RESTRUCTURED CURRICULUM
AND SYLLABI IN
CHOICE BASED COURSE,
CREDIT AND SEMESTER SYSTEM
( CBCSS )

BSc ZOOLOGY PROGRAMME
INTRODUCED FROM 2009 ADMISSION ONWARDS
(Modified syllabus for 2012 admission onwards)

BOARD OF STUDIES IN ZOOLOGY (UG)

Mahatma Gandhi University P D Hills Kottayam .Kerala.
CONTENTS

A. Model I B.Sc. Zoology Programme
   COURSE STRUCTURE
   Scheme of Examination
   Syllabus – (1) Zoology Core Courses 1-12
      Theory
      Practical
   (2) Zoology core choice based courses
   (3) Zoology open courses for other streams

4. B. Sc. Zoology Complementary courses for Botany Model I
5. B. Sc. Zoology Complementary courses for Botany Model II

   Scheme of Examination
   Syllabus
      Theory
      Practical

B. Biological Techniques and Specimen preparation – UGC Sponsored.

C. Model II B.Sc. Zoology Programme (Vocational)

1. Aquaculture
2. Food Microbiology
3. Medical Microbiology
   Subjects – work distribution,
   Scheme of Examination and Syllabus
   Core subject – Zoology
   Vocational Subjects
   Complementary Subjects

D. Double core B.Sc. Zoology and Industrial Microbiology.

Report of the Board of Studies
B.Sc. ZOOLOGY PROGRAMME

Programme Objectives

The B.Sc. Zoology programme is designed to help the students to:

1. Impart basic knowledge of 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 certain applied branches to enable them for self employment.

6. Impart awareness of the conservation of the biosphere.
Programme Outcomes

The graduate of this programme should be able to

1. Identify and list out common animals
2. Explain various physiological changes in our bodies
3. Analyze the impact of environment on our bodies
4. Understand various genetic abnormalities
5. Develop respect for nature
6. Explain the role and impact of different environmental conservation programmes
7. Identify animals beneficial to humans
8. Identify various potential risk factors to health of humans
9. Explain the importance of genetic engineering
10. Use tools of information technology for all activities related to zoology

Comments

1. These outcomes do not naturally get translated into specific courses
2. Designing courses to meet these outcomes is very difficult task and would constitute significant deviation from the current text book based approaches.
Course structure:

The U.G. programme in Zoology must include (a) Common Courses, (b) Core Courses, (c) Complementary Courses, (d) Open Courses and (e) Project. No course shall carry more than 4 credits. The student shall select any Choice Based Course offered by the Department which offers the core courses, depending on the availability of teachers and infrastructure facilities, in the institution. Open course shall be offered in any subject and the student shall have the option to do courses offered by other Departments.

Course coding:

Every course in the programme is coded according to the following criteria.

1. The first letter plus second letter /another letter from the programme ie., ZY
2. One digit to indicate the semester. ie., ZY1 (Zoology, 1st semester)
3. One letter from the type of courses such as, A for common course, B for core course, C for Complementary course, D for Open course. ie., ZY1B (Zoology, 1st semester Core course)
4. Two digits to indicate the course number of that semester. ie., ZY1BO1 (Zoology, 1st semester, Core course, course number is 01)
5. The letter U to indicate for Under Graduate Programme.
6. One letter V for the Vocational course
7. ie., ZY1BO1U (Zoology, 1st semester, Core course, courses number 01, U for UG Programme)
8. The letter (P) denotes practical
## ZOOLOGY CODES

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZY</td>
<td>Zoology</td>
</tr>
<tr>
<td>ZYB</td>
<td>Zoology Core Course</td>
</tr>
<tr>
<td>ZY (P)</td>
<td>Zoology Core Practical</td>
</tr>
<tr>
<td>ZYD</td>
<td>Zoology Open Course</td>
</tr>
<tr>
<td>ZYC</td>
<td>Zoology Complementary Zoology</td>
</tr>
<tr>
<td>ZYC (P)</td>
<td>Zoology Complementary Zoology Practical ‘Model I’</td>
</tr>
<tr>
<td>ZAV</td>
<td>Zoology Vocational Aquaculture</td>
</tr>
<tr>
<td>ZMV</td>
<td>Zoology Vocational Medical Microbiology</td>
</tr>
<tr>
<td>ZFV</td>
<td>Zoology Vocational Food Microbiology</td>
</tr>
<tr>
<td>ZBV</td>
<td>UGC Sponsored Vocational – Biological Techniques and Specimen preparation.</td>
</tr>
<tr>
<td>ZY6BPVU</td>
<td>Zoology 6th semester core project viva undergraduate.</td>
</tr>
<tr>
<td>ZYCV</td>
<td>Zoology Complementary Zoology for Vocational (Model II)</td>
</tr>
</tbody>
</table>

The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam
INVESTIGATORY PROJECT, FIELD STUDY/ (STUDY TOUR) AND GROUP ACTIVITY

A. Study tour/ field study, visit to research institute and various places of zoological Importance

Field study/study tours should be conducted for not less than 6 days (completed during the entire programme), preferably spreading the study in the first to sixth semesters. Students are expected to visit research institutes and various places of zoological importance.

B. Group Activity

Students are expected to do one group activity in the fifth semester and submit the report in the sixth semester for external practical examination, along with study tour report

A maximum of ten students can choose any one group activity like aquarium management, vermicomposting, bee keeping, and conduct of zoological exhibitions, designing of posters of zoological importance, surveys related to disease outbreaks, community health programmes or any matter of zoological interest.

C. Project Work

Each student is expected to complete 1 investigatory project in the sixth semester and report shall be submitted for the external practical examination. Project presentation and Viva-Voce will be conducted by the external examiners along with the 6th semester practical examinations. The projects are to be identified during the second semester of the programme with the help of the supervising teacher, and the work can be started latest by the beginning of the 3rd semester. The student has to maintain a log book showing the progress of the project work, duly signed by the supervising teacher, and may be shown to the external examiners on demand.

For A, B and C- total 36 hours and total 1 credit (18 hours in 5th semester and 18 hours in 6th semester).

Zero Credit Courses:

Zero Credit courses shall be included in the programme to encourage advanced learners and shall be indicated in the score sheet. Permission for obtaining Zero credit courses shall be in accordance with the rules and regulations of the University. The Zero Credit courses shall be done only under the supervision of a university approved permanent faculty member of the department which offers the core courses.
Examinations:

The evaluation of each course shall contain two parts such as Internal or In-Semester Assessment (IA) and External or End-Semester Assessment (EA). The ratio between internal and external examinations shall be 1:3. The Internal and External examinations shall be evaluated using Direct Grading system based on 5-point scale as given below.

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Performance</th>
<th>Grade point (G)</th>
<th>Grade Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Excellent</td>
<td>4</td>
<td>3.5 to 4.00</td>
</tr>
<tr>
<td>B</td>
<td>Very Good</td>
<td>3</td>
<td>2.5 to 3.49</td>
</tr>
<tr>
<td>C</td>
<td>Good</td>
<td>2</td>
<td>1.5 to 2.49</td>
</tr>
<tr>
<td>D</td>
<td>Average</td>
<td>1</td>
<td>0.5 to 1.49</td>
</tr>
<tr>
<td>E</td>
<td>Poor</td>
<td>0</td>
<td>0.00 to 0.49</td>
</tr>
</tbody>
</table>

PROGRAMME CLASSIFICATION. The grade cards shall indicate the percentage equivalent to corresponding points of CGPA with a 7 point scale secured by the student as follows.

<table>
<thead>
<tr>
<th>CGPA</th>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.80 to 4.00</td>
<td>A+</td>
<td>95.00--100</td>
</tr>
<tr>
<td>3.50 to 3.79</td>
<td>A</td>
<td>87.50&lt;94.99</td>
</tr>
<tr>
<td>3.00 to 3.49</td>
<td>B+</td>
<td>75.00&lt;87.49</td>
</tr>
<tr>
<td>2.50 to 2.99</td>
<td>B</td>
<td>62.50&lt;74.99</td>
</tr>
<tr>
<td>2.00 to 2.49</td>
<td>C+</td>
<td>50.00&lt;62.49</td>
</tr>
<tr>
<td>1.50 to 1.99</td>
<td>C</td>
<td>37.50&lt;49.99</td>
</tr>
<tr>
<td>1.00 to 1.49</td>
<td>D</td>
<td>25&lt;37.49</td>
</tr>
</tbody>
</table>
A separate minimum of D grade for internal and external are required for a pass for a course. For a pass in a programme a separate minimum of Grade D is required for all the courses and (must score a minimum of CGPA 1.5 to 1.99) an overall grade of C and above.

**Internal or In-Semester Assessment (IA):**

Internal evaluation is to be done by continuous assessments on the following components. The Components of the internal evaluation for theory and practical and their weights are as below.

**Theory**

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance*</td>
<td>1</td>
</tr>
<tr>
<td>Assignment</td>
<td>1</td>
</tr>
<tr>
<td>Seminar</td>
<td>1</td>
</tr>
<tr>
<td>Best two test papers</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5</strong></td>
</tr>
</tbody>
</table>
*Attendance*

<table>
<thead>
<tr>
<th>% of Attendance</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above 90%</td>
<td>A</td>
</tr>
<tr>
<td>Between 85 and 90</td>
<td>B</td>
</tr>
<tr>
<td>Between 80 and 85</td>
<td>C</td>
</tr>
<tr>
<td>Between 75 and 80</td>
<td>D</td>
</tr>
<tr>
<td>Below 75</td>
<td>E</td>
</tr>
</tbody>
</table>

Assignments: Best of two assignments are considered per course. The student has to take a minimum of 1 seminar per course. A minimum of 2 class tests are to be attended. The grades of best 2 tests are to be taken.

**Practical**

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance</td>
<td>1</td>
</tr>
<tr>
<td>Laboratory Involvement</td>
<td>2</td>
</tr>
<tr>
<td>Test</td>
<td>2</td>
</tr>
<tr>
<td>Record</td>
<td>2</td>
</tr>
<tr>
<td>Viva-Voce/Quiz</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
</tr>
</tbody>
</table>

*Attendance & Laboratory Involvement**

<table>
<thead>
<tr>
<th>Attendance *</th>
<th>Laboratory Involvement **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance above 90% = A</td>
<td>Punctuality +</td>
</tr>
<tr>
<td>89% to 85% = B</td>
<td>Handling Equipments +</td>
</tr>
<tr>
<td>84% to 80% = C</td>
<td>Skill in Laboratory work +</td>
</tr>
<tr>
<td>79% to 75% = D</td>
<td>Group Interaction = A</td>
</tr>
<tr>
<td>Below 75 = E</td>
<td></td>
</tr>
</tbody>
</table>
The evaluation of all components is to be published and is to be acknowledged by the candidate. All documents of internal assessments are to be kept in the institution for 2 years and shall be made available for verification by the university. The responsibility of evaluating the internal assessment is vested on the teacher(s) who teach the course.

**External or End-Semester Assessment (EA):**

The external examination of all semesters shall be conducted by the university on the close of each semester. There will be no supplementary exams. For reappearance/ improvement as per university rules, students can appear along with the next batch.

**Examinations (Practical):**

The practical examinations for the odd semesters are conducted internally by the question papers and schedule from the university. For even semesters, external practical examinations are conducted by the university with a common time-table and questions set by the university. One examiner shall be external and the other internal, both selected from a panel of examiners published by the university. The duration of practical examinations of Core & Complementary of model 1, 2, & 3 Zoology are of 3 hours.

The graded score sheet of practical & theory internals duly certified by the head of the institution, should be sent to the university before the commencement of the end semester university examinations on theory courses.

**Pattern of Questions (Theory):**

Questions shall be set to assess knowledge acquired, standard application of knowledge, application of knowledge in new situations, critical
evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. He/She shall also submit a detailed scheme of evaluation along with the question paper.

A question paper shall be a judicious mix of objective type, short answer type, short essay type/problem solving type and long essay type questions. Different types of questions shall be given different weights to quantify their range.

For all semesters:

1. The examination has duration of 3 hours
2. Each question paper has four parts A, B, C & D.
3. Part A contains 16 objective type questions of which the candidate has to answer all. Each bunch of 4 questions carries a weightage of 1.
4. Part B contains 8 short answer type questions spanning the entire syllabus and the candidate has to answer 5 questions. Each question carries a weight of 1.
5. Part C contains 6 short essay type spanning the entire syllabus and the candidate has to answer 4 questions. Each question carries a weight of 2.
6. Part D contains 3 essay type questions spanning the entire syllabus and the candidate has to answer 2 questions. Each question carries a weight of 4.

Evaluation of problems in the grading system:

Numerical problems in Biostatistics & Bioinformatics shall be graded in the following way.

1. Correct formula with correct substitution and answer : A
2. Correct formula with correct substitution and answer but wrong or no unit. : B
3. Correct formula with correct substitution and wrong answer : C
4. Formula alone is correct : D
5. Even formula is incorrect : E

Evaluation of practical examinations:

The Board of Examiners constituted by the University shall have the freedom for formulating the scheme of evaluation of the concerned practical examination.

Student Strength for practical:

There shall be at least one teacher to supervise a batch of not more than 15 students in each laboratory session.
### RESTRUCTURED CURRICULUM FOR
### B.Sc. DEGREE IN ZOOLOGY PROGRAMME
### COURSE STRUCTURE

### SCHEME OF INSTRUCTIONAL HOURS AND CREDITS

(TOTAL CREDITS 120)

<table>
<thead>
<tr>
<th>Semester I</th>
<th>Total Credits 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Course Title</td>
</tr>
<tr>
<td>1</td>
<td>Common Course  English - 1</td>
</tr>
<tr>
<td>2</td>
<td>Common Course English - 2</td>
</tr>
<tr>
<td>3</td>
<td>Common Course III Second Language - 1</td>
</tr>
<tr>
<td>4</td>
<td>Core Course I General  Methodology and Perspectives in Science</td>
</tr>
<tr>
<td>5</td>
<td>Core Course I Practical General  Methodology and Instrumentation</td>
</tr>
<tr>
<td>6</td>
<td>1st Complementary Course Chemistry I/Biochemistry I</td>
</tr>
<tr>
<td>7</td>
<td>1st Complementary Course Chemistry Practicals I</td>
</tr>
<tr>
<td>8</td>
<td>2nd Complementary Course Botany I</td>
</tr>
<tr>
<td>9</td>
<td>2nd Complementary Course Botany Practicals I</td>
</tr>
<tr>
<td>Total</td>
<td>25 hrs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester 2</th>
<th>Total Credits 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Course Title</td>
</tr>
<tr>
<td>1</td>
<td>Common Course  IV  English  3</td>
</tr>
<tr>
<td>2</td>
<td>Common Course V English 4</td>
</tr>
<tr>
<td>3</td>
<td>Common Course VI  Second Language -2</td>
</tr>
<tr>
<td>4</td>
<td>Core Course II Biodiversity and Modern Systematics</td>
</tr>
<tr>
<td>5</td>
<td>Core Course II Practical Biodiversity and Modern Systematics</td>
</tr>
<tr>
<td>6</td>
<td>1st Complementary Course Chemistry II/Biochemistry II</td>
</tr>
<tr>
<td>7</td>
<td>1st Complementary Course Practicals II</td>
</tr>
<tr>
<td>8</td>
<td>2nd Complementary Course Botany II</td>
</tr>
<tr>
<td>9</td>
<td>2nd Complementary Course Practicals II</td>
</tr>
<tr>
<td>Total</td>
<td>25 hrs</td>
</tr>
</tbody>
</table>
## Semester 3

<table>
<thead>
<tr>
<th>No</th>
<th>Course Title</th>
<th>Hrs/Week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Common Course VII English</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Common Course VIII Second Language</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Core Course III Animal Diversity - Non Chordata</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Core Course III Practical Animal Diversity - Non Chordata</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Complementary Course III Chemistry III/Biochemistry III</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Complementary Course III Practicals III</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Complementary Course III Botany III</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Complementary Course III Practicals III</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>25 hrs</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>

## Semester 4

<table>
<thead>
<tr>
<th>No</th>
<th>Course Title</th>
<th>Hrs/Week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Common Course IX English -6</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Common Course X Second language</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Core Course IV Animal Diversity –Chordata</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Core Course IV Practical Animal Diversity –Chordata</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Complementary Course IV Chemistry IV/Biochemistry IV</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Complementary Course IV Chem. Practicals.</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Complementary Course IV Botany IV</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Complementary Course IV Botany Practicals.</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>25 hrs</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>
### Semester 5
#### Total Credits 20

<table>
<thead>
<tr>
<th>No</th>
<th>Course Title</th>
<th>Hrs/Week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Core Course V Cell Biology and Molecular Biology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Core Course VI Environmental Biology, Toxicology and Disaster management</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Core Course VII Evolution, Zoogeography and Ethology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Core Course VIII Biochemistry, Human Physiology and Endocrinology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Core Course Practicals (Core V, VI, VII &amp;VIII)</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Core Course Field Study, Study tour and Group activity</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Open Course (For other streams)/Elective 1 – Man, Nature and Sustainable Development Elective 2 – Human Genetics, Nutrition, Community health and Sanitation Elective 3 – Vocational zoology Elective 4 Food Microbiology Elective- 5 Ecotourism</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>25 hrs</td>
</tr>
</tbody>
</table>

#### Semester 6
#### Total Credits 20

<table>
<thead>
<tr>
<th>No</th>
<th>Course Title</th>
<th>Hrs/Week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Core Course IX Reproductive and Developmental Biology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Core Course X Genetics and Biotechnology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Core Course XI Microbiology and Immunology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Core Course XII – General informatics, Bioinformatics and Biostatistics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Core Course Choice based (Electives)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elective I - Ecotourism</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elective 2 - Nutrition, Community Health, and Sanitation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elective 3 Economic Zoology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Core Course Practicals (IX, X, XI &amp; XII)</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Project work &amp; Field Visit/Study Tour, Visit to research institutes, Group activity</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>25 hrs</td>
<td>20</td>
</tr>
</tbody>
</table>
B.Sc. ZOOLOGY PROGRAMME

CORE COURSES

SCHEME OF DISTRIBUTION OF INSTRUCTIONAL HOURS

<table>
<thead>
<tr>
<th>Name of semester</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>First semester</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Second semester</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Third semester</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Fourth semester</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Fifth semester</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Field Study and Group activity</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sixth semester</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Project work (in 6th semester), Visit to research institutes</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

RECORDS

1. General Methodology and Instrumentation
2. Biodiversity and Modern Systematics
3. Animal Diversity - Non-Chordata
4. Animal Diversity - Chordata
5. Cell Biology and Molecular Biology
6. Environmental Biology, Toxicology and Disaster Management
7. Evolution, Zoogeography and Ethology
8. Biochemistry, Physiology and Endocrinology
9. Reproductive and Developmental Biology
10. Genetics and Biotechnology
11. Microbiology and Immunology
12. General Informatics, Bioinformatics and Biostatistics
Each Record will be having external and internal evaluation. A total of one credit is allotted for each record and the respective practical.

**CORE COURSES**

**SCHEME OF DISTRIBUTION OF HOURS AND CREDIT**

<table>
<thead>
<tr>
<th>Name of semester</th>
<th>Code</th>
<th>Name of core course</th>
<th>Hrs</th>
<th>Inst Hrs/week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ZY1B01U</td>
<td>General Methodology and Perspectives in science</td>
<td>36</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>[P]</td>
<td>(Practical)- General Methodology &amp; instrumentation</td>
<td>36</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>ZY2B02U</td>
<td>Biodiversity &amp; Modern systematics</td>
<td>36</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>[P]</td>
<td>(Practical) Biodiversity &amp; Modern systematics</td>
<td>36</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>ZY3B03U</td>
<td>Animal Diversity Non Chordata</td>
<td>54</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>[P]</td>
<td>(Practical) Animal Diversity Non chordata</td>
<td>36</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>ZY4B04U</td>
<td>Animal Diversity Chordata</td>
<td>54</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>[P]</td>
<td>(Practical) Animal Diversity – Chordata</td>
<td>36</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>ZY5B05U</td>
<td>Cell Biology and Molecular Biology</td>
<td>54</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>[P]</td>
<td>(Practical) – Cell Biology and Molecular Biology</td>
<td>36</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>ZY5B06U</td>
<td>Environmental Biology, Toxicology and Disaster Management</td>
<td>54</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>[P]</td>
<td>(Practical) – Environmental Biology, Toxicology and Disaster</td>
<td>36</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Year</td>
<td>Code</td>
<td>Course Details</td>
<td>Credits</td>
<td>Theory</td>
<td>Lab</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>-----------------------------------------------------</td>
<td>---------</td>
<td>--------</td>
<td>-----</td>
</tr>
<tr>
<td>5</td>
<td>ZY5B07U</td>
<td>Evolution, Zoogeography and Ethology</td>
<td>54</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>ZY5B07U</td>
<td>(Practical) Evolution, Zoogeography and Ethology</td>
<td>36</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>ZY5B08U</td>
<td>Biochemistry, Physiology and Endocrinology</td>
<td>54</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>ZY5B08U</td>
<td>(Practical) - Biochemistry, Physiology &amp; Endocrinology</td>
<td>36</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>ZY6B09U</td>
<td>Reproductive and Developmental Biology</td>
<td>54</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>ZY6B09U</td>
<td>(Practical) - Reproductive and Developmental Biology</td>
<td>36</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>ZY6B10U</td>
<td>Genetics and Biotechnology</td>
<td>54</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>ZY6B10U</td>
<td>(Practical) Genetics &amp; Biotechnology</td>
<td>36</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>ZY6B11U</td>
<td>Microbiology and Immunology</td>
<td>54</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>ZY6B11U</td>
<td>(Practical) – Microbiology and Immunology</td>
<td>36</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>ZY6B12U</td>
<td>General informatics Bioinformatics and Biostatistics</td>
<td>54</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>ZY6B12U</td>
<td>(Practical) General Informatics, Bio informatics and Bio statistics</td>
<td>36</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
CORE CHOICE BASED COURSE (6th SEMESTER)  

The students of Zoology Programme of each college can select any of the three in consultation with the Faculty of the Department.

<table>
<thead>
<tr>
<th>Semester</th>
<th>Code</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>ZY6B13U</td>
<td>Ecotourism</td>
<td>72</td>
</tr>
<tr>
<td>6</td>
<td>ZY6B14U</td>
<td>Nutrition, community health and Sanitation</td>
<td>72</td>
</tr>
<tr>
<td>6</td>
<td>ZY6B15U</td>
<td>Economic Zoology</td>
<td>72</td>
</tr>
<tr>
<td>Project</td>
<td>ZY6BPVU</td>
<td>Project and Viva (6th Semester)</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visit to research institutes (6th Semester)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Study tour/Field study, Group activity (5th Semester)</td>
<td></td>
</tr>
</tbody>
</table>

Students are free to choose any Research Topic related with courses of Zoology programme for their investigatory project work in consultation with their supervising teacher.

OPEN COURSES FOR OTHER STREAMS - Electives

<table>
<thead>
<tr>
<th>Semester</th>
<th>Code</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>ZY5D01U</td>
<td>Man, Nature and Sustainable Development</td>
<td>72</td>
</tr>
<tr>
<td>5</td>
<td>ZY5D02U</td>
<td>Human Genetics, Nutrition, Community health and Sanitation</td>
<td>72</td>
</tr>
<tr>
<td>5</td>
<td>ZY5D03U</td>
<td>Vocational Zoology</td>
<td>72</td>
</tr>
<tr>
<td>5</td>
<td>ZY5D04U</td>
<td>Food Microbiology</td>
<td>72</td>
</tr>
<tr>
<td>5</td>
<td>ZY5D05U</td>
<td>Ecotourism</td>
<td>72</td>
</tr>
<tr>
<td>Semester</td>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
<td>------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>1</td>
<td>ZY1C01U</td>
<td>Animal Diversity – Non-Chordata</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>ZY1C01U [P]</td>
<td>(Practical) - Animal Diversity –</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-Chordata</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>ZY2C02U</td>
<td>Animal Diversity – Chordata</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>ZY2CO2U [P]</td>
<td>(Practical) - Animal Diversity –</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chordata</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>ZY3C03U</td>
<td>Human Physiology and Immunology</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>ZY3C03U [P]</td>
<td>(Practical) - Human Physiology and</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Immunology</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>ZY4C04U</td>
<td>Applied Zoology</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>ZY4C04U [P]</td>
<td>(Practical) - Applied Zoology</td>
<td></td>
</tr>
<tr>
<td>Semester</td>
<td>Code</td>
<td>Course</td>
<td>Hrs</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>-----------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Semester 1</td>
<td>ZY1CVO1U</td>
<td>Animal Diversity-Non Chordata</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>ZY1CVO1U (P)</td>
<td>Animal Diversity-Non Chordata (Practical)</td>
<td>36</td>
</tr>
<tr>
<td>Semester 2</td>
<td>ZY2CVO2U</td>
<td>Animal Diversity-Chordata</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>ZY2CVO2U (P)</td>
<td>Animal Diversity-Chordata (Practical)</td>
<td>36</td>
</tr>
<tr>
<td>Semester 3</td>
<td>ZY3CVO3U</td>
<td>Human physiology &amp; Immunology</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>ZY3CVO3U (P)</td>
<td>Human physiology &amp; Immunology (Practical)</td>
<td>36</td>
</tr>
<tr>
<td>Semester 4</td>
<td>ZY4CVO4U</td>
<td>Applied Zoology</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>ZY4CVO4U (P)</td>
<td>Applied Zoology (Practical)</td>
<td>36</td>
</tr>
</tbody>
</table>
SCHEME OF EXAMINATIONS

Theory Examinations will be conducted by the University at the end of the respective semester in which the course is conducted.

Duration 3 Hrs (Internal: External weightage = 1:3)

SCHEME OF EXAMINATION THEORY (CORE COURSE)

<table>
<thead>
<tr>
<th>SEMESTER</th>
<th>CODE</th>
<th>COURSE</th>
<th>HRS</th>
<th>INTERNAL</th>
<th>EXTERNAL</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEM I</td>
<td>ZY1B01U</td>
<td>General Methodology and Perspectives in Science</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>SEM II</td>
<td>ZY2B02U</td>
<td>Biodiversity and Modern Systematics</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>SEM III</td>
<td>ZY3B03U</td>
<td>Animal diversity -Non Chordata</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>SEM IV</td>
<td>ZY4B04U</td>
<td>Animal Diversity Chordata</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>SEM V</td>
<td>ZY5B05U</td>
<td>Cell Biology And Molecular Biology</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ZY5B06U</td>
<td>Environmental Biology Toxicology and Disaster Management</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ZY5B07U</td>
<td>Evolution Zoogeography and Ethology</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ZY5B08U</td>
<td>Biochemistry Physiology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEM VI</td>
<td>ZY6B09U</td>
<td>Reproductive and Developmental Biology</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>--------</td>
<td>---------</td>
<td>----------------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>ZY6B10U</td>
<td>Genetics and Biotechnology</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ZY6B11U</td>
<td>Microbiology and Immunology</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ZY6B12U</td>
<td>General Informatics, Bioinformatics and Biostatistics</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>ELECTIVE</td>
<td>ZY6B13U</td>
<td>Ecotourism</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>ZOOLOGY</td>
<td>ZY6B14U</td>
<td>Nutrition, Community health And Sanitation</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CORE CHOICE BASED</td>
<td>ZY6B15U</td>
<td>Economic Zoology</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
## OPEN COURSES FOR OTHER STREAMS

<table>
<thead>
<tr>
<th>SEM 5 Electives</th>
<th>Code</th>
<th>Course</th>
<th>Exam duration</th>
<th>Internal</th>
<th>External</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ZY5D01U</td>
<td>Man, Nature and Sustainable Development</td>
<td>3 Hrs</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>ZY5D02U</td>
<td>Human Genetics, nutrition, community health and Sanitation</td>
<td>3 Hrs</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>ZY5D03U</td>
<td>Vocational Zoology</td>
<td>3 Hrs</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>ZY5D04U</td>
<td>Food Microbiology</td>
<td>3 Hrs</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>ZY5D05U</td>
<td>Ecotourism</td>
<td>3 Hrs</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

## SCHEME OF PRACTICAL EXAMINATIONS

University Practical Examinations will be conducted at the end of even Semesters with one external & one internal examiner and for odd semesters with one internal examiner

### A. Scheme of Practical Examinations at the end of 1, 2, 3 & 4 semester

<table>
<thead>
<tr>
<th>Semest er</th>
<th>Code</th>
<th>Exam duration</th>
<th>Course</th>
<th>Internal</th>
<th>External</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ZY1B01U</td>
<td>3Hrs</td>
<td>General Methodology &amp; Instrumentation</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>ZY2B02U</td>
<td>3Hrs</td>
<td>Biodiversity &amp; Modern systematics</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>ZY3B03U</td>
<td>3Hrs</td>
<td>Animal Diversity – Non chordata</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>ZY4B04U</td>
<td>3Hrs</td>
<td>Animal Diversity Chordata</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>
### B. Scheme of Practical Examinations at the end of 5th Semester

<table>
<thead>
<tr>
<th></th>
<th>Code</th>
<th>Type</th>
<th>Title</th>
<th>1</th>
<th>3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>ZY5B05U</td>
<td>P</td>
<td>Cell Biology &amp; Molecular Biology</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>ZY5B06U</td>
<td>P</td>
<td>Environmental Biology, Toxicology, and Disaster Management</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>ZY5B07U</td>
<td>P</td>
<td>Evolution &amp; Zoogeography</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>ZY5B08U</td>
<td>P</td>
<td>Biochemistry, Physiology &amp; Endocrinology</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

### C. Scheme of Practical Examinations at the end of 6th Semester

<table>
<thead>
<tr>
<th></th>
<th>Code</th>
<th>Type</th>
<th>Title</th>
<th>1</th>
<th>3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>ZY6B09U</td>
<td>P</td>
<td>Reproductive and Developmental Biology</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>ZY6B10U</td>
<td>P</td>
<td>Genetics &amp; Biotechnology</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>ZY6B11U</td>
<td>P</td>
<td>Microbiology and Immunology</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>ZY6B12U</td>
<td>P</td>
<td>General Informatics, Bioinformatics and Biostatistics</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>ZY6BPVU</td>
<td>P</td>
<td>Project and Viva Study Tour, Field Study Report, Group activity</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total**: 13
Curriculum for BSc. Zoology Programme

The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam

<table>
<thead>
<tr>
<th>TOTAL CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
</tr>
<tr>
<td>Core + Choice Based Core</td>
</tr>
<tr>
<td>Open course</td>
</tr>
<tr>
<td>Practicals</td>
</tr>
<tr>
<td>Practical + Project and Viva + Field Study Report, Group activity</td>
</tr>
</tbody>
</table>

| Total | 54 credits |

**SCHEME OF PRACTICAL CORE COURSES**

(External exam)

(SEMESTER -1,2,3,4,&6)

**External**

Weightage: 25

| Record       | 4 |
|--------------|
| Part-A       |
| Major practical | a) 4+ b) 4 = 8 |
| Part-B       |
| Minor practical | a) 2+ b) 1 = 3 |
| Part-C       |
| Spotters/problem | a) 5 items of 2 weightage each |
|              | 5×2 = 10 |
| Total        | 25 |

**SEMESTER 5**

**RECORD**

**WEIGHT -4**

**PART A** MAJOR PRACTICAL  WEIGHT a)-4,b)-4,c)-4

**PART B** MINOR ,,  WEIGHT 4&1

**PART C** SPOTTERS  WEIGHT 2X2 = 4

**TOTAL**  WEIGHT 25

**CREDIT -1**
FIELD STUDY, RESEARCH INSTITUTE VISIT, GROUP ACTIVITY, PROJECT AND VIVA  
(Credit 1)

Weightage

<table>
<thead>
<tr>
<th></th>
<th>Weightage (Internal)</th>
<th>Weightage (External)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Study report</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Group Activity</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Project</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Log book showing the progress of project work duly signed by the supervising teacher &amp; HOD</td>
<td>Project report</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Title-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Abstract-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Introduction + Literature review-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Methodology-4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Results-4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Discussion &amp; Conclusion-4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neat presentation and Novelty-4 (presentation using OHP / LCD, / chart/ brief narration in front of examiners &amp; students -in 7 Minutes)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Viva Voce-4 / (Question &amp;answer session after powerpoint or OHP / chart/ narration/ any type of presentation -4)</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>25</td>
</tr>
</tbody>
</table>
B.Sc ZOOLOGY PROGRAMME
MODEL - I
SYLLABI

SEMESTER I

ZY1B01U Core Course I

GENERAL METHODOLOGY AND PERSPECTIVES IN SCIENCE

36 hrs
Credits 2

Objectives

- To make aware of the basic philosophy of science, its history, concepts and scope
- To develop proper scientific mind, culture and work habits
- To familiarize with the basic tools and techniques of scientific study with emphasis on biological sciences

Pre-requisite:

- Basic knowledge on various sciences and definitions of scientific terms
- An awareness on role of research in science

PART – I BIOLOGY - THE LIFE SCIENCE

Module I. Science and Scientific Studies (4 hrs)

Types of knowledge: practical, theoretical, and scientific knowledge.

Information.

What is science; what is not science; laws of science.

Basis for scientific laws and factual truths.

Science as a human activity, scientific temper, empiricism.

Vocabulary of science, science disciplines.

Revolutions in Science and Technology

Core Readings


Kuhn, Thomas. 1996 *The Structure of Scientific Revolutions* 3rd ed.: University of Chicago Press, Chicago, IL


**Module II. What is Biology?** (4 hrs)

- Life and its manifestations.
- History of Biology
  - Biology in ancient times
  - Landmarks in the progress of Biology
- Branches of Biology

**Core Readings**


Ernst Myer. 1997. *This is Biology: The Science of the living World.* University Press, Hyderabad, India

Ernst Myer. 1997. *This is Biology: The Science of the living World.* University Press, Hyderabad, India

Kuhn, Thomas. 1996 *The Structure of Scientific Revolutions* 3rd ed.: University of Chicago Press, Chicago, IL

Module III. Tools and Techniques in Biology (12 hrs)

Scientific drawing -Purpose and principle

Basic understanding on principle and uses of the following:

Microscopy (a) Light microscopy,

Bright field (Compound Microscope), Phase contrast, Dark field microscopy, Fluorescence, Polarization microscopy, Video microscopy.

(b) Electron - Scanning (SEM), Transmission (TEM) and STEM Micrometry – Stage and Eyepiece micrometers

Camera Lucida

Instrumentation

- pH Meter

Separation Techniques

- Centrifuge

- Chromatography

- Electrophoresis

Analytical techniques

- Colorimeter

- Spectrophotometer

- X-ray crystallography

Core readings


Module IV. Animal Collection techniques  
- Collection methods, techniques and equipments
  Plankton
  Insects
  Fish
  Bird
- Preservation techniques – Taxidermy
- Rearing techniques
  Laboratory and field.

