Concepts and facts, Biosafety regulation of products, producers and consumers.	**CLO8**		
3	Status of biosafety regulations in the developed and developing countries including the United Nation Environment Programme (UNEP/FDA).	**CLO9**		
4	Biohazardous materials: definitions, biological hazard and classification of microbes.	**CLO 10**		

4	Waste management: Infectious/Biohazardous substance, Non-biohazardous waste, Treatment and disposal of biohazardous waste.	**CLO 11**		
4	Bangladesh biosafety and Biosecurity Guidelines, Scope and objectives of biosafety guidelines.	**CLO 12,**		

*** Per week 2 classes**

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 26.25 marks and 3.75 marks will be for class attendance. The course final examination, comprising 45 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (26.25 marks), Attendance: 3.75 marks

Bloom's Category Marks (out of 17.5)	**In-course**	**Assignment**
1. Remember	5	
2. Understand	5	
3. Apply	5	
4. Analyze	5	
5. Evaluate	5	
6. Create	1.25	

Year-end Examination

Bloom's Category Marks (out of 45)	**Test**
1.Remember	10
2.Understand	10
3.Apply	10
4.Analyze	5
5.Evaluate	5
6.Create	5

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Hall, E.J. 2000. *Radiology for the Radiobiologists*. Lippnicot, Philadelphia P.A. Suntharalingam, N., Podgorsak, E. B. and J.H., Hendry. 2006. *Basic Radiobiology*. In Radiation Oncology Physics: *A Handbook for Teachers and Students published by IAEA (ISBN 92-0-107304-6)* World Health Organization 2020. *Laboratory Biosafety Manual Fourth Edition Associated Monographs*. [ISBN 978-92-4-001139-7 (electronic version) ISBN 978-92-4-001140-3 (print version)] U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institutes of Health. 2020. *Biosafety in Microbiological and Biomedical Laboratories*. 6th edition
Supplementary Reading	International Atomic Energy Agency, Vienna, 1982. *Training Manual on Food Irradiation Technology and Techniques Second Edition*. Joint FAO/IAEA Division of Isotope and Radiation of Atomic Energy for Food and Agricultural Development

Visiting hours: 9:00 am to 5:00 pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 403	**Biostatistics**	**Core course**	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

Biostatistics is a pivotal subject that basically deals with biological data including their collection and various methods/tools/tests for data analysis to conduct research projects, experiments and surveys. Statistical knowledge is very imperative to understanding the sampling methods, experimental design, analyzing data, and the research findings. This course aims at developing student's capability to design and conduct quality researches allowing them to extract meaningful insights from biological data, that ultimately contribute to the improvement of various fields like Fisheries, Entomology, Wildlife Biology, Parasitology and Molecular Biology and Genetics, Public Health, and Ecology etc. Therefore, Biostatistics course is designed to provide the student with knowledge, skills and understanding on the data collection and summarization, analysis of data with various tools ant tests and on the interpretation of research findings to improve their professional careers in research and academic arena.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Be familiar with various statistical tools and techniques to address various statistical issues problems encountered in various experiment and investigations and research projects.
- Enhance their understanding on sampling techniques, data collection, data presentation and on the analysis and summarization of data.
- Critically evaluate the results, identify potential biases, and make the decisions from research findings
- Conduct scientific investigations, experiments, and research projects applying essential statistical knowledge and skills.

Mapping with SDGs

This course directly and indirectly contributes to the following Sustainable Development Goals (SDGs): SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action) and SDG 17 (Partnerships for the Goals).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to		PLO covered
CLO1	Understand the principles and applications of biostatistics in biological research, including the collection, processing, and presentation of data. (Understand)	PLO1, PLO3
CLO2	Analyze biological data using measures of central tendency, dispersion, and statistical tests (e.g., regression, ANOVA, non-parametric tests, and confidence intervals). (Analyze)	PLO2

CLO3	Apply experimental designs and sampling methods in biological research, ensuring valid and reliable data collection and analysis. (Apply)	PLO5
CLO4	Understand and apply key statistical distributions (e.g., normal, Poisson) and transform data to meet analytical assumptions for accurate interpretation. (Understand, Apply)	PLO3
CLO5	Design and conduct research projects, including formulating research questions, hypotheses, and methodology (Apply)	PLO9
CLO6	Analyze and apply appropriate statistical techniques to evaluate and interpret research findings, ensuring accurate conclusions. (Analyze, Apply)	PLO8

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
3	Definition, scope and application of biostatistics in biological sciences. Collection, processing and presentation of statistical data. Variables and frequency distribution.	**CLO1 CLO3**	Visual and Auditory Sessions	Class attendance, In-course Exam and Final theory Exam
4	Measures of central tendency- arithmetic mean; weighted mean; mode and median. Measure of dispersion- variance; standard deviation; standard error.	**CLO2**		
6	Parametric tests- Regression analysis and correlation; Linear regression analysis, Least square method. t-test, Analysis of variance (ANOVA - one and two-way ANOVA. Multiple range test (MRT).	**CLO2 CLO5**		
3	Estimation of confidence limit. Non-parametric analysis – Man-Whitney, Kruskal-Willis, Wilkockson, and Friedman tests; Chi-square test for independent and goodness of fit.	**CLO2 CLO5**		
5	Distribution of statistical data-normal and poison distributions; transformation of data for normality. Significance test based on normal distribution; F-test; Probit analysis. Experimental designs. Sampling.	**CLO3 CLO4**		
3	Introduction to Statistical Software: Overview, types (R, SPSS, SAS, Python etc.) and their applications.	**CLO3 CLO5 CLO6**		

*** Per week 2 classes**

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be two in-course examinations, each consisting of 17.5 marks, and 5 marks will be allocated for students' class attendance. In in-course examination, questions will be of objective and short types. The students will be frequently asked questions in the classrooms to assess performances. A course final examination of 60 marks will be conducted by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	2.5	
2. Understand	5	
3. Apply	3	
4. Analyze	5	
5. Evaluate	2	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	10
2.Understand	05
3.Apply	10
4.Analyze	2.5
5.Evaluate	2.5
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Parker, R.E. 1983. *Introductory Statistics for Biology.* The Institute of Biology's Studies in Biology. 43, Edward Arnold, UK. Sokal, R.R. and Rohlf, F.J. 1981. *Biometry - The Principles and Practice of Statistics in Biological Research.* W.H. Freeman and Company, New York.

Visiting hours: 9:00 am to 5:00 pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 404	**Research Methodology**	**Core course**	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

A research methodology course for the students of Zoology or Life Science is very essential for fostering their foundational knowledge and practical skills in designing and conducting research and scientific investigations. This course is designed covering introductory to advanced topics like research hypothesis and research questions, experimental design, data analysis, critical evaluation of research findings, scientific writing and research ethics. Therefore, this course focuses on developing student's capability to design and conduct quality researches with the knowledge and skills required to competently undertake research assignments, and finally for preparing the research reports and scientific papers.

Specific objectives of the course

Upon completion of this course, the student will be able to-

- Identify and recognize the processes and techniques in identifying research areas, setting objectives, developing research hypothesis and questions and also be able to address the questions and objectives of a research project.
- Design experimental design, data analysis with relevant tests, methods and tools.
- Understand research ethics and their practice in a specific research project.
- Develop research proposal and conduct research project and ultimately write research reports and scientific papers.

Mapping with SDGs

This course directly and indirectly contributes to the following Sustainable Development Goals (SDGs): SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action) and SDG 17 (Partnerships for the Goals).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to		PLO covered
CLO1	Design and conduct research projects, including formulating research questions, hypotheses, and methodology, while ensuring ethical considerations. (Apply)	PLO9
CLO2	Analyze and apply appropriate statistical techniques to evaluate and interpret research findings, ensuring accurate conclusions. (Analyze, Apply)	PLO8
CLO3	Write research proposals, reports, and scientific papers, effectively communicating research findings and demonstrating critical thinking. (Apply)	PLO3
CLO4	Understand the significance of intellectual property rights (IPR), research commercialization, and environmental and ethical impacts in research. (Understand)	PLO4, PLO3

CLO5	Utilize scientific literature (e.g., zoological records, journals, and biological abstracts) to inform research and stay current with developments in the field. (Apply)	PLO3

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
3	**Research Methodology:** Research concept, definition and process; Planning a research project - background information; types; adaptive and on-firm researches; innovative research.	**CLO1**	Visual and digital learning, Problem-solving sessions, Interactive discussion and Feedback	Class attendance, In-course Exam and Final theory Exam
4	Hypothesis and setting research questions; approach to experimental design; statistical design and development of methodology. Data collection and analysis.	**CLO2**		
5	Writing research proposals; thesis; scientific papers and field reports with case studies for each.	**CLO3**		
2	Types of research papers; monographs; serials; series; periodicals; reviews; journals, etc.	**CLO3**		
3	Environmental impacts of research; ethics in research. Precaution against hazards during research work.	**CLO1**		
2	Concept and importance of commercialization of research and entrepreneurship.	**CLO4**		
2	Use of Zoological records; periodicals and biological abstracts. Quality of publications; impact factors.	**CLO5**		
2	Intellectual Property Rights (IPR) - concept, importance and processes.	**CLO4**		

*** Per week 2 classes**

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be two in-course examinations, each consisting of 17.5 marks, and 5 marks will be allocated for students' class attendance. In in-course examination, questions will be of objective and short types. The students will be frequently asked questions in the classrooms to assess performances. A course final examination of 60 marks will be conducted by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	2.5	
2. Understand	5	
3. Apply	3	
4. Analyze	5	
5. Evaluate	2	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	8
2.Understand	8
3.Apply	5
4.Analyze	5
5.Evaluate	4
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	i) Parker, R.E. 1983. *Introductory Statistics for Biology.* The Institute of Biology's Studies in Biology. 43, Edward Arnold, UK. ii) Sokal, R.R. and Rohlf, F.J. 1981. *Biometry - The Principles and Practice of Statistics in Biological Research.* W.H. Freeman and Company, New York. iii) Research methodology. 2013. C.R. Kothari and Garg G. 3rd ed., New Age International Publishers, New Delhi, India. iv) Kumar, R. 2011. Research Methodology: a step-by-step guide for beginners (3rd edition). London, UK: TJ International Ltd, Padstow, Corwall. v) Laake, P., Benestad, HB. & Olsen, BR 2007. Research Methodology in the Medical and Biological Sciences. Academic Press, Elsevier, London,. vi) Shamoo, A. ochResnik, D. 2009. Responsible Conduct of Research. (Second edition) Oxford University Press.

