

# Syllabus

**BS (Honours) Programme in Zoology  
under The Four Year Integrated Grading System  
for the sessions: 2020-2021, 2021-2022, 2022-2023, and 2023-2024**



**Department of Zoology  
University of Dhaka**

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**Dhaka**

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**BS (Honours) in Zoology**  
**Guidelines for Letter Grading System for BS (Hons.) Programme**  
**Applicable for the Sessions 2018-2019, 2019-2020, 2020-2021, 2021-2022**

## **1. Introduction to the BS Programme**

**Title** - Bachelor of Science (Honours) in Zoology/BS (Honours) in Zoology

### **General Objectives of the Programme**

The BS (Honours) Course in Zoology is a comprehensive and integrated degree programme, aligned to meet the expectations of country's policy for tertiary education. 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. The major focuses of the BS 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.). 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.

**Duration of the Programme:** The duration of the BS (Honours) programme is 4 (four) consecutive academic calendar years, designated as 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> 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 1<sup>st</sup> year BS (Honours) Course is made through an admission test conducted under 'Ka'-unit admission, controlled centrally by the university. Student seeking admission in Zoology needs to go through the 'Ka'-unit admission test.

## **2. Structure of Curriculum**

**2.1 Assignment of Credits and Credit hours:** The entire BS (Honours) programme is covered by a set of theoretical and practical (laboratory/field/seminar/project) 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 (Honours) degree is 128 and a student must need to earn all the credits for the successful completion of his/her graduation programme.

**2.2 Distribution of Credits in Zoology:** A year-wise distribution of credits for a four year BS (Honours) in Zoology under the integrated annual grading system is as follows:

	1 <sup>st</sup> Year	2 <sup>nd</sup> Year	3 <sup>rd</sup> Year	4 <sup>th</sup> Year	Total credit
<b>Zoology Core courses:</b>					
Theory	14	18	29	31	92
Practical	4	4	8	8	24
Viva-voce	2	2	2	2	8
<b>Extra-Departmental courses:</b>	4 (Botany-1)	4 (Botany-II)	--	--	16
Theory & Practical	4 (Biochemistry)	4 (Microbiology)			
<b>Total</b>	<b>28</b>	<b>32</b>	<b>39</b>	<b>41</b>	<b>140</b>

### 2.3 Assessment

**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.

- 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.
- The distribution of marks for a theoretical course will be as follows:
 

Class attendance	5%
In-course examination	35%
Course final examination	60%
- In case of practical course, marks distribution will be as follows:
 

Class attendance	5%
In-course assessment	35%
Course final examination	60%
- 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%
- 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.
- 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.
- Oral test (viva-voce) will be conducted by the departmental examination committee approved by the university.

(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 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 1<sup>st</sup> examiner (the course teachers) and the 2<sup>nd</sup> 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 3<sup>rd</sup> 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.

## 2.4 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.

## 2.5 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.

## 2.6 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.

## 2.7 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:

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

The Cumulative Grade Point Average (CGPA) of 2<sup>nd</sup> year, 3<sup>rd</sup> year and 4<sup>th</sup> 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 128 credits, after successful completion of his/her 4 year graduate programme, the final CGPA will be calculated using all the credits attempted.

## 2.8 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%** classes but **less than 75%** 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%** classes will not be allowed to appear for final examination for that year/session.

## 3. Promotion

- a) *Promotion from 1<sup>st</sup> year to 2<sup>nd</sup> 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 (5) and must pass the failed courses to continue studies in the 2<sup>nd</sup> year.
- b) *Promotion from 2<sup>nd</sup> year to 3<sup>rd</sup> 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 (5) and pass the failed courses to continue studies in the 3<sup>rd</sup> year.
- c) *Promotion from 3<sup>rd</sup> year to 4<sup>th</sup> 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 (5) and pass the failed courses to be allowed to continue studies in the 4<sup>th</sup> year.

#### **4. Retake Examination (may be taken only in case of course final examination)**

Student who has been promoted on probation for failing in course(s) must sit for retake examination of the failed courses, within 6 weeks after publication of results, conducted by the respective original examination committee for the year. Expenses of the retake examinations (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 promoted, but his/her transcript will be marked to identify the courses retaken. If any student fails to earn the required credits, his/her promotion on probation will be deemed cancelled.

- 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 4<sup>th</sup> 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.

#### **5. Readmission**

- a) A Student failing to earn the requisite credits and/or GPA/CGPA (see clause 4.7 and 4.8 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 BS 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.

## **6. 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.

## **7. 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 4<sup>th</sup> 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.

## **8. 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'.

## **9. Requirements for Graduation**

- a) To graduate with a Bachelor's degree, a minimum total of 128 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. 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.

## **11. 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.










## **12. Other General Regulations**








- a) Respective statutory authorities of the University shall design, 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 Examination 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 are 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.

## **13. Publication of Results**

The yearly and final degree 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.

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

<b>SDGs</b>	<b>Relevancy of Syllabus to the SDGs</b>
Goal 1: No poverty 	BS Course: Zool. 304; Zool. 305.  MS Course: ZF 604; ZF 608; ZF 610; ZW 628; ZG 648; ZG 649.
Goal 2: Zero hunger 	BS Course: Zool. 208; Zool. 305; Zool. 401; Zool. 402; Zool. 404; Zool. 407.  MS Course: ZF 604; ZF 606; ZF 607; ZF 608; ZE 616; ZE 617 ZP 638; ZG 648; ZG 649.
Goal 3: Good health and well-being for people 	BS Course: Zool. 208; Zool. 302; Zool. 305; Zool. 401; Zool. 402; Zool. 403; Zool. 404; Zool. 405; Zool. 406; Zool. 407.  MS Course: ZE 618; ZE 620; ZP 639; ZP 640; ZP 643; ZP 644; ZG 645; ZG 646; ZG 647; ZG 648.
Goal 4: Quality education 	
Goal 5: Gender equality 	Zool. 305.
Goal 6: Clean water and sanitation 	BS Course: Zool. 102; Zool. 103; Zool. 104; Zool. 105; Zool. 106; Zool. 401; Zool. 404.  MS Course: ZP 640; ZG 649.
Goal 9: Industry, Innovation, and Infrastructure 	BS Course: Zool. 204; Zool. 208; Zool. 404; Zool. 405; Zool. 407.  MS Course: ZF 604; ZF 605; ZF 608; ZG 646; ZG 647; ZG 648.
Goal 10: Reducing inequalities	BS Course: Zool. 208; Zool. 404.