Core Readings

PART II: BIOLOGY AND RESEARCH  
Module V. Bioethics

Introduction
Animal rights and animal laws in India.
Prevention of cruelty to animals Act 1960
Wildlife protection act 1972 and Amendments
Biodiversity Act 2003.
Concept of 3 R – conservation (Refined- to minimize suffering, Reduced – to minimize animals, Replaced – modern tools and alternate means )
Animal use in research and education.
Laboratory animal use, care and welfare
Animal protection initiatives
Animal Welfare, Animal Welfare Board, India CPCSEA
Working with Humans, harm, risk, and benefits.Consent.
Special Cases: Children and Vulnerable people, Equality, Anonymity, Confidentiality, Information Storage and dissemination
Right to information- 2005.
Core Readings


Module VI. Research Methodology (5 hrs)
Scientific method
Research Projects- Steps and process. Types.
Research Communication
Research report writing (Structure of a scientific paper)
Presentation techniques
Project proposal writing
Assignment, seminar, debate, workshop, colloquium, Conference
- Brief description and major differences

Core Readings


Module VII. Units of measurements (1 hr)
Calculations and related conversions of each:
- Metric system- length; surface; weight
- Square measures
- Cubic measures (volumetric)
- Circular or angular measure
Curriculum for BSc. Zoology Programme

- Concentrations- percent volume; ppt; ppm
- Chemical – molarity, normality
- Temperature- Celsius, centigrade, Fahrenheit

**Core readings**


**Selected Further Readings**


Kuhn, Thomas. 1996 The Structure of Scientific Revolutions. 3rd ed.: University of Chicago Press, Chicago, IL


Sateesh, M.K. 2008 Bioethics and Biosafety; I.K. International Publishing House (Module V)

Taylor D.J. Green N.P.O, Stout G.W. Editor R. S. Oper, 2008 Biological science (Third edition Cambridge University press
ZY1B01U [P] Practical I: General Methodology and Instrumentation

36 hours
Credit 1

1. Study of simple and compound light microscopes
2. Micrometry – calibration and measurement of microscopic objects – low power
3. Camera Lucida (draw a few diagrams using Camera Lucida)
4. Paper chromatography (demonstration only)
5. Instrumentation – demonstration (write notes on principle, equipment and its use)
   - pH Meter
   - Colorimeter/ Spectrophotometer
   - Centrifuge
   - Electrophoresis
6. Scientific drawing (representatives from any five taxa)
7. Insect collection and preservation techniques (Group Activity)
SEMESTER II

ZY2B02U Core Course 2

BIODIVERSITY AND MODERN SYSTEMATICS

36 hrs

Credits 2

Objectives:

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

Pre requisite:

- Basic knowledge on the living world, plant and animal kingdom
- Knowledge on biodiversity and its conservation
- Knowledge on biological classification and representative organism of major taxa

PART I: BIODIVERSITY (26 Hrs)

Module I – Introduction to Biodiversity (2 hrs)

Definition

Historical perspective

Concepts –

Nature – environment – biodiversity

Scope and importance

Core Readings


Thomas AP.,(Editor) 2009 Biodiversity,Scope and Challenges- Green Leaf Publications Kottayam

**Module II – Levels of biodiversity** *(5 hrs)*

- Genetic, Species, Ecosystem
- Domesticated, Microbial diversity
- Distribution of biodiversity on earth
- Tropical, temperate and polar
- Landscapes and interactions
- Biodiversity hotspots

**Core Readings**


**Module III – Values of biodiversity** *(4 hrs)*

- Direct use value
- Indirect use value
- Non use value
- Ecosystem services

**Core Readings**

Module IV – Threats to biodiversity (5 hrs)

Types of threats
- Habitat loss, man- wildlife conflict (with case studies)
- Invasive species
- Pollution
- Over exploitation and human population
- Climate change

Core Readings


Module V – Biodiversity conservation and management (6 hrs)

Conservation strategies

In situ, ex situ
- National parks, Sanctuaries and Biosphere reserves

International efforts
- Convention on Biological Diversity (CBD)
- IUCN- WCMC, UNEP

Legal measures
- Wild life Protection Act, 1972
- The Environment Protection Act, 1986
- Forest (Conservation) Act1980, 1988
  - Biodiversity Act 2002
  - Biodiversity rule 2004

National biodiversity action plan
- People’s participation – Peoples biodiversity register (PBR)

Local initiatives

Core Readings

The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam
A.P.Thomas (Editor) 2009 Biodiversity – Scope & Challenges. Green leaf publications. Kottayam


Module VI – Biodiversity estimation – tools and techniques (4 hrs)

Sampling techniques -
  Quadrat
  Line transect

Measurements
  Density
  Abundance
  Frequency

Biodiversity indices – concepts
  Shannon-Weiner, Simpson

Core Readings


PART II – MODERN TAXONOMY (10 hrs)

Module VII – Taxonomical Principles (6 hrs)

Brief history
  Concepts and definition
  Approaches of taxonomy
  Molecular taxonomy
  Importance of classification
  Phylogeny and Taxonomy – Tree of Life, bar coding of life

Zoological nomenclature
  International Code of Zoological Nomenclature (ICZN)
Core Readings

Module VIII – Tools and techniques (4 hrs)
Identification Keys
- Dichotomous keys (Single access key)
- Polytomous key
- Multi access key
- Advantages and disadvantages

Core Readings

Selected Further Readings
Land resource based perspective plan for 2020 AD. Kerala State Land Use Board, Thiruvananthapuram


Nair, M.P., Pushpangathan, P., Rajasekharan, S., Narayanan Nair, K. and Dan Mathew. “*Jaivavaividhyam*” (Biodiversity). State Institute of Languages, Thiruvananthapuram


Thomas A.P., (Editor) 2009 Biodiversity scope & challenges. Green Leaf publications Kottayam


**Web Resources**

http://tolweb.org

http://www.biosis.org  
http://ucmp.berkely.edu

http://species.enviroweb.;org  
http://iczn.org

http://www.unep.org  
http://www.iucn.org

http://www.cbd.org
ZY2B02U [P] Practical 2

BIODIVERSITY AND MODERN SYSTEMATICS

36 hrs
Credit 1

1. Quadrate study
2. Transect study
3. Sampling
4. Species area curve
5. Identification using keys
   - Insect
   - Fish
   - Snake
6. Taxa, identification techniques
   - Bird body parts
   - Butterfly/ dragonfly body parts and  venation
7. Simple identification of any 20 animals (local – represent all taxa)
   - Common name and scientific name
8. Field study (compulsory)
   - Visit to two important areas of biodiversity
   - Report on local biodiversity conservation efforts
   - Eg. Sacred grooves, medicinal plant garden

Report should be submitted by each student
SEMESTER III

ZY3B03U CORE COURSE 3

ANIMAL DIVERSITY- NON CHORDATA

Objectives

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

MODULE I

Introduction: Briefly mention the following (2 hrs)

Classification – Keys and Principles.
Nomenclature (Uninominal, Binomial, & Trinomial), Law of Priority.
Two kingdom and Five kingdom classification.
Symmetry - Asymmetry, Spherical, Radial, Biradial and Bilateral
Coelom – Acoelomates, Pseudocoelomates and Eucoelomates
Schizocoelom, Enterocoelom., Protostomia and Deuterostomia

Kingdom Protista Type: Paramecium (10hrs)

Salient features and classification up to phyla

1. Phylum Rhizopoda: Amoeba
2. Phylum Actinopoda: Actinophrys
3. Phylum Dinoflagellata: Noctiluca
4. Phylum Parabasalia: Trychonympha
5. Phylum Metamonada: Giardia
6. Phylum Kinetoplasta: Trypanosoma
7. Phylum Euglenophyta: Euglena
8. Phylum Cryptophyta: Cryptomonas
9. Phylum Opalinata: Opalina
10. Phylum Bacillariophyta: Diatoms
11. Phylum Chlorophyta: Volvox
12. Phylum Choanoflagellata : Proterospongia
13. Phylum Ciliophora : Paramecium
14. Phylum Sporozoa : Plasmodium
15. Phylum Microsporidia : Nosema

(Mention any five general characters for each phylum. Detailed accounts of examples are not necessary.)

General Topics: (1) Parasitic Protozoans (2). Life cycle of Plasmodium

Kingdom Animalia Outline classification of Kingdom Animalia. (1hr)

Three branches - Mesozoa, parazoa, Eumetazoa.

Core Readings

MODULE II

Mesozoa - Eg. Rhopalura.

Phylum Porifera. (3 hrs)
Classification upto classes.
Class III – Demospongia. Eg. Cliona.

General Topics

Phylum Coelenterata Type: Obelia (6hrs)
Classification upto classes.

General Topics: Coral and coral reefs with special reference to conservation of reef fauna.

2. Polymorphism in Coelenterates

Core Readings

**MODULE III**

**Phylum Ctenophora.** (1 hr)

Eg. Pleurobrachia.

**Phylum Platyhelminthes** (3hrs)

Classification upto classes.

Class I - Turbellaria. Eg. Planaria.

Class II – Trematoda Eg. Fasciola

Class III- Cestoda Eg. *Taenia saginata.*

**General Topics**-

1. Life history of *Fasciola hepatica.*

2. Platyhelminth parasites of Man and Dog (Schistosoma, *Taenia solium*, Echinococcus).

**Phylum Nematoda** (3hrs)

Class phasmidia Eg. Enterobius, Ascaris

Class Aphasmidia Eg. Trichinella

**General Topic**-

Pathogenic nematodes. (*Wuchereria bancrofti, Ancylostoma duodenale*, Trichinella).

**Phylum Annelida** (2 hrs)

Classification upto classes.

Class I- Archiannelida Eg. Polygordius

Class II – Polychaeta Eg. Chaetopterus

Class III- Oligochaeta Eg. Megascolex.

Class IV - Hirudinomorpha Eg. Ozobranchus, Hirudinaria

**Core Readings**


MODULE IV

Phylum - Onychophora

Eg. Peripatus (Mention its affinities).

Phylum Arthropoda

Type: Panaeus

Classification upto classes.

Divided into 3 subphylla.

1. Sub Phylum - Trilobitomorpha

Class - Trilobita (mention salient features).

2. Sub Phylum- Mandibulata

Class I – Crustacea       Eg. Sacculina
Class II- Chilopoda       Eg. Centipede (Scolopendra)
Class III – Symphyla       Eg. Scutigerella
Class IV – Diplopoda       Eg. Millipede   (Spirostreptus)
Class V - Insecta       Eg. Dragon fly
Class VI – Pauropoda   Eg. Pauropus

3. Sub Phylum - Chelicerata

Class - Merostomata       Eg. Limulus
Class II – Arachnida       Eg. Scorpion

General Topics

1. Vectorial Arthropods
2. Larval forms of Penaeus

Core Readings


MODULE V

Phylum Mollusca

Classification upto classes

Class I- Monoplacophora   Eg. Neopilina
Class II- Amphineura  Eg. Chiton
Class III- Gastropoda  Eg. Aplysia
Class IV- Scaphopoda  Eg. Dentalium
Class V- Pelecypoda  Eg. Pinctada
Class VI- Cephalopoda  Eg. Sepia

**General Topic**-
Pearl formation and culture

**Phylum Echinodermata** (4 hrs)
Classification upto classes

Class I- Asteroidea  Eg. Astropecten
Class II- Ophiuroidea  Eg. Ophiothrix
Class III- Echinoidea  Eg. Echinus
Class IV- Holothuroidea  Eg. Holothuria
Class V – Crinoidea  Eg. Antedon

**General Topics**
1. Water vascular system.
2. Larval forms of Echinoderms

**Minor Phyla** (2 hrs)
1. Chaetognatha  Eg. Sagitta
2. Sipunculida  Eg. Sipunculus
3. Rotifera  Eg. Brachionus

**Phylum Hemichordata** (1 hr)
Eg. Balanoglossus

**Core Readings**
Zoological Society of Kerala Study material. *Animal Diversity* 2002 & 2010

**Selected Further Readings**
Thomas A.P (Editor) 2009 Invertebrata. Green leaf publications Kottayam
ZY3B03U [P] Practical 3
ANIMAL DIVERSITY- NON CHORDATA

36 hrs.
Credit 1

Scientific Drawing:-
Make scientific drawings of 5 locally available invertebrate specimens belonging to different phyla.

Anatomy:-

Study of sections. (Any two)
1. Hydra.
2. Ascaris
3. Earthworm
4. Fasciola

Dissections
1. Prawn - Nervous system
2. Cockroach - Nervous system

Mounting:-
1. Nereis - Parapodia
2. Cockroach - Salivary glands
3. Mouth parts - Plant bug/ House fly/ Mosquito. (Any Two)
4. Prawn appendages.

Identification:-

General identification- The students are expected to identify the following Phylum-wise number of animals by their generic names and 20% of these by their specific names. Protista -2, Porifera-1, Coelenterata-2, Platyhelminthes-1, Annelida-2, Arthropoda-3, Mollusca- 2, Echinodermata-2

Taxonomic identification with key:-
Identification of insects up to the level of order.
SEMESTER IV

ZY4B04U CORE COURSE 4
ANIMAL DIVERSITY – CHORDATA

Objectives

1. To make the student observe the diversity in chordates and their systematic position.
2. To make them aware of the economic importance of some classes.

MODULE I
Introduction

Phylum Chordata - General classification
(Classification up to order – Sub phylum, Super class, Class, Subclass, Order)

1. Sub phylum: Urochordata
   - Class I Larvacea Eg. Oikopleura
   - Class II Asciidiacea Eg: Ascidia (Mention Retrogressive Metamorphosis)
   - Class III Thaliacea Eg: Doliolum

2. Sub phylum: Cephalochordata
   Example - Amphioxus

Core Readings
Young J.Z. 2006 The life of Vertebrates Oxford University Press (Third Ed.)
India Ed.
MODULE II

3. Sub phylum: Vertebrata

4. Division 1 – Agnatha (2 Hrs)
   - Class I Ostracodermi Eg: Cephalaspis
   - Class II Cyclostomata Eg: Petromyzon

Division 2 – Gnathostomata (10 Hrs)

Super class Pisces

Class: Chondrichthyes
   - Sub class - Elasmobranchi Eg: Narcine
   - Sub class Holocephali Eg: Chimaera

Class: Osteichthyes
   - Sub class – Choanichthyes
     - Order 1 Crossopterigii Eg: Latimeria
     - Order 2 Dipnoi Eg: Lepidosiren
   - Sub class: - Actinopterygii
     - Super order 1. Chondrostei Eg: Acipencer
     - Super order 2. Holostei Eg: Amia
     - Super order 3. Teleostei Eg: Sardine

General topics

1. Accessory respiratory organs in fish.
2. Parental care in fishes.
4. Migration in fishes
5. Common culture fishes of Kerala
6. Lung fishes

Core Readings
Young J.Z. 2006  The life of Vertebrates Oxford University Press (Third Ed.) India Ed.
Curriculum for BSc. Zoology Programme

The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam

Jhingran 1977, Fish and Fisheries of India, Hindustan Publishing Co.

**MODULE III**

**Super class: Tetrapoda** (10 Hrs)

Class Amphibia

**Type Frog**

Order I Anura Eg: Hyla

Order II Urodela Eg: Amblystoma (Mention axolotl larva and neotony)

Order III Apoda Eg: Ichthyophis.

**Class Reptilia** (4 Hrs)

Sub class I: Anapsida

Order Chelonia Eg: Chelone

Sub class II: Parapsida Eg: Ichthyosaurus

Sub class III: Diapsida

Order I Rhynchocephalia Eg: Sphenodon

Order II Squamata Eg: Chamaleon

Sub class IV: Synapsida Eg: Cynognathus

**General topic**

Identification of poisonous and non poisonous snakes

**Class Aves** 4 Hrs

**Sub class I: Archeornithes** Eg: Archaeopteryx (Affinities)

**Sub class II: Neornithes**

Super order I: Palaeognathe Eg: Struthio

Super order II: Neognathe Eg: Brahminy kite

**General topics**

1. Migrations in birds

2. Flight adaptions in birds

**Core Readings**


MODULE IV

Class Mammalia        (18 Hrs)
Type: Rabbit

Sub class I: Prototheria  Eg: Echidna
Sub class II: Metatheria  Eg: Macropus
Sub class III: Eutheria

Order 1. Insectivora  Eg: Talpa
Order 2 Dermoptera  Eg: Galeopithecus
Order 3. Chiroptera  Eg: Pteropus
Order 4. Primates  Eg: Loris
Order 5 Carnivora  Eg: Panthera
Order 6 Edentata  Eg: Armadillo
Order 7 Pholidota  Eg: Manis
Order 8 Proboscidea  Eg: Elephas
Order 9 Hyracoidea  Eg: Procavia
Order 10 Sirenia  Eg: Dugong
Order 11 Perissodactyla  Eg: Zebra
Order 12 Artiodactyla  Eg: Cameleus
Order 13 Lagomorpha  Eg: Oryctolagus
Order 14 Rodentia  Eg: Porcupine
Order 15 Tubulidentata  Eg: Orycteropus
Order 16 Cetacea  Eg: Delphinus

General topics
1. Dentition in Mammals
2. Aquatic Mammals

Core Readings
Thomas A P (Editor) 2010 Chordata .Green leaf publications Kottayam
Selected Further Readings

Jhingran 1977, Fish and Fisheries of India, Hindustan Publishing Co.
Young J.Z. 2006 The life of Vertebrates Oxford University Press (Third Ed.) India Ed.
ZY4B04U [P] PRACTICAL 4
ANIMAL DIVERSITY  CHORDATA

36hrs
Credit 1

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

2. **Dissections**
   Frog: Photographs/diagrams/one dissected & preserved specimen each/models may be used for study.
   1. Frog Viscera
   2. Frog Digestive System
   3. Frog Arterial System
   4. Frog 9th & 1st Spinal nerve
   5. Frog Sciatic Plexus
   6. Frog Brain

   Mounting of placoid scales/cycloid/ctenoid scales

3. **Osteology**
   Frog vertebrae
   Pectoral and pelvic girdles of Frog and Rabbit
   Skull of Rabbit (Diastema -dentition
   Turtle – plastron and carapace

4. **Study of sections.**
   Amphioxus T. S. through pharynx/T.S. through intestine

5. **Identification:-**

   **General identification** -
   Identify all the animals by their generic names and 25% of them by their specific names.

7. Taxonomic identification with key:-
   i) Identification of fishes up to the level of order.
   ii) Identification of snakes up to family.
SEMESTER V
ZY5B05U CORE COURSE 5
CELL BIOLOGY AND MOLECULAR BIOLOGY

54 Hrs
Credits 3

Objectives:
1. To emphasize the central role of Cell biology and Molecular biology, being the most developing areas of biological science.
2. To make aware of different cell organelles, their structure and role in living organisms.
3. To introduce the nature of genetic materials at molecular level, their expression and regulation.
4. To develop critical thinking, skill and research aptitudes.

PART I - CELL BIOLOGY

Module I  History of cell and molecular biology  (2 hrs)
Cell theory, Prokaryotes, Eukaryotes, Actinomycetes, Mycoplasmas, Virus, Virion and Viroids, Prions,

Core Readings
Thomas AP (Editor)2011 Cell&Molecular Biology T
Zoological Society of Kerala Study material. 2002. Cell Biology, Genetics and Biotechnology Chapter – 1
Zoological Society of Kerala Study material. 2008. Microbiology and Immunology Chapter – 1

Module II Cell membrane & Permeability  (6 hrs)
Molecular models of cell membrane
(Sandwich model, Unit membrane model, Fluid mosaic model)
Modifications of plasma membrane. (Microvilli, tight junction, gap junction, desmosomes)
Cell permeability - Diffusion, Osmosis, Passive transport, Active transport, Cell coat and Cell recognition.

Core Readings


Zoological Society of Kerala Study material. 2002. Cell Biology, Genetics and Biotechnology Chapter – 4


Module III Ultrastructure of Cytoplasm (7 hrs)

Cytoskeleton - Microtubules, microfilaments, intermediate filaments.
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.

Core Readings

Zoological Society of Kerala Study material. 2002. Cell Biology, Genetics and Biotechnology Chapter – 4

Module IV Nucleus (6 hrs)


Core Readings

Zoological Society of Kerala Study material. 2002. Cell Biology, Genetics and Biotechnology Chapter – 4

New Delhi

Module V  
Cell Division  
(3 Hrs.)
Cell cycle - G₁, S, G₂ and M phases
Mitosis and Meiosis
Core Readings
Zoological Society of Kerala Study material. 2002. Cell Biology, Genetics and Biotechnology Chapter – 6

Module VI  
Cell Communication  
(3 Hrs.)
Cell signalling - Signalling molecules (neuro-transmitters, hormones, growth factors, cytokines, vitamin A and D derivatives)
Role of cyclic AMP
Core Readings
Karp. G., 1996 Cell and Moecular Biology, Concepts and Experiments
John Wiley and Sons New York.

PART II - MOLECULAR BIOLOGY  
27 Hrs.
Module VII Nature of Genetic Materials  
(7 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, Pseudogenes, Overlapping genes, Transposons
Core Readings
Module VIII Gene Expressions (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.

Core Readings

Module IX Gene regulations (8 hrs)
Prokaryotic (inducible, repressible systems), Operon concept -Lac operon and Tryptophan operon. Brief account of Eukaryotic gene regulation, Definitions- Global control – Stimulon and modulon, Catabolite repression (Glucose effect).

Core Readings
Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology* Chapter – 9

**Selected Further Readings**

Ariel G Loewy Philip Sickevitz, John R. Menninger and Jonathan A.N. Gallants  


Cohn N.S. 1979 Elements of Cytology (Freeman Book Company).


Swanson Metz and Young (1983) Cytology and Cytogenetics (Macmillan and Co. Ltd.)


Veer Bala Rastogi. (2008). Fundamental of Molecular Biology, Ani Books, India


ZY5B05U [P] PRACTICAL 5
CELL BIOLOGY AND MOLECULAR BIOLOGY

36 hrs
Credit 1

1. Squash preparation of onion root tip for mitotic stages

2. Mounting of polytene chromosome (Drosophila/Chironomus.) Demonstration

3. Tissues (permanent slides of epithelial tissues, striated muscle, smooth muscle, cartilage, bone)

4. Identification of meiotic stages (slide/figure)

5. Identification of cell organelles

6. Models (DNA, DNA replication, RNA – Different types.)

7. Preparation of temporary whole mount.

8. Preparation of permanent whole mount (demonstration)

9. Preparation of human blood smear and identification of Leucocytes
SEMESTER V

ZY5B06U CORE COURSE 6
ENVIRONMENTAL BIOLOGY, TOXICOLOGY AND DISASTER MANAGEMENT

54 hrs
Credits 3

Objectives

- To impart basic knowledge on ecosystems and their functioning
- To learn about various types of anthropogenic pressures on ecosystem, related degradation and management measures
- To study toxicants, their impacts on human health and environment and remedial measures
- To create awareness about disasters, prevention and mitigation measures

Pre-requisite:

- Basic knowledge on ecosystem, food chain, food web and energy flow
- General awareness on pollution and their impacts

PART I: ENVIRONMENTAL BIOLOGY (44 Hrs)

Module I – Introduction (2 hrs)

History, development
Scope, branches

Core Readings


**Module II – Ecosystems**

(20 hrs)

Concept, classification

Terrestrial ecosystem

Abiotic/ biotic components (Brief description only)

Interactions

Classification (Types)

- Forest
- Desert
- Grassland

Causes of land degradation with special reference to Kerala

Freshwater ecosystem

Physico chemical nature (Brief description only)

Types

- Lentic
- Lotic

Ground water

Threat to freshwater resources of Kerala

Watershed management

Marine ecosystem

Physico chemical nature (Brief description only)

- Intertidal zone
- Rocky shore
- Muddy shore
- Sandy shore
- Coral reefs
- Open sea
Pelagic realm
Benthic realm
Wetland and mangroves
   Estuaries
   Convention on wetlands (Ramsar, 1971)
   Ramsar sites in Kerala – threats and conservation aspects

Core Readings


Nambiar, K.R. 2008.*Textbook of Environmental Studies (For Undergraduate Courses as per the UGC Model Syllabus)*. Scitech Publications (India) Pvt. Ltd. Chennai, India.


Module III – Man and Environment (8 hrs)

   Natural resources
   Introduction (concept)
   Energy resources
   Conventional
   Non conventional
   Inexhaustible
   Energy conservation measures

Core Readings


**Module IV – Global environmental changes** (9 hrs)

- Global warming
  - Green house effect
  - Ozone depletion
- Climate change (Brief description only)
  - Definition- recent developments
  - Kyoto protocol
  - IPCC/UNFCC
  - Carbon credit
  - Carbon sequestration
  - Carbon trading

**Core Readings**


**Module V – Municipal Solid Waste** (3 hrs)

- Plastic pollution
  - Types of plastics
  - Problems of plastics
  - Management strategies
Biovastes and their management. –aerobic and anaerobic systems.

e-waste

Major types and sources
  Toxic ingredients
  Effects on environment and human health (Brief description only)
  Management strategies

Core Readings


Module V – Local environmental issues (2 hrs)
  Impact of tourism on ecology
  Landscape changes

Core Readings

**PART II. DISASTER MANAGEMENT AND TOXICOLOGY** (10 Hrs)

Module VI – Disaster Management (5 hrs)
  Definition
  Classification
    Natural
    Anthropogenic
    Hybrid
  Earthquake
  Landslide
  Flood
  Drought
  Cyclone
Tsunami
Mitigation measures

Core Readings

Module VII: Toxicology 5 hrs
Definition
History of toxicology
Classification – occurrence/ source
Role of toxicology
Toxicants of biological origin
Afflatoxin
Botulinum toxin
Heavy metal toxicants
Food additives

Core Readings

Selected Further Readings
Ahuwalie V.K., Sunita Malhotra, 2009 Environmental science, Ane Books Pvt. Ltd.


Erach Bharucha 2008 (UGC). Test Book of Environmental Studies of Undergraduate course. University Press


Misra S.P., Pandy S.N. 2009 Essential Environmental Students, Ane books Pvt. Ltd.


Robert May & Angela Mc Lean 2007 Theoretical Ecology. Principles and Application, Oxford University press (India Ed.)


The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam

ZY5B06U [P] PRACTICAL 6
ENVIRONMENTAL BIOLOGY, TOXICOLOGY & DISASTER MANAGEMENT

36 hrs
Credit 1

1. Estimation of dissolved oxygen
2. Estimation of dissolved carbon dioxide
3. Estimation of Soil Organic Carbon (Demonstration only)
4. Plankton count
5. Identification of freshwater/marine plankton
6. Extraction of soil organisms (Demonstration only)
7. Identification of minerals and rocks
8. Sechi disc, Plankton Net
9. Compulsory Field Study report on one Terrestrial/Marine/Freshwater ecosystem
SEMESTER V

ZY5B07U CORE COURSE 7
EVOLUTION, ZOOGEOGRAPHY AND ETHOLOGY

54 hrs
Credits 3

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
- To impart basic knowledge on animal behavioural patterns and their role

Prerequisite:
- Basic knowledge on principles of inheritance and variation
- Knowledge on molecular basis of inheritance
- Basic understanding on the mechanism and factors affecting evolution
- Knowledge on origin and evolution of man, Evidences of Evolution.

PART I – EVOLUTION (30 hrs)

Module I – Origin of life (5 hrs)
- Introduction
- Origin of universe
- Chemical evolution
  - Miller-Urey experiment
  - Haldane and Oparin theory

Module II – Theories of organic evolution (7 hrs)
- Lamarckism
  - Critical analysis of Lamarck’s propositions
- Weisman’s germplasm theory
- Mutation theory.

The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam
Darwinism.

Critical analysis of Darwinism

Modern Synthetic theory (Neo Darwinism)
Neutral theory of molecular evolution

**Module III – Population genetics and evolution** (6 hrs)

Genetic basis of variation

Hardy Weinberg equilibrium

Change in gene frequencies

Factors affecting gene frequencies (brief account only)

**Module IV – Evolution above species level** (8 hrs)

Adaptive radiation

Microevolution

Macroevolution

Evolution of horse

Mega evolution

Punctuated equilibrium

Speciation - Phylectic and True - Sympatric and Allopatric.

Evolution of horse.

**Module V – Geological time scale** (4 hrs)

Geological dating with radioactive elements

Mass extinction

**Core Readings (Modules 1-5)**


Strickberger, M.W. 2000. *Evolution*. Jones and Bartlett, Boston. (Module 1-5)

Verma P.S. and Agarwal V.K 2007 *Cell biology, Genetics, Molecular Biology, Evaluation and Ecology*, S. Chand & Company New Delhi (Module 1-5)

**PART II – ZOOGEOGRAPHY AND ETHOLOGY** (24 hrs)

**Module VI – Zoogeography: Introduction** (5 hrs)

- Origin of oceans and continents
- Plateetectonics – continental drift
- Zoogeographical realms
- Insular fauna-Continental Islands eg Medagascal.
- Oceanic Islands eg Galapagoes.
- Biogeography of India – with special reference to Western Ghats

**Module VII – Animal distribution** (5 hrs)

- Types and means of animal distribution
- Barriers in animal distribution.

**Core Readings**

**Zoogeography**


**Module VIII – Ethology**

(1 hr)

Definition

History and scope of ethology

**Module IX – Learning and imprinting**

(8 hrs)

Types of learning with examples

Experiments by K. Lorenz

**Module X – Ethology of man**

(5 hrs)

Sociobiology and evolution of human behaviour

 Primates and human socio groups

 Human pheromones

**Core Readings**


Zoological Society of Kerala Study material. 2002. *Environmental Biology and Ethology*. Published by Zoological Society of Kerala (Module 6, 7, 8 & 9)

**Selected Further Readings**

**Evolution**


**Ethology**


ZY5B07U [P] PRACTICAL 7
EVOLUTION, ZOOGEOGRAPHY AND ETHOLOGY

36 hrs
Credit 1

1. Identification of Zoogeographical realms using map
2. Study on endemic species of each realm
3. Identification of different stages of horse evolution
4. Study on Homology / Analogy
5. Study on connecting links
6. Pheromone traps
7. Skinner box/T Maze
8. Identification of behaviour showing pictures
9. Experiment to demonstrate phototaxis using Drosophila/House fly
10. Experiment to demonstrate chemotaxis using Drosophila/House fly
SEMESTER V

ZY5B08U CORE COURSE 8
BIOCHEMISTRY, PHYSIOLOGY AND ENDOCRINOLOGY

54 hrs
Credits 3

Objectives:
1. This course will provide students with a deep knowledge in biochemistry, physiology and endocrinology.
2. Defining and explaining the basic principles of biochemistry useful for biological studies for illustrating different kinds of food, their structure, function and metabolism.
3. Explaining various aspects of physiological activities of animals with special reference to humans.
4. Students will acquire a broad understanding of the hormonal regulation of physiological processes in invertebrates and vertebrates.
5. By the end of the course, students should be familiar with hormonal regulation of physiological systems in several invertebrate and vertebrate systems.
6. This also will provide a basic understanding of the experimental methods and designs that can be used for further study and research.
7. The achievement of above objectives along with periodic class discussions of current events in science, will benefit students in their further studies in the biological/physiological sciences and health-related fields, and will contribute to the critical societal goal of a scientifically literate citizenry.
Part I. BIOCHEMISTRY 18 Hours

Module 1 - GENERAL BIOCHEMISTRY, BIOELEMENTS AND BIOMOLECULES 4 hrs
Carbohydrates, protein and lipids – structure of basic compounds, classifications with examples and its biological importance.

Core Readings
Harper’s Illustrated Biochemistry, 27th Ed, Mc Graw Hill

Module -2 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.

Core Readings
Harper’s Illustrated Biochemistry, 27th Ed, Mc Graw Hill

Module 3- 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.

Core Readings
Harper’s Illustrated Biochemistry, 27th Ed, Mc Graw Hill

Part II. HUMAN PHYSIOLOGY 26 Hrs

Module 4- NUTRITION 5 hrs
Nutrients, classification, RDA, Balanced diet.
Antioxidants and functions, Mineral metabolism, Role of Ca, Fe, Na, K, and P.

Role of vitamins
Food adulteration, Defects of modern food habits (importance of fibers in food), weight control, nutrition during pregnancy, breast feeding, anorexia, acidity and
ulcers, flatulence, fasting and its significance, malfunctions of gastro intestinal tract.

**Core Readings**

Guyton 2002: Text Book of Medical Physiology Saunders pp.718-833

Prosser & Brown 2006: Comparative Animal Physiology

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

**Module 5 – RESPIRATION**

5 hrs

Gas transport, Factors affecting transport of respiratory gases through blood, oxy-hemoglobin curve, Bohr effect, reverse Bohr effect, Haldane effect, neural (voluntary and automatic) and chemical control (mention the role of carotid and aortic bodies) of respiration, smoking and its physiological effects, carbon monoxide poisoning, oxygen toxicity, nitrogen narcosis, dysbarism, oxygen therapy, artificial respiration, respiratory disorders – hypoxia, hypocapnia, hypercapnia, asphyxia.

**Core Readings**


**Module 6 – CIRCULATION**

4 hrs

Cerebral circulation, blood brain barrier and cerebrospinal fluid, Haemo dynamic principles, formation and fate of blood cells, Blood composition, blood clotting mechanism – intrinsic and extrinsic pathways, clotting factors, anticoagulants, blood transfusion (safety and security problems), mention haemostasis, haemolysis, jaundice, thrombosis, ESR.

**Core Readings**


Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

**Module 7 – EXCRETION**

4 hrs
Urea cycle (in detail), renal handling of individual substances eg. glucose, sodium, urea, water, factors affecting GFR, concept of plasma clearance, acid base balance and homeostasis, kidney disorders – acute renal failure, chronic renal failure-glomerular nephritis, pyelonephritis, nephrotic syndrome and kidney stones.

Core Readings
Guyton 2002: Text Book of Medical Physiology Saunders pp.264-379
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Module 8-MUSCLE PHYSIOLOGY 3hrs
Electrical, chemical and morphological changes and ionic fluxes during contraction of striated muscle fibre, Cori cycle, electrophysiology of muscle, threshold and spike potentials, simple muscle twitch, whole muscle contraction, isotonic and isometric contraction, latent and refractory periods, summation, beneficial effect, superposition curve, tetanus, tonus, staircase phenomenon, fatigue, oxygen debt, rigor mortis.

Core Readings
Guyton 2002: Text Book of Medical Physiology Saunders pp.52-86
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Module 9–NEUROPHYSIOLOGY 3 hrs.
Synaptic transmission & properties of synapses, neurotransmitters, role of dopamine and serotonin. EEG, memory, short term and long term sleep, dream, Neural disorders- dyslexia, Parkinson’s disease, epilepsy, Alzheimer’s disease, schizophrenia.

Core Readings
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala
Module 10 -SPORTS PHYSIOLOGY  
2hrs
Muscular, Respiratory and cardiovascular changes during exercise, dope test, drug abuse.
Significance of exercise in body fitness. (Guyton pp 968-978)

Core Readings
Guyton 2002: Text Book of Medical Physiology Saunders pp.968-978
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Part III ENDOCRINOLOGY  
11 hrs

Module 11  
5 hrs
Hormones as messengers, classification and types of hormones. General principles of hormone action, Concept of hormone receptors, hormonal control of homeostasis.

Core Readings
Guyton 2002: Text Book of Medical Physiology Saunders pp.836-966
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Module 12  
6 hrs
Secretion, Regulation, Functions and Disorders of hormones of Hypothalamus, Hypophysis, Pineal, Thyroid, Parathyroid, Thymus, Islets of Langerhans, Adrenal, Gonads, Placenta, Gastro intestinal hormones.

Core Readings
Guyton 2002: Text Book of Medical Physiology Saunders pp.836-966
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Selected Further Readings
Human Physiology
Best and Taylor: Physiological basis of Medical practice
Chakrabarti, Ghosh &: Human Physiology, the New Book StallSchana.
Chatterjee C.C.: Human Physiology, Vol I & II Medical Allied Agency
Guyton : Text Book of Medical Physiology Saunders
Joshi : Nutrition and Dietetics , Tata Mc. Graw Hill
Mackenna & Callander : Illustrated Physiology, Churchill Livingstone
Powar Human Physiology
Prosser & Brown : Comparative Animal Physiology

Endocrinology
Bentley, P.J.Comparative Vertebrate Endocrinology, Cambridge University Press.
David O. Norris Vertebrate Endocrinology 3th Edition,
Gorbman ,A et. al. Comparative endocrinology, John Wiley &Sons.
Martin, C.R. Endocrine Physiology, Oxford University Press
Williams, R.H. Textbook of Endocrinology, W.B. Saunders

Biochemistry
Ackerman E, Biophysical Science, Prentice Hall Inc.
Awapara J, Introduction to Biological chemistry, Prentice-Hall of India
Cohn E E and Stumpf P K, outlines of Biochemistry, Wiley Eastern
Foster, R.L. Nature of Enzymology
Harper’s Illustrated Biochemistry, 27 th Ed, Mc Graw Hill
Lehninger, Biochemistry , Kalyani Publications
Lodish et. al. Molecular Cell Biology
Rangnatha Rao K, Text Book of Biochemistry, Prentice-Hall of India
Roy K N, A Text Book of Biophysics, New Central Book Agency
Stryer, Biochemistry, W.H Freeman and Co., Newyork
ZY5B08U [P] PRACTICAL 8
BIOCHEMISTRY HUMAN PHYSIOLOGY AND ENDOCRINOLOGY

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) Effect of hypertonic, hypotonic and isotonic solutions on the diameter of RBC.
6) Instruments: Kymograph, Sphygmomanometer and Stethoscope (principle and use) Measurement of blood pressure using a sphygmomanometer (demonstration)

ENDOCRINOLOGY
1. Cockroach – Corpora cardiaca & Corpora allata (Demonstration)
2. Human hormonal disorders (Diagrams/Photographs)

BIOCHEMISTRY
1. Qualitative analysis of protein, glucose, starch and lipids.
SEMESTER VI

ZY6B09U Core course 9

REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY

54 hrs
Credits 3

Objectives

1. This will provide a basic understanding of the experimental methods and designs that can be used for further study and research.
2. The achievement of above objectives along with periodic class discussions of current events in science, will benefit students in their further studies in the biological/physiological sciences and health-related fields, and will contribute to the critical societal goal of a scientifically literate citizenry.

Module 1

Introduction

Scope of developmental biology, definition, sub-divisions (Descriptive, Comparative, Experimental and Chemical). Early history of embryology. (Preformation and Epigenesis, Recapitulation theory or Biogenetic law, Germplasm theory (Weisman)

Reproductive Organs and Gametogenesis.

Human reproductive organs and gametogenesis (brief account) significance.

Egg types.

Classification of eggs, based on the amount, distribution and position of yolk. Mosaic, regulative and cleidoic eggs. Influence of yolk on development. Polarity, symmetry and egg content.

Sexual cycle

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

Approach and binding of spermatozoa, activation of the egg, amphimixis. Parthenogenesis (brief account) natural and artificial. Arrhenotoky, Thelytoky, Obligatory and Facultative Significance

Core Readings

Balnisky B.I 1981 An Introduction to Embryology, W.B. Saunders and Co.
Majumdar N. N - Vetbrate embryology
Vijayakumarn Nair K. and P. V George. A manual of developmental biology, Continental publications , Trivandrum
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Module II 18 hrs

Cleavage

Types, planes of cleavage (radial and spiral with examples) Cell lineage (brief account). Holoblastic (equal, unequal) and Meroblastic cleavage (discoidal and superficial). Patterns of cleavage (radial, bilateral and rotative). Influence of yolk on cleavage.

Blastulation

Blastula formation, Types of blastula (coeloblastula, stereoblastula, Discoblastula, Blastocyst with examples).

Fate maps

Concept of fate maps, construction of fate maps. (artificial and natural). A typical vertebrate fate maps. Significance of fate map.

Gastrulation

Definition, Morphogenetic cell movements (brief account). Epiboly, Emboly (invagination, involution, delamination, convergence, divergence infiltration). Concept of germ layers (brief account) and its derivatives.
Cell differentiation and gene action—with special reference to Drosophila.

Totipotency, Pleuripotency, Unipotency of embryonic cells. Determination and differentiation in embryonic development, Gene action, control of gene expression. (brief accounts)

EMBRYOLOGY OF FROG - Gametes, Fertilization, cleavage, blastulation, fate map, gastrulation, notogenesis, neurulation, development of nervous system and sense organs (eye only). Metamorphosis (brief account only)

Core Readings
Balnisky B.I 1981 An Introduction to Embryology, W.B. Saunders and Co.
Majumdar N. N - Vertebrate embryoology
Vijayakumarn Nair K. and P. V George. A manual of developmental biology, Continental publications, Trivandrum
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Module III 18 hrs

Embryology of chick

Structure of egg, fertilization, cleavage, blastulation, gastrulation. Mention brief account of 18 hour chick embryo and 24 hour chick embryo. Extra embryonic membranes in chick.

Human development

Blastocyst, foetal membranes and placenta. Types of placenta (brief account). Classification of placenta based on

Nature of contact.
Mode of implantation.
Histological intimacy of foetal and maternal tissue.
Functions of placenta.

Experimental embryology.

Spemann’s constriction experiments, Organizer and embryonic induction. Invitro fertilization (test tube baby) Amniocentesis, Embryo transfer technology, Cloning, Stem cell research.