Visiting hours: 9:00 am to 5:00 pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course title	Course type	No. of credits	Credit hours	Total marks
Zool. 405	**Entomology**	**Core course**	**4**	**60**	**100**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course:
Insects are the most diverse organisms on the earth; they are essential for the functions of most of the ecosystems, particularly the terrestrial ecosystems. Much of our economic productivity depends upon insects, they also cause immense damage to agriculture and transmit some of the most common and lethal diseases. The objective of this course is to give a generalized idea centered on the above-mentioned areas of entomology with particular focuses on the insect taxonomy highlighting the classification scheme of insects, diverse anatomical and morphological features across the groups, insect ecology, physiology, reproduction and developmental stages in insects. The course also focuses on some applied aspects of entomology, including the pest control, culture of insects for agricultural and other product purposes.

Specific objectives of the course
Upon completion of the course, the student will be able to-

- Provide general knowledge about the insect structure, function and classification schemes.
- Learn about the different morphological structures, anatomical features of different organ systems and their physiological functions.
- Increase their ability to identify insects in the field and in the laboratory.
- Introduce them to some aspects of insect biology, life history; nature of damage and control measures of insect pests of agricultural importance.

Mapping with SDGs
This course is relevant to achieves SDG3 (Good health and wellbeing for people), SDG 4(Quality education), SDG 12 (Responsible consumption and production) SDG14 (Life below water) SDG15(Life on land)

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	describe the insect body wall structure and derivatives with labeled diagram (understand)	PLO1
CLO2	Analyze the variations and modifications of different insect body parts with appropriate labeled diagram (Analyze)	PLO1, PLO2
CLO3	Describe the developmental stages of insect life cycle (understand)	PLO1
CLO4	Identify and classify Class Insecta with distinguish characters (Apply)	PLO1, PLO3
CLO5	Analyze and compare the distinguishing characteristics, life cycle and economic importance of different insect orders (Analyze)	PLO1, PLO2, PLO3
CLO6	Describe the physiology of digestion, the dietary requirements and the role of microorganisms in insect digestion (Analyze)	PLO1, PLO8
CLO7	Describe the physiology of insects circulatory, respiratory, excretory and nervous system of insects (Understand)	PLO1, PLO8
CLO8	Analyze different types of endocrine glands involve in insect moulting and exocrine glands involve in defensive secretion (Analyze)	PLO1, PLO8

CLO9	Discuss the sensory activities of insects (Understand)	PLO1, PLO8
CLO10	Identify different insect pests and describe life history of different crop, fruit tree pests with their control measures (Apply)	PLO1, PLO2, PLO7
CLO11	Categorize different tea, forest tree, stored grain pests to control the pest infestation (Analyze)	PLO1, PLO2, PLO7

Outcome Based Education (OBE) Curriculum
Part- B

Course plan specifying content, CLOs, Co-curricular activities, Teaching-learning and assessment strategy mapped with CLOs:

No of class/ (*week)	**Topic**	**Corres-ponding CLOs**	**Teaching learning strategy**	**Assessment strategy**
2	**Insect morphology**: Body wall: Structure and derivatives.	**CLO1**	Visual and Auditory	Class attendance, Oral presentation, In-course Exam and final theory
8	Head: Types, segmentation, sutures and areas; mouth parts- types, modifications and feeding adaptations; antenna - types and structure; Eye: Compound eye and ocellus structure, and image formation. Thorax: Wing- structure, venation and modifications; leg- structure and modifications. Muscles: structure and types.	**CLO2**		
3	Insect life stages: egg, nymph/larva, and pupa.	**CLO3**		
5	**Insect Taxonomy:** Insect identifying characters; principles of insect classification. Detailed classification of the class Insecta up to orders and sub-orders.	**CLO4**		
8	Description of the following orders including their general and diagnostic characteristics, habit, habitat, reproduction and life cycle, economic importance: Apterygota - Collembola; Exopterygota - Ephemeroptera, Odonata, Orthoptera, Isoptera, Mallophaga, Anoplura, Hemiptera, and Homoptera; and Endopterygota- Coleoptera, Lepidoptera, Diptera and Hymenoptera.	**CLO5**		
2	Insect Physiology: Physiology of digestion, dietary requirements of insects, role of microorganisms in insect nutrition and digestion.	**CLO6**		
9	Physiology of circulation; haemolymph, connective tissue and plasma. Physiology of respiration in terrestrial, aquatic and endoparasitic insects. Physiology of excretion: salt and water regulation; excretion of ingested organic molecules; physiology and integration of nervous system.	**CLO7**		

	Physiology of moulting: exocrine glands and defensive secretions;	**CLO8**		
2	eye vision, light production; perception and cryptobiosis.	**CLO9**		
10	Agricultural entomology: General information on insects related to agricultural crops; stored grains; grain products; vegetables, fruits, tea and forest trees. Pest: Definition and types. Biology, life history, nature of damage and control measures of the following pests: Jute pests - jute hairy caterpillar, jute semilooper and jute mites; Sugarcane pests - sugarcane top shoot borer and stem borer; Rice pests - rice ear-cutting caterpillar, rice stem borers, rice hispa; Vegetable pests - brinjal fruit and shoot borer, potato tuber worm, epilachna beetle and mustard aphid; Fruit tree pests & fruit pests - mango fruit borer, mango stem and shoot borer, citrus leaf miner, palm beetle;	**CLO10**		
3	Tea pests- tea pest-chart of Bangladesh; tea pest problems; mite pests; insect pests (shoot pests, leaf pests, flush pests, root pests); and Forest tree/timber pests - pest problems in forest nurseries and plantations. Biology, nature of injury and control measures of major and minor insect pests of forest trees and vegetation; stored grains and grain products - rice weevil, rice moth, red flour beetle, rice meal moth, saw-toothed grain beetle, pulse beetles, and dried-fish pests.	**CLO11**		

*** Per week 3 classes**

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be two in-course examinations, consisting of 17.5 marks each and 5 marks will be allocated for students' attendance in the class. The question in the in-course tests will be of fill in the blanks, objective and short types. The students will be frequently asked questions in the classroom to assess performances. A course final examination, consisting of 60 marks, will be taken centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks) each in-course, Attendance: 5 marks

Bloom's Category Marks (out of 17.5)	**In-course**	**Assignment**

1. Remember	5	
2. Understand	5	
3. Apply	5	
4. Analyze	2.5	
5. Evaluate		
6. Create		

Year-end Examination

Bloom's Category Marks (out of 60)	Test
1.Remember	15
2.Understand	20
3.Apply	15
4.Analyze	10
5.Evaluate	
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Borror, D.J, Delong D.M. and Triplehorn, C.A. 1964. An Introduction to the study of Insects. Halt. Reinhart and Winston, USA. Snodgrass, R.E. 1935. Principles of Insect Morphology. Tata McGraw Hill Publ. Co. Ltd., New Delhi, India. Kabir A.K.M.F. 1975. Jute Pests of Bangladesh. Bangladesh Jute Research Institute, Dhaka, Bangladesh. Metcalf, C.L. and Flint, W.P. (revised by R.I. Metcalf). 1962. Destructive and Useful Insects- their habits and control. Tata McGraw Hill Pub. Co. Ltd., New Delhi, India. Pedigo, L.P. 2002. Entomology and Pest Management. Prentice-Hall of India Pvt. Ltd., New Delhi, India.
Supplementary Reading	Gullan, P.J. and Cranston, P.S. 1999. The insects: An outline of entomology. Kluwer Academic Publishers, Boston, London. Wiggesworth, V.B. 1972. The Principles of Insect Physiology. The English Language Book Society and Matheuen & Co. Ltd., London. Richards, O.W. and Davies, R.G. (revised by A.D. Imm's). 1977. A General Text Book of Entomology. The English Language Book Society and Mathuen & Co. Ltd., London. Ross, H.H. 1964. A Text Book of Entomology. John Wiley and Sons, New York. Sana, R.I. 1989. Tea Science. Ashrafia BoiGhar, Dhaka, Bangladesh.

Visiting hours: 09:00 am to 5:00 pm on working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 406	**Fisheries and Aquaculture**	**Core course**	**4**	**60**	**100**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

This course provides students with some basic aspects of fisheries, emphasizing on systematics, biology, population dynamics, resource management, aquaculture, post-harvest technology and fish diseases. Biological concepts of the course include morphology, behaviour, reproduction and life history strategies of fisheries species. It also covers the logistic and quantitative methodologies associated with undertaking a biological investigation into the population dynamics of a species. These assessments of fisheries species include reproductive biology, age determination, growth modeling, stock discrimination, population stock abundance and dietary analysis. This course will also introduce the students to a range of aquaculture practices of common culture able finfish and shrimp species in the country, induced breeding techniques, broodstock management, common fish harvesting and processing techniques and practices.

Specific objectives of the course

Upon completion of the course, the student will be able to-

- Introduce them to a wide range of aspects related to fisheries biology, fisheries management and aquaculture practices.
- Understand the major aspects of fish biology and fish population dynamics.
- Enhance their knowledge about the fisheries resources of the country and its management.
- Make them familiar with the fish and shrimp culture techniques, induced breeding of fishes and fish processing techniques.

