MAHATMA GANDHI UNIVERSITY
Priyadarshini Hills, Kottayam 686 560

CURRICULUM OF
CHOICE BASED CREDIT SYSTEM
FOR
UNDERGRADUATE

ZOOLOGY PROGRAMME

2017 ADMISSION ONWARDS
PREPARED
BY
BOARD OF STUDIES
AND
FACULTY OF SCIENCE
ACKNOWLEDGEMENT

The unstinted support provided by some profound personalities and their guidance has immensely contributed to the successful completion of this syllabus restructuring venture.

The initiative taken by the Hon. Vice Chancellor of Mahatma Gandhi University towards restructuring the curriculum of the undergraduate courses of this university is gratefully acknowledged here. Under his leadership, this restructuring effort by a team of Professors has been successfully completed.

The relentless support by the Hon. Pro Vice Chancellor and the Registrar of M. G. University, for the successful completion of the syllabus restructuring is also gratefully acknowledged.

The gratitude felt towards the Syndicate members for their encouragement and continuous support right through the entire exercise is to be mentioned here with gratitude.

The hospitality shown by the M. G. University staff and the assistance provided by them in various stages of this endeavor of restructuring is also acknowledged here.

Any venture of this magnitude requires the whole hearted support of several individuals in their official capacity or otherwise, directly or indirectly associated with the process. The magnanimity of each and every such person is being etched here in golden words.

Dean – Faculty of Science
M G University, Kottayam.
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          ii. Practical
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1. INTRODUCTION

Curriculum restructuring is the responsibility of any University that offers different courses. As per U.G.C guidelines it should be revised every three years. Accordingly the authorities of M.G University have taken the initiative to restructure the syllabus of each course for the benefit of the students.

According to Altman and Cashin “the primary purpose of a syllabus is to communicate to one’s students what the course is about, why the course is taught, where it is going, and what will be required of the students, for them to complete the course with a passing grade. Claire Johnson says “the syllabus functions as a major communication device that provides details of how student learning will be assessed and about the roles of both Students and Instructors in the learning and assessment process. The syllabus is a “description” and “plan” for a course and if well written may be a tool that improves student learning, facilitates faculty teaching, improves communication between faculty members about their courses and assists with monitoring program quality says Claire Johnson (2006). Additionally Parke,Fix and Harris suggest that “ the syllabus serves as a contract between the Instructor and the learner”.

The M.G. University is well recognised among Universities for their quickness in updating technologies. It is the recipient of the award for computerization among the Universities. Ever since its inception, the M.G.University has had the history of updating its syllabi for the various courses offered. Presently, this exercise has resulted in the syllabus of Zoology, for the undergraduate students undergoing model I, II and III courses, reaching successful updation.

India, a mega biodiversity nation stands out as a fascinating destination, exhibiting an incredible diversity in its fauna and flora. Innumerable species of organisms live here contributing to India’s most beautiful natural topography.. All round development becomes possible only by exploring the vast potential of the still unknown resources of nature. Zoology undergraduate students are therefore made to go through the realities like Biota,anatomy and physiology of living organisms, DNA biotechnology, diseases, pathogens and parasites, environment, resources, protection of endangered organisms and their conservation, the “right to live” of all organisms in this world, and finally scientific knowledge about cottage industries, prompting students to involve in self employment programs.

The constant and unstinted efforts of the entire faculty of Zoology within M.G.University has been instrumental in framing this syllabus for the subject Zoology in this form. The faculty of Zoology proudly and sincerely submit herewith this updated syllabus in Zoology for its implementation in the coming three years.
2. **AIMS & OBJECTIVES**

The BSc. Zoology programme is designed to help the students to:

1. Acquire basic knowledge of various disciplines of Zoology and General Biology meant both for a graduate terminal course and for higher studies.
2. Inculcate interest in nature and love of nature.
3. Understand the rich diversity of organisms and their ecological and evolutionary significance.
4. Imbibe basic skills in the observation and study of nature, biological techniques, experimental skills and scientific investigation.
5. Create awareness on the internal harmony of different body systems and the need for maintaining good health through appropriate lifestyle.
6. Acquire basic knowledge and skills in certain applied branches for self-employment.
7. Impart awareness of the conservation of the biosphere.

3. **DURATION OF THE COURSE**

The duration of U.G. programmes have 6 semesters. There shall be two Semesters in an academic year, the odd semester commences in June and on completion, the even Semester commences after a semester-break of one or two days with two months vacation during April and May. (The commencement of first semester may be delayed owing to the finalization of the admission processes.)

4. **PROGRAMME STRUCTURE - B.Sc Model I**

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### B.Sc Model II

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<td>Credits required from Core + Complementary + Vocational Courses including Project</td>
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### B.Sc Model III

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5. **EVALUATIONS:**

The evaluation of each paper shall contain two parts:

(i) Internal Assessment

(ii) External Assessment

The internal to external assessment ratio shall be 1:4.