	
<p>Goal 12: Responsible consumption and production</p> 	<p>BS Course: Zool. 208; Zool. 302; Zool. 401; Zool. 402; Zool. 403 Zool. 404; Zool. 405; Zool. 406; Zool. 407.</p> <p>MS Course: ZF 604; ZF 605; ZF 608; ZE 619; ZG 648; ZG 649.</p>
<p>Goal 13: Climate action</p> 	<p>BS Course: Zool. 304; Zool. 401; Zool. 402; Zool. 403; Zool. 404; Zool. 405; Zool. 406; Zool. 407.</p> <p>MS Course: ZE 615; ZG 646; ZG 647 ZG 648; ZG 649.</p>
<p>Goal 14: Life below water</p> 	<p>BS 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. 404; Zool. 403; Zool. 405; Zool. 406; Zool. 407.</p> <p>MS Course: ZF 601-ZF 610; ZP. 636.; ZP 637; ZW 626; ZW 627; ZW 628; ZW 629; ZG 645; ZG 646; ZG 647.</p>
<p>Goal 15: Life on land</p> 	<p>BS 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. 403; Zool. 405; Zool. 406; Zool. 407.</p> <p>MS Course: ZP 635; ZW 625; ZW 626; ZW 628; ZW 629; ZE 614; ZE 615; ZE 619; ZG 645; ZG 646; ZG 647; ZG 648; ZG 649.</p>
<p>Goal 16: Peace, justice and strong institutions</p> 	<p>BS Course: Zool. 208; Zool. 402</p> <p>MS Course: ZF 610; ZW 626; ZG 649.</p>
<p>Goal 17: Partnerships for the goals</p> 	<p>The department has collaboration and partnership with a number foreign and national universities, research organizations and NGOs to achieve its goal.</p>

## 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	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

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**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	Ecological field study	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

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**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	Biostatistics and Research Methodology	4 credits
Zool. 307	Evolution, Zoogeography and Paleontology	4 credits
Zool. 308	Neurobiology and Endocrinology	2 credits
Zool. 309	Terrestrial and aquatic ecosystem visit	2 credits
Zool. 310	Practical	8 credits
Zool. 311	Viva-voce	2 credits
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<b>Total:</b>		<b>39 credits</b>

### **FOURTH YEAR**

#### **Departmental courses**

Zool. 401	Environmental Pollution and Human Ecology	3 credits
Zool. 402	Radiation Biology and Biosafety Regulation	3 credits
Zool. 403	Biodiversity, Conservation and Bioresource Management	3 credits
Zool. 404	Entomology	4 credits
Zool. 405	Fisheries and Aquaculture	4 credits
Zool. 406	Wildlife and Wildlife Management	4 credits
Zool. 407	General Parasitology	4 credits
Zool. 408	Molecular Genetics	4 credits
Zool. 414	Mangrove ecosystem visit	2 credits
Zool. 415	Practical	8 credits
Zool. 416	Viva-voce	2 credits
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<b>Total:</b>		<b>41 credits</b>

**First Year BS (Honours) Programme in Zoology**  
**Sessions: 2020-2021, 2021-2022, 2022-2023, and 2023-2024**

Course No.	Course title	No. of credits	Credit hours
Zool. 101	Introductory Zoology	3	45

**Introduction to Zoology:** Definition, scope, emergence of zoology as a subject. Branches of Zoology and relation to other branches of science. History of the development of zoological studies in Bangladesh.

**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.

**Organization in animal body:** Body constituents; biological molecules (biomolecules); cell- cytoplasm and nucleus; tissue, organs; organ systems.

**Basis of animal classification:** Cell differentiation; germ layers; coelom, symmetry, segmentation (metamerism); tagmatization, body coverings; appendages, skeleton, etc.

**Functional organization and integration of animal body:** Gene and gene function, DNA, nervous and hormonal regulation, homeostasis.

**Levels of organization in organisms:** Pre-cellular level - biomolecule; sub-cellular level - 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.

**Concept of species,** sub-species, variety, sibling species, overview of naming of species.

**Overview of animal classification system:** History of classification and classification system, taxonomic categories, taxonomic keys and characters and their uses.

**Methods of studying animals:** Collection (sampling), transportation, preservation, identification, description, reference materials and publication.

**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.

**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 foot prints.

**Biodiversity:** Concept, components, importance and values, bioresources – threats and conservation importance

**Faunal diversity:** Terminology related to fauna; faunal diversity with special reference to Bangladesh.

**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, Wildlife Act and Biodiversity of Bangladesh.

**Environmental pollution:** Air, water and noise pollution (an outline of causes and effects only).

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- Karp, G. 2005. Cell and Molecular Biology (Concept and Experiments). 4th edition. John Wiley and Sons Inc., New York.
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- 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.

Course No.	Course Title	No. of credits	Credit hours
Zool. 102	Protozoology	2	30

**Diversity:** Introduction to protozoan diversity.

**Classification:** Detailed classification up to orders with characteristics and examples of Protozoa.

**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.

**Type study:** Systematic position, habitat, morphology, development, special features (if any) and major systems of the following protozoan species: *Euglena viridis*, *Paramecium caudatum* and *Entamoeba histolytica*.

**Short description:** 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*.

**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).

## References

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- Hickman, C.P., Roberts, L.S. and Larson, A. 2001. Integrated Principles of Zoology. 11th edition. McGraw-Hill Co. Inc., New York, USA.
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Course No.	Course Title	No. of Credits	Credit Hours
Zool. 103	Porifera, Cnidaria and Ctenophora	2	30

**Phylum Porifera:** Classification of the phylum Porifera up to orders with diagnostic and general characteristics and examples of each taxonomic category.

**Type study:** Systematic position, habitat, morphology, development, special features (if any) and major systems of *Scypha* sp.

**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).

**Short description:** Habit and habitat, food and feeding, breeding and economic importance of the following sponges: *Spongilla*, *Oscarella*, *Cliona*, *Chalina* and *Euspongia*.

Affinities and phylogenetic position of Porifera.

**Phylum Cnidaria:** Classification of the phylum Cnidaria up to orders with diagnostic and general characteristics with examples of each taxonomic category.

**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*.

**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).

**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*.

**Coral:** Coral reef, coral reef formation and distribution.

**Phylum Ctenophora:** Classification of the phylum Ctenophora up to orders with diagnostic and general characteristics with examples.

**Type study:** Systematic position, habitat, morphology, development, special features (if any) and major systems of *Hormiphora [=Pleurobrachia]*; its affinities with other animals.

**Short description:** Habit and habitat, food and feeding, breeding and economic importance of the following ctenophores: *Cestum* and *Beroe*.

## References

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Hickman, C.P., Roberts, L.S. and Larson, A. 2001. *Integrated Principles of Zoology*. 11<sup>th</sup> edition. McGraw-Hill Co. Inc., New York, USA.

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Course No.	Course Title	No. of Credits	Credit Hours
Zool. 104	Platyhelminthes and Nematoda	2	30

**Phylum Platyhelminthes:** Classification of the phylum Platyhelminthes up to orders with diagnostic and general characteristics with examples.

**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*.

**Short description:** Habit and habitat, food and feeding, breeding and economic importance of the following Platyhelminthes: *Convoluta*, *Polystomum*, *Aspidogaster*, *Schistosoma*, *Gyrocotyle*, *Diphyllobothrium* and *Hymenolopis*.

**Comparative study of Platyhelminthes:** 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).



**Phylum Nematoda:** Classification of the phylum Nematoda up to orders with diagnostic and general characteristics and examples.

**Type study:** Systematic position, habitat, morphology, development, special features (if any) and major systems of *Ascaris lumbricoides*.

**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*.

## References

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Chatterjee, K.D. 2009. *Parasitology, protozoology and helminthology*. CBS Publishers and Distributors Pvt. Ltd. New Delhi, India.

Kotpal, R.L. 2005. *Helminthes*. Rastogi Publications. Meerut, India.

Course No	Course title	No of credits	Credit Hours
Zool. 105	Mollusca and Annelida	2	30

**Phylum Mollusca:** Classification of the phylum Mollusca up to orders with diagnostic and general characteristics and examples.

**Type study:** Systematic position, habitat, development, morphological features and major physiological systems of *Pila globosa*.

**Short description:** Habit and habitat, basic structure and economic importance of the following molluscs: *Neopilina*, *Chiton*, *Aplysia*, *Dentalium*, *Lamellidens*, *Mytilus*, *Loligo*, *Sepia*, *Octopus* and *Nautilus*.

