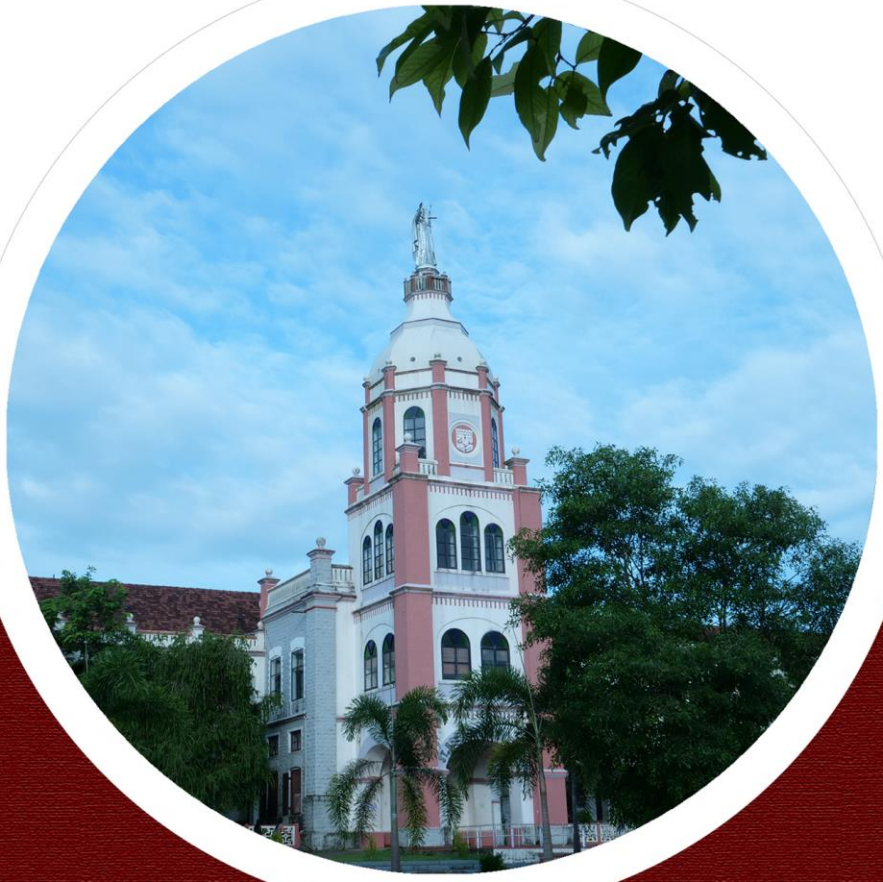
DEPARTMENT OF
ZOOLOGY



Curriculum and Syllabus for
Undergraduate Programmes
Under Credit Semester System
(with effect from 2019 admissions)

St Berchmans College
Founded 1922
AUTONOMOUS | College with Potential for Excellence | Reaccredited by NAAC with A Grade
Affiliated to Mahatma Gandhi University, Kottayam, Kerala
Changanassery, Kottayam, Kerala, India-686101

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BOARD OF STUDIES

Members

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   St. Josephs College, Devagiri (Autonomous)
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    Rajiv Gandhi center for Biotechnology
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    Associate Professor, Department of Zoology
    S. D. College, Alappuzha

12. **J. Patrick David**
    Ecologist, Periyar Tiger Conservation Foundation
    Thekkady, Kerala

PROGRAMME OBJECTIVES

The B.Sc. Zoology programme is designed to:

1. Impart basic knowledge in various branches of Zoology and General biology meant both for a graduate terminal course and for higher studies.
2. Inculcate interest in and love of nature with its myriad living creatures.
3. Understand the unity of life with the rich diversity of organisms and their ecological and evolutionary significance.
4. Acquire basic skills in the observation and study of nature, biological techniques, experimental skills and scientific investigation.
5. Acquire basic knowledge and skills in applied branches to enable them for self employment.
6. Generate awareness about the conservation of the biosphere.

PROGRAMME OUTCOME

The graduate of this programme should be able to

1. Develop respect for nature
2. Explain the importance of biodiversity
3. Identify and list out common animals
4. Understand the basic principles of evolution and adaptations in animals
5. Appreciate the influence of environment on the life of organisms
6. Explain various physiological & biochemical processes in our bodies
7. Understand the basic genetic mechanisms in organisms
8. Identify potential risk factors to health of human beings
9. Use tools of information technology for the study of biology
10. Develop the skills to pursue advanced studies in biology

REGULATIONS FOR UNDERGRADUATE (UG) PROGRAMMES UNDER CREDIT SEMESTER SYSTEM (SB-CSS-UG) 2019

1. SHORT TITLE

1.1 These Regulations shall be called St. Berchmans College (Autonomous) Regulations (2019) governing undergraduate programmes under Credit Semester System.

1.2 These Regulations shall come into force with effect from the academic year 2019 - 20 onwards.

2. SCOPE

2.1 The regulation provided herein shall apply to all regular undergraduate programmes, BA/BSc/BCom/BCA, conducted by St. Berchmans College (Autonomous) with effect from the academic year 2019 - 20.

3. DEFINITIONS

3.1 'University' means Mahatma Gandhi University, Kottayam, Kerala.

3.2 'College' means St. Berchmans College (Autonomous).

3.3 There shall be an Academic Committee nominated by the Principal to look after the matters relating to the SB-CSS-UG system.

3.4 'Academic Council' means the Committee consisting of members as provided under section 107 of the University Act 2014, Government of Kerala.

3.5 'Parent Department' means the Department, which offers a particular undergraduate programme.

3.6 'Department Council' means the body of all teachers of a Department in the College.

3.7 'Faculty Mentor' is a teacher nominated by a Department Council to coordinate the continuous evaluation and other academic activities of the undergraduate programme undertaken in the Department.

3.8 'Programme' means a three year programme of study and examinations spread over six semesters, the successful completion of which would lead to the award of a degree.

3.9 'Duration of Programme' means the period of time required for the conduct of the programme. The duration of an undergraduate programme shall be six (6) semesters.

3.10 'Semester' means a term consisting of a minimum 90 working days, inclusive of tutorials, examination days and other academic activities within a period of six months.

3.11 'Course' means a portion of a subject to be taught and evaluated in a semester.

3.12 'Course Teacher' means the teacher who is taking classes on the course.

3.13 'Core Course' means a course in the subject of specialization within a degree programme. It includes a course on environmental studies and human rights.

3.14 'Complementary Course' means a course, which would enrich the study of core courses.

3.15 'Common Course I' means a course that comes under the category of courses for English.

3.16 'Common Course II' means additional language, which can be opted by a student, from among the languages offered by the College.

3.17 The Common Course I and II is compulsory for all students undergoing undergraduate programmes.

3.18 'Open Course' means a course offered by the departments other than the parent department outside the field specialization of the student, which can be opted by a student.

3.19 'Elective Course' means a course, which can be substituted, by equivalent course from the same subject.

3.20 'Vocational Course' means a course that enables the students to enhance their practical skills and ability to pursue a vocation in their subject of specialization.

3.21 'Audit Course' means a course opted by the students, in addition to the compulsory courses, in order to develop their skills and social responsibility.

3.22 'Extra Credit Course' means a course opted by the students, in addition to the compulsory courses, in order to gain additional credit that would boost the performance level and additional skills.

3.23 Extra credit and audit courses shall be completed by working outside the regular teaching hours.

3.24 There will be two categories of extra credit courses, mandatory and optional. If a student fails to complete the mandatory course, he/she shall complete the same within the tenure of the programme.

The details of the extra credit and audit courses are given below:

Semester	Course	Type
I	Course on Basic Life Support System and Disaster Management	Compulsory, audit course, Grades shall be given
I to VI	Value Education	Compulsory, extra credit
	Virtual Lab experiments/MOOC	Optional, extra credit
II & III	Add on Course	Compulsory, extra credit, Grades shall be given
Summer vacation following semester II	50 hours (10 days) Social Awareness Programme	Compulsory, extra credit, Grades shall be given
IV	Internship/Skill Training	Compulsory, audit course, Grades shall be given
V	Finishing School	Compulsory, audit course

3.25 'On the Job Training' means a job training course given to the students to acquaint them with various industrial skills.

3.26 'Project' means a regular project work with stated credits on which the student conducts a project under the supervision of a teacher in the parent department/any appropriate research centre in order to submit a dissertation on the project work as specified.

3.27 'Dissertation' means a minor thesis to be submitted at the end of a research work carried out by each student on a specific area.

3.28 'Plagiarism' is the unreferenced use of other authors' material in dissertations and is a serious academic offence.

3.29 'Seminar' means a lecture expected to train the student in self-study, collection of relevant matter from books and internet resources, editing, document writing, typing and presentation.

3.30 'Improvement Examination' is an examination conducted to improve the performance of a student in the courses of a particular semester as per the exam manual.

3.31 'Supplementary Examination' is an examination conducted for students who fail in the courses of a particular semester as per the exam manual.

3.32 The minimum credits, required for completing an undergraduate programme is one hundred and twenty (120).

3.33 'Credit' (C) of a course is a measure of the weekly unit of work assigned for that course in a semester.

3.34 'Course Credit': One credit of the course is defined as a minimum of one (1) hour lecture/minimum of two (2) hours lab/field work per week for eighteen (18) weeks in a semester. The course will be considered as completed only by conducting the final examination.

3.35 'Grade' means a letter symbol (A, B, C etc.) which indicates the broad level of performance of a student in a course/semester/programme.

3.36 'Grade Point' (GP) is the numerical indicator of the percentage of marks awarded to a student in a course.

3.37 'Credit Point' (CP) of a course is the value obtained by multiplying the grade point (GP) by the credit (C) of the course.

3.38 'Semester Grade Point Average' (SGPA) of a semester is calculated by dividing total credit points obtained by the student in a semester by total credits of that semester and shall be rounded off to two decimal places.

3.39 'Cumulative Grade Point Average' (CGPA) is the value obtained by dividing the sum of credit points in all the courses obtained by the student for the entire programme by the total credits of the whole programme and shall be rounded off to two decimal places.

3.40 'Institution Average' is the value obtained by dividing the sum of the marks obtained by all students in a particular course by the number of students in the respective course.

3.41 'Weighted Average Score' means the score obtained by dividing sum of the products of marks secured and credit of each course by the total credits of that semester/programme and shall be rounded off to two decimal places.

3.42 'Grace Marks' means marks awarded to course/courses as per the choice of the student, in recognition of meritorious achievements of a student in NCC/NSS/sports/arts and cultural activities.

3.43 First, Second, Third, Fourth and Fifth position shall be awarded to students who come in the first five places based on the overall CGPA secured in the programme in the first chance itself.

4. PROGRAMME STRUCTURE

4.1. The programme shall include core courses, vocational courses, complementary courses, common courses, open course and elective courses. There shall be a project/dissertation to be undertaken by all students. The programme will also include assignments, seminars, practical, viva-voce, OJT, field visit, industry visit etc., if they are specified in the curriculum.

4.2. Total credits for the programme is one hundred and twenty (120). The credit distribution is shown below.

Programme duration	6 Semesters
Total credits required for successful completion of the programme	120
Minimum credits required from Core + Elective + Project + Complementary courses	79
Minimum credits required from Common courses	38
Minimum credits required from Open course	3
Minimum attendance required	75%

4.3. **Project/Dissertation**

All students shall do a project/research work in the area of core course during the programme. The project/ research work shall be done individually or as a group of maximum five (5) students. The projects/research work shall be identified during the 4th semester of the programme with the help of the supervising teacher. The report of the project/research work shall be submitted to the department during 6th semester and shall be produced before the examiners appointed by the College. The project report/dissertation shall be subject to internal and external evaluation followed by a viva-voce/defence.

4.4. **Field visit**

A field visit to a biodiversity rich area should be conducted during the 1st semester. The visit is intended to study the biodiversity and conservation status of the area and forms a part of the practical course during Semester 1. Each student is required to prepare a report of the visit which will be evaluated during the practical examination at the end of the semester.

4.5. **Study Tour and Visit to Research Institutes**

Study tour and visit to research institutes should be conducted preferably during the 5th semester. During the study tour, students are expected to visit different habitats, zoos, aquaria and other places of zoological importance. They must also visit research institutes to familiarize themselves with the process of research in biological sciences.

4.6. **Field course for Elective**

During 6th semester, the student may opt for either of the two electives offered – Wildlife Biology or Eco-tourism. Each elective has a field course component incorporated into the syllabus to train the students in the practical aspects of the course.

i) **Wildlife Biology Field Course**

A Wildlife field course preferably of 3 days should be conducted during the 6th semester of the programme. The field course is meant as a practical adjunct to the Wildlife Biology elective course offered during Semester 6 and the students are expected to attain training in various aspects of Wildlife Biology, its conservation and management. A report of the course should be submitted and viva voce conducted at the end of 6th semester.

ii) **Eco-Tourism Field course**

The Eco-Tourism elective course offered during the 6th semester has a field course component incorporated to train the students in various nuances of Eco-tourism. The students will be undergo training under experts in the field and gain hands on experience in handling eco-tourism projects. A report of the course should be submitted and viva voce conducted at the end of 6th semester.

4.7. **Evaluations**

The evaluation of each course shall contain two parts.

i Internal or In-Semester Assessment (ISA)

ii External or End-Semester Assessment (ESA)

Both ISA and ESA shall be carried out using indirect grading. The ISA:ESA ratio shall be 1:4, for courses with or without practical. There shall be a maximum of eighty (80) marks for external evaluation and twenty (20) marks for internal evaluation.

4.8. **In-semester assessment**

The components of the internal or in-semester assessment and their marks are as below.

Common Courses

There are four components for ISA, which include attendance, assignment/seminar and in-semester examinations. All the components of the internal assessment are mandatory.

Component	Marks
Attendance	2
Assignment/Seminar	5
Class test	5
Model examination	8
Total	**20**

Marks for attendance

% of Attendance	Marks
Above 90	2
75 – 90	1

(Decimals shall be rounded off to the next higher whole number)

Courses without practical (other than common courses)

Component	Marks
Attendance	2
Viva	4
Assignment/Seminar	4
Class test	4
Model examination	6
Total	**20**

Marks for attendance

% of Attendance	Marks
Above 90	2
75 – 90	1

(Decimals shall be rounded off to the next higher whole number)

Courses with practical

Component	Marks
Attendance	2
Viva	3
Assignment/Seminar	2
Class test	3
Model examination	5
Total	**15**

Marks for attendance

% of Attendance	Marks
Above 90	2
75 – 90	1

(Decimals shall be rounded off to the next higher whole number)

Internal assessment of practical courses

The internal assessment of practical courses shall be conducted either annually or in each semester. The components for internal assessment are given below.

Internal assessment of practical courses evaluated in each semester

Component	Marks
Attendance	1
Lab Test	2
Record*	2
Total	**5**

*Marks awarded for Record shall be related to number of experiments/practicals recorded.

Marks for attendance

% of Attendance	Marks
Above 75	1

(Decimals shall be rounded off to the next higher whole number)

Internal assessment of practical courses evaluated annually

Component	Marks
Attendance	2
Lab Test	4
Record*	4
Total	**10**

*Marks awarded for Record shall be related to number of experiments/practicals recorded.

Marks for attendance

% of Attendance	Marks
Above 90	2
75 – 90	1

(Decimals shall be rounded off to the next higher whole number)

4.9. **Assignments**

Assignments shall be submitted for every course in the first four semesters. At least one assignment for each course shall be submitted in each semester.

4.10. **Seminar**

A student shall present a seminar in the fifth and sixth semesters.

4.11. **In-semester examination**

Every student shall undergo at least two in-semester examinations as class test and model examination as internal component for every course.

4.12. To ensure transparency of the evaluation process, the ISA mark awarded to the students in each course in a semester shall be published on the notice board according to the schedule in the academic calendar published by the College. There shall not be any chance for improvement of ISA. The course teacher and the faculty mentor shall maintain the academic record of each student registered for the course which shall be forwarded to the office of the Controller of Examinations through the Head of the Department and a copy shall be kept in the office of the Head of the Department for at least two years for verification.

4.13. A student who has not secured minimum marks in internal examinations can redo the same before the end semester examination of the semester concerned.

4.14. **End-semester assessment**

The end-semester examination in theory and practical courses shall be conducted by the College.

4.15. The end-semester examinations shall be conducted at the end of each semester. There shall be one end-semester examination of three (3) hours duration in each lecture based course.

4.16. The question paper shall be strictly on the basis of model question paper set by Board of Studies.

4.17. A question paper may contain short answer type/annotation, short essay type questions/problems and long essay type questions. Marks for each type of question can vary from programme to programme, but a general pattern may be followed by the Board of Studies.

4.18. End-semester Examination question pattern shall be as given below.

Courses without practical

Section	Total No. of Questions	Questions to be Answered	Marks	Total Marks for the Section
A	12	10	2	20
B	9	6	5	30
C	4	2	15	30
			Maximum	**80**

Courses with practical

Section	Total No. of Questions	Questions to be Answered	Marks	Total Marks for the Section
A	12	10	2	20
B	9	6	4	24
C	4	2	8	16
			Maximum	**60**

4.19. Photocopies of the answer scripts of the external examination shall be made available to the students for scrutiny as per the regulations in the examination manual.

4.20. Practical examination shall be conducted annually or in each semester. The duration and frequency of practical examination shall be decided by the respective Board of Studies.

4.21. Practical examination shall be conducted by one external examiner and one internal examiner.

4.22. The marks for end-semester theory and practical examinations are given below

Course	Marks
Courses without practical	80
Course with practical	60
Practical (assessment in each semester)	20
Practical (odd and even semester combined)	40

4.23. The project report/dissertation shall be subject to internal and external evaluation followed by a viva-voce at the end of the programme. Internal Evaluation is to be done by the supervising teacher and external evaluation by an external evaluation board consisting of an examiner appointed by the Controller of Examinations and the Head of the Department or his nominee. A viva-voce/defence related to the project work shall be conducted by the external evaluation board and students have to attend the viva-voce/defence individually.

Components of Project Evaluation	Marks
Internal Evaluation	20
Dissertation (External)	50
Viva-Voce (External)	30
Total	**100**

4.24. If the student fails in project evaluation, he or she shall submit the project report/dissertation after modifying it on the basis of the recommendations of the examiners.

4.25. Evaluation of field course for the elective course offered in 6th semester

Components of Field Course evaluation	Marks
Attendance (Internal)	2
Field diary (Internal)	3
Field course report (External)	10
Viva-voce (External)	10
Total	**25**

4.26. For all courses (theory and practical) an indirect grading system based on a seven (7) point scale according to the percentage of marks (ISA + ESA) is used to evaluate the performance of the student in that course. The percentage shall be rounded mathematically to the nearest whole number.

Percentage of Marks	Grade	Performance	Grade Point
95 and above	S	Outstanding	10
85 to below 95	A+	Excellent	9
75 to below 85	A	Very Good	8
65 to below 75	B+	Good	7
55 to below 65	B	Above Average	6
45 to below 55	C	Satisfactory	5
35 to below 45	D	Pass	4
Below 35	F	Failure	0

5. CREDIT POINT AND GRADE POINT AVERAGE

5.1. **Credit Point**

Credit Point (CP) of a course is calculated using the formula

CP = C × GP

where C is the credit and GP is the grade point

5.2. **Semester Grade Point Average**

Semester Grade Point Average (SGPA) is calculated using the formula

SGPA = TCP/TCS

where TCP is the total credit point of all the courses in the semester and TCS is the total credits in the semester

GPA shall be rounded off to two decimal places.

5.3. **Cumulative Grade Point Average**

Cumulative Grade Point Average (CGPA) is calculated using the formula

CGPA = TCP/TC

where TCP is the total credit point of all the courses in the whole programme and TC is the total credit in the whole programme

GPA shall be rounded off to two decimal places.

5.4 Grade Point Average (GPA) of different category of courses viz. Common Course I, Common Course II, Complementary Course I, Complementary Course II, Vocational Course, Core Course etc. are calculated using the formula

GPA = TCP/TC

where TCP is the Total Credit Point of a category of course and TC is the total credit of that category of course

Grades for the different courses, semesters, Semester Grade Point Average (SGPA) and grades for overall programme, Cumulative Grade Point Average (CGPA) are given based on the corresponding Grade Point Average (GPA) as shown below:

GPA	Grade	Performance
9.5 and above	S	Outstanding
8.5 to below 9.5	A+	Excellent
7.5 to below 8.5	A	Very Good
6.5 to below 7.5	B+	Good
5.5 to below 6.5	B	Above Average
4.5 to below 5.5	C	Satisfactory
3.5 to below 4.5	D	Pass
Below 3.5	F	Failure

5.5. A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass in a course.

5.6. For a pass in a programme, a separate minimum of grade 'D' is required for all the individual courses.

5.7. If a candidate secures F Grade for any one of the courses offered in a semester/programme, only F grade will be awarded for that semester/programme until the student improves this to D grade or above within the permitted period.

5.8. Candidate who secures D grade and above will be eligible for higher studies.

6. SUPPLEMENTARY/IMPROVEMENT EXAMINATION

6.1 There will be supplementary examinations and chance for improvement. Only one chance will be given for improving the marks of a course.

6.2 There shall not be any improvement examination for practical examinations and examinations of the final year.

7. ATTENDANCE

7.5. The minimum requirement of aggregate attendance during a semester for appearing the end semester examination shall be 75%. Condonation of shortage of attendance to a maximum of ten (10) days in a semester subject to a maximum of two times during the whole period of undergraduate programme may be granted by the College. This condonation shall not be counted for internal assessment.

7.6. Benefit of attendance may be granted to students representing the College, University, State or Nation in Sports, NCC, NSS or Cultural or any other officially sponsored activities such as College union/University union activities etc., on production of participation/attendance certificates, within one week from competent authorities, for the actual number of days participated, subject to a maximum of ten (10) days in a semester, on the specific recommendations of the Faculty Mentor and Head of the Department.