Mapping with SDGs

This course directly and indirectly contributes to the following Sustainable Development Goals (SDGs): SDG 2 (Zero Hunger), SDG 14 (Life Below Water), SDG 12 (Responsible Consumption and Production)

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to		PLO covered
CLO1	Understand the principles and techniques of fishery systematics, including the collection, preservation, and taxonomic study of fish and shellfishes (Understand).	PLO1, PLO5
CLO2	Recognize and explain the classification of fishes based on diagnostic characters and examples (Understand).	PLO1
CLO3	Analyze the principles of fish biology, including food and feeding, growth, condition factor, and reproductive biology (Analyze).	PLO1
CLO4	Analyze population dynamics by estimating mortality rates, population size, and Maximum Sustainable Yield (MSY), and apply these concepts to assess exploited populations (Analyze).	PLO3
CLO5	Apply principles of fisheries resource management, including fish sanctuaries and conservation efforts, and evaluate the fishery resources of	PLO2, PLO7

	Bangladesh (Apply).	
CLO6	Analyze and apply the methods for fish harvesting, spoilage, and preservation, including traditional and modern techniques like icing, freezing, salting, and canning (Analyze, Apply).	PLO5
CLO7	Understand the concept, history, and techniques of aquaculture, and apply these methods to design and optimize aquafarming systems for carp, shrimp, and other farmed species (Understand, Apply).	PLO1
CLO8	Analyze and apply knowledge of fish diseases, including microbial, bacterial, and parasitic diseases, to develop control measures for maintaining fish health (Analyze, Apply).	PLO2, PLO5, PLO6

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
6	**Fishery systematic:** Principles and techniques of fishery systematics including collection, preservation and taxonomic studies of fish and shellfishes; classification of fishes with diagnostic characters and examples.	**CLO1, CLO2**	Visual and digital learning, Problem-solving sessions, Interactive discussion, and Feedback	Class attendance, Assignment, In-course Exam and Final theory Exam
12	**Fish biology and population dynamics:** Principles and techniques of fish biology; food and feeding, growth, condition factor and meristic relationship. Maturation and spawning habit; reproductive biology including fecundity; GSI, refractory period. Estimation of mortality rates; population size and MSY. Theories of fishing. Age and growth and estimation of growth parameters, gear selectivity; tagging and marking types and techniques. Analysis of exploited population.	**CLO3, CLO4**		
6	**Fishery resources:** Fish habitat diversity; shellfish and finfish resources of Bangladesh. Fish production statistics. Government and non-government fisheries organizations; research institutions; cooperatives and their activities. Principles and techniques of fisheries resources management. Concept of fish sanctuaries. Fish conservation acts and Fisheries Policy of Bangladesh.	**CLO5**		
7	**Fish harvesting and processing:** Traditional fish harvesting crafts, gears and lines of Bangladesh; modern trawl fishing and miscellaneous techniques of harvesting. Fish spoilage and post-mortem changes; principles,	**CLO6**		

	and physical, chemical and microbial aspects of spoilage; Rigor mortis. Fish processing and preservation by icing and freezing, drying, salting, smoking, pickling and canning.			
15	**Aquaculture:** Concept, history and scope of aquaculture. Site selection factors/criteria and categories for aquafarm; components of carp and shrimp hatchery. Design and construction of ponds, cages and pens; Culture types and common farmed species of fish. Shellfish and seaweed. Steps of pond fish culture. Integrated fish farming types. Induced breeding techniques of carp and shrimp. Inbreeding problems and preventive measures. Mariculture/coastal aquaculture types; shrimp, pearl, oyster and fish culture in the coast and mangrove areas.	**CLO7**		
8	**Fish diseases:** Concepts, scopes and economic role of fish diseases. Microbial bacterial and fungal diseases of shrimp and fish. Parasitic disease (protozoan and metazoan diseases) of fish with their causes, mode of infection; symptoms and control measures. Miscellaneous non-infectious and nutritional diseases of carp and catfish.	**CLO8, CLO6**		

*** Per week 2 classes**

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. At the beginning of each class students' feedback on previous class lecture will be taken. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be two in-course examinations, each consisting of 17.5 marks, and 5 marks will be allocated for students' class attendance. In in-course examination, questions will be of objective and short types. The students will be frequently asked questions in the classrooms to assess performances. A course final examination of 60 marks will be conducted by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	**In-course**	**Assignment**
1. Remember	2.5	
2. Understand	5	
3. Apply	3	

4. Analyze	5	
5. Evaluate	2	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 60)	Test
1.Remember	10
2.Understand	20
3.Apply	10
4.Analyze	15
5.Evaluate	5
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Bardach, J.E., Ryther, J.H. and McLarney, W.O. 1972. Aquaculture: the farming and husbandry of freshwater and marine organisms. Wiley-Blackwell, New Jersey, USA. Boyd, C.E. 1979. *Water Quality of Warmwater Fish Ponds.* Auburn University, Alabama, USA. Huet, M. 1986. *Text Book of Fish Culture- Breeding and Cultivation of Fish.* Fishing News Books, Oxford, UK. Jhingran, V.G. and Pullin, R.S.V. 1988. *A Hatchery Manual for the Common, Chinese and Indian Major Carps.* ADB and ICLARM. Kumar, D. 1992. *Fish Culture in Undrainable Ponds.* A Manual for Extension. FAO Fisheries. Pillay, T.V.R. 1993. *Aquaculture- Principles and Practices.* Fishing News Books, Oxford, UK. Roberts, R.J. 2012. *Fish Pathology.4th ed.* Wiley Blackwell, Oxford, USA, 597p. Van Duijn, C.J. 1956. *Diseases of Fishes.* Water Life, London.

Visiting hours: 9:00 am to 5:00 pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 407	**Wildlife and Wildlife Management**	**Core course**	**4**	**60**	**100**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

Study of wildlife and wildlife management has been a focus area of biological studies with the growing concern over rapid decline in wildlife worldwide. This course focuses on the four most evolved and highest classes of animals: Amphibia, Reptilia, Aves and Mammalia with particular concentration on the diversity in Bangladesh. This course also offers an abridged concept of wildlife management, Wildlife (Conservation and Security) Act 2012 as well as of the protected areas of Bangladesh. The particular focuses of the course include classification of these four groups of animals, some aspects of wildlife biology, behaviour, ecology and their economic importance. The course also highlights the methods and tools for wildlife conservation and protected area management.

Specific objectives of the course

Upon completion of the course, the student will be able to-

- Introduce the amphibians, reptilians, birds and mammals, their diversity, ecology and behaviour.
- Disseminate information on the status of wildlife management in Bangladesh.
- Delineate Conservation (Wildlife and Security) Act 2012.
- Be familiar with IUCN Red List and Protected Area Categories.

Mapping with SDGs

This course is relevant to achieves SDG4 (Quality education), SDG14 (Life below water), and SDG15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to		PLO covered
CLO1	Identify and categorize different species of amphibians and reptilians with explaining their distribution, fitness and behavioural diversification. (Remember, Understand and Analyze)	PLO1, PLO2
	Estimate costs and benefits of herpetofauna with a plan for conservation actions measures (Apply and Create)	
CLO2	Explain the numerical assessment on bird species and the different aspects of their feeding, breeding and migratory behaviors (Remember and Understand)	PLO1, PLO2
	Investigate and analyze any reason for behavioral changes of birds (Analyze)	
CLO3	Identify mammalian species with describing their feeding and reproductive diversification (Remember and Understand)	PLO1, PLO2
	Explain the mammalian adaptability and criticize on the distinguishing factors for mammalian extinction in Bangladesh (Understand and Analyze)	
CLO4	Construct and design the effective study methods to assess wildlife population (Apply and Evaluate)	PLO2, PLO5, PLO8
	Explain the causes and consequences/impacts of wildlife loss with designing strategies for wildlife conservation by managing protected areas and enacting	

	wildlife acts and laws (Understand Apply and Create)	

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
16	**Herpetology:** Diversity of herpetofauna. Adaptation to different habitats. Status and distribution of amphibians and reptiles of the Oriental Region with special reference to Bangladesh. Food and feeding habits of amphibians and reptiles in relation to agriculture, forestry and fisheries. Breeding biology: season, nesting, egg-laying and parental care of amphibians and reptiles.	**CLO1**	Visual and Auditory	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
10	**Ornithology:** Diversity of birds. Locomotor and feeding adaptations. Food and feeding habits. Breeding behaviour: territoriality, courtship, mating, nests, eggs, incubation, nestlings, breeding success, breeding season, brood parasitism, parental care, migration patterns: timing and significance.	**CLO2**		
18	**Mammalogy:** Diversity of mammals with special reference to Bangladesh; status and distribution of mammals of the Oriental Region with special reference to Bangladesh. Mammalian adaptations to different habitats. Food and feeding behaviour of mammals: (i) foraging and food selection, (ii) diet, (iii) grazing and browsing. Breeding biology– breeding season, calls, territoriality, mating, pregnancy, gestation, lactation and parental care of deer, squirrel and primates. Extinct and threatened mammals of Bangladesh.	**CLO3**		
10	**Wildlife Management:** Introduction, concept and principles. Causes of decline of wildlife population. Wildlife conservation measures. Population, population density and population dynamics. Frequency of occurrence and relative abundance. Various methods of population analysis. Bangladesh Wildlife (Conservation & Security) Act 2012. Concept and types of protected areas. Protected areas of Bangladesh. Protected area management	**CLO4**		

*** Per week 2 classes**

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations and video presentations. Classes will be made participatory and interactive through questions and answers, and individual/group work exercises in the classroom.

Assessment Pattern
Two in-course examinations, each of one hour duration and consisting of 17.5 marks each, will be taken.
A total of 5 marks is allocated for students' class attendance. The questions for in-course examinations
will be of objective, short types. A course final examination will be conducted by the university, which
will carry 60 marks.