General Topics
1. Regeneration in animals
2. Placentation in mammals and their significance.
3. Human intervention in reproduction- contraception & birth control,
   Abortion – biological aspects, Ethical issues, Infertility, IVF, GIFT, & ZIFT
   (Intra fallopian transfer gamete/zygote)

Core Readings
Cambridge university press. Ref pp 748 biology 755
Balnisky B.I 1981 An Introduction to Embryology, W.B. Saunders and Co.
Majumdar N. N - Vetebrate embryology
Vijayakumarn Nair K.and P. V George. A manual of developmental biology,
Continental publications , Trivandrum
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and
Developmental Biology Published by Zoological Society of Kerala

Module IV 8 hrs
Teratology / Dysmorphology.
   Definition, Teratogen / Teratogenic agents. Ionizing radiation, infection
   (herpes virus, parvo virus-B 19, rubella virus, syphilis, cytomegalovirus ,
   toxoplasmosis).
Developmental defects
   Prenatal death (miscarriage and still birth). Intrauterine Growth
   Retardation (IUGR)
Congenital abnormalities (birth defects)
   Structural defects (malformation, deformation, disruption) functional
defects. (inborn errors of metabolism, mental retardation).
Causes of malformation. (brief accounts.)
   Genetic disorders (single gene defects)
   Chromosome aberration, aneuploidy (numerical abnormalities.
   Structural abnormalities (deletion, insertion and re-arrangements)
   Chromosomal mosaicisms
   Environmental factors. (external factors)
Chemicals, drugs, hormones and vitamins.
Multifactorial and idiopathic disorders

**Core Readings**
Dutta 2007 Obstetrics, Church Livingston 17 Ed
Harrison, Harriosns Book of Internal Medicine Chruch Livingston 17th Ed.

**Selected Further Readings**
Balnisky B.I 1981 An Introduction to Embryology, W.B. Saunders and Co.
Berry A. K - An introduction to embryology.
Dutta 2007 Obstetrics, Chuch Livingston 17 Ed
Gilbert S. F - Developmental biology
Harrison, Harriosns Book of Internal Medicine Chruch Livingston 17th Ed.
Jain P. C - Elements of developmental biology.
John Rigo Fundamental Genetics Cambridge University Press. 2009
Julio Collado Vides & Relf Hofestadt Gene Regulation and Metabolism Post
 genomic Computeded Approaches, Ane Book 2004
Majumdar N. N - Vetebrate embryoogy
Melissa A – Gibbs, A practical Guide to Developmental Biology, Oxford
university press (Int. student edition) 2006
Sobte R.C., Sharma V.L. Essentials of Modern Biology Press Book India 2008
Vijayakumarn Nair K.and P. V George. A manual of developmental biology,
Continental publications, Trivandrum.
Arora M.P. Embryology. Himalaya Publishing House (Module I, Module II,
Module III)
Publishing House.


**Web Resources**

www.Wikipedia.com. (Module IV)

www.medpedia.com. (Module IV)
ZY6B09U [P] PRACTICAL 9
REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY

36 hrs
Credit 1

Practical

Model/Chart/ Slide/ specimen may be used for items 1 to 5

1. Embryological studies- Blastula (frog, chick)
2. Embryo transfer, cloning, gastrula (frog, chick)
3. Amniocentesis
4. Study of placenta- pig and man
5. 18 hour, 24 hour, 33 hour and 48 hour chick embryo (18-48 hrs, any four slides).
6. Candling method.
7. Vital staining- (chick embryo)-{Has to be done by every student.}
8. GSI.Gonado Somatic Index(Demonstration only)
9. Study of male and female reproductive system of a teleost fish/cockroach .(Dissect and display, sketch and label)
SEMESTER VI

ZY6B10U CORE COURSE 10
GENETICS AND BIOTECHNOLOGY

54 hrs
Credits 3

Objectives of the Course

1. To emphasize the central role that genetics and biotechnology plays in the life of all organisms.
2. To introduce the student to some of the present and future applications of bio-sciences
3. To develop critical thinking skill and research aptitude among students, by introducing the frontier areas of the biological science.

Part I GENETICS

Module -I Introduction: Scope and importance of genetics, Brief explanation of the following terms- gene, alleles, genotype, phenotype, genome, homozygous and heterozygous, wild type and mutant alleles, dominant and recessive traits, test cross and back cross, reciprocal cross, Mendelism – Mendel’s laws, Mendelian traits in man
Chromosome theory of heredity.

Core Readings

Module –II Interaction of genes: Allelic and non Allelic. Allelic- incomplete dominance Co-dominance Non allelic interactions, – complementary
supplementary, epistasis – dominant (feather colour in fowl) and recessive (coat colour in mice) Polygenes (Skin colour inheritance in man) pleiotropism, modifying genes, lethal genes (Brief account with one example each) Multiple alleles(eg) Coat Colour in rabbits. Man ABO blood group Rh factor, Blood group and its inheritance (Genetic problems related to this topic are included in practicals)

**Core Readings**


**Module-III**

Linkage and recombination of genes based on Morgan’s work in Drosophila (Complete and incomplete linkage) Linkage map Chromosome mapping .

**Core Readings**

Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology Chapter 5

**Module IV**


**Core Readings**
Curriculum for BSc Zoology Programme

Module V
Mutations, Types of Mutations. Germinal, Sex linked mutations. Chromosomal mutations - structural and numerical changes. Gene mutation (point mutation) Molecular basis of gene mutations – tautomerism- Induced mutations Physical and chemical mutagens

Core Readings

Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology


Module VI
Extra nuclear inheritance (Cytoplasmic inheritance Characteristics: Organella DNA (Mitochondrial and plastid DNA) Kappa particles in paramecium.

Core Readings


Module VII
**Bacterial genetics**: Bacterial genome Recombination in Bacteria – Bacterial transformation. Transduction, conjugation F mediated sex duction. Resistance transfer factor (RTF) Mechanism of drug resistance in bacteria Transposable genetic elements in bacteria, basic components and mechanisms of transposition in bacteria.
Core Readings

Panicker S. Abraham G and Francis G. 2008. *Microbiology and Immunology* Published by Zoological Society of Kerala Chapter 10


Module VIII  
**Human Genetics:** Karyotyping- Normal human chromosome complement. Pedigree Analysis Aneuploidy and Non disjunction.


Core Readings

Stern C. 1973. Principles of Human Genetics (W.H. Freeman and
Curriculum for BSc. Zoology Programme

The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam

Veer Bala Rastogi – Fundamental of Mol. Biology Ane students Education 2008

Part II BIOTECHNOLOGY

Module IX Definition and scope of Biotechnology

Core Readings
Sudha Gangal- Principles & Practice of Animal Tissue Culture.
University Press. Pp- 128-135

Module X Basic aspects of Genetic Engineering.

Tools-Enzymes-Restriction enzymes and DNA ligases.
Vectors-Plasmids and Phage vectors.
Isolation of gene/DNA.
Techniques-Production of recombinant DNA. Briefly mention rDNA transfer and screening methods. Cloning in host cells. Virus mediated gene transfer, DNA mediated gene transfer.

Module X1 General Techniques in Biotechnology.

Techniques in gene cloning; PCR technique and DNA Amplification.

Blotting Techniques- Southern Blotting
Northern Blotting
Western Blotting
Identification of DNA, mRNA, and Protein.

DNA hybridization, Fluorescence in situ Hybridization (FISH), Colony hybridization.

DNA finger printing and its applications.


Stem cell cultures, Therapeutic cloning, human ES cell cultures, Human EG cell cultures and Human EC cell cultures, Potential uses of stem cells. Animal cell and tissue culture.

Core Readings

Sobti & Sharma 2008 Essentials of Modern Biology Ane’s Student Edition Chapter 2 p. 89

Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology, Published by Zoological Society of Kerala


Core Readings


Sobti & Sharma 2008 Essentials of Modern Biology Ane’s Student Edition Chapter 2 p. 89
Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology, Published by Zoological Society of Kerala


Module XII

Practical Applications of Biotechnology (Brief account only) (5 hrs)

Bioremediation.

Tissue culture – Principle and uses

Technology of mammalian and plant cell culture.

Single cell protein (SCP) The economic implications of SCP.

Biotechnology and Medicine:

Gene therapy

Stem cell therapy

Monoclonal antibodies,

Pharmaceuticals and Biopharmaceuticals -Hormones (insulin, somatostatin, interferon, Lymphokines, Cytokines) Antibiotics, Vaccines.

Biotechnology in agriculture and forestry – Microbial insecticides, Resistance of plants to weedicides, insect pest and microbial diseases. Production of transgenic plants.

Animal biotechnology – Genetic Engineering for transgenic animals.

Fermentation technology in food and beverages

Core Readings

Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology, Published by Zoological Society of
Module XIII Problems in Biotechnology 3 hrs


Core Readings
John E. Smith Biotechnology Cambridge Low priced ed. (Third Ed) 2005
Selected Further Readings


Benjamin Lewin 2004 Gene VIII Oxford University Press


C.W. Fox, J.B. Wolf Evolutionary Genetics Concept of Case Studies, Oxford university Press 2006


John E. Smith Biotechnology Cambridge Low priced ed. (Third Ed) 2005

Madingan, Martinko and Parker 2002, Biology of Microorganisms, Brock Eighth Ed. Prentice Hall


Prave D. Faustu and Sitting W and Subasten D.A (Eds) 1987 Fundamentals of Biotechnology (VCH publishers. Germany)
Sinnat Dunn & Dobzhansky 1959. Principles of Genetics (T.M.H. New Delhi)
Susantha Gosnalibke – Merged Evolution (Long term implication of Biotechnology and Information Technology) Gordon & Breech Pub. 2005
Veer Bala Rastogi – Fundamental of Mol. Biology Ane students Education 2008
ZY6B10U [P] PRACTICAL 10

GENETICS AND BIOTECHNOLOGY

36 hrs
Credit 1

1. Genetic problems – (Problems from each type)
   (a) Mono and Dihybrid ratio (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, Klinefelters and Down’s Syndrome.

4. Study of the karyotype and idiogram from the given photograph of somatic metaphase chromosome-(Human)

5. Sexing of Drosophila melanogaster

6. Isolation of DNA (Demonstration)

7. Study of Polymerase Chain Reaction (Demonstration)

8. Western blotting of proteins from SDS-polyacrylamide gel (Demonstration)

9. Southern blotting of DNA fragments from agarosegel (Demonstration)

10. Northern Blotting of RNA molecules (Demonstration)

(Students are expected to visit the near by research institution / Biotechnology departments/ research centre, and see the demonstration of practicals 5, 6, 7, and 8, Video showif they do not have such facility in their institution)

Core Reading
SEMESTER VI

ZY6B11U CORE COURSE 11
MICROBIOLOGY AND IMMUNOLOGY

54 hrs
Credits 3

Objectives of the course

1. To inspire the students in learning the frontier areas of biological sciences
2. To make them aware of the pathogens, health related problems, their origin and treatment.
3. To equip the students with the knowledge of modern developments and recent trends in biological sciences

PART I MICROBIOLOGY 27hrs

Module 1 Introduction and Scope of Microbiology 2 hr
Outline classification of bacteria, fungi, viruses,

Core Readings
Panicker, S. Francis G., and Abraham G.K. 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala
Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane’s student Editions 2009

Module 2 Methods in Microbiology 6 hrs
Sterilization and disinfection. Different methods, physical and chemical. Sterilization by moist and dry heat, by filtration, by irradiation, preparation of culture media (aerobic and anaerobic cultivation) Selective media, enrichment media and differential media, Plating techniques and isolation of pure colonies, culture preservation techniques – refrigeration, deep freezing, freezing under liquid nitrogen and lyophilization.
Core Readings
Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed.
Ane’s student Editions 2009

Module 3
Morphology and fine structure of bacteria, size, shape and arrangements. Flagella, Pili, Capsule, cell wall and its composition, Cytoplasmic membrane, protoplast, spheroplast, , nuclear material, cell inclusions, Bacterial spores

Core Readings
Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed.
Ane’s student Editions 2009

Module 4
Bacterial Growth, Effect of various factors on bacterial growth. 2 hrs cell division., Nutritional requirements. Enumeration of bacteria ;Total count & viable count Bacterial growth curve

Core Readings
Panicker, S. Francis G., and Abraham G.K. 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 3
Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed.
Ane’s student Editions 2009
Module 5  
Basic Virology  
3 hrs  
Viruses -Structure of Viruses Human, Animal, Plant and Bacterial  
Viruses. Replication of viruses, cultivation of animal and plant viruses.  
Viral assay  
Core Readings  
Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and  
Immunology, Study Material Series published by Zoological Society  
of Kerala Chapter 2  
Anthanarayan R & C.K. Jayaram Paniker. Textbook of Microbiology  
Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed.  
Ane’s student Editions 2009  

Module 6  
Infections  
2 hrs  
Types, Primary and secondary infections. Cross infection , nosocomial  
infection  
Infection, endogenous and exogenous infections, different sources of  
infections, contagious diseases (Epidemic, endemic and pandemic)  
modes of transmission of diseases (by food, water, air, vectors, and  
carriers. Mention different types of carriers, healthy carriers,  
convalescent carriers, temporary and chronic carriers, contact carriers,  
paradoxical carriers , bacteraemia, Septicaemia  
Core Readings  
Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology  
(2008) Orient Longman Private Ltd  
Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and  
Immunoloy, Study Material Series published by Zoological  
Society of Kerala Chapter 8.  
Park K., Park’s Text Book of Preventive and Social Medicine – 2002,  
17t Ed. Banarasidass Bhenot Publications
Module 7  Diseases caused by different pathogens, epidemiology, symptomology, principles of laboratory diagnosis of Bacterial, viral and fungal diseases: A brief study of two examples from each category bacterial: Tuberculosis & Typhoid Viral : Influenza & Polio Fungal: Dermatophytoses & Candidiasis

Core Readings
Panicker, S. Francis G., and Abraham G.K. 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 7
Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed.
Ane’s student Editions 2009

PART II IMMUNOLOGY  27 hrs
Module 8  Introduction to immunology  4 hrs
Types of immunity, innate immunity, Mechanism of innate immunity (eg. Barriers, Phagocytosis, inflammation.) acquired - passive & active Vaccines types of vaccines, live, killed, toxoids, recombinant DNA

Core Readings
Panicker, S. Francis G., and Abraham G.K. 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 1
Ivan Roitt, 2002 Essentials of Immunology ELBS

Module 9  Antigens Antibodies Complements  7hrs
Types of Antigens, haptens, antigenic determinants. Basic structure of immunoglobulins. Different classes of immunoglobulins and functions Complement system, biological effects of complements- a brief study

Core Readings
Panicker, S. Francis G., and Abraham G.K. 2008, Microbiology and Immunology, Study Material Series published by Zoological
Module 10  
Antigen-antibody reactions, Precipitation test, Agglutination Test, 7 hrs  
Clinical applications of antigen antibody reaction: Eg: Widal, VDRL, HIV test (ELISA) Complement fixation test, Coombs test  

**Core Readings**  
Panicker, S. Francis G., and Abraham G.K. 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala  
Ivan Roitt, 2002 *Essentials of Immunology ELBS*  

Module 11  
Immune Response system  
5 hrs  
Primary and secondary lymphoid organs. Cells of the immune system – Leucocytes, Lymphocytes T & B cells, Macrophages, Plasma cells, Memory cells, MHC Antibody synthesis, primary and secondary responses, Monoclonal antibodies – Hybridoma technology, uses.  

**Core Readings**  
Ivan Roitt, 2002 *Essentials of Immunology ELBS*  

Module 12  
Immunopathology- immune disorders  
4hrs  
(Hypersensitivity, autoimmunity and immunodeficiency)  
Different types of hypersensitivity reactions -  
A brief study on anaphylaxis, atopy, serum sickness and delayed hypersensitivity  
Autoimmunity, mechanisms of autoimmunization  
A brief study on autoimmune diseases eg. Lymphadenoid goiter, thyrotoxicosis, rheumatoid arthritis and systemic lupus erythematosus  
Transplantation Immunity - Graft rejection, major histocompatibility, Human leukocyte antigen system - (HLA) immuno
-suppression  Immunohaematology, Immunology of blood transfusion,  
Erythroblastosis foetalis.

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and 
Immunology, Study Material Series published by Zoological 
Society of Kerala

Ivan Roitt, 2002 Essentials of Immunology ELBS

Selected Further Readings

Orient Longman Private Ltd.

Colemen: 2002  Fundamentals of Immunology

Darla J. Wise & Gordon R. Carter: 2004:Immunology A Comprehensive Review 
Iowa state University Press. A Blackwell science company,

Hans G. Sch Legal General Microbiology  Seventh Ed. Cambridge Low Price 
Ed.

Helen Hapel, Maused Harney Siraj Misbah and Next Snowden: 2006 Essentials of 
Clinical Immunology Fifth Ed. Blackwell Publishing Company,

Cambridge University Press 

Ivan Roitt: 2002 Essentials of Immunology ELBS.

K. Park, Park’s Text Book of Preventive and Social Medicine – 2002, 17t Ed. 
Banarasidass Bhenot Publications 

Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane’s student 
Editions 2009

Keith Wilson and John Walker, 2009, Principles and Techniques of Biochemistry 
and Molecular Biology  Sixth Ed. Cambridge University Press


Prakesh Arora M. Anes Illustrated Dictionary of Immunology, Ane Book India.

2002

Prescott. Microbiology 2nd edition
ZY6B11U [P] Practical 11
MICROBIOLOGY AND IMMUNOLOGY

36 hrs
Credit 1

1. Instruments – Autoclave, Hot air oven, Bacteriological incubator – Working and use in Microbiology lab.

2. Cleaning and sterilization of glasswares

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 (Demonstration)
   (a) Streak plate technique and isolation of pure colonies.
   (b) Lawn culture
   (c) Stab culture
   (d) Pour plate culture
   (e) Liquid culture

5. Serial dilution and Standard Plate Count (SPC) calculation of Cfu/ml in well water sample (demonstration).

6. Examination of microbes in living condition
   (a) Wet mount
   (b) Hanging drop method for demonstrating motility of bacteria.


8. Antibiotic sensitivity test (demonstration).

9. Preparation of a fungal smear – Lactophenol cottonblue staining and mounting

10. Determination of ABO blood groups and Rh factor (Antigen –antibody Reaction)

11. Study through photographs/ illustration, the primary immune (Bone marrow and thymus) and secondary immune (spleen and lymph nodes) organs in Rat/Man.
SEMESTER VI

ZY6B12U CORE COURSE 12

GENERAL INFORMATICS, BIOINFORMATICS AND BIOSTATISTICS

54 hrs
Credits 3

Objectives of the course

1. To inspire the students in learning the frontier areas of biological sciences
2. To update and expand basic informatics skills and attitudes relevant to the emerging knowledge of society and also to equip the students to effectively utilize the digital knowledge resources in learning.
3. To equip the students with the knowledge of modern developments and recent trends in biological sciences

Part I    GENERAL INFORMATICS                                       12 hrs

Module 1. Introduction
Microprocessors – RAM, ROM, EPROM, Memory systems, input, output devices.
Disk operating systems, booting, formatting.

Core Readings

Module 2. Operating systems:
DOS, Windows, Linux (only basics), MS Office (MS word, Excel, Access and PowerPoint) computer programming, Networking (LAN, WAN), Internet, World Wide Web, Databases and information retrieval.
New technology in Internet

Core Readings
Part II  BIOINFORMATICS  24 hours
Module 3            8 hrs

Definition, Nature & Scope of Bioinformatics - Contrast between Bioinformatics and Computational Biology; Key Bio-sequences in Molecular Biology - DNA, RNA and Amino-acid sequences - Popular Databases in Bioinformatics - NCBI, DDJB, PDB, OMIM; BLAST & FASTA sequence file formats, Approach of Comparative Biology based on sequence comparison - The basic idea of sequence comparison (algorithms not required) - idea of scoring matrices

Core Readings

3. Rastogi et. al., Bioinformatics: Methods and Applications, Prentice Hall of India.

Further Readings:

1. Introduction to Bioinformatics, Arthur M. Lesk, OXFORD publishers.
2. D. Mount, Bioinformatics: sequence & Genome Analysis, Cold spring Harbor press, USA.
   applications in biological science and medicine, CRC Press, Washington, D.C.

Module 4            8 hrs.

The Blast search engine - important features - Idea of Multiple sequence alignment – Proteomics: Basic ideas of Protein Structure prediction- Concept of Homology Modeling- Idea of Molecular Phylogenetics - advantages and computational procedure (only description of use of a package such as Phylip)

Core Readings

3. Rastogi et. al., Bioinformatics: Methods and Applications, Prentice Hall of India.

Selected further Readings

1. Introduction to Bioinformatics, Arthur M. Lesk, OXFORD publishers.
2. D. Mount, Bioinformatics: sequence & Genome Analysis, Cold spring Harbor press, USA.
applications in biological science and medicine, CRC Press, Washington, D.C.

Module 5

6 hrs.

Basic concepts of computer Aided Drug Discovery- General description of drug 
discovery pipeline- concept of Personalized medicine; Bioinformatics tools:
(i) Molecular Visualization Software - Rasmol (Basic features only) - (ii) ORF 
finding (iii) gene finding, (iii) BLAST (iv) Hydrophobicity Prediction (v) Single 
Nucleotide Polymorphism (SNP) prediction using GENSNIP

Core Readings

2003

Education.

3. Rastogi et. al., Bioinformatics: Methods and Applications, Prentice Hall of India.

Selected further Readings

1. Introduction to Bioinformatics, Arthur M. Lesk, OXFORD publishers.

2. D. Mount, Bioinformatics: sequence & Genome Analysis, Cold spring Harbor press, 
USA.

3. Xiong, Jin. [2006], Essential Bioinformatics, Cambridge University Press, New 
York.

Module 6 Future Prospects: 2 hrs.

1. Human brain Project

2. Computer simulation and visualization of molecular structure

3. Protein structure prediction.

Core Readings

Rashidi, Hooman H. and Buehler, Lukas K. [2001]. Bioinformatics Basics 
applications in biological science and medicine, CRC Press, Washington, 
D.C.

Part III BIOSTATISTICS Total- 18 hrs.

Module 7. Sample & Sampling techniques 2 hrs

Collection of data, Classification of data, Frequency distribution tables,
Graphical representation: - Bar diagrams, Histogram, Pie diagram and Frequency curves.

**Core Readings**


**Module 8. Measures of Central Tendency**  
3hrs
Mean, Median, Mode (Direct method only)

**Core Readings**


**Module 9. Measures of dispersion**  
4 hrs
Range, Quartile Deviation, Mean Deviation, Standard Deviation, Standard error. (Merits & demerits).

**Core Readings**


**Module 10. Probability Distributions**  
3 hrs
Normal, Binomial, Poisson distribution (Brief description only)

**Core Readings**


**Module 11. Correlation**  
4 hrs
Definition, Types of correlation.

**Core Readings**

Module 12. Test of Hypothesis and Test of Significance  

Basic concept, Levels of significance, test of significance, Procedure for testing hypothesis, types of hypothesis- Null hypothesis and Alternate hypothesis. Chi-square test.

Core Readings


Selected Further Readings
Chavali, L.N. 2009 Bioinformatics & Bioprogramming in Cambridge University press


Khan and Khanum, 1990 Fundamentals of biostatistics


Nikolay Kolchamvov and Ralf Hofestaedt-2008 Bioinformatics of Genome Regulation and structure. Springer international Ed.


Paul G. Hegg’s and Teresa K. Altwood- 2005,. Bioinformatics and Molecular Evolution Blackwell publishers.


ZY6B12U [P] Core Course 12 Practical

General informatics, Bioinformatics and Biostatistics

36 hrs
Credit 1

1. MS Word: Mail merge—Preparing mark sheet of students
2. MS Excel: To create mean and median
3. MS Access: To create grade of students
5. Frequency distribution of the given samples to find out arithmetic mean, median, mode.
6. Range and standard deviation for a biological data
7. Correlation using any biological data.
8. Download a specified sequence from NCBI and search with it in BLAST and report results with comments.
9. Download molecular structure data files of DNA, Sugar, Water etc and inspect them through Rasmol.
10. Download a specified DNA sequence from NCBI and identify ORF & genes, if any, in it.
11. Download a specified AA sequence from NCBI and plot its hydrophobicity profile.
12. Download and study at least two samples of genome sequences.
13. . . Spotters—copies of genome sequences and proteins.

Model questions of Bioinformatics (Theory and Practicals)

1. Define bioinformatics. How is it different from computational biology?
2. Explain one standard file format for bio-sequences.
3. Explain important features of NCBI or PDB.
4. How does bioinformatics help comparative biology?

5. Explain how two DNA fragments ATTT and TTT can be compared?

6. What are scoring matrices? Why is it essential in sequence comparison?

7. Explain important features of BLAST.

8. What is multiple sequence alignment? Where is it useful?

9. What is the need for protein structure prediction?

10. Explain the concept of homology modeling.

11. Compare molecular phylogenetics with traditional phylogenetics.

12. Explain the process of Tree construction using molecular phylogenetics software.

13. Explain the basic drug discovery pipeline.

14. Explain the features of Rasmol.
CORE CHOICE BASED COURSES
MODEL – I/MODEL- II/Double Core/BT&SP
SEMESTER VI

ZOOOLOGY CORE CHOICE BASED COURSES
FOR B.Sc. ZOOLOGY PROGRAMME

ELECTIVE I
ZY6B13 U        ECOTOURISM

72 hr
4hrs/week
Credits 3

Objectives:

1. To introduce the concepts, principles and applications of tourism and its sustainability
2. To critically analyse the cost and benefits of ecotourism, including related laws and policies, community involvement and future trends
3. To develop an appreciation among students with respect to tourism development from the sustainability perspective
4. To equip the students with basic knowledge for the emerging ecotourism industry

Module I. Fundamentals of Tourism       (5 hr)

Tourism, concepts and definitions
History, types
Motivation of travel – future trends

Core Readings
Module II. Ecotourism (12 hr)

What is ecotourism?
Concepts of eco-tourism
The facilitating sectors
Attractions
  Geography, heritage
  Wildlife, nature
Quality Control

Core Readings

Module III. Major areas of eco-tourism (10 hr.)

Concepts, practices and case studies for each:
  Marine tourism
  Wildlife tourism
  Adventure tourism

Core Readings


**Module IV. Tourist destinations** (10 hr)
- 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

**Core Readings**


**Module V. Problems and prospects of eco-tourism** (8 hr)
- Economics and benefits of ecotourism
- Cultural issues and negative aspects of ecotourism
- Environmental Impacts of Tourism

**Core Readings**


**Module VI. Environment, conservation of natural resources and eco-tourism** (10 hr)
- 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

Core Readings
Ghimire, K.B. and M. Pimbert. 1997. Social change and conservation:
   environmental politics and impacts of national parks and protected areas.
Middleton, V. 1998. Sustainable tourism: a marketing perspective. Woburn, MA :
Rave Chauhan. 2006. Ecotourism: Trends and challenges. Vista International
   Publishing group, New Delhi.
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.
Western, D. and Wright, R.M., eds. 1994. Natural Connections: perspectives in
   VI)

Module VII. Eco-tourism business (10 hr)
Ecotourism marketing
Who are eco-tourists? Ecotourism companies
Emerging trends in eco-tourism
   Cultural tourism
   Pilgrimage tourism
   Farm tourism
   Backwater tourism
Health tourism

**Core Readings**

**Module VIII. Eco-tourism guides** (7 hr)
Ecotourism guiding and case studies

**Core Readings**

**Activities**
Preparation of questionnaire
Field testing
Report writing on an ecotourism initiative

**Selected Further Readings**


SEMESTER VI

ZOOLOGY CORE CHOICE BASED COURSES
FOR B.Sc. ZOOLOGY PROGRAMME

ELECTIVE II       ZY6B14 U
NUTRITION, COMMUNITY HEALTH AND SANITATION

72 hrs
4 hrs/week
Credits 3

Objectives of the Course

1. To develop critical thinking skill and research aptitude among students, by introducing the frontier areas of the biological science.
2. To emphasize the central role that biological sciences plays in the life of all organisms.
3. To introduce the student to some of the present and future applications of bio-sciences

Course outline

PART – I NUTRITION AND COMMUNITY HEALTH

Module -I
Definition and Meaning of Health
Dimensions and Determination of Health
Physical Activity and Health benefits
Effect of exercise on body systems – Circulatory, Respiratory, Endocrine, Skeletal and Muscular
Programmes on Community health promotion (Individual, Family and Society) Dangers of alcoholic and drug abuse, medico-legal implications

Core Readings

Creating a life of Health and Fitness, London Allyn and Bacon Inc.


Rai. B.C. Health Education and Hygiene. Published by Prakashan Kendra, Lucknow

Module II Nutrition and Health 10 hrs
Concept of Food and Nutrition, Balanced diet
Vitamins, Malnutrition, Deficiency Disease
Determining Caloric intake and expenditure
Obesity, causes and preventing measures – role of Diet and exercise, BMI

Core Readings


Core Readings
Norman Bezzaant HELP First Aid for everyday emergencies. Jaico Publishing House, Bombay, Delhi


Module IV Life Skills Education 6 hrs
Physical activity, emotional adjustment and well being, Yoga,
Meditation and Relaxation, Psychoneuroimmunology

**Core Readings**

Edlen Gordon Janes and Barttlet. Human Genetics a modern Synthesis. Published by Boston. P 39, 266-270

---

**PART II  COMMUNITY HEALTH AND SANITATION**

**Module V**


**Core Readings**


Monica Cheesbrough, Laboratory Manual for Tropical Counties Vol.II LBS.

**Module VI**

Public Health and Food borne diseases. Their preventative measures. Food poisoning caused by toxins produced by microbes eg Staphylococcal food poisoning, Botulism, Salmonellosis. Food infection caused by growth of microorganisms in the human body after the contaminated food has been eaten. Eg Food Infection hepatitis (hepatitis A)
Core Readings
Pelczar M.J. Jr. E.C.S. Chane & N.R. Krieg, Microbiology
Published by Zoological Society of Kerala.

Module VII  Public health and diseases  12 hrs
Emerging pathogens and diseases - Swine Flue (H1N1), Bird Flue (H5N1), SARS, Anthrax, Reemerging pathogens and diseases –TB, Chikungunya
Vector borne (mosquito) diseases and their control measures (Chikungunya , Malaria, Filariasis and Dengu fever)
Mosquito eradication
Leptospirosis and preventive measures – Rodent control measures.
Cancer – Types of cancers, Carcinogens, Causes of Cancer, Morphological Structural Biochemical & behavioural changes of cancer cells

Core Readings
K Park, (2008) Park’s Text Book of Preventive and Social Medicine

Selected Further Readings
Mc Graw Hill Inc
Published by Boston.
Monica Cheesbrough, Laboratory Manual for Tropical Countries Vol.II LBS.
Norman Bezzaant HELP First Aid for everyday emergencies. Jaico Publishing House, Bombay, Delhi

Pelczar M.J. Jr. E.C.S. Chane & N.R. Krieg, Microbiology (Concept & Applications)

Rai. B.C. Health Education and Hygiene. Published by Prakashan Kendra, Lucknow

SEMESTER VI

ZOLOGY CORE CHOICE BASED COURSES
FOR B.Sc. ZOOLOGY PROGRAMME
ELECTIVE III
ZY6B15U ECONOMIC ZOOLOGY

Objectives of the Course
1. To develop critical thinking skill and research aptitude among students, by introducing the frontier areas of the biological science.
2. To emphasize the central role that biological sciences plays in the life of all organisms.
3. To introduce the student to some of the present and future applications of bio-sciences

Part I APPLIED ENTOMOLOGY 18 hrs
Module I  Pests of common crops of Kerala ( Paddy and Coconut )
Morphology, damages caused and control measures.

Pests of coconut – *Oryctes rhinoceros, Rhyncophorus ferrugineus, Nephantis serinopa*, eriophid mite (*Aceria guereronis*),

Pest of paddy – *Leptocorisa acuta, Spodoptera mauritia*, Rice stem borer (*Scirpophaga incertulas, Nilaparvata lugens*)

Pest of stored food products – *Trogoderma granarium, Tribolium castaneum, Sitophilus oryzae*

Insect pest management
1 Chemical control- Classification and chemical composition of pesticides
Insecticides and their mode of action, trade names
2. Biological control methods – give examples, insects used in biological control programme Microbial insecticides
3. Autocidal control (sterile male technique)
Core Readings
Nair M R G K- Insect pests of Crops of India
M S Mony – Applied Entomology
Larry P. pedigo, Entomology and Pest management, prentice hall of India Delhi.

Part II MANAGEMENT OF ORNAMENTAL FISH BREEDING AND AQUARIUM MANAGEMENT 18 hrs

Module 2
1 Ornamental Fish Breeding 15 hrs

Core Readings
MPEDA A hand Book on Aquafarming- Ornamental fishes, MPEDA Kochin.
Applied Zoology, Study Material Published by Zoological Society of Kerala, CMS College Campus
George cust & Peter Bird, Tropical Fresh water Aquaria, Hamlyn London.

Module 3 Aquarium management 3hrs
Aquarium, Aims of aquarium, Requirement of an aquarium, Setting an aquarium, Aquarium fishes

Core Readings
Applied Zoology , Study Material Published by Zoological Society Of Kerala , CMS college Campus
Pillai T.V.R., Aquaculture , principles and practices.

Part III – VERMICULTURE 8 hrs
Module 4 Vermiculture
Introduction, ecological classification of earth worms. Life history.
Species of earth worms used for vermiculite, role of earth worm in solid waste management, in agriculture, in medicine etc. preparation of vermibed, preparation of vermi compost, Preparation of vermiwash,

Core Readings
Applied Zoology, Study Material Zoological Society Of Kerala, CMS college Campus

Part IV – APICULTURE 18 hrs
Module 5 Bee Keeping

Field visit and report writing 10 hrs
Field visit and report writing on any two items are taken for internal evaluation, instead of assignment and seminar

Core Readings
NPCS Board, The complete book on Bee keeping and honey processing, NIIR Project consultancy services, 106- E kamala nagar Delhi – 110007.

Selected Further Readings
Addison Webb, Bee Keeping- for profit and pleasure, agrobios India Ltd.
Ananthakrishnan T.N.Dimensions of Molecular Entomology. University
Applied Zoology, Study Material Zoological Society Of Kerala, CMS college Campus
Chauhan, H.V.S. Poultry, Disease, diagnosis and treatment, Wiley eastern Ltd Delhi.
Farm made aquafeeds FAO fisheries technical paper, 343.
George cust & Peter Bird, Tropical Fresh water Aquaria, Hamlyn London.
Larry P. pedigo, Entomology and Pest management, Prentice hall of India Delhi.
MPEDA A hand Book on Aquafarming- Ornamental fishes, MPEDA Kochin.
NPCS Board, The complete book on Bee keeping and honey processing, NIIR Project consultancy services, 106- E kamala nagar Delhi – 110007.
Pillai T.V.R., Aquaculture, principles and practices.
Sukla. Upadhay, Economic Zoology
Verreth J., Fish larval nutrition, Chapman & Hall Publ.
OPEN COURSES FOR OTHER STREAMS
SEMESTER V

OPEN COURSES FOR OTHER STREAMS

ELECTIVE I

ZY5D01U MAN, NATURE AND SUSTAINABLE DEVELOPMENT

72 hrs
4hrs/Week
Credits 4

Objectives

1. To understand how Man originated and attained present status
2. To learn the basic concepts of Ecosystems and its functioning
3. To study the use and abuse of nature by Man
4. To learn the different resources available on earth
5. To Study global environmental problems and its impact on human well being
6. To appreciate the perspectives of Man on nature and learn the strategies for conservation
7. To familiarize with sustainable development and develop an attitude for sustainability
8. To dismantle compartmentalization of knowledge, reveals links between different disciplines and promotes solutions which reconcile interests of nature and human beings. Such a holistic approach is necessary for sustainable development.

Module I. Man in Nature

10 hrs

Introduction
Evolution of Man
Out of Africa and Candelabra Model
The Fossils and the Molecular Evidences
Ancient Migration and Peopling of India
Hunter-Gatherer and the Agriculturist
Speech and Languages
Cultural Evolution
Altruism and Morality

**Core Readings**


**Module II. The Biosphere**

10 hrs

- Earth-Continents and Continental drift
- Concept of Landscapes and Habitats
- Lithosphere- Forest (Tropical and Temperate)
- Grasslands, Deserts and Montane
  - The Biomes of the World
- Hydrosphere- Oceans, Estuaries
  - Freshwater
  - Water the Elixir of Life
- Atmosphere- Structure and stratification

**Core Readings**


Module III. Dominance of Man on Earth  7 hr
Industrial Revolution
Human Population Growth
Resource Utilization
   Environmental Consequences
Modern Agriculture and Green Revolution
   Environmental Impacts
Imperialism and its Ecological Root

Core Readings

Module IV. Natural Resources  5 hr
Renewable and Non-renewable
Biodiversity
Importance of Biodiversity -the Six E's
   Hotspots of Biodiversity
Biotic Richness of India
Monoculture and loss of Genetic Diversity
Extinction Crisis, IUCN and Red Data Book

Core Readings

Module V. Global Environmental Issues Threatening Natural Resources and Human Life  12 hr
Deforestation, Landscape alterations, Soil erosion, Flood and Drought, Desertification, Overexploitation, Pollution (Air, Water and Soil- Pollutants and Consequences only), Acid rain, Ozone depletion, Green house effect and Global Warming (use case studies to illustrate the points) Waste disposal (Biodegradable and Non-degradable eg. Plastic and E-waste), Oil spill Energy - Production,
Consumption and its Impact on Environment Quality of the Environment and Human Health

Core Readings

**Module VI. Man’s Perspective on Nature**

10 hr

- Eco Spirituality, Eco-theology and Eco-feminism
- Community initiatives
- Indigenous People’s Perspective (tribal and traditional communities)
- Native American, Amazonian, Australian Aborigines, Bishnoi

Contributions of - John Muir, Aldo Leopold, Thoreau, Rachel Carson
Edward Abbey, Arne Ness, Carolyn Merchant, Vandana Shiva

Core Readings

**Module VII. Global Strategies for Conservation**

8 hrs

- UN conference on Man and Environment-1972
- UNEP and its Contributions
- The World Conservation Strategy-1980
- World Commission on Environment and Development
- The Earth Summit -1992
- The UNFCC and IPCC
- Conservation Strategies in India-MoEF
- Legal System- Mention Major Conservation Acts
- People’s Participation in Conservation:
  - Chipko Movement and Narmada Bachao Andolan,
  - Silent Valley

Core Readings
Module VIII Sustainable Development 10 hrs

Definition and Concept
Principles and Goals
Environment versus Development Debate
Johannesburg Conference -2002
Strategies for Sustainable development
Sustainable Development in the era of Globalization
Gandhian Environmentalism
Education for Sustainable Development (UNESCO-ESD)
Building a Sustainable society
Sustainable life styles

Core Readings

Selected Further Readings


Gandhi, M.K.-Writings on Ecology


Ramesh,B.R and Rajan Gurukkal,. 2007.*Forest Landscapes of the Southern Western Ghats, IndiaBiodiversity, Human Ecology and management Strategies*. French Institute of Pondicherry, India


**Web Resources**

http://www.unesco.org/education/desd
http://ucmp.berkely.edu
http://www.unep.org
http://www.iucn.org
http://www.iisd.org
http://www.natrual-resources.org
http://www.sdnp.nic.in
http://www.teriin.org
www.grist.org
SEMESTER V

OPEN COURSES FOR OTHER STREAMS

ELECTIVE II

ZY5D02U HUMAN GENETICS, NUTRITION, COMMUNITY HEALTH AND SANITATION

72 hrs
4hrs/Week
Credits 4

Objectives of the Course

- To develop critical thinking skill and research aptitude among students, by introducing the frontier areas of the biological science.
- To emphasize the central role that biological sciences plays in the life of all organisms.
- To introduce the student to some of the present and future applications of bio-sciences

PART I  HUMAN GENETICS

Module I  Human normal chromosome complement. Genetic disorders in man. 9 hrs

Core Readings
DNA finger printing and applications – Probing for criminals – Method to resolve paternity and maternity disputes.
Causes of human infertility – a brief account. Human genome project – a brief account.