**EXTERNAL EXAMINATION AND INTERNAL EVALUATION**

The external theory examination of all semesters shall be conducted by the University at the end of each semester. Internal evaluation is to be done by continuous assessment.

**ASSIGNMENTS**

At least one assignment should be done in each semester for all papers.
INTERNAL ASSESSMENT TEST PAPERS

The test papers & evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of internal assessments are to be kept in the college for two 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 paper.

EXTERNAL EXAMINATION

The external theory examination of all semesters shall be conducted by the University at the end of each semester. Students having a minimum of 75% average attendance for all the courses only can register for the examination. Condonation of shortage of attendance to a maximum of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme may be granted by the University on valid grounds. This condonation shall not be counted for internal assessment. Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on production of participation/attendance certificates, within one week, from competent authorities and endorsed by the Head of the institution. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also. Those students who are not eligible even with condonation of shortage of attendance shall repeat the semester along with the next batch after obtaining readmission.

All students are to do a project in the area of core course. This project can be done individually or in groups (not more than three students) which may be carried out in or outside the campus. Special sanction shall be obtained from the Vice Chancellor to those new generation programmes and programmes related to projects which involve larger groups. The projects are to be identified during the fifth semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners appointed by the University. External Project evaluation and Viva / Presentation is compulsory for all subjects and will be conducted at the end of the programme. There will be no supplementary exams. For reappearance/ improvement, the students can appear along with the next batch.

6. CONSOLIDATED SCHEME FOR BSC ZOOLOGY PROGRAMME

MODEL-1 (1- VI SEMESTERS)
(TOTAL CREDITS 120)
(TOTAL HOURS 150 Hrs.)
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| Total | 25 hrs | 17 |

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**Total**

Semester 3

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Semester 4
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<td>3 – Man, nature &amp; Sustainable Development</td>
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<td>Credits</td>
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<td>Elective 3: Vector &amp; Vector borne Diseases</td>
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**Total** 25 hrs 25
7. SCHEME OF DISTRIBUTION OF INSTRUCTIONAL HOURS

B.Sc. ZOOLOGY PROGRAMME: CORE COURSES – MODEL I

<table>
<thead>
<tr>
<th>Name of semester</th>
<th>Theory</th>
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<td>Sixth semester</td>
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<td>Project work (in sixth sem.),</td>
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<td>Visit to research institute</td>
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RECORDS

1. General perspectives in Science & Protistan Diversity
2. Animal Diversity – Non Chordata
3. Animal Diversity - Chordata
4. Research Methodology, Biophysics and Biostatistics
5. Environmental Biology & Human rights
6. Cell Biology & Genetics
7. Evolution and Ethology & Zoogeography
8. Human Physiology, Biochemistry & Endocrinology
9. Developmental Biology
10. Microbiology and Immunology
11. Biotechnology, Bioinformatics & Molecular Biology
12. Occupational Zoology

Each Record will be having external and internal evaluation. A total of 1 credit will be allotted for each record and respective practical.

FIELD STUDY/ (STUDY TOUR)
Study tour/field study, visit to research institute and various places of zoological Importance

A study tour is compulsory. 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.
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.

A brief report on any two activities mentioned in each elective paper should be submitted as a component of assignment for internal evaluation.

8. SCHEME OF DISTRIBUTION OF HOURS AND CREDIT

B.Sc. ZOOLOGY PROGRAMME : MODEL -1  CORE COURSE

<table>
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<th>Inst Hrs/week</th>
<th>Credit</th>
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<td>Environmental Biology &amp; Human rights</td>
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<td>Human Physiology, Biochemistry &amp; Endocrinology</td>
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<td>Title of the Course (Select any one from each group)</td>
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<td>Inst Hrs/week</td>
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<td>Public Health &amp; Nutrition</td>
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<td>Man, Nature &amp; Sustainable Development</td>
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<td>Nutrition, Health &amp; Life Style Management</td>
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10. SCHEME OF EXAMINATIONS

a. SCHEME OF EXAMINATION - THEORY (CORE COURSE)

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 ratio =1:4)

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<th>Course Category</th>
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### Zoology Open Courses - Semester 5 (Select any 1 from 3)

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<td>Public Health &amp; Nutrition</td>
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<td>Man, Nature &amp; Sustainable Development</td>
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### Zoology Open Courses - Semester 6 (Select any 1 from the four)

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<td>Agricultural Pest Management</td>
<td>Choice Based Course-2</td>
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<td>Vector &amp; Vector Bourne Diseases</td>
<td>Choice Based Course-3</td>
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<tr>
<td>ZY6CBT03</td>
<td>Nutrition, Health &amp; Life Style Management</td>
<td>Choice Based Course -4</td>
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### SCHEME OF PRACTICAL EXAMINATIONS

University Practical Examinations will be conducted at the end of even semester 2, 4 and 6.