CIE- Continuous Internal Evaluation (35 marks), Attendance: 5 marks

Bloom's Category Marks (out of 17.5)	In-course	Assignment
1. Remember	4	
2. Understand	5	
3. Apply	10	
4. Analyze	10	
5. Evaluate	3	
6. Create	3	

Year-end Examination

Bloom's Category Marks (out of 30)	Test
1.Remember	7
2.Understand	8
3.Apply	20
4.Analyze	15
5.Evaluate	5
6.Create	5

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Dudley, N. (ed.). 2008. Guidelines for Applying Protected Area Management Categories. IUCN, International Union for Conservation of Nature, Gland. Hosetti, B.B. 2005. Concepts in Wildlife Management, 2nd edition. Daya Publishing House, Delhi. Khanna, D. R. and Yadav, P. R. 2005. Biology of Birds. Discovery Publishing House, New Delhi. Sinclair, A.R.E., John, M.F. and Cavghley, G. 2006. Wildlife Ecology,

	Conservation and Management. Blackwell Publishing Ltd. London, Paris, Berlin, Vienna. Sodhi, N.S. and Ehrlich, P.R. 2010. Conservation Biology for All. Oxford University Press, Oxford, UK. Stolton, S., Shadie, P. and Dudley, N. 2013. IUCN WCPA Best Practice Guidance on Recognising Protected Areas and Assigning Management Categories and Governance Types, Best Practice Protected Area Guidelines Series No. 21. IUCN, International Union for Conservation of Nature, Gland. Soule, M.E. (ed.). 1996. Conservation biology: The science of scarcity and diversity. Sinauer Associates, Inc. Massachusetts, USA. Wallace, G. J. 1971. An Introduction to Ornithology. Second Edition. The Macmillan Company, New York.
Supplementary Reading	Dyke, F.V. 2008. Conservation Biology – Foundations, Concepts and Applications. Springer Science - Business Media, New York. 2015. Red List of Bangladesh: A Brief on Assessment Result. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka. Siddiqui, K.U., Islam, M.A., Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A., Haque, E.U., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., Khondker M. and Rahman, M.M. (eds.). 2008. Encyclopedia of Flora and Fauna of Bangladesh. Vol. 26. Birds. Asiatic Society of Bangladesh, Dhaka. Welty, J. C. 1982. Life of Birds. Saunders College Publishing, USA.

Visiting hours: 9:00 am to 5:00pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 408	**General Parasitology**	**Core course**	**4**	**60**	**100**

Prerequisites: As per University requirements for admission into the program.

Rationale of the course

The course General Parasitology deals with studies of basic idea of parasitology and biology of common parasites of different groups of vertebrate animals. Basic understanding of Parasitology and knowledge of common parasites are essential for students of Zoology. The course particularly focuses on the basic idea of parasitology, host-parasite association, distribution of parasites, control of parasites, and biology of common parasites of different groups of vertebrate animals including man. A basic understanding of parasitology and knowledge of common parasites are essential for Zoology students, and they are particularly useful to those who would like to specialize and develop a career in Parasitology.

Specific objectives of the course

Upon completion of the course, the student will be able to-

- Give a detailed idea of the different types of relationships among animals, especially of parasitism.
- Enhance students' understanding of the history and evolution of parasites.
- Enhance students' knowledge about the different parasites of humans and domesticated animals, their biology, development, and effects on hosts.
- Enable students' learning on the control of common parasites of humans and domesticated animals.

Mapping with SDGs

This course is relevant to achieving SDG3 (Good health and well-being for people), SDG4 (Quality education), SDG12 (Responsible consumption and production), SDG13 (Climate action) SDG14 (Life below water) and SDG15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	Define parasitology and explain the types and related terms (Remember)	PLO1, PLO6
CLO2	Identify different types of association (Understand)	PLO1, PLO2
CLO3	Describe History**,** origin and evolution of different groups of parasites. (Understand)	PLO2, PLO3
CLO4	Explain the relationship between host and parasite (Analyzed)	PLO1, PLO2
CLO5	Define vectors and explain their role in parasitology (Apply).	PLO4, PLO6
CLO6	Describe the systematic position, morphology, life cycle, pathogenicity, epidemiology, and control of parasites of invertebrate hosts (Understand)	PLO1, PLO6
CLO7	Describe the systematic position, morphology, life cycle, pathogenicity, epidemiology, and control of parasites of fishes (Understand)	PLO1, PLO6

CLO8	Describe the systematic position, morphology, life cycle, pathogenicity, epidemiology, and control of parasites of amphibians (Understand)	PLO1, PLO6
CLO9	Describe the systematic position, morphology, life cycle, pathogenicity, epidemiology, and control of parasites of reptiles (Understand)	PLO1, PLO6
CLO10	Describe the systematic position, morphology, life cycle, pathogenicity, epidemiology, and control of parasites of birds (Understand)	PLO1, PLO6
CLO11	Describe the systematic position, morphology, life cycle, pathogenicity, epidemiology, and control of parasites of mammals other than humans (Understand)	PLO1, PLO6
CLO12	Describe the systematic position, morphology, life cycle, pathogenicity, epidemiology, and control of parasites of humans (Understand)	PLO1, PLO6

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
3	**Introduction to parasitology**: concept, types and related terms.	**CLO1**	Visual and Auditory	Class attendance, In-course Exam and Final theory Exam
2	**Detailed study** of basic ideas and principles of different types of association.	**CLO2**		
5	**History of parasitology:** origin of parasites and evolution of different groups of parasites.	**CLO3**		
8	**Host-parasite relationship:** tissue and organ level effects: (a) effects of parasites on the host; and (b) effects of hosts on parasites. Effects of host behaviour, diet and hormone.	**CLO4**		
2	**Vectors:** vectors and their role in parasitology.	**CLO5**		
3	**Common animal parasites:** systematic position, morphology, life-cycle, pathogenicity, epidemiology, and control of important parasites of different groups of animals: **Parasites of invertebrate hosts**: *Nosema, Haplosporidium, Aspidogaster, Agamermis and Sacculina.*	**CLO6**		
6	**Parasites of fish**: *Cryptobia, Henneguya, Myxobolus, Trichodina, Ichthyophthirius, Gyrodactylus, Gnathostoma, Pallisentis, Argulus, Ergasilus, Lernaea and Caligus.*	**CLO7**		
2	**Parasites of amphibians:** *Opalina, Polystoma* and *Haematoloeclus.*	**CLO8**		
2	**Parasites of reptiles:** *Haemogregarina, Megalodiscus* and *Amplicaecum.*	**CLO9**		
3	**Parasites of birds:** *Eimeria, Leucocytozoon, Histomonas, Heterakis, Raillietina and Argas..*	**CLO10**		
6	**Parasites of mammals other than humans**: *Moniezia, Dicrocoelium, Dipylidium, Dirofilaria, Capillaria, Ixodes, Dermacentor,*	**CLO11**		

	Ornithodoros and *Demodex*			
12	**Parasites of humans:** *Cryptosporidium, Leishmania, Trypanosoma, Toxoplasma, Giardia, Trichomonas, Clonorchis, Schistosoma, Taenia, Echinococcus, Trichurus, Ancylostoma, Strongyloides, Ascaris, Enterobius, Wuchereria, Pediculus* and *Sarcoptes.*	**CLO12**		

*** Per week 2 classes**

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classrooms. Students' feedback on previous lecture will be taken at the beginning of each class. Students' feedback on the overall course delivery and content will be taken in the last class through a questionnaire survey.

Assessment Pattern

There will be one in-course examination, consisting of 17.5 marks and 2.5 marks will be for class attendance. The course final examination, comprising 30 marks, will be conducted centrally by the university.

CIE- Continuous Internal Evaluation (17.5 marks), Attendance: 2.5 marks

Bloom's Category Marks (out of 17.5)	**In-course**	**Assignment**
1. Remember	5	
2. Understand	5	
3. Apply	7.5	
4. Analyze		
5. Evaluate		
6. Create		

Year-end Examination

Bloom's Category Marks (out of 60)	**Test**
1.Remember	5
2.Understand	20
3.Apply	15
4.Analyze	10
5.Evaluate	5
6.Create	5

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Cheng, T.C. (ed.). 1971. The Biology of Animal Parasites, Butterworths, London. Schmidt, G.D. and Roberts, L.S. 1996. Foundations of Parasitology. Wm. C. Brown Publishers, USA. Cheng, T.C. 1997. General Parasitology. Academic Press, New York, USA. Croll, N.A. 1973. Parasitism and other Associations. Pitman. London. Kennedy, C.R. 1975. Ecological Animal Parasitology. Blackwell Scientific Publications, London, Paris, Berlin, Vienna. Philip W.J. 1979. The Biology of Parasites. Edward Arnold Ltd., UK. Read, C.P. 1970. Parasitism and Symbiology. Ronair Press Co., New York, USA. Read, C.P. 1972. Animal Parasitism. Prentice Hall, Inc., N.J, USA
Supplementary Reading	Cox F.E.G. (ed.). 1993. Modern Parasitology. Blackwell Science, London, Paris, Berlin, Vienna.

Visiting hours: 9:00 am to 5:00pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 409	**Molecular Genetics**	**Core course**	**4**	**60**	**100**

Prerequisites: As per University requirements for the admission into program.

The rationale of the course

This course aims to provide a comprehensive understanding of the molecular basis of heredity, the fundamental processes that govern gene structure, function, and regulation, as well as the mechanisms underlying genetic mutations and repair. It bridges foundational molecular biology concepts with applied genetic technologies, equipping students with the theoretical and practical knowledge required for advanced studies and research in genetics and biotechnology. Emphasizing the molecular mechanisms of DNA replication, transcription, translation, and gene regulation, the course integrates these concepts with cutting-edge applications such as genetic engineering and its implications in medicine, agriculture, and industry.

Specific objectives of the course

The primary objective of this course is to equip students with a thorough understanding of the molecular principles underlying heredity, gene expression, and genetic variation. By focusing on the chemical and structural properties of DNA, RNA, and proteins, as well as their roles in replication, transcription, translation, and regulation, students will develop a strong foundation in molecular genetics. The course also aims to foster critical thinking and analytical skills by introducing students to genetic engineering technologies and their real-world applications in medicine, agriculture, and industry. This course ultimately prepares students to critically engage with cutting-edge advancements in genetics and apply their knowledge to solve complex biological problems.

Upon completion of the course, the student will be able to-

- Gain comprehensive knowledge of the molecular mechanisms of genetic material and its transmission.
- Develop skills to analyze and interpret key genetic processes, such as replication, transcription, and translation, at the molecular level.
- Understand the implications of gene regulation, mutations, and DNA repair in health and disease.
- Learn the principles and applications of genetic engineering techniques, preparing them for future research or industry roles.
- Cultivate an appreciation for the broader applications of genetics in addressing global challenges, such as food security, healthcare, and sustainable development.

Mapping with SDGs

This course is relevant to achieving SDG 2 - Zero Hunger, SDG 3 - Good Health and Well-being, SDG 4 - Quality Education, SDG 9 - Industry, Innovation, and Infrastructure.