Core Readings

PART – II  NUTRITION AND COMMUNITY HEALTH  18 hrs

Module -III  Definition and Meaning of Health  5 hrs
Dimensions and Determination of Health
Physical Activity and Health benefits
Effect of exercise on body systems – Circulatory, Respiratory, Endocrine, Skeletal and Muscular
Programmes on Community health promotion (Individual, Family and Society) Dangers of alcoholic and drug abuse, medico-legal implications

Core Readings
Rai. B.C. Health Education and Hygiene. Published by Prakashan Kendra, Lucknow

Module IV Nutrition and Health
Concept of Food and Nutrition, Balanced diet
Vitamins, Malnutrition, Deficiency Disease
Determining Caloric intake and expenditure
Obesity, causes and preventing measures – Role of Diet and Exercise, BMI

Core Readings
18th Edition. Banarasidass Bhenot Publication

Module V Safety Education and Health Promotion

Core Readings
Norman Bezzaant HELP First Aid for everyday emergencies. Jaico Publishing House, Bombay, Delhi

Module VI Life Skills Education
Physical activity, emotional adjustment and well being,. Yoga, Meditation and Relaxation, Psychoneuroimmunology

Core Readings
Edlen Gordon Janes and Barttlet. Human Genatics a modern Synthesis. Published by Boston. P 39, 266-270
PART III COMMUNITY HEALTH AND SANITATION  

Module VII  
12 hrs  
Potable water quality monitoring and waste water management.  
Faecal bacteriae and pathogenic microorganisms transmitted by water. Cholera and Typhoid. Determination of sanitary quality of drinking water, water purification techniques.  
Vermi composting a method of solid waste management  

Core Readings  
Monica Cheesbrough, Laboratory Manual for Tropical Counties Vol.II LBS.  

Module VIII  
Public Health and Food borne diseases and their prevention  
12 hrs  
Food poisoning caused by toxins produced by microbes eg Staphylococcal food poisoning, Botulism, Salmonellosis  
Food infection caused by growth of microorganisms in the human body after the contaminated food has been eaten. Eg Food Infection hepatitis (hepatitis A)  

Core Readings  

Module IX  
Public health and diseases (a) Emerging pathogens and diseases –  
12 hrs  
Swine flue (H1N1), bird flue (H5N1), SARS, Anthrax  
Reemerging pathogens and diseases – TB, Chikungunya  

The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam
. (b) Vector borne diseases (mosquito) and their control measures
(Chikungunya, Malaria, Filariasis and Dengue fever)
Mosquito eradication (c) Leptospirosis and preventive measures –
Rodent control measures (d) Cancer different types, causes of cancer,
carcinogens, diet & cancer (e) HIV, AIDS – causes & preventive
measures

**Core Readings**
Zoological Society of Kerala Study Material Series 2002 – Cell
biology Genetics & Biotechnology published by Zoological Society
of Kerala.
K Park, (2008) Park’s Text Book of Preventive and Social

**Selected Further Readings**
Fashey, Tomas D, Insel, Paul M and Roth Walt (2005) Fit and Well. New
York; Mc Graw Hill Inc
Greenberg, Jerol S and Dintiman George B (1997) Wellness Creating a life of
Health and Fitness, London Allyn and Bacon Inc.
Published by Boston.
Monica Cheesbrough, Laboratory Manual for Tropical Counties Vol.II LBS.
Norman Bezzaant HELP First Aid for everyday emergencies. Jaico Publishing
House, Bombay, Delhi
Pelczar M.J. Jr. E.C.S. Chane & N.R. Krieg, Microbiology (Concept &
Applications)
Rai. B.C. Health Education and Hygiene. Published by Prakashan Kendra,
Lucknow
**SEMESTER V**

**OPEN COURSES FOR OTHER STREAMS**

**ELECTIVE III**

**ZY5D03U  VOCATIONAL ZOOLOGY**

72 hrs

4hrs/Week

Credits 4

**Objectives of the Course**

- To develop critical thinking skill and research aptitude among students, by introducing the frontier areas of the biological science.
- To emphasize the central role that biological sciences plays in the life of all organisms.
- To introduce the student to some of the present and future applications of bio-sciences

**Module 1 Ornamental Fish Breeding**


**Core Readings**

George cust & Peter Bird, Tropical Fresh water Aquaria, Hamlyn London.


MPEDA A handbook on Aquafarming- Ornamental fishes, MPEDA Kochin.

Pillai T.V.R., Aquaculture , principles and practices.


**Module 2 Aquarium management**

5hrs
Aquarium, Aims of aquarium, Requirement of an aquarium, Setting an aquarium, Aquarium management, Aquarium fishes.

**Core Readings**

Applied Zoology, Study Material Zoological Society Of Kerala, published by Zoological Society of Kerala
George cust & Peter Bird, Tropical Fresh water Aquaria, Hamlyn London.
Pillai T.V.R., Aquaculture, principles and practices.

**Module 3 Rabbit farming**

10hrs

**Activity:** visit a rabbit farm and make a report on the economics of rabbit farming.

**Core Readings**

Applied Zoology, Study Material Zoological Society Of Kerala, published by Zoological Society of Kerala
Packages of Practices and Recommendations, Veterinary and Animal Husbandary 2001, Directorate of extension, Kerala Agriculture University, Mannuthy.

**Module 4 Quail farming (Coturnix coturnix)**

4 hrs
Introduction, care of quail chicks, care of adult quails, care of breeding quails, ration for quail, care of hatching eggs, health care, use of quail egg and meat. Sources of quality chicks.

**Core Readings**
Module 5  Vermiculture and composting      8 hrs
Activity :- Preparation of a vermiculture unit or visit to a vermicomposting unit.
Core Readings
Applied Zoology, Study Material Zoological Society Of Kerala, published by Zoological Society of Kerala

Module 6  Bee Keeping                      16 hrs
Definition, sp. Of bees cultured, organization of honey bee colony, bee keeping methods (modern method only) and equipments, management and maintenance of an apiary-growth period, dividing the colony, uniting two colonies, replacing old queen with new queen, honey flow period, Bee pasturage. Dearth period. Enemies of bees. Bee diseases. Uses of honey and wax. Apitherapy. Propolis Royal jelly. . Agencies supporting apiculture.
Activity :- visit to an apiculture unit and prepare a note.
Core Readings
Larry P. pedigo, Entomology and Pest management, Prentice hall of India Delhi.
NPCS Board, The complete book on Bee keeping and honey processing, NIIR Project consultancy services, 106- E kamala Nagar Delhi – 110007.

Module 7  Sericulture                     14hrs
Activity: Visit a sericulture unit and make report

Core Readings
Applied Zoology, Study Material Zoological Society Of Kerala, published by Zoological Society of Kerala

Field visit and report writing
Visit to any two units and present the report separately. This is to be taken for internal evaluation in the place of assignments and seminar.

Selected Further Readings
Addison Webb, Bee Keeping- for profit and pleasure, agrobios India Ltd.
Applied Zoology, Study Material Zoological Society of Kerala, CMS college Campus Kottayam.
Farm made aquafeeds FAO fisheries technical paper, 343.
George cust & Peter Bird, Tropical Fresh water Aquaria, Hamlyin London.
H.V.S. Chauhan, Poultry, Disease, diagnosis and treatment, Wiley eastern Ltd Delhi.
Larry P. pedigo, Entomology and Pest management, Prentice hall of India Delhi.
MPEDA A handbook on Aquafarming- Ornamental fishes, MPEDA Kochin.
NPCS Board, The complete book on Bee keeping and honey processing, NIIR Project consultancy services, 106- E kamala Nagar Delhi – 110007.
Packages of Practices and Recommendations, Veterinary and Animal Husbandary 2001, Directorate of extension, Kerala Agriculture University, Mannuthy.
SEMESTER V

OPEN COURSE FOR OTHER STREAMS

ELECTIVE IV

ZY5D04U - FOOD MICROBIOLOGY

72 hrs
4 hrs / week
Credit  4

Module 1. Food as a substrate for micro organisms, micro-organisms important in food microbiology- moulds, yeasts and bacteria; brief account of each group; general characteristics and importance; Principles of food preservation – asepsis – removal of micro organisms, anaerobic conditions – high and low temperatures – drying, chemical preservatives – food additives. - 15Hrs

Module 2. General principles underlying food spoilage and contamination; canned food – sugar products; vegetables, fruits, meat and meat products, milk and milk products, fish, sea food – spoilages. - 12 Hrs


Module 4 Food fermentations and food produced by microbes; bread, vinegar, Single Cell Proteins, mushroom cultivation; production of alcohol and fermented beverages, beer and wine. - 10 Hrs

Module 5 Food borne poisonings, infections and indications; Microbiology of food sanitation- Hazard Analysis Critical Control Points (HACCP), Microbiological criteria for foods. - 7Hrs

MODULE 6 (Activity Oriented Study) 18 hrs

1. Isolation and identification of micro organisms from infected fruits and vegetables
2. Observation of food borne pathogens
3. Identification of bacteria from Idli batter and curd
4. Direct microscopic examination of milk / water by standard plate count
5. Methylene blue Reductase test for milk

Report writing Report of activity oriented study is to be prepared and submitted by each candidate and has to be taken for internal evaluation in the place of assignment and seminar

Core Readings

1. W.C. Frazier and Westhoff - Food Microbiology
2. Jey - Modern food Microbiology
3. Powar and Daginawala - General Microbiology
4. Stanier - Microbial World
5. Prescot, Harley, and Klein’s - Microbiology

OPEN COURSE FOR OTHER STREAMS

ELECTIVE 5 ZY5D05U ECOTOURISM

72 hrs, 4hrs/week Credit -4

(Syllabus and hour distribution is exactly same as that given in choice based Zoology core course elective ECOTOURISM & have 4 credits as open course)
ZOOOLOGY COMPLEMENTARY COURSES FOR
MODEL I & II
ZOOLOGY COMPLEMENTARY COURSE FOR BOTANY
MODEL I AND SIMILAR PROGRAMMES (HOME SCIENCE/
BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION)

Semester I

ZY1C01U Animal Diversity – Non Chordata

2 hrs/week
36 hrs
Credit – 2

Objectives

1. To acquire knowledge on the taxonomic status of various Invertebrate animals and animal groups.
2. To familiarize the students with the diverse group of organisms around us.
3. To develop an aptitude for understanding nature and its rich bio-diversity.

Module 1

General Introduction

1 hr

5 Kingdom classification, Classification in general

Core Readings

Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd
Vijayakumaran Nair, Jayakumar J & Paul P I (2007)
Animal Diversity (2002). Published by Zoological Society of Kerala.

Module 2

Kingdom Protista

7 hrs
Salient features and classification up to phyla

1. Phylum Rhizopoda : Amoeba
2. Phylum Actinopoda : Actinophrys
3. Phylum Dinoflagellata : Noctiluca
4. Phylum Parabasalia : Trychonympha
5. Phylum Metamonada : Giardia
6. Phylum Kinetoplasta : Trypanosoma
7. Phylum Euglenophyta : Euglena
8. Phylum Cryptophyta : Cryptomonas
9. Phylum Opalinata : Opalina
10. Phylum Bacillariophyta : Diatoms
11. Phylum Chlorophyta : Volvox
12. Phylum Choanoflagellata : Proterospongia
13. Phylum Ciliophora : Paramecium
14. Phylum Sporozoa : Plasmodium
15. Phylum Microsporidia : Nosema

(Mention any five general characters for each phylum. Detailed accounts of examples are not necessary.)

Pathogenic protista – Plasmodium, Entamoeba.

Core Readings
Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd
Vijayakumaran Nair, Jayakumar J & Paul P I (2007)
Protista & Animal Diversity Academica Publications.

Module 3
Mesozoa – eg. Rhopalura (mention 5 salient features ) 2 hrs
Parazoa
Phylum Porifera – e.g. Leucosolenia
Phylum Placozoa – e.g. Trycoplax adherens.

Core Readings

Module 4
Phylum: Coelenterata 3hrs
Salient features, Classification up to classes
1. Hydrozoa – Physalia
2. Scyphozoa – Aurelia
3. Anthozoa – Adamsia
Corals and coral reefs.

Core Readings

Module 5
Phylum - Platyhelminthes 2 hes
Salient features, classification up to classes
1. Turbellaria – Planaria
2. Trematoda – Fasciola
3. Cestoda – Taenia solium

**Core Readings**

**Module 6**
Phylum Nematoda  2 hrs
Salient features, classification up to classes
   1. Phasmidia - Wuchereria
   2. Aphasmidia – Trichinella

**Module 7**
Phylum - Annelida  2 hrs
Salient features, classification upto classes
   1. Polychaeta, - Nereis
   2. Oligochaeta – Earthworm – Pheretima
   3. Hirudinomorpha – Hirudinaria

**Core Readings**

**Module 8**
Phylum Arthropoda  10 hrs
Salient features

Type - Prawn - Penaeus

Classification upto classes

Subphylum Chelicerata

Class 1. Merostoma – Limulus

2. Arachinida – Spider

3. Pycnogonida – Nymphon

Subphylum Mandibulata

Class 1. Crustacea – Daphnia

2. Chilopoda - Centepede

3. Symphyla - Scutigerella

4. Diplopoda - Millipede

5. Pauropoda - Pauropus

6. Insecta - Butterfly

(Detailed account of examples are not necessary)

**Phylum Onychophora** – eg. Peripatus (Mention its affinities)

Insect pests

1. Pests of coconut – *Oryctes rhinoceros, Rhynchophorus ferrugineus, Nephantis serinopa, Eriphid mite*

2. Pests of paddy – *Leptocorisa acuta, Spodoptera mauritius*

3. Pests of stored grains - *Trogoderma granarium, Tribolium castaneum, Sitophilus oryzae*

**Core Readings**


**Module: - 9**
Phylum – Mollusca
Salient features and classification upto classes

1. Apalcophora – Neomenia
2. Monoplacophora – Neopalina
3. Bivalvia – Perna
4. Polyplacophora – Chiton
5. Gastropoda – Xancus
6. Cephalopoda – Sepia
7. Scaphopoda – Dentalium

Core Readings

Module 10
Phylum - Echinodermata
Salient features , classification upto classes
Class 1. Asteroidea – Astropecten
2. Ophiuroidea - Ophiothrix
3. Echinoidea – Echinus
4. Holothuroidea – Cucumaria
5. Crinoidea – Antedon

Core Readings
of Kerala.

Animal Diversity (2002). Published by Zoological Society of Kerala.

Module 11
Phylum Hemichordata 1 hr
Salient features eg: Balanoglossus

Core Readings

Selected Further Readings


Practicals

ZY1C01U [P] ANIMAL DIVERSITY – NON CHORDATA

2 hr/week,
36 hrs
Credit – 1

1. Scientific drawing - 5 specimens
2. Simple identification – 25 invertebrates (Out of which 15 by their scientific names)
4. Dissection - Prawn Nervous system
5. Dissection - Cockroach Nervous system
6. Mounting – Prawn Appendages
7. Mounting – Cockroach Mouth parts
SEMIESTER II
ZOOLOGY COMPLEMENTARY COURSE FOR BOTANY MODEL I AND SIMILAR PROGRAMMES (HOME SCIENCE/ BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION)

ZY2C02U - ANIMAL DIVERSITY – CHORDATA

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

Module I
Phylum Chordata
General characters of the Phylum Chordata
Classification upto classes
Sub phylum I Urochordata
   General characters
Class 1 Larvacea eg. Oikopleura
   2. Asciidiacea eg. Ascidia
   3. Thaliacea eg. Salpa
Subphylum II Cephalochordata
   General characters eg. Brachiostoma
Subphylum III Vertebrata
   General characters
Division I Agnatha
   General characters
Class 1 Cyclostomata eg. Petreromyzon
Class 2 Ostracodemi eg. Cephalapis
Division 2 Gnathostomata
   General characters
Super class Pisces and Super class Tetrapoda

Core Readings
Series. Published by Zoological Society of Kerala

Module II 3 hrs
Super class Pisces
General characters
Class 1. Chondrichthyes eg. Narcine
Class 2. Osteichthyes eg. Latimeria
Accessory respiratory organs in fishes.

Core Readings
Series. Published by Zoological Society of Kerala

Module III 16 hrs
Super Class Tetrapoda
General characters
Class : Amphibia General characters
Type : Rana hexadactyla
Order I. Urodela eg. Amblystoma
II. Anura eg. Bufo
III . Apoda eg. Icthyophis

Core Readings
Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by Zoological Society of Kerala

Module IV Class Reptilia

<table>
<thead>
<tr>
<th>Subclass</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>I: Anapsida</td>
<td>Chelone</td>
</tr>
<tr>
<td>II: Diapsida</td>
<td>Chameleon</td>
</tr>
<tr>
<td>III: Parapsida</td>
<td>Icthyosaurus</td>
</tr>
</tbody>
</table>

Poisonous and non-poisonous snakes of India

Core Readings
Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by Zoological Society of Kerala

Module V Class Aves

<table>
<thead>
<tr>
<th>Subclass</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>I: Archeornithes</td>
<td>Archaeopteryx</td>
</tr>
<tr>
<td>II: Neornithes</td>
<td>Struthio</td>
</tr>
</tbody>
</table>

Flight adaptations of birds

Core Readings
Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by Zoological Society of Kerala
Module VI Class – Mammalia  

General characters
Sub class I Prototheria eg. Echidna
Sub Class II Metatheria eg. Macropus
Sub class III Eutheria eg. Elephas
Aquatic mammals

Core Readings
Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by Zoological Society of Kerala

Selected Further Readings
Deoras, P.J. 1981. Snakes of India (National Book Trust of India.)
Induchoodan, 1986, Kweralathile Pakshikal (Kerala Sahitya Academy, Trichur).
Whitaker, R. 1978 Common Indian Snakes – A field Guide Macmillan and Co. of India Ltd.)
Young J.Z. Life of mammals (Oxford University Press).
Practicals

ZY2C02U [P] - ANIMAL DIVERSITY – CHORDATA

2 hrs/week
36 hrs
Credit I

1. Morphology
   Scientific drawing – 5 specimens of chordates
2. Simple identification of 10 chordates (Out of which 5 by their scientific names)
3. Osteology – Vertebrae and girdles of Frog
4. Snake identification - 3 poisonous and 3 non poisonous with key
5. Mounting of placoid scales of shark
6. Dissections:
   Frog: Photographs/Diagrams/one dissected & preserved specimen each/models may be used for the study.
   1. Frog – Viscera
   2. Frog – Digestive System
   3. Frog – Arterial System
   4. Frog – Sciatic plexus
   5. Frog – Brain
SEMESTER III

ZOOLOGY COMPLEMENTARY COURSE FOR BOTANY (MODEL I) AND SIMILAR PROGRAMMES (HOME SCIENCE/ BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION)

ZY3C03U - HUMAN PHYSIOLOGY AND IMMUNOLOGY

3 hrs/week
54 hrs
Credits 3

Objectives

- To inspire the students in learning the frontier areas of biological sciences
- To appreciate the correlation between structure and function of organisms
- To make them aware of the health related problems, their origin and treatment.

Part I  HUMAN PHYSIOLOGY  36 hrs

Module 1: Nutrition  3 hrs

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

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.718-833
Prosser & Brown 2006: Comparative Animal Physiology
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Module 2: Respiration  5 hrs

Transport of \(O_2\) and \(CO_2\) in blood, respiratory disorders – Dyspnoea, Hypoxia, Asphyxia, Hypo and Hypercapnia, CO poisoning, smoking and its physiological effects.
Core Readings
Guyton 2002: Text Book of Medical Physiology Saunders pp432-509
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Module 3: Circulation 7 hrs
Blood – Composition and function, Brief account of mechanism of blood clotting; Disorders of blood clotting – Haemophilia, cerebral and pulmonary thrombosis, Cerebral haemorrhage, Blood pressure and factors controlling it; electrocardiogram, Cardiovascular disorders – Arteriosclerosis, Myocardial infraction, Angiogram and Angioplasty.

Core Readings
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Module 4 Excretion 6 hrs
Structure of human nephrone, 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 – myeleonephritis, glomerular nephritis, nephrotic syndrome, Dialysis

Core Readings
Guyton 2002: Text Book of Medical Physiology Saunders pp.264-379
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Module 5 Neurophysiology 6 hrs
Structure of typical neuron, myelenated and non myelenated 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, Alzheimer’s syndrome, Dyslexia.

**Core Readings**
Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

**Module 6 Muscle Physiology**
4 hrs
Striated, Non striated and Cardiac muscle, Ultra structure of striated muscle fibre, Mechanism of muscle contraction, Threshold and spike potential, Fatigue, \( \text{O}_2 \) dept, Rigor mortis.

**Core Readings**
Guyton 2002: Text Book of Medical Physiology Saunders pp.52-86
Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

**Module 7 Endocrinology**
5 hrs
Endocrine glands and their hormones, mode of action (in brief), Hypothalamus, Pituitary, Thyroid, Parathyroid, Thymus, Islets of Langerhands, Adrenal, Testis and ovary, Hormonal disorders.

**Core Readings**
Guyton 2002: Text Book of Medical Physiology Saunders pp.836-966
Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

**Part II IMMUNOLOGY**
18 hrs

**Module 8**
3 hrs
Introduction to immunology
Types of immunity, innate immunity, acquired, passive, active
Mechanism of innate immunity (eg. Barriers, phagocytosis, inflammation)
Complement System, biological effects of complements.

Core Readings
Panicker, S. Francis G., and Abraham G.K. 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 1
Ivan Roitt, 2002 Essentials of Immunology ELBS

Module 9  5 hrs
Antigens and antibodies
Types of antigens, haptens, antigenic determinants.
Basic structure of immunoglobulins, Different classes of immunoglobulins and functions.

Core Readings
Panicker, S. Francis G., and Abraham G.K. 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 4
Ivan Roitt, 2002 Essentials of Immunology ELBS

Module 10  5 hrs
Antigen antibody reactions
Precipitation test, agglutination test,
Clinical applications of antigen antibody reaction, Widal, VDRL, HIV test (ELISA), Complement Fixation Test, and Coombs test.

Core Readings
Panicker, S. Francis G., and Abraham G.K. 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala
Ivan Roitt, 2002 Essentials of Immunology ELBS

Module 11  5 hrs
(Brief accounts of the followings)
Immune response system
Primary and secondary lymphoid organs,
Cells of Immune system – Leucocytes, lymphocytes, T&B cells, Macrophages, Plasma cells, Memory cells, MHC, Antibody synthesis, Monoclonal antibodies, Hybridoma technology
Imune disorders – hypersensitivity, Auto immunity & Immunodeficiency, AIDS,

Core Readings
Ivan Roitt, 2002 Essentials of Immunology ELBS

Selected Further Readings
Colemen: Fundamentals of Immunology
Guyton, Medical Physiology
Ivan Roitt: Essentials of Immunology ELBS.
Mahavankutty, Medical Physiology
Mahupathra, Human Physiology, Current Books
Michael J. Gibuay, Ian A. Macdonald and Helen M. Roche, Nutrition and Metabolism.


Prosser and Brown, Comparative Animal Physiology

Sebastian Prof. M.M., Animal Physiology

William S Hoar, Animal Physiology.
ZY3C03U[P] - HUMAN PHYSIOLOGY AND IMMUNOLOGY

2Hrs/Week
36Hrs
Credit 1

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

ZOOLOGY COMPLEMENTARY COURSE FOR BOTANY (MODEL I) AND SIMILAR PROGRAMMES (HOME SCIENCE/ BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION)

ZY4C04U - APPLIED ZOOLOGY

3hrs/week
54 hrs
Credits 3

OBJECTIVES

Equip the students interested in the applied branches of zoology with skills and knowledge which can lead to self employment opportunities.

Module 1: Aquaculture

Traditional methods of aquaculture, Advantages and salient features of aquaculture, Types of aquaculture, Biotic and abiotic factors of water, Importance of Alga in aquaculture, Common Cultivable fishes of Kerala Economic importance and morphology of culturable species

Catla, Rohu, Mrigal, Cyprinus carpio, Etroplus, & Tilapia .
Penaeus indicus, P. monodon, Perna viridis/Perna indicus, Pinctada fucata.
Pond culture (Construction and maintenance ) Brief Description of Carp culture Composite fish culture. Integrated Fish Culture, Induced breeding in fishes, Important Fish Diseases. Fish preservation and processing
Aquarium management, Setting up of an Aquarium, Biological filter and Aeration . Common species of Aquarium fishes.
Prawn culture, Mussel culture , Pearl culture

Core Readings:
Applied Zoology; (2002) Published by Zoological Society Of Kerala

Module 2  Sericulture

Harvesting and stifling of cocoons. Silkworm diseases. Preventive and control measures.
Core Readings:
Applied Zoology; (2002) Published by Zoological Society Of Kerala

Module 3 Vermiculture

Core Readings:
Applied Zoology; (2002) Published by Zoological Society Of Kerala
Venkitaraman, P.R., 1983, Text Book of Economic Zoology (Sudarsana Publ. Cochin)

Module 4 Apiculture

Core Readings:
Applied Zoology; (2002) Published by Zoological Society Of Kerala
Shukla G.S., & Updhyay V.B., Economic Zoology (Rastogi Publ. Meerut)

Selected Further Readings
Alikunhi, K.h., Fish Clulture in India (ICAR, New Delhi)
Bhosh, C.C., 1949, Silk Production and Weaving in India (CSIR), New Delhi
Director. Zoological Survey of India, 1994, earthworms Resources and Vermiculture
Jhingran, V.G., 1985 Fish and Fisheries of India (Hindustan Publ. Corporation, New Delhi)
Kurien, C.V. & Sebastian V.C., Prawn Fisheries in India (Hindustan Publ. Corporation, New Delhi)
Krishnaswami, S., 1986 Improved Method of Rearing Young age Silk worms (Central Silk board Bangalore)
Krishnaswami, S., 1986, New Technology of Silkworm Rearing (Central Silk Board Bangalore)
Menon, K.N., 1970 Malsyakrishi (State Institute of language, Trivandrum)
Mysore Silk Association, 1986, Silkworm rearing and Diseases of Silkworms
Shukla G.S., & Updhyay V.B., Economic Zoology (Rastogi Publ. Meerut)
Andhra Pradesh Agricultural University, Hydrabad
Sinhan, V.R.P. & Ramachandran, V., 1985, Fresh water Fish Culture (ICAR, New Delhi)
Singh, S., 1962 Bee keeping in India (ICAR, New Delhi)
Singh, V.P.P. and Ramachandran, V., 1985 Freshwater Fish Culture (ICAR, New Delhi)
Ullal, S. R. and Narasimahanna, M.N., Handbook of Practical Sericulture (Central Silk Board Bombay.)
Venkitaraman, P.R., 1983, Text Book of Economic Zoology (Sudarsana Publ. Cochin)
Practicals

ZY4C04U [P] - APPLIED ZOOLOGY

2 hrs/week
1 credit
36 hrs

1. General Identification, Economic importance, Morphology, scientific names and common names of the following
   a. Economic importance and morphology of culturable species
      (Catla, Rohu, Mrigal, Grass carp, Common carp, Etroplus, Tilapia)
      *Penaeus indicus*, *P. monodon*,
      *Perna viridis*/*P. indicus*
      *Pinctada fucata*
   b. 2 species of earthworms used in Vermiculture
   c. Two species of honey bees
   d. Silkworm. Cocoon/Adult

2. Castes of bees

3. Bee keeping equipments Beehive, Smoker, honey extractor

4. Beeswax, Honey, Silk, Vermicompost (Identification-Uses)

5. Chandrika/Natrika used in sericulture

6. Fish diseases (any 2 diagrams/specimens)

7. Fish Parasite (any one)
SEMESTER I  
ZY1CV01U  
ZOOLOGY COMPLEMENTARY COURSE FOR BOTANY  
(MODEL II) ANIMAL DIVERSITY - NON CHORDATA  

Objectives  
54 hrs.  Credits 2  
1. To study the scientific classification of invertebrate fauna.  
2. To learn the physiological and anatomical peculiarities of some invertebrate phyla through type study.  
3. To learn the evolutionary significance of various invertebrate fauna  
4. To stimulate the curiosity in living things around them.  

MODULE I  

Introduction: Briefly mention the following  
(2 hrs)  
Classification – Keys and Principles.  
Nomenclature (Uninominal, Binomial, & Trinomial), Law of Priority.  
Two kingdom and Five kingdom classification.  
Symmetry - Asymmetry, Spherical, Radial, Biradial and Bilateral  
Coelom – Acoelomates, Pseudocoelomates and Eucoelomates  
Schizocoelom, Enterocoelom. Protostomia and Deuterostomia  

Kingdom Protista Type: Paramecium  
(10hrs)  
Salient features and classification up to phyla  
1. Phylum Rhizopoda : Amoeba  
2. Phylum Actinopoda : Actinophys  
3. Phylum Dinoflagellata : Noctiluca  
4. Phylum Parabasalia : Trychonympha  
5. Phylum Metamonada : Giardia  
6. Phylum Kinetoplasta : Trypanosoma  
7. Phylum Euglenophyta : Euglena  
8. Phylum Cryptophyta : Cryptomonas  
9. Phylum Opalinata : Opalina  
10. Phylum Bacillariophyta : Diatoms
11. Phylum Chlorophyta: Volvox
12. Phylum Choanoflagellata: Proterospongia
13. Phylum Ciliophora: Paramecium
14. Phylum Sporozoa: Plasmodium
15. Phylum Microsporidia: Nosema

(Mention any five general characters for each phylum. Detailed accounts of examples are not necessary.)

**General Topics:**
1. Parasitic Protozoans
2. Life cycle of Plasmodium

**Kingdom Animalia**
Outline classification of Kingdom Animalia. (1hr)
Three branches - Mesozoa, parazoa, Eumetazoa.

**Core Readings**

**MODULE II**

**Mesozoa** - Eg. Rhopalura.

**Phylum Porifera.** (3 hrs)
Classification upto classes.
Class III – Demospongia Eg. Cliona.

**General Topics**

**Phylum Coelenterata Type: Obelia** (6hrs)
Classification upto classes.
General Topics-
2. Polymorphism in Coelenterates

Core Readings

MODULE III

Phylum Ctenophora. (1 hr)
Eg. Pleurobrachia.

Phylum Platyhelminthes (3 hrs)
Classification upto classes.
Class I - Turbellaria. Eg. Planaria.
Class II – Trematoda Eg. Fasciola
Class III- Cestoda Eg. Taenia saginata.

General Topics-
1. Life history of Fasciola hepatica.
2. Platyhelminth parasites of Man and Dog (Schistosoma, Taenia solium, Echinococcus).

Phylum Nematoda (3 hrs)
Class Phasmidia Eg. Enterobius, Ascaris
Class Aphasmidia Eg. Trichinella

General Topic-
Pathogenic nematodes. (Wuchereria bancrofti, Ancylostoma duodenale, Trichinella).

Phylum Annelida (2 hrs)
Classification upto classes.
Class I- Archiannelida Eg. Polygordius
Class II – Polychaeta Eg. Chaetopterus
Class III- Oligochaeta Eg. Megascolex.
Class IV - Hirudinomorpha Eg. Ozobranchus, Hirudinaria
Core Readings

MODULE IV (12 hrs)

Phylum Onychophora
Eg. Peripatus (Mention its affinities).

Phylum Arthropoda
Type: Panaeus
Classification upto classes.
Divided into 4 subphyla.

1. Sub Phylum - Trilobitomorpha
   Class - Trilobita (mention salient features).

2. Sub Phylum- Mandibulata
   Class I – Crustacea Eg. Sacculina
   Class II- Chilopoda Eg. Centipede (Scolopendra)
   Class III Symphyla Eg. Scutigerella
   Class IV – Diplopoda Eg. Millipede (Spirostreptus)
   Class V - Insecta Eg. Dragon fly
   Class VI – Pauropoda Eg. Pauropus

3. Sub Phylum - Chelicerata
   Class - Merostomata Eg. Limulus
   Class II – Arachnida Eg. Scorpion

General Topics
3. Vectorial Arthropods
4. Larval forms of Penaeus

Core Readings
MODULE V

Phylum Mollusca (4 hrs)
Classification upto classes
Class I- Monoplacophora Eg. Neopilina
Class II- Amphineura Eg. Chiton
Class III- Gastropoda Eg. Aplysia
Class IV- Scaphopoda Eg. Dentalium
Class V- Pelecypoda Eg. Pinctada
Class VI- Cephalopoda Eg. Sepia

General Topic-
Pearl formation and culture

Phylum Echinodermata (4 hrs)
Classification upto classes
Class I- Asteroidea Eg. Astropecten
Class II- Ophiuroidea Eg. Ophiothrix
Class III- Echinoidea Eg. Echinus
Class IV- Holothuroidea Eg. Holothuria
Class V – Crinoidea Eg. Antedon

General Topics
1. Water vascular system.
2. Larval forms of Echinoderms

Minor Phyla (2 hrs)
1. Chaetognatha Eg. Sagitta
2. Sipunculida Eg. Sipunculus
3. Rotifera Eg. Brachionus

Phylum Hemichordata (1 hr)
Eg. Balanoglossus

Core Readings
Selected Further Readings


ZY1CV01U [P] Practical 1

ANIMAL DIVERSITY - NON CHORDATA

36 hrs.

Credit 1

Scientific Drawing:-
Make scientific drawings of 5 locally available invertebrate specimens belonging to different phyla.

Anatomy:-

Study of sections. (Any two)
1. Hydra.
2. Ascaris
3. Earthworm
4. Fasciola

Dissections
1. Prawn - Nervous system
2. Cockroach - Nervous system

Mounting:-
1. Nereis - Parapodia
2. Cockroach - Salivary glands
3. Mouth parts - Plant bug/ House fly/ Mosquito. (Any Two)
4. Prawn appendages.

Identification:-

General identification- The students are expected to identify the following Phylum-wise number of animals by their generic names and 20% of these by their specific names. Protista-2, Porifera-1, Coelenterata-2, Platyhelminthes-1, Annelida-2, Arthropoda-3, Mollusca-2, Echinodermata-2

Taxonomic identification with key:-
Identification of insects up to the level of order.
SEMESTER II

ZY2CV02U

ANIMAL DIVERSITY – CHORDATA

54 Hrs
Credits  2

Objectives
1. To make the student observe the diversity in chordates and their systematic position.
2. To make them aware of the economic importance of some classes.

MODULE I

Introduction (1 Hr)

Phylum Chordata - General classification
(Classification up to order – Sub phylum, Super class, Class, Subclass, Order)

5. Sub phylum : Urochordata (3 Hrs)
   Class I Larvacea Eg. Oikopleura
   Class II Ascidiacea Eg: Ascidia (Mention Retrgressive Metamorphosis)
   Class III Thaliacea Eg: Doliolum

6. Sub phylum: Cephalochordata (2 Hrs)
   Example - Amphioxus

Core Readings
Young J.Z. 2006 The life of Vertebrates Oxford University Press (Third Ed.) India Ed.
7. **Sub phylum: Vertebrata**

8. **Division 1 – Agnatha** (2 Hrs)
   - Class I: Ostracodermi  Eg: Cephalaspis
   - Class II: Cyclostomata  Eg: Petromyzon

**Division 2 – Gnathostomata** (10 Hrs)

Super class Pisces

Class: **Chondrichthyes**
   - Sub class - Elasmobranchi  Eg: Narcine
   - Sub class  Holocephali  Eg: Chimaera

Class: **Osteichthyes**
   - Sub class – Choanichthyes
     - Order 1 Crossopterigii  Eg: Latimeria
     - Order 2 Dipnoi  Eg: Lepidosiren
   - Sub class: - Actinopterygii
     - Super order 1.  Chondrostei  Eg: Acipencer
     - Super order 2.  Holostei  Eg: Amia
     - Super order 3.  Teleostei  Eg: Sardine

**General topics**

7. Accessory respiratory organs in fish.
10. Migration in fishes
11. Common culture fishes of Kerala
12. Lung fishes

**Core Readings**

Young J.Z. 2006 The life of Vertebrates Oxford University Press (Third Ed.)
India Ed.
Jhingran 1977, Fish and Fisheries of India, Hindustan Publishing Co.
MODULE III

**Super class: Tetrapoda** (10 Hrs)

Class Amphibia

*Type – Rana hexadactyla*

- Order I Anura Eg: Hyla
- Order II Urodela Eg: Amblystoma (Mention axolotl larva and neotony)
- Order III Apoda Eg: Ichthyophis.