**Comparative study of Mollusca:** Adaptive diversity, molluscan shells, torsion and detorsion, ctenidia, foot and its modifications.

**Phylum Annelida:** Classification of the phylum Annelida up to orders with diagnostic and general characteristics with examples of each taxonomic category.

**Type study:** Systematic position, habitat, development, special features (if any) and major systems of *Nereis* sp.

**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*.

**Comparative study of Annelida:** Segmental organs, development and larval forms.

## References

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.

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.

Ruppert, E.E. and Barnes, R.D. 1994. *Invertebrate Zoology*. 6th edition. Saunders College Publishing Co., New York.

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.

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 106	Arthropoda and Echinodermata	2	30

**Phylum Arthropoda:** Classification of the phylum Arthropoda up to orders with diagnostic and general characteristics and examples.

**Type study:** Systematic position, habitat, morphology, development, special features (if any) and major systems of *Macrobrachium rosenbergii*.

**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.

**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)

**Phylum Echinodermata:** Classification of the phylum Echinodermata up to orders with diagnostic and general characteristics and examples.

**Type study:** Systematic position, habitat, morphology, development and major systems of *Asterias* sp.

**Short description:** Habit and habitat, food and feeding, breeding and economic importance of the following echinoderms: *Astropecten*, *Ophiura*, *Echinus*, *Cucumaria* and *Antedon*.

**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).

## References

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*. 11<sup>th</sup> edition. McGraw-Hill Co. Inc., New York, USA. (PDF available: <http://www.ciens.ucv.ve>).

Storer, T.I., Usinger, R.L., Stebbins, R.C. and Nybakken, J.W. 2001. *General Zoology*. 6<sup>th</sup> edition. Tata McGraw-Hill Co. Ltd., New Delhi, India. (Free download: <https://www.goodreads.com/book/show/4452321-general-zoology>).

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 109	Field study	1	15

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) found in the visited area. All students should participate in the program. After returning, they should make a presentation and submit a scientific report. Alternatively, students may be asked to present on selected topics from the syllabus. Assessment will be done by the Members of concerned Examination Committee.

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 110	Practical	4	60

### Study of museum specimens (Invertebrates)

Invertebrates representing protozoan phyla to the phylum Echinodermata

### 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.

### 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, antennular, uropod, telson lengths and their ratios;

c. Insect: total, cephalic, thoracic, abdominal lengths and widths and their ratios.

### 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 according to the instruction of class teacher; they will place these on a paper sheet, label and display.*)

### Invertebrate dissections:

*Apple snail (Pila)* - digestive and nervous systems;  
Earthworm - digestive, circulatory and nervous systems;  
Cockroach - digestive and nervous systems; and  
Prawn - circulatory and nervous systems.

**Students need to prepare practical notebooks and reports.**

### References

- 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.
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- Verma, P. S. (ed.) 1982. *A Manual of Practical Zoology: Invertebrates*. S. Chand & Company, India.

Course No.	Course Title	No. of Credits
Zool. 111	Viva-voce	2

## Second Year BS (Honours) Programme in Zoology

Sessions: 2020-2021, 2021-2022, 2022-2023, and 2023-2024

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 201	Minor phyla and Lower chordates	2	30

**Minor phyla:** Introduction, general characteristics, habitat, distribution, affinities and brief morphological descriptions of the following minor phyla:

Mesozoa : *Dicyema* Rotifera : Any typical rotifer  
Gastrotricha : *Chaetonotus* Nematomorpha : *Gordius*  
Acanthocephala : *Macrocanthorhynchus* Priapulida : *Priapulidus*  
Onychophora : *Peripatus capensis* Phoronida : *Phoronis*  
Ectoprocta : *Plumatella* Chaetognatha : *Sagitta*  
Brachiopoda : a common lampshell Hemichordata : *Balanoglossus*

**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.

**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*

### References

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

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 202	Chondrichthyes and Osteichthyes	2	30

**Chondrichthyes:** Definition and characteristics, morphometric and meristics chapters of Chondrichthyes; Classification up to orders with diagnostic and general characters and examples and affinities; Extinct and archaic fishes.

**Type study:** Systematic position, habitat, morphology, development, special features (if any) and major systems of *Scoliodon*.

**Short description** of the habit, habitat, food and feeding, breeding of sharks, skates and rays.

**Osteichthyes:** Definition and characteristics, morphometric and meristics of Osteichthyes; classification up to orders with examples; extinct and archaic fishes.

**Type study:** Systematic position, habitat, morphology, development, special features and major systems of *Labeo rohita*.

**Short description** of the 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.

### References

- Bone, Q., Marshall, N.B. and Blaxter, J.H.S. 1995. *Biology of fishes*. 2nd Edition, London : Chapman & 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.

Course No.	Course Title	No. of credits	Credit hours
Zool. 203	Amphibia and Reptilia	2	30

**Amphibia:** Classification up to orders (living and nonliving) with characteristics and examples.

**Type study:** Systematic position, habitat, morphology, development, special features and major systems of toad/frog.

**Short description** of the habit, habitat, food and feeding, breeding, special features and distribution of caecilians, *Necturus*, *Salamander*, *Ambystoma*, *Typhlops*, *Seymouria* and extinct amphibians.

**Adaptive radiation**, secondary sex characters and parental care.

**Reptilia:** Classification of living (up to sub-orders) and extinct (up to orders) reptiles with characteristics and examples.

**Type study of *Hemidactylus*:** External morphology; internal anatomy including skeletal, digestive, respiratory, circulatory, excretory, nervous and reproductive systems; food and feeding habits.

**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.

**Economic 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.

**Adaptive radiation** and difference between lizards and snake, tortoise/turtles and terrapins, alligator and crocodile.

## References

- Hickman, C.P., Roberts, L.S. and Larson, A. 2001. *Integrated Principles of Zoology*. 11<sup>th</sup> 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.
- Weichert, 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, UK.
- Zug, G.R. 1993. *Herpetology: An Introduction to Biology of Amphibians and Reptiles*. Academic Press Inc., San Diego, USA.
- Parker, T.J. and Haswell, W.A.. 1959. *A Textbook of Zoology*. Vol. 2. Macmillan, & Co., London, UK.

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 204	Aves and Mammalia	2	30

**Aves:** Classification of the class Aves up to orders with characteristics and examples.

**Type study of pigeon:** Morphology, skeletal, digestive, respiratory, circulatory, excretory, nervous, muscular, and reproductive systems; air sacs, feathers and flight adaptation.

**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).

**Mammalia:** Classification of the class Mammalia up to orders with diagnostic characters and examples.

**Type study of Guinea-pig:** External morphology, skeletal, digestive, respiratory, circulatory, excretory, nervous, reproductive, and endocrine systems.

**Short description** of the habit, habitat, food and feeding, breeding and distribution of egg laying mammals, marsupials, aquatic mammals, flying mammals, nonhuman primates, rodents.

### References

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.

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 205	Cytology and Histology	2	30

**Cytology: Part I** - Introduction; preview of cell; chemistry of the cell; macromolecules (proteins and nucleic acids); eukaryotic cell organelles; stem cell; cell differentiation- cell growth and aging, causes of aging and theories of aging.

**Cytology: Part II** - Bioenergetics: Cell membrane structure and functions; cell membrane models- early models, and fluid mosaic model; transport across membranes (diffusion), active transport.