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	Explain the properties of genetic material and the DNA structure with nucleosome organization. (Remember)	PLO1
CLO2	The semi-conservative replication process, emphasizing key events and the functions of DNA polymerase and telomerase. and (Understand)	PLO1, PLO3
CLO3	Examine the molecular basis of genetic recombination and its implications for genome stability and diversity. (Analysis)	PLO6
CLO4	Identify types and causes of gene mutations, as well as mechanisms of DNA repair such as mismatch repair, base-excision repair, and nucleotide-excision repair. (Remember)	PLO1, PLO3
CLO5	Describe the process of transcription, including the roles of genes, promoters, terminators, and RNA polymerases in initiation, elongation, and termination. (Understand)	PLO1
CLO6	Discuss the genetic code, including codons, anticodons, and the role of ribosomes in the translation process. (Understand)	PLO1
CLO7	Apply the principles of gene regulation to explain differences in prokaryotic and eukaryotic transcriptional and post-transcriptional regulation mechanisms. (Application)	PLO3
CLO8	Utilize recombinant DNA techniques such as PCR, gene cloning, and transgenesis for genetic engineering applications in model organisms like fruit flies and mice. (Application)	PLO1, PLO3, PLO5
CLO9	Analyze the roles of RNA types (mRNA, tRNA, rRNA) and RNA processing mechanisms like splicing, editing, and microRNA in gene expression. (Analysis)	PLO6
CLO10	Evaluate the applications of genetics in pharmaceuticals, agriculture, gene therapy, genetic testing, and DNA fingerprinting, considering their impact and future scope in science and society (Evaluation)	PLO1, PLO4, PLO9

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class	Topic	Corresponding CLOs	Teaching Learning Strategy	Assessment Strategy
5	DNA- the chemical nature of the gene: Characteristics of genetic material; the molecular basis of heredity; the structure of DNA; DNA packaging – nucleosome and its structural organization.	**CLO1**	Visual and Auditory	Class attendance, Oral Presentation, In-course

7	DNA replication and recombination: DNA replication: semi-conservative replication, DNA polymerase; events at the replication fork; replication of the lagging strand; replication of telomeres; consequences of defects in telomerase. Replication of genomes: origins of replication; cell cycle control of DNA replication. Molecular basis of recombination.	**CLO2, CLO3**		Exam and Final theory Exam.
5	Gene Mutations and DNA Repair: Types and Causes of mutations: replication errors, mutagens; DNA repair: Mismatch Repair, Direct Repair, Base-Excision Repair, Nucleotide-Excision Repair and Other Types of DNA Repair. Genetic diseases and faulty DNA repair.	**CLO4**		
4	Transcription: Structure and function of gene; promoters and terminators; transcriptional initiation, elongation and termination, RNA polymerases.	**CLO5**		
3	The Genetic Code and Translation: The genetic code, codons, anticodons, the ribosome and translation.	**CLO6**		
6	Control of Gene Expression: General principles of gene regulation; Prokaryotic gene regulation: the Lac operon; Eukaryotic gene regulation: regulation of transcription, promoters, enhancer elements; post transcriptional and post-translational regulation.	**CLO7**		
12	Genetic Engineering: Basic concepts; recombinant DNA techniques; cloning genes; PCR amplification of DNA; use of PCR in species identification; transgenesis - generating transgenic animals with special reference to model organisms: fruitfly and mouse.	**CLO8**		
3	RNA molecules and RNA processing: mRNA, tRNA and rRNA; RNA splicing; RNA editing; microRNA.	**CLO9**		
5	Broader areas of application of Genetics: Pharmaceuticals; Specialized Bacteria; Agricultural Products; Oligonucleotide Drugs; Genetic Testing; Gene Therapy; Gene Mapping; DNA Fingerprinting. Future scope of Genetics.	**CLO10**		

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power-point presentations, flip charts, video films, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classroom.

Assessment Pattern

There will be two in-course examinations, each consisting of 17.5 marks; 5 marks are reserved for class attendance. The course final examination will be of 60.

CIE- Continuous Internal Evaluation (35 marks), Attendance: 5 marks

Bloom's Category Marks (out of 35)	In-course	Assignment
1. Remember	10	
2. Understand	8	
3. Apply	5	
4. Analyze	7	
5. Evaluate	2.5	
6. Create	2.5	

Year-end Examination

Bloom's Category Marks (out of 60)	Test
1.Remember	10
2.Understand	15
3.Apply	10
4.Analyze	15
5.Evaluate	5
6.Create	5

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Brown, T.A. 2000. Essential Molecular Biology (A Practical Approach). 2nd edition. Oxford University Press, UK. Karp, G. 2005. Cell and Molecular Biology (Concept and Experiments). 4th edition. John Wiley and Sons Inc., New York, USA. Sambrook, J. and Russell, D.W. 2001. Molecular Cloning (A Laboratory Manual). Cold Spring Harbor Laboratory Press, USA. Stern, C. 1968. Principles of Human Genetics, 2nd edition. Eurasia Publishing House Ltd., New Delhi, India. Tave, D. 1993. Genetics for Fish Hatchery Managers, Van Nostrand. 2nd edition. Reinhold Publisher, California, USA. Turner, P.C., McLennan, A.G., Bates, A.D. and White, M.R.H. 2000. Instant Notes Molecular Biology. 2nd edition. BIOS Scientific Publishers Limited, UK. Winter, P.C., Hickey, G.I. and Fletcher. H.L. 2003. Instant Notes on Genetics. 2nd edition. BIOS Scientific Publishers Limited, UK. Klug, W.S. and Cummings, M.R. 2017. Concepts of Genetics. 11th edition. Pearson Education, Inc., New Jersey, USA. Snustad D. P., M. J. Simmons. 2015. Principles of Genetics. 7th Ed. John Willey and Sons. Inc. New York, USA.

	Pierce, Benjamin A. 2012. Genetics: a conceptual approach, 4 th edition. W. H. Freeman and Company, New York.
Supplementary Reading	**N/A**

Visiting hours: 9:00 am to 5:00 pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	No. of Credits	Credit hours	Total Marks
Zool. 410	Ecological field studies in Mangrove ecosystems	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

Field study is an integral subject for undergraduate students of Zoology that provides practical and hands-on experience in studying fauna and flora and their environments. Field based courses expand the knowledge of field research methods, identifying species, collecting and analyzing data for ecological investigations, animal behavior, and conservation of animals in the natural environment. Therefore, this course is designed for students during the academic year focusing on mangrove ecosystems to study and observe the faunal diversity, habitats, community structure, population characteristics of species and their interaction to biotic and abiotic factors. Students will be able to put their knowledge and skills to practice by designing and conducting a small ecological investigation under this field course.

Specific objectives of the course

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

- Identify and apply the methods to study the populations of species including their habitat preferences, distributions and home ranges and other aspects of ecology.
- Assess the diversity of fauna and flora (identification and estimation) and investigate ecology of populations, species and communities in their environment.
- Develop the skills to gather reliable data in the field and to keep the record information for future use.
- Design and conducting field-based research studies to generate original biological knowledge.
- Work in a team to develop and carry out a field research project.

Mapping with SDGs

This course is relevant to achieve SDG4 (Quality education), SDG 13 (Climate action), SDG14 (Life below water), and SDG15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		**PLO covered**
CLO 1	State, recognize and use various sampling techniques for animals and plants in mangrove environment. (Remember, Understand and Apply)	PLO1, PLO2
CLO 2	Identify, describe and criticize the analysis methods for ecological data. (Remember, Understand and Analyze)	PLO2, PLO3
CLO 3	Describe and assess the species and ecosystems diversity of a particular area. (Understand and Evaluate)	PLO2, PLO3
CLO 4	Apply the knowledge gained from mangrove ecosystems for biodiversity conservation and environmental management (Apply)	PLO3, PLO5

CLO 5	Communicate, discuss and justify the outputs of ecological field work to a scientific community via report, meeting, seminar and group presentation. (Understand, Evaluate and Create)	PLO8, PLO9

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class	Topic	Corresponding CLOs	Teaching-Learning Strategy	Assessment Strategy
8	Pre-field lectures: Preparation and planning of field studies; field safety measures; Defining the aim of the field study; field site selection; Introducing faunal diversity of selected ecosystems including their identification. Ecological aspects of field investigations. Faunal observation/survey techniques; Data and sample collection and analysis. Briefing on report writing and presentation	**CLO 1 CLO 2 CLO 3 CLO 4 CLO 5**	Visual, Auditory and Visual, Auditory, Practical demonstration	On-field assessment, report writing and presentation
22	Field visit: Visit the assigned field area, particularly the marine, island and hilly area; On-site Assessment.		Field demonstration and observation	

*** Per week 2 classes**

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be taught using a blended approach, including pre-field lectures, visiting particular field sites, group meeting and presentation. Lectures for the preparation and planning of field, contents of studies and safety measures will be provided by faculties (preferably members of examination committees or other teachers assigned by academic committee) with power point presentations, online resources, printed information and video clips. All events will be made participatory and interactive through Q & A (questions and answers) sessions, group meeting and discussions. In the field, the students will be guided by the teachers to carry out the specific project of ecological investigations in small groups for approximately 3 to 5 days. Students' feedback on the overall course contents, way of delivery and field activities will be taken through an open discission in the field

Assessment Pattern

Assessment will be done by the Members of the concerned Examination Committee. Three-step assessments will be followed, including onsite assessment (written examination), presentation and

report writing. Onsite assessment, presentation and report writing will carry 40%, 30 % and 30 % marks, respectively.

CIE- Continuous Internal Evaluation (out of 20 marks)

Bloom's Category Marks	In-course	Assignment
1. Remember	3	
2. Understand	5	
3. Apply	5	
4. Analyze	5	
5. Evaluate	2	
6. Create	3	

Year-end Examination (out of 30 marks)

Bloom's Category Marks	Test
1.Remember	5
2.Understand	15
3.Apply	5
4.Analyze	2.5
5.Evaluate	2.5
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	i) Odum, E.P. and Barrett, G.W. 2005. Fundamentals of Ecology. 5th edition. Thomson Brooks/Cole Publishing Co., USA. ii) Henderson, P. A. 2003. Practical methods in Ecology. John Wiley & Sons. iii) Sokal, R.R. and Rohlf, F.J. 1981. Biometry - The Principles and Practice of Statistics in Biological Research. W.H. Freeman and Company, New York. iv) Magurran, A.E., 2013. *Ecological diversity and its measurement*. Springer Science & Business Media.