7.7. A student who does not satisfy the requirements of attendance shall not be permitted to appear for the end-semester examinations.

7.8. Those students who are not eligible even with condonation of shortage of attendance shall repeat the course along with the next batch after obtaining readmission.

8. BOARD OF STUDIES AND COURSES

8.5. The Board of Studies concerned shall design all the courses offered in the UG programme. The Board shall design and introduce new courses, modify or re-design existing courses and replace any existing courses with new/modified courses to facilitate better exposure and training for the students.

8.6. The syllabus of a programme shall contain programme objectives and programme outcome.

8.7. The syllabus of a course shall contain the title of the course, course objectives, course outcome, contact hours, the number of credits, reference materials and model questions.

8.8. Each course shall have an alpha numeric code which includes abbreviation of the course in two letters, the semester number, course code and the serial number of the course.

8.9. Every programme conducted under Credit Semester System shall be monitored by the Academic Council.

9. REGISTRATION

9.5. A student who registers his/her name for the external examination for a semester will be eligible for promotion to the next semester.

9.6. A student who has completed the entire curriculum requirement, but could not register for the semester examination can register notionally, for getting eligibility for promotion to the next semester.

9.7. A student may be permitted to complete the programme, on valid reasons, within a period of twelve (12) continuous semesters from the date of commencement of the first semester of the programme.

9.8. The minimum strength of students for open courses is 15 and the maximum is 75 per batch.

9.9. Each student shall register for the open courses in the prescribed registration form in consultation with the faculty mentor during fourth semester. Faculty mentor shall permit registration on the basis of the preferences of the student and availability of seats.

10. ADMISSION

10.5. The admission to all UG programmes shall be as per the rules and regulations of the College/University.

10.6. The eligibility criteria for admission shall be as announced by the College/University from time to time.

10.7. Separate rank lists shall be drawn up for seats under reservation quota as per the existing rules.

10.8. There shall be an academic and examination calendar prepared by the College for the conduct of the programmes.

11. **MARK CUM GRADE CARD**

11.5. The College under its seal shall issue to the students, a Mark cum Grade Card on completion of each semester, which shall contain the following information.

i. Name of the Student
ii. Register Number
iii. Photo of the student
iv. Degree
v. Programme
vi. Semester and Name of the Examination
vii. Month and Year of Examination
viii. Stream
ix. Course Code, Title and Credits of each course opted in the semester
x. Marks for ISA, ESA, Total Marks (ISA + ESA), Maximum Marks, Letter Grade, Grade Point (GP), Credit Point (CP) and Institution Average in each course opted in the semester
xi. Total Credits, Marks Awarded, Credit Point, SGPA and Letter Grade in the semester
xii. Weighted Average Score
xiii. Result

xiv. Credits/Grade of Extra Credit and Audit Courses

11.6. The final Mark cum Grade Card issued at the end of the final semester shall contain the details of all courses taken during the entire programme including those taken over and above the prescribed minimum credits for obtaining the degree. The final Mark Cum Grade Card shall show the CGPA and the overall letter grade of a student for the entire programme.

11.7. A separate grade card shall be issued at the end of the final semester showing the extra credit and audit courses attended by the student, grade and credits acquired.

12. AWARD OF DEGREE

The successful completion of all courses other than extra credit and audit courses with 'D' grade shall be the minimum requirement for the award of the degree.

13. MONITORING COMMITTEE

There shall be a Monitoring Committee constituted by the Principal to monitor the internal evaluation conducted by the College. The Course Teacher, Faculty Mentor, and the College Coordinator shall keep all the records of the continuous evaluation, for at least a period of two years, for verification.

14. GRIEVANCE REDRESS MECHANISM

14.5. In order to address the grievance of students regarding ISA, a two-level grievance redress mechanism is envisaged.

14.6. A student can approach the upper level only if grievance is not addressed at the lower level.

14.7. Department level: The Principal shall form a Grievance Redress Committee in each Department comprising of course teacher and one senior teacher as members and the Head of the Department as Chairman. The Committee shall address all grievances relating to the internal assessment of the students.

14.8. College level: There shall be a College level Grievance Redress Committee comprising of Faculty Mentor, two senior teachers and two staff council members (one shall be an elected member) and the Principal as Chairman. The Committee shall address all grievances relating to the internal assessment of the students.

15. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Principal shall, for a period of three years from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any programme with such modifications as may be necessary.

REGULATIONS FOR ADD ON COURSES FOR UNDERGRADUATE PROGRAMMES

1. DEFINITIONS

1.1 'Add On Course General Coordinator' is a senior teacher nominated by the Principal to coordinate and monitor the Add On courses conducted by various departments.

1.2 'Add On Course Coordinator' is a teacher nominated by a Department Council to coordinate the evaluation and other academic activities of the Add On Course undertaken in the Department.

2. COURSE STRUCTURE

2.1 Add On Course shall be completed outside the regular teaching hours of the undergraduate programmes and shall be completed within the first four semesters of the programme.

2.2 The credit will be awarded only if the student get D grade (35% marks) and above.

2.3 A student can earn any number of extra credits according to his/her choice.

2.4 The minimum credits for an Add On Course shall be two (2).

3. EVALUATIONS

The evaluation of each course shall be done internally and contain two parts.

i. Continuous evaluation
ii. Final evaluation

Both continuous evaluation and final evaluation shall be carried out using indirect grading. The marks for continuous evaluation is twenty (20) and that of final evaluation is eighty (80).

Continuous evaluation

The components of the continuous evaluation and their marks are as below.

For all courses without practical

There are two components for continuous evaluation, which include attendance and assignment. All the components of the continuous evaluation are mandatory.

Components	Marks
Attendance	10
Assignment	10
Total	**20**

Marks for attendance

% of Attendance	Marks
90 and above	10
85 - 89	8
80 – 84	6
76 – 79	4
75	2

(Decimals shall be rounded mathematically to the nearest whole number)

For all courses with practical

The components for continuous evaluation of courses with practical are given below.

Components	Marks
Attendance	10
Lab involvement	10
Total	**20**

Marks for attendance

% of Attendance	Marks
90 and above	10
85 - 89	8
80 – 84	6
76 – 79	4
75	2

(Decimals shall be rounded mathematically to the nearest whole number)

Assignments

At least one assignment shall be submitted for each course.

4. **FINAL EVALUATION**

The final evaluation of theory and practical courses shall be conducted by the College/Department. It can be eighty marks written examination or eighty marks project/practical examination or eighty marks written and project/practical examination combined, as decided by the Board of Studies.

4.1 The question paper shall be strictly on the basis of model question paper set by Board of Studies.

4.2 A question paper may contain objective type, short answer type/annotation, short essay type questions/problems and long essay type questions.

4.3 The duration of written examination shall be decided by the respective Board of Studies and the duration of the practical examination shall be decided by the concerned course coordinator.

4.4 Practical examination shall be conducted by one internal examiner.

4.5 For all courses (theory and practical) an indirect grading system based on a seven (7) point scale according to the percentage of marks (ISA + ESA) is used to evaluate the performance of the student in that course. The percentage shall be rounded mathematically to the nearest whole number.

Percentage of Marks	Grade	Performance
95 and above	S	Outstanding
85 to below 95	A+	Excellent
75 to below 85	A	Very Good
65 to below 75	B+	Good
55 to below 65	B	Above Average
45 to below 55	C	Satisfactory
35 to below 45	D	Pass
Below 35	F	Failure

4.6 A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass in a course.

5. **ATTENDANCE**

The minimum requirement of aggregate attendance for appearing the final evaluation shall be 75%.

6. **BOARD OF STUDIES AND COURSES**

6.1 The Board of Studies concerned shall design the Add On Course offered by the department. The

Board shall design and introduce new Add On Course, modify or redesign existing Add On Course and replace any existing Add On course with new/modified Add On course to facilitate better exposure and training for the students.

6.2 The syllabus of an Add On course shall also include the title of the course, contact hours, the number of credits, reference materials and question paper pattern.

6.3 Each course shall have an alpha numeric code which includes programme code, abbreviation of the course in two letters, course code and serial number of the course

6.4 The Add On courses conducted under Credit Semester System shall be monitored by the Academic Council.

6.5 For redressing the complaints in connection with the conduct of Add On course, students shall approach the Grievance Redress Committee functioning in the college.

REGULATIONS FOR CERTIFICATE COURSE IN VALUE EDUCATION FOR UNDERGRADUATE PROGRAMMES

Value Education is a compulsory extra credit course for all the students admitted to the undergraduate programmes.

i. **Duration**

The duration of the course shall be three academic years (six semesters) spanning 60 hrs. There shall be minimum 20 hours in an academic year.

ii. **Evaluation**

The evaluation of each course shall contain two parts.

i.Continuous evaluation

ii. Final evaluation

There shall be a maximum of forty (40) marks for external assessment and ten (10) marks for internal assessment.

Continuous Evaluation

Assignment

The students are supposed to submit at least one assignment in every year and five (5) marks will be given for a submitted assignment

Attendance

The minimum requirement of aggregate attendance during a semester for appearing the end final examination shall be 75%.

Marks for attendance

Maximum of five (5) marks will be given for attendance as follows.

% of Attendance	Marks
90 and above	5
85-89	4
80-84	3
76-79	2
75	1

(Decimals shall be rounded off to the next higher whole number)

Final evaluation

The final examination shall be conducted by the course coordinator. The final assessment examination shall be conducted at the end of every year. There shall be an annual written examination of one and a half hours (1½) duration. The question paper shall be strictly on the basis of model question paper set by Expert Committee. A question paper consists of short answer type, short essay type and long essay type questions.

A separate minimum of 30% marks each for internal and external assessment (continuous and final evaluation) and aggregate minimum of 35% are required for a pass in a course.

iii. **Grading**

The total marks of the course shall be one hundred and fifty (150). The grading of the course is as follows:

Percentage of Marks	Grade	Performance
95 and above	S	Outstanding
85 to below 95	A+	Excellent
75 to below 85	A	Very Good
65 to below 75	B+	Good
55 to below 65	B	Above Average
45 to below 55	C	Satisfactory
35 to below 45	D	Pass
Below 35	F	Failure

iv. **Award of certificate**

The course is envisaged with three levels in three academic years. There shall be examination in every year. If a student does not acquire minimum marks he/she can continue with further levels. But he/ she shall be eligible to get certificate only after completing all the levels successfully. The certificate will be issued after completing all the levels with minimum grade D for the pass. On successful completion of the course, grade card shall be issued to the students indicating the grade. The college issues the certificate on value education to all the undergraduate students who successfully complete the course. The course shall be completed during the tenure of the programme.

REGULATIONS FOR COURSE ON BASIC LIFE SUPPORT SYSTEM AND DISASTER MANAGEMENT (BLS & DM)

i. The course on BLS & DM shall be conducted by a nodal centre created in the college.

ii. The nodal centre shall include at least one teacher from each department. A teacher shall be nominated as the Director of BLS & DM.

iii. The team of teachers under BLS & DM shall function as the trainers for BLS & DM.

iv. The team of teachers under BLS & DM shall be given intensive training on Basic Life Support System and Disaster Management and the team shall be equipped with adequate numbers of mannequins and kits for imparting the training to students.

v. Each student shall under go five (5) hours of hands on training in BLS & DM organised by the Centre for BLS & DM.

vi. The training sessions shall be organised on weekends/holidays/vacation during the first semester of the programme.

vii. After the completion of the training, the skills acquired shall be evaluated using an online test and grades shall be awarded.

viii. Nodal centre for BLS & DM shall conduct online test and publish the results.

ix. The grading of the course is as follows:

Percentage of Marks	Grade	Performance
95 and above	S	Outstanding
85 to below 95	A+	Excellent
75 to below 85	A	Very Good
65 to below 75	B+	Good
55 to below 65	B	Above Average
45 to below 55	C	Satisfactory
35 to below 45	D	Pass
Below 35	F	Failure

x. Students who could not complete the requirements of the BLS & DM training shall appear for the same along with the next batch. There shall be two redo opportunity.

xi. For redressing the complaints in connection with the conduct of BLS & DM students shall approach the Grievance Redress Committee functioning in the college.

REGULATIONS FOR SOCIAL AWARENESS PROGRAMME (SAP)

i. Social Awareness Programme shall be conducted by a nodal centre created in the college.

ii. The nodal centre shall include at least one teacher from each department. A teacher shall be nominated as the Director of the SAP.

iii. The centre shall identify the areas where the students can serve the society through the SAP.

iv. During the first semester itself, the centre for SAP shall organise programmes to sensitize the students about the significance and relevance of SAP and publish a list of different areas where they can work as volunteers. Students shall register their preferences (three) with the centre for SAP. The centre shall allot students to various areas based on their preference. For the preparation of the allotment list, the marks obtained in the higher secondary examination shall also be used as a criterion. Centre for SAP shall take the help of the Head of the concerned department and the mentor(s) of the concerned batch at the time of finalization of the allotment list.

v. Students shall carry out the voluntary work allotted to them after the regular class hours/weekends/holidays falling in the second semester or the summer vacation following the second semester.

vi. Evaluation of the SAP activity shall be based on the hours of work put in by a student. A minimum of 50 hours of social work (corresponding to 50 marks) is required for the successful completion of SAP. Every additional work beyond the minimum 50 hours shall fetch five (5) marks per hour. Maximum marks shall be 100. Students who donate blood during the second semester shall be given 10 marks upon the production of the certificate from the medical officer. However, Marks earned through blood donation shall not be counted for a pass in the programme. Mark for blood donation shall be awarded only once during the SAP.

vii. Upon completion of SAP, the marks earned and the grades awarded shall be published by the Director of SAP. The grading is as follows:

Percentage of Marks	Grade	Performance
95 and above	S	Outstanding
85 to below 95	A+	Excellent
75 to below 85	A	Very Good
65 to below 75	B+	Good
55 to below 65	B	Above Average
45 to below 55	C	Satisfactory
35 to below 45	D	Pass
Below 35	F	Failure

viii. Two credits shall be awarded to students who complete the requirements of SAP.

ix. Students who could not complete the requirements of the SAP shall appear for the same with the next batch. There shall be two redo opportunity.

x. For redressing the complaints regarding allotment, harassment at the place of work, and the marks and grades awarded students shall approach the Grievance Redress Committee functioning in the college.

xi. Director of SAP has the right to exclude students who are physically handicapped from SAP.

REGULATIONS FOR INTERNSHIP/SKILL TRAINING PROGRAMME

i. Every UG student shall undergo an internship for a minimum period of five days (25 hours) at a centre identified by the concerned department. In the case of disciplines where internship opportunities are scanty (eg. Mathematics) special skill training programmes with duration of five days (25 hours) shall be organised.

ii. Each department shall identify a teacher in charge for internship/skill training programme.

iii. The department shall select institutions for internship/organising skill training programme.

iv. Internship/skill training programme shall be carried out preferably during the summer vacation following the fourth semester or during the Christmas vacation falling in the fourth semester or holidays falling in the semester.

v. At the end of the stipulated period of internship each student shall produce an internship completion cum attendance certificate and an illustrated report of the training he/she has underwent, duly certified by the tutor and Head of the institution where the internship has been undertaken.

vi. Students undergoing skill training programme shall submit a training completion cum attendance certificate and a report of the training he/she has underwent, duly certified by the trainer, teacher co-ordinator of the programme from the concerned department and the head of the department concerned.

vii. Upon receipt of the internship completion cum attendance certificate and illustrated report of the training or a training completion cum attendance certificate and a report of the training, the teacher in charge of internship/skill training programme shall prepare a list of students who have completed the internship/skill training programme and a list of students who failed to complete the programme. Head of the department shall verify the lists and forward the lists to the Controller of Examinations.

viii. Students who could not complete the requirements of the internship/skill training programme shall appear for the same with the next batch. There shall be only one redo opportunity.

REGULATIONS FOR FINISHING SCHOOL

i. The training to help students develop their soft skills and interview skills, 'the finishing school', shall be coordinated by a nodal centre.

ii. The nodal centre shall include at least one teacher from each department. A teacher shall be nominated as the Director of the nodal centre.

iii. The training shall impart soft skills comprising of language skills, personal presentation and grooming, resume preparation, group discussion techniques, and interview skills among the undergraduate students.

iv. This course shall be conducted during the fifth semester for all the undergraduate students.

v. There will be a total of 20 contact hours which shall be handled by a team of professional members/faculty. In addition, a one-day outbound training session by a team of professional trainers that touches on the aspects of creativity, problem solving and team building shall also be organized.

vi. The students shall be assessed and grades shall be awarded based on the components as shown below.

Component	Marks
Attendance	5
Class Test	10
Assignments	10
Group discussion	10
Interview	15
Total	**50**

vii. The grading of the course is as follows:

Percentage of Marks	Grade	Performance
95 and above	S	Outstanding
85 to below 95	A+	Excellent
75 to below 85	A	Very Good
65 to below 75	B+	Good
55 to below 65	B	Above Average
45 to below 55	C	Satisfactory
35 to below 45	D	Pass
Below 35	F	Failure

viii. For redressing the complaints in connection with the conduct of finishing school students shall approach the Grievance Redress Committee.

VIRTUAL LAB EXPERIMENTS/MOOC COURSES

i. There shall be a Nodal officer and a team of teachers to coordinate the logistics for conducting Virtual Lab experiments and MOOC courses and to authenticate the claims of the students regarding the successful completion of the Virtual Lab experiments and or MOOC courses.

ii. Students who are desirous to do Virtual Lab experiments and or MOOC courses shall register with the Nodal officer at the beginning of the experiment session/MOOC course. Students also shall submit proof of successful completion of the same to the Nodal officer.

iii. Upon receipt of valid proof, the nodal officer shall recommend, to the Controller of Examinations, the award of extra credits. In the case of Virtual Lab experiments, 36 hours of virtual experimentation shall equal one credit and in the case of MOOC courses 18 hours of course work shall equal one credit.

iv. College shall arrange infrastructure for taking up Virtual Lab experiments and/or MOOC courses.

Model Markcum Grade Card

St Berchmans College
Founded 1922
AUTONOMOUS | College with Potential for Excellence | Reaccredited by NAAC with A Grade
Affiliated to Mahatma Gandhi University, Kottayam, Kerala
Changanassery, Kottayam, Kerala, India-686101

MARK CUM GRADE CARD

Date:

Name of the Candidate :

Permanent Register Number (PRN) :

Degree :

Programme :

Stream :

Name of Examination :

Photo

Course Code	Course Title	Credits (C)	Marks						Grade Awarded (G)	Grade Point (GP)	Credit Point (CP)	Institution Average	Result
			ISA		ESA		Total						
			Awarded	Maximum	Awarded	Maximum	Awarded	Maximum					
	Common Course I												
	Common Course II												
	Core Course												
	Complementary Course												
	Complementary Course												
	Total												
	Weighted Average Score												
	Semester Result												
	SGPA												
	End of Statement												

Entered by:

Verified by:

Controller of Examinations **Principal**

St Berchmans College
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Affiliated to Mahatma Gandhi University, Kottayam, Kerala
Changanassery, Kottayam, Kerala, India - 686101, Tel: 91-481-2420025, 9961231314
E-mail: sbc@sbcollege.org Web: www.sbcollege.ac.in

CONSOLIDATED MARK CUM GRADE CARD

Photo

Name of the Candidate :

Permanent Register Number (PRN) :

Degree :

Programme :

Stream :

Date :

Course Code	Course Title	Credits (C)	Marks						Grade Awarded (G)	Grade Point (GP)	Credit Point (CP)	Institution Average	Result
			ISA		ESA		Total						
			Awarded	Maximum	Awarded	Maximum	Awarded	Maximum					
SEMESTER I													
	Common Course I **Common Course II** **Core Course** **Complementary Course** **Complementary Course**												

SEMESTER II													
	Common Course I **Common Course II** **Core Course** **Complementary Course** **Complementary Course**												
SEMESTER III													
	Common Course I **Common Course II** **Core Course** **Complementary Course** **Complementary Course**												
SEMESTER IV													
	Common Course I **Common Course II** **Core Course** **Complementary Course** **Complementary Course**												
SEMESTER V													
	Core Course **Open Course**												
SEMESTER VI													
	Core Course **Project**												

SEMESTER RESULTS

Semester	Marks Awarded	Maximum Marks	Credits	SGPA	Grade	Month & Year of Passing	Result
I							
II							
III							
IV							
V							
VI							

PROGRAMME PART RESULTS

Programme Part	Marks Awarded	Maximum Marks	Credits	CGPA	Grade
Common Course I:					
Common Course II:					
Core Course:					
Complementary Course:					
Complementary Course:					
Open Course:					
Total					

FINAL RESULT

CUMULATIVE GRADE POINT AVERAGE (CGPA) =

GRADE =

*** Separate grade card is issued for Audit and Extra Credit courses.**
**** Grace Mark awarded.**

Entered by:

Verified by:

Controller of Examinations **Principal**

Reverse side of the Mark cum Grade Card (COMMON FOR ALL SEMESTERS)

Description of the Evaluation Process

Grade and Grade Point

The evaluation of each course comprises of internal and external components in the ratio 1:4 for all Courses. Grades and Grade Points are given on a seven (7) point scale based on the percentage of Total Marks (ISA + ESA) as given in Table 1. Decimals are corrected to the nearest whole number.

Credit Point and Grade Point Average

Credit Point (CP) of a course is calculated using the formula

CP = C × GP

where C is the Credit and GP is the Grade Point

Grade Point Average of a Semester (SGPA) or Cumulative Grade Point Average (CGPA) for a Programme is calculated using the formula

SGPA or CGPA = TCP/TC

where TCP is the Total Credit Point for the semester/programme and TC is the Total Credit for the semester/programme

GPA shall be rounded off to two decimal places.