**Intracellular compartments:** endoplasmic reticulum and Golgi complex- glycosylation, exocytosis, endocytosis; lysosomes, vacuoles, peroxisomes, Redox reactions and glycolysis; mitochondria and aerobic respiration.

**Nucleus:** chromosome structure, types, models and chemistry; DNA as the genetic material; structure of DNA; DNA packing.

**Cytoskeletal systems-** microtubules, microfilaments and intermediate filaments.

**Histology:** Tissue, structure and functions; types of tissues- epithelial, connective, muscular and nervous tissue with locations and functions.

**Histology of alimentary canal-** esophagus, stomach, duodenum, intestine and rectum.

**Histology** of pancreas, liver, lung, kidney, and gonad, ovary and testis.

### References

Alberts B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. 2002. *Molecular Biology of the Cell*. 4<sup>th</sup> edition. Garland Science, New York, USA.

Brown, T. 2012. *Introduction to Genetics: A Molecular Approach*. Garland Science, New York, USA.

Snustad, P. and Simmons, M. J. 2003. *Principles of Genetics*. 3<sup>rd</sup> Edition. John Willey and Sons. Inc., New York, USA.

Klug, W.S. and Cummings, M.R. 2003. *Concepts of Genetics*. 7<sup>th</sup> edition. Pearson Education, Inc., New Jersey, USA.

Course No.	Course Title	No. of Credits	Credit ours
Zool. 206	Developmental Biology	2	30

**Introduction:** Theories of developmental biology (epigenesis, pangenesis and germplasm).

**Reproductive process:** Asexual, sexual and parthenogenesis reproduction; reproductive peculiarities; monogamy and polygamy.

**Gametes and gametogenesis:** Ultra-structure of a typical sperm, Spermatogenesis; Ultra-structure of an egg, types of eggs, oogenesis.

**Fertilization:** Types and significance of fertilization; sperm-egg interactions; fate of sperm mitochondria.

**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.

**Organogenesis:** Fate of germ layers, early embryology of *Nereis* and chicks; embryonic development of zebrafish (*Danio rerio*).

**Embryological derivatives of mammals:** Placentation, types and functions of placenta in mammals.

**Applied embryology:** Fruit fly in research. Cryopreservation. Infertility and its treatment in human. Embryonic stem cell for human welfare. Animal farming and transgenic animals.

## References

Balinsky, B.L. 1981. *An Introduction to Embryology*, 5<sup>th</sup>edn. 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*, 4<sup>th</sup>edn. WBC McGraw-Hill Book Co. Inc. Boston, USA.

Course No.	Course title	No. of credits	Credit hours
Zool. 207	Animal Systematics and Nomenclature	2	30

## Animal systematics

**Taxonomy and systematics:** Definition, and differences between taxonomy and systematics; importance of taxonomy; role of taxonomy.

**History of taxonomy:** Old and new systematics; levels of taxonomy.

**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.

**Taxonomic collection, preservation, curating, identification** (different methods of identification including taxonomic keys), taxonomic publication.

Types of taxonomic publications; reference works in taxonomy.

**Taxonomy and biodiversity:** Taxonomy, a vital component of biodiversity management.

**Cladistics:** Concepts; cladogram.

**Barcoding** in taxonomy.

## Nomenclature

**International Code of Zoological Nomenclature (ICZN):** Origin of ICZN; the International Zoological Commission and the International Zoological Congress, and their roles in nomenclature.

**Type method:** Definition of type and typification; kind of types; significance.

**Formation of names:** Generic and specific names.

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

**Rules of nomenclature:** Essential rules including law of priority (not more than 15 rules).

## References

Blackwelder RE. 1967. *Taxonomy - A Text and Reference Book*. JohnWiley & Sons, New York.

Kapoor, V.C. 2017. *Theory and Practice of Animal Taxonomy*. 8<sup>th</sup> edition. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, India.

Mayr, E. and Ashlock, P.D. 1969. *Principles of Systematic Zoology*. 2<sup>nd</sup> edition. McGraw Hill Education Pvt. Ltd. (Reprinted in 2014), India.

Quicke, D.L.J. 1993. *Principles and Techniques of Contemporary Taxonomy*. BlackWell, London.

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 208	Applied and Economic Zoology	2	30

Applied zoology: Ways of animal cultivation and cropping; culture, ranching, rearing and capture. 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.

**Economic Zoology:** definition, economic importance of major animal groups: Protozoa, cnidaria, annelid, arthropods (beneficial and harmful insects and crustacean), mollusca, fishes, amphibian, reptilian and mammals. Poisonous and venomous animals.

**Introduction to invertebrate and vertebrate pests,** methods of damage caused by major pests integrated pest management.

**Vectors and parasites** of major animal diseases.

Zoonosis and anthroponosis.

### References

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.

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.

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.

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 209	Ecological field study	1	15

A Field trip should be organized for the students during the academic year to study and observe the ecosystems, habitats, community structure and organisms in the forest ecosystems. All students should participate in the program. After returning, they should make a presentation and submit a scientific report. Alternatively, students may be asked to present on selected topics from the syllabus. Assessment will be done by the Members of concerned Examination Committee.

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 210	Practical	4	60

**Study of museum specimens (Vertebrates):** Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves and Mammalia.

**Comparative osteology:** Skeletal structures of fishes, amphibians, reptiles, birds and mammals; preparation of a skeleton of any cultured/largely available vertebrate.

**Vertebrate Dissections:** 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.



**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.

**Local study tour and preparation of a report on the tour**

**Preparation of practical notebooks and field reports**

**References**

- 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.
- Zug, G.R. 1993. *Herpetology: An Introduction to Biology of Amphibians and Reptiles*. Academic Press Inc., San Diego, USA.

Course No.	Course Title	No. of Credits
Zool. 211	Viva-voce	2

## Third Year BS (Honours) Programme in Zoology

Sessions: 2020-2021, 2021-2022, 2022-2023, and 2023-2024

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 301	Comparative Vertebrate Zoology	4	60

### Adaptive radiation in different groups of vertebrates

Adaptive radiation in fishes, amphibians, reptiles, birds and mammals.

**Integumentary system:** Definition, structure and comparative anatomy of integument proper in different vertebrate groups.

**Integumentary derivatives:** glands, scales, feathers, hair, beaks, claws, nails, hooves, horns and antlers.

**Digestive system:** General structure and modification of alimentary canal in different vertebrate groups; associated glands in the digestive system.

**Teeth:** function, structure, types and comparative anatomy in different groups; dentition in mammals.

### Basic plan and phylogenetic modifications among vertebrate classes

**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.

**Circulatory system:** Modification of aortic arches in reptiles, birds and mammals.

**Nervous system:** Brain, spinal cord and cranial nerves of vertebrates.

**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.

### References

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.

Young, J.Z. 1962. *Life of Vertebrates*. 2<sup>nd</sup> edition. Oxford at the Clarendon Press, London.

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 302	Animal Genetics	2	30

### General Genetics:

Introduction, history, development and scope of animal genetics; Mendel's laws and modification of Mendelian ratios; pedigree; epistasis, penetrance and expressivity, reversion, pleiotropism; types and theories of linkage; mechanism, types and theories of crossing over; sex determination systems and theories in animal; sex-linked inheritance; types and significance of mutations.

### Cytogenetics:

General outline of chromosome structure, mitotic karyotypes of fruit fly, carp fish and human; Nucleosome and its structural organization in eukaryotic chromosomes; Types and significance of chromosomal aberrations with special reference to animals; Types and mechanism of gynandromorphism; Cytogenetic analysis of animal chromosomal anomalies with reference to polytene and lampbrush chromosomes.