**Class Reptilia** (4 Hrs)

Sub class I: Anapsida

- Order Chelonia Eg: Chelone

Sub class II: Parapsida Eg: Ichthyosaurus

Sub class III: Diapsida

- Order I Rhynchocephalia Eg: Sphenodon
- Order II Squamata Eg: Chamaleon

Sub class IV: Synapsida Eg: Cynognathus

**General topic**

Identification of poisonous and non poisonous snakes

**Class Aves**

*Sub class I: Archeornithes* Eg: Archaeopteryx (Affinities)

*Sub class II: Neornithes*

- Super order I: Palaeognathe Eg: Struthio
- Super order II: Neognathe Eg: Brahminy kite

**General topics**

3. Migrations in birds
4. Flight adaptations in birds

**Core Readings**

MODULE IV

Class Mammalia (18 Hrs)
Type: Rabbit

Sub class I: Prototheria Eg: Echidna
Sub class II: Metatheria Eg: Macropus
Sub class III: Eutheria
- Order 1. Insectivora Eg: Talpa
- Order 2 Dermoptera Eg: Galeopithecus
- Order 3. Chiroptera Eg: Pteropus
- Order 4. Primates Eg: Loris
- Order 5 Carnivora Eg: Panthera
- Order 6 Edentata Eg: Armadillo
- Order 7 Pholidota Eg: Manis
- Order 8 Proboscidea Eg: Elephas
- Order 9 Hyracoidea Eg: Procavia
- Order 10 Sirenia Eg: Dugong
- Order 11 Perissodactyla Eg: Zebra
- Order 12 Artiodactyla Eg: Cameleus
- Order 13 Lagomorpha Eg: Oryctolagus
- Order 14 Rodentia Eg: Porcupine
- Order 15 Tubulidentata Eg: Orycteropus
- Order 16 Cetacea Eg: Delphinus

General topics
1. Dentition in Mammals
2. Aquatic Mammals

Core Readings
Zoological Society of Kerala Study material. *Animal Diversity* 2002

**Selected Further Readings**


Jhingran 1977, Fish and Fisheries of India, Hindustan Publishing Co.


Young J.Z. 2006 The life of Vertebrates Oxford University Press (Third Ed.) India Ed.
ZY2CV02U [P] PRACTICAL 2

ANIMAL DIVERSITY  CHORDATA

36hrs
Credit 1

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

2. Dissections
   Frog: Photographs/diagrams/one dissected & preserved specimens and models may be used for study.
   1. Frog Viscera
   2. Frog Digestive System
   3. Frog Arterial System
   4. Frog 9th 1st Spinal nerve
   5. Frog Sciatic Plexus
   6. Frog Brain

   Mounting of placoid scales/cycloid/ctenoid scales

3. Osteology
   Frog vertebrae
   Pectoral and pelvic girdles of Frog and Rabbit
   Skull of Rabbit (Diastema - dentition
   Turtle – plastron and carapace

4. Study of sections.
   Amphioxus T. S. through pharynx/T.S. through intestine

5. Identification:-
   General identification-
   Identify all the animals by their generic names and 25% of them by their specific names.

6. Taxonomic identification with key:-
   i) Identification of fishes up to the level of order.
   ii) Identification of snakes up to family.
SEMESTER III (common for model 1&2)

ZOOLOGY COMPLEMENTARY COURSE FOR BOTANY
(MODEL II) AND SIMILAR PROGRAMMES

ZY3CV03U - HUMAN PHYSIOLOGY AND IMMUNOLOGY

3 hrs/week
54 hrs
Credits 3

Objectives

- To inspire the students in learning the frontier areas of biological sciences
- To appreciate the correlation between structure and function of organisms
- To make them aware of the health related problems, their origin and treatment.

Part I  HUMAN PHYSIOLOGY 36 hrs

Module 1: Nutrition 3 hrs

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

Core Readings
Guyton 2002: Text Book of Medical Physiology Saunders pp.718-833
Prosser & Brown 2006: Comparative Animal Physiology
Zoological Society of Kerala, Study material 2002.  Biochemistry,
Physiology and Developmental Biology Published by Zoological Society of Kerala

Module 2: Respiration 5 hrs

Transport of O₂ and CO₂ in blood, respiratory disorders – Dyspnoea, Hypoxia, Asphyxia, Hypo and Hypercapnia, CO poisoning, smoking and its physiological effects.

Core Readings
Guyton 2002: Text Book of Medical Physiology Saunders pp432-509
Zoological Society of Kerala, Study material 2002.  Biochemistry,
aPhysiology and Developmental Biology Published by Zoological Society of Kerala

Module 3: Circulation 7 hrs

Blood – Composition and function, Brief account of mechanism of blood clotting; Disorders of blood clotting – Haemophilia, cerebral and pulmonary thrombosis, Cerebral haemorrhage, Blood pressure and factors controlling it; electrocardiogram, Cardiovascular disorders – Arteriosclerosis, Myocardial infraction, Angiogram and Angioplasty.

Core Readings

Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Module 4 Excretion 6 hrs

Structure of human nephrone, 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 – myeleonephritis, glomerular nephritis, nephrotic syndrome, Dialysis

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.264-379
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Module 5 Neurophysiology 6 hrs

Structure of typical neuron, myelenated and non myelenated nerve fibres; Nerve impulse – initiation and propagation of nerve impulse, All or none law, Saltatory conduction, Synaptic transmission, Neurotransmitters, Brain waves, Electroencephalogram, Neural disorders – Parkinson’s disease, Epilepsy, Alzheimer’s syndrome, Dyslexia.
Core Readings
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Module 6 Muscle Physiology 4 hrs
Striated, Non striated and Cardiac muscle, Ultra structure of striated muscle fibre, Mechanism of muscle contraction, Threshold and spike potential, Fatigue, O_2 dept, Rigor mortis.

Core Readings
Guyton 2002: Text Book of Medical Physiology Saunders pp.52-86
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Module 7 Endocrinology 5 hrs
Endocrine glands and their hormones, mode of action (in brief), Hypothalamus, Pituitary, Thyroid, Parathyroid, Thymus, Islets of Langerhands, Adrenal, Testis and ovary, Hormonal disorders.

Core Readings
Guyton 2002: Text Book of Medical Physiology Saunders pp.836-966
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala

Part II IMMUNOLOGY 18 hrs
Module 8 3 hrs
Introduction to immunology
Types of immunity, innate immunity, acquired, passive, active
Mechanism of innate immunity (eg. Barriers, phagocytosis, inflammation)
Complement System, biological effects of complements.
Core Readings
Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunoloy, Study Material Series published by Zoological Society of Kerala Chapter 1
Ivan Roitt, 2002 Essentials of Immunology ELBS

Module 9  5 hrs
Antigens and antibodies
Types of antigens, haptens, antigenic determinants.
Basic structure of immunoglobulins, Different classes of immunoglobulins and functions.

Core Readings
Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunoloy, Study Material Series published by Zoological Society of Kerala Chapter 4
Ivan Roitt, 2002 Essentials of Immunology ELBS

Module 10  5 hrs
Antigen antibody reactions
Precipitation test, agglutination test,
Clinical applications of antigen antibody reaction, Widal, VDRL, HIV test (ELISA), Complement Fixation Test, and Coombs test.

Core Readings
Ivan Roitt, 2002 Essentials of Immunology ELBS

Module 11  5 hrs
(Brief accounts of the followings)
Immune response system
Primary and secondary lymphoid organs,
Cells of Immune system – Leucocytes, lymphocytes, T&B cells,
Macrophages, Plasma cells, Memory cells, MHC, Antibody synthesis,
Monoclonal antibodies, Hybridoma technology

Immune disorders – hypersensitivity, Auto immunity & Immunodeficiency, AIDS,


**Core Readings**


Ivan Roitt, 2002 *Essentials of Immunology ELBS*


**Selected Further Readings**


Colemen: Fundamentals of Immunology

Guyton, Medical Physiology

Ivan Roitt: Essentials of Immunology ELBS.

Madhavankutty, Medical Physiology

Mahupathra, Human Physiology, Current Books


Michael J. Gibuay, Ian A. Macdonald and Helen M. Roche, Nutrition and Metabolism.


Park, K. Park’s Text Book of Preventive and Social Medicine – 2002, 17t Ed.
Banarasidass Bhenot Publications
Prosser and Brown, Comparative Animal Physiology
Sebastian Prof. M.M., Animal Physiology
William S Hoar, Animal Physiology.
ZY3CV03U[P] - HUMAN PHYSIOLOGY AND IMMUNOLOGY

2Hrs/Week
36Hrs
Credit 1

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

ZOOOLOGY COMPLEMENTARY COURSE FOR BOTANY
(MODEL II) AND SIMILAR PROGRAMMES

ZY4CV04U - APPLIED ZOOLOGY

3hrs/week
54 hrs
Credits 3

OBJECTIVES

Equip the students interested in the Applied branches of zoology with skills and knowledge which can lead to self employment opportunities.

Module 1: Aquaculture

Traditional methods of aquaculture, Advantages and salient features of aquaculture, Types of aquaculture, Biotic and abiotic factors of water, Importance of Alga in aquaculture, Common Cultivable fishes of Kerala Economic importance and morphology of culturable species. Catla, Rohu, Mrigal, Cyprinus carpio, Etroplus, Tilapia, Penaeus indicus, P. monodon, Perna viridis/Perna indicus, Pinctada fucata

Pond culture (Construction and maintenance ) Brief Description of Carp culture Composite fish culture. Integrated Fish Culture, Induced breeding in fishes, Important Fish Diseases. Fish preservation and processing Aquarium management, Setting up of an Aquarium, Biological filter and Aeration. Common species of Aquarium fishes. Prawn culture, Mussel culture, Pearl culture

Core Readings:
Applied Zoology; (2002) Published by Zoological Society Of Kerala

Module 2 Sericulture

Harvesting and stifling of cocoons. Silkworm diseases. Preventive and control measures.

**Core Readings:**

Applied Zoology; (2002) Published by Zoological Society Of Kerala


**Module 3 Vermiculture**


**Core Readings:**

Applied Zoology; (2002) Published by Zoological Society Of Kerala

Venkitaraman, P.R., 1983, Text Book of Economic Zoology (Sudarsana Publ. Cochin)

**Module 4 Apiculture**


**Core Readings:**

Applied Zoology; (2002) Published by Zoological Society Of Kerala

Shukla G.S., & Updhyay V.B., Economic Zoology (Rastogi Publ. Meerut)

**Selected Further Readings**

Alikunhi, K.h., Fish Cluture in India (ICAR, New Delhi)

Bhosh, C.C., 1949, Silk Production and Weaving in India (CSIR), New Delhi

Director, Zoological Survey of India, 1994, earthworms Resources and Vermiculture

Curriculum for BSc. Zoology Programme

Jhingran, V.G., 1985 Fish and Fisheries of India (Hindustan Publ. Corporation, New Delhi)

Kurien, C.V. & Sebastian V.C., Prawn Fisheries in India (Hindustan Publ. Corporation, New Delhi)

Krishnaswami, S., 1986 Improved Method of Rearing Young age Silk worms (Central Silk board Bangalore)

Krishnaswami, S., 1986, New Technology of Silkworm Rearing (Central Silk Board Bangalore)


Menon, K.N., 1970 Malsyakrishi (State Institute of language, Trivandrum)

Mysore Silk Association, 1986, Silkworm rearing and Diseases of Silkworms


Shukla G.S., & Updhyay V.B., Economic Zoology (Rastogi Publ. Meerut)

Andhra Pradesh Agricultural University, Hydrabad

Sinhan, V.R.P. & Ramachandran, V., 1985, Fresh water Fish Culture (ICAR, New Delhi)

Singh, S., 1962 Bee keeping in India (ICAR, New Delhi)

Singh, V.P.P. and Ramachandran, V., 1985 Freshwater Fish Culture (ICAR, New Delhi)


Ullal, S. R. and Narasimahanna, M.N., Handbook of Practical Sericulture (Central Silk Board Bombay.)

Venkitaraman, P.R., 1983, Text Book of Economic Zoology (Sudarsana Publ. Cochin)
Practicals

ZY4CV04U [P] - APPLIED ZOOLOGY

2 hrs/week
1 credit
36 hrs

1. General Identification, Economic importance, Morphology, scientific names and common names of the following
   a. Economic important and morphology of culturable species
      (Catla, Rohu, Grass carp, Common carp, Etroplus Tilapia)
      Penaeus indicus/P. monodon
      Perna viridis, Pinctada fucata
   b. 2 species of earthworms used in Vermiculture
   c. Two species of honey bees
   d. Silkworm. Cocoon/Adult

2. Castes of bees

3. Bee keeping equipments Beehive, Smoker, honey extractor

4. Beeswax, Honey, Silk, Vermicompost (Identification-Uses)

5. Chandrika/Natrika used in sericulture

6. Fish diseases (any 2 diagrams/specimens)

7. Fish parasite (any 1)
UGC SPONSORED PROGRAMME

BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION
BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION
(BT & SP) (UGC SPONSORED)

Total Credits 120
Total Instructional Hours 150

SCHEME

SEMESTER I

<table>
<thead>
<tr>
<th></th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“Common Course In English” <em>(From Board of studies – English)</em></td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Core 1: General Methodology And Perspectives in Science <em>(From Board of Studies – Zoology)</em> Practical</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Core 2: Preparation Of Biological Specimens: Plants Practical</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Core 3: Preparation Of Biological Specimens: Animals Practical</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Practical Training OJT 54 Hrs</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Complementary-1: “Biochemistry-1” <em>(From Board of Studies – Biochemistry)</em> Practical</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Complementary-2: “Zoology -1” <em>(From Board of Studies – Zoology)</em> Practical</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>

SEMESTER II

<table>
<thead>
<tr>
<th></th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“Common Course In English” <em>(From Board of studies – English)</em></td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Core 4: General Biological Techniques Practical</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Core 5: Preparation of Permanent Slides Practical</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Core 6: Clinical Chemistry And Clinical Microbiology Practical</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Practical Training OJT 54 Hrs</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Complementary-1: “Biochemistry-2” <em>(From Board Of Studies – Biochemistry)</em></td>
<td>2</td>
</tr>
</tbody>
</table>
Curriculum for BSc. Zoology Programme

The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam

**SEMESTER II**

<table>
<thead>
<tr>
<th>6</th>
<th>Complementary-2: “Zoology -2” (From Board of Studies: Zoology)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6</th>
<th>Complementary-2: “Zoology -2” (From Board of Studies: Zoology)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>2</td>
</tr>
</tbody>
</table>

| Total | 25 | 20 |

**SEMESTER III**

<table>
<thead>
<tr>
<th>1</th>
<th>Core 7: Physiology With Clinical Correlation-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>Core 7: Physiology With Clinical Correlation-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2</th>
<th>Core 8: Physiology With Clinical Correlation-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2</th>
<th>Core 8: Physiology With Clinical Correlation-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3</th>
<th>Core 9: General Laboratory Techniques And Electronics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3</th>
<th>Core 9: General Laboratory Techniques And Electronics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4</th>
<th>Complementary-1: “Biochemistry -3” (From Board of Studies – Biochemistry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4</th>
<th>Complementary-1: “Biochemistry -3” (From Board of Studies – Biochemistry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5</th>
<th>Complementary-2: “Zoology -3” (From Board of Studies: Zoology)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5</th>
<th>Complementary-2: “Zoology -3” (From Board of Studies: Zoology)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>2</td>
</tr>
</tbody>
</table>

| Total | 25 | 20 |

**SEMESTER IV**

<table>
<thead>
<tr>
<th>1</th>
<th>Core 10: Teaching Laboratory Techniques, And Water, Soil And Air Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>Core 10: Teaching Laboratory Techniques, And Water, Soil And Air Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2</th>
<th>Core 11: Tissue Culture And Gene Manipulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2</th>
<th>Core 11: Tissue Culture And Gene Manipulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3</th>
<th>Core 12: Production And Marketing Of Biological Specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3</th>
<th>Core 12: Production And Marketing Of Biological Specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4</th>
<th>Complementary-1: “Biochemistry -4” (From Board of Studies – Biochemistry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4</th>
<th>Complementary-1: “Biochemistry -4” (From Board of Studies – Biochemistry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5</th>
<th>Complementary-2: “Zoology -4” (From Board of Studies: Zoology)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5</th>
<th>Complementary-2: “Zoology -4” (From Board of Studies: Zoology)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>2</td>
</tr>
</tbody>
</table>

| Total | 25 | 20 |

*During the 2nd year /3rd year the students will undergo 36 hours of Practical Training in Plant Tissue Culture at an Industrial Center = 2 Additional Credits.*
### SEMESTER V

<table>
<thead>
<tr>
<th></th>
<th>Core 13: Cell Biology And Molecular Biology <em>(From Board of Studies - Zoology)</em></th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Core</strong></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Core 14: Environmental Biology, Toxicology And Disaster Management <em>(From Board of Studies - Zoology)</em></th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td><strong>Core</strong></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Core 15: Radiological, Biochemical And Advanced Instrumentation Techniques</th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td><strong>Core</strong></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Core 16: Entrepreneurship Development And Marketing</th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td><strong>Core</strong></td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th><strong>Open Course:</strong> Human Genetics, Nutrition, Community Health And Sanitation – /Food Microbiology <em>(From Board of Studies - Zoology)</em></th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td><strong>Core</strong></td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Practical</strong></td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total** | 25 | 20 |

### SEMESTER VI

<table>
<thead>
<tr>
<th></th>
<th>Core 17: Genetics And Biotechnology <em>(From Board of Studies - Zoology)</em></th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Core</strong></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Core 18: Reproductive And Developmental Biology <em>(From Board of Studies - Oology)</em></th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td><strong>Core</strong></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Core 19:Microbiology And Immunology <em>(From Board of Studies - Zoology)</em></th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td><strong>Core</strong></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Core 20:General Informatics, Bioinformatics And Biostatistics <em>(From Board of Studies – Zoology)</em></th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td><strong>Core</strong></td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th><strong>Core Choice-Based:</strong> Nutrition, Community Health And Sanitation/ Ecotourism <em>(From Board of Studies - Zoology)</em></th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td><strong>Core</strong></td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Practical</strong></td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>OJT Training  BT &amp; SP</th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td><strong>Core</strong></td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total** | 25 | 20 |
SEMESTER I

ZB1VB02U CORE 2: PREPARATION OF BIOLOGICAL
SPECIMENS-1: PLANTS

36 hrs
2 credits

Module 1 (9 hrs)
Broad classification of plants; Plants of economic value; identification of common biological specimens for classroom use.

Module 2 (9 hrs)
Where and how to collect plants; preparation and storage of herbarium sheets; preparation of dry specimens for display boxes; preparation of museum specimens.

Module 3 (6 hrs)
Collection and preservation of specimens for anatomical and cytological studies.

Module 4 (12 hrs)
Modeling materials: characteristics of teaching models, proportions, durability, attractiveness, innovativeness.

Core Readings for Module 1, 2, 3, 4

ZB1VB02U CORE 2 PRACTICALS
PREPARATION OF BIOLOGICAL SPECIMENS-1: PLANTS

36 hrs
1 credit

1. Preparation of herbarium sheets. (6 hours)
2. Preparation of museum specimens (5 hours)
3. Preparation of display boxes of dry plant and plant product mounts. (5 hours)
4. Preparation of whole mounts. (6 hours)
5. Collection and preservation of materials for anatomical and cytological studies. (2 hours)
6. Preparation of teaching models [plaster of Paris, epoxy resin, clay] (12 hours)
SEMESTER I

ZB1VB03U CORE 3: PREPARATION OF BIOLOGICAL SPECIMENS-2: ANIMALS

36 hrs

2 credits

Module 1 (10 hrs)
Where and how to collect animals (from Protozoa to Mammals)

Module 2 (12 hrs)
Life cycles of representative animals from each phylum.

Module 3 (2 hrs)
Preparation of museum specimens.

Module 4 (2 hrs)
Preparation of skeletons.

Module 5 (2 hrs)
Alizarin preparation and resin-embedded specimens

Module 6 (8 hrs)
Taxidermy

Core Readings for Module 1, 2, 3, 4, 5, 6

ZB1VB03U CORE 3: PRACTICALS PREPARATION OF BIOLOGICAL SPECIMENS-2: ANIMALS

36 hrs
1 credit

1. Whole mount preparation of small animals and parts of animals. (10 hours)
2. Alizarin preparation and resin-embedded specimens (6 hours)
3. Preparation of articulated skeletons. (6 hours)
4. Taxidermy (10 hours)
5. Preserving materials for class room use. (4 hours)
SEMESTER II

ZB2VB04U CORE 4: GENERAL BIOLOGICAL TECHNIQUES

36 hrs
2 credits

Module 1 (9 hrs)
Microscopes: Light, phase contrast, fluorescence, stereoscopic, electron;
Magnification and Resolution; Ocular and stage micrometers; Hemocytometer;
Camera lucida; Common problems associated with light microscopes.

Module 2 (6 hrs)
Staining: Fixatives, mounting media, and sealing methods; stains for anatomy,
histochemistry, cytology and microorganisms – the principles behind their uses.

Module 3 (9 hrs)
Special Techniques: Hanging drop culture; fixing and embedding of plant and animal materials; Preparation of blocks; microtome and its maintenance;
Section cutting.

Module 4 (12 hrs)
Micrbiological Techniques: Types of solid and liquid culture media for bacteria, fungi, algae and protozoa (at least 2 for each); Sterilization methods;
Maintenance of Autoclave; Cell counting and other methods for measuring microbial growth; Storage and maintenance of Stock cultures.

Core Readings for Module 1, 2, 3, 4
ZB2VB04U CORE 4: PRACTICAL GENERAL BIOLOGICAL TECHNIQUES

36 hrs
1 credit

1. Light microscope: its parts and their description (2 hours)
2. Use of ocular and stage micrometers for measurement of width of hair etc. (2 hours)
3. Hanging drop technique. (1 hour)
4. Microtomy [plant or animal] (12 hours)
5. Aseptic procedures in initiating and maintaining a bacterial culture. (6 hours)
6. Histochemistry of carbohydrates, proteins, lipids and nucleic acids. (9 hours)
7. Counting cells in hemocytometer ; Growth Curve (4 hours)
SEMESTER II

ZB2VB05U CORE 5: PREPARATION OF PERMANENT SLIDES

36 hrs
2 credits

Module 1 (9 hrs)
Anatomy of Plants: Special features of anatomical sections of monocot and dicot stems and roots; Double staining methods; Special staining methods; Preparation and storage of permanent slides.

Module 2 (12 hrs)
Anatomy of Animals: Organs and tissues commonly used in the classroom; Preparation of sections involving microtome and cryostat; Special staining methods; Preparation and storage of permanent slides.

Module 3 (6 hrs)
Cell division stages: Stages of Mitosis and Meiosis in Plants and Animals; Sources of materials; Preparation of permanent slides showing stages of division; Use of chemicals to arrest division; Special stains and their preparation.

Module 4 (9 hrs)
Microorganisms: Identification of common microorganisms; their sources and culture techniques; Staining and preparation of permanent slides and their storage.

Core Readings for Module 1, 2, 3, 4

ZB2VB05U CORE 5: PRACTICAL PREPARATION OF PERMANENT SLIDES

5. Preparation of double stained permanent slides of animals and plants. (12 hours)
6. Preparation of stained permanent slides of organs and tissues of animals. (12 hours)
7. Preparation of permanent slides of microorganisms. (12 hours)
SEMESTER II
ZB2VB06U CORE 6: CLINICAL CHEMISTRY AND CLINICAL MICROBIOLOGY

36 hrs Credits 2

Module 1 (9 hrs)
Functions of various organs and their clinical assessment (Brief treatment only but emphasizing the biochemical aspect): e.g., liver, kidney, heart, pancreas, lung, ..

Module 2 (6 hrs)
Biochemical changes in the organs under pathological conditions.
(Liver,kidney,heart,pancreas,lungs)

Module 3 (12 hrs)
Routine biochemical tests: e.g., Estimation of: blood glucose, Total protein in serum, serum albumin, blood urea, creatinine in blood, serum bilirubin, serum triglycerides, serum cholesterol.

Module 4 (4 hrs)
Microorganisms of medical importance: Examples each from clinically important bacteria, (Pseudomonas,Vibrio) fungi (Dermatophytes), viruses(Chicken pox virus,Measles virus), protista (E.histolytica) and helminthes(Round worm,Pinworm).

Module 5 (5 hrs)
Diagnostic characteristics of the examples given in module 4 above (culture characteristics, morphology etc).

Core Readings for Module 1, 2, 3, 4, 5

ZB2VB06U CORE 6: PRACTICAL CLINICAL CHEMISTRY AND CLINICAL MICROBIOLOGY

36 hrs

Credit 1

1. Estimation of: blood glucose, total protein in serum, serum albumin, blood urea, creatinine in blood, serum bilirubin, serum triglycerides, serum cholesterol, (15 hours)

2. Media preparation, Inoculation, and maintenance of bacteria. (8 hours)

3. Gram staining (2 hours)

4. HIV spot test (2 hours)

5. Identification of microorganisms (Bacteria - Staphylococcus, E.coli, Klebsiella, Bacillus, Pseudomonas,), (Fungi-Aspergillus, Penicillium) (Protista-E.histolytica) and (Helminthes – Round worm, Pin worm) of clinical significance .9hrs
SEMESTER III

ZB3VB07U CORE 7: PHYSIOLOGY WITH CLINICAL CORRELATION-1 54 hrs

Credits 3

Module 1 (3 hours)
Homeostasis

Module 2 (12 hrs)
Gastro-intestinal system: Anatomy and functional organization; common clinical abnormalities associated with nutrient metabolism.

Module 3 (15 hrs)
Cardiovascular system: Anatomy and functional organization; Common clinical abnormalities

Module 4 (9 hrs)
Respiratory system: Anatomy and functional organization, common clinical abnormalities.

Module 5 (15 hrs)
Endocrine system: (Brief account only) Major hormones, common clinical abnormalities.

Core Readings for Module 1, 2, 3, 4, 5

ZB3VB07U 7 CORE 7: PRACTICAL PHYSIOLOGY WITH CLINICAL CORRELATION-1

36hrs
Credit 1

1. Action of trypsin / pepsin on proteins. (2 hours)

2. Influence of concentration, pH and temperature on activity of salivary amylase. (4 hours)

3. Determination of O₂ uptake by cockroach [Respirometer] (3 hours)

4. Effect of adrenalin on the heart beat of frog. (2 hours)

5. Determination of rbc, wbc, differential wbc, and platelet counts (12 hours)

6. Estimation of haemoglobin (2 hours)

7. Demonstration of hemin crystals (1 hour)

8. ESR (2 hours)

9. Blood grouping (ABO, Rh). (2 hours)

10. Bleeding time and Clotting time (6 hours)
SEMESTER III
ZB3VB08U CORE 8: PHYSIOLOGY WITH CLINICAL CORRELATION-2

54 hrs
Credits 3

Module 1 (15 hrs)
Nervous system (brief account only): Anatomy and functional organization, common clinical abnormalities.

Module 2 (15 hrs)
Sense organs: Anatomy and functional organization of the sense organs for vision, hearing, taste, common clinical abnormalities.

Module 3 (12 hrs)
Muscular system: (brief account only) Details of muscle contraction, common clinical abnormalities.

Module 4 (12 hrs)
Excretory system: Anatomy and functional organization, common clinical abnormalities.

Core Readings for Module 1, 2, 3, 4

ZB3VB08U CORE 8: PHYSIOLOGY WITH CLINICAL CORRELATION-2

36 hrs

Credits 2

1. Effect of acetylcholine on the heart rate of frog (compare with the effect of adrenaline) (2 hours)
2. Recording of muscle twitch in frog using kymograph. (4 hours)
3. Detection of glucose, protein and occult blood in urine. (6 hours)
4. Survey of colour blindness in the student population. (6 hours)
5. Hospital visit to study the incidence of otolaryngological, and renal diseases in the local community. (18 hours)
SEMESTER III

ZB3VB09U CORE 9: GENERAL LABORATORY TECHNIQUES AND ELECTRONICS

54 Hrs
Credits 3

Module 1 (6 hrs)
Distillation of water: Types of distillation stills [metal, solar, glass still].

Module 2 (9 hrs)
Ion exchangers and how they work, regeneration of ion exchangers.

Module 3 (4 hrs)
Cleaning agents for various types of dirty glass wares, pipette cleaners.

Module 4 (4 hrs)
Methods of sterilization and storage of glassware.

Module 5 (6 hrs)
Solutions: Definition of solute, solvent, molar, molal, normality, weight by weight, weight by volume, percent, ppm, ppb; inter conversion between percent, molar and normal; method of dilution and sources of error.

Module 6 (6 hrs)
pH meter and its working [various types of electrodes] Theory of buffering, some standard buffers [acetate, phosphate, tris, tris-glycine]

Module 7 (12 hrs)
Simple circuits: How to read a circuit diagram, parallel and series connections, fuses, plugs, wires for common electrical equipment, voltage stabilizers, safety in handling electrical equipment.

Module 8 (7 hrs)
Temperature sensing control devices: thermometers, thermocouples, thermostats.

Core Readings for Module 1, 2, 3, 4, 5, 6, 7, 8

ZB3VB09U CORE 9: PRACTICAL GENERAL LABORATORY
TECHNIQUES AND ELECTRONICS

36 Hrs
Credit 1

1. Components of distillation stills and ion exchanger. (2 hours)
2. Cleaning of dirty glass wares using various cleaning agents. (3 hours)
3. Sterilization of glass wares [using hot air oven and autoclave (4 hours)
4. Preparation of solutions with molar/molal/normal concentrations. (3 hours)
5. Preparation of buffers and measurement of pH. (3 hours)
6. Simple circuits, soldering, changing plugs, wires and fuses. (12 hours)
7. Electronic components: Capacitors, diodes, Zenor diode, inductor, resistor, transformer, transistor [understanding the function of electromagnetic relay] (9 hours)
SEMESTER IV

ZB4VB10U CORE 10: TEACHING LABORATORY TECHNIQUES, AND WATER, SOIL AND AIR ANALYSIS

54 Hrs
Credits 3

Module 1 (9 hrs)
Organization of a teaching laboratory: equipment, reagents, glass wares, specimens, purchase and maintenance of stock register

Module 2 (9 hrs)
Maintenance of living organisms: aquarium, terrarium, animal houses, garden.

Module 3 (9 hrs)
Distribution of plants and animals, methods of survey, determination of frequency dominance

Module 4 (9 hrs)
Abiotic and biotic pollutants of water and their indicators; assay techniques.

Module 5 (9 hrs)
Air pollution-Assay techniques

Module 6 (9 hrs)
Soil pollution-Assay techniques.

Core Readings for Module 1, 2, 3, 4, 5, 6

ZB4VB10U CORE 10: PRACTICAL TEACHING LABORATORY TECHNIQUES, AND WATER, SOIL AND AIR ANALYSIS

36 Hrs
Credit 1

1. Maintenance of living organisms [aquarium and terrarium] common problems and their solutions. (9 hours)

2. Survey methods [quadrate, transect and point method] (12 hours)

3. Frequency distribution of animals in a specific area of campus. (3 hours)

4. Analysis of water pollutants [abiotic & biotic] (6 hours)

5. Analysis of soil pollutants [abiotic] (4 hours)

6. Analysis of air pollutants [abiotic] (2 hours)
SEMESTER IV

ZB4VB11U CORE 11: TISSUE CULTURE AND GENE MANIPULATION

54 Hrs
Credits 3

Module 1 (9 hrs)
Plant and animal cell culture, growth media and maintenance of culture.

Module 2 (15 hrs)
Characteristics of plant cells in culture, meristem, anther, embryo, ovule, ovary and endosperm culture.

Module 3 (9 hrs)
Characteristics of animal cells in culture, hybridoma technology.

Module 4 (6 hrs)
Germ plasm storage, somatic hybridization.

Module 5 (8 hrs)
Restriction enzymes, ligases, cloning vectors [plasmids & phage DNA]

Module 6 (4 hrs)
Isolation of DNA, gene transfer methods, identification and selection of recombinants.

Module 7 (3 hrs)
An overview of a cloning experiment [from start to finish]

Core Readings for Module 1, 2, 3, 4, 5, 6, 7

ZB4VB11U CORE 11: PRACTICAL TISSUE CULTURE AND GENE MANIPULATION

36 Hrs
Credit  1

1. Media formulation for plant tissue culture (4 hours)
2. Surface sterilization. (2 hours)
3. Callus induction. (2 hours)
4. Auxillary bud culture. (2 hours)
5. Isolation of protoplast. (4 hours)
6. Isolation of genomic DNA and its quantification. (9 hours)
7. Isolation of plasmid DNA. (6 hours)
8. Restriction digestion, ligation, bacterial transformation. (5 hours)
9. PCR demonstration. (2 hours)
SEMESTER IV

ZB4 VB12U  CORE 12: PRODUCTION AND MARKETING OF BIOLOGICAL SPECIMENS

54 Hrs  
Credit 3

Module 1  
(3 hrs)
Market survey techniques.

Module 2  
(6 hrs)
Organization of a production centre, minimal requirements, stage-wise expansion, purchase, collection and storage of raw materials.

Module 3  
(12 hrs)
Accounts, book keeping and quotations, storage and packing of finished products, recovery of waste materials.

Module 4  
(9 hrs)
Need, scope and approaches for project formulation, structure of project reports.

Core Readings for Module 1, 2, 3, 4

ZB4 VB12U  CORE 12: PRACTICAL PRODUCTION AND
MARKETING OF BIOLOGICAL SPECIMENS

36 hrs

Credit  1

1. Conduct of mini market survey: Data collection through questionnaire and
personal visits. (20 hours)

2. Break even analysis. (10 hours)

3. Business letters. (6 hours)
SEMESTER V

ZB5VB15U CORE 15: RADIOLOGICAL, BIOCHEMICAL AND ADVANCED INSTRUMENTATION TECHNIQUES

54 hrs
Credits 3

Module 1 (6 hrs)
Types and sources of radiation-effect of various types of radiation on biological systems, LD

Module 2 (12 hrs)
Isotopes, definition, isotopes of common biological use, techniques for detection of isotopes [autoradiography, Geiger counting technique, liquid scintillation, Gamma counter]

Module 3 (7 hrs)
Isotope dilution technique; waste disposal and cleaning of contaminated glass ware.

Module 4 (5 hrs)
Safety in use of radiation sources and radio isotopes.

Module 5 (9 hrs)
Chromatography techniques- theory, methods and application of paper, gas, affinity, ion exchange chromatography, TLC, HPLC, Gel filtration.

Module 6 (6 hrs)
Electrophoresis: Theory, methods and applications, paper and gel electrophoresis

Module 7 (9 hrs)
Polymerase chain reaction, DNA sequencing, DNA fingerprinting.

Core Readings for Module 1, 2, 3, 4, 5, 6, 7


**ZB5VB15U CORE 15: PRACTICAL**

36 hrs  
Credit 1

1. Types and effects of various radiations. Isotope dilution techniques. (Visit to a radioisotope lab.) (5 hours)
2. Problems in radiology [on half cycle, quantity, disposal] (3 hours)
3. Paper chromatography, TLC (8 hours)
4. AGE, PAGE (10 hours)
5. Southern blotting (4 hours)
6. PCR (6 hours)
SEMESTER V
ZB5VB16U CORE 16: ENTREPRENEURSHIP DEVELOPMENT AND MARKETING

72 hrs
4hrs/week
Credits 3

Module 1 (18 hrs)
Institutions, financing procedure and financial incentives.