The percentage of marks is calculated using the formula;

$$\% \text{ Marks} = \left(\frac{\text{total marks obtained}}{\text{maximum marks}}\right) \times 100$$

Percentage of Marks	Grade	Performance	Grade Point
95 and above	S	Outstanding	10
85 to below 95	A+	Excellent	9
75 to below 85	A	Very Good	8
65 to below 75	B+	Good	7
55 to below 65	B	Above Average	6
45 to below 55	C	Satisfactory	5
35 to below 45	D	Pass	4
Below 35	F	Failure	0

Table 1

Grades for the different Semesters and overall Programme are given based on the corresponding GPA, as shown in Table 2.

GPA	Grade	Performance
9.5 and above	S	Outstanding
8.5 to below 9.5	A+	Excellent
7.5 to below 8.5	A	Very Good
6.5 to below 7.5	B+	Good
5.5 to below 6.5	B	Above Average
4.5 to below 5.5	C	Satisfactory
3.5 to below 4.5	D	Pass
Below 3.5	F	Failure

Table 2

Weighted Average Score (WAS) is the score obtained by dividing sum of the products of marks secured and credit of each course by the total credits of that semester/programme and shall be rounded off to two decimal places.

Note: Course title followed by (P) stands for practical course. A separate minimum of 30% marks each for internal and external assessments (for both theory and practical) and an aggregate minimum of 35% marks is required for a pass in each course. For a pass in a programme, a separate minimum of Grade D for all the individual courses and an overall Grade D or above are mandatory. If a candidate secures Grade F for any one of the courses offered in a Semester/Programme, only Grade F will be awarded for that Semester/Programme until the candidate improves this to Grade D or above within the permitted period.

PROGRAMME STRUCTURE

Semester I

Sl. No.	Course	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
2	Common Course I	4	3	100
3	Common Course II	4	4	100
4	Core Course	2	2	75
5	Core Course Practical	2	Evaluation at the end of Semester II	
6	Complementary Course: Chemistry	2	2	75
7	Complementary Course Practical: Chemistry	2	Evaluation at the end of Semester II	
8	Complementary Course: Botany	2	2	75
9	Complementary Course Practical: Botany	2	1	25
	Total	**25**	**18**	**550**

Semester II

Sl. No.	Course	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
2	Common Course I	4	3	100
3	Common Course II	4	4	100
4	Core Course	2	2	75
5	Core Course Practical	2	2	50
6	Complementary Course: Chemistry	2	2	75
7	Complementary Course Practical: Chemistry	2	2	50
8	Complementary Course: Botany	2	2	75
9	Complementary Course Practical: Botany	2	1	25
	Total	**25**	**22**	**650**

Semester III

Sl. No.	Course	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
2	Common Course II	5	4	100
3	Core Course	3	3	75
4	Core Course Practical	2	Evaluation at the end of Semester IV	
5	Complementary Course: Chemistry	3	3	75
6	Complementary Course Practicals: Chemistry	2	Evaluation at the end of Semester IV	
7	Complementary Course: Botany	3	3	75
8	Complementary Course Practicals: Botany	2	1	25
	Total	**25**	**18**	**450**

Semester IV

Sl. No.	Course	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
2	Common Course II	5	4	100
3	Core Course	3	3	75
4	Core Course Practical	2	2	50
5	Complementary Course: Chemistry	3	3	75
6	Complementary Course Practicals: Chemistry	2	2	50
7	Complementary Course: Botany	3	3	75
8	Complementary Course Practicals: Botany	2	1	25
	Total	**25**	**22**	**550**

Semester V

Sl. No.	Course	Hours/ Week	Credit	Marks
1	Core Course	3	3	75
2	Core Course	3	3	75
3	Core Course	4	3	75
4	Core Course	4	3	75
5	Core Course Practical	2	Evaluation at the end of Semester VI	
6	Core Course Practical	2		
7	Core Course Practical	2		
8	Core Course Practical	2		
9	Open Course	3	3	100
	Total	**25**	**15**	**400**

Semester VI

Sl. No.	Course	Hours/ Week	Credit	Marks
1	Core Course	4	3	75
2	Core Course	3	3	75
3	Core Course	3	3	75
4	Core Course	3	3	75
5	Elective Course	4	3	75
6	Core Course Practical	2	2	50
7	Core Course Practical	2	2	50
8	Core Course Practical	2	2	50
9	Core Course Practical	2	2	50
10	Field Course for Core Elective	-	1	25
11	Investigatory Project	-	1	100
	Total	**25**	**25**	**700**
	Grand Total	**-**	**120**	**3300**

OUTLINE OF THE CORE COURSES

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
Semester I							
BBZO101	Fundamentals of Biodiversity and Biosystematics *(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)*	2	36	2	15	60	75
	Biodiversity and Evolutionary Biology (P) *(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)*	2	36	Evaluation at the end of Semester II			
Semester II							
BBZO202	Evolutionary Biology and Zoogeography *(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)*	2	36	2	15	60	75
BBZO2P01	Biodiversity and Evolutionary Biology (P) *(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)*	2	36	2	10	40	50
Semester III							
BBZO303	Animal Diversity - Non Chordata *(Common for BSc Zoology and BScZoology & Industrial Microbiology programmes)*	3	54	3	15	60	75
	Animal Diversity (P) *(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)*	2	36	Evaluation at the end of Semester IV			
Semester IV							
BBZO404	Animal Diversity – Chordata *(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)*	3	54	3	15	60	75
BBZO405	Research Methodology and Biostatistics *(For BSc Zoology & Industrial Microbiology programme)*	2	36	2	20	80	100
BBZO4P02	Animal Diversity (P) *(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)*	2	36	2	10	40	50
Semester V							
BBZO506	Research Methodology, Instrumentation and Biostatistics *(For BSc Zoology programme)*	3	54	3	15	60	75
BBZO507	Cell Biology and Molecular Biology *(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)*	3	54	3	15	60	75
BBZO508	Environmental Biology and Human Rights *(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)*	4	72	3	15	60	75
BBZO509	Biochemistry and Physiology *(For BSc Zoology programme)*	4	72	3	15	60	75
BBZO510	Animal Physiology *(For BSc Zoology & Industrial Microbiology programme)*	3	54	3	15	60	75
	Cell Biology, Genetics and Bioinformatics (P) *(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)*	2	36	Evaluation at the end of Semester VI			
	Ecology and Developmental Biology (P) *(Common for BSc Zoology and Zoology & Industrial Microbiology programmes)*	2	36				
	Biochemistry, Physiology, Endocrinology and Ethology (P) *(For BSc Zoology programme)*	2	36				

	Instrumentation, Biostatistics, Microbiology and Immunology (P) *(ForBSc Zoology programme)*	2	36	Evaluation at the end of Semester VI			
	Animal Physiology, Endocrinology and Ethology (P) *(For BSc Zoology & Industrial Microbiology programme)*	2	36				
Semester VI							
BBZO611	Genetics, Biotechnology and Bioinformatics *(For BSc Zoology programme)*	4	72	3	15	60	75
BBZO612	Microbiology and Immunology *(For BSc Zoology programme)*	3	54	3	15	60	75
BBZO613	Endocrinology, Reproductive Biology and Ethology *(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)*	3	54	3	15	60	75
BBZO614	Developmental Biology *(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)*	3	54	3	15	60	75
BBZO615	Genetics and Bioinformatics *(For BSc Zoology & Industrial Microbiology programme)*	3	54	3	15	60	75
BBZO6P03	Cell Biology, Genetics and Bioinformatics (P) *(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)*	2	36	2	10	40	50
BBZO6P04	Ecology and Developmental Biology (P) *(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)*	2	36	2	10	40	50
BBZO6P05	Biochemistry, Physiology, Endocrinology and Ethology (P) *(For BSc Zoology programme)*	2	36	2	10	40	50
BBZO6P06	Instrumentation, Biostatistics, Microbiology and Immunology (P) *(ForBSc Zoology programme)*	2	36	2	10	40	50
BBZO6P07	Animal Physiology, Endocrinology and Ethology (P) *(For BSc Zoology & Industrial Microbiology programme)*	2	36	2	10	40	50
BBZO6PJ	Investigatory Project	-	-	1	20	80	100

ELECTIVE COURSES FOR BSC ZOOLOGY PROGRAMME

Any one of the following theory course and its corresponding field course may be opted by the students of BSc Zoology programme during Semester VI.

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
BBZO6E01	Wildlife Biology, Conservation and Management	4	72	3	15	60	75
BBZO6F01	Wildlife Biology Field Course	-	-	1	5	20	25
BBZO6E02	Eco-Tourism	4	72	3	15	60	75
BBZO6F02	Eco-Tourism Field Course	-	-	1	5	20	25

OUTLINE OF COMPLEMENTARY COURSES FOR BSc BOTANY AND BSc BOTANY & BIOTECHNOLOGY PROGRAMMES

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
Semester I							
BDZO101	Animal Diversity – Non Chordata	2	36	2	15	60	75
	Animal Diversity (P)	2	36	Evaluation at the end of Semester II			
Semester II							
BDZO202	Animal Diversity – Chordata	2	36	2	15	60	75
BDZO2P01	Animal Diversity (P)	2	36	2	10	40	50
Semester III							
BDZO303	Human Physiology and Immunology	3	54	3	15	60	75
	Human Physiology and Applied Zoology (P)	2	36	Evaluation at the end of Semester IV			
Semester IV							
BDZO404	Applied Zoology	3	54	3	15	60	75
BDZO4P02	Human Physiology and Applied Zoology (P)	2	36	2	10	40	50

OPEN COURSE

Course Code	Course Title	Hours /Week	Total Hours	Credit	ISA	ESA	Total
BOZO501	Health and Wellness	3	54	3	20	80	100

ADD ON COURSE

Course Code	Course Title	Total Hours	Credit	CE	FE	Total
BZOEX01	Ornamental Fisheries and Aquarium Management	36	2	20	80	100

SEMESTER I

BBZO101: FUNDAMENTALS OF BIODIVERSITY AND BIOSYSTEMATICS

(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)

Total Hours:36

Credit: 2

Course Objectives:

- To create appreciation on diversity of life on earth
- To understand different levels of biological diversity
- To familiarize taxa level identification of animal
- To learn biodiversity estimation techniques
- To create interest in conservation of biodiversity

Course Outcome:

- Identify and list out common animals
- Knowledge on biodiversity and its conservation
- Knowledge on biological classification and representative organism of major taxa

PART I – BIODIVERSITY (24 hrs)

Module I - Introduction to Biodiversity (12 hrs)

Biodiversity and its significance; Biodiversity as a natural resource

Levels of biodiversity - species, domesticated, genetic, alpha, beta, gamma.

Biodiversity distribution - tropical, temperate and polar

Biological hot spots- significance, global, Indian

Western ghats - ecological, social, cultural and economic aspects

Values of biodiversity; Threats to biodiversity; Role of invasive species

Module II - Conservation & Management of Biodiversity (8 hrs)

Need for biodiversity conservation; Global measures; 3Rs in biodiversity

Importance of wetlands; Types of wetlands; Significance of mangroves; Importance of Kuttanad biodiversity.

Endemic species and their conservation; Red Data Book and its significance; Conservation methods: Ex- situ, In-situ

Module III - Biodiversity Estimation **(4 hrs)**

Biodiversity aspects: species richness, abundance, evenness

Biodiversity indices: Shannon- Weinner index, Simpson index, Pilou's index

Sampling techniques: Quadrate, Transect

Remote sensing

PART II - BIOSYSTEMATICS (12 hrs)

Module IV - Introduction to Biosystematics **(4 hrs)**

Importance of systematics; Animal classification-hierarchy; ICZN code; Nomenclature: Linnaean, Trinomial

Morphological, numerical and phylogenetic systems of classification; DNA bar-coding

Module V - Animal collection and preservation techniques **(8 hrs)**

Collection and preservation techniques

Taxidermy - definition and methods, (reptiles, birds and mammals)

References:

1. Andrew S. Pullin 2002. Conservation Biology. Cambridge University Press, Cambridge, UK.
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3. Forman, R.T and M. Gordaon. 1986. Landscape Ecology. John Wiley &Sons, NY, USA.
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6. Karunakaran, C.K. 2003. Politics of vanishing forests in Kerala. Kerala Sastra Sahitya Parishat, Thiruvananthapuram.
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8. Myers, Norman.1984. The Primary Source: Tropical Forests and Our Future. W.W. Nortan & Company, NY, USA
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10. Ramesh, B.R and Rajan Gurukkal., 2007. Forest Landscapes of the Southern Western Ghats, India Biodiversity, Human Ecology and management Strategies. French Institute of Pondicherry, India.
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12. Supriyo Chakraborty. 2004, Biodiversity. Pointer Publishers, Jaipur, India.

SEMESTER II

BBZO202: EVOLUTIONARY BIOLOGY AND ZOOGEOGRAPHY

(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)

Total Hours:36

Credit: 2

Course Objectives:

- To acquire knowledge about the evolutionary history of earth (living and non-living)
- To learn various tools and techniques for evolutionary studies
- To study the distribution of animals on earth, its pattern, evolution and causative factors

Course Outcomes:

- Understand the evidence for evolution
- Understand that evolution entails changes in the genetic composition of populations
- Understand the pattern and the distribution of animals on earth

PART I – EVOLUTIONARY BIOLOGY (27 hrs)

Module I –Origin and History of life (3 hrs)

Introduction, Chemical evolution, Miller-Urey experiment, Haldane and Oparin theory

Geological time scale, Mass extinction

Module II – Theories of organic evolution (5 hrs)

Lamarckism- principles, examples and criticism

Darwinism- Natural selection theory, examples and criticism

Modern Synthetic theory (Neo Darwinism)

Neutral theory of molecular evolution

Module III – Evidences for evolution (5 hrs)

Evidences from morphology and anatomy, Physiology and biochemistry, Embryology, Palaeontology

Types of fossils, Dating of fossils

Module IV – Patterns of evolution **(4 hrs)**

Adaptive radiation, convergent evolution and parallel evolution

Microevolution, Macroevolution and Mega evolution

Gradualism, case study of horse evolution; Punctuated equilibrium, case study of foraminiferans

Module V – Population genetics and evolution **(5 hrs)**

Genetic basis of variation, Hardy Weinberg equilibrium, Change in gene frequencies, Factors affecting gene frequencies

Module VI – Species and speciation **(5 hrs)**

Species concept – Morphological, biological, evolutionary and phylogenetic Speciation – types and mechanism; Isolating mechanisms

PART II – ZOOGEOGRAPHY (9 hrs)

Module VII – Zoogeographical Realms **(5hrs)**

Origin of continents- Plate tectonics/ continental drift

Zoogeographical realms; Biogeography of India

Insular fauna: Continental Island- Madagascar; Oceanic Island- Galapagos

Module VIII – Animal Distribution **(4 hrs)**

Kinds of animal distribution

Factors and means of animal distribution

Barriers in animal distribution

References:

Evolutionary Biology

1. Barnes, C.W. 1988. Earth, Time and Life. John Wiley &Sons, New York
2. Bull J.J and H. A. Wichman. 2001. Applied Evolution. Annu. Rev. Ecol. Syst. 32:183-217
3. Chattopadhyay Sajib. 2002. Life: Origin, Evolution and Adaptation. Books and Allied (P) Ltd.Kolkata,India.
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10. Verma P.S. and Agarwal V.K, 2007 Cell biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company, New Delhi

Zoogeography

1. A.R. Wallace, 1962. The geographical distribution of animals. Hafner Publ. Co.
2. Alfred Russel Wallace, 1876. The Geographical Distribution of Animals, With a Study of the Relations of Living and Extinct Faunas as Elucidating the Past Changes of the Earth's Surface,: Harper and Brothers, New York
3. Frank Evers Beddard, 2008. A Text-Book of Zoogeography. BiblioBazaar, LLC, USA
4. S K Tiwari, Faunal Regions of the World. Vedams eBooks (P) Ltd, New Delhi, India.
5. Shivkumar Tiwari, 1985. Readings in Indian Zoogeography (vol.1). Today & Tomorrow Printers & Publishers, New Delhi
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PRACTICAL

BBZO2P01: BIODIVERSITY AND EVOLUTIONARY BIOLOGY

(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)

Total Hours:36

Credit: 2

Course Objectives:

- To understand the unity of life with the rich diversity of organisms and their ecological and evolutionary significance

Course Outcomes:

- Students will analyze structural-functional relationships in biological organs, tissues and cells as developed through evolutionary mechanisms

PART A: BIODIVERSITY

1. Sampling
2. Quadrate study
3. Transect study
4. Species area curve
5. Identification of Biodiversity hot spots using Google Earth
6. Identification using keys (4 specimens each)
   - Insect
   - Fish
   - Snake
7. Taxa identification techniques
   - Bird body parts
   - Butterfly/ dragonfly body parts and venation
8. Simple identification of any 20 local animals representing different taxa
   - Common name and scientific name
9. Field study:

   Visit a biodiversity rich area and submit a report on the biodiversity and conservation efforts there. (*Individual report should be submitted by each student.*)

PART B: EVOLUTIONARY BIOLOGY

1. Identification of Zoogeographical realms using Google Earth
2. Study of endemic species of each realm
3. Study of evolution of animals using Virtual lab
4. Study of Homology / Analogy
5. Study of connecting links
6. Study of living fossils
7. Study of Geological time scale
8. Study of vestigial organs
9. Calculation of gene/ allele frequency using Hardy- Weinberg equilibrium
10. Identification of Drosophila mutants

SEMESTER III

BBZO303: ANIMAL DIVERSITY- NON CHORDATA

(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)

Total Hours:54

Credit: 3

Course Objectives:

- To study the scientific classification of invertebrate fauna
- To learn the physiological and anatomical peculiarities of some invertebrate phyla through type study
- To learn the evolutionary significance of various invertebrate fauna
- To stimulate the curiosity in living things around them.

Course Outcomes:

- Identify and list out various invertebrate fauna
- Acquire knowledge on invertebrate classification and representative organism of major taxa

Module I - Introduction to Invertebrates **(2 hrs)**

Outlines of classification

Phylogeny- cell number, embryology and body symmetry, developmental pattern

Module II - Kingdom Protista **(7 hrs)**

General characteristics and outline classification

Type: Paramecium

Life history of parasitic protozoan –Plasmodium

A brief description of Entamoeba, Trypanosoma, Leishmania.

Module III - Kingdom Animalia **(1hr)**

Outline classification; Mesosoa and Metazoa

Phylum Mesozoa - Rhopalura

Module IV – Subkingdom Metazoa **(2 hrs)**

Levels of animal organization; Body layers; Symmetry; Coelom; Metamerism

Germ layers; Protostomes and Dueterostomes; Cephalisation

Body plan of animals- Blind sac and Tube within tube

Module V – Phylum Porifera & Placozoa (2 hrs)

Phylum Porifera: General characteristics; Outline classification; Canal system in Sponges

Class Calcarea - Leucosollenia

Class Desmospongia - Spongilla

Class Hexactinellida – Euplectella

Phylum Placozoa - *Trycoplax adherens*

Module VI – Phylum Coelenterata (3 hrs)

General characteristics; Outline classification

Class Hydrozoa – Hydra, Obelia

Class Scyphozoa - Aurelia

Class Anthozoa - Sea Anemone

Polymorphism in Coelentrates; Coral reefs with reference to Indian ocean; Threats and conservation of coral reefs

Module VII – Phylum Ctenophora (1 hr)

Major characteristics (Mention the affinities of Ctenophores)

Pleurobrachia

Module VIII - Phylum Platyhelminthes (5 hrs)

General characteristics; Outline classification

Class Turbellaria - Bipalium

Class Digenea(Trematoda) - Fasciola and its life cycle

Class Aspidogastra - Aspidogaster

Class Monogenea - Entobdella

Class Cestoda - Tape worm

Module IX – Phylum Aschelminthes (4 hrs)

General characteristics; Outline classification

Class Nematoda - Ascaris

Class Nematomorpha - Gordius

Class Gastrotrichia - Chaetonotus

Class Kinorhyncha - Echinoderes

Brief study of Parasitic nematodes -Enterobius, Blood fluke, Hook worm, Filarial worm

Module X – Phylum Annelida **(4 hrs)**

General characteristics; Outline classification

Class Polychaeta - Nereis

Class Archiannelida - Polygordis

Class Oligochaeta - Earth worm

Class Hirudinea – Hirudinaria, Haemadipsa

Vermicomposting; Economically important earthworm species

Module XI - Phylum Arthropoda **(13 hrs)**

General characteristics; Outline classification

Type: Penaeus

Subphylum Trilobitomorpha

Class Trilobita (Extinct)

Subphylum Chelicerata

Class Merostoma – Limulus

Class Arachinida – Spider

Class Pycnogonida – Nymphon

Subphylum Mandibulata

Class Crustacea – Daphnia

Class Chilopoda - Centepede

Class Symphyla - Scutigerella

Class Diplopoda - Millipede

Class Pauropoda - Pauropus

Class Insecta – Butterfly

Beneficial Insects: Honey bee, Lac insect, Silk insect

Vectors and vector borne diseases: Dengue, JE, Chickungunya

Insect pests of agricultural importance – Paddy, Coconut

Pests of Fruits and Vegetables(Brief mention only)

Prawn and Lobster fisheries

Module XII - Phylum Mollusca **(4 hrs)**

General characteristics; Outline classification

Class Monoplacophora - Neopilina

Class Amphineura - Chiton

Class Scaphopoda - Dentalium

Class Gastropoda - Pila

Class Bivalvia - Lamellidens

Class Cephalopoda - Loligo

Pearl culture and Mussel culture

Module XIII – Phylum Echinodermata (**3 hrs)**

General characteristics; Outline classification

Class Asteroidea – Astropecten

Class Ophiuroidea - Ophiothrix

Class Echinoidea – Echinus

Class Holothuroidea – Cucumaria

Class Crinoidea – Antedon

Water vascular system in Echinoderms

Module XIV - Phylum Hemichordata **(1hr)**

General characteristics –Balanoglossus

Module XV - Minor Phyla **(2 hrs)**

Sipunculida; Chaetognatha; Rotifera; Onychophora, Acantocephala

References:

1. Barnes, R.D., 1987. Invertebrate Zoology W.B. Saunders, New York.
2. Barrington, E.J.W., 1967. Invertebrate Structure and function ELBS and Nelson , London.
3. Bernhard Grzimek, 2003, Grzimek's Animal Life Encyclopedia, 17 Volumes, Gale Publishers, Michigan, USA
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10. Mayer, E. 1980. Principles of Systematic Zoology, Tata McGraw Hill Publishing Co., New Delhi.
11. Nair, K.K. Ananthakrishnan, T.N. David, B.V. 1976. General and Applied Entomology, T.M.H. New Delhi.
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13. P S Verma, E L Jordon, 2009, Invertebrate Zoology, S Chand Publishers, New Delhi

SEMESTER IV

BBZO404: ANIMAL DIVERSITY – CHORDATA

(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)

Total Hours:54

Credit: 3

Course Objectives:

- To make the student observe the diversity in chordates and their systematic position
- To learn the physiological and anatomical peculiarities of some vertebrate phyla through type study
- To make them aware of the evolutionary significance and economic importance of different vertebrate classes

Course Outcomes:

- Identify and list out various vertebrate fauna
- Acquire knowledge on vertebrate classification and representative organism of major taxa

Module I - Introduction to Phylum Chordata **(1 hr)**

General characteristics

(Classification up to order – Sub Phylum, Super class, Class, Sub class, Order)

Module II - Sub phylum Urochordata **(3 hrs)**

Class I : Larvacea - Oikopleura

Class II: Ascidiacea - Ascidia (Mention Retrogressive Metamorphosis)

Class III: Thaliacea - Doliolum

Module III - Sub phylum Cephalochordata **(1 hr)**

Amphioxus

Module IV - Division Agnatha **(2 hrs)**

Class I: Ostracodermi - Cephalaspis

Class II: Cyclostomata - Petromyzon, Myxine

Module V - Division Gnathostomata **(12 hrs)**

Super class Pisces

Class I: Chondrichthyes

Sub class Elasmobranchi - Narcine

Sub class Holocephali - Chimaera

Class II: Osteichthyes

Sub class Choanichthyes

Order I: Crossopterigii - Latimeria

Order II: Dipnoi - Lepidosiren

Sub class Actinopterygii

Super order 1. Chondrostei - Acipencer

Super order 2. Holostei - Amia

Super order 3. Teleostei – Sardine

Accessory respiratory organs in fish; Scales in fishes; Common culture fishes of Kerala(traditional and recent trends)

Fresh water fishes of Kerala (Brief mention only)

Module VI - Super class Tetrapoda **(4 hrs)**

Class: Amphibia

Order I: Anura - Euphlyctis

Order II: Urodela - Amblystoma (Axolotl larva and neoteny)

Order III: Apoda - Ichthyophis

Frogs and toads of Kerala(Brief mention only)

Module VII – Class Reptilia **(5 hrs)**

Sub class I: Anapsida

Order Chelonia - Chelone

Sub class II: Parapsida - Ichthyosaurus

Sub class III: Diapsida

Order I Rhynchocephalia - Sphenodon

Order II Squamata - Chamaleon

Sub class IV: Synapsida - Cynognathus

Identification of poisonous and non poisonous snakes; Snakes of Kerala

Module VIII - Class Aves **(6 hrs)**

Sub class I: Archaeornithes - Archaeopteryx (Affinities)

Sub class II: Neornithes

Super order I: Palaeognathae - Struthio

Super order II: Neognathae - Brahminy kite

Flight adaptations in birds; Migration in Birds;

Birds of Kerala(Brief mention only)

Module IX - Class Mammalia **(20 hrs)**

Type: *Homo sapiens*

Tissue types

Anatomy of following systems:

Digestive system

Circulatory system: structure of heart, arteries, veins and capillaries; mention Lymphatic system

Respiratory system: Larynx, Trachea, Bronchi, Lungs, Alveoli

Nervous system: Structure of neuron and brain

Excretory system: Structure of Kidney

Sub class I: Prototheria - Echidna

Sub class II: Metatheria - Macropus

Sub class III: Eutheria

Order 1. Insectivora - Talpa

Order 2. Dermoptera - Galeopithecus

Order 3. Chiroptera - Pteropus

Order 4. Primates - Loris

Order 5. Carnivora - Panthera

Order 6. Edentata - Armadillo

Order 7. Pholibota - Manis

Order 8. Proboscidea - Elephas

Order 9. Hydracoidea - Procavia

Order 10. Sirenia - Dugong

Order 11. Perissodactyla - Zebra

Order 12. Artiodactyla - Cameleus

Order 13. Lagomorpha - Oryctolagus

Order 14. Rodentia - Porcupine

Order 15. Tubulidentata - Orycteropus

Order 16. Cetacea - Delphinus

Dentition in Mammals; Aquatic Mammals

Mammals of Kerala (Brief mention only)

References:

1. Ashok Captain and Romulus Whitake, 2008. Snakes of India -The Field Guide. Draco Books.
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3. Charpurey K. G., 2008. The Snakes Of India. Westland Publishers, Chennai
4. Daniel J.C., 2002. The Book of Indian Reptiles and Amphibians First Edition. Oxford University Press
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12. Kotpal R.L., 2000. Modern Text Book of zoology, Vertebrates, Rastogi Publications, Meerut.
13. Murthy TSN, 2009. A Pocket Book on Indian Reptiles (Crocodiles, Testudines, Lizards and Snakes). Nature Books, New Delhi
14. Murthy TSN, 2010. The Reptile fauna of India. Neha Publishers & Distributors
15. Nigam and Sobti, 2000. Functional Organization of Chordates. Shoban Lal Nagin Chand and Co. New Delhi.
16. Salim Ali, 1996. The book of Indian birds. Bombay Natural History Society.
17. Sashikumar C, 2011. Birds of Kerala: Status and Distribution. DC Books Pvt Ltd.

18. Vivek Menon, 2009. Mammals of India. Princeton University Press.USA
19. Vivek Menon and J. C. Daniel, 2003. A field guide to Indian mammals. Dorling Kindersley, India in association with Penguin Book, India
20. Young J.Z. 2006. The life of Vertebrates Oxford University Press (Third Ed.) India

BBZO405: RESEARCH METHODOLOGY AND BIOSTATISTICS

(Only for BSc Zoology & Industrial Microbiology programme)

Total Hours:36

Credit: 2

Course Objectives:

- Acquire basic skills in the observation and study of nature, experimental skills and scientific investigation
- Acquire knowledge on basic research methods and statistical analysis
- Apply various techniques in developing experimental design
- Appreciate limitations of conclusions drawn from experimental data

Course Outcomes:

- Learn the research and statistical analysis pr
- Demonstrate skill in relevant literature analysis, experimental design, performance of experimental protocols and statistical analysis of results
- Deveolop skills for oral and written communication of research findings

PART I - RESEARCH METHODOLOGY (24 hrs)

Module I - Introduction (4 hrs)

Basic concepts of research: Meaning, Objectives

Types of Research: Descriptive/Analytical, Applied/Fundamental, Quantitative/Qualitative, Conceptual/Empirical

Module II - Research Design (4 hrs)

Basic principles; Meaning, need and features of good design; Types of research designs

Module III – Research Documentation & Presentation (4 hrs)

Scientific documentation and communication; Research report writing (Thesis and dissertations, Research articles, Oral communications); Bibliography formats; Plagiarism

Presentation techniques: Assignment, Seminar, Debate, Workshop, Colloquium, Conference

Module IV – Measurements (8 hrs)

Units of measurements; Calculations and related conversions of measurement units

Metric system- length; surface; weight; Square measures; Cubic measures; Volumetric; Circular or angular measure

Concentration - percent volume; ppt; ppm

Chemical – Molarity, Normality

Temperature- Celsius, centigrade, Fahrenheit

Module V - Bioethics **(4 hrs)**

Introduction; Animal rights and animal laws in India; Animal use in research and education; Laboratory animal use, care and welfare; Animal protection initiatives; Animal Welfare Board of India

Working with Humans: harm, risk, and benefits; Consent.

PART II – BIOSTATISTICS (12 hrs)

Module VI - Sample & Sampling techniques **(5 hrs)**

Collection of data; Classification of data; Frequency distribution tables

Graphical representation: - Bar diagrams, Histogram, Pie diagram and Frequency curves

Module VII - Measures of Central Tendency **(2 hrs)**

Mean, Median, Mode (Direct method only)

Module VIII - Measures of dispersion **(5 hrs)**

Range; Quartile Deviation; Mean Deviation; Standard Deviation; Standard error (Merits & demerits)

References:

Research Methodology

1. Anderson, J, Durston, B.H. and Poole, M. 1992. Thesis and assignment writing. Wiley Eastern Ltd.
2. Baker Kathy (Ed.), 1998, At the Bench: A Laboratory Navigator, Cold Spring Harbor Laboratory Press, New York,
3. Day, R.A. 1993. How to write and publish a scientific paper. Cambridge University Press.
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7. Marie, M. 2005. Animal Bioethics: Principles and Teaching Methods Wageningen Academic Publishers
8. Ruxton, G.D. and Colegrave, N. 2006. Experimental design for the life sciences. Oxford University Press. Chapters 1-6.
9. Sateesh, M.K. 2008 Bioethics and Biosafety;I.K. International Publishing House

Biostatistics

1. Bailey,N.T.J. 1994. Statistical Methods in Biology (3rd ed). Cambridge University Press.
2. Chap T.Le.2003. Introductory Biostatistics. John Wiley &Sons, NJ, USA.
3. Daniel, W.W. 2006. Biostatistics: A Foundation for Analysis in the Health Sciences (7th edn). John Wiley & Sons, New York.
4. Sundar Rao,P.S.S and J.Richard.2006.Introduction to Biostatistics and Research Methods (4th edn). Prentice Hall, New Delhi.
5. Zar, Jerrold H. 2008. Biostatistical Analysis (3rdedn.). Pearson Education Inc., New Delhi.
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PRACTICAL

BBZO4P02: ANIMAL DIVERSITY

(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)

Total Hours:36

Credit: 2

Course Objectives:

- To study the scientific classification of invertebrate and vertebrate fauna
- To learn the physiological and anatomical peculiarities of some invertebrate and vertebrate phyla through type study.

Course Outcomes:

- Students can identify and list out various invertebrate and vertebrate fauna
- Students acquire knowledge on invertebrate and vertebrate classification and representative organism and their anatomical features.

PART A: NON CHORDATA

Scientific Drawing:-

Make scientific drawings of 5 locally available invertebrate specimens belonging to different phyla.

Anatomy:-

Study of sections

1. Hydra.
2. Ascaris (male or female)
3. Fasciola
4. Earthworm (TS through intestine)

Study of nervous system in Prawn

Study of digestive system in Cockroach

Identification of common mosquitoes(4 genuses)

Mounting:-

1. Mouth parts – House fly and Honey Bee
2. Prawn appendages.

Identification:-

General identification- The students are expected to identify the following Phylum –wise number of animals by their scientific names. Protista -2, Porifera-1, Coelenterata-2, Platyhelminthes-1, Annelida-2, Arthropoda-3, Mollusca- 2, Echinodermata-2

PART B: CHORDATA

1. **Morphology**

   Scientific Drawing: Make scientific drawing of 5 locally available vertebrate specimens belonging to different classes

   Mounting of placoid scales/cycloid/ctenoid scales

2. **Study of Human Anatomy using Virtual lab**

   1. Viscera
   2. Digestive System
   3. Heart
   4. Respiratory System
   5. Excretory System
   6. Brain
   7. Reproductive System – Male & Female

3. **Study of sections**

   Human skin, Cartilage, Bone

4. **Osteology**

   Human vertebrae (Typical, Atlas, Axis, Lumbar)

   Pectoral and pelvic girdles of Man

5. Dentition in Mammals (Dog, Rabbit, Man)

6. Study of feathers

7. **Identification:-**

   General identification of poisonous snakes (Cobra, Viper, Krait)

   Non poisonous (Rat snake, Natrix, Python)

   Identify animals by their scientific names: Protochordata-1, Pisces-4, Amphibia-3, Reptilia- 4, Aves-1, Mammalia-2.

8. **Taxonomic identification with key:-**

   i) Identification of fishes up to the level of order.

   ii) Identification of snakes up to family.

SEMESTER V

BBZO506: RESEARCH METHODOLOGY, INSTRUMENTATION AND BIOSTATISTICS

(Only for BSc Zoology programme)

Total Hours:54

Credit: 3

Course Objectives:

- Acquire basic skills in the observation and study of nature, experimental skills and scientific investigation
- Acquire knowledge on basic research methods and statistical analysis
- Apply various techniques in developing experimental design
- Appreciate limitations of conclusions drawn from experimental data

Course Outcomes:

- Learn the research and statistical analysis pr
- Demonstrate skill in relevant literature analysis, experimental design, performance of experimental protocols and statistical analysis of results
- Deveolop skills for oral and written communication of research findings

PART I - RESEARCH METHODOLOGY (18 hrs)

Module I - Introduction (5 hrs)

Basic concepts of research: Meaning, Objectives

Types of Research: Descriptive/Analytical, Applied/Fundamental, Quantitative/Qualitative, Conceptual/Empirical

Module II - Research Design (4 hrs)

Basic principles; Meaning, need and features of good design; Types of research designs

Module III – Research Documentation & Presentation (5 hrs)

Scientific documentation and communication; Research report writing (Thesis and dissertations, Research articles, Oral communications); Bibliography formats; Plagiarism

Presentation techniques: Assignment, Seminar, Debate, Workshop, Colloquium, Conference

Module IV - Bioethics **(4 hrs)**

Introduction; Animal rights and animal laws in India; Animal use in research and education; Laboratory animal use, care and welfare; Animal protection initiatives; Animal Welfare Board of India

Working with Humans: harm, risk, and benefits; Consent

PART II – INSTRUMENTATION (22 hrs)

Module V - Research Tools **(14 hrs)**

Light microscopy – Simple and Compound, Phase Contrast Microscope, Electron Microscope: SEM and TEM, pH Meter, Centrifuge, Electrophoresis, Colorimeter, Chromatography

Computer simulation of biological systems

Module VI – Measurements **(8 hrs)**

Units of measurements; Calculations and related conversions of measurement units

Metric system- length; surface; weight; Square measures; Cubic measures; Volumetric; Circular or angular measure

Concentration - percent volume; ppt; ppm

Chemical – Molarity, Normality

Temperature- Celsius, centigrade, Fahrenheit

PART III – BIOSTATISTICS (14 hrs)

Module VII - Sample & Sampling techniques **(6 hrs)**

Collection of data; Classification of data; Frequency distribution tables

Graphical representation: - Bar diagrams, Histogram, Pie diagram and Frequency curves

Module VIII - Measures of Central Tendency **(2 hrs)**

Mean, Median, Mode (Direct method only)

Module IX- Measures of dispersion **(6 hrs)**

Range; Quartile Deviation; Mean Deviation; Standard Deviation; Standard error (Merits & demerits)

References:

Research Methodology

1. Anderson, J, Durston, B.H. and Poole, M. 1992. Thesis and assignment writing. Wiley Eastern Ltd.
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Instrumentation

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2. Ghatak K.L. 2011.Techniques and Methods in Biology. PHI Learning Pvt. Ltd. New Delhi
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Biostatistics

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9. Daniel, W.W. 2006. Biostatistics: A Foundation for Analysis in the Health Sciences (7th edn). John Wiley & Sons, New York.
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11. Zar, Jerrold H. 2008. Biostatistical Analysis (3rdedn.). Pearson Education Inc., New Delhi.
12. Veer Bala Rastogi, 2015, Biostatisitcs, MedTec, Delhi

BBZO507: CELL BIOLOGY AND MOLECULAR BIOLOGY

(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)

Total Hours:54

Credit: 3

Course Objectives:

- Understand the structures and purposes of basic components of prokaryotic and eukaryotic cells
- To make aware of different cell organelles, their structure and role in living organisms
- To understand how the cellular components are used to generate and utilize energy in cells
- To introduce the nature of genetic materials at molecular level, their expression and regulation.

Course Outcomes:

- Acquire the knowledge of evolution of cells, its diversity, cell organelles and the mechanism of cell divisions
- Appreciate the nature of genetic material, gene regulation and its expression

PART I - CELL BIOLOGY (27 hrs)

Module I - Introduction (2 hrs)

Cell theory

Eukaryote, Prokaryote, Mycoplasma; Virus; Viroid; Prion

Module II - Cell membrane & Permeability (5 hrs)

Molecular models of cell membrane: Sandwich model; Unit membrane model; Fluid mosaic model

Cell permeability – Diffusion; Osmosis; Passive transport; Active transport

Modifications of plasma membrane: Microvilli; Tight junction; Gap junction; Desmosomes Glycocalyx

Module III - Ultra structure of Cell organelles (8 hrs)

Endoplasmic Reticulum - Structure and functions

Ribosomes (Prokaryotic and Eukaryotic)

Golgi complex - Structure and functions

Lysosomes - Polymorphism; GERL concept; functions

Mitochondria - Structure and functions; Symbiont hypothesis

Cytoskeleton: Microtubules; Microfilaments; Intermediate Filaments

Module IV - Nucleus **(6 hrs)**

Structure and functions of interphase nucleus

Nuclear membrane; Pore complex

Structure and functions of nucleolus

Chromosome structure; Nucleosomes; Heterochromatin; Euchromatin

Polytene chromosomes, Balbiani rings, Endomitosis; Lamp brush chromosomes

Module V - Cell Division **(3 hrs)**

Cell cycle - G_1, S, G_2 and M phases

Mitosis, Meiosis and Amitosis

Module VI – Cancer & Ageing **(3 hrs)**

Types of tumors-benign and malignant

Types of cancers-Carcinoma, Sarcoma, Lymphoma, Leukemia

Causes of cancer- Physical, Chemical and Biological

Properties of cancer cells

Brief account on Ageing, Theories of Ageing

PART II - MOLECULAR BIOLOGY (27 hrs)

Module VII - Nature of Genetic Material **(9 hrs)**

Discovery of DNA as genetic material – Griffith's transformation experiments; Hershey Chase experiment of Bacteriophage infection

Structure and types of DNA & RNA

DNA replication

Modern concept of gene (Cistron, Muton, Recon, Viral genes)

Prokaryotic genome; Eukaryotic genome

Brief account of the following - Split genes (introns and exons), Junk genes; Pseudo genes; Overlapping genes; Transposons

Module VIII - Gene Expression **(12 hrs)**

Central Dogma of molecular biology; one gene-one enzyme hypothesis; One gene-one polypeptide hypothesis

Characteristics of genetic code; Contributions of Hargobind Khorana

Protein synthesis - Transcription (Prokaryotic and eukaryotic); Reverse transcription; Post transcriptional modifications

Translation, Post translational modifications

Module IX - Gene Regulation (6 hrs)

Prokaryotic: Operon concept - Lac operon and Tryptophan operon; Catabolite repression (Glucose effect).

Brief account of Eukaryotic gene regulation

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1. Alberts Bruce, 2014, Molecular Biology of the Cell, W. W. Norton & Company, NY, USA
2. Brown T A, 2016 Gene cloning and DNA Analysis.wiley Blackwell.UK
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BBZO508: ENVIRONMENTAL BIOLOGY AND HUMAN RIGHTS

(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)

Total Hours:72

Credit: 3

Course Objectives:

- To impart basic knowledge on ecosystems and their functioning
- To list abiotic and biotic factors that affect, the distribution, dispersal, and behavior of organisms
- To learn about various types of anthropogenic pressures on ecosystem, related degradation and management measures
- Identify factors that affect biological diversity and the functioning of ecological systems
- To create awareness about human rights and to prevent its violation

Course Outcomes:

- Understand the importance of ecosystem components and its maintenance and management measures
- Able to evaluate the pollutants and their impact on organisms and environment
- Learn to mitigate pollutants and anthropogenic activity that degrades ecosystem functions
- Better understand Human rights and its protection

Module I - Environmental Issues (18 hrs)

Global and local environmental issues: global warming and climate change (use case studies to illustrate the points)

Ozone depletion; greenhouse effect; acid rain; carbon trading, carbon credit; carbon sequestration; IPCC/UNFCC

Nuclear accidents and nuclear holocaust

Sand mining; wetland reclamation; landscape changes; deforestation; soil erosion. flood and drought, desertification, overexploitation, threats to fresh water resources of Kerala; tourism and its impact on environment.

Pollution: air pollution; water pollution; soil pollution; noise pollution; pesticide pollution, solid waste management: causes, effects and control measures of urban and industrial waste-biodegradable and non-degradable

Disaster management : Introduction to hazards; hazards classification; natural and anthropogenic, disaster management - earthquakes; cyclone; tsunami; floods; landslides; droughts

Module II - Human Rights (18 hrs)

National and International Perspectives: Definitions of Human Right, Relevance of Human Rights in India-Social Aspects-Economic Aspects-Political Aspects, Human Rights International Norms, UDHR-Civil and political rights-Economic, social and cultural rights-Rights against torture, Discrimination and forced labour-Rights of the child

Human Rights and duties in India- Preamble to the Indian constitution-Human Rights and Duties in Indian constitution

Deprivation of Human Rights-The core issues: Poverty-Overpopulation-Illiteracy-Unsustainable Development, Disadvantageous Groups (Women, Children, SC/ST, Homeless and slum dwellers, physically and mentally handicapped, refugees and internally displaced persons).

Redressal Mechanisms against Human Rights Violation: Judiciary -Government systems for Redressal - NHRC and other Statutory Commissions-Media advocacy-Creation of Human Rights Literacy and Awareness

Module III - Basic concepts of Ecology (3 hrs)

Definition of ecology, scope of ecological study, Approaches to ecology- based on taxonomy, habitat, levels organization- autecology, synecology.

Module IV - Concepts of Population Ecology (5 hrs)

Characteristics of population- size and density, dispersion, age structure, natality, mortality, biotic potential and life tables.