### 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.

### **Eugenics and Animal breeding:**

Concept of eugenics; Introduction, application of breeding system, viz. inbreeding and out-breeding, pure line selection; application of breeding systems to economically important animals.

### **References**

- 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 Wiley and Sons. Inc. New York, USA. (PDF available: <https://www.slideshare.net/hijobaba/principles-of-genetics-6-e-isbn-978-0470903599-snustad-simmons>)
- 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.

Course No	Course title	No of credits	Credit Hours
Zool. 303	Animal Behavior, Welfare and Ethics	3	45

**Introduction to animal behavior:** Definition, historical background, environmental influence and natural selections. Population breeding potential (BP) - environmental resistance (ER).

#### **Evolution and development of behavior**

**Instinct versus learning:** Instinct, different kinds of learning; sensitive period; use of tools; intelligence and cognition

**Patterns of behavior:** tropism, taxes, reflexes; thermoregulation, play; biological clocks; body maintenance. Photoperiodism and its influence. Peck order and its types. Scent marking and its kinds; hoarding and types.

**Different forms of behavior:** Feeding behavior; anti-predatory behavior, locomotory behavior; conflict behavior, communication behavior; social behavior; breeding behavior; parental care and sexual behavior in different groups of animals. Breeding behavior of sea horse; 3-spined stickleback and sea-gull.

**Behavioral genetics:** Influences of genes in behavioral pattern and performances

Introduction to animal welfare: History, culture and concepts of animal welfare and ethics, animal and moral concern, welfare assessment and 5 freedoms, physiological indicators of welfare.

Scientific approaches to welfare: abnormal behavior, disease, 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.

### **References**

- 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. Eds. 3rd Edition. Anmol Publications Pvt. Ltd. New Delhi, India.

Course No.	Course title	No. of credits	Credit hours
Zool. 304	Fundamental and Advanced Ecology	4	60

### Fundamental Ecology:

Concepts, types and scopes of ecology. Ecological principles and concept of ecosystem.

**Ecosystem:** Energy flow in ecosystem; food chains; food webs and trophic levels; trophic structure and ecological pyramids; transfer of food energy; ecological efficiencies. Development and evolution of ecosystem; concept of the climax; evolution of the ecosystem; coevolution; group selection.

**Ecological factors:** biotic and abiotic.

**Biogeochemical cycles:** Nitrogen, water and carbon cycles.

**Principle of limiting factors:** Liebig's Law of the Minimum; Shelford's Law of Tolerance.

**Concepts of habitat and ecological niche:** Ecological equivalent; character displacement; allopatry and sympatry; biological clock.

**Terrestrial ecology:** Tundra, forest, desert and grassland biomes including their physical characters, climatic conditions, vegetation and animal adaptations.

**Fresh water ecology:** Lotic and lentic habitats and their characteristics; major fauna; pond, lake and river ecosystems.

**Estuarine ecology:** Characteristics; major fauna.

**Marine ecology:** Marine environment, marine biota, zonation of the sea, communities of the marine environment.

### Advanced Ecology:

**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. Concept of carrying capacity; concept of population regulation and stability; concept of density dependent and density independent action.

**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.

**Community ecology:** Biotic community concept; concept of ecological dominance; community structure; composition and stratification; community analysis; species diversity in community; pattern in communities; ecotones and concept of edge effect; ecological corridor.

**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.

**Life table:** concept, types and construction.

**Ecological models:** Concept, types and significance.

**Systems ecology:** concepts.

### References

- Begon, M., Townsend, C. R., Harper, J. L. 2006. *Ecology: From individuals to ecosystems*. (4th ed.). Blackwell, New Jersey, USA.
- Odum, E.P. and Barrett, G.W. 2005. *Fundamentals of Ecology*. 5th edition. Thomson Brooks/Cole Publishing Co., USA.
- Primack, R.B. 1998. *Essential of Conservation Biology*. 2nd edition. Sinauer Associates, Inc. Pub., Sunderland, Massachusetts, USA.
- Ricklefs, R.E. and Miller, G.L. 1999. *Ecology*. W.H. Freeman and Company, New York.
- Smith, T. M. and Smith, R.L. 2012. *Elements of Ecology*. 8th Edition. Pearson, USA.
- Southwood, T.R.E. 1978. *Ecological methods- with particular reference to the study of insect populations*. Chapman and Hall, London.
- Turk, A., Wittes, J.J., Turk, J. and Wittes, R.E. 1978. *Environmental Science*. W.B. Saunders Company, Philadelphia, USA.

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 305	Human Physiology, Reproduction and Family Planning, and Population Studies	4	60

### Human Physiology:

**Digestion:** Definitions of food, nutrition and digestion, digestion of carbohydrates, proteins and lipids; role of liver and pancreas in digestion.

**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.

**Respiration:** Definition and phases; respiratory movement of breathing; physiology of respiration and regulation of respiration.

**Excretion:** Definition; physiology of excretion and urine formation; regulation of excretion.

**Muscle contraction:** Chemistry and theories of muscle contraction; neuromuscular action; characteristics of muscle twitch; motor unit; summation; tetanus and muscle dystrophies.

**Bone:** Structure and types; ossification; bone growth; reabsorption and bone disorder.

**Hormone:** Types, sources and functions; regulation of hormone secretion; mode of action of hormone; effects of abnormal secretions of hormones.

**Metabolism:** Carbohydrates, glycolysis and citric acid cycle, electron transport system.

**Nervous system:** Neurons, physiology of different types of nervous system; role of cranial nerves; physiology of hearing; equilibrium and balance of vision.

### Reproduction & Family Planning:

**Human reproductive system** and accessory glands; sex hormones; regulation of menstrual cycle and pregnancy. Disorders of reproductive system.

**Fertilization;** pregnancy and placenta, and foetal development. Importance of family planning; birth control principles and methods.

### Population Studies:

**Demographic perspective:** Introduction; population and its growth; nature of population; population changes; pre-modern population doctrines.

**The Malthusian perspective;** the Marxist perspective; revised Malthus and modern population theories; theory of the demographic transition.

**An overview of world population.** Population processes. Components of mortality, measuring mortality; social class differential in mortality; trends and levels in mortality.

**Fertility concepts and measurements;** fertility trends; levels and explanations. Population structures and characteristics; age and sex structure.

**Human migration:** definition, types and explanations of migration and measuring migration. Population growth and development.

### References

Chatterjee, C.C. 1977. *Human Physiology*. Medical Allied Agency, Kolkata, India.

Weeks, J.R. 2016. *Population: An Introduction to Concepts and Issues*. 12th edition.

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 306	Biostatistics and Research Methodology	4	60

### Biostatistics:

Definition, scope and application of biostatistics in biological sciences. Collection, processing and presentation of statistical data. Variables and frequency distribution.

Measures of central tendency- arithmetic mean; weighted mean; mode and median. Measure of dispersion- variance; standard deviation; standard error.

Estimation of confidence limit. Non-parametric analysis – Man-Whitney, Kruskal-Willis, Wilcoxon, and Friedman tests; Chi-square test for independent and goodness of fit.

Parametric tests- Regression analysis and correlation; Linear regression analysis, Least square method. Analysis of variance (ANOVA - one- and two-way ANOVA. Multiple range test (MRT).

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.

### Research Methodology:

Research concept, definition and process; Planning a research project - background information; types; adaptive and on-firm researches; innovative research.