Module 2 (18 hrs)
Resource management: man, machine and materials, quality control/ quality assurance and testing of products

Module 3 (18 hrs)
Elements of marketing & sales management [Nature of product and market strategy, packaging and advertising, after sales service]

Module 4 (18 hrs)
Income tax, sales tax and excise rules

Core Readings for Module 1, 2, 3, 4.
ZB5VB16U (P) CORE 16: PRACTICAL ENTREPRENEURSHIP DEVELOPMENT AND MARKETING

36 hrs
Credit 1

1. Preparation and analysis of a project (18 hours)

2. Entrepreneurial motivation training through games, role playing, discussions and exercises (8 hours)

3. Preparation of report on an industry/firm (10 hours)
MODEL II B.SC. ZOOLOGY PROGRAMME 
(VOCATIONAL)

1. Aquaculture (ZAV)
2. Food Microbiology (ZFV)
3. Medical Microbiology (ZMV)
VOCAATIONAL SUBJECT – AQUACULTURE

VOCAATIONAL COURSES

COURSE I : PRINCIPLES AND METHODS IN AQUACULTURE  
ZA1V01U

COURSE II : HATCHERY AND CULTURE TECHNIQUES  
ZA1V02 U

PRACTICAL-I : PRINCIPLES AND METHODS IN AQUACULTURE &  
ZA1V02 U (P) HATCHERY AND CULTURE TECHNIQUES

COURSE III  
ZA2V03U : CAPTURE FISHERY

COURSE IV  
ZA2V04U : BIOLOGY OF FISHES

PRACTICAL 2 : CAPTURE FISHERY & BIOLOGY OF FISHES  
ZA2V04 U (P)

COURSE V  
ZA3V05U : FISHERIES ENVIRONMENT

PRACTICAL 3 : FISHERIES ENVIRONMENT  
ZA3V05U (P)

COURSE VI : FISH NUTRITION  
ZA3V06U

Practical 4 : FISH NUTRITION  
ZA3V06U (P)

COURSE VII : REPRODUCTIVE PHYSIOLOGY AND  
ZA4V07U ENDOCRINOLOGY

Practical 5 : REPRODUCTIVE PHYSIOLOGY AND  
ZA4V07U (P) ENDOCRINOLOGY

COURSE VIII : MICROBIOLOGY, PATHOLOGY AND POST
ZA4V08U HARVEST TECHNOLOGY

Practical 6 : MICROBIOLOGY, PATHOLOGY AND POST HARVEST  
ZA4V08U (P) TECHNOLOGY
VOCATIONAL SUBJECT: FOOD MICROBIOLOGY

VOCATIONAL COURSES

COURSE I : GENERAL MICROBIOLOGY
ZF1V01U
COURSE II : BIOINSTRUMENTATION
ZF1V02U
Practical I : GENERAL MICROBIOLOGY
ZF1V02U (P) & BIOINSTRUMENTATION
COURSE III : GENERAL METHODOLOGY
ZF2V03U
COURSE IV : ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY
ZF2V04U
Practical II : GENERAL METHODOLOGY, ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY
ZF2V04U (P)
COURSE V : DAIRY MICROBIOLOGY
ZF3V05U
Practical III : DAIRY MICROBIOLOGY
ZF3V05U (P)
COURSE VI : FOOD MICROBIOLOGY – MICROBIOLOGY OF SPOILAGE OF FOOD, METHODS OF FOOD PRESERVATION AND MICROBIOLOGICAL EXAMINATION OF FOOD
ZF3V06U
Practical IV : FOOD MICROBIOLOGY – MICROBIOLOGY OF SPOILAGE OF FOOD, METHODS OF FOOD PRESERVATION AND MICROBIOLOGICAL EXAMINATION OF FOOD
ZF3V06U (P)
COURSE VII : FOOD MICROBIOLOGY - MICROBIOLOGY OF CEREALS, BEVERAGES, EGG, MEAT AND FERMENTED FOOD
ZF4V07U
Practical V : FOOD MICROBIOLOGY - MICROBIOLOGY OF CEREALS, BEVERAGES, EGG, MEAT AND FERMENTED FOOD
ZF4V07U (P)
COURSE VIII : INDUSTRIAL MICROBIOLOGY
ZF4V08U
Practical VI: INDUSTRIAL MICROBIOLOGY
ZF4V08U (P)
VOCATIONAL SUBJECT: MEDICAL MICROBIOLOGY

VOCATIONAL COURSES

COURSE I : GENERAL MICROBIOLOGY  
ZM1V01U

COURSE II : BIOINSTRUMENTATION  
ZM1V02U

Practical I : GENERAL MICROBIOLOGY  
ZM1V02U (P) & BIOINSTRUMENTATION

COURSE III : GENERAL METHODOLOGY  
ZM2V03U

COURSE IV : ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY  
ZM2V04U

Practical II : GENERAL METHODOLOGY, ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY  
ZM2V04U (P)

COURSE V : PARASITOLOGY  
ZM3V05U

Practical V : PARASITOLOGY  
ZM3V05U (P)

COURSE VI : MEDICAL ENTOMOLOGY AND MYCOLOGY  
ZM3V06U

Practical VI : MEDICAL ENTOMOLOGY AND MYCOLOGY  
ZM3V06U (P)

COURSE VII : MEDICAL BACTERIOLOGY AND VIROLOGY  
ZM4V07U

Practical VII : MEDICAL BACTERIOLOGY AND VIROLOGY  
ZM4V07U (P)

COURSE VIII : MEDICAL MICROBIOLOGY  
ZM4V08U

Practical VIII : MEDICAL MICROBIOLOGY  
ZM4V08U (P)
The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam

**RESTRUCTURED CURRICULUM FOR B.SC. (MODEL II VOCATIONAL) DEGREE IN ZOOLOGY PROGRAMME**

**COURSE STRUCTURE**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Title</th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Common Course English – 1</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Common Course Sec. Language – 1</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Core Course - 1 General Methodology and Perspectives in Science</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Practical- I - General Methodology and Instrumentation</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Vocational Course – 1 Principles and Methods in Aquaculture (A) / General Microbiology (F/M)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Vocational Course – II Hatchery and Culture techniques (A)/ Bioinstrumentation (F/M)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Principles and Methods in Aquaculture, Hatchery and Culture techniques (A)/ General Microbiology and Bioinstrumentation (F/M)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Complementary Course – 1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>25</strong></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>
## SEMESTER I

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Title</th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Common Course English – 2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Common Course Sec. Language – 2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Core Course - 2 Biodiversity and Modern Systematics</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Practical 2 - Biodiversity and Modern Systematics</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Vocational Course – 3 Capture Fishery (A) / General Methodology (F/M)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Vocational Course – 4 Biology of Fishes (A) / Environmental and Agricultural Microbiology (F/M)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Practical 2 Capture Fishery and Biology of Fishes (A) / General Methodology, Environmental and Agricultural Microbiology (F/M)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>On The Job Training (2 Weeks)</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Complementary Course – 2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>25</strong></td>
<td><strong>21</strong></td>
</tr>
</tbody>
</table>
## SEMESTER III

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Title</th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Common Course  English – 3</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Core Course - 3  Animal Diversity Non-Chordata</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical 3 -  Animal Diversity Non-Chordata</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Vocational Course – 5  Fisheries Environment (A)/Dairy Microbiology (F)/ Parasitology (M)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Practical 3 Fisheries Environment (A)/Dairy Microbiology (F)/ Parasitology (M)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Vocational Course – 6  Fish nutrition (A) / Medical Entomology and Mycology(M) / Microbiology of Spoilage of food , Methods of Preservation of food and Microbiological examination of food (F)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Practical 4 Fish nutrition (A) / Medical Entomology and Mycology(M) / Microbiology of Spoilage of food , Methods of Preservation of food and Microbiological examination of food (F)</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Complementary Course – 3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>
## SEMESTER IV

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Title</th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Common Course English – 4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Core Course - 4 Animal Diversity Chordata</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practicals 4 - Animal Diversity Chordata</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Vocational Course – 7 Reproductive Physiology and Endocrinology (A)/ Medical Bacteriology and Virology (M) / Microbiology of cereals, beverages, Egg, Meat and Fermented food (F)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Practical 5 Reproductive Physiology and Endocrinology (A)/ Medical Bacteriology and Virology (M) / Microbiology of cereals, beverages, Egg, Meat and Fermented food (F)</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Vocational Course – 8 Microbiology, Pathology and Post Harvest Technology (A)/ Clinical Microbiology (M) / Industrial Microbiology (F)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Practical 6 Microbiology, Pathology and Post Harvest Technology (A)/ Clinical Microbiology (M) / Industrial Microbiology (F)</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Complementary Course – 4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practicals</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>25</td>
<td>20</td>
</tr>
</tbody>
</table>
### SEMESTER V

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Title</th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Core Course  - 5  Cell Biology and Molecular Biology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical  5  -  Cell Biology and Molecular Biology</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Group activity and Field Study (Practical Hr 1) Report to be submitted in VI$^\text{th}$ Semester along with Project in Practical Exam</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Core Course 6 Environmental Biology , Toxicology and Disaster Management</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical  6  Environmental Biology , Toxicology and Disaster Management</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Core Course 7 Evolution, Zoogeography and Ethology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical  7  Evolution, Zoogeography and Ethology</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Core Course – 8 Biochemistry, Human Physiology and Endocrinology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical 8 Biochemistry, Human Physiology and Endocrinology</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Open Course: Man, Nature and Sustainable Development/ Human Genetics, Nutrition , Community Health and Sanitation/ Management of Ornamental fish breeding , Rabbit farming, Poultry, Quail farming, Vermiculture, Beekeeping and Sericulture /Food Microbiology</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>25</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>
# SEMESTER VI

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Title</th>
<th>Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Core Course - 9 Reproductive and Developmental Biology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical 9 - Reproductive and Developmental Biology</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Core Course 10 Genetics and Biotechnology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical 10 Genetics and Biotechnology</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Core Course11 Microbiology and Immunology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical 11 Microbiology and Immunology</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Core Course – 12 General Informatics , Bioinformatics and Biostatistics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Practical 12 General Informatics , Bioinformatics and Biostatistics</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Core Choice based Courses</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Ecotourism/ Nutrition, Community Health and Sanitation/ Applied Entomology, Management of Ornamental fish breeding/ Vermiculture and Beekeeping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Project</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Practical – Field Study and Group Activity (as in Core) (1 hour)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>25</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>

## Model 2 Programmes in Zoology and Core Courses

Instructional Hours, Credit, Total Instructional Hours, University Examination, Weightage Internal and External Evaluation of Core Courses will follow the same pattern as in Model 1 Zoology Programme.

For Vocational Courses also University Examination will be conducted at the end of each Semester both for Theory and Practical. Duration of examination is 3 hrs and Internal External weightage ratio is 1:3.
C. SCHEME OF EXAMINATION COMPLEMENTARY SUBJECT

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Weightage ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Theory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ext.</td>
</tr>
<tr>
<td>1</td>
<td>I</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>II</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>III</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>IV</td>
<td>3</td>
</tr>
</tbody>
</table>
SEMESTER I

MODEL II B.SC. ZOOLOGY PROGRAMME (VOCATIONAL)

AQUACULTURE

THEORY

ZA1V01U COURSE I PRINCIPLES AND METHODS IN AQUACULTURE

36Hrs

Credits 2

Module 1

(1 hrs)

History of aquaculture – Scope and importance. Significance of aquaculture compared to other agricultural systems and commercial fisheries.

Core Readings
1. Aquaculture – Principles and Practices
   T.V.R.Pillay
   Fishing News Books
2. Open sea Mariculture
   Hanson and Goodwin

Module 2

(3 hrs)

Types of aquaculture – Freshwater brackish water and Mari culture. Shell fish culture, Finfish culture, Monoculture, Polyculture.

Core Readings
1. Aquaculture – Principles and Practices
   T.V.R.Pillay
   Fishing News Books
2. Handbook of Fisheries and Aquaculture
   Indian Council of Agricultural Research.

Module 3

(3 hrs)

Integrated farming – The concept of recycling of organic waste for maximum production. Rice cum fish culture. Culture practices and economics of duck cum fish, poultry cum fish and pig cum fish culture.

Core Readings
1. Aquaculture – Principles and Practices
   T.V.R.Pillay
   Fishing News Books
2. Handbook of Fisheries and Aquaculture
   Indian Council of Agricultural Research.
Additional Reading
3. Coastal Aquaculture in India
   R. Santhanam, N. Ramanathan and B. Jegadeesan

**Module 4**  
(7 hrs)

Site selection procedures – study of topography of pond site. Soil quality parameters – physical, soil type, porosity, percolation, shear strength rate of compassion etc. Chemical – salinity, pH, nutrients, toxic gases etc. Water quality parameters – Chemical salinity, pH, dissolved oxygen, pollution,. Physical – suspended solids, availability. Biological parameters – presence of juveniles/seedlings, predators/competitors, introduction to plankton, nekton and important groups.

**Core Readings**

1. Water quality in ponds for aquaculture.
   C.E. Boyd. 1990
   Agricultural experiment Station, Auburn University, Auburn, Alabama.
   482 pages
2. Handbook on design, construction and Equipment in coastal aquaculture (Shrimp Farming).
   Anand S. Upadhyay
   Allied publishers Ltd., Bombay

Additional reading

   CMFRI Special Publication No. 22.
   CMFRI, Kochi.
2. Handbook on Aquafarming
   Aquaculture Engineering and Water quality Management
   The Marine Products Export Development Agency.
   MPEDA, Kochi.

**Module 5**  
(5 hrs)


**Core Readings**

1. Handbook on design, construction and Equipment in coastal aquaculture (Shrimp Farming).
   Anand S. Upadhyay
   Allied publishers Ltd., Bombay
2. A text book of fish culture- Breeding and cultivation of fish
   Marcel Huet
   Fishing News (Books) Ltd
   23 Rosemount Avenue, West Byfleet, Surrey, England

3. A guide to prawn farming in Kerala. 52 pages
   CMFRI Special publication No.21.

4. A Manual of Freshwater Aquaculture
   R. Santhanam, N. Sukumaran & P. Natarajan, (1990)

Additional Reading
1. A Manual on shrimp farming
   The Marine products Export Development Agency, MPEDA

Module 6 (5 hrs)

Pond preparation-Drying, elimination of pests and predators. Preparation of
nursery and stocking ponds. Manuring, Production of plankton. Stocking -

Core Readings
1. Principles of Aquaculture
   Robert R. Stickney

2. Encyclopedia of Aquaculture
   Robert R. Stickney

3. A Manual of Freshwater Aquaculture
   R. Santhanam, N. Sukumaran & P. Natarajan, (1990)

4. Fish and Fisheries of India
   V. G. Jhingran

Additional Reading
1. A guide to prawn farming in Kerala. 52 pages
   CMFRI Special publication No.21.

2. Aquaculture Engineering
   Wheaton

3. Breeding and Seed production of finfish and shellfish
   P. C. Thomas, Suresh Ch. Rath and Kanta Das Mohapatra
   Daya Publishing House, New Delhi

Module 7 (5 hrs)

Fresh water cultivable fishes and their external characters-Indian Major Craps,
Catfish, Eel, Tilapia, Trouts, Salmon, Mahseer, Channa sps. Clarius, Anabas,
Heteropnuestes. Fresh water resource of India- Rivers, Reservoirs, Lakes.
Core Readings
1. Fresh water fishes of India Vol I and II
   Arun Jhingran
2. Taxonomy of Freshwater fishes of India
   Jayaraman

Additional reading
1. Freshwater Fishes
   Handbook on Aquafarming
   The Marine Products Export Development Authority

Module 8  (5 hrs )
Cultivable species of crustaceans and mulluscs: Identification and external characters. Shrimp, freshwater prawn, crab, lobster, pearl oyster, edible oyster, mussel clams.

Core Readings
1. The commercial molluscs of India
   CMFRI Bulletin No. 25.
2. Winter School on Recent advances in Mussel and Edible oyster farming and Marine Pearl production
   CMFRI
   Compiled and Edited by K.K.Appukuttan, Director Winter School, CMFRI 2005.
3. Pearl Culture.
   CMFRI, Bulletin No. 39,, 1987. 136 pages
4. Oyster Culture-Status and Prospects
   CMFRI, Bulletin No. 38., 1987. 78 pages
   CMFRI Bulletin No. 29., 1980. 56 pages

Additional Reading
1. Handbook on Aquafarming
   Molluscs
   MPEDA

Module 9  (2 hrs )
Brackish water aquaculture-Introduction, the tidal range, salinity and the biota.
Curriculum for BSc. Zoology Programme

Core Readings

1. A text book of fish culture- Breeding and cultivation of fish
   Marcel Huet
   Fishing News (Books) Ltd
   23 Rosemount Avenue, West Byfleet , Surrey, England

2. A Manual of Freshwater Aquaculture
   R. Santhanam, N. Sukumaran & P. Natarajan, (1990)

3. Coastal Aquaculture in India
   R. Santhanam, N. Ramanathan and B. Jegadeesan

Additional Reading

1. Handbook on design, construction and Equipment in coastal aquaculture
   (Shrimp Farming).
   Anand S. Upadhyay
   Allied publishers Ltd., Bombay

Module 10

(1 hrs)

Reservoir fisheries management practices and present problems. Development of fisheries of Indian reservoirs.

Core Readings

   Reservoir Fisheries of India
   Sugunan V.V.

2. Handbook of Fisheries and Aquaculture
   Indian Council of Agricultural Research

Additional Reading

3. Fish and Fisheries of India
   V.G. Jhingran.

Selected Further Readings

A text book of fish culture- Breeding and cultivation of fish, Marcel Huet
   Fishing News (Books) Ltd, 23 Rosemount Avenue, West Byfleet, Surrey, England

Principles of Aquaculture, Robert R. Stickney, John Wiley and Sons Inc.
   502 pages. Coastal Aquaculture in India
   R. Santhanam, N. Ramanathan and B. Jegadeesan
SEMESTER I

ZA1V02U COURSE II HATCHERY AND CULTURE TECHNIQUES

36 hrs
Credits 2

Module 1  
(2 hrs )

Present status and future prospects of fin fish culture and shell fish culture.

Core Readings
1. Hanbook of Fisheries and Aquaculture  
   Indian Council of Agricultural Research.  
   Website:  
   www.fao.org

Module 2  
(3 hrs )

Hatcheries – Different types, fin fish (Carp, Mullet), Molluscan (Edible and pearl oyster), Crustacean (Prawn)

Core Readings
1. CRC Handbook of Mariculture  
   Vol.I. Finfish culture  
   Vol.II. Crustacean culture
2. Marine shrimp culture- Principles and Practices  
   Editors: James Lester and Arlo .W. Fast
3. Aquaculture – Principles and Practices  
   T.V.R.Pillay  
   Fishing News Books
4. Aquaculture  
5. Additional Reading
   MPEDA Handbook on aquaculture

Module 3  
(5 hrs )


Core Readings
1. Aquaculture – Principles and Practices  
   T.V.R.Pillay  
   Fishing News Books
2. Additional Reading
   Handbook of Fisheries and Aquaculture  
   Indian Council of Agricultural Research.
3. Fish and Fisheries of India  
   V.G.Jhingran
4. Coastal Aquaculture in India  
   R.Santhanam, N.Ramanathan and B. Jegadeesan  
   CBS Publishers & distributors, New Delhi. 1990
5. A Manual of Freshwater Aquaculture  
   R.Santhanam, N.Sukumaran & P. Natarajan, (1990)


**Module 4**

*Culture of Tilapia- Different species and culture techniques of Mullet, Milk fish*

**Core Readings**

1. Water quality in ponds for aquaculture.  
   Boyd C.E. 1990  
   Agricultural Experiment station, Auburn University, Auburn  
   Alabama.482 pages.
3. Aquaculture – Principles and Practices  
   T.V.R.Pillay  
   Fishing News Books
4. A text book of fish culture- Breeding and cultivation of fish  
   Marcel Huet  
   Fishing News (Books) Ltd  
   23 Rosemount Avenue, West Byfleet, Surrey, Engl
5. Handbook on Aqua farming  
   Aquaculture Engineering and Water quality Management  
   The Marine Products Export Development Agency.  
   MPEDA, Kochi.
6. Handbook on Aquafarming  
   Sea Fishes  
   The Marine Products Export Development Agency.  
   MPEDA, Kochi.

**Module 5**

*Culture of cold water fishes in India. History, Practices followed and prospects*

**Core Readings**

1. Cold water fisheries of India  
Module 6  
(4 hrs)
Culture of macrobrachium sps; Prawn and Crab. Present status and future prospects. Prawn culture-Seed resources, prawn filtration practices, shrimp farming-extensive, semi intensive and intensive.

Core Readings
1. Artificial reef & sea Farming Technologies  
CMFRI bulletin No.48,(1996),126 pages.
Arlo W. Fast & James Lester
4. Breeding & Seed Production of Finfish and Shell fish  
Daya Publishing House, New Delhi.

Additional Reading
1. MPEDA  
A Manual on Shrimp Farming
2. MPEDA
3. Hand book on Shrimp Farming
4. MPEDA  
A Manual on Seed production and Farming of the giant Fresh water Prawn Macrobrachium Rosenbergii
5. MPEDA  
Hand book on Aquafarming  
Shrimp Hatchery
6. CMFRI Special Publication No. 21(1985),52 pages  
A guide to prawn Farming in Kerala.

Module 7  
(4 hrs)
Culture of Mollusca- mussel, pearl oyster, edible oyster, clams.

Core Readings
1. Korringa P. 1976  
Farming Marine Organisms Low in the food Chain  
Elsevier Scientific Publishing Co.  
Amsterdam, Netherlands, 264 pages.
2. Farming Bivalve Molluscs: Method for study & development  
DB Quayle and G.F. Newkirk  
World Aquaculture, Vol I. Published by the world Aquaculture Society in Association with The IDRC. 294 pages.
3. CMFRI bulletin No. 29(1980)  
Coastal Aquaculture, Mussel Farming, Progress and prospects, 56 pages
Module 8 (5 hrs)

Culture of ornamental fishes - setting up and maintenance of Aquaria. Breeding techniques of Aquarium fishes; gold fish, angel fish, gouramies.

Core Readings

1. Breeding and Seed production of finfish and shellfish
   P.C.Thomas, Suresh Ch. Rath and Kanta Das Mohapatra
   Daya Publishing House, New Delhi


Module 9 (2 hrs)

Frog culture: Different species of edible frog, their biology, prospects and constraints, culture of sea weeds, culture of holothurians

Core Readings


2. Aquaculture
   John E. Bardach, John H. Ryther and William O. Mc Lanney


Module 10 (2 hrs)

Culture of live feeds - micro algae, artemia, rotifer, daphnia.

Core Readings


2. MPEDA Handbook on Aquafarming Live Feed.

Module 11

Fish culture in relation to public health. Larvivorous fishes and their biology.

Core Readings

1. Fish and Fisheries of India
   V.G.Jhingran
2. Khanna S.S.
   An Introduction to Fisheries ,Central Book Depot, Allahabad.
SEMESTER II

ZA2V03U COURSE III CAPTURE FISHERY

36 hrs
Credits 2

Module 1  (5 hrs)
Craft and gear-Types of fishing craft in India –Traditional and Mechanized –
Fishing gear material: Properties of fishing gear appurtenances,floats,sinkers-
description. Major fishing gears and their operation. Static gear – Gill nets, Long
line and Fish traps, Mobile gear-Drag nets-Trawl, Seine nets-Pure seine, Shore
seines.

Core Readings
   technology..ICAR. New Delhi.
2. Von Brandt. Fishing gears of the world

Module 2  (4 hrs)
Commercially important orders, families, genera and species of elasmobranches
and teleost of the Indian region and their identification. Identification of
commercially important species of prawn, crab, lobster, bivalve, gastropod and
cephalopods.

Core Readings
1. FAO species identification sheets for the western Indian ocean.
2. Talwar and Kakker. Commercial sea fishes of India
3. Kurien C.V. and Sebastian.V.C.. Prawns and prawn fisheries of India
   Publishing House, New Delhi.
7. Website: www.fishbase.org

Module 3  (4 hrs)
Inland capture fishery resources of India. Riverine fisheries. Fisheries of major
carps and catfishes.
Curriculum for BSc. Zoology Programme

Core Readings


Module 4 (4 hrs)

Cold water fisheries resources. Fisheries of trout, mahseer and other cold water species, Development and management.

Core Readings


Module 5 (4 hrs)

Lacustrine fisheries- Species, catches, potential and problems of development and management.

Core Readings


Module 6 (4 hrs)

Estuarine fisheries, Fisheries of clupeids, prawns, mollusks and other important groups. Problems confronting to brackish water fisheries and inland fisheries.

Core Readings


Module 7 (2 hrs)

Marine fisheries resources of India. Historical background and recent trends. Fisheries resources of the continental shelf.
Core Readings

1. CMFRI. Bulletin No. 27. (1976). Exploited marine Fishery resources of India. A synoptic survey with comments on potential resources. 36 pages.
2. CMFRI. Status and Perspective in Marine Fisheries Research in India. (2007). 404 pages.
3. CMFRI. (2003). Status of exploited Marine Fishery resources of India. 308 pages

Module 8

Pelagic fishery resources of India. Fisheries of oil sardine, lesser sardine, anchovies, mackerel, ribbon fishes.

Core Readings


Module 9

Demersal fisheries. Fisheries of elasmobranches, Bombay duck, cat fishes, silver bellies, sciaenids, pomfrets, threadfins, threadfin breams and other perches. Flatfishes, Prawns, Lobsters, Crabs, Mussels, Oysters and Clams.

Core Readings

4. Kurien C.V. and Sebastian.V.C.. Prawns and prawn fisheries of India
Module 10  
(3hrs )

Biological aspects of fishery management, Principles of conservation, concept and practice. Population dynamics. Concept of recruitment and yields, problems of over fishing, MSY.

**Core Readings**

SEMESTER II

ZBA204U COURSE IV BIOLOGY OF FISHES 36 hrs

Credits 2

Module 1 (3 hrs)

Need for taxonomy, binomial nomenclature, Data requirements for classification of fishes, Methods for collection of taxonomic data, Study of external morphology of a typical; elasmobranch and a typical teleost, Variations in form and structures used in taxonomic studies.

Core Readings


Module 2 (10hrs)

Internal anatomy of fish- Alimentary canal and associated structures. Gills, swim bladder, accessory respiratory organs, Heart and circulatory system, cranium and skeletal system Nervous and lateral line system, sense organs and Reproductive system. General organization of internal organs of prawn, crab, bivalve and cephalopod.

Core Readings

1. Karl.E.Bond. Biology of Fishes
7. Kurien C.V. and Sebastian.V.C.. Prawns and prawn fisheries of India
Module 3
(5 hrs)
Excretion, osmotic and ionic regulation in marine and freshwater fishes.
Swimming activity.
Core Readings

Module 4
(5 hrs)
Visual behaviour, Reproductive behaviour and parental care, Social behaviour-
Aggregation and shoaling. Migration of fish- anadromous and catadromous,
Chemoreception and feeding behaviour.
Core Readings

Module 5
(5 hrs)
The habits of fishes. Natural food of fishes. Feeding habits in various groups of
marine and fresh water fishes inhabiting contrasting habits. Feeding habits of
prawn, crab, bivalve and cephalopod.
Core Readings
   of marine prawns (129 pages)
4. CMFRI (2005) Winter School on Recent advances in Mussel and Edible
   Oyster farming & Pearl Production Compiled and edited by Appukuttan
   K.K.

Module 6
(8 hrs)
Growth of fishes- Absolute and relative growth, isometric growth and allometric
growth. The cube law. Methods for determination of growth checks. Length
frequency analysis. Analysis of growth using hard parts like scales, otoloiths and
vertebrae. Estimation of growth by direct methods. Marking and tagging of fish for
growth studies. Ova Diameter Frequency and Spawning Frequency.
Determination of size at first maturity and spawning season.
Core Readings

SEMESTER III

ZA3V05U COURSE V FISHERIES ENVIRONMENT 36 hrs
Credits 2

Module 1 (5 hrs)

Core Readings
3. Otto Kinne. Elements of ecology,
4. Sverdrup et al. The Oceans.
5. Nybakken. Marine Biology

Module 2 (10 hrs)
General introduction to aquatic environments such as lentic, lotic, Lacustrine etc. Basic marine meteorology- weather, air-sea interactions. Monsoons, seasonal changes, circulation of water masses, Waves, Tides and sediment transportation.

Core Readings
2. Laevatsu and Hayes. Fisheries oceanography

Module 3 (7 hrs)
Physical and chemical parameters such as temperature, salinity, oxygen, nutrition etc. of aquatic environment. Phytoplankton and primary production, Zooplankton and secondary production.

Core Readings

Module 4 (4 hrs)
Core Readings

1. Austen. Marine microbiology
2. Pelczar and Chang. Introduction to Microbiology.

Module 5 (10 hrs)


Core Readings

SEMESTER III

ZA3V06U COURSE VI FISH NUTRITION 36 hrs

Credits 2

Module 1  (5 hrs)

Digestive system of fish, Digestive physiology of fish- Proteins, carbohydrates, fats, vitamins and minerals in fish nutrition.

Core Readings


Module 2  (8 hrs)

Gross energy, Digestive energy, metabolizable energy. Net energy, heat increment, Protein utilization. (Protein Efficiency Ratio, Protein conversion ratio, Productive protein value) Crude fibre, Nitrogen free extract and Ash. Food conversion ratio.

Core Readings

3. CMFRI. Proceedings of the Summer Institute in Recent Advances in Finfish and Shellfish nutrition.

Module 3  (8 hrs)

Core Readings

2. MPEDA Handbook on Aquaculture. Fish Nutrition.
3. CMFRI. Proceedings of the Summer Institute in Recent Advances in Finfish and Shellfish nutrition

Module 4  
(5 hrs )


Core Readings

2. MPEDA Handbook on Aquaculture. Fish Nutrition.
3. CMFRI. Proceedings of the Summer Institute in Recent Advances in Finfish and Shellfish nutrition

Module 5  
(10 hrs )


Core Readings

1. CMFRI. Proceedings of the Summer Institute in Recent Advances in Finfish and Shellfish nutrition
SEMESTER IV

ZA4V07U COURSE VII REPRODUCTIVE PHYSIOLOGY AND ENDOCRINOLOGY  

36 hrs  

Credits 2

Module 1  

(6 hrs )


Core Readings

5. Proceedings of the symposium on the Reproductive Physiology of Fish, Wageningen, The Netherlands. 2-6 August.  

Module 2  

(6 hrs )

Neurosecretary and endocrine systems in fin fishes- neuroendocrine control of reproduction, organisation and structure. Hypothalamus and pituitary in fishes-control of gonadal maturation-gonadotropin releasing hormones, gonadotropin and sex steroids.

Core Readings

4. Yadav.B.N. Fish endocrinology.  
Module 3 (6 hrs)


Core Readings


Module 4 (10 hrs)

Principles of induced maturation and spawning-Environmental control of reproduction-Levels of control in induced breeding and maturation. Use of hormones and hormone analogues(methods of hormonal administration).

HYPHOPHYSATION-ANAESTHETICS-OVAPRIM-LINPE METHOD-Eyestalk ablation its principle and application in crustacean hatcheries. Use of hormones or producing monosex population and sex reversal-cryopreservation of gametes.

Core Readings

1. Harvey and Hoar. Induced Breeding in Fish: Theory and Practice.
3. Chondar.S.L. Hypophysation of Indian major carps.
7. Advance in Marine Biology. Vol 29,
8. CIBA bulletin No.10.
Chapter 20- Live preservation of fish gametes.

Module 5  (8 hrs )
Embryonic and early development-Types of egg and larvae- metamorphosis of larvae, larval life and feeding habits.

Core Readings
SEMESTER IV

ZA4V08U COURSE VIII MICROBIOLOGY, PATHOLOGY AND
POST HARVEST TECHNOLOGY

36hrs
Credits 2

Module 1
(6 hrs)
Post harvesting techniques-sorting, grading, processing, packing, storing and marketing.

Core Readings

Module 2
(8 hrs)
Biochemical composition of fish, spoilage of fish-post mortem changes and rigor mortis-Enzymatic, microbial, rancidity. Indices of spoilage-organooleptic, chemical and microbial.

Core Readings
2. Handbook of Fisheries and Aquaculture
   Indian Council of Agricultural Research.
   ICAR.New Delhi.

Module 3
(6 hrs)
Preservation of fish – Freezing, canning and curing-principle and techniques.

Core Readings
   ICAR.New Delhi.
Module 4  
(8hrs)
Bacteriology-Important bacteria in spoilage, important bacteria of sanitary significance-staphylococcus, E-coli, Vibrio cholorae, salmonella. Sterilization techniques, preparation of different culture media, estimation of total plate count, staining techniques.

Core Readings
2. Austen. Marine microbiology
   Pelczar and Chang. Introduction to Microbiology.

Module 5  
(6 hrs)
Diseases of fin fish and shrimp-microbial, viral, fungal, parasitic, protozoan and nutritional diseases and remedial measures.

Core Readings
   T.F.H.Publications

Module 6  
(2 hrs)
Hazard analysis and critical control points in seafood industry.

Core Readings
   ICAR.New Delhi.
SEMESTER I
AQUACULTURE PRACTICALS
ZA1V02U (P) PRINCIPLES AND METHODS IN AQUACULTURE, HATCHERY AND CULTURE TECHNIQUES

36 Hrs
Credit 1

1. Identification and major biological characteristics of cultivable organisms
2. Study of common weed and predatory fishes in aquaculture ponds
4. Gut contents analysis of herbivorous and carnivorous fishes for evaluating the food and feeding habits.
5. Identification of different larval stages and hatchery operations of prawn
6. Setting up and keeping of aquariums
7. Visit to carp and prawn hatcheries.

SEMESTER II
ZA2V04U (P) PRACTICAL – II CAPTURE FISHERY & BIOLOGY

36 Hrs
Credit 1

1. Identification of commercially important fishes, crustaceans and molluscs.
2. Fish- Study of external morphology, scales and alimentary canal.
3. Dissecting and identification of internal organs of a fish and Dissection of fish otoliths.
4. Prawn- Study of external morphology, digestive system and nervous system
5. Gill structure- Herbivorous, carnivorous and omnivorous fishes.
6. Gill structure of a prawn - Dissection
7. Molluscs- Study of morphology, and Dissection of Gills
8. Rate of oxygen consumption in relation to body weight of a fish or prawn
SEMESTER III

ZA3V05U(P) PRACTICAL – III FISHERIES ENVIRONMENT

54 Hrs
Credit 2

1. Determination of salinity, dissolved oxygen, primary productivity, PH, total alkalinity, hardness, nitrate, nitrite and ammonia.
2. Determination of soil pH, organic matter
3. Study of common fresh water, brackish water and marine phytoplankton, zooplankton and benthos
4. Quantitative evaluation of phytoplankton and zooplankton in culture ponds
5. Calculation of lime requirement
6. Identification of the common Ancillary Marine Resources – Corals, Sea cucumber and Sea weeds
7. Equipments and Instruments used for the collection of Environmental Data – Plankton samplers and Counters including haemocytometer, Digital pH meter, Salinometer, Spectrophotometer, Colorimeter etc.
8. Study of Ecological sub-divisions of the sea, Principles of Remote sensing and software used (Wikimapia.org)
SEMESTER III

ZA3V06U (P) PRACTICAL – IV FISH NUTRITION

54 Hrs
Credit 2

2. Comparative study of Digestive system of Herbivorous (Mullet) and Carnivorous (Saurida sp) fishes
3. Estimation of proteins and Polysaccharides
4. Formulation of artificial feed for aquarium fishes and prawns with locally available ingredients.
5. Study of identification feed ingredients of plant origin and animal origin (oil cakes and meals eg: Groundnut oil cake, coconut oil cake, Mustard oil cake, Fish meal, Crustacean meals, Molluscan meals, Blood meal etc)
6. Use of Pearson’s square method in balancing feed ingredients.
7. Study of equipments used in feed preparation (Oven, Pelletiser, Feed Press and Die Plate, Extruders etc.)
8. Study of non-conventional feed stuffs eg. Spirulina etc. and Feed Additives (Binders, Antibiotics etc)
SEMESTER IV
ZA4V07U(P) PRACTICAL – V REPRODUCTIVE PHYSIOLOGY AND ENCOCRINOLOGY

54 Hrs
Credit 2

1. Dissection of reproductive organs of Teleost fish.
2. Dissection of reproductive organs of Prawn and Crab.
3. Eyestalk ablation technique and electrocautery apparatus (Demonstration)
4. Methods of hormone injection in fish.
5. Observation of larval and embryonic stages in fish egg development.
7. Neuroendocrine organs in fishes and prawns.
8. Equipments used in cryopreservation (Cryocan, French straws etc)
SEMESTER IV
ZA4V08U(P) PRACTICAL – VI MICROBIOLOGY, PATHOLOGY AND POST HARVEST TECHNOLOGY

54 Hrs
Credit 2

1. Sterilisation techniques, preparation of culture media (TGBE and Nutrient Agar Media), nutrient agar slants, staining techniques (Gram staining)
2. Determination of total plate count
3. Types of bacterial colonies
4. Instruments used in bacteriological Studies (Inoculation chamber, Autoclave, Colony counter etc.)
5. Examination of internal and external organs of diseased fish and shell fishes.
6. Identification of parasites in fishes and shell fishes.
7. Materials used in fish processing and packaging (Cans, Retortable pouches etc.)

Selected Further Readings
A.J Matty Fish Endocrinology
Advances in harvest technology- ICAR Winter School 2003, Fishing technology division, CIFT, Cochin.
Artificial reefs and sea farming technologies. CMFRI Bull No. 48.
Bal and Rao, Marine fisheries.
Bardach, Rhyther & Mclarney : Aquaculture
Benegal, Methods of fish production in fresh waters.
Chemistry and biochemistry of marine food products, Roy E. Martin AVI Publ. Co. West Port.
CMFRI- Statistics of marine landings in India.
CMFRI-The commercial molluscs of India.
Das, P. and Jhingran, A.G. (Eds.). Fish Genetics in India.
E.J.W Barrington, Invertibrate structure and function.
Ed. T.V.R. Pillai: Advances in Aquaculture
Farm made aquafeeds, FAO Fisheries Technical Paper 343.
Gopakumar, K. Text of fish processing technology, New Delhi, ICAR, 2002.
Harvey & Hoar, Induced breeding in fish-Theory and practice.
Highnam & Hill, Comparitive Endocrinology of invertebrate.
Jeremiah Lester, E. Freezing effects on food quality, Marcel Dekker, New York, 1996.

Jinghran, V.C. Fish and fisheries of India.

Khanna, S.S (1993), Fish and fisheries, Daya publications house, Delhi.


MPEDA Hand Book on aqua farming. Indian lobsters.

MPEDA Hand Book on aqua farming. Sea fishes

MPEDA Hand Book on aqua farming. Seaweed, sea urchin and sea cucumber.

Munro, Marine and Freshwater fishes of Ceylon.


Pillai, T.V.R. Aquaculture development progress and prospects.

Pillai, T.V.R. Aquaculture principles and practices.


Roberts, R.J. Fish pathology.

Robertson, G.L. Food packaging, New York, Marcel Dekker, VII.


S.L. Chondar, Hypophysation of Indian major Carp.

Saigal and Jinghran, Cold water fisheries of India

Sandhu, G.S (1990); Research techniques in biological Sciences. Anmol Publishing hose, Delhi


Sindermann, C.J. Principal diseases of marine fish and shell fish.

Snahotra, M.K Shrimp feed formulation and feed management, CMFRI Spl. Publications.


Srivastava, C.B.L. (1985), A text Book of Fishery Science India mahal, 22, sarojini naidu Mary

Status of research in marine fisheries and mariculture, CMFRI Spl. Publ. No. 67.


Transportation of live fin fishes and shell fishes, CMFRI Spl. Publ. No.66.

Turner & Bagnara, General Endocrinology.


Water quality management in aquaculture, CMFRI Spl. Publ. No. 22.
VOCA TIO NA L SUB J EC T FOOD MI C ROB IOLOGY
SE MESTE R I
ZF1V01U  C OURSE I – G ENERAL MI C ROB IOLOGY

36 Hrs
Credits 2

Module 1  
(7 hrs)
The historical development of microbiology, classification of microorganisms – Two types of cellular organization – Prokaryotic & Eukaryotic, Principles of microbial taxonomy, classification of bacteria according to Bergy’s manual, classification based on molecular techniques.

Core Readings

Module 2  
(5 hrs)

Core Readings

Module 3  
(5 hrs)
Morphology and fine structure of bacteria, size, shape and arrangements. Flagella, pili, capsule, cell wall and its composition. Cytoplasmic membrane, protoplasts, spheroplasts, intracellular membrane systems, cytoplasm, vacuoles, nuclear material, Bacterial spores, cell inclusions.
Core Readings

Module 4 (5 hrs)
Study of morphology of bacteria – Bacterial staining – simple staining, gram’s staining, acid fast staining, capsule staining, flagella staining, spore staining, negative staining – Indian ink staining. Measurement of microbial size and numbers.