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<td>III Environmental Biology, Toxicology, Cell Biology &amp; Genetics</td>
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**c. Total Credits for Core Course**

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d. SCHEME OF FIELD STUDY, RESEARCH INSTITUTE VISIT, GROUP ACTIVITY, PROJECT AND VIVA-CORE COURSE (Credit 2)

Marks Maximum 100

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<th>Project: Log book showing the progress of project work duly signed by the supervising teacher &amp; HOD</th>
<th>Internal Assessments (I)</th>
<th>External Assessments (E)</th>
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<td>Abstract- 3 Marks</td>
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<td>Introduction &amp; Review of literature- 10 Marks</td>
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<td>Results- 10 Marks</td>
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<td>Discussion &amp; Conclusion - 10 Marks</td>
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<td>Neat presentation and Novelty- 5 Marks</td>
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<td>Presentation &amp; Viva- 30Marks</td>
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<td>(Student can present the project using OHP or LCD, in 7 Minutes) Viva Voce.</td>
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e. ON THE JOB TRAINING PROGRAMME (OJ)

Each student is expected to do an ‘on the job training programme’ (OJ) outside the campus during the VI semester for Model II & Model III Programmes to acquire experimental skills, practical experience, scientific knowledge and also to equip themselves for self employment. The evaluation includes internal assessment (20 marks) and external assessment (80 marks). The external assessment includes the following components,

- Attendence – 10 marks
- Report submission – 40 marks
- Presentation & viva – 30 marks
11. COMPLEMENTARY ZOOLOGY COURSES OFFERED BY ZOOLOGY DEPARTMENT FOR - MODEL I – BSc BOTANY / BSc HOME SCIENCE  
MODEL II – BSc BOTANY / VOCATIONAL SUBJECTS  
MODEL III – BSc (BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION)

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12. SYLLABUS:

B.Sc ZOOLOGY PROGRAMME

MODEL – I

THEORY & PRACTICALS
SEMESTER 1. ZY1CRT01. CORE COURSE 1.

GENERAL PERSPECTIVES IN SCIENCE & PROTISTAN DIVERSITY

36 Hrs

Credits 2

Objectives:

• To create an awareness on the basic philosophy of science, concepts and scope
• To understand different levels of biological diversity through the systematic classification
• To familiarize taxa level identification of animals
• To make interest in Protistan diversity
• To impart knowledge on parasitic forms of lower invertebrates.

PART I  PERSPECTIVES IN SCIENCE                   8Hrs

Module I Introduction to Scientific Studies        4Hrs
Types of knowledge: practical, theoretical, and scientific knowledge. What is science, features of science, Deductive and inductive models, scientific temper, empiricism vocabulary of science.

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 Zoology, Scope of Zoology

PART II  SYSTEMATICS                                10 Hrs

Module III–Taxonomical Principles and tools

Identification tools
Taxonomic key. Types: Single access key- Dichotomous [linked and nested] and Polytomous key, Multi access key, Computer aided Interactive Key

Advantages and Disadvantages

PART III: PROTISTAN DIVERSITY 18 Hrs

Module IV – Kingdom Protista Type: *Paramecium* 5 Hrs

Salient features of Kingdom Protista 10 Hrs

Classification of Protista up to phyla

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

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

General Topics: 3 Hrs

1. Parasitic protists (diseases mode of transmission and prophylactic measures) - Entamoeba, Trypanosoma, Plasmodium (detailed account of life cycle), Leishmania.

References


Taylor, Green, Stout (2008) Biological Science, Cambridge University, Press, p


Thomas A P (Editor) 2010 The Invertebrates, Green leaf publications Kottayam

27
SEMESTER 1

CORE COURSE PAPER 1
PERSPECTIVES IN SCIENCE & PROTISTAN DIVERSITY

(PRACTICAL)

36 Hrs
2 Credits

1. Taxa, identification techniques
   Bird body parts
   Butterfly/ dragonfly body parts

2. Identification using keys
   Insect, Fish, Snake (Poisonous & Non Poisonous )
   (Any 3 specimens from each category)

3. General identification - The students are expected to identify any 6 Protistans studied
   by their generic names and write the general characters of their Phylum.