Hypothesis and setting research questions; approach to experimental design; statistical design and development of methodology. Data collection and analysis.

Writing research proposals; thesis; scientific papers and field reports with case studies for each.

Types of research papers; monographs; serials; series; periodicals; reviews; journals, etc.

Environmental impacts of research; ethics in research. Precaution against hazards during research work.

Concept and importance of commercialization of research and entrepreneurship.

Use of Zoological records; periodicals and biological abstracts. Quality of publications; impact factors.

Intellectual Property Rights (IPR) - concept, importance and processes.

### References

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.

Zar, J. H. 1999. *Biostatistical analysis*. Pearson Education India.

Huntsberger, D. V. 1961. Elements of statistical inference.

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 307	Evolution, Zoogeography and Palaeontology	4	60

### Evolution:

**Origin of life:** theories, main lines of animal evolution.

History of evolutionary thoughts of Lamarck, Darwim and Wallace

**Evidences of organic evolution-** biogeography, comparative anatomy, embryology, comparative physiology, biochemistry, palaeontology and genetics.

**Origin of variation:** gene mutation, chromosomal mutation, continuous versus discontinuous variations.

**Origin of species:** natural selection, isolation, and species formation. Polyploidy, convergent, divergent and parallel evolution.

Adaptation and animal variation and distribution of species.

**Process of evolution:** Macro-and micro-evolution, *Archaeopteryx*.

**Speciation:** Concept, factors and process of evolution.

Modern trends in evolutionary thoughts.

### Paleontology:

**Introduction:** Concept, history and scope of paleontology.

**Fossils:** types and significance of fossils; fossilization processes.

Geological time scale with characteristic fauna.

History of evolution of horse, camel, elephant and man.

### Zoogeography:

**Introduction:** definition, scopes, determinants and barriers of animal distribution;, history of emergence of zoogeography.

Past history of land water distribution; Pangea and Gondwana land.

**Continental drift:** theories, evidences and impacts on animal distribution.  
**Pleistocene glaciation:** causes, facts and impacts on animal distribution.  
**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.  
 Faunal relationship among different zoogeographical regions.  
 Insular and transitional and Siwalik Fauna.

## References

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.

Course No.	Course Title	No. of Credits	Credit hours
Zool. 308	Neurobiology and Endocrinology	2	30

## Neurobiology

Overview of course, History of neurobiology  
 Cells of the nervous system, structure of neurons and glia  
 Neuronal membranes, membrane structure, movement of ions  
 Ionic basis of resting membrane potential  
 Action Potentials, voltage-gated ion channels, Ligand-gated ion channels  
 Synapse structure, Neurotransmitters, Synaptic transmission, Principles of synaptic integration  
 Ion channels and receptors (cholinergic, dopaminergic, serotonergic, etc.)  
 Sensory systems. Physical events turned into information.  
 Central processing of information: reception to perception  
 Neural processing in a behavioral context: Flight controls in insects; Electric fish and bio-robotics  
 Motivation, Emotion, Sleep, Language; Attention. Development, Neural Plasticity, and Aging of the Brain. Learning and Memory.  
 Neurological disorders: Epilepsy and Seizures; Alzheimer's disease and Dementia; Parkinson's disease.  
 Treatment of neurological diseases

## Endocrinology

General concepts and branches of endocrinology.  
 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.  
 General classes of hormones: peptide, thyroid, steroid, neuro-transmitters, neuropeptides, chalcones, peptide-growth stimulating factors, eicosanoids and pheromones.  
 Hormones of endocrine glands: synthesis and control of synthesis, storage, metabolism and functions.  
 Endocrinology of pregnancy, parturition and lactation.  
 Pathophysiology of hypothalamic, pituitary, pineal, thyroid, parathyroid, GI tract, pancreatic islets, adrenal and gonadal hormones. Imaging and nuclear medicine in endocrine disease and hormone-replacement therapies.  
 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.  
 Human Health Consequences of Endocrine-Disrupting Chemicals

## References

- Dale Purves, George J. Augustine, David Fitzpatrick, William C. Hall, Anthony-Samuel Lamantia (2011). Neuroscience 5th Edition: 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. Molecular Cell Biology: Scientific American Book, Inc. USA
- Norris, D. O. Vertebrate Endocrinology: Academic Press, New York
- D Groot. L. J. (ed.), W. B. Saunder Philadelphia. Endocrinology, Vol. I, II, III: Biochemical Actions of Hormones: Litwack, G. Academic Press.
- Brook, C.G.D. and Marshall, N.J. Essential Endocrinology: Blackwell Publishing.

Course No.	Course Title	No. of Credits	Credit hours
Zool. 309	Terrestrial and aquatic ecosystem visit	2	30

A Field trip should be organized for the students during the academic year to study and observe the terrestrial and aquatic ecosystems, habitats, community structure and organisms. All students should participate in the program. After returning, they should make a presentation and submit a scientific report. Alternatively, students may be asked to present on selected topics from the syllabus. Assessment will be done by the Members of concerned Examination Committee.

Course No.	Course Title	No. of Credits	Credit hours
Zool. 310	Practical	8	120

**Microtomy:** Technique of histological slide/whole-mount preparation.

**Blood grouping:** Blood grouping and preparation of human blood smear.

**Water quality:** Measurement of dissolved oxygen, carbon dioxide, ammonia, nitrite, pH, turbidity, salinity, alkalinity and hardness of water.

**Freshwater organisms:** Identification of planktonic and benthic macro- and micro-fauna.

**Laboratory culture:** Culture of protozoans (*Paramecium* sp., *Euglena* sp.), rotifers, *Hydra*, earthworm, *Drosophila*, cockroach or any stored product insect pest.

**Ecology:** a. Study of the population dynamics of any one of the above cultured/reared species in the laboratory and studying their growth rate calculation of the intrinsic rate of natural increase; carrying capacity; population growth form, whether J-shaped or logistic [S-shaped]; identification of mortality factors; data collection, analysis, description and comments/remarks; b. Study of the abundance of the population of a species in a given area by using quadrat/transect method; c. Visiting a pond to study pond ecosystem including faunal and floral composition and food chain; d. Local field visit to a forest to study its ecology, the animals and their adaptations; preparation of a report on the visit; e. Tour to a seashore to study the animals and their ecological adaptations; preparation of a report on the visits.

**Animal Genetics:** Activity on Mendelian pattern of inheritance in *Drosophila* sp.

**Animal behaviour:** Observation and analysis of animal behaviour.

**Biostatistics:** Preparation of frequency distribution table; measures of arithmetic mean, mode, median, variance, standard deviation and standard error; correlation and regression analysis;



Chi-square test and t-test; ANOVA.

**Research methodology:** Activity on research process.

**Preparation of practical notebooks, field reports and other assignments**

## References

### 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*. 5<sup>th</sup> edition. Thomson Brooks/Cole Publishing Co., USA.

Mellanby, H. 1963. *Animal Life in Freshwater-A guide to freshwater invertebrates*. 6<sup>th</sup> edition. Methuen & Co. Ltd., London.

### Economic Zoology:

Chatterjee, K.D. 2009. *Medical Parasitology*. CBS Publishers & Distributors, India.

Cheng, T.C. 1997. *General Parasitology*. Academic Press, New York, USA.

Metcalf, C.L. and Flint, W.P. 1962 (revised by R.I. Metcalf). *Destructive and Useful Insects- their habits and control*. Tata McGraw Hill Publ. Co. Ltd., New Delhi, India.