Visiting hours: 09:00 am to 5:00 pm on working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 411	**Practical**	Core	8	120	200

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

The main purpose of this course is to provide a comprehensive interdisciplinary understanding of Zoological science, integrating practical and applied contents of Entomology, Fisheries, Genetics and Molecular biology, Parasitology and Wildlife Biology. In addition, practical knowledge of biostatistics will increase the student's capacity for conducting research projects in future. this practical course based on hands-on demonstration has been designed aligning with the major theoretical courses taught in the fourth year of the Undergraduate Program. Basically, this course is designed bridging all theoretical courses to foster deeper understanding, skill development, critical thinking of students. Therefore, this course will have broader implications and applicability in their professional careers including academia, environment, industry or other relevant field.

Specific objectives of the course

Upon completion of the course, the students will be able to-

- Carry out the taxonomic study of fish, shellfish, insects, parasites and wildlife species emphasising on the use of methods and techniques to identify these groups.
- Understand the field and laboratory based ecological methods for the conservation and management of fish and wildlife resources.
- Identify and apply general techniques for investigating anatomical and physiological and genetic aspects of fish, insects, parasites and other wildlife species.
- Apply practical parasitology techniques relevant to host-parasite interaction studies and wildlife disease monitoring.
- Develop practical skills in classical genetic techniques (such as inheritance studies in model organisms like *Drosophila*) and in molecular techniques, including genomic DNA isolation, PCR, and gel electrophoresis, for analysing genetic materials.
- Recognise and use cytogenetic processes, including mitosis, meiosis, and polytene chromosome analysis, and their relevance to cell division and gene expression.
- Equip with biostatistical tools, methods and tests and to apply those in the relevant research projects, experiment or investigations.

Mapping with SDGs

This course is closely aligned with several Sustainable Development Goals (SDGs), including SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 6 (Clean Water and Sanitation), SDG 14 (Life Below Water), and SDG 15 (Life on Land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to		PLO covered
	ENTOMOLOGY	
CLO 1	Demonstrate proficiency in the collection, preservation, and identification of insects, classify them up to the family, genus, and species levels, and compose detailed reports following established guidelines (Apply, analyze, and evaluate).	PLO1, PLO2, PLO5, PLO6
CLO 2	Examine, detach, display, draw, label, and analyze the different insect body parts, including mouthparts, antennae, wings and wing venation, and legs, while commenting on their adaptations (Analyze).	PLO1, PLO2, PLO5
CLO 3	Dissect selected insects to examine the digestive system and its structural variations related to feeding habits, and analyze the reproductive system, including the male and female organs such as the testis, ovary, and ovariole (Analyze).	PLO1, PLO2, PLO5
CLO4	Prepare a smear and detect the Haemocytes of insect.	PLO2, PLO5
CLO5	Collect and identify insect pests of different crops and vegetables, fruit tree pests, stored grains and grain products, dry-fish pests with labeled diagrams, classification, characteristics and taxonomic notes. (Analyze)	PLO1, PLO2, PLO5
	FISHERIES	
CLO 1	Recognize, describe and apply the taxonomic techniques for the identification of crustaceans, molluscs and fishes. (Remember, Understand and Apply)	PLO1
CLO 2	Demonstrate and assess the anatomical and physiological peculiarities of fish. (Understand and Evaluate)	PLO3, PLO4
CLO 3	Identify and describe the fishing gears and crafts and criticize their uses in maximum sustainable yield of fisheries resources. (Remember, Understand and Evaluate)	PLO2, PLO3, PLO4
CLO4	Describe and apply the practical knowledge regarding age determination, hathery and fish farm management, feed formulation, plankton analysis in aquaculture and fisheries resources management. (Understand and Apply)	PLO5, PLO8, PLO9
	WILDLIFE BIOLOGY	
CLO1	Classify and interpret different groups of museum specimens using standard taxonomic techniques (Understand, Apply)	PLO1, PLO5
CLO2	Demonstrate/apply and compare different wildlife study techniques (Apply, Analyze)	PLO3, PLO5
CLO3	Analyze and formulate through practical techniques such as slide preparation and microscopic analysis (Analyze, Evaluate)	PLO3, PLO5
	PARASITOLOGY	
CLO1	Identify and describe protozoan, helminth and arthropod parasites from different host species (Remember and Understand)	PLO1, PLO2, PLO6
CLO2	Categorize different groups of parasites from animal hosts (Analyze)	PLO1, PLO2, PLO6
CLO3	Construct inventory of parasites from different host species (Evaluate)	PLO1, PLO3, PLO5
CLO4	Demonstrate parasites from invertebrate hosts (Apply)	PLO2, PLO5, PLO6
CLO5	Collect and identify parasites from fecal samples (Evaluate and Remember)	PLO2, PLO6

	MOLECULAR GENETICS	
CLO1	Examine genetic inheritance patterns in Drosophila sp. and interpret principles of Mendelian and non-Mendelian inheritance through hands-on experimental crosses. (Analyze).	PLO1, PLO3, PLO7
CLO2	Observe and characterize polytene chromosomes from Drosophila or Bactrocera, highlighting their structural organization and functional relevance. (Understand).	PLO1, PLO5
CLO3	Extract genomic DNA from biological samples, conduct PCR and agarose gel electrophoresis, and accurately analyze and interpret the resulting data. (Apply).	PLO3, PLO5
CLO4	Determine allele and genotype frequencies using the ABO blood group system as a model, and assess population genetic diversity, focusing on the evolutionary significance of multiple alleles. (Evaluate).	PLO2, PLO6
CLO5	Keep an organized and comprehensive practical notebook to document experimental procedures and results, and compile detailed reports integrating laboratory findings effectively. (Create).	PLO8, PLO9
	BIOSTATISTICS	
CLO1	Understand and describe the basic statistical methods, tools and tests and. (Understand & Apply)	PLO3, PLO5
CLO2	Recognize and describe graphical presentation of biological data relevant to specific statistical tests	PLO3, PLO5
CLO3	Analyze the biological data with statistical tools and test and assess those statistical methods to solve real-world problems, enabling better decision-making based on data analyzed.	PLO8, PLO9
CLO4	Apply and criticize the statistical methods for conducting research project and scientific experiment and investigation	PLO8, PLO9

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class/ (*Week)	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
7	**ENTOMOLOGY**			
2	Insect Taxonomy: Collection of insects of common orders. Insect identification: Selected insects up to family level; Insects up to generic and species levels; Collection, preservation and identification of insects; Report preparation (Class teacher will give guidelines).	**CLO1**	Visual/ Auditory: Lectures, and Presentation Group and One to one demonstration	Class attendance, Oral Presentation, In-course Exam and Final Practical Examination
1	Insect morphology: Different types of the mouth parts, antennae, wings and wing venation, legs of insects. (Students will detach the above-mentioned insect body parts, display, draw and label them and make comments on their adaptations).	**CLO2**		
2	Insect anatomy: Study of the functional systems of insects through dissection of	**CLO3**		

	selected insects: a) Digestive system: Structural variations related to feeding habits. b) Reproductive system: Male and female systems- testis, ovary and ovariole.			
1	Insect physiology: Haemocytes of insects (students will prepare slides for the haemocytes of insects and draw and label them).	**CLO4**		
1	Agricultural entomology: Collection and identification of the pests of different agricultural crops and vegetables, fruits, stored grains and grain products, dry-fish pests. (Students will collect the above-mentioned insect pests and study them in the classroom. The study includes proper recording with labeled diagrams, classification, characteristics and taxonomic notes).	**CLO5**		
12	**FISHERIES**			
4	Taxonomic identification of crustaceans, molluscs and fishes of Bangladesh.	**CLO1**	Visual /Auditory: Lectures, and Presentation Group and One to one demonstration	Class attendance, , In-course Exam and Final practical Examination
3	Dissection of the digestive, circulatory respiratory and nervous and reproductive systems of *Labeo rohita*. Study of mouth structure of fish in relation to food and feeding habits.	**CLO2**		
2	Age determination of fish by scale, otolith and fin ray. Crafts and gears used in fishing.	**CLO3, CLO4**		
2	Qualitative and quantitative study of plankton and macro benthic organisms. Feed formulation and feed preparation techniques	**CLO4**		
1	Field visits for the observation of hatchery operation, fish processing, catch assessment and for fishing effort survey.	**CLO4**		
10	**WILDLIFE BIOLOGY**			
6	Taxonomy of museum specimens: Amphibians, reptiles, birds and mammals.	**CLO1**	Visual /Auditory: Lectures, and Presentation Group and One to one demonstration	Class attendance, In-course Exam and Final Practical Exam.
1	Wildlife study technique: Population census, transect and plot counting, netting and trapping, preservation and identification, tagging, marking, ringing, observatory.	**CLO2**		
1	Preparation of slides: Hairs of mammals.	**CLO3**		
1	Food habit analysis: Frog/lizard/pigeon.	**CLO3**		
1	Field trips to wildlife observation sites	**CLO2**		
7	**PARASITOLOGY**			
2	Identify and describe protozoan, helminth and arthropod parasites from different host species (Remember and Understand)	**CLO1**	Visual /Auditory: Lectures, and Presentation	Class attendance, In-course
1	Categorize different groups of parasites from animal hosts (Analyze)	**CLO2**		