Population dynamics, growth rates- exponential and logistic, carrying capacity. Population regulation- density dependent and independent regulation.Concept of limiting factors: Liebig's and Shelford's laws of limiting factors. Population fluctuation and population cycles. r-selected and k-selected populations.

Module V - Concepts of Community Ecology (7 hrs)

Characteristics of a community, Ecotone and Edge effect, Keystone and dominant species, Concepts of Ecological Niche and Guild

Animal interactions: Positive- Commensalism- Mutualism-Protocooperation, Negative- Predation-Parasitism-Competition-Antibiosis

Module VI - Concepts of Ecosystem (12 hrs)

Definition of ecosystem. Components of ecosystem -Abiotic and Biotic components.Classification.

Fresh water habitat types; Lentic and lotic-Characteristics, stratifications, types of ponds, adaptations.

Marine habitat: characteristics, zonation and animal adaptations.

Estuarine ecosystem- characteristics, significance, conservation; Mangroves-significance, mangroves of Kerala, causes of mangrove ecosystem destruction and conservation. Wetland – characteristics, significance and conservation, Ramsar sites in Kerala

Terrestrial biomes- Tundra, Conifer Forest, Deciduous Forests, Tropical Rain Forest, Chapparal, Tropical Savannah, Grassland , Desert

Functions of ecosystem - Food chain; Detritus and grazing food chains , food web

Energy flow through the ecosystem, Laws of Thermodynamics, Ecological pyramids.

Module VII - Biogeochemical cycles (3 hrs)

Concept, gaseous and sedimentary cycles-Nitrogen cycle and phosphorus cycle.

Module VIII - Resource Ecology (6 hrs)

Natural resources and its sustainable management

Renewable and non-renewable energy resources; Mineral resources; hydropower; tidal power

Green building concept and green technology concept

References:

1. Ahluwalia V. K. and Sunita Malhotra, 2009, Environmental Science, Ane Books, New Delhi
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BBZO509: BIOCHEMISTRY AND PHYSIOLOGY

(Only for BSc Zoology programme)

Total Hours:72

Credit: 3

Course Objectives:

- To explain the fundamental biochemical principles and the molecular and cellular basis of physiological functions in animals
- Define and explain the basic principles of biochemistry by illustrating different kinds of biomolecules, their structure, function and metabolism
- Explaining various aspects of physiological activities of animals with special reference to humans

Course Outcomes:

- Students will be able to demonstrate an understanding of fundamental biochemical principles, such as the structure/function of biomolecules, metabolic pathways, and the regulation of biological/biochemical processes.
- They learn to integrate the regulation of organ system functions in a whole animal

PART I – BIOCHEMISTRY (18 hrs)

Module I – General Biochemistry & Biomolecules (5 hrs)

Carbohydrates, protein and lipids – structure of basic compounds, classifications with examples and its biological importance.

Module II - Metabolism (9 hrs)

Carbohydrate metabolism- Glycolysis, glycogenolysis, gluconeogenesis, glycolysis –citric acid cycle, ATP synthesis, Hexose monophosphate shunt

Lipid metabolism- Biosynthesis and oxidation of fatty acids- Beta oxidation, Physiologically important compounds synthesized from cholesterol.

Protein metabolism- Deamination, transamination, transmethylation, decarboxylation, ornithine cycle and Uric acid synthesis

Module III – Enzymes (4 hrs)

Chemical nature of enzymes, mechanism of enzyme action, factors influencing enzyme action (temperature, pH, enzyme concentration, substrate concentration), enzyme activation, enzyme inhibition, allosteric enzyme, isoenzymes, co-enzyme.

PART II – PHYSIOLOGY (54 Hrs)

Module IV - Nutrition (7 hrs)

Types of nutrition; Major and minor nutrients; Importance of fiber in diet; Digestion and absorption of carbohydrates, proteins and lipids; Nervous and hormonal control of digestion; Special modes of digestion: ruminant and symbiotic

Balanced diet; Nutritional disorders: Overnutrition, malnutrition, undernutrition, Defects of modern food habits, Obesity, Anorexia, acidity and ulcers, flatulence.

Module V - Respiration (8 hrs)

Respiration in animals: cutaneous, tracheal, branchial, pulmonary. Exchange and transport of respiratory gases. Respiratory pigments in animals: hemoglobin(mention structure), myoglobin, hemocyanin, haemerythrin, chlorocruorin.

Exchange and transport of respiratory gases, Oxy-hemoglobin curve, Bohr effect, reverse Bohr effect and Haldane effect.

Respiratory disturbances and disorders: Dyspnoea, asthma, emphysema, Anoxia, hypoxia, cyanosis, hypocapnia, hypercapnia and asphyxia; Carbon monoxide poisoning

Respiratory adaptations to high altitudes, Physiological adaptations of deep sea animals, Physiological problems of deep sea diving.

Module VI – Circulation (8 hrs)

Organs and mechanism of circulation;Types of heart

Cardiac cycle, Control and rhythmicity of the heart beat- Pacemakers, Pulse, Blood pressure and disorders, Neural and Hormonal control.

Human Blood and its constituents, Buffer system in blood, Blood clotting mechanism: intrinsic and extrinsic pathways, clotting factors, disorders of blood clotting, anticoagulants, blood groups and transfusion.

Circulatory disorders- Myocardial infarction, angina pectoris, cardiac arrest, thrombus and embolus, arteriosclerosis and atherosclerosis.

Clinical analysis- Electrocardiogram (ECG), Erythrocyte sedimentation rate (ESR), Haematocrit, Total and differential blood cell count

Module VII – Excretion (7 hrs)

Patterns of nitrogen excretion in animals: ammonotelism, ureotelism, uricotelism.

Structure of nephron, formation of urine, counter current mechanism, water and salt balance, acid-base control and homeostasis; Hormonal control of kidney functions.

Composition of urine- normal and abnormal constituents, Diseases of the kidney- Kidney stones, Proteinurea, Nephrosis, Pyelonephritis.

Artificial kidney (haemodialysis), Peritonial dialysis and Kidney transplantation.

Module VIII – Muscle Physiology (7 hrs)

Muscular movements, Types of muscles

Vertebrate skeletal muscle: Structure and function; Mechanism, Biochemistry and Energetics of muscle contraction

Neuromuscular junction

Electrophysiology of muscle, threshold and spike potentials, simple muscle twitch, whole muscle contraction, isotonic and isometric contraction, latent and refractory periods, summation, beneficial effect, tetanus, tonus, staircase phenomenon, fatigue, oxygen debt, rigor mortis.

Module IX – Neurophysiology (7 hrs)

Structure and types of neurons, Nerve fiber and impulse propagation, Synaptic transmission & properties of synapses, neurotransmitters, role of dopamine and serotonin. Neuroreceptors. Reflexes and types of reflexes.

Central nervous system, Peripheral nervous system and Autonomous Nervous System

Electroencephalogram (EEG)

Neural disorders- Parkinson's disease, Dementia, Alzheimer's disease, Dyslexia, Epilepsy, Schizophrenia.

Module X – Sensory Physiology (5 hrs)

Chemoreceptors: Gustatory receptors- taste buds, Olfactory receptors

Mechanoreceptors: statoreceptors

Phonoreceptors- Physiology of hearing

Touch receptors

Photoreceptors- Physiology of vision

Thermoreceptors

Module XI – Environmental Physiology (5 hrs)

Body Temperature and its Regulation, Poikilotherms, Homeotherms

Physiological adaptation to cold; Shivering; Dormancy; Hibernation; Aestivation

Photoperiodism

Stress Physiology- Stress factors(internal & external), Stress adaptations

References:

Biochemistry

1. Elliott,W.H . and C. Elliott. 2003. Biochemistry and Molecular Biology. Oxford University Press, Oxford, UK.
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Physiology

1. Bentley,P.J., 1998. Comparative Vertebrate Endocrinology (3rd edn). Cambridge University Press
2. Ganong, W.F 2012. Review of Medical physiology. Appleton and lang, Norwalk.
3. Guyton, A.C. 2016. Text Book of Medical physiology. Prism Books Pvt.Ltd.Bangalore
4. Hill, W.R., Wyse, G.A and Anderson, M. 2007. Animal Physiology (2nd edn). Sinauer Associates Inc.Publishers, MA, USA.
5. Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India,New Delhi.
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8. Prosser, C.L., 1991. Comparative Animal Physiology. Wiley Publishers, NJ, USA
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10. Squires,E.J. 2003 Applied Animal Endocrinology, CABI Publications,UK.

11. Timothy J. Bradley. 2009.Animal Osmoregulation. OABS, Oxford University Press, UK.
12. Wilmer, P., G. Stone and I .Jonston. 1997. Environmental Physiology of Animals (2nd edn). Blackwell Publishers, NY, USA.

BBZO510: ANIMAL PHYSIOLOGY

(Only for BSc Zoology & Industrial Microbiology programme)

Total Hours:54

Credit: 3

Course Objectives:

- To explain the molecular and cellular basis of physiological functions in animals
- To explain various aspects of physiological activities of animals with special reference to humans

Course Outcomes:

- Students will be able to understand the fundamental physiological functions of organ system and its regulatory mechanisms
- Students will be able to integrate the regulation of organ system functions in a whole animal

Module I - Nutrition (7 hrs)

Types of nutrition; Major and minor nutrients; Importance of fiber in diet; Digestion and absorption of carbohydrates, proteins and lipids; Nervous and hormonal control of digestion; Special modes of digestion: ruminant and symbiotic

Balanced diet; Nutritional disorders: Overnutrition, malnutrition, undernutrition, Defects of modern food habits, Obesity, Anorexia, acidity and ulcers, flatulence.

Module II - Respiration (8 hrs)

Respiration in animals: cutaneous, tracheal, branchial, pulmonary. Exchange and transport of respiratory gases. Respiratory pigments in animals: hemoglobin(mention structure), myoglobin, hemocyanin, haemerythrin, chlorocruorin.

Exchange and transport of respiratory gases, Oxy-hemoglobin curve, Bohr effect, reverse Bohr effect and Haldane effect.

Respiratory disturbances and disorders: Dyspnoea, asthma, emphysema, Anoxia, hypoxia, cyanosis, hypocapnia, hypercapnia and asphyxia; Carbon monoxide poisoning

Respiratory adaptations to high altitudes, Physiological adaptations of deep sea animals, Physiological problems of deep sea diving.

Module III – Circulation (8 hrs)

Organs and mechanism of circulation;Types of heart

Cardiac cycle, Control and rhythmicity of the heart beat- Pacemakers, Pulse, Blood pressure and disorders, Neural and Hormonal control.

Human Blood and its constituents, Buffer system in blood, Blood clotting mechanism: intrinsic and extrinsic pathways, clotting factors, disorders of blood clotting, anticoagulants, blood groups and transfusion.

Circulatory disorders- Myocardial infarction, angina pectoris, cardiac arrest, thrombus and embolus, arteriosclerosis and atherosclerosis.

Clinical analysis- Electrocardiogram (ECG), Erythrocyte sedimentation rate (ESR), Haematocrit, Total and differential blood cell count

Module IV – Excretion (7 hrs)

Patterns of nitrogen excretion in animals: ammonotelism, ureotelism, uricotelism.

Structure of nephron, formation of urine, counter current mechanism, water and salt balance, acid-base control and homeostasis; Hormonal control of kidney functions.

Composition of urine- normal and abnormal constituents, Diseases of the kidney- Kidney stones, Proteinurea, Nephrosis, Pyelonephritis.

Artificial kidney (haemodialysis), Peritonial dialysis and Kidney transplantation.

Module V – Muscle Physiology (7 hrs)

Muscular movements, Types of muscles

Vertebrate skeletal muscle: Structure and function; Mechanism, Biochemistry and Energetics of muscle contraction

Neuromuscular junction

Electrophysiology of muscle, threshold and spike potentials, simple muscle twitch, whole muscle contraction, isotonic and isometric contraction, latent and refractory periods, summation, beneficial effect, tetanus, tonus, staircase phenomenon, fatigue, oxygen debt, rigor mortis.

Module VI – Neurophysiology (7 hrs)

Structure and types of neurons, Nerve fiber and impulse propagation, Synaptic transmission & properties of synapses, neurotransmitters, role of dopamine and serotonin. Neuroreceptors. Reflexes and types of reflexes.

Central nervous system, Peripheral nervous system and Autonomous Nervous System

Electroencephalogram (EEG)

Neural disorders- Parkinson's disease, Dementia, Alzheimer's disease, Dyslexia, Epilepsy, Schizophrenia.

Module VII – Sensory Physiology **(5 hrs)**

Chemoreceptors: Gustatory receptors- taste buds, Olfactory receptors

Mechanoreceptors: statoreceptors

Phonoreceptors- Physiology of hearing

Touch receptors

Photoreceptors- Physiology of vision

Thermoreceptors

Module VIII – Environmental Physiology **(5 hrs)**

Body Temperature and its Regulation, Poikilotherms, Homeotherms

Physiological adaptation to cold; Shivering; Dormancy; Hibernation; Aestivation

Photoperiodism

Stress Physiology- Stress factors(internal & external), Stress adaptations

References

1. Bentley,P.J., 1998. Comparative Vertebrate Endocrinology (3rd edn). Cambridge University Press, UK
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4. Hill, W.R., Wyse, G.A and Anderson, M. 2007. Animal Physiology (2nd edn). Sinauer Associates Inc.Publishers, MA, USA.
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6. Larsson, P.R. et al., 2002. William's Text Book of Endocrinology (10th edn).W.B. Saunders, Philadelphia
7. Moyers, D.C and Schulte, P.M. 2007. Principles of Animal Physiology (2nd edn). Benjamin Cummings,CA, USA
8. Prosser, C.L., 1991. Comparative Animal Physiology. Wiley Publishers, NJ, USA
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11. Timothy J. Bradley. 2009.Animal Osmoregulation. OABS, Oxford University Press, UK.
12. Wilmer, P., G. Stone and I .Jonston. 1997. Environmental Physiology of Animals (2nd edn). Blackwell Publishers, NY, USA.

SEMESTER VI

BBZO611: GENETICS, BIOTECHNOLOGY AND BIOINFORMATICS

(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)

Total Hours:72

Credit: 3

Course Objectives:

- To emphasis the basic principles of inheritance at the molecular, cellular and organismal levels
- To equip the students with biotechnological application in biological science
- To update and expand basic bioinformatics skills and to effectively utilize the digital knowledge resources in learning

Course Outcomes:

- Students will learn the basic principles of inheritance at the molecular, cellular and organismal levels
- Better understanding on Biotechnological application and Bioinformatcs tools

PART I - GENETICS (36 hrs)

Module I - Introduction **(2 hrs)**

Gene and alleles, genotype and phenotype, homozygous and heterozygous, wild type and mutant alleles, Chromosome theory of heredity

Module II - Mendelism **(3 hrs)**

Mendel's laws, Dominant and recessive traits, test cross and back cross, reciprocal cross, Mendelian traits in man

Module III - Interaction of genes **(5 hrs)**

Allelic: Incomplete dominance, Co-dominance

Non allelic interactions: Complementary, supplementary

Epistasis: Dominant (feather colour in fowl), Recessive (coat colour in mice)

Polygenes (Skin colour inheritance in man)

Pleiotropism; Modifying genes; Lethal genes (Brief account with one example each)

Multiple alleles (coat colour in rabbits, ABO blood group, Rh factor and its inheritance)

Module IV - Linkage and Recombination **(3 hrs)**

Morgan's work in Drosophila (Complete and incomplete linkage)

Arrangement of linked genes-cis and trans

Recombination

Cytological evidence of crossing over (Stern's Experiment)

Module V - Sex determination **(3 hrs)**

Sex chromosomes and autosomes

Chromosomal mechanism sex determination (XX-XO, XX-XY, ZW-ZZ)

Sex determination in man; Barr bodies and Lyon hypotheses (Dosage compensation); Role of Y chromosome

Sex determination in honey bees; Sex determination in Drosophila; Intersex; Gynandromorphs

Hormonal influence on sex determination; Sex reversal

Environmental influence; Genic balance theory; Hermaphroditism

Module VI - Sex linked Inheritance **(1 hr)**

Definition, Characteristics of sex linked inheritance (criss-cross inheritance)

Haemophilia and colour blindness

Pseudoautosomal genes (incompletely sex-linked genes)

Holandric genes; Sex limited and sex influenced traits in man

Module VII - Mutations **(5 hrs)**

Types of Mutations: Somatic and germinal; Induced and random

Chromosomal mutations - structural and numerical changes

Gene mutation (point mutation)

Molecular basis of gene mutations: Transversions, Transitions, Frame shift

Mutagens: Physical, Chemical, Biological

Module VIII - Extra nuclear Inheritance **(2 hrs)**

Kappa particles in Paramecium

Maternal effect genes in snail

Module IX - Bacterial Genetics **(4 hrs)**

Bacterial genome

Recombination in Bacteria

Bacterial transformation; Transduction; Conjugation; F mediated sexduction

Module X - Human Genetics **(8 hrs)**

Pedigree Analysis; Karyotyping- Normal human chromosome complement

Aneuploidy and Non disjunction

Genetic disorders in Man: Chromosomal anomalies- Autosomal: Down syndrome; Edward's syndrome; Cri-du-chat syndrome

Sex chromosomal - Klinefelter's syndrome; Turners syndrome

Single gene disorders (Brief mention): Sickle cell anaemia and Brachydactyly

Inborn errors of metabolism: Phenylketonuria; Alkaptonuria; Albinism and Tyrosinosis

Multifactorial disorders: Polygenic traits - Cleft lip and cleft palate.

Prenatal Diagnosis: Amniocentesis; Choriovillus sampling; Ultrasound scanning; Fetoscopy;

Genetic counselling

Eugenics, Euphenics and Euthenics

PART II – BIOTECHNOLOGY (18 hrs)

Module XI - Tools and Techniques of Genetic Engineering **(14 hrs)**

Tools: Enzymes- Restriction enzymes and DNA ligases

Vectors: Plasmids and Phage vectors

Production of recombinant DNA(Briefly mention)

Gene transfer: Virus mediated and DNA mediated

PCR technique and DNA amplification

Blotting Techniques: Southern Blotting; Northern Blotting; Western Blotting

DNA hybridization: Fluorescence *in-situ* Hybridization (FISH), Colony hybridization

DNA finger printing and its applications

RFLP- markers and applications

Gene libraries; Genomic and cDNA libraries

Potential uses of stem cells

Module XII - Applications of Biotechnology **(4 hrs)**

Tissue culture – Principle and uses

Single cell protein (SCP)

Biotechnology and Medicine: Therapeutic cloning; Gene therapy; Monoclonal antibodies; Humulin

Antibiotics; DNA Vaccines

Biotechnology in agriculture : Microbial insecticides; GMO

Problems in Biotechnology: Hazards of genetic engineering; Ethical issues; Biowar

PART III - BIOINFORMATICS (18 hrs)

Module XIII – Biological Information Management (8 hrs)

Introduction

Concept of gene and genome

Genome sequencing projects

Storing and accessing sequence data: roles of databases and internet

Bioinformatics Databases

- Sequence databases- NCBI GenBank, SWISS-PROT
- Structure database- PDB

Database searching and data retrieval

Module XIV - Sequence Analysis (8 hrs)

Sequence alignment: Global and Local alignments

Brief introduction to scoring matrices

Pair-wise sequence alignment, BLAST

Multiple sequence alignment

Concept of comparative genomics

Module XV – Structural Bioinformatics (2 hrs)

Molecular Visualization Tool – Rasmol

Computer Aided Drug Discovery

References:

Genetics & Biotechnology

1. Balasubramanian D., K. Dharmarajan J., Kunthala Jayaraman, 2007, Concept in Biotechnology. Universities Press
2. Benjamin Lewin 2017, Genes XII, Oxford University Press, Massachusetts, USA

3. Brown T A ,2016, Gene cloning and DNA Analysis.Wiley Blackwell.UK
4. Colin Ratledge & Bijorn Kristiansen, 2008, Basic Biotechnology 3 rd ed. Cambridge University
5. Desmand S.T. Nicholi, 2007, An introduction to Genetic Engineering Cambridge University Press
6. Frank H, Stephenson, 2006, Calculation for Molecular Biology and Biotechnology . Academic press
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8. H. K. Das, Textbook of Biotechnology, 2017, Wiley India, New Delhi
9. Janarthanan S & Vincent S., 2007, Practical Biotechnology: Method and Protocols. Orient Blackswan, Hyderabad
10. John E. Smith Biotechnology Cambridge Low priced ed. (Third Ed) 2005
11. Singh B.D. Biotechnology 2002, Kalyan Publishers New Delhi.
12. Strickberger W.M. 1990. Genetics (Mac Millan Publishing Co.)
13. Sudha Gangal Biotechnology Principles And & practice of Animal Tissue culture, Universities Press 2007
14. Susantha Gosnalibke – Merged Evolution (Long term implication of Biotechnology and Information Technology) Gordon & Breech Pub. 2005
15. Veer Bala Rastogi – Fundamental of Mol. Biology Ane students Education 2008
16. Verma P.S. and Agarwal V.K. 1988 Genetics, S. Chand and Co. New Delhi

Bioinformatics

1. Claverie & Notredame, 2003, Bioinformatics - A Beginners Guide, Wiley-Dreamtech India Pvt Ltd
2. Dan E. Krane and Michael L. Raymer, 2003, Fundamental Concepts of Bio-informatics, Pearson Education CA, USA
3. D. Mount, 2004, Bioinformatics: sequence & Genome Analysis, Cold spring Harbor press, USA.
4. Arthur M. Lesk, 2008, Introduction to Bioinformatics,Oxford University Press, UK
5. Rashidi, Hooman H. and Buehler, Lukas K. 2001. Bioinformatics Basics, CRC Press, Washington DC, USA
6. Xiong, Jin. 2006, Essential Bioinformatics, Cambridge University Press, New York.