Pedigo, L.P. 2002. *Entomology and Pest Management*. 4<sup>th</sup> edition. Prentice-Hall of India Pvt. Ltd., New Delhi, India.

### 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.

### Animal Genetics:

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>)

### 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.

(Books for further consultation will be recommended by the course teachers.)

Course No.	Course Title	No. of Credits
Zool. 311	Viva-voce	2

## Fourth Year BS (Honours) Programme in Zoology

Sessions: 2020-2021, 2021-2022, 2022-2023, and 2023-2024

Course No.	Course Title	No. of credits	Credit hours
Zool. 401	Environmental Pollution and Human Ecology	3	45

### Environmental Pollution:

Introduction: Concept, terminologies, definitions and types of pollution.

Air pollution: Definition, major types, sources, effects on biosphere and control measures.

Noise pollution: Definition, sources, effects on human and animals and prevention methods.

Water pollution: Definition, sources, types, effects on ecosystem and treatment methods.

Soil pollution: Definition, sources, effects on ecosystem and prevention.

Environmental Impact Assessment (EIA): Introduction, definition, stages/levels, clearance categories; procedural steps; assessment methods and report structure.

Environmental Management Plan (EMP): Purpose, definitions, components including mitigation; enhancement and monitoring plans; implementation and people's participation.

### Human ecology:

Introduction; History of human distribution.

Human types and their distribution.

Ecological impact on man's physical features, social and cultural life.

Impact of population expansion on environment.

Developmental activities and their impacts on environment.

Course No.	Course Title	No. of credits	Credit hours
Zool. 402	Radiation biology and biosafety regulations	3	45

### Radiation Biology:

Introduction to radiobiology and its status; atomic structure and radiation phenomenon.

Types of radiation and its characteristics; units of measurement of radiation.

Sources of radiations-natural and artificial sources.

Biological hazards of radiation and effects of radiation on human.

Permissible doses, safe handling and personal monitoring; detectors.

Radioisotopes and their use in biological, medical and agricultural researches.

Use of radiation in food preservation and protection.

### Biosafety Regulations

Concepts and facts, Biosafety regulation of products, producers and consumers. status of biosafety regulations in the developed and developing countries including the United Nation Environment Programme (UNEP/FDA). Biohazardous materials: definitions, biological hazard and classification of microbes. Waste management: Infectious/Biohazardous substance, Non-biohazardous waste, Treatment and disposal of biohazardous waste. Bangladesh biosafety and Biosecurity Guidelines, Scope and objectives of biosafety guidelines.

### References

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*. Wodsworth Publishing Company, Belmont, California, USA.

- Odum, E.P. 1971. *Fundamentals of Ecology*. W.B. Saunders Company, Philadelphia, 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.

Course No.	Course Title	No. of credits	Credit hours
Zool. 403	<b>Biodiversity, Biodiversity Conservation and Bioresource Management</b>	3	45

### **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.

### **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.

### **Bioresource management:**

**Introduction to bioresource management:** Definition, scopes, classification of bioresources; 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.

### **References**

- Arms, K. 1990. *Environmental Science*. Saunders College Publishing, a division of Holt, Rinehart and Winston, Inc., New York.
- Bashar, M.A. 2004. *Instant Basics of Environment*. Positron Publications. Dhaka, Bangladesh.
- Groombridge, B. 1992. *Global Biodiversity*. World Conservation Monitoring Centre. Global Biodiversity: Status of the Earth's living resources. Chapman & Hall, London.
- IUCN. 1994. *Guidelines for Protected Area Management Categories*.
- Jeffries, M.J. 1997. *Biodiversity and Conservation*. Routledge, London.
- Park, C. 2001. *The Environment*. Routledge an imprint of Taylor and Francis Group 11 New Fetter Lane, London.
- Primack, R.B. 1998. *Essentials of Conservation Biology*. Sinauer Associates, Inc., USA.

Course No.	Course title	No. of credits	Credit hours
Zool. 404	Entomology	4	60

### **Insect morphology:**

**Body wall:** Structure and derivatives.

**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.

**Insect life stages:** egg, nymph/larva, and pupa.

### **Insect taxonomy:**

Insect identifying characters; principles of insect classification.

Detailed classification of the class Insecta up to orders and sub-orders.

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.

### **Insect physiology:**

Physiology of digestion, dietary requirements of insects, role of microorganisms in insect nutrition and digestion.

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.

**Physiology of moulting:** exocrine glands and defensive secretions; eye vision, light production; perception and cryptobiosis.

### **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;

**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.

### **References**

Borror, D.J, DeLong D.M. and Triplehorn, C.A. 1964. *An Introduction to the study of Insects*. Halt. Reinhart and Winston, USA.

Kabir A.K.M.F. 1975. *Jute Pests of Bangladesh*. Bangladesh Jute Research Institute, Dhaka, Bangladesh.

Gullan, P.J. and Cranston, P.S. 1999. *The insects: An outline of entomology*. Kluwer Academic Publishers, Boston, London.

- 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.
- 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.
- Snodgrass, R.E. 1935. *Principles of Insect Morphology*. Tata McGraw Hill Publ. Co. Ltd., New Delhi, India.
- Wiggsworth, V.B. 1972. *The Principles of Insect Physiology*. The English Language Book Society and Matheuen & Co. Ltd., London.

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 405	Fisheries and Aquaculture	4	60

**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.

**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.

**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.

**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, and physical, chemical and microbial aspects of spoilage; Rigor mortis. Fish processing and preservation by icing and freezing, drying, salting, smoking, pickling and canning.

**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.

**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.

**References**

- 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*. 4<sup>th</sup> ed. Wiley Blackwell, Oxford, USA, 597p.
- Van Duijn, C.J. 1956. *Diseases of Fishes*. Water Life, London.

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 406	Wildlife and Wildlife Management	4	60

### 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.

### 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.

### 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.

### 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.

### References

- Dudley, N. (ed.). 2008. *Guidelines for Applying Protected Area Management Categories*. IUCN, International Union for Conservation of Nature, Gland.
- Dyke, F.V. 2008. *Conservation Biology – Foundations, Concepts and Applications*. Springer Science - Business Media, New York.
- Hosetti, B.B. 2005. *Concepts in Wildlife Management*, 2<sup>nd</sup> edition. Daya Publishing House, Delhi.
- IUCN Bangladesh. 2015. *Red List of Bangladesh: A Brief on Assessment Result*. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka.
- Khanna, D. R. and Yadav, P. R. 2005. *Biology of Birds*. Discovery Publishing House, New Delhi.
- 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.
- Sinclair, A.R.E., John, M.F. and Cavigley, 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.
- Soule, M.E. (ed.). 1996. *Conservation biology: The science of scarcity and diversity*. Sinauer Associates, Inc. Massachusetts, USA.

- 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.
- Wallace, G. J. 1971. *An Introduction to Ornithology*. Second Edition. The Macmillan Company, New York.
- Welty, J. C. 1982. *Life of Birds*. Saunders College Publishing, USA.

Course No.	Course Title	No. of credits	Credit hours
Zool. 407	General Parasitology	4	60

**Introduction to parasitology:** concept, types and related terms.

**Detailed study** of basic ideas and principles of different types of association.

**History of parasitology:** origin of parasites and evolution of different groups of parasites.

**Host-parasite relationship:** tissue and organ level effects: (a) effects of parasites on host; and (b) effects of hosts on parasites. Effects of host behaviour, diet and hormone.