Core Readings

Module 5 (3 hrs)
Bacterial growth (eg: E.coli). Modes of cell division, new cell formation, Factors affecting microbial growth nutritional requirements and nutritional grouping of microbes. Bacterial growth curve. Cultivation of bacteria. Culture media and methods, Anaerobic methods

Core Readings

Module 6 (6 hrs)
Bacterial genetics – Transformation, Transduction and conjugation. Extra chromosomal genetic material, plasmids, cosmids, transposons, insertion sequences, overlapping genes, silent genes, exon and intron, evolutionary
significance of silent gene, ribonuleoprotein, genetic recombination and its prospects, basics of recombinant RNA and recombinatal DNA technology. (Brief account only)

**Core Readings**

**Selected Further Readings**
Essentials of Microbiology by Purohit & Singh.
Manual of Microbiology, Tools and Techniques by Kanika Sharma.
SEMESTER I

ZF1V02U COURSE II – BIOINSTRUMENTATION

36 Hrs

Credits 2

Module 1  
(7 hrs )


Core Readings

Module 2  
(4 hrs )

pH meter – different methods of pH measurements. Colorimetry, spectrophotometry (UV, visible and infrared) – Principle, instrumentation and application.

Core Readings

Module 3  
(15 hrs )

Centrifugation – Principle, instrumentation, methods and types of centrifugation, application biological science.
Core Readings

Module 4 (10 hrs)
Basic idea of biological safety cabinets, laminar air flow, incubator, colony counter, micrometer, autoclave, hot air oven.

Core Readings

Selected Further Readings
Beacker & Deamer The World of cell.
Harley Klein. Microbiology, 6th Edition by Prescott,
SEMESTER II

ZF2V03U COURSE III: GENERAL METHODOLOGY

36 Hrs
Credits 2

Module 1 (10 hrs)
Chromatography techniques: Paper chromatography, thin layer chromatography, column chromatography, gas chromatography, affinity chromatography, gel filtration.

Core Readings
Kllittaker. Fermentation technology

Module 2 (10 hrs)
Electrophoresis: Principle & applications. Types of Electrophoresis:

Core Readings
Kllittaker. Fermentation technology

Module 3 (10 hrs)
Fermentation techniques: Factors involved in Fermenter design, differences between biochemical reactions, rate process, operational consideration, local conditions within a Fermenter. Fermenter configurations, the batch Fermenter, continuous stirred tank Fermenter, the tubular Fermenter, the fluidized bed Fermenter, solid state Fermenter.
Core Readings
Kllittaker. Fermentation technology

Module 4 (6 hrs)
Introduction to tracer techniques: Fluorescent tracer, Isotope, ELISA.

Core Readings
Kllittaker. Fermentation technology

Selected Further Readings
A.H. Patel. Industrial Microbiology
Jayaram Pamilees & Ananthanarayan, Microbiology,
Kanika Sharma Manual of Microbiology, Tools & Techniques
Kllittaker. Fermentation technology
Swaroop Pathalc & Arora Laboratory in Biology
Welson & Goulding Tools & Techniques in Biology
SEMESTER II  
ZF2V04U COURSE IV ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY  

MODULE 1  
10Hrs  

Core Readings  

MODULE 2  
10 Hrs  

Core Readings  

MODULE 3  
10 Hrs  
Role of microorganisms in Agriculture: Biofertilizer (Bacterial, Algae, Mycorrhizae), Biopesticides (Bacterial, viral, fungal). Common bacterial, fungal and viral plant diseases  

Core Readings  
MODULE 4  
6 Hrs


Core Readings

Selected Further Readings
SEMESTER III

ZF3V05U COURSE V – DAIRY MICROBIOLOGY 36 hours
Credits 2

Module 1 10 hrs

Core Readings
W.C. Frasier & Westhoff, Food Microbiology,
Shakuntala N, Manay, M. Shadaksharaswamy, Food facts and Principles 2nd ed.
New Age International publishers

Module 2 10 hrs
Bacteriological examination of milk. Preservation of milk – pasteurization, different methods and advantages, sterilization, dehydration, Bacteriological standards and grading of milk

Core Readings
W.C. Frasier & Westhoff, Food Microbiology,
Shakuntala N, Manay, M. Shadaksharaswamy, Food facts and Principles 2nd ed.
New Age International publishers

Module 3 30 hrs
Type of milk and milk products: whole milk, low fat milk, skim milk, vitamin D milk, ultra high temperature processed milk, low sodium milk, homogenized milk, toned milk, concentrated milk, sweetened condensed milk evaporated milk, dry milk, low lactose milk, Kefis and Kumiss, fermented milks – lahior curd, cream butter milk, lassie, butter, ghee, cheeses, yoghurt, frozen desserts, contamination, spoilage and preservation. Lactic starter cultures

Core Readings
W.C. Frasier & Westhoff, Food Microbiology,
Shakuntala N, Manay, M. Shadakpharaowamy, Food facts and Principles 2nd ed.

New Age International publishers

Module 4  
6hrs
Milk borne disease, microbial diseases of dairy cattle and its control measures.

Core Readings
W.C. Frasier & Westhoff, Food Microbiology,
Shakuntala N, Manay, M. Shadakpharaowamy, Food facts and Principles 2nd ed.

New Age International publishers

Selected Further Readings
W.C. Frasier & Westhoff, Food Microbiology,
James M. Jay, Modern food microbiology, 4th ed.
Shakuntala N, Manay, M. Shadakpharaowamy, Food facts and Principles 2nd ed.

New Age International publishers

Marion Bennion, Introductory foods, 10th edition.
Winton and Winton, Milk and Milk Products
Norman N, Potter, Joseph H Hotchkis, Food Science, 5th ed.
Ahmed, M., N., Food Science and Nutrition
Sivasankar B., Food Processing and Preservation
Subha Lakshmi and Sobha, A. Udipi, Food Processing and Preservation
Blank F.C., Handbook of food nutrition
SEMESTER III

ZF3V06U COURSE VI FOOD MICROBIOLOGY - MICROBIOLOGY OF SPOILAGE OF FOOD, METHODS OF FOOD PRESERVATION AND MICROBIOLOGICAL EXAMINATION OF FOOD

36 hrs

Credits 2

Module 1 6 hrs

Food as a substrate for microorganisms. Types of food. Important parameters of food that affect their microbiology – hydrogen ion concentration (pH), water activity, oxidation reduction potential, nutrient content, inhibitory substances and biological structure.

Core Readings
M.R. Adams, M.O. Moss, Food Microbiology
W.C. Frazier and Westhoff, Food Microbiology

Module 2 10 hrs

Microorganisms - important in food microbiology, Bacterial – morphological, cultural and physiological characteristics important in food bacteriology, Important groups of bacteria associated with various foods. Moulds and yeast associated with different foods. Source of contamination of food – from green plants and fruits, animals, soil, air, sewage, water and during handling and processing.

Core Readings
M.R. Adams, M.O. Moss, Food Microbiology
W.C. Frazier and Westhoff, Food Microbiology

Module 3 7 hrs

General principles underlying spoilage of food; Chemical changes caused by microorganisms: Causes of spoilage, classification of food by case of spoilage: factors affecting kinds and number of growth of microorganisms
Core Readings
M.R. Adams, M.O. Moss, Food Microbiology
W.C. Frazier and Westhoff, Food Microbiology

Module 4 7 hrs
Principles of food preservation, Asepsis, removal of microorganism, maintenance of anaerobic conditions, preservation by the use of high temperature, low temperature, drying, food additives and irradiation.

Core Readings
M.R. Adams, M.O. Moss, Food Microbiology
W.C. Frazier and Westhoff, Food Microbiology

Module 5 6 hrs
Methods for the microbiological examination of foods: indicator organisms, direct examination, culture techniques, Enumeration methods – plate counts, most probable number counts: dye reduction test. Rapid methods for the detection of specific organism and toxins – immunological methods

Core Readings
M.R. Adams, M.O. Moss, Food Microbiology
W.C. Frazier and Westhoff, Food Microbiology
SEMESTER IV

ZF4V07U COURSE VII – FOOD MICROBIOLOGY - MICROBIOLOGY OF CEREALS, BEVERAGES, EGG, MEAT AND FERMENTED FOOD

36hrs
Credits 2

Module 1  12 hrs
Microbiology of cereal grains, flours, bread, cakes and other bakery products, bottled beverages, wines, fruits, and vegetables spices & other condiments.

Core Readings
M.R. Adams, M.O. Moss, Food microbiology, New Age International (P) Ltd. Publishers

Module 2  12 hrs
Microbiology of egg, meat and meat products. Contamination, preservation and spoilage of egg, meats, of different origin, fish and prawns

Core Readings
M.R. Adams, M.O. Moss, Food microbiology, New Age International (P) Ltd. Publishers

Module 3  12 hrs
Core Readings
M.R. Adams, M.O. Moss, Food microbiology, New Age International (P) Ltd. Publishers

Selected Further Readings
M.R. Adams, M.O. Moss, Food microbiology, New Age International (P) Ltd. Publishers
James M. Jay, Modern food microbiology, Van Nostand Reinhold Company
SEMESTER IV

ZF4V08U COURSE VIII – INDUSTRIAL MICROBIOLOGY

36 hrs
Credits 2

Module 1 (12 hrs)

General introduction, historical developments of industrial microbiology, scope of industrial microbiology, discovery of the microbial world, experiments of Pasteur, Era of discovery of antibiotics, the discovery of anaerobic life. Industrial fermentation, Submerged and solid fermentation, Fermentors fermenter design, Sterilization, process control.

Core Readings

A.H. Patel, Industrial microbiology, Mac Millan India Ltd.

Module 2 (12 hrs)


Core Readings

A.H. Patel, Industrial microbiology, Mac Millan India Ltd.
L.E. Cesida, Industrial Microbiology, New Age International Publishers

Module 3 (12 hrs)

Production of organic acids; acetic acid, citric acid, lactic acid, gibberllic acid, oxalic acid. Production of amino acids; lysine and glutamic acid, production of...

**Core Readings**

A.H. Patel, Industrial microbiology, Mac Millan India Ltd.

L.E. Cesida, Industrial Microbiology, New Age International Publishers

**Selected Further Readings**

A.H. Patel, Industrial microbiology, Mac Millan India Ltd.


SEMESTER I

ZF1V02U (P) PRACTICAL I GENERAL MICROBIOLOGY & BIOINSTRUMENTATION

36 hrs
Credit 1

1. Cleaning and sterilization of glassware, Autoclave, hot air oven, incubator and Laminar air flow bench.

2. Preparation of Solid and liquid media for microbial cultures.
   a. Liquid media (1) peptone water/ Glucose broth (2) Nutrient broth
   b. Solid media (1) Nutrient agar (2) Mac Conkey’s agar (3) Blood agar
      (4) Chocolate agar
   c. Semi Solid agar (d) Firm agar (e) Biphasic media

3. Culture methods (a) streak culture (b) Lawn culture
   (c) Stab culture
   (d) pour plate culture (e) Liquid culture.

1. Demonstration of selective and differential media

2. Isolation of pure colonies (a) streak plate method (b) pour plate method
   (c) subculturing (picking off) technique (d) Broth cultures.

6 Calibration of an ocular micrometer for different objectives of a microscope.

Measurement of microorganisms by the use of an ocular micrometer.

7 Bacterial Staining Method (a) Simple Staining (b) Gram’s staining

The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam
(c) Acid-fast staining  (d) capsule staining  (e) flagella staining  (f) spore staining  (g) Negative staining – Indian ink preparation.

8 Examination of microbes in Living condition
(a) wet mount  (b) Hanging drop method for demonstrating motility of bacteria

9 Instrumentation and working principle
(a) pH meter  (b) colorimeter  (c) Laminar air flow Bench  (d) Autoclave  
(e) Hot air oven  (f) Colony counter.
SEMESTER II

ZF2V04U(P) - PRACTICAL II GENERAL METHODOLOGY, ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

36 hrs
Credit 1

1. Introduction to chromatographic techniques.
2. Paper chromatographic separation of aminoacids.
   Paper chromatographic separation of carbohydrates.
3. pH measurement of culture media.
5. Biofermentor, its parts and function.
6. Isolation and enumeration of bacteria from soil.
   Isolation and enumeration of fungi from soil.
7. Enumeration of micro organisms in air by open plate method.
8. Standard plate count count technique for the isolation and enumeration of microorganisms in water.
9 Basic idea about (a) Trickling filter (b) membrane filter system
   (c)Anaerobic sludge digester
SEMESTER III
ZF3V05U(P) PRACTICAL-III DAIRY MICROBIOLOGY

54 hrs
Credit 2

1. Qualitative analysis of milk by standard plate count method
2. Quality testing of milk by rezazurin test
3. Methylene blue reduction test for microbial contamination of milk.
4. Litmus milk reaction
5. Detection of mastitis through milk test

SEMESTER III
ZF3V06U(P) PRACTICAL- IV FOOD MICROBIOLOGY - MICROBIOLOGY OF SPOILAGE OF FOOD, METHODS OF FOOD PRESERVATION AND MICROBIOLOGICAL EXAMINATION OF FOOD

54hrs
Credit 2

1. Isolation of Lactobacilli and Staphylococcus from curd
2. Enumeration of bacterial from spoiled food.
3. Enumeration of fungi from spoiled food
4. Isolation and identification of bacteria from spoiled food samples (vegetables, meat, fish) Biochemical tests for microbes used for identification. Fermentation of carbohydrates IMV i C test, Urease catalase and oxidase test

SEMESTER IV
ZF4V07U(P) PRACTICAL V – FOOD MICROBIOLOGY - MICROBIOLOGY OF CEREALS , BEVERAGES , EGG, MEAT AND FERMENTED FOOD

54 hrs
Credit 2

1. Isolation and identification of fungi from spoiled food samples (vegetables, meat, fish)
2. Isolation of *Aspergillus flavus* from spoiled food
3. Inhibitory effect of low temperature on microbial growth
SEMESTER IV

ZF4V08U(P) PRACTICAL VI– INDUSTRIAL MICROBIOLOGY

54 hrs
Credit 2

1. Determination of fermentation by using yeast
2. Wine production
3. Cultivation of edible mushrooms
4. Isolation and maintenance of industrially important microbes from soil/environment (a) bacteria, (b) algae (c) bacteriophage (d) Fungi

Selected Further Readings
A.H.Patel Industrial Microbiology, Macmillan India.

A.H.Patel.Industrial Biotechnology

Ananthanarayan & Jayaram Panicker Text book of Microbiology.

H.A.Moddy Environment Microbiology

J.R.Norriz, D.J Road, A.K.Varma Methods in Microbiology – Vol.XXIV by

K. R.Aneja Experiments in Microbiology, Plant pathology and Biotechnology by.

New age international publishers.

Monica Cheesbrough, Medical Laboratory manual for Tropical Countries

Microbiology – Vol.I & II ELEBS.

R.C Dubey & D.K.Maheshwari A text book of microbiology, S.Chand &

Company Ltd.

R.C.Dubey, D.K.Maheshwari, Practical microbiology, S.Chand & Company Ltd.

R.Cruickshank et al.Medical Microbiology

Swaroop, Pathak and Arora Laboratory Techniques in Biology

Welson and Goulding Tools and Techniques in Biology
VOCATIONAL SUBJECT MEDICAL MICROBIOLOGY

SEMESTER I

ZM1V01U  COURSE I – GENERAL MICROBIOLOGY

36 Hrs

Credits 2

Module 1  (7 hrs)

The historical development of microbiology, classification of microorganisms – Two types of cellular organization – Prokaryotic & Eukaryotic, Principles of microbial taxonomy, Classification of bacteria according to Bergy’s manual, classification based on molecular techniques.

Core Readings

Module 2  (5 hrs)


Core Readings

Module 3  (10 hrs)

Morphology and fine structure of bacteria, size, shape and arrangements. Flagella, pili, capsule, cell wall and its composition. Cytoplasmic membrane, protoplasts, spheroplasts, intracellular membrane systems, cytoplasm, vacuoles, nuclear material, bacterial spores, cell inclusions.
Core Readings

Module 4 (5 hrs)
Study of morphology of bacteria – Bacterial staining – simple staining, gram’s staining, acid fast staining, capsule staining, flagella staining, spore staining, negative staining – Indian ink staining. Measurement of microbial size and numbers.

Core Readings

Module 5 (3 hrs)

Core Readings

Module 6 (6 hrs)
Bacterial genetics – Transformation, Transduction and conjugation. Extrachromosomal genetic material, plasmids, cosmids, transposons, insertion sequences, overlapping genes, silent genes, exon and intron, evolutionary
significance of silent gene, ribonuleoprotein, genetic recombination and its prospects, basics of recombinant RNA and recombinal DNA technology. (Brief account only)

**Core Readings**


**Selected Further Readings**


Essentials of Microbiology by Purohit & Singh.


Manual of Microbiology, Tools and Techniques by Kanika Sharma.


SEMESTER I

ZM1V02U COURSE II – BIOINSTRUMENTATION

36 Hrs
Credits 2

Module 1 (7 hrs)

Microscopy: - light microscopy, bright field, Dark field, phase contrast microscopy, fluorescence, transmission and scanning electron microscopy.
Specimen preparation for light and electron microscopy.

Core Readings

Module 2 (4 hrs)

pH meter – different methods of pH measurements. Colorimetry, spectrophotometry (UV, visible and infrared) – Principle, instrumentation and application.

Core Readings

Module 3 (15 hrs)

Centrifugation – Principle, instrumentation, methods and types of centrifugation, application biological science.

Core Readings

Module 4 (10 hrs)
Basic idea of biological safety cabinets, laminar air flow, incubator, colony counter, micrometer, autoclave, hot air oven.

**Core Readings**


**Selected Further Readings**

Beacker & Deamer The World of cell.


Harley Klein. Microbiology, 6th Edition by Prescott,


SEMESTER II

ZM2V03U COURSE III: GENERAL METHODOLOGY

36 Hrs
Credits 2

Module 1  (10 hrs )

Chromatography techniques: Paper chromatography, thin layer chromatography, column chromatography, gas chromatography, affinity chromatography, gel filtration.

Core Readings
Jayaram Paniker & Ananthanarayan, Microbiology.
Kanika Sharma Manual of Microbiology, Tools & Techniques

Module 2  (10 hrs )

Electrophoresis: Principle & applications. Types of Electrophoresis:
1. Free electrophoresis – moving boundary electrophoresis.
2. Zone electrophoresis – paper or gel. Immuno electrophoresis, isoelectric focusing.

Core Readings
Jayaram Paniker & Ananthanarayan, Microbiology.
Kanika Sharma Manual of Microbiology, Tools & Techniques

Module 3  (10 hrs )

Fermentation techniques: Factors involved in Fermenter design, differences between biochemical reactions, rate process, operational consideration, local conditions within a Fermenter. Fermenter configurations, the batch Fermenter, continuous stirred tank Fermenter, the tubular Fermenter, the fluidized bed Fermenter, solid state Fermenter.

Core Readings
Jayaram Paniker & Ananthanarayan, Microbiology.
Kanika Sharma Manual of Microbiology, Tools & Techniques
Module 4                                                                       (6 hrs)

Introduction to tracer techniques: Fluorescent tracer, Isotope, ELISA.

Core Readings
Jayaram Paniker & Ananthanarayan, Microbiology.
Kanika Sharma Manual of Microbiology, Tools & Techniques

Selected Further Readings
   A.H. Patel. Industrial Microbiology
   Jayaram Paniker & Ananthanarayan, Microbiology.
   Kanika Sharma Manual of Microbiology, Tools & Techniques
   Kllittaker. Fermentation technology
   Swaroop Pathalc & Arora Laboratory in Biology
   Welson & Goulding Tools & Techniques in Biology
SEMESTER II

ZM2V04U COURSE IV ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

MODULE 1

10 Hrs


Core Readings

MODULE 2

10 Hrs


Core Readings
MODULE 3  
6 Hrs
Role of microorganisms in Agriculture: Rhizosphere concept, Biofertilizer (Bacterial, Algae, Mycorrhizae), Biopesticides (Bacterial, viral, fungal). Common bacterial, fungal and viral plant diseases.

Core Readings

MODULE 4  
10 Hrs

Core Readings

Selected Further Readings
SEMESTER III

ZM3V05U COURSE V PARASITOLOGY

36 Hrs
Credits 2

MODULE I  6 Hrs
An elementary study of the types of animal association, parasitism, commensalisms and symbiosis. Type of parasites, classification of protozoan and helminthes.

Core Readings
Medical parasitology, Third Edition, R.L. Ichupujani and Rajesh Bhatia, Jaypee Brothers medical publishers

MODULE II  10 Hrs
An elementary knowledge of the structure, life history of the parasites belonging to the following genera with references to the forms seen in human pathological material and methods used to identify them. Protozoa: Entamoeba, Trichomonas, Chilomastix, Enteromonas, Trypanosoma, Leishmania, Giardia, Plasmodium, Isospora, Eimeria and Balantidium, Toxoplasma.

Core Readings
Medical parasitology, Third Edition, R.L. Ichupujani and Rajesh Bhatia, Jaypee Brothers medical publishers

MODULE III  10 Hrs
Morphology, life cycle, laboratory diagnosis of helminthes: (a) Platyhelminthes: Diphyllobothrium, sparganum, Taenia, Echinococcus Hymanloep’s, Schistosoma, Fasciola, Fasciolosis, colonorchis, paragonimus (b) Nemathelminthes: Ascaris, Ancylostoma, Necator, Strongyloides, Trichinella, Enterobius, Trichurias, Wuchereria, Brugia, Dracunculus
Core Readings

MODULE IV 10 Hrs
Collection and preservation of specimens for parasitological examination, transport of specimens, detection of intestinal parasites; Detection and identification of amoeba and other intestinal protozoa and other parasites. Examination of blood parasites thick and thin smears for malarial, filarial and other parasites

Core Readings

Selected Further Readings
An introduction to parasitology by A.C. Chandler.
Animal parasites in man by Geoffrey lanage.
Clinical parasitology by E.C. Faust and P.F. Russel (sections I, II & V)
Human protozoalogy and Helminthology by IRC Macfarlene
Medical parasitology by N.C. Dey
Medical Helminthology by J.K. Watson
Outline of medical parasitology by John Larsh
SEMESTER III

ZM3V06U COURSE VI   MEDICAL ENTOMOLOGY AND MYCOLOGY

36 Hrs
Credits2

MODULE I                                                                   6 Hrs
Classification of arthropods of public health importance, role of Arthropods in the transmission of disease, insecticides used for the control of arthropods of public health importance.

Core Readings
Medical Entomology including Epidemiology of Vector - borne diseases by Dr. A.P. Pandya

MODULE II                                                                10 Hrs

Core Readings
Medical Entomology including Epidemiology of Vector - borne diseases by Dr. A.P. Pandya
MODULE III  
5 Hrs  
Classification of fungi; collection of specimens, Examinations of fungus culture technique, mounting fluids and stains media used in medical mycology Routine mycological techniques, general consideration, maintenance of fungus culture.  

Core Readings  
Medical Entomology including Epidemiology of Vectroer - borend diseases by Dr. A.P. Pandya  
Text Book of Microbiology, Sixth edition, R. Ananthanarayan and C.K. J. Paniker

MODULE IV  
10 hrs  
Superficial mycoses: General characters, disease and etiological agents of *Tinea versicolor*, *Black piedra*, *White piedra*, *Tinea nigra* subcutaneous: General characters, disease and etiological agents of Sporotrichosis, Chromoblastomycosis, Maduromycosis, Systemic mycoses.  

Core Readings  
Medical Entomology including Epidemiology of Vectroer - borend diseases by Dr. A.P. Pandya  
Text Book of Microbiology, Sixth edition, R. Ananthanarayan and C.K. J. Paniker

MODULE V  
5hrs  
Opportunistic fungal infections due to Aspergillus and mucor. Mycotoxins, Aflatoxicosis.  

Core Readings  
Medical Entomology including Epidemiology of Vectroer - borend diseases by Dr. A.P. Pandya  
Text Book of Microbiology, Sixth edition, R. Ananthanarayan and C.K. J. Paniker

Selected Further Readings  
A guide to Medical Entomology by W.W. Service  
Laboratory Technique for the Study of Malaria by Percy Shate and Maljorke Maryson
Medical Entomology including Epidemiology of Vector - boren diseases by Dr. A.P. Pandya

Morphology and Taxonomy of Fungi by Bassey B.A.


Medical Mycology by Rippon

SEMESTER IV

ZM4V07U COURSE VII MEDICAL BACTERIOLOGY AND VIROLOGY

36 hrs
Credits 2

Module I  12 hrs
A systematic study of Staphylococcus aureus, Streptococci (Str. pyogenes and Str. pneumonia) Neisseriae (N. meningitides and N. gonorrhoeae), Corynebacterium diphtheriae, Bacillus anthracis, Escherichia coli, Klebsiella pneumoniae, Shigella, Bordatella Pertussis, Pseudomonas aeruginosa, Vibrio cholerae,

Core Readings
Gabriel Virella, B.I. Microbiology and Infectious diseases, 3rd ed. Waery Publications

Module 2  12 hrs
Diseases caused by different pathogens; epidemiology, symptomology, diagnosis and treatment of Tuberculosis, Syphilis Actinomycosis, Rickettsial diseases, chlamydial infections, Mycoplasmal diseases.

Core Readings
Gabriel Virella, B.I. Microbiology and Infectious diseases, 3rd ed. Waery Publications

Module 3  12 hrs
Viral diseases: Herpes virus, Orthomyxovirus (influenza), Paramyxoviruses, (mumps, measles) Rubella, Hepatitis, Rhabdo viruses, AIDS Viruses, Polio, Arboviruses, Oncogenic viruses

Core Readings
Gabriel Virella, B.I. Microbiology and Infectious diseases, 3rd ed. Waery Publications
Selected Further Readings

Cruikshank R., Medical Microbiology
Gabriel Virella, B.I. Microbiology and Infectious diseases, 3rd ed. Waery Publications
Monica Cheesbrough, Medical Laboratory Manual for Tropical Countiesd, Vol. I & II Microbiology
SEMESTER IV

ZM4V08U COURSE VIII CLINICAL MICROBIOLOGY

36 hrs

Credits 2

Module 1

9 hrs

Microbiology laboratory safety, General concepts for specimen collection and handling, General procedures in the laboratory, diagnosis of infectious diseases, Antimicrobial chemotherapy.

Core Readings


Chakraborty P., A textbook of Microbiology, 1st edition, New Central Book Agency (P) Ltd.

Module 2

10 hrs

Respiratory tract infections: infections of the upper and lower respiratory tract

Core Readings


Chakraborty P., A textbook of Microbiology, 1st edition, New Central Book Agency (P) Ltd.

Module 3

5 hrs

Aetiology, Pathogenesis, clinical features, lab diagnosis and treatment of gastrointestinal tract infections.

Core Readings


Chakraborty P., A textbook of Microbiology, 1st edition, New Central Book Agency (P) Ltd.
Module 4  
7 hrs  

Core Readings


Chakraborthy P., A textbook of Microbiology, 1st edition, New Central Book Agency (P) Ltd.

Module 5  
5 hrs  
Infections of the nerve system. Aetiology, Pathogenesis And clinical features.

Core Readings


Chakraborthy P., A textbook of Microbiology, 1st edition, New Central Book Agency (P) Ltd.

Selected Further Readings


Chakraborthy P., A textbook of Microbiology, 1st edition, New Central Book Agency (P) Ltd.

Gabriel Virella, B.I. Microbiology and Infectious diseases, 3rd edition, Waverly Publications

SEMESTER I

ZM1V01U(P) PRACTICAL I GENERAL MICROBIOLOGY & BIOINSTRUMENTATION

36 hrs
Credit 1

1. Cleaning and sterilization of glassware, Autoclave, hot air oven, incubator and Laminar air flow bench.

2. Preparation of Solid and liquid media for microbial cultures.
   
   d. Liquid media (1) peptone water/Glucose broth (2) Nutrient broth
   e. Solid media (1) Nutrient agar (2) Mac Conkey’s agar (3) Blood agar
      (4) Chocolate agar
   f. Semi Solid agar (d) Firm agar (e) Biphasic media

3. Culture methods (a) streak culture (b) Lawn culture (c) Stab culture
   (d) pour plate culture (e) Liquid culture.

4. Demonstration of selective and differential media

5. Isolation of pure colonies (a) streak plate method (b) pour plate method
   (c) subculturing (picking off) technique (d) Broth cultures.
6 Calibration of an ocular micrometer for different objectives of a microscope.
Measurement of microorganisms by the use of an ocular micrometer.

7 Bacterial Staining Method
(a) Simple Staining
(b) Gram’s staining
(c) Acid-fast staining
(d) capsule staining
(e) flagella staining
(f) spore staining
(g) Negative staining – Indian ink preparation.

8 Examination of microbes in Living condition
(a) wet mount
(b) Hanging drop method for demonstrating motility of bacteria

9 Instrumentation and working principle
(a) pH meter
(b) colorimeter
(c) Laminar air flow Bench
(d) Autoclave
(e) Hot air oven
(f) Colony counter.
SEMESTER II

ZM2V04U(P) - PRACTICAL II GENERAL METHODOLOGY
ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

36 hrs
Credit 1

1. Introduction to chromatographic techniques.

2. Paper chromatographic separation of aminoacids.

3. pH measurement of culture media.


5. Biofermentor, its parts and function.

6 Isolation and enumeration of bacteria from soil.

   Isolation and enumeration of fungi from soil.

a. Enumeration of micro organisms in air by open plate method.

8 Standard plate count count technique for the isolation and enumeration of microorganisms in water.

   a. Basic idea about (a) Trickling filter (b) membrane filter system

      (c)Anaerobic sludge digester
SEMESTER III

ZM3V05U(P) PARASITOLOGY  54 hrs

Credit 2

1. Introduction to parasitology - Collection and processing of clinical specimens for parasites.

2. Examination of faeces for parasites.

3. Examination of blood for parasites.
   a) Preparation of thick smear
   b) Preparation of thin smear

4. Identification of Protozoan and Helminthic parasites

SEMESTER III

ZM3V06U(P) PRACTICAL-IV MEDICAL ENTOMOLOGY AND MYCOLOGY

54 hrs

Credit 2

1. Identification of Vectors of clinical importance
   a. Mosquito
   b. Fleas
   c. Ticks and Mites
   d. Louse
   e. Bed bug

2. Introduction and general principles for the lab diagnosis of fungal infections. Collection of samples
3. Slide culture method for cultivation of fungus

4. Study of morphology of fungi
   Fungal staining, lactophenol cotton blue mounting

5. Identification of fungal pathogens
   a) Aspergillus  b) Penecillium  c0 Rhizopus  d)Mucor

SEMESTER IV

ZM4V07U(P) PRACTICAL-V MEDICAL BACTERIOLOGY AND VIROLOGY

54 hrs
Credit 2

1. Biochemical tests for the identification of microbes
   a. Fermentation of carbohydrates
   b. IMViC test
   c. Urease test
   d. Catalase test
   e. Oxidase test

2. Antibiotic sensitivity test

3. Carbohydrate utilization test for the identification of E. coli Salmonalla, Shiegella and Proteus (Triple sugar iron test)

4. Test for hemolytic property of bacteria

5. Method of cultivation of virus
SEMESTER IV

ZM4V08U(P) PRACTICAL-VI  CLINICAL MICROBIOLOGY

54 hrs
Credit 2

1. Microbiology of laboratory safety, General concept for specimen collection, handling. General procedures in the laboratory diagnosis of infectious diseases.

2. VDRL

3. Widal

4. Enumeration of bacteria from urine by Pour Plate method.

Selected Further Reference

A.H.Patel Industrial Microbiology, Macmillan India.

A.H.Patel.Industrial Biotechnology

Ananthanarayan & Jayaram Panicker Text book of Microbiology.

H.A.Moddy Environment Microbiology

J.R.Norriiz, D.J Road, A.K.Varma Methods in Microbiology – Vol.XXIV by

K. R.Aneja Experiments in Microbiology, Plant pathology and Biotechnology by.

New age international publishers.

Monica Cheesbrough, Medical Laboratory manual for Tropical Countries

Microbiology – Vol.I & II ELEBS.

R.C Dubey & D.K.Maheshwari A text book of microbiology, S.Chand &

Company Ltd.

R.C.Dubey, D.K.Maheshwari, Practical microbiology, S.Chand & Company Ltd.

R.Cruickshank et al.Medical Microbiology

Swaroop, Pathak and Arora Laboratory Techniques in Biology

Welson and Goulding Tools and Techniques in Biology
MAHATMA GANDHI UNIVERSITY
PRIYADARSHINI HILLS
KOTTAYAM – 686 560

CURRICULUM AND SYLLABI

FOR

B.Sc INDUSTRIAL MICROBIOLOGY AND ZOOLOGY

DOUBLE CORE

[VOCATIONAL EDUCATIONAL PROGRAMME]

COURSE, CREDIT AND SEMESTER SYSTEM AND GRADING

2009 ADMISSION ONWARDS
(MODIFIED SYLLABUS FOR 2012 ADMISSION ONWARDS)

THE BOARD OF STUDIES ZOOLOGY PROGRAMME
PROGRAMME OBJECTIVES

The programme is designed to help the students to:

- Impart basic knowledge of Industrial Microbiology, Zoology and related subjects meant both for a graduate terminal course and for higher studies.
- Acquire basic knowledge and skills for employment in the field of Microbiology especially Industrial Microbiology.
- Inculcate interest and love of nature with its myriad living creatures.
- Understand the unity of life with the rich diversity of microbes and other organisms.
- Acquire basic skills for the utilization of microbes for human welfare.
- Impart awareness of the conservation of the biosphere.

CODES

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Core</td>
</tr>
<tr>
<td>C</td>
<td>Complementary</td>
</tr>
<tr>
<td>EDP</td>
<td>Entrepreneur Development Programme</td>
</tr>
<tr>
<td>IA</td>
<td>Internal Assessment</td>
</tr>
<tr>
<td>ZY</td>
<td>Zoology Core</td>
</tr>
<tr>
<td>IMZ</td>
<td>Industrial Microbiology and Zoology Programme</td>
</tr>
<tr>
<td>IT</td>
<td>Instructional Time</td>
</tr>
<tr>
<td>OJT</td>
<td>On the Job Training</td>
</tr>
<tr>
<td>P</td>
<td>Practical</td>
</tr>
<tr>
<td>S</td>
<td>Semester</td>
</tr>
<tr>
<td>T</td>
<td>Theory</td>
</tr>
</tbody>
</table>
Curriculum for BSc. Zoology Programme

U Undergraduate

UE University Examination

VE Vocational Education

ZY1B01U- Zoology Semester I Core Course I Undergraduate

IMZ1B01U- Industrial Microbiology(Zoology) Semester I Core Course I Undergraduate.