BBZO612: MICROBIOLOGY AND IMMUNOLOGY

(Only for BSc Zoology programme)

Total Hours:54

Credit: 3

Course Objectives:

- To inspire the students in learning about microbial organisms, their culture and preservation techniques
- To make students aware of the pathogens, health related problems, their origin and treatment
- To impart basic knowledge of the organization and function of the immune system

Course Outcomes:

- Students will learn microbial classification, microbial cultures and identification procedures
- Students will learn to distinguish microbial disease, its pathogenesis and control measures
- Students will be able to identify the cellular and molecular basis of immune responsiveness.

PART I - MICROBIOLOGY (27 hrs)

Module I - Introduction to Microbiology (2 hrs)

Scope of Microbiology; Outline classification of bacteria, fungi and viruses

Module II - Methods in Microbiology (8 hrs)

Methods of sterilization and disinfection: Physical; Chemical

Preparation of culture media: Selective media; Enrichment media; Enriched media; Differential media

Plating techniques and isolation of pure colonies; Aerobic and anaerobic cultivation

Culture preservation techniques: Refrigeration, Deep freezing, Freezing under liquid nitrogen; Lyophilization

Module III - Basic Bacteriology (4 hrs)

Morphology and fine structure of bacteria; Flagella, Pili, Capsule, Cell wall and its composition; Cytoplasmic membrane; Protoplast; Spheroplast; Nuclear material , Cell inclusions, Bacterial spores

Module IV - Basic Virology **(4 hrs)**

Viruses -Structure of Viruses; Human, Animal, Plant and Bacterial Viruses; Replication of viruses – Lytic and lysogenic cycle

Module V - Microbial Infections **(3 hrs)**

Primary and secondary infections; Cross infection; Nosocomial infection; Endogenous and exogenous infections

Epidemic, endemic and pandemic; Modes of transmission of diseases: by food, water, air and vectors

Module VI - Microbial Diseases **(6 hrs)**

A brief study of the following microbial diseases:-

Bacterial: Tuberculosis & Typhoid

Viral :Swine Flu, Bird Flu, Dengue, Chikungunya

Fungal: Dermatophytoses & Candidiasis

PART II - IMMUNOLOGY (27 hrs)

Module VII - Introduction to Immunology **(4 hrs)**

Types of immunity; Acquired immunity- passive & active

Innate immunity - Mechanism of innate immunity, Barriers

Phagocytosis; Inflammation

Module VIII - Antigens and Antibodies **(6 hrs)**

Types of antigens; haptens; antigenic determinants

Basic structure of immunoglobulins

Different classes of immunoglobulins and functions

Complement system, biological effects of complement

Module IX - Antigen-antibody reactions **(5 hrs)**

Precipitation test; Agglutination Test

Clinical applications of antigen - antibody reaction: Widal test; VDRL; ELISA; Complement fixation test; Coombs test

Module X - Immune Response system **(5 hrs)**

Primary and secondary lymphoid organs

Cells and tissues of the immune system

Primary and secondary responses

Monoclonal antibodies; Hybridoma technology

Module XI – Immunopathology **(7 hrs)**

Hypersensitivity - types of hypersensitivity reactions

Autoimmunity - causes; Graves disease; Hashimoto thyroiditis; Pernicious anemia

Immunodeficiency- primary and secondary

Transplantation immunology; Graft rejection

Major Histocompatibility complex; Human leukocyte antigen system

Immunohaematology, Immunology of blood transfusion, Erythroblastosis foetalis

References:

Microbiology

1. Ananthanarayan R & C.K. Jayaram Panicker, 2017, Textbook of Microbiology, Orient Longman Private Ltd.
2. Arora, D.R. and Arora, B, 2008, Text Book of Microbiology, CBS Publishers and Distributers, New Delhi
3. Chakraborty, P. A., 2009, Text Book of Microbiology. New Central Book Agency, New Delhi
4. Harma and Kanika.2009. Manual of Microbiology Tools and Techniques. Ane Books Pvt. Ltd. New Delhi
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8. Laning, M Prescot. John,P. Harley and Donald A Klein. 2008. Microbiology 7th edn. McGraw Hill International,NJ, USA
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10. Michael J. Pelczar ECS,Chan & Noel. R. Kreig, 1996, Microbiology5th ed., Tata McGraw Hill, New Delhi

11. Prescott. 2013, Microbiology, McGraw-Hill Higher Education, New York, USA
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Immunology

1. Abbas, A.K., Lichtman,A.K and Pober , J.S. 1997. Cellular and Molecular Immunology. W.B. Saunders Co. New York, USA
2. Ashim K. Chakravarthy, 1998, Immunology, Tata McGraw-Hill, New Delhi
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9. Ivan M. Roitt, 2002. Essential of Immunology. ELBS, New Delhi.
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BBZO613: ENDOCRINOLOGY, REPRODUCTIVE BIOLOGY AND ETHOLOGY

(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)

Total Hours:54

Credit: 3

Course Objectives:

- To equip students to acquire a broad understanding of the hormonal regulation of physiological processes in invertebrates and vertebrates
- To familiarize students with hormonal regulation of reproduction and behavior in vertebrate systems
- To impart basic knowledge on animal behavioral patterns and their role

Course Outcomes:

- Students learn the hormonal regulation of physiological processes in invertebrates and vertebrates
- Students learn about the hormonal regulation of reproduction and behavior in vertebrate systems
- Familiarize with animal behavioral patterns and their significance

PART I- ENDOCRINOLOGY (20 hrs)

Module I – General Principles (6 hrs)

Hormones as messengers; classification and types of hormones

Mechanism of hormone action, Concept of hormone receptors, Hormonal control of homeostasis.

Module II – Endocrine Glands (14 hrs)

Secretion, regulation, functions and disorders of hormones of Hypothalamus, Hypophysis, Pineal, Thyroid, Parathyroid, Thymus, Islets of Langerhans, Adrenal, Gonads, Placenta

Gastro intestinal hormones

Part II - REPRODUCTIVE BIOLOGY (16 hrs)

Module III - Reproductive organs and Gametogenesis (8 hrs)

Human reproductive organs; Ultra structure of testes and ovary

Spermatogensis and oogenesis; Structure of human sperm and egg; Hormonal control of gametogenesis

Module IV - Sexual cycle **(8 hrs)**

Estrus cycle (non-primate) and menstrual cycle (primate cycle); Hormonal control of menstrual cycle

Puberty; Menarche; Menstrual cycle; Pregnancy; Parturition; Lactation; Menopause and associated physiological changes

Part III - ETHOLOGY (18 hrs)

Module V - Introduction **(1 hr)**

Scope and branches of Ethology

Module VI – Learning & Motivation **(5 hrs)**

Instinct; Taxes; Kineses

Types of learning with examples; latent learning; Lorenz experiments; Pavlov's experiments in classical conditioning; short and long term memory; Types of motivation

Module VII - Communication **(4 hrs)**

Origin and evolution of communication system

Types of communication with examples-electrical, chemical, olfactory, auditory, visual, echolocation, pheromonal communication in social insects and primates

Module VIII - Orientation and navigation **(5hrs)**

Definition; significance of migration; Migration in fishes, birds and wild animals

Types of migration; Navigational cues

Module IX - Biological rhythm **(3hrs)**

Types of biological rhythms with specific examples: circadian, circannual, lunar, tidal; Biological clock

References:

Endocrinology

1. Chandra S. Negi, 2009, Introduction to Endocrinology, Prentice Hall India, New Delhi

2. David O. Norris 2007, Vertebrate Endocrinology Elsevier Science, Amsterdam, Netherlands
3. Hadley, M.E. 2007. Endocrinology, 6th ed. Prentice Hall, Upper Saddle River, NJ. USA
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Reproductive Biology

1. Balnisky B.I 2004, An Introduction to Embryology, Thomson Brooks, USA
2. Berril, N.J and Kars G, 1986, Developmental biology, Mc Graw Hill, New York, USA
3. Bruce M Carlson, 2007, Foundations of Embryology, Tata McGraw Hill, New Delhi
4. Gilbert S. F, 2016, Developmental biology. Sinauer Associates. Oxford University Press, UK
5. Melissa A Gibbs, 2006, A practical Guide to Developmental Biology, Oxford University Press, UK
6. Vijayakumarn Nair K.and P. V George, 2007, A manual of developmental biology, Academica Publications, Trivandrum.

Ethology

1. Alcock, 2013, Exploring Animal Behaviour- An Evolutionary Approach, Edn. Sinauer Associates Inc. MA,USA.
2. Dawkins, M.S. 1995.Unravelling Animal Behaviour. Harlow Longman.
3. Don Bradshaw, 2003, Vertebrate Ecophysiology-An Introduction to its Principles and Applications, Cambridge University Press, UK
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5. Fatik Baran Mandal, 2015, A Textbook of Animal Behaviour, PHI Pvt Ltd, New Delhi
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BBZO614: DEVELOPMENTAL BIOLOGY

(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)

Total Hours:54

Credit: 3

Course Objectives:

- To provide a glimpse of scope and historical background of developmental biology to the students
- To impart knowledge regarding basic concepts of differentiation and growth, differential gene expression as well as cytoplasmic determinants
- To develop detailed understanding of essential events of developmental biology
- To give adequate information to the students regarding metamorphosis, regeneration and ageing processes.
- To make the students aware about modern implications of developmental biology by impartment of knowledge regarding teratogenesis, in-vitro fertilization, stem cells and amniocentesis techniques

Course Outcomes:

- Students will learn how the single cell zygote formed at fertilisation forms an embryo and then a fully formed adult organism
- Students understands the post embryonic development especially, metamorphosis, regeneration and ageing processes.
- Students become aware about modern implications of developmental biology

Module I - Early History **(1 hr)**

Preformation, Epigenesis , Biogenetic law

Comparative embryology; Evolutionary embryology

Module II - Classification of Eggs **(5 hrs)**

Classification of eggs based on the amount, distribution and position of yolk; Mosaic and regulative, Cleidoic and non cleidoic egg

Influence of yolk on development

Egg polarity; Egg symmetry

Module III - Fertilization and Zygote formation **(5 hrs)**

Attraction of sperm and the egg; Binding of spermatozoa- fertilization tube formation; Cortical reactions; Activation of the egg; Amphimixis; Significance of fertilization

Parthenogenesis: Natural parthenogenesis; Arrhenotoky; Thelytoky; Obligatory and Facultative; Artificial Parthenogenesis; Significance of parthenogenesis

Module IV - Cleavage **(3 hrs)**

Planes of cleavage - Meridional, vertical, equatorial and latitudinal

Types - Holoblastic and Meroblastic

Patterns - radial, bilateral and spiral

Determinate and indeterminate

Cleavage laws

Factors affecting cleavage

Module V - Cell lineage **(1hr)**

Significance; Method of cell lineage with an example

Module VI - Morulation and Blastulation **(4 hrs)**

Formation of morula; Blastula formation, Types of blastula; Factors affecting blastulation

Module VII - Fate maps **(4 hrs)**

Concept of fate maps; Significance of fate map; Construction of fate maps; Natural and artificial fate maps

Vital staining, carbon particle, Radioactive labeling, Histochemical, Cytological and genetical

Fate maps of frog and chick

Module VIII - Gastrulation **(5 hrs)**

Events of gastrulation

Morphogenetic cell movements: Epiboly and Emboly (invagination, involution , delamination , infiltration convergence, divergence, ingression, constriction, extension and concrescence).

Module IX - Tubulation **(1 hr)**

Neurogenesis and neural crest cells; Notogenesis; Mesogenesis

Module X – Germ Layers **(2 hrs)**

Concept of germ layers and their derivatives

Module XI - Stem Cells **(2 hrs)**

Properties and type of stem cells

Totipotency, Pluripotency, Unipotency of embryonic cells

Module XII - Early Embryology of Frog (**5 hrs)**

Gametes, fertilization, cleavage ,blastulation, fate map, gastrulation, notogenesis, neurulation, development of nervous system and eye

Module XIII - Embryology of Chick **(6 hrs)**

Brief account of 18 hour chick embryo and 24 hour chick embryo.

Extra embryonic membranes in chick.

Module XIV- Mammalian Development **(7 hrs)**

Blastocyst; Implantation

Foetal membranes and placenta; Placenta in mammals; Functions of placenta

Classification of placenta based on nature of contact, mode of implantation and histological intimacy of foetal and maternal tissue

Contraception & birth control; MTP

Infertility- Causes of infertility-male and female; IVF, test tube babies, GIFT & ZIFT; Embryo transfer technology

Module XV - Experimental Embryology (**3 hrs)**

Spemann's constriction and transplantation experiments

Organizer and embryonic induction

References:

1. Balnisky B.I 2004, An Introduction to Embryology, Thomson Brooks, USA
2. Berril, N.J and Kars G. 1986. Developmental biology, Mc Graw Hill,New York, USA
3. Bruce M Carlson, 2007, Foundations of Embryology, Tata McGraw Hill, New Delhi
4. C. S. Potten, 2008, Stem Cells, Academic Press, London, UK

5. Elena Notarianni and Martin J. Evans, 2007, Embryonic Stem Cells, Oxford University Press, UK
6. Gilbert S. F, 2016, Developmental biology. Sinauer Associates. Oxford University Press, UK
7. Lewis Wolpert, 2002, Principles of Development, Oxford University Press, UK
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BBZO615: GENETICS AND BIOINFORMATICS

(Only for BSc Zoology & Industrial Microbiology programme)

Total Hours: 54

Credit: 3

Course Objectives:

- To emphasis the basic principles of inheritance at the molecular, cellular and organismal levels
- To equip the students with biotechnological application in biological science
- To update and expand basic bioinformatics skills and to effectively utilize the digital knowledge resources in learning

Course Outcomes:

- Students will learn the basic principles of inheritance at the molecular, cellular and organismal levels
- Better understanding on Biotechnological application and Bioinformatcs tools

PART I - GENETICS (36 hrs)

Module I - Introduction (2 hrs)

Gene and alleles, genotype and phenotype, homozygous and heterozygous, wild type and mutant alleles, Chromosome theory of heredity

Module II - Mendelism (3hrs)

Mendel's laws, Dominant and recessive traits, test cross and back cross, reciprocal cross, Mendelian traits in man

Module III - Interaction of Genes (5 hrs)

Allelic: Incomplete dominance, Co-dominance

Non allelic interactions: Complementary, supplementary

Epistasis: Dominant (feather colour in fowl), Recessive (coat colour in mice)

Polygenes (Skin colour inheritance in man)

Pleiotropism; Modifying genes; Lethal genes (Brief account with one example each)

Multiple alleles (coat colour in rabbits, ABO blood group, Rh factor and its inheritance)

Module IV - Linkage and Recombination **(3hrs)**

Morgan's work in Drosophila (Complete and incomplete linkage)

Arrangement of linked genes-cis and trans

Recombination

Cytological evidence of crossing over (Stern's Experiment)

Module V - Sex Determination **(3hrs)**

Sex chromosomes and autosomes

Chromosomal mechanism sex determination (XX-XO, XX-XY, ZW-ZZ)

Sex determination in man; Barr bodies and Lyon hypotheses (Dosage compensation);

Role of Y chromosome

Sex determination in honey bees; Sex determination in Drosophila; Intersex;

Gynandromorphs

Hormonal influence on sex determination; Sex reversal

Environmental influence; Genic balance theory; Hermaphroditism

Module VI - Sex Linked Inheritance **(1 hr)**

Definition, Characteristics of sex linked inheritance (criss-cross inheritance)

Haemophilia and colour blindness

Pseudoautosomal genes (incompletely sex-linked genes)

Holandric genes; Sex limited and sex influenced traits in man

Module VII - Mutations **(5hrs)**

Types of Mutations: Somatic and germinal; Induced and random

Chromosomal mutations - structural and numerical changes

Gene mutation (point mutation)

Molecular basis of gene mutations: Transversions, Transitions, Frame shift

Mutagens: Physical, Chemical, Biological

Module VIII - Extra Nuclear Inheritance (**2hrs)**

Kappa particles in Paramecium

Maternal effect genes in snail

Module IX - Bacterial Genetics **(4 hrs)**

Bacterial genome

Recombination in Bacteria

Bacterial transformation; Transduction; Conjugation; F mediated sexduction

Module X - Human Genetics **(8hrs)**

Pedigree Analysis; Karyotyping- Normal human chromosome complement

Aneuploidy and Non disjunction

Genetic disorders in Man: Chromosomal anomalies- Autosomal: Down syndrome; Edward's syndrome; Cri-du-chat syndrome

Sex chromosomal - Klinefelter's syndrome; Turners syndrome

Single gene disorders (Brief mention): Sickle cell anaemia and Brachydactyly

Inborn errors of metabolism: Phenylketonuria; Alkaptonuria; Albinism and Tyrosinosis

Multifactorial disorders: Polygenic traits - Cleft lip and cleft palate.

Prenatal Diagnosis: Amniocentesis; Choriovillus sampling; Ultrasound scanning; Fetoscopy; Genetic counselling

Eugenics, Euphenics and Euthenics

PART II - BIOINFORMATICS (18 hrs)

Module XI – Biological Information Management **(8 hrs)**

Introduction

Concept of gene and genome

Genome sequencing projects

Storing and accessing sequence data: roles of databases and internet

Bioinformatics Databases

- Sequence databases- NCBI GenBank, SWISS-PROT
- Structure database- PDB

Database searching and data retrieval

Module XII - Sequence Analysis **(8 hrs)**

Sequence alignment: Global and Local alignments

Brief introduction to scoring matrices

Pair-wise sequence alignment, BLAST

Multiple sequence alignment

Concept of comparative genomics

Module XIII – Structural Bioinformatics **(2 hrs)**

Molecular Visualization Tool – Rasmol

Computer Aided Drug Discovery

References:

Genetics

1. Benjamin Lewin 2017, Genes XII, Oxford University Press, Massachusetts, USA
2. Brown T A ,2016, Gene cloning and DNA Analysis.Wiley Blackwell.UK
3. Desmand S.T. Nicholi, 2007, An introduction to Genetic Engineering Cambridge University Press
4. Frank H, Stephenson, 2006, Calculation for Molecular Biology and Biotechnology . Academic press
5. Gardner E.J. and Snustand D.P., 2011, Principles of Genetcis, John Wiley & Sons New York
6. John E. Smith Biotechnology Cambridge Low priced ed. (Third Ed) 2005
7. Strickberger W.M. 1990. Genetics (Mac Millan Publishing Co.)
8. Susantha Gosnalibke – Merged Evolution (Long term implication of Biotechnology and Information Technology) Gordon & Breech Pub. 2005
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1. Claverie & Notredame, 2003, Bioinformatics - A Beginners Guide, Wiley-Dreamtech India Pvt Ltd
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4. Arthur M. Lesk, 2008, Introduction to Bioinformatics,Oxford University Press, UK
5. Rashidi, Hooman H. and Buehler, Lukas K. 2001. Bioinformatics Basics, CRC Press, Washington DC, USA
6. Xiong, Jin. 2006, Essential Bioinformatics, Cambridge University Press, New York.

PRACTICAL

BBZO6P03: CELL BIOLOGY, GENETICS AND BIOINFORMATICS

(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)

Total Hours:72

Credit: 2

Course Objectives:

- To make the students aware of different cell organelles, their structure and role in living organisms
- To emphasis the basic principles of inheritance at the molecular, cellular and organismal levels
- To update and expand basic bioinformatics skills and to effectively utilize the digital knowledge resources in learning

Course Outcomes:

- Students acquire the knowledge of cell diversity, cell organelles and the mechanism of cell divisions
- Students understand the nature of genetic material, gene regulation and its expression
- Students will learn the basic principles of inheritance at the molecular, cellular and organismal levels
- Learn to use Bioinformatcs tools

PART A: CELL BIOLOGY

1. Study of tissues using permanent slides of epithelial tissues(Squamous, Cuboidal, Columnar), striated muscle, smooth muscle, neuron, cartilage and bone.
2. Isolation, staining and mounting of striated muscle fibre.
3. Squash preparation of onion root tip and identification of mitotic stages.
4. Mounting of polytene chromosome (Drosophila/Chironomus).
5. Identification of meiotic stages using permanent slides.
6. Preparation of human blood smear and identification of blood cells.
7. Study of tonicity using RBC.
8. Comparative study of prokaryotic and eukaryotic cells.
9. Identification of cell organelles.
10. Models (DNA, DNA replication, RNA – Different types)

PART B: GENETICS AND BIOINFORMATICS

1. Genetics problems – (Problems from each type)

   (a) Mono and Dihybrid cross (b) Back cross (c) Multiple alleles.
2. Study of barr body in human buccal epithelium.
3. Study through photographs of the Karyotype- Turner's Syndrome , Klinefelter's and Down's Syndrome.
4. Sex linked inheritance (color blindness, hyper trichosis, ichthyosis, hemophelia)
5. Autosomal disorders (sickle cell anemia, brachydactyly)
6. Sexing of Drosophila melanogaster
7. Isolation of genomic DNA
8. Downloading Nucleotide and Protein sequence files from databases
9. Downloading PDB structure files and visualizing using Rasmol
10. Sequence Analysis using BLAST, CLUSTAL Omega

BBZO6P04: ECOLOGY AND DEVELOPMENTAL BIOLOGY

(Common for BSc Zoology and BSc Zoology & Industrial Microbiology programmes)

Total Hours:72

Credit: 2

Course Objectives:

- To impart basic knowledge on ecosystems and their functioning
- To list abiotic and biotic factors that affect the distribution and dispersal of organisms
- To apply concepts and theories from biology to ecological examples.
- To emphasize the significant processes of early embryonic stages of development

Course Outcomes:

- Students gain practical knowledge in ecosystem components and their functions
- Students learn early embryonic stages of development in chick embryo

PART A: ECOLOGY

1. Estimation of dissolved oxygen
2. Estimation of dissolved carbon dioxide
3. Collection and identification of freshwater/ marine plankton
4. Plankton count(Fresh water/ marine)
5. Extraction of soil organisms
6. Study of soil types
7. Identification of minerals and rocks
8. Transparency measurements using Secchi disc
9. Study of pond ecosystem and preparation of food web

PART B: DEVELOPMENTAL BIOLOGY

1. Study of egg types
2. Embryological studies- Blastula (frog, chick)
3. Amniocentesis
4. Study of mammalian sperm and ovum
5. Study of placenta- rabbit and man
6. Study of 18 hour & 24 hour chick embryo slides
7. Egg candling
8. Mounting of chick embryo (36- 48 hr)

BBZO6P05: BIOCHEMISTRY, PHYSIOLOGY, ENDOCRINOLOGY AND ETHOLOGY

(Only for BSc Zoology programme)

Total Hours:72

Credit: 2

Course Objectives:

- Define and explain the basic principles of biochemistry useful for biological studies
- To explain the molecular and cellular basis of physiological functions in animals
- Acquire a broad understanding of the histology of endocrine organs in vertebrates
- To impart basic knowledge on animal behavioral patterns and their role

Course Outcomes:

- Students will be able to demonstrate an understanding of biomolecules, by the qualitative identification of biomolecules
- Students learn the endocrine organs and its histology in vertebrates
- Familiarize with animal behavioral patterns and their significance

PART A: BIOCHEMISTRY AND PHYSIOLOGY

Biochemistry

1. Qualitative analysis of sugars – glucose, fructose, lactose, maltose and starch
2. Qualitative analysis of lipids (Sudan III) and Cholesterol (Liebermann Burchard test)
3. Estimation of serum glucose by O-Toluidine method (Colorimetric)
4. Determination of salivary amylase activity in time intervals (starch-iodine test)

Physiology

1. Determination of haemoglobin content of blood
2. Total RBC count using Haemocytometer
3. Total WBC count using Haemocytometer
4. Estimation of PCV
5. Instruments: Sphygmomanometer and Stethoscope (principle and use)
6. Measurement of blood pressure using a Sphygmomanometer

PART B: ENDOCRINOLOGY AND ETHOLOGY

1. Study of permanent histological slides of endocrine glands.

   T.S. of Pituitary gland

T.S. of Thyroid gland

T.S. of Adrenal Gland

T.S. of Islets of langarhance

T.S. of Testis

T.S. of Ovary

2. Study of pituitary gland of fishes
3. Study of male and female reproductive system of a teleost fish
4. Pheromone traps
5. Skinner box/T Maze
6. Identification of behaviour showing pictures
7. Experiment to demonstrate phototaxis using Drosophila/House fly

BBZO6P06: INSTRUMENTATION, BIOSTATISTICS, MICROBIOLOGY AND IMMUNOLOGY

(Only for BSc Zoology programme)

Total Hours:72

Credit: 2

Course Objectives:

- Impart knowledge on basic instrumentation and statistical analysis
- To inspire the students in learning the microbial organisms, its culture and preservation techniques.
- To make students aware of the pathogens, health related problems, their origin and treatment.
- To impart basic knowledge of the organization and function of the immune system.