**Vectors:** vectors and their role in parasitology.

**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*.

**Parasites of fish:** *Cryptobia, Henneguya, Myxobolus, Trichodina, Ichthyophthirius, Gyrodactylus, Gnathostoma, Pallisentis, Argulus, Ergasilus, Lernaea and Caligus*.

**Parasites of amphibians:** *Opalina, Polystoma and Haematoloecus*.

**Parasites of reptiles:** *Haemogregarina, Megalodiscus and Amplicaeum*.

**Parasites of birds:** *Eimeria, Leucocytozoon, Histomonas, Heterakis, Raillietina and Argas*.

**Parasites of mammals other than humans:** *Moniezia, Dicrocoelium, Dipylidium, Dirofilaria, Capillaria, Ixodes, Dermacentor, Ornithodoros and Demodex*.

**Parasites of humans:** *Cryptosporidium, Leishmania, Trypanosoma, Toxoplasma, Giardia, Trichomonas, Clonorchis, Schistosoma, Taenia, Echinococcus, Trichurus, Ancylostoma, Strongyloides, Ascaris, Enterobius, Wuchereria, Pediculus and Sarcoptes*.

## References

- Cheng, T.C. (ed.). 1971. *The Biology of Animal Parasites*, Butterworths, London.
- Cheng, T.C. 1997. *General Parasitology*. Academic Press, New York, USA.
- Cox F.E.G. (ed.). 1993. *Modern Parasitology*. Blackwell Science, London, Paris, Berlin, Vienna.
- Croll, N.A. 1973. *Parasitism and other Associations*. Pitman. London.
- Jawetz, E., Melnik, J.L. and Addberg, A. 1980. *A Review of Medical Parasitology*. Lange Medical Publications, California, USA.
- Kennedy, C.R. 1975. *Ecological Animal Parasitology*. Blackwell Scientific Publications, London, Paris, Berlin, Vienna.
- Lom, J. and Dykova, I. 1992. *Protozoan Parasites of Fishes*. Elsevier, Amsterdam, London, New York, Tokyo, Japan.
- 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.
- Schmidt, G.D. and Roberts, L.S. 1996. *Foundations of Parasitology*. Wm. C. Brown Publishers, USA.

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 408	Molecular Genetics	4	60

**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.

**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.

**Transcription:**

Structure and function of gene; promoters and terminators; transcriptional initiation, elongation and termination, RNA polymerases.

**RNA molecules and RNA processing:**

mRNA, tRNA and rRNA; RNA splicing; RNA editing; microRNA.

**The Genetic Code and Translation:**

The genetic code, codons, anticodons, the ribosome and translation.

**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.

**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.

**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.

**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.

**References**

- Brown, T.A. 2000. *Essential Molecular Biology (A Practical Approach)*. 2<sup>nd</sup> edition. Oxford University Press, UK.
- Karp, G. 2005. *Cell and Molecular Biology (Concept and Experiments)*. 4<sup>th</sup> 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*, 2<sup>nd</sup> edition. Eurasia Publishing House Ltd., New Delhi, India.
- Tave, D. 1993. *Genetics for Fish Hatchery Managers*, Van Nostrand. 2<sup>nd</sup> edition. Reinhold Publisher, California, USA.
- Turner, P.C., McLennan, A.G., Bates, A.D. and White, M.R.H. 2000. *Instant Notes Molecular Biology*. 2<sup>nd</sup> edition. BIOS Scientific Publishers Limited, UK.
- Winter, P.C., Hickey, G.I. and Fletcher. H.L. 2003. *Instant Notes on Genetics*. 2<sup>nd</sup> edition. BIOS Scientific Publishers Limited, UK.



Course No.	Course Title	No. of Credits	Credit Hours
Zool. 414	Mangrove ecosystem visit	2	30

A Field trip should be organized for the students during the academic year to study and observe the mangrove ecosystem, Salt marsh, Sand dunes. nearshore and offshore island ecosystems, community structure and organisms. All students should participate in the program. After returning, they should make a presentation and submit a scientific report. Alternatively, students may be asked to present on selected topics from the syllabus. Assessment will be done by the Members of concerned Examination Committee.

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 415	Practical	8	120

### Entomology:

**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).

**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).

**Insect anatomy:** Study of the functional systems of insects through dissection of selected insects:

- Digestive system: Structural variations related to feeding habits.
- Reproductive system: Male and female systems- testis, ovary and ovariole.

**Insect physiology:** Haemocytes of insects (students will prepare slides for the haemocytes of insects and draw and label them).

**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).

### Fisheries:

**Taxonomic identification of crustaceans, molluscs and fishes of Bangladesh.** **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.

**Age determination of fish** by scale, otolith and fin ray.

**Crafts and gears** modules.

**Qualitative and quantitative study of plankton and macro benthic organisms.**

**Feed formulation and feed preparation** techniques.

**Field visits:** Hatchery operation; fish processing; catch assessment and fishing effort survey.

### Wildlife Biology:

**Taxonomy of museum specimens:** Amphibians, reptiles, birds and mammals.

**Wildlife study technique:** Population census, transect and plot counting, netting and trapping, preservation and identification, tagging, marking, ringing, observatory.

**Preparation of slides:** Hairs of mammals.

**Food habit analysis:** Frog/lizard/pigeon.

**Field trips and reports.**

### Parasitology:

Basic procedures for collection, fixation and preservation of protozoans, helminths and arthropod parasites for microscopic study.

Taxonomic identification of animal and human parasites of different groups.

Procedure for inventory of ectoparasites and endoparasites of vertebrate host/s.

Demonstration of parasites from invertebrate hosts like snail and cockroach.  
Collection, preparation and identification of parasites from faecal samples.

### **Genetics and Molecular Biology:**

**Basic/ Mendelian Genetics:** Exploring genetic inheritance in *Drosophila* sp.

**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*.

**Molecular Genetics:** Genomic DNA isolation, PCR analysis and Agarose Gel Electrophoresis.

**Population Genetics:** Measuring genetic diversity by multiple alleles (e.g ABO blood groups).

### **Preparation of practical notebooks and field reports**

### **References**

#### **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.

#### **Fisheries**

- Ahmed, N. 1961. *Fishing Crafts of East Pakistan*, Directorate of Fisheries, Government of East Pakistan, Dacca.
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Course No.	Course Title	No. of Credits
Zool. 416	Viva-voce	2

## First Year BS (Honours) in Zoology

(Extra Departmental Course)

Sessions: 2020-2021, 2021-2022, 2022-2023, 2023-2024

Course No.	Course Title	No. of Credits	Credit Hours
Zool. 1001	Animal Diversity (including practical)	4	60

### A. Non-Chordata:

**Classification:** Brief classification of each non-chordate phylum up to orders with special reference to local forms, their affinities and economic importance.

**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:** food and feeding habits, digestive, respiratory, circulatory, excretory, nervous and reproductive systems of *Pila*. **Arthropoda:** *Apis* sp. and its social behaviour; Life-cycle of jute-hairy caterpillar; Pulse Beetle and Rice Hispa. **Echinodermata:** General characters of different classes of echinoderms; Type study of *Astropecten*. **Minor phyla:** General idea about the different groups of animal under minor phyla.

**Hemichordata:** General characters and affinities.

### 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*. **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*.

### C. Wildlife biology:

Introduction to wildlife, and the broad classification of the wildlife of Bangladesh; Wildlife preservation and its importance in Bangladesh.

### 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.
- RUI (*Labeo rohita*):** External morphology, dissection of circulatory system and reproductive systems.
- Preparation of practical notebooks**

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