4. Identification of any 4 economically important protists/parasitic protists
   (Slides/figures may be used for identification)

5. Identification of two Protistan from pond water

SEMESTER 11. ZY2CRT02
CORE COURSE 11: ANIMAL DIVERSITY - NON CHORDATA

36 Hrs
Credits 2

Objectives:
- To create appreciation on diversity of life on earth
- To understand different levels of biological diversity through the systematic
  classification of invertebrate fauna
- To familiarize taxa level identification of animals
- To understand the evolutionary significance of invertebrate fauna
- To instill curiosity on invertebrates around us
- To impart knowledge on parasitic forms of lower invertebrates.
MODULE I  Kingdom Animalia  
Outline classification of Kingdom Animalia

Three branches - Mesozoa, parazoa and Eumetazoa

Mesozoa: Phylum Orthonectida - eg. Rhopalura (mention 5 salient features)

Parazoa:

1. Phylum Placozoa – Eg. Trycoplax adherens
2. Phylum Porifera – Classification upto classes; Mention gemmules
   Class I- Calcarea.       Eg. Sycon,
   Class II – Hexactinellida. Eg. Euplectella.
   Class III - Demospongia   Eg. Cliona.

General Topics

1. Canal system in sponges.

Phylum Coelenterata - Classification upto classes

Class I - Hydrozoa   Eg. Eg. Obelia - mention Metagenesis
Class II- Scyphozoa Eg. Rhizostoma.
Class III- Anthozoa Eg. Metridium.

General Topics:

2. Polymorphism in Coelenterates

Phylum Ctenophora - Eg. Pleurobrachia.

MODULE II

Phylum Platyhelminthes  Salient features; classification up to classes  3 Hrs

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 Nemathelminthes(Nematoda)  2 Hrs

Salient features, classification up to classes

Class: Phasmidia   Eg. Enterobius,
Class: Aphasisdia   Eg. Trichinella
General Topic
Pathogenic nematodes in man. (Wuchereria bancrofti, Ascaris lubricoides, Ancylostoma duodenale, Trichinella).

Phylum Annelida: 2 Hrs
Salient features, Classification up to classes.
- Class I - Archiannelida Eg. Polygordius
- Class II - Polychaeta Eg. Chaetopterus
- Class III - Oligochaeta Eg. Megascoleci
- Class IV - Hirudinea Eg. Ozobranchus, Hirudinaria

MODULE III 14 Hrs
Phylum Onychophora
Eg. Peripatus (Mention its affinities).

Phylum Arthropoda Salient features, Classification up to classes
Type: Prawn – Fenneropenaeus (Penaeus)

1. Sub Phylum – Trilobitomorpha
Class - Trilobita (mention the salient features).
Eg. Triarthrus – A trilobite (extinct)

2. Subphylum – Chelicerata
- Class 1 Merostomata (Xiphosura) (Eg. Limulus)
- Class 2, Arachnida (Eg. Palamnaeus - Scorpion)
- Class 3 Pycnogonida (Eg. Pycnogonum – Sea spider)

3. Subphylum – Crustacea
- Class 1 Branchiopoda Eg. Daphnia
- Class 2 Ostracoda Eg. Cypris - seed shrimp
- Class 3 Copepoda Eg. Cyclops
- Class 4 Remipedia Eg. Speleonecles (eyeless crustacean seen in caves)
- Class 5 Branchiura Eg. Argulus (common fish louse)
- Class 6 Cirripedia Eg. Sacculina (parasitic castrator of crabs)
- Class 7 Malacostraca Eg. Squilla (spot tail mantis shrimp)

4. Subphylum - Uniramia
- Class 1 Chilopoda Eg. Scolopendra – (Centipede)
- Class 2 Symphyla Eg. Scutigerella – (garden centipedes or pseudocentipedes)
- Class 3 Diplopoda Eg. Spirostreptus - (Millipede)
- Class 4 Pauropoda Eg. Pauropus
Class 5 Hexapoda (Insecta)  Eg. *Bombyx mori* – (silk moth)

**MODULE IV**

**Phylum Mollusca**  
3 Hrs

Salient features, Classification upto classes

Class I - Apalcophora  Eg. *Neomenia*  
Class II - Monoplacophora  Eg. *Neopilina*  
Class III Amphineura  Eg. *Chiton*  
Class IV Gastropoda  Eg. *Aplysia*  
Class V Scaphopoda  Eg. *Dentalium*  
Class VI Pelecypoda (Bivalvia)  Eg. *Pinctada*  
Class VII Cephalopoda  Eg. *Sepia*

**Phylum Echinodermata**  
3 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 in Echinodermata

**Phylum Hemichordata:**  
2 Hrs

Eg. Balanoglossus

**Minor Phyla**

1. Chaetognatha  Eg. *Sagitta*  
2. Sipunculida  Eg. *Sipunculus*

**References:**


   Animal Diversity, Zoological Society of Kerala, Kottayam


18. Thomas A P (Editor) 2010 The Invertebrates, Green leaf publications Kottayam

PRACTICAL
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 (male and female)
3. Earthworm
4. Fasciola

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

Mounting:
1. Prawn appendages.