ZY6B11(a)U-Zoology Semester 6 Core Course 11(a) [Immunology]

Undergraduate

<table>
<thead>
<tr>
<th>Courses</th>
<th>Credits</th>
<th>Total Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Common Course – English</td>
<td>4+4</td>
<td>8</td>
</tr>
<tr>
<td>2 Complementary I Biochemistry</td>
<td>3+3+4+4</td>
<td>14</td>
</tr>
<tr>
<td>3 Complementary II Computer Science</td>
<td>3+7+3+6</td>
<td>19</td>
</tr>
<tr>
<td>4 Open Course</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5 Core Industrial Microbiology</td>
<td>7+3+10+7+4</td>
<td>29</td>
</tr>
<tr>
<td>6 Core Zoology</td>
<td>3+3+4+4+16+16</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grand Total</td>
</tr>
</tbody>
</table>

The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam
### COURSE STRUCTURE AND SCHEME

Total Credits - 120  
Total Instructional hours - 150

#### INSTRUCTIONAL TIME & CREDIT ALLOCATION  [COURSE WISE]

### SEMESTER I

<table>
<thead>
<tr>
<th>SL NO</th>
<th>Course Title</th>
<th>No of hours/Week</th>
<th>Number of Credits</th>
<th>Total Credits</th>
<th>Total Hrs/Sem</th>
<th>Univ. Exam Hrs</th>
<th>IA</th>
<th>EA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ENCN1 Common Course Communication skills in English [Board of studies English]</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>90</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Core I Industrial Microbiology Course I IMZ1 B 01 U Fundamentals of Microbiology Practical</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Core I Industrial Microbiology Course II IMZ 1 B 02 U Biostatistics &amp; Bioinstrumentation</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Core II Zoology Course I ZY 1 B 01 U General Methodology &amp; Perspectives in Science Practical (Zoology Board syllabus)</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>36</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Complementary I Biochemistry Course I Elementary Biochemistry I [Biochemistry Board syllabus] Practical</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>36</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
### SEMESTER II

<table>
<thead>
<tr>
<th>SL NO</th>
<th>Course Title</th>
<th>No of hours/Week</th>
<th>No of Credit(s)</th>
<th>Total Credits</th>
<th>Total Hrs/Sem</th>
<th>Univ. Exam Hrs</th>
<th>IA</th>
<th>EA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Common Course in English II Critical Thinking, Academic writing &amp; Presentation. [Board of studies English]</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>90</td>
<td>3 1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Core I Industrial Microbiology Course III IMZ 2 B 03U Microbial physiology Practical</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>72</td>
<td>3 1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Core II Zoology Course II ZY 2 B 02 U Biodiversity &amp; Modern Systematics Practical</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>36</td>
<td>3 1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Complementary I Biochemistry Course II Elementary Biochemistry II [Biochemistry Board syllabus] Practical</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>36</td>
<td>3 1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Complementary II Computer Science Course II Programming with C Language (Computer Science Board Syllabus) Practical</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td>36</td>
<td>3 1</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL** | **25 Hrs** | **20 Credit** | **20 Credit** |
### SEMESTER III

<table>
<thead>
<tr>
<th>SL NO</th>
<th>Course Title</th>
<th>No of hours/Week</th>
<th>Number of Credits</th>
<th>Total Credits</th>
<th>Tota l Hrs/ Sem</th>
<th>Univ. Exam Hrs</th>
<th>IA</th>
<th>EA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Core I Industrial Microbiology Course IV</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>36</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>IMZ 3 B 04 U Medical Microbiology and Virology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Core I Industrial Microbiology CourseV</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>36</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>IMZ 3 B 05U Molecular Biology and Microbial Biotechnology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Core I Industrial Microbiology CourseVI</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>IMZ 3 B 06U Basics of Industrial Microbiology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Core II Zoology CourseIII ZY 3 B 03 U</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Animal Diversity – Non chordata (Zoology Board syllabus)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Complementary I Biochemistry CourseIII Enzymology &amp; Metabolism-(1)</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>[Biochemistry Board syllabus]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>1</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Complementary II Computer Science Course III</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>36</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Web technology and Programming (Computer Science Board Syllabus)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>0</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>25 Hrs</td>
<td>20 Credit</td>
<td>20 Credit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SL NO</td>
<td>Course Title</td>
<td>No of hours/Week</td>
<td>Number of Credits</td>
<td>Total Credits</td>
<td>Total Hrs/Sem</td>
<td>Univ. Exam Hrs</td>
<td>IA</td>
<td>EA</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------------</td>
<td>-------------------</td>
<td>---------------</td>
<td>---------------</td>
<td>----------------</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>1</td>
<td>Core I Industrial Microbiology Course VII IMZ 4 B 07U Fermentation Technology Practical</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Core I Industrial Microbiology Course VIII IMZ 4B 08U Agricultural Microbiology &amp; Biofertilizers Practical</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Project Core I Enterpreneurship Development Programme and OJT 1 week</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Core II Zoology CourseIV ZY 4 B 04 U Animal Diversity-Chordata Practical</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td>36</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Complementary I Biochemistry CourseIV Biochemistry Metabolism (2) [Biochemistry Board syllabus] Practical</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Complementary II Computer Science Course IV Visual Programming Techniques Software lab IV Practical</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>36</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td></td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>25 Hrs</strong></td>
<td><strong>20 Credit</strong></td>
<td><strong>20 Credit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### SEMESTER V

<table>
<thead>
<tr>
<th>SL NO</th>
<th>Course Title</th>
<th>No of hours/ Week</th>
<th>Number of Credits</th>
<th>Total Credits</th>
<th>Total Hrs/ Sem</th>
<th>Univ. Exam Hrs</th>
<th>IA</th>
<th>EA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Open course ZY5D04U Food Microbiology/ Any open course offered by the Institution</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>72</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Core II Zoology Project work and group activity (Credit I in 6th Semester)</td>
<td>1</td>
<td></td>
<td></td>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Core II Zoology Course V ZY 5 B 05 U Cell Biology &amp; Molecular Biology Practical</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Core II Zoology Course VI ZY 5 B 06 U Environmental Biology, Toxicology &amp; Disaster Management Practical</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Core II Zoology Course VII ZY 5 B 07 U Evolution, Zoo geography &amp; Ethology Practical</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Core II Zoology Course VIII ZY 5 B 08 U Biochemistry, Human physiology &amp; Endocrinology Practical</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>25 Hrs</strong></td>
<td><strong>20 Credit</strong></td>
<td><strong>20 Credit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## SEMESTER VI

<table>
<thead>
<tr>
<th>SL NO</th>
<th>Course Title</th>
<th>No of hours/Week</th>
<th>Number of Credits</th>
<th>Total Credits</th>
<th>Total Hrs/Sem</th>
<th>Univ. Exam Hrs</th>
<th>IA</th>
<th>EA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Core I Industrial Microbiology Course IX IMZ 6 B 09 U Microbial Waste Management Practical</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>36</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Core I project Enterpreneurship Development programme &amp; OJT 1 week</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>18</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Core II Zoology Course IX ZY 6 B 09 U Reproductive &amp; Developmental Biology Practical</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Core II Zoology Course X ZY 6 B10U Genetics &amp; Biotechnology</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>36</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Core II Zoology Course XI(a) ZY 6 B11(a) U Immunology (Zoology Core syllabus modified) Practical</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>36</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Core II Zoology Course 12 ZY6B12 U General Informatics, Bioinformatics and Biostatistics Practical</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>54</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Core II Zoology Project work and field visit Group activity</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>18</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>25 Hrs</td>
<td>20</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam
### CURRICULUM FOR BSc.Zoology Programme

The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam

**TOTAL CREDITS – 120**

<table>
<thead>
<tr>
<th>SEMESTER</th>
<th>Common Course</th>
<th>Complementary</th>
<th>Core I</th>
<th>Core II</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>ENGLISH</td>
<td>BIO-CHEMISTRY</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>COMPUTER SCIENCE</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>II</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>III</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>IV</td>
<td>4</td>
<td>3</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>V</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>VI</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>TOTAL</td>
<td>8</td>
<td>14</td>
<td>19</td>
<td>29</td>
</tr>
</tbody>
</table>

**RECORDS CORE I – INDUSTRIAL MICROBIOLOGY**

1. Fundamentals of Microbiology
2. Microbial Physiology
3. Molecular Biology, Microbial Bio technology
4. Basics of Industrial Microbiology
5. Fermentation Technology
6. Agricultural Microbiology & Bio fertilizers
7. Microbial Waste Management
8. Project Record- Entrepreneurship Development Programme
9. Report of the OJT assignments

**RECORDS – CORE II ZOOLOGY**

1. General Methodology and Instrumentation
2. Biodiversity and Modern Systematics
3. Animal Diversity - Non-Chordata
4. Animal Diversity - Chordata
5. Cell Biology and Molecular Biology
6. Environmental Biology, Toxicology and Disaster Management
7. Evolution, Zoogeography and Ethology
8. Biochemistry, Human Physiology and Endocrinology
9. Reproductive and Developmental Biology
10. Genetics and Biotechnology
11. Immunology
12. General Informatics, Bioinformatics and Biostatistics.
13. Project Report & Group Activity and field study report

MODE OF TRANSACTION

An optimum combination of classroom lectures, demonstrations, practical work, assignments, seminars, classroom test, entrepreneurship development programme, On-the-Job training programme will be used for the transaction of the curriculum.

ON THE JOB TRAINING PROGRAMME [OJT] AND PROJECT OF CORE I [CREDIT 1]

The On-The-Job Training programme is intended to bring the curriculum to the reality of the world of work.

This programme enables the students to apply their classroom knowledge to live situations under the joint supervision of the tutor and a mentor.

The OJT has two components namely OJT-1 and OJT-2, each of one week duration, implemented during the semester IV and Semester VI.

At the end of the each OJT programme students are expected to produce a detailed report of the OJT assignments, which must necessarily be those of direct interest to the host organization. (Internal Evaluation only)
ENTREPRENEURSHIP DEVELOPMENT PROGRAMME [EDP]

(Total 36 Hrs IV Sem 18 Hrs and VI Sem 18 Hrs)

This programme will help the students to develop entrepreneurial capabilities with the local/regional, production/service establishments in industrial Microbiology. The programme will expose the students to design and develop an industry/organization related to industrial microbiology for a small-scale production/service sector.

Project and OJT Credit 1

<table>
<thead>
<tr>
<th>IA OJT</th>
<th>EA Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>Weight</td>
</tr>
<tr>
<td>(4+4) = 8</td>
<td>25</td>
</tr>
</tbody>
</table>

Project report have to be submitted in VIth semester

External assessment, Project report and Viva Voce – Weight 25

Project Report:
Scope and relevance: weight 1
Methodology: weight 4
Data analysis: weight 4
Economic viability: weight 4
Language, Literature & Bibliography: weight 4

Presentation of the project report: weight 4
Viva-voce: weight 4

Total weight 25
EVALUATION OF OJT

A system of continuous evaluation will be followed during the OJT programme.

As the educational process in the OJT programme seeks out and the Mentor at the training organisation/institute and the tutor will jointly assess focuses attention on many latent attributes, which do not surface in the normal classroom situation the OJT programme of the student.

Mentor Assessment of OJT

The mentor at the training organization will assess the performance of the student for 50% of the total weight and according to the following scheme.

Attendance and punctuality &

Observation of TO’s etiquette Weight 1
Technical competence: Weight 1
Responsibility/dependability: Weight 1
Group-interpersonal skills: Weight 1

---------
Total Weight 4

Tutor Assessment of OJT

The tutor will assess the performance of the candidate for the rest 50% of the total weight on the basis of the consolidated OJT assignment report signed by the student's mentor and according to the following scheme.

Methodology & Content Weight 1
Presentation style: Weight 1
Technical exposure: Weight 1
Language of the report Weight 1

---------
Total Weight 4
Examinations:

The evaluation of each course shall contain two parts such as Internal or In-Semester Assessment (IA) and External or End-Semester Assessment (EA). The ratio between internal and external examinations shall be 1:3. The Internal and External examinations shall be evaluated using direct grading system based on 5-point scale.

**Internal or In-Semester Assessment (IA):**

Internal evaluation is to be done by continuous assessments on the following components. The Components of the internal evaluation for theory and practical and their weights are as below.

<table>
<thead>
<tr>
<th>Theory</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance*</td>
<td>1</td>
</tr>
<tr>
<td>Assignment</td>
<td>1</td>
</tr>
<tr>
<td>Seminar</td>
<td>1</td>
</tr>
<tr>
<td>Best two test papers</td>
<td>2</td>
</tr>
</tbody>
</table>

*Attendance

<table>
<thead>
<tr>
<th>% of Attendance</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;90%</td>
<td>A</td>
</tr>
<tr>
<td>Between 85 and 90</td>
<td>B</td>
</tr>
<tr>
<td>Between 80 and 85</td>
<td>C</td>
</tr>
<tr>
<td>Between 75 and 80</td>
<td>D</td>
</tr>
<tr>
<td>&lt; 75</td>
<td>E</td>
</tr>
</tbody>
</table>
Assignments: Best of two assignments are considered per course. The student has to take a minimum of 1 seminar per course. A minimum of 2 class tests are to be attended. The grades of best 2 tests are to be taken.

**Internal Assessment of Practical**

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance *</td>
<td>1</td>
</tr>
<tr>
<td>Laboratory Involvement **</td>
<td>2</td>
</tr>
<tr>
<td>Test</td>
<td>2</td>
</tr>
<tr>
<td>Record</td>
<td>2</td>
</tr>
<tr>
<td>Viva-Voce/Quiz</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attendance *</th>
<th>Laboratory Involvement **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance &gt;90% = A</td>
<td>Punctuality +</td>
</tr>
<tr>
<td>89% to 85% = B</td>
<td>Handling Equipments +</td>
</tr>
<tr>
<td>84% to 80% = C</td>
<td>Skill in Laboratory work +</td>
</tr>
<tr>
<td>79% to 75% = D</td>
<td>Group Interaction = A</td>
</tr>
<tr>
<td>&lt; 75 = E</td>
<td></td>
</tr>
</tbody>
</table>

The evaluation of all components is to be published and is to be acknowledged by the candidate.

**External or End-Semester Assessment (EA):**

The external examination of all semesters shall be conducted by the university on the close of each semester except for EDP (Course XI-Ind.Microbiology). There will be no supplementary exams. For reappearance/improvement as per university rules, students can appear along with the next batch.
Pattern of Questions (Theory):

Questions shall be set to assess knowledge acquired, standard application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. He/She shall also submit a detailed scheme of evaluation along with the question paper.

A question paper shall be a judicious mix of objective type, short answer type, short essay type /problem solving type and long essay type questions. Different types of questions shall be given different weights to quantify their range.

For all semesters:

2. The examination has duration of 3 hours

3. Each question paper has four parts A, B, C & D.

4. Part A contains 16 objective type questions of which the candidate has to answer all. Each bunch of 4 questions carries a weightage of 1

5. Part B contains 8 short answer type questions spanning the entire syllabus and the candidate has to answer 5 questions. Each question carries a weightage of 1.

6. Part C contains 6 short essay type spanning the entire syllabus and the candidate has to answer 4 questions. Each question carries a weightage of 2.

7. Part D contains 3 essay type questions spanning the entire syllabus and the candidate has to answer 2 questions. Each question carries a weightage of 4.
### SCHEME OF PRACTICAL ON CORE COURSES

(External exam)

<table>
<thead>
<tr>
<th>External</th>
<th>Weight : 25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Record</td>
<td>4</td>
</tr>
<tr>
<td>Part-A</td>
<td>Major practical</td>
</tr>
<tr>
<td>Part-B</td>
<td>Minor practical</td>
</tr>
</tbody>
</table>
| Part-C   | Spotters/problem | a) 5 items of 2 weightage each  
\hline
\multicolumn{1}{c}{5 \times 2 = 10} \n\hline
\hline
Total     | 2           |

### FIELD STUDY, RESEARCH INSTITUTE VISIT, GROUP ACTIVITY, PROJECT AND VIVA

(Credit 1)

**Weightage**

<table>
<thead>
<tr>
<th></th>
<th>Weight (Internal)</th>
<th>Weight (External)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Study report</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Group Activity</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Project</td>
<td>2</td>
<td>Project report</td>
</tr>
<tr>
<td>Log book showing the progress of project work duly signed by the supervising teacher &amp; HOD</td>
<td></td>
<td>Title-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Abstract-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Introduction + Literature review-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Methodology-4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Results-4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Discussion &amp; Conclusion-4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neat presentation and Novelty-4 (Student can present the project using OHP or LCD, in 7 Minutes)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Viva Voce-4</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>25</td>
</tr>
</tbody>
</table>
Double Core – Industrial Microbiology and Zoology

- Double Core programme is exempted from Core choice Board Courses (Electives) that is designed for Model I and Model II (VIth Semester) However they have open courses in Vth Semester as other Model I and Model II programmes.
- Syllabus for Core II Zoology follows the same pattern of Instructional Hrs, University exams credits, Practicals, IA and EA as in Model I Zoology Programme.
- Course I to XII (1-12) are the same as that of Zoology Core Model I except Course XI (11)
- Course XI is ZY6B11 (a) U Immunology as given in scheme.
- The Syllabus of ZY6B11 (a) U Theory and ZYB 11 (a) U(P) Practical is given below
SYLLABUS FOR
B.Sc ZOOLOGY CORE

(Course I to course XII are the same as that of Zoology Core Model I except Course XI. Course XI is given below)

ZY 6 B 11(a)U - IMMUNOLOGY
36 hrs
Credit 2

Module 1
Introduction to immunology
Types of immunity, innate immunity, acquired, passive, active
Mechanism of innate immunity (eg. Barriers, Phagocytosis, inflammation.

Core Readings
Panicker, S. Francis G., and Abraham G.K. 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 1

Module 2
Antigens and Antibodies
8 hrs
Types of Antigens, Factors influencing antigenicity, Epitopes, haptens, antigenic determinants. Basic structure of immunoglobulins. Different classes of immunoglobulins and functions

Core Readings
Panicker, S. Francis G., and Abraham G.K. 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 4

Module 3
Antigen-antibody reactions, Precipitation test, Agglutination Test, 7 hrs
Clinical applications of antigen antibody reaction Complement system
and its biological importance: Eg: Widal, VDRL, HIV test (ELISA)
Complement fixation test, Coombs test.

**Core Readings**
Panicker, S. Francis G., and Abraham G.K. 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala
Ivan Roitt, 2002 *Essentials of Immunology ELBS*

**Module 4**
**Immune Response system**
8 hrs
Primary and secondary lymphoid organs. Cells of the immune system – Leucocytes, Lymphocytes T & B cells, Macrophages, Plasma cells, Memory cells, MHC Antibody synthesis, primary and secondary responses, Monoclonal antibodies – Hybridoma technology, uses, Polyclonal antibodies. Cytokines

**Core Readings**
Ivan Roitt, 2002 *Essentials of Immunology ELBS*

**Module 5**
**Immunopathology- immune disorders**
5hrs
(Hypersensitivity, autoimmunity and immunodeficiency)
Different types of hypersensitivity reactions - Mechanism of allergic reaction, Anaphylaxis and atopy, Mechanism of immune complex disease.
(Eg. Arthus reaction, Serum sickness)
Autoimmunity, Delayed hypersensitivity, Autoimmune diseases (A brief account)
Transplantation Immunity - Graft rejection, major histocompatibility, Human leukocyte antigen system - (HLA) immuno-suppression, Graft versus host reaction – Tumour immunity-
Immune responses in malignancy, Immunotherapy, Immunohaematology, Immunology of blood transfusion,
Erythroblastosis foetalis.
Immunodeficiency, AIDS

**Core Readings**

Panicker, S. Francis G., and Abraham G.K. 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala

Ivan Roitt, 2002 *Essentials of Immunology* ELBS

**Module 6** Vaccines

3 hrs

Brief history of vaccination, principles of vaccines, major types of vaccines (BCG, DPT, Polio vaccine and TAB vaccines) DNA vaccines, toxoides, adjuvants. Recent trends in vaccine preparation

**Core Readings**


**Selected Further Readings**


Colemen: 2002 Fundamentals of Immunology


Hans G. Sch Legal General Microbiology Seventh Ed. Cambridge Low Price Ed.

Helen Hapel, Maused Harney Siraj Misbah and Next Snowden: 2006 Essentials of Clinical Immunology Fifth Ed. Blackwell Publishing Company,


Ivan Roitt: 2002 Essentials of Immunology ELBS.


Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane’s student Editions 2009
ZY 6 B 11(a)U (P) PRACTICAL IMMUNOLOGY

36 hrs
Credit 1

1. Antibiotic sensitivity test.

2. Determination of ABO blood groups and Rh factor (Antigen –antibody Reaction)

3. Study through photographs/ illustration, the primary immune (Bone marrow and thymus) and secondary immune (spleen and lymph nodes) organs in Rat/Man.

4. ELISA

5. RIA

6. WIDAL Test
SYLLABUS FOR CORE I

INDUSTRIAL MICROBIOLOGY
SEMESTER I

IM Z 1 B 01 U - FUNDAMENTALS OF MICROBIOLOGY

54Hrs

Credit 3

Module 1. The historical development and scope of Microbiology - 5 hrs

Module 2. Diversity of Microbial world- Principle of Classification- Outline classification of Bacteria according to Bergy’s manual (including Cyanobacteria), Fungi, Viruses, Actinomycetes and Mycoplasma. Two types of cellular organization – Prokaryotic & Eukaryotic - 7 hrs

Module 3. Ultra structure of Microbes:

a) Morphology and fine structure of bacteria, size, shape and arrangements of Flagella, Pili, capsule, cell wall and its composition. Cytoplasmic membrane, protoplasts, spheroplasts, intracellular membrane systems, cytoplasm, vacuoles, nuclear material, spores and cysts, endospores, cell inclusions. Modes of cell division.

b) Viruses- General structure (Plant virus & Animal Virus) - properties- viral envelope-capsid – virions, prions – Nucleic acid – Replication of Virus

c) Morphology and ultra structure of Cyanobacteria, Mycoplasma, Actinomycetes, and Fungi (Rhizopus, Pencillium, Aspergillus, Mucor and Fusarium) - 20 hrs


Module 5. Preparation of culture media (aerobic and anaerobic cultivation) Selective media, enrichment media and differential media plating techniques- Techniques and isolation of pure colonies. Culture preservation techniques (Refrigeration, Freezing and liquid nitrogen and lyophilization). Methods of staining – simple stain, differential stain (Gram stain, acid fast stain), Structural stain (spore staining, flagellar staining, capsule staining). Measurement of microbial size and number. - 12 hrs
IM Z 1 B 01 U (P) PRACTICAL - FUNDAMENTALS OF MICROBIOLOGY

36 hrs
Credit 1

1. Preparation of Media-(Liquid media, Solid media, Semisolid media)
2. Cleaning and Sterilization of glassware
3. Maintenance of culture room
4. Isolation methods
   - Serial dilution
   - Spread Plate
   - Streak Plate, Pour Plate methods, Stab culture method, Lawn Culture.
5. Staining techniques
   - Simple staining
   - Differential staining – Gram staining, Acid fast staining
   - Capsule staining, Flagella staining, Spore staining, Negative Staining-Indian ink Preparation
6. Lacto phenol cotton blue mounting of fungi
7. Haemocytometry
8. Motility of Bacteria
   - Hanging drop method, Wet mount

Core Readings
1. Y K Parsher - Modern microbiology
2. Y K Parsher - Microbiology
3. S N Prasad - Applied microbiology
4. S. S Purohit - Microbiology, fundamentals and application 6th edition
5. Pelzar Reid and Chan - Microbiology; McGraw Hill
6. Prescott - Microbiology
7. Daniel Lim - Microbiology
8. Jeffrey C Pommervil – Fundamentals microbiology
9. K R Aneja - Experiments in Microbiology
10. R C Dubey - Practical Microbiology.
SEMESTER I

IM Z 1 B 02 U - BIOSTATISTICS & INSTRUMENTATION

54 Hour
Credit 3

Module 1

-10 hrs

NSTRUMENTATION

Module 2
Instruments – Basic principles & usage:


-10 hrs

Module 3

Filtration apparatus: Laminar air flow (filtration of air), Seitz filter (filtration of liquids), Sintered Glass Filter, Membrane filter.

-16 hrs

Module 4
Activity
1) Paper chromatography for the identification of amino acids

2) Colorimetric estimation of Amino acids (Any Two)

18 hrs
SEMESTER II

IM Z 2 B  03 U COURSE III  MICROBIAL PHYSIOLOGY  
72 Hours  
Credit-2

8 hrs

Module 2. Growth: Factors affecting growth, bacterial growth curves; Continuous culturing of bacteria- chemostat generation time; Counting of bacteria- viable and non-viable counts, SPC, Direct microscopic count, turbidometric estimation  
10 hrs

18 hrs

Module 4. Respiratory pathways: Breakdown of carbohydrates through glycolysis, Kerb’s cycle & its significance, fermentation, pentose phosphate pathway, oxidative and substrate level phosphorylation, gluconeogenesis  
8 hrs

Module 5. Nitrogen metabolism: Nitrogen fixation in symbiotic and free living system, Photosynthetic and non-photosynthetic systems, oxygen regulation of nitrogen fixation, nitrification, denitrification and ammonifying bacteria, pathway of nitrate assimilation in photosynthetic and non-photosynthetic systems, transamination and deamination reactions, Carbon cycle  
18 hrs

Module 6. Introduction to Antibiotics:-Classification of Antibiotics Antibiotic Sensitivity test (Qualitative and Quantitative) Examples- Structure & mode of action (Penicillin Chloramphenicol.)  
10 hrs
IM Z 2 B 03U (P) PRACTICAL - MICROBIAL PHYSIOLOGY  54 hrs
Credit 1

1. Effect of pH on the growth of bacteria on solid media
2. Effect of salt on the growth of Microorganisms
3. Effect of antibiotics on bacterial growth by paper disc method
4. Biochemical Tests
   - Triple sugar iron agar test
   - IMVIC tests
   - Starch hydrolysis
   - Gelatine liquefaction
   - Catalase test
   - Urease test
5. Determination of growth phase of E. coli by measurement of O.D.

CORE READINGS

1. Moat and Foster  - Microbial physiology
2. Pelzar Reid and Chan  - Microbiology
3. Comprehensive Biotechnology - Vol I, II, III,IV
4. Prescott  – Microbiology
5. Ananthanarayan and Jayaram Panicker - Text book of Microbiology
6. Jaquelyin G Black  - Microbiology
7. DR. N.Kannan  - Laboratory manual of General Microbiology
SEMESTER III

IM Z 3 B 04 U MEDICAL MICROBIOLOGY AND VIROLOGY

36 Hrs
Credit-2

Module 1. Normal microbial flora of Human body, A systematic study of
Staphylococcus aureus, Streptococci (Str. pyogenes and Str. Pneumonia), Bacillus anthracis, Escherichia coli, Klebsiella pneumoniae, Shigella, Pseudomonas aeruginosa, Vibrio cholerae.

10hrs

Module 2. Urinary tract infections, Genital tract infections, Sexually transmitted disease, and Nosocomial infections

5 hrs

Module 3. Diseases caused by different pathogens; epidemiology, symptomology, diagnosis and treatment of Tuberculosis, Syphilis, Actinomycosis.

6 hrs

Module 4. Respiratory tract infections: infections of the upper and lower respiratory tract

5 hrs

Module 5. Viral diseases: Herpes virus, Orthomyxovirus (influenza), Paramyxoviruses, (mumps, measles), Rubella, Hepatitis, Rhabdo viruses, AIDS Viruses, Polio, Arboviruses, Oncogenic viruses

10hrs

Module 6. Activity

1. Test for hemolytic property of bacteria

2. Identification of Bacteria

CORE READINGS:


2. Cruikshank R. - Medical Microbiology


4. Topley and Wilson - Principles of Bacteriology, Virology and Immunity, Vol.3

5. Dalton and Nottebart (Eds) --Interpretative Medical Microbiology

6. Baron, Peterson and Finegold - Bailey and Scott’s Diagnostic Microbiology.
SEMESTER III

IM Z 3 B 05U - MOLECULAR BIOLOGY & MICROBIAL BIOTECHNOLOGY

36 Hours
Credit 2

Module 1. Function of macromolecules: Early observation on the mechanism of heredity, DNA as the genetic material, Exons and Introns, Transposons, IS elements, DNA replication, protein synthesis, and regulation of gene expression in microbes.-Overlapping genes, Silent genes 10 hrs

Module 2. Structural Organization of genomes in prokaryotes 3 hrs

Module 3. Mutation: Molecular mechanism of mutation, forward and reverse mutation, transition, transversion, and chemical induced mutations 5 Hrs

Module 4. Genetic recombination in bacteria: Transformation, transduction and conjugation. Use of transformation, transduction and conjugation in genetic mapping, preparation of genetic maps. 6 Hrs


Module 6. Antibiotics – Industrial production of β Lactam antibiotics (Penicillin and its relatives) Amino glycosides and tetracylines 6 hrs
IM Z 3 B 05U (P) PRACTICAL - MOLECULAR BIOLOGY & MICROBIAL BIOTECHNOLOGY

36 HRS

Credit 1

1. Isolation of Chromosomal DNA
2. Immobilization technique using *Yeast cells* by alginate beads
3. Study of Transformation, Transduction & Conjugation
4. Detection of blood groups
5. PCR demonstration
6. DNA finger printing steps illustrations

CORE READINGS

1. E. J. Gardner - Principles of genetics
2. Levin - Genes
3. Davis and Harper - General Microbiology
4. Old and Primrose - Biotechnology
5. Glick Molecular - Biotechnology
6. Ananthanaraynan and Jayaram Panicker - Text Book of Microbiology
7. Davis - Immunology
8. Roitt ELBS - Essential Immunology
SEMESTER III

**IM Z 3 B 06 U -BASICS OF INDUSTRIAL MICROBIOLOGY**

54 Hours
Credit 3

**Module 1.** General introduction: History and development of Industrial Microbiology - Scope of industrial microbiology – Discovery of microbial world – The experiments of Pasteur – The era of the discovery of Antibiotic - the discovery of anaerobic life – The physiological significance of fermentation. 

12 Hrs

**Module 2.** Production Strains – screening techniques – strain development and preservation – serial subculture – preservation by over layers – culture with mineral oil – lyophylization or freeze drying – principles of storage of microbes at low temperatures or in liquid nitrogen. Methods for the storage of fungi.

15 Hrs


20 hrs

**Module 4** Fermentation process: Surface, Submerged and Continuous fermentation

7 hrs

**IM Z 3 B 06 U (P) Practical - BASICS OF INDUSTRIAL MICROBIOLOGY**

36 hrs
Credit 1

1. Study of alcoholic fermentation of fruit juice by yeast
2. Production of citric acid by *Aspergillus niger*
3. Estimation of citric acid

**CORE READINGS**

1. R. A. Atlas, McMillan - Microbiology, Fundamentals and Application
2. Pelzar, Reid and Chew - Microbiology
3. A H Patel - Industrial Microbiology, Macmillan India
4. Casida - Industrial Microbiology
5. Whittaker - Fermentation Technology
6. P F Stanbury - Principles of Fermentation Technology

The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam
SEMESTER IV

IM Z 4 B  07 U -FERMENTATION TECHNOLOGY  

54 Hours
Credit 2

Module 1. Production of Various compounds

**Pharmaceuticals:** Antibiotics (Penicillin, Streptomycin),

**Vitamins:** Riboflavin, Cyanocobalamine

**Steroids**

**Organic acids:** Acetic acid, citric acid, lactic acid, and Gibberlic acid.

**Amino acids:** Lysine, glutamic acid

**Enzymes:** Protease, amylase, peptidase

**Solvents:** Ethanol, Glycerol

**Fuel** Methane

- 30 Hrs

Module 2. Microbial Recovery of Metals- Bioleaching of copper, Gold & Uranium

- 9 hrs

Module 3. Microbially enhanced oil recovery (MEOR).

- 15 Hrs

IM Z 4 B  07 U (P) PRACTICAL - FERMENTATION TECHNOLOGY  

36 hrs 
Credit 1

1. Cultivation of mushroom
2. Estimation of Lactic acid

CORE READINGS

1. Whittaker - Fermentation Technology
2. Casida - Industrial Microbiology
3. A.H. Patel - India Industrial Microbiology
5. Prescott - Industrial Microbiology
6. Purohit S.S. - Pharmaceutical Microbiology
SEMESTER IV

**IM Z 4 B 08 U AGRICULTURAL MICROBIOLOGY & BIO FERTILIZERS**

54 Hours  
Credit 3

10 Hrs

Module 2. Microorganisms in Agriculture: Nitrogen fixation, symbiotic and non-symbiotic associations  
10 Hrs

- Downy mildew of grapes  
- Tikka disease of groundnut  
- Citrus canker  
- Bacterial leaf blight of rice  
- Mycoplasmal diseases – sandal spik  
- Grassy shoot disease of sugar cane  
- Viral disease – TMV  
15 Hrs

12 Hrs

Module 5. Bio pesticides: *B. thuringensis*, Nuclear Polyhedrosis Virus  
7 Hrs

**IM Z 4 B 08 U (P) PRACTICAL - AGRICULTURAL MICROBIOLOGY & BIO FERTILIZERS**

36 hrs  
Credit 1

1. Isolation and enumeration of microorganisms in soil  
2. Study of Rhizobium from root nodules  
3. Study of antagonism between soil microorganisms  
4. Study of Rhizophane and Phylloplane microorganisms  
5. Study of plant pathogens

REFERENCES

1. Martin - Soil Microbiology  
2. Hill and Wrignt - Pesticide Microbiology  
3. R.S. Malhotra - Plant Pathology  
4. Carr and Whitton - Biology of Cyanobacteria  
5. J.R. Norria D.J. Road, A.K. Verma - Methods in Microbiology, Vol. XXIV

*The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam*
SEMESTER V

OPEN COURSE
(Students can follow any open course offered by the institution)

ZY5D04U - FOOD MICROBIOLOGY

72 hrs

Credit 4

Module 1. Food as a substrate for microorganisms, micro-organisms important in food microbiology- moulds, yeasts and bacteria; brief account of each group; general characteristics and importance; Principles of food preservation – asepsis – removal of microorganisms, anaerobic conditions – high and low temperatures – drying, chemical preservatives – food additives.

15 Hrs

Module 2. General principles underlying food spoilage and contamination; canned food – sugar products; vegetables, fruits, meat and meat products, milk and milk products, fish, sea food – spoilages.

12 Hrs


10 Hrs

Module 4. Food fermentations and food produced by microbes; bread, vinegar, Single Cell Proteins, mushroom cultivation; production of alcohol and fermented beverages, beer and wine.

10 Hrs

Module 5. Food borne poisonings, infections and indications; Microbiology of food sanitation- Hazard Analysis Critical Control Points (HACCP), Microbiological criteria for foods.

7 Hrs
MODULE 6 (Activity Oriented Study)  

1. Isolation and identification of micro organisms from infected fruits and vegetables  
2. Observation of food borne pathogens  
3. Identification of bacteria from Idli batter and curd  
4. Direct microscopic examination of milk / water by standard plate count  
5. Methylene blue Reductase test for milk

Report writing

Report of activity oriented study is to be prepared and submitted by each candidate and has to be taken for internal evaluation in the place of assignment and seminar

Core Readings

1. W.C. Frazier and Westhoff - Food Microbiology  
2. Jey - Modern food Microbiology  
3. Powar and Daginawala - General Microbiology  
4. Stanier - Microbial World  
5. Prescot, Harley, and Klein’s - Microbiology
SEMESTER VI

IM Z 6 B0 9 U MICROBIAL WASTE MANAGEMENT 54 Hours
Credit 3

Module 1. Solid waste disposal; sanitary landfills, composting; Role of microorganisms in composting – worm composting - biomethanation.

14 Hrs

Module 2. Treatment of liquid waste; Microbiology of municipal sewage; sewage treatment – primary secondary and tertiary treatments; disinfections; industrial effluents – paper mill, leather industries fertilizer industries and Beveries – Microbial and chemical characteristics, BOD,COD, microbes as indicators of waste water, pollution treatments processes, septic tank municipal treatment processes, mechanical treatment and biological treatment, trickling filters, inhoff tank, activated sludge process, oxidation ponds, anaerobic sludge digestion rotating disc.

20 Hrs

Module 3. Biodegradation of environmental pollutants; Hospital waste management, Bioremediation, application of bioremediation of hazardous wastes, dyes, oil ,pesticides; Bio sorption; Microbial deterioration of paints, biodegradation of wool, leather, plastics.

20 hrs.

IM Z 6B 09 U (P) PRACTICAL - MICROBIAL WASTE MANAGEMENT 36 hrs
Credit 1

1. Bacterial examination of water by MPN technique and IMVIC test
2. Estimation of BOD and COD from water, soil and sewage

Core Readings

1. Pelzer, Reid and Chan - Microbiology
2. Gandy and Gandy - Microbiology for Environmental Scientists and Engineers
3. Rodolfs, Willem - Industrial Waste: Their disposal and Treatment

The Board of Studies in Zoology (UG), Mahatma Gandhi University, Kottayam
REPORT OF BOARD OF STUDIES

Members

1. **Dr. Susan Panicker** *(Chairperson)*  
   Associate Professor and HOD, Dept of Zoology, Baselius College, Kottayam

2. **Mr. T.G. Ramachandran Pillai**, D.B. College, Pampa, Parumala

3. **Mr. Baby Augustine**, St. Thomas College, Pala

4. **Mr. George K. Thomas**, St. George College, Aruvithura

5. **Dr. Abraham Samuel K.**, C.M.S. College, Kottayam

6. **Mr. Sunny Jose**, St. Xavier’s College, Vaikom

7. **Mrs. K.V. Zeena**, Maharajas College, Ernakulam

8. **Dr. John Joseph**, S.H. College, Thevara

9. **Mr. Thomas M. Paimpalil**, St. Stephen’s College, Uzhavoor

10. **Mrs. Syamala M.V.**, Maharajas College, Ernakulam

11. **Dr. Jyothis Mathew**, School of Biosciences, Mahatma Gandhi University

Brief Report

The members of the Board of Studies met several times and worked out the format for the proposed restructuring of the undergraduate programme in Zoology in Choice Based, Credit and Semester System and introduction of Grading in Valuation as per the guidelines envisaged by the University. The chairperson and members met experts in various disciplines of the subject, and attended workshops conducted by the experts form KSHEC.

The five-day workshop was conducted by the University in continuation of the Board of Studies chairperson’s meeting on 8-5-09 FN and Board of Studies members meeting on 8-5-09 AN. The workshop was conducted on 14-5-09, 15-5-09, 20, 21, and 22 May 2009 at School of Environmental Studies, Mahatma Gandhi University, P.D. Hills, Kottayam. 61 teachers attended the workshop. The Hon. Vice Chancellor Dr. Rajan Gurukkal inaugurated the workshop. Hon.
ProVice-Chancellor Dr. Rajan Varghese presided over the meeting, Prof. K. Mathew, Prof. Chandra Shekharan and Prof. Sadasivan Nair. Members Syndicate gave the guidelines for the workshop. The resource persons participated in the workshop (July 24, 25 and 31, 2009) were Dr. Achuth Sankar Nair, Dr. K.G. Padmakumar, Dr. Jose Joseph, Dr. Isaac P. Abraham, Rev. Dr. K.M. George, Dr. Francis Xavier, Dr. Susan Panicker, Prof. K. Mathew, Dr. Punnen Kurian, Dr. Thomas Philip, Dr. Gigi K. Joseph (May 14, 15, 20, 21, 22) Dr. A.P. Thomas, Dr. N.J. Rao, Dr. Jyothis Mathew, Dr. Aloysius M. Sebastian, Dr. Punnen Kurian, Dr. Nelson P. Abraham, Dr. Shaju Thomas, Dr. Alice K. Thomas Dr. Shirly Annie Oommen, Mrs. Gladys Francis, Dr. Reethamma O.V. Mrs. Antonio Roseline, Mr. T.K. Mukundan, Dr. K.J. Benny, Mr. Jose Abraham, Mrs. Bina Jacob, Dr. Sampath Kumar, Dr. Susan Thomas, Miss. Tigi Paul, Mr. Madhusudhanan, and Miss Usha P. Hariharan. Dr. Jyothis Mathew, Dr. T. Thomas Philip Issac P. Thomas and Mr. Jojo Joseph gave expert advice in the formulation of syllabus for Microbiology, Immunology, Bioinformatics and Biological Techniques and Specimen preparation. The teams constituted under the leadership of Members of Board of Studies discussed in detail the syllabi and presented the courses and suggestions emerged from these group discussions and presentations helped to restructure the programme as envisaged by the Kerala State Higher Education Council and Mahatma Gandhi University. The participants contributed actively to the cause and appreciated the University in restructuring the undergraduate syllabi in Choice Based Course, Credit, and Semester System and introduction of grading pattern in valuation. The Chairperson Dr. Susan Panicker is thankful to the authorities of the Kerala Higher Education Council and Mahatma Gandhi University, the members of Board of Studies, Prof. Jacob Kurian Onattu, Principal Baslelius College, Kottayam, Dr. A.P. Thomas, Director School of Environmental Sciences and the faculty and resources participants for their wholehearted cooperation and help throughout the venture. Thanks are due to Lars Computers MG University, Ms. Chippi Sarah Kuriakose and Rahul Ramesh, Baslelius College, Kottayam. Curriculum review workshop was conducted on 6&7 December 2011 and the Board of studies meeting held on 15/12/2011 discussed and
recommended the modifications to be implemented in syllabus with effect from 2012 admission onwards.