2	Construct inventory of parasites from different host species (Evaluate)	**CLO3**	Group and One to one demonstration	Exam and Final Practical Examination
1	Demonstrate parasites from invertebrate hosts (Apply)	**CLO4**		
1	Collect and identify parasites from fecal samples (Evaluate and Remember)	**CLO5**		
8	**MOLECULAR GENETICS**			
2	**Basic/ Mendelian Genetics:** Exploring genetic inheritance in Drosophila sp.	**CLO1**	Visual /Auditory: Lectures, and Presentation Group and One to one demonstration	Class attendance, In-course Examination and Final Practical Examination.
2	**Cytogenetics:** (a) Study of different stages of mitotic and meiotic cell division by smearing fruit fly/grasshopper testis, (b) Study of polytene chromosomes from third instar larvae of *Drosophila*/*Bactrocera*.	**CLO2**		
3	**Molecular Genetics:** Genomic DNA isolation, PCR analysis and Agarose Gel Electrophoresis.	**CLO3**		
1	**Population Genetics:** Measuring genetic diversity by multiple alleles (e.g ABO blood groups.)	**CLO4**		
	Preparation of practical notebooks and field reports	**CLO5**		
7	**BIOSTATISTICS**			
1	Preparation of frequency distribution table, histogram, Ogive curve and frequency polygon	**CLO1, CLO2 CLO3, CLO4**	Visual /Auditory: Lectures, and Presentation Group and One to one demonstration	Class attendance, In-course Examination and Final Practical Examination
1	Measures of central tendency and dispersion: arithmetic mean, mode, median, variance, standard deviation and standard error	**CLO1, CLO2 CLO3, CLO4**		
2	t -test: One-sample, two-sample (Student's t-test or idependent t-test) and paired t-test Analysis of Variance (ANOVA): One-way and Two-way analysis	**CLO1, CLO2 CLO3, CLO4**		
2	Correlation analysis: Measuring Correlation Coefficient of Pearson and Spearman Rank Correlation, Significance test of Correlation Coefficient; Regression analysis: Simple linear Regression Analysis	**CLO1, CLO2 CLO3, CLO4**		
1	Chi-square test: chi-square goodness of fit test and chi-square test of independence	**CLO1, CLO2, CLO3, CLO4**		

*** Per week 5 class**

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through practical demonstration classes, hands-on trainings and lectures. A number of teachers will be present in the classroom to guide the individual students on how to proceed with their practical works in the laboratory. The classes will be aided with audio-visual materials, video clips relating to different topics. Necessary study materials including online resources, logistics and equipment will be provided to students. Classes will be made participatory and interactive through group work exercises, one to one demonstration and Q & A (questions and answers) sessions. The students will prepare practical note books on each practical work performed in the laboratory. If require, course teachers may organize local study tours to supplement the laboratory works.

Assessment Pattern
There will be five in-course examinations, each consisting of 14.0 marks, a portion of which will be allocated for practical note books; 10 marks are reserved for class attendance. The course final examination will be of 120.

Assessment
There will be 5 in-course examinations, each consisting of 14 marks, and 10 marks are allocated for class attendance. The course final practical examinations will be of 120 and study tour reports. The table below shows the detailed break up of in-course exam marks.

CIE- Continuous Internal Evaluation (14 marks), Attendance: 2 marks

Bloom's Category Marks (out of 14)	In-course	Assignment
1. Remember	2.5	
2. Understand	2.5	
3. Apply	3	
4. Analyze	3	
5. Evaluate	3	
6. Create		

Year-end Examination

Bloom's Category Marks (out of 20)	Test
1.Remember	3
2.Understand	3
3.Apply	4
4.Analyze	5
5.Evaluate	5
6.Create	

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	***Entomology***
	Borror, D.J. Delong D.M. and. Triplehorn C.A.1964. *An Introduction to the study of Insects,* Halt. Reinhart and Winston, USA. Gullan, P.J. and Cranston, P.S. 1999. *The insects: An outline of entomology*. Kluwer Academic Publishers, Boston, London. Richards, O.W. and Davies, R.G. (revised by A.D. Imm's). 1977. *A General*

	Text Book of Entomology. The English Language Book Society and Mathuen & Co. Ltd., London. Snodgrass, R.E. 1935. *Principles of Insect Morphology.* Tata McGraw Hill Publ. Co. Ltd., New Delhi. Wiggesworth, V.B. 1972. *The Principles of Insect Physiology*. English Language Book Society and Matheuen& Co. Ltd., London.
Recommended Reading	***Wildlife Biology***
	Hasan, M.K., M.M.H. Khan, and M.M. Feeroz. 2014. *Amphibians and Reptiles of Bangladesh: A Field Guide*. Arannayk Fundation, Dhaka Bangladesh. 191 pp. Khan, M.M.H. 2018. Photographic Guide to the Wildlife of Bangladesh. Arannayk Foundation, Dhaka, Bangladesh.488pp. S.M.H. Kabir, M. Ahmad, A.T.A. Ahmed, A.K.A. Rahman, Z.U. Ahmed, Z.N.T. Begum, M.A. Hassan, and M. Khondker (ed.). *Encyclopedia of flora and fauna of Bangladesh Volume 25: Amphibians and reptiles*. Dhaka: Asiatic Society of Bangladesh. 204 p. Siddiqui, K.U., M.A Islam, Kabir, S.M.H., M. Ahmad, A.T.A. Ahmed, A.K.A. Rahman, E.U. Haque, Z.U. Ahmed, Z.N.T. Begum, M.A. Hasan, M. Khondker and M.M Rahman (eds.). 2008. *Encyclopedia of flora and fauna of Bangladesh*, Vol. 26. *Birds*. Asiatic society of Bangladesh, Dhaka. 632 pp.
Supplementary Reading	IUCN Bangladesh. 2015. *Red List of Bangladesh Volume 2-4: Mammals, Birds, Reptiles and Amphibians*. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh, pp. 320.
Recommended Reading	***Parasitology***
	Chatterjee, K.D. 2009. *Medical Parasitology*. CBS Publishers & Distributors, Dhaka, Bangladesh. Cheesburgh, M. 1987. *Medical Laboratory Manual for Tropical Countries*. ELBS Publishing, UK. Cheng, T.C. 1997. *General Parasitology*. Academic Press, New York, USA. Garcia, L.S. and Ash, L.R. 1975. *Diagnostic Parasitology Clinical Laboratory Manual*. The C.V. Mosby Company, USA. Schmidt, G.D. and Roberts, L.S. 1996. *Foundations of Parasitology*. Wm. C. Brown Publishers, USA. Soulsby, E.J.L. 1982. *Helminths, Arthropods and Protozoa of Domesticated Animals*. Bailliere Tindall Publishers, UK. Yamaguti, S. 195. *Systema Helminthum*. Vol. I, II., III The cestodes of vertebrates. Interscience Publishers Inc., New York. Yamaguti, S. 1961. *Systema Helminthum*. Vol III. The nematodes of vertebrates. Interscience Publishers Inc., New York. Yamaguti, S.1958. *Systema Helminthum*. Vol I. The trematodes of vertebrates. Interscience Publishers Inc., New York.
Recommended Reading	***Molecular Genetics***
	Brown, T.A. 2000. Essential Molecular Biology (A Practical Approach). 2nd edition. Oxford University Press, UK. Sambrook, J. and Russell, D.W. 2001. Molecular Cloning (A Laboratory Manual). Cold Spring Harbor Laboratory Press, USA. Stern, C. 1968. Principles of Human Genetics, 2nd edition. Eurasia Publishing House Ltd., New Delhi, India.

	Turner, P.C., McLennan, A.G., Bates, A.D. and White, M.R.H. 2000. Instant Notes on Molecular Biology. 2nd edition. BIOS Scientific Publishers Limited, UK.

Visiting hours: 9:00 am to 5:00pm on the working days (if available).

Outcome Based Education (OBE) Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 412	**Viva voce**	**Core course**	**2**	**30**	**50**

Prerequisites: As per University requirements for the admission into program.

Rationale of the course

Viva voce or oral examination is an integral component of the BS programme in Zoology. This is a mandatory course for the students by which students demonstrate their secured knowledge, expertise, and understanding of theoretical and practical courses. It's also an opportunity for the examiners to evaluate the academic abilities of students, and ultimately for determining whether they have met the requirements of promoting to the upper class.

Specific objectives of the course

By the end of the course, students will be able to:

- Prepare students for presenting their in-depth knowledge of the broader field of study programme.
- Improve the ability of students to communicate to scientific world with secured skills and expertise
- Assess student's understanding of the programme.

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to learn		PLO covered
CLO1	Identify and describe the core concepts of all courses assigned to this year, and apply these concepts, and their communication skills. (Remember and understand)	PLO3, PLO7, PLO8, PLO9
CLO2	Demonstrate knowledge of Fisheries, Entomology, Parasitology, Wildlife Biology and genetics, and explain their understanding in a verbal, interactive setting. (Understand and Assess)	
CLO3	Recognise and assess the current state of knowledge on a particular issue or topics of the programme. (Remember and Evaluate)	
CLO4	Demonstrate and assess their academic feats with critical analysis and interpretation of various aspects of the courses. (Understand, Evaluate and Crate)	

Outcome Based Education (OBE) Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Class	Topic	Corres-ponding CLOs	Teaching-Learning Strategy	Assessment Strategy
No specific classes will be assigned	The contents will cover all theoretical and practical courses.	**All CLOs**	N/A	Oral examination will be conducted by examination committee.

Outcome Based Education (OBE) Curriculum
Part- C

Assessment and Evaluation:

The course will follow interactive lectures of all theoretical and practical courses of the BS programme. Besides, regular class discussions and individual or group mentoring sessions will also provide instructions for viva voce. All faculty members will instruct the students in this regard.

Assessment
This is a two-credit course that carries 50 marks. The respective Examination Committee including external members will assess overall student's knowledge asking questions from the contents of respective syllabus of the BS programme and student will answer questions accordingly.

Outcome Based Education (OBE) Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	References mentioned for the theory course
Supplementary Reading	References mentioned for the theory course

Visiting hours: 9:00 am to 5:00pm on the working days (if available).

Outcome- Based Curriculum
Part- A

Course No.	Course Title	Course Type	No. of Credits	Credit Hours	Total Marks
Zool. 1001	**Animal Diversity (including practical)**	**Core course**	**4**	**60**	**100**

Prerequisites: As per the University requirements for admission into the program.