Course Outcomes:

- Students will learn the statistical analysis process, analysis of results and oral and written communication of conclusions
- Acquire knowledge on basic instrumentation techniques, its principles and application
- Students learn to make culture mediums, microbial cultures and identification procedures using staining protocols
- Students learn to distinguish microbial disease, its pathogenesis and control measures using immunologic protocols

PART A: INSTRUMENTATION AND BIOSTATISTICS

1. Magnification and focusing of objects using light microscopes
2. Phase contrast microscopy
3. Micrometry – calibration and measurement of microscopic objects
4. Camera Lucida (draw a few diagrams using Camera Lucida)
5. Paper chromatography
6. Demonstration

    Determination of pH using pH meter

    Separation of colloids using centrifuge

    Principle and applications of colorimeter

    Principle and applications of electrophoresis
7. Graphical representation of data using MS Excel

Line diagram

Bar diagram

Pie diagram

PART B: MICROBIOLOGY AND IMMUNOLOGY

1. Instruments –Autoclave, Hot air oven, Laminar Air Flow, Bacteriological incubator – Working and use in Microbiology lab.
2. Cleaning and sterilization of glassware
3. Preparation of solid and liquid media for microbial cultures. (Ingredients, pH and method of preparation) (Demonstration)

   (a) Solid media (1) Nutrient agar (2) Mac Conkey's agar

   (b) Liquid Media (1) Nutrient broth (2) Peptone water.

   (c) Semi solid agar

   (d) Firm agar
4. Culture methods

   (a) Streak plate technique

   (d) Pour plate culture

   (e) Liquid culture
5. Examination of microbes in living condition

   Hanging drop method for demonstrating motility of bacteria.
6. Gram staining – preparation, procedure, identification of Gram + ve and Gram –ve bacteria.
7. Determination of ABO blood groups and Rh factor (Antigen –antibody Reaction)

BBZO6P07: ANIMAL PHYSIOLOGY, ENDOCRINOLOGY AND ETHOLOGY

(Only for BSc Zoology & Industrial Microbiology programme)

Total Hours:72

Credit: 2

Course Objectives:

- To explain the molecular and cellular basis of physiological functions in animals
- Students will acquire a broad understanding of the hormonal regulation of physiological processes in invertebrates and vertebrates
- To impart basic knowledge on animal behavioral patterns and their role

Course Outcomes:

- Students will be able to integrate the regulation of organ system functions in a whole animal
- Students will learn the hormonal regulation of physiological processes in invertebrates and vertebrates
- Familiarize with animal behavioral patterns and their significance

PART A: ANIMAL PHYSIOLOGY

1. Preparation of Human blood smear & identification of leucocytes
2. Determination of haemoglobin content of blood
3. Total RBC count using Haemocytometer
4. Total WBC count using Haemocytometer
5. Differential count of WBC
6. Estimation of PCV
7. Identification of human blood groups, A, AB, B and O, Rh factor
8. Effect of different anti-coagulants on blood clotting time
9. Salivary amylase activity on starch
10. Abnormal constituents of Urine- Sugar, Ketone bodies, Albumin
11. Instruments (Principle & use)– Sphygmomanometer , Stethoscope
12. Measurement of blood pressure using a sphygmomanometer

PART B: ENDOCRINOLOGY AND ETHOLOGY

1. Study of permanent histological slides of endocrine glands.

T.S. of Pituitary gland

T.S. of Thyroid gland

T.S. of Adrenal gland

T.S. of Islets of langarhance

T.S. of Testis

T.S. of Ovary

2. Study of pituitary gland of fishes
3. Study of male and female reproductive system of a teleost fish
4. Pheromone traps
5. Skinner box/T Maze
6. Identification of behaviour showing pictures
7. Experiment to demonstrate phototaxis using Drosophila/House fly

ELECTIVE COURSES

BBZO6E01: WILDLIFE BIOLOGY, CONSERVATION AND MANAGEMENT

(Only for BSc Zoology programme)

Total Hours:72

Credit: 3

Course Objectives:

- Familiarize with endemic wildlife species, their habitats and conservation efforts
- To explain the conservation issues in a manner that is both environmentally sound and within the confines of political and social limitations

Course Outcomes:

- Identify the means by which species' declines can be detected, diagnosed, and remedied
- Identify the means by which community and ecosystem declines can be detected, diagnosed and remedied
- Recognize and appreciate some of the controversial issues in biological conservation
- Recognize the practical and economic limitations of implementing management actions to conserve species and habitats
- Evaluate current issues related to conservation during class discussions and in formal presentations

Module I - Introduction to Wildlife Biology **(4 hrs)**

Definition of Wildlife, its scope and importance.

Wildlife wealth of India

Threats to wildlife

Human intervention, overexploitation, tourism.

Habitat destruction, degradation and fragmentation.

Invasive species, Feral animals, Human-wildlife conflicts

Module II - Habitat Ecology **(8 hrs)**

Biomes - Concept and characteristics.

Biome types in India – Alpine Tundra, Grassland Biome, Forest Biome, Desert Biome, and Aquatic Biomes.

Biogeographical Zones of India- Trans Himalayan, Himalayan, Desert, Semiarid, Western Ghats, Deccan Peninsula, Gangetic Plains, Northeast Zone, Costal Zone, Islands.

Importance of forest, Forest Cover in India. Forest types of India.

Nature of damage to forests, cause, preventive and protective measures.

Forest fires: harmful and beneficial effects; control measure against fires.

Module III – Behavioural Ecology of Wild Animals (10 hrs)

Communication and signalling- Modes of Communication.

Significance of Signalling, Handicap Principle.

Deceptive Signals, Eaves dropping

Example of communication – Bee Dance

Home range and territoriality. Scent marking.

Cost and benefits of Territorial Defence.

Migration and Navigation during migration.

Courtship displays and its biological significance.

Social behaviour of Ungulates, Wild dogs, Primates and Elephants in brief.

Module IV - Distribution & Diversity of Indian Wildlife (14 hrs)

Major National Parks: Jim Corbett, Gir, Kaziranga, Sunderbans, Nagerhole, Ranthambhore, Keoladeo Ghana.

National Parks and Wildlife Sanctuaries in Kerala

Important Indian wild fauna: Indian Tiger, Asiatic Lion, Indian one horned Rhinoceros, Indian Elephant, Gaur, Lion-tailed Macaque, Dhole, Sloth Bear, Nilgiri Tahr, Malabar Giant Squirrel, Great Indian Hornbill, Gangetic Dolphin.

Module V - Wildlife Monitoring: Tools and Techniques (18 hrs)

Wildlife Census- Objectives and Considerations

Methods of population surveys: Direct count - Total Counts and Sample counts, Capture-mark-recapture estimate, tagging and banding, Drive counts, Road side Count, Transect Method-Line and Belt transects. Point count Method, Waterhole Census Method, Quadrate sampling, Territory Mapping.

Indirect counts (Sign Survey) – Pellet/Scat/Dung counts, Call counts, and Track counts, Foot Prints, Nest Counts, Den Survey, Day Beds, Diggings.

Pug mark - Tiger Pug mark- Design and Measurement. Pugmark Impression Pads. Plaster Casts, Tiger Tracer, Digital Pugmark Census Technique. Criticism of Pugmark census method.

Camera traps in wildlife research- Application and types.

Radio telemetry- (VHF Radio Tracking), Satellite Telemetry-(UHF Radio Tracking), GPS Tracking.

Use of Geographic Information System (GIS) in wildlife study

Scat analysis.

Photography.

Field requirements, equipment, field clothing-use of hides.

Module VI - Wildlife Conservation and Management (18 hrs)

Protected Areas –Concept and Design

Types of Protected Areas- Wildlife Sanctuary, National Park, Conservation Reserve, Community Reserve.

Concept of Biosphere reserve, Zonation and management of biosphere reserve: cores, buffers and transition Zones.

Critical wildlife habitats (CWH).

Concept of Corridors -Types of Corridors, Animals using Wildlife corridors, Advantages and problems associated with wildlife corridors.

Joint Forest Management Programme

Captive breeding and repopulation programme, Role of Zoos, Parks, Oceanarium; Gene banks and germplasm conservation;

Laws in wildlife conservation- Wildlife (Protection) Act – 1972

National and international conventions – CITES, TRAFFIC

Brief study of Project Tiger, Project Elephant, Lion Conservation Project, and Crocodile Breeding Projects. Sariska Incident.

Governmental and Non-Governmental Organizations in Wildlife conservation, management and research: MoEF, WII, WWF, WCS, BNHS.

References:

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2. Amita Saxena, 2017, Wildlife Management: Concept, Analysis and Conservation, Daya Publishing House, New Delhi
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6. Bernhard Grzimek, 2003, Grzimek's Animal Life Encyclopedia, 17 Volumes, Gale Publishers, Michigan, USA
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9. Johnsingh A. J. T. and Nima Manjrekar, 2012, Mammals of South Asia, Volume 1. Universities Press (India) Pvt Ltd, Hyderabad, India
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13. Primack RB, 2014, Essentials of Conservation Biology, Oxford University Press, UK
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17. Vivek Menon, 2014, Indian Mammals: A Field Guide, HachetteBook Publishing India, Gurgaon

BBZO6E02: ECO-TOURISM

(Only for BSc Zoology programme)

Total Hours:72

Credit: 3

Course Objectives:

- Provide students with a broad understanding of environmental issues and their impact upon the tourism industry
- To critically analyse the cost and benefits of ecotourism, including related laws and policies, community involvement and future trends
- To develop an appreciation among students with respect to tourism development from the sustainability perspective
- To equip the students with basic knowledge for the emerging ecotourism industry

Course Outcomes:

- Students understand the principles, context and practice of scientific ecotourism
- Students understand key issues related to sustainable use of ecotourism destinations
- Students understand the key elements of good interpretation and use these to communicate science concepts
- Critically appraise current ecotourism practices and gain experience in engaging with industry partners.

Module I - Fundamentals of Tourism **(5 hrs)**

Tourism, concepts and definitions

History

Motivation of travel – future trends

Module II - Ecotourism **(12 hrs)**

What is eco-tourism?

Concepts of eco-tourism

The facilitating sectors

Attractions: Geography, heritage,Wildlife, nature

Quality Control

Module III - Major areas of eco-tourism **(10 hrs)**

Concepts, practices and case studies for:

Marine tourism

Wildlife tourism

Adventure tourism

Module IV -Tourist destinations **(10 hrs)**

Common characteristics of tourist destinations

Spatial strategies for destinations

Visitor Management strategies for destinations with special reference to tourist spots of Kerala

Public sector initiatives

Private enterprises

Module V - Problems and prospects of eco-tourism **(8 hrs)**

Economics and benefits of ecotourism

Cultural issues and negative aspects of ecotourism

Environmental Impacts of Tourism

Module VI – Eco-conservation and eco-tourism **(10 hrs)**

Environment and conservation: basic principles

Current practices of eco-conservation in tourism industry

Sustainable tourism and society

Community based eco-tourism

Eco-development committee (EDC) of Periyar Tiger Reserve

People's initiatives

Module VII - Eco-tourism business **(10 hrs)**

Ecotourism marketing

Who are eco-tourists? Ecotourism companies

Emerging trends in eco-tourism

Cultural tourism

Pilgrimage tourism

Farm tourism

Backwater tourism

Health tourism

Module VIII - Eco-tourism guides **(7 hrs)**

Ecotourism guiding and case studies

Activities

Field studies

Survey

Report writing on an ecotourism initiative

References:

1. Bhattacharya, A.K. 2005. Ecotourism and livelihoods. Concepts publishing Co, New Delhi
2. Brian Garrod and Julie C. Wilson. 2002. Marine Ecosystem. Channel View Publications.
3. Bruner, E.M. 2005. Culture on tour: ethnographies of travel. The University of Chicago Press.
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9. Rave Chauhan. 2006. Ecotourism: Trends and challenges. Vista International Publishing group, New Delhi.
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11. Wearing S. and J. Neil. 1999. Ecotourism: impacts, potentials, and possibilities. Boston: Butterworth-Heinemann.
12. Weaver, D. 1998. Ecotourism in the less developed world. New York : CAB International.

13. Wells, M. & Brandon, K. 1992. People and Parks: linking protected area management with local communities. Washington, D.C.: the World Bank.
14. West, P.C. and Brechin, S.R., eds. 1991. Resident Peoples and National Parks: social dilemmas and strategies in international conservation. University of Arizona Press.
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COMPLEMENTARY COURSES

SEMESTER I

BDZO101: ANIMAL DIVERSITY – NON CHORDATA

Total Hours:36

Credit: 2

Course Objectives:

- To acquire knowledge on the taxonomic status of various Invertebrate animals and animal groups
- To develop an aptitude for understanding nature and its rich bio-diversity

Course Outcomes:

- Identify and list out various invertebrate fauna
- Acquire Knowledge on Invertebrate classification and representative organism of major taxa

Module I- Introduction **(1 hr)**

General Introduction; five kingdom classification

Module II - Kingdom Protista **(3 hrs)**

Salient features

Pathogenic Protista – Plasmodium, Entamoeba, Leishmania

Module III – Subkingdom Mesozoa & Parazoa **(2 hrs)**

Phylum Mesozoa- Rhopalura

Parazoa: Phylum Porifera – Leucosolenia

Phylum Placozoa –*Trycoplax adherens*

Module IV - Phylum Coelenterata **(4 hrs)**

Salient features, Classification up to classes

Class 1: Hydrozoa – Physalia

Class 2: Scyphozoa – Aurelia

Class 3: Anthozoa – Adamsia

Corals and coral reefs; Polymorphism in Coelentrata

Module V - Phylum - Platyhelminthes **(2 hrs)**

Salient features, classification up to classes

Class 1: Turbellaria – Planaria

Class 2: Trematoda – Fasciola

Class 3: Cestoda – *Taenia solium*

Module VI – Phylum Aschelminthes **(4 hrs)**

General characteristics; Outline classification

Class 1: Nematoda - Ascaris

Class 2: Nematomorpha - Gordius

Class 3: Gastrotrichia - Chaetonotus

Class 4: Kinorhyncha - Echinoderes

Brief study of Parasitic nematodes -Enterobius, Hook worm, Pin worm

Module VII - Phylum Annelida **(2 hrs)**

Salient features, classification up to classes

Class 1: Polychaeta - Nereis

Class 2: Archiannelida - Polygordius

Class 3: Oligochaeta – Earthworm – Pheretima

Class 4: Hirudinomorpha – Hirudinaria

Module VIII - Phylum Arthropoda **(10 hrs)**

Salient features, classification up to classes

Subphylum I: Trilobitomorpha

Class: Trilobita (Extinct)

Subphylum II: Chelicerata

Class 1: Merostoma – Limulus

Class 2: Arachinida – Spider

Class 3: Pycnogonida – Nymphon

Subphylum III: Mandibulata

Class 1: Crustacea – Daphnia

Class 2: Chilopoda - Centepede

Class 3: Symphyla - Scutigerella

Class 4: Diplopoda - Millipede

Class 5: Pauropoda - Pauropus

Class 6: Insecta – Butterfly

Larval forms of Crustacea

Insect pests

1. Pests of coconut – *Oryctes rhinoceros, Rhynchophorus ferrugineus, Nephantis serinopa,* Eriophid mite
2. Pests of paddy – *Leptocorisa acuta, Spodoptera mauritius*
3. Pests of stored grains - *Trogoderma granarium, Tribolium castaneum, Sitophilus oryzae*

Insect vectors and vector borne diseases- Mosquito, Rat flea, House fly, Sand fly, Glossinia

Phylum Onychophora – Peripatus (Mention its affinities)

Module IX - Phylum Mollusca **(3 hrs)**

General characteristics; Outline classification

Class 1: Monoplacophora - Neopilina

Class 2: Amphineura - Chiton

Class 3: Scaphopoda - Dentalium

Class 4: Gastropoda - Pila

Class 5: Bivalvia - Lamellidens

Class 6: Cephalopoda -Loligo

Module X - Phylum Echinodermata **(4 hrs)**

Salient features, classification up to classes

Class 1: Asteroidea – Astropecten

Class 2: Ophiuroidea - Ophiothrix

Class 3: Echinoidea – Echinus

Class 4: Holothuroidea – Cucumaria

Class 5: Crinoidea – Antedon

Water vascular system in Echinodermata

Module XI - Phylum Hemichordata **(1 hr)**

Salient features; Balanoglossus

References:

1. Barnes, R.D., 1987. Invertebrate Zoology W.B. Saunders, New York.
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13. P S Verma, E L Jordon, 2009, Invertebrate Zoology, S Chand Publishers, New Delhi

SEMESTER II

BDZO202: ANIMAL DIVERSITY – CHORDATA

Total Hours:36

Credit: 2

Course Objectives:

- To acquire knowledge on the taxonomic status of the various vertebrate animal groups
- To familiarise the students with the diverse groups of organisms around us
- To develop an aptitude for understanding nature and its rich biodiversity.

Course Outcomes:

- Identify and list out various Vertebrate fauna
- Aquired knowledge on Vertebrate classification and representative organisms of major taxa

Module I - Phylum Chordata **(10 hrs)**

General characters of the Phylum Chordata; Classification up to classes

Sub phylum I: Urochordata- General characters

Class 1: Larvacea - Oikopleura

Class 2: Ascidiacea - Ascidia

Class 3: Thaliacea - Salpa

Retrogressive metamorphosis

Subphylum II: Cephalochordata- General characters - Brachiostoma

Subphylum III: Vertebrata- General characters

Division I: Agnatha - General characters

Class 1: Cyclostomata - Petreromyzon

Class 2: Ostracodemi – Cephalaspis

Division II: Gnathostomata- General characters

Super class Pisces and Super class Tetrapoda

Module II – Super class Pisces **(7 hrs)**

General characters

Class 1: Chondrichthyes - Narcine

Class 2: Osteichthyes - Sardine, Latimeria

Lung fishes; Accessory respiratory organs in fishes; Migration in fishes; Scales in fishes

Module III - Super class Tetrapoda **(4 hrs)**

General characters

Class : Amphibia - General characters

Order I: Urodela - Amblystoma

II: Anura - Bufo

III: Apoda - Ichthyophis

Parental care in Amphibians

Module IV - Class Reptilia **(5 hrs)**

General characters

Sub class I: Anapsida - Chelone

Sub class II: Diapsida - Chameleon

Subclass III: Parapsida - Icthyosaurus

Poisonous and non-poisonous snakes of India

Module V - Class Aves **(5 hrs)**

General characters

Sub class I: Archaeornithes - Archaeopteryx

Sub class II: Neornithes - Pigeon

Flight adaptations of birds; Migration in birds; Flightless birds

Module VI - Class Mammalia **(5 hrs)**

General characters

Sub class I: Prototheria - Echidna

Sub class II: Metatheria - Macropus

Sub class III: Eutheria - Elephas

Aquatic mammals; Dentition in mammals

References:

1. Ashok Captain and Romulus Whitake, 2008. Snakes of India -The Field Guide. Draco Books, UK

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17. Sashikumar C, 2011. Birds of Kerala: Status and Distribution. DC Books Pvt Ltd.
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PRACTICAL

BDZO2P01: ANIMAL DIVERSITY

Total Hours:72

Credit:2

Course Objectives:

- To study the scientific classification of invertebrate and vertebrate fauna
- To learn the physiological and anatomical peculiarities of some invertebrate and vertebrate phyla

Course Outcomes:

- Identify and list out various invertebrate and vertebrate fauna
- Aquired knowledge on invertebrate and vertebrate classification and representative organism and their anatomical features

PART A: NON CHORDATA

Scientific Drawing:-

Make scientific drawings of 5 locally available invertebrate specimens belonging to different phyla.