Rationale of the course

Knowing the diverse range of animals and their activities has been a fascination for mankind. This course offers a comprehensive package of learning opportunities for undergraduate students whose primary subject is Botany. The course has been designed to help students learning in zoology, aiming at introducing them to the diverse range of animal groups, their morphological and anatomical features, and their biology. In particular, students will study the classification schemes of major phyla with distinguishing characters and structural and functional systems of representative animals, as well as notes on their biology, ecology, food and feeding, and reproduction under this course. The course is integrated with a practical component for providing practical knowledge and skills focusing on animal identification and investigation of the internal organs through dissecting the animal's body. The course is helpful for students who require some generalized ideas about the animal kingdom, a glimpse of their biology, and wildlife conservation and management strategies.

Specific objectives of the course

By the end of the course, students will be able to:

- Strengthen their understanding of the diversity within the animal kingdom.
- Broaden their knowledge of various non-chordate and chordate phyla, including their structural features, behaviors, habitats, ecological significance, and economic value.
- Gain a general understanding of animal conservation and management practices in the context of Bangladesh.

Mapping with SDGs

This course is relevant to achieves SDG4 (Quality education), SDG13 (Climate Action), SDG14 (Life below water), and SDG15 (Life on land).

Course Learning Outcomes (CLOs) and Mapping with Program Learning Outcomes (PLOs)

Upon completion of this course the students will be able to		PLO covered
CLO1	Explain brief details on the animal diversity highlighting few representatives of non-chordate and chordate groups.	PLO1, PLO3
CLO2	Learn the classification of different non-chordate and chordate phyla up to orders (reported from Bangladesh) and identify different species of non-chordates and chordates.	PLO1, PLO2
CLO3	Compare different non-chordates and chordates with their habits, habitats, ecological role and economic importance.	PLO1, PLO2
CLO4	Comprehend the history, current status and prospect of wildlife and different threatened species conservation in Bangladesh.	
CLO5	Develop analytical skills to correlate structural adaptations with functions and interpret evolutionary relationships among non-chordates and chordates (Analyze, Evaluate)	PLO2, PLO7

CLO6	Describe the past and present days non-chordates and chordates (e.g. arthropods, amphibians, reptiles) with an illustration on extinct groups (e.g. dinosaurs) (Understand, Apply)	PLO1, PLO2, PLO7
CLO7	Explore the diversity of different non-chordates and chordates phyla (e.g. arthropods, birds, etc.) with explaining the adaptive features including feathers useful to flying in aerial habitats (remember, Understand, Analyze)	PLO1, PLO2
CLO8	Describe the different functional systems of non-chordates and chordates with the appropriate schematic diagrams (Remember, Understand)	PLO2, PLO4
CLO9	Identify and categorize representatives from the animal kingdom, from non-chordates (Protozoa to Echinodermata) and chordates (Amphibia to Mammalia) with their significant ecological and economical roles; their conservation status followed by the conservation measures in Bangladesh (remember, Analyze, Create)	PLO1, PLO2, PLO7, PLO8
CLO10	Identify and describe key morphological characters of non-chordate and chordate specimens with performing dissection of representatives (such as the cockroach, prawn, bony fish, etc.) to know about the major systems and document findings in practical notebook (Remember, Understand, Apply, Create)	PLO7, PLO8, PLO9

Outcome- Based Curriculum
Part- B

Course Plan Specifying content, CLOs, Co-Curricular activities, Teaching-Learning and Assessment Strategy Mapped with CLOs:

No. of Classes required	Topic	Corres-ponding (CLOs)	Teaching Learning Strategy	Assessment Strategy
20	**A. Non-chordates. Classification**: Brief classification of each non-chordate phylum up to orders with special reference to local forms, their affinities and economic importance.	**CLO1, CLO2, CLO3, CLO4**	Interactive lectures, diagrams, visuals, discussions	Class attendance, Oral Presentation, In-course Exam and Final theory Exam
10	**Type study:** Detailed type study including habit, habitat, morphology and major systems of the following: **Protozoa:** *Paramecium* and *Entamoeba*. **Porifera:** *Sycon*. **Coelenterata:** *Obelia;* Coral reef, its types and formation. **Platyhelminthes:** *Taenia solium*. **Nematoda:** *Tylenchus*. **Annelida:** *Nereis*. **Mollusca:** *Pila, Laemellidens* **Arthropoda:** *Apis* sp. and its social behaviour; Life-cycle of jute-hairy caterpillar; Pulse Beetle and Rice Hispa. **Echinodermata:** *Astropecten*. **Minor phyla:** General idea about the different groups of animal under minor phyla. **Hemichordata:** General characters and	**CLO1, CLO2, CLO3, CLO 4, CLO5, CLO6, CLO7**		

No. of Classes required	Topic	Corres-ponding (CLOs)	Teaching Learning Strategy	Assessment Strategy
	affinities.			
19	**B. Chordata** **Classification**: Broad classification up to class with special reference to local forms and their economic importance. **Type study**: Detailed type study including habit, habitat, morphology and major systems of the following: **Urochordata**: *Ascidia*. **Cephalochordata**: *Branchiostoma*. **Cyclostomata**: *Petromyzon*. **Chondrichthyes**: *Scoliodon*. **Osteichthyes**: Food and feeding habits, digestive, respiratory, circulatory, excretory, nervous and reproductive systems of *Labeo*.	**CLO1, CLO2, CLO3, CLO 4**		
	Amphibia: fossil and living amphibians. **Reptilia:** General idea about dinosaurs. **Aves:** *Columbia*; General idea about flight and flightless birds, flight adaptation and feather types. **Mammalia:** *Cavia*.	**CLO5, CLO6, CLO7**		
2	**C. Wildlife Biology** Introduction to wildlife, and the broad classification of the wildlife of Bangladesh; Wildlife preservation and its importance in Bangladesh.	**CLO6, CLO7, CLO8, CLO9**		
5	**D. Practical** **Study of museum specimens** representing all major non-chordate and chordate phyla. **Cockroach**: External morphology, mouth parts, salivary gland and dissection of nervous system. **Prawn**: External features, dissection of digestive system. ***Labeo***: External morphology, dissection of circulatory system and reproductive systems. **Preparation of practical notebooks**	**CLO6, CLO7, CLO8, CLO9**		

Distribution of class lectures: Total number of lecture: 60

Class/ lecture type	Number of classes	Class/ lecture type	Number of classes
Lecture with discussion (including two classes for Students' group presentation, if required for the course)	56	In-course examination	2
		Review class	2

Outcome- Based Curriculum
Part- C

Assessment and Evaluation:

Instructional strategies of the course

The course will be delivered through lectures and discussions, aided by power point presentations, video clips, etc. Classes will be made participatory and interactive through questions and answers, and group work exercises in the classroom. For practical component of the course, practical demonstration classes will be organized. Museum specimens will be provided to study, and the dissection practices will be performed on a number selected animal. A number of teachers will guide the students in the laboratory. Content/s of the upcoming class will be announced to the students. At the beginning of each class, there will be a brief review session on the previous lecture topic.

Assessment Pattern

The theory and practical component of the course will comprise 80% and 20% marks respectively. There will be two in-course examinations for the theory part of the course, which will comprise a total marks of 15marks for in-course and 5 marks for class attendance. A course final examination on theoretical part (60 marks) and final practical examination (20 marks) will be held separately. Practical note book will be
evaluated.

CIE- Continuous Internal Evaluation including final practical examination (35 marks), Attendance: 5 marks

Bloom's Category Marks (out of 15)	**In-course**	**Assignment**
1. Remember	2.5	
2. Understand	3	
3. Apply	3	
4. Analyze	2.5	
5. Evaluate	2	
6. Create	2	

Year-end Examination

Bloom's Category Marks (out of 60)	**Test**
1.Remember	10
2.Understand	12
3.Apply	12
4.Analyze	10
5.Evaluate	8
6.Create	8

Outcome- Based Curriculum
Part- D

Learning Materials:

References	
Recommended Reading	Barnes, R.D. 1980. *Invertebrate Zoology*. WB Saunders Co., Philadelphia, USA. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. 2001. *The Invertebrates: A synthesis.* Blackwell Scientific Publications, Oxford, UK.

	Barrington, E.J.W. 1979. Invertebrate Structure and Function. John Wiley & Sons., New York. Chakraborty, T. and Quddus, M.M.A. 1998. Byabaharik Pranibiggan. Practical Zoology on Non Chordata (in Bangla). Bangla Academy. Dhaka. Hickman, C.P., Roberts, L.S. and Larson, A. 2001. *Integrated Principles of Zoology*. 11th edition. McGraw-Hill Co. Inc., New York, USA. Hyman, L.H. 1959. *The Invertebrates*. Vols. 1-6, MacGraw Hill Co., New York. IUCN Bangladesh. 2015. *Red List of Bangladesh: A Brief on Assessment Result*. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka. Kabir, S.M.H., Ahmed, M., Ahmed, A.T.A., Rahman, A.K.A., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., and Khondker, M. (ed.) 2009. *Encyclopedia of Flora and Fauna of Bangladesh, Volumes 13-28. Fauna (non-chordates, chordates and minor phyla).* Asiatic Society of Bangladesh, Dhaka. Kotpal, R. L. 2000. Modern Textbook of Zoology, Vertebrates, 2nd edition, Rakesh Kumar Rastogi, Meerut, New Delhi, India. Marshall, A.J. and Williams, W.D. 1972. Textbook of Zoology: Invertebrates. English Language Book Society, London. Parker, T.J. and W.A. Haswell. 1959. A Textbook of Zoology. Macmillan & Co., London. Romer, A.S. 1965. The Vertebrate Body. 3rd edition. W.B. Saunders, London. Ruppert, E.E. and Barnes.R.D. 1994. Invertebrate Zoology. 6th edition. Saunders College Publishing Co., New York, London. Sinha, A.K., Adhikari, S. and Ganguly, B.B. 1978. Biology of Animals, Vol. II. New Central Book Agency, Kolkata, India. Storer, T.I., Usinger, R.L., Stebbins, R.C. and Nybakken, J.W. 2001. *General Zoology*. 6th edition. Tata McGraw-Hill Co. Ltd., New Delhi, India. Young, J.Z. 1974. *The Life of Vertebrates,* Oxford University Press, London.
Supplementary Reading	IUCN Bangladesh. 2015. *Red List of Bangladesh: A Brief on Assessment Result*. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh.

Visiting hours: 9:00 am to 5:00 pm on the working days (if available).