Anatomy:-

Study of sections

1. Hydra.
2. Ascaris (male or female)
3. Fasciola
4. Earthworm (TS through intestine)

Study of nervous system in Prawn

Study of digestive system in Cockroach

Identification of common mosquitoes(4 genus)

Mounting:-

Mouth parts – House fly and Honey bee.

Prawn appendages.

Identification:-

General identification- The students are expected to identify the following Phylum –wise number of animals by their scientific names: Protista -2, Porifera-1, Coelenterata-2, Platyhelminthes-1, Annelida-2, Arthropoda-3, Mollusca- 2, Echinodermata-2

PART B: CHORDATA

Morphology

Scientific Drawing- Make scientific drawing of 5 locally available vertebrate specimens belonging to different classes

Mounting of placoid scales/cycloid/ctenoid scales

Study of feathers

Study of sections

Amphioxus T. S. through pharynx/T.S. through intestine

Osteology

Frog vertebrae

Pectoral and pelvic girdles of Frog

Dentition in Mammals (Dog, Rabbit, Man)

Identification:-

General identification of poisonous snakes(Cobra, Viper, Krait) non poisonous(Rat snake, Natrix, Python)

General identification-

Identify all the animals by their scientific names: Protochordata-1, Pisces-4, Amphibia-3, Reptilia- 4, Aves-1, Mammalia-2.

Taxonomic identification with key:-

Identification of fishes up to the level of order.

SEMESTER III

BDZO303: HUMAN PHYSIOLOGY AND IMMUNOLOGY

Total Hours:54

Credit: 3

Course Objectives:

- To explain the molecular and cellular basis of physiological functions in animals
- To explain various aspects of physiological activities of animals with special reference to humans
- To impart basic knowledge of the organization and function of the immune system

Course Outcomes:

- Students will be able to understand the fundamental physiological functions of organ system and its regulatory mechanisms
- Students learn the basic knowledge of the organization and function of the immune system

Part I - HUMAN PHYSIOLOGY (36 hrs)

Module I – Nutrition **(4 hrs)**

Digestive organs and associated glands in man

Balanced diet, Recommended Dietary Allowance (RDA)

Importance of fiber in diet

Malnutrition disorders, Vitamin deficiencies, Mineral deficiencies (Iron, Calcium and Iodine)

Module II - Respiration **(4 hrs)**

Respiratory organs in man

Exchange and transport of respiratory gases

Respiratory pigments: hemoglobin (mention structure), myoglobin

Respiratory disorders – Dyspnoea, Hypoxia, Asphyxia, Hypo and Hypercapnia, CO poisoning

Smoking and its physiological effects

Module III - Circulation **(6 hrs)**

Structure of human heart

Blood – Composition and function, Brief account of mechanism of blood clotting, Blood groups and transfusion

Haemophilia, Cerebral and pulmonary thrombosis, Cerebral haemorrhage

Blood pressure, ECG

Cardiovascular disorders – Arteriosclerosis, Myocardial infarction, Angiogram and Angioplasty

Module IV – Excretion **(6 hrs)**

Structure of human nephron

Composition of urine – normal and abnormal constituents

Urine formation: ultra filtration, selective reabsorption, tubular secretion and counter current mechanism

Hormonal control of renal function

Kidney disorders – Pyelonephritis, Glomerulonephritis

Module V - Neurophysiology **(6 hrs)**

Structure of typical neuron

Myelinated and non myelinated nerve fibres

Nerve impulse – initiation and propagation of nerve impulse, All or none law Saltatory conduction, Synaptic transmission, Neurotransmitters

Brian waves, Electroencephalogram

Neural disorders – Parkinson's disease, Epilepsy, Alzheimier's disease

Module VI - Muscle Physiology **(4 hrs)**

Striated, Non striated and Cardiac muscle

Ultra structure of striated muscle fibre

Mechanism of muscle contraction

Threshold and spike potential, Simple muscle twitch

Fatigue, Rigor mortis

Module VII - Endocrinology **(6 hrs)**

Endocrine glands and their hormones:

Hypothalamus and Pituitary

Thyroid and Parathyroid

Islets of Langerhans

Adrenal Medulla and Adrenal Cortex

Testis and Ovary

Hormonal disorders

Part II – IMMUNOLOGY (18 hrs)

Module VIII - Introduction to immunology (4 hrs)

Types of immunity: Innate, Acquired, Passive and Active and humoral and cell mediated

Mechanism of innate immunity-Barriers. Complement System, biological effects of complements

Module IX - Antigens and antibodies (5 hrs)

Types of antigens; antigenicity and immunogenicity, Factors affecting immunogenicity, Haptens; Antigenic determinants.

Basic structure of immunoglobulins, Different classes of immunoglobulins and functions.

Module X - Antigen- antibody reactions (3 hrs)

Nature of antigen-antibody reaction, specificity and cross reactivity, affinity and avidity.

Principle of Precipitation and Agglutination test, Clinical applications of antigen-antibody reaction-Widal, VDRL, HIV test (ELISA)

Module XI - Immune response system (6 hrs)

Primary and secondary immune response. Cells of Immune system –Lymphocytes- T&B cells, plasma cells, memory cells, NK cells, neutrophils, eosinophils, basophils, monocytes and macrophages.

Monoclonal antibodies, Hybridoma technology, applications of monoclonal antibodies

Immune disorders – Hypersensitivity, Auto immunity, Immunodeficiency- primary and secondary, AIDS. (Brief study)

Vaccines –Principle, Major types of vaccines with examples- Killed vaccines, live attenuated Vaccines, subunit vaccines, conjugate vaccines, recombinant vaccines, DNA vaccines

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3. Guyton, A.C. 2016. Text Book of Medical physiology. Prism Books Pvt.Ltd.Bangalore
4. Hill, W.R., Wyse, G.A and Anderson, M. 2007. Animal Physiology (2nd edn). Sinauer Associates Inc.Publishers, MA, USA.
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Immunology

1. Abbas, A.K., Lichtman,A.K and Pober , J.S. 1997. Cellular and Molecular Immunology. W.B. Saunders Co. New York, USA
2. Ashim K. Chakravarthy, 1998, Immunology, Tata McGraw-Hill, New Delhi
3. Chakraborty, A.K. 2006. Immunology and Immunotechnology, Oxford University Press, New Delhi
4. Darla,J, Wise & Gordeon,R.Carter. 2004. Immunology- A Comprehensive Review. Iowa State University Press. A Blackwell Science Co,USA
5. David Male,Jonathan Brostoff, David Roth and Ivan Roitt. 2006. Immunology. Mosby, Edinburgh,UK
6. Goldsby, R.A.,Kindt, T.J. and Osborne, B.A.2000. Immunology (4th edn.). W.H. Freeman and Co. NY,USA.
7. Hannigan, B. M., Moore, C. B. T. and Quinn, D. G. 2010. Immunology. Viva Books, New Delhi.

8. Helen Chappel and Maused Harney, 2006. Essentials of Clinical Immunology (5th edn.) Blackwell Scientific Publications
9. Ivan M. Roitt, 2002. Essential of Immunology. ELBS, New Delhi.
10. Khan. F.H. 2009. The Elements of Immunolgy. Pearson Education.New Delhi.
11. Kuby J, 2000. Immunology (7th edn.). WH Freeman & Co. New York.
12. Richard Coico and Geoffrey Sunshine. 2009. Immunology: A short course. Wiley-Blackwell,CA,USA

SEMESTER IV

BDZO404: APPLIED ZOOLOGY

Total Hours:54

Credit: 3

Course Objectives:

- To develop self-employment skills among students, by introducing the applied areas of Zoology like like aquaculture, apiculture, sericulture and vermiculture
- To emphasize the role of useful organisms in making value added products and as income generating source

Course Outcomes:

- Students gain knowledge for self-employment in the applied areas like aquaculture, apiculture, sericulture and vermiculture
- Learn to employ the role of useful organisms in making economically important value added products and as an income generating source

Module I – Introduction to Aquaculture **(4 hrs)**

Advantages and salient features of aquaculture

Types of aquaculture

Biotic and abiotic factors of water

Importance of algae in aquaculture

Module II – Pisciculture **(12 hrs)**

Construction and maintenance of culture pond

Morphology and economic importance of cultivable fishes of Kerala: Catla, Rohu, Mrigal, Etroplus & Tilapia

Carp culture

Composite fish culture; Integrated Fish Culture

Induced breeding in fishes

Important Fish Diseases

Fish preservation and processing

Module III - Aquarium management **(2 hrs)**

Setting up of an Aquarium; Types of filtration

Styles in Aquarium setting

Common species of Aquarium fishes; Aquarium plants

Module IV - Shrimp culture, Mussel culture & Pearl culture **(8 hrs)**

Shrimp culture: Major species of cultured shrimps

Types of culture, Culture practices

Mussel culture: Culture techniques: Bottom culture, Raft culture, Long line culture, Rack culture

Major species of mussels cultured in India

Pearl culture: Perl oysters; Method of pearl formation

Culture practices: Collection of Oysters, Preparation of graft, Preparation of nucleus

Implatation of nucleus: Mantle cavity insertion, Mantle tissue insertion, Gonadial insertion

Rearing and harvesting.

Module V - Sericulture **(10 hrs)**

Major species of silkworms cultured in India

Life cycle of silkworms; Silk gland

Silkworm rearing techniques: Collection of eggs, Incubation, Rearing of larvae, Mounting of worms, Harvesting of cocoons

Processiong of cocoons: Stifling, Reeeling, Lacing and Skeing

Silkworm diseases: Pebrine, Muscardine, Flacherie, Grasserie

Module VI - Vermiculture **(6 hrs)**

Species of Earthworms suitable for vermiculture

Reproduction and life cycle of earth worms

Physical and Chemical effects of Vermiculture

Vermicomposting: Site Selection, Cement pit; Soil pit; Preparation of pit; Maintenance and monitoring of pit

Module VII - Apiculture **(12 hrs)**

Species of Honey bees

Organization of honeybee colony

Bee keeping methods and equipments

Apiary management and maintenance

Stingless bee keeping (Meliponiculture)

Bee pasturage, Pollination by honey bees

Byproducts of honey bees and their uses

Diseases and pests of honey bees, control measures.

References:

1. Jhingran, V.G., 1985 Fish and Fisheries of India (Hindustan Publ. Corporation, New Delhi)
2. Kamaleshwar Pandy, Shukla J. P., 2013, Fish and Fisheries, Rastogi Publication, Meerut
3. Kurien, C.V. & Sebastian V.C., Prawn Fisheries in India (Hindustan Publ. Corporation, New Delhi)
4. Krishnaswami, S., 1986, New Technology of Silkworm Rearing (Central Silk Board Bangalore)
5. Lee, K. E., 1985, Earthworms, Their Ecology and relationships with Soils and Land use. Academics Press.
6. Supriti Sarkar, Gautam Kundu and Korak Kanti Chakai, 2016, An Introduction ot Economic Zoology, New Central Book Agency, London, UK
7. Sinhan, V.R.P. & Ramachandran, V., 1985, Fresh water Fish Culture (ICAR, New Delhi)
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9. Ullal, S. R. and Narasimahanna, M.N., Handbook of Practical Sericulture (Central Silk Board Bombay.)
10. Venkitaraman, P.R., 1983, Text Book of Economic Zoology (Sudarsana Publ. Cochin)
11. Vinita Jaiswal and Kamal Kumar Jaiswal, 2014, Economic Zoology, PHI Pvt. Ltd, New Delhi
12. Zade S. B. et al, 2011, Principles of Aquaculture, Himalaya Publications, New Delhi

PRACTICAL

BDZO4P02: HUMAN PHYSIOLOGY AND APPLIED ZOOLOGY

Total Hours:72

Credit: 2

Course Objectives:

- To explain the molecular and cellular basis of physiological functions in animals
- To impart basic knowledge of the organization and function of the immune system
- To emphasize the role of useful organisms in making economically important value added products, their diseases and identification

Course Outcomes:

- Students will be able to understand the fundamental physiological functions of organ system
- Students learn the qualitative analysis of biomolecules
- Students learn to identify useful organisms, their diseases and their economically important products

PART A: HUMAN PHYSIOLOGY

1. Preparation of Human blood smear and identification of leucocytes
2. Qualitative analysis of Reducing Sugar, Protein and Lipid
3. Action of Salivary amylase on Starch
4. Estimation of Haemoglobin
5. Identification of human blood groups, A, AB, B and O, Rh factor
6. Instruments (Principle and use)– Sphygmomanometer , Stethoscope Measurement of blood pressure using Sphygmomanometer

PART B: APPLIED ZOOLOGY

1. General Identification, Economic importance, Morphology, scientific names and common names of the following
    a. Economic importance and morphology of culturable species (Catla, Rohu, Grass carp, Common carp, Etroplus, Tilapia) *Penaeus indicus,/P.monodon,*

Perna viridis/P.indicus

Pinctada fucata

b. Aquarium equipments- Power head, power filter, canister, aerators

c . Two species of earthworms used in Vermiculture

d. Two species of honey bees

e. Silkworm. Cocoon/Adult

2. Castes of bees
3. Bee keeping equipments
4. Beeswax, Honey, Silk, Vermicompost (Identification-Uses)
5. Chandrika /Natrika used in sericulture
6. Fish diseases (any 2diagrams/specimens)
7. Fish Parasite (any one)

OPEN COURSE

BOZO501: HEALTH AND WELLNESS

Total Hours:54

Credit: 3

Course Objectives:

- To introduce the importance of health and wellness to students of other programmes
- To emphasize the central role of maintaining good health for wellness
- To introduce the student to the recent diseases and health issues

Course Outcomes:

- Students can clearly articulate the relationship between health and one's capacity to meet personal, academic, and life goals
- Clearly articulate the essential connections between personal health and the health of the natural environment and of the community
- Consistently exhibits behaviors that demonstrate a clear sense of personal role in fostering and sustaining a healthy sense of community that includes well-being for all

Module I – Introduction **(1 hr)**

Definition and meaning of health

Dimensions and determinants of health

Module II - Food and Nutrition **(4 hrs)**

Importance of nutrition; Macro and micro nutrients: Carbohydrates, Proteins, Lipids, Minerals, Vitamins, Water. Significance of dietary fibre

Meal pattern; Balanced diet; BMR; Malnutrition

Module III - Health and Exercise **(3 hrs)**

BMI; Diet and Exercise; Physical activity and health benefits

Effect of exercise on body systems

Module IV – Food and Water borne diseases **(6 hrs)**

Food and water safety: general principles of hygiene

Important food borne illness- Staphylococcal food poisoning, Salmonellosis, Amoebiasis

Important water borne illness- Cholera,Typhoid and Hepatits A

Module V - Emerging Infectious Diseases (4 hrs)

Swine flu (H1N1); Bird flu (H5N1); Chikungunya; Dengue fever; Leptospirosis Role of vectors in spread of diseases

Module VI- Life Style Diseases (4 hrs)

Obesity: causes and preventing measures

Diabetes: causes and management

Cardiovascular disorders: prevention and management

Cancer: different types, causes of cancer, carcinogens, diet & cancer

Module VII - Immunity (2 hrs)

Types of immunity; Antigen and Antibody; Vaccination

Module VIII - Replacement and Restoration Therapies (2 hrs)

Organ transplantation; Cell replacement therapy; Gene therapy

Module IX –Sexual Health and Hygiene (7 hrs)

Male and Female reproductive organs and hormones

Age related sexual changes –infantile, adolescent, adult

Female Reproductive cycle

Sexually Transmitted Diseases: Syphilis, Genital warts, Chlamydia, Chancroid, Trichomoniasis, Gonorrhea, Genital herpes, AIDS

Module X - Human Reproduction and Infertility (8 hrs)

Human sperm and ovum, Fertilization

Pregnancy and associated changes

Pre-natal diagnosis:- Ultra sound scanning, Amniocentesis, Chorionic Villus Sampling, Fetoscopy

Human sex determination

Parturition and lactation, Importance of breast milk

Causes of male and female infertility

Assisted Reproductive Techniques- IVF, ICSI, GIFT, ZIFT, Donor Insemination (DI), Surrogacy

Module XI - Mental Health and Disorders (4 hrs)

Concept of mental health; Emotional adjustment and well being

Yoga; Meditation and Relaxation

Anxiety disorders; Bipolar disorder; Depression

Treatments for mental disorders

Module XII - Drug Abuse (4 hrs)

Tobacco related illnesses and tobacco control

Alcoholism

Drug and substance abuse

Abuse related illnesses and their control

Addiction; De-addiction

Module XIII - Old age and associated problems (2 hrs)

Health problems of the elderly: Arthritis; Osteoporosis; Alzheimer's disease; Parkinson's disease

Module XIV – Biology for Human Welfare (3 hrs)

DNA finger printing and applications – Probing for criminals, method to resolve paternity and maternity disputes

Human genome project – a brief account

Genetically Modified Organisms

References:

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2. Fashey, Tomas D, Insel, Paul M and Roth Walt 2005, Fit and Well. New York; Mc Graw Hill Inc
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8. K. Park, 2017, Parks Text Book Of Preventive & Social Medicine, Banarsidas Bhanot Publishers, Jabalpur
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ADD ON COURSE

BZOEX01: ORNAMENTAL FISHERIES AND AQUARIUM MANAGEMENT

Total Hours:36

Credit: 2

Objectives of the Course-

1. To create interest among students engage themselves in creative and productive pass time activities.
2. To create curiosity among students regarding varieties of ornamental fishes.
3. To provide scientific skills necessary for aquarium construction and management.
4. To give scientific knowledge to pursue ornamental fisheries as a hobby and a source of income.
5. To develop entrepreneurship among the youth.
6. To make them aware of the importance of environmental protection and conservation of biodiversity.

Course I - Theory (20 hrs)

1. Introduction, Present status and history of ornamental fish culture. (1 hr)
2. Fish - General Morphology & Structure (1 hr)
3. Physiochemical Parameters in Fish culture. (2 hrs)
4. Fresh water ornamental fishes & Brief account of Salt water Ornamental fishes (3 hrs)
5. Nutrition & Feeding of aquarium fishes. (1 hr)
6. Common Diseases of Aquarium Fishes(2 hrs)
7. Breeding of Ornamental Fishes in general, Induced breeding-Principle and Methods (5 hrs)
8. Aquarium- Objectives and Types. (2 hrs)
9. Harvesting and transportation of ornamental fishes, Marketing of ornamental fishes (1 hr)
10. Aquascaping (2 hrs)

Course II - Practical (8 hrs)

1. Identification of Ornamental Fishes. (2 hrs)
2. Common Aquarium Plants. (1 hr)

3. Equipment Used In Aquarium. (3 hrs)
4. Setting up of an aquarium.(2 hrs)

Field visit (8 hrs)

Field visit to well-established commercial aquarium fish culture units. An individual report of visit is to be prepared and submitted along with record during practical evaluation.

Reading List

1. P. K. Talwar, Arun Gopal Jhingran, 1991, Inland fishes of India and adjacent countries, Volume 2 Oxford & IBH Pub. Co.
2. Jhingran,V.G,1975, Fish and Fisheries of India, Hindustan Publishing Corporation (India), 1975
3. Pandey.K, Shukla J.P,2015, Fish and Fisheries, Rasthogi Publication,Meerut
4. Aranmula Hariharaputhran, 1991, Veettiloru Aquarium, Kerala Bhasha Institute, Thiruvananthapuram.
5. Mary Chandy, 1970, Fishes, National Book Trust, New Delhi.
6. Menon K.N, 1994, Mathsyakrishi, Kerala Bhasha Institute, Thiruvananthapuram.
7. Nampoothiripadu, V.M.N., 1982, Veettiloru Aquarium, Kerala Shastrashahitya Parishat, Thiruvananthapuram.

MODEL QUESTION PAPER

ST. BERCHMANS COLLEGE (AUTONOMOUS), CHANGANACHERRY

BSc Zoology

Semester VI

BBZO6E01: Wildlife Biology, Conservation & Management

Time: 3 Hours **Maximum: 60 Marks**

Part A

Answer **any ten** *questions. Each question carries* **2 *marks***.

1. Define wildlife.
2. Name any two National Parks in Kerala.
3. What is darting?
4. What is pellet count?
5. Name any two *ex-situ* conservation methods for wild animals.
6. What are Biosphere reserves?
7. What does CITES stand for?
8. What are wildlife corridors?
9. What are social animals? Give two examples.
10. What is meant by scent marking?
11. What are feral animals? Give two examples.
12. Differentiate between vulnerable and endangered animals.

(10 x 2 = 20)

Part B

Answer any **six** *questions. Each question carries* **4 *marks*.**

13. Explain the scientific value of wildlife.
14. Wildlife is a treasure of genetic resources. Elaborate.
15. Write a note on Corbett National Park.
16. Describe the features of Indian one horned rhinoceros.
17. Comment on the different forest types in India?
18. Describe how gene banks help in wildlife conservation.
19. Describe the zonation of wildlife habitats.
20. Write a note on Project tiger.
21. Comment on forest fires.

(6 x 4 = 24)

Part C

*Answer any **two** questions. Each question carries 8 **marks**.*

22. Write an essay on various threats to wildlife.

23. Describe the values of wildlife and the steps taken for their conservation.

24. Write an essay on various wildlife monitoring techniques.

25. Explain various behavioural aspects of wild animals.

(2 x 8 = 16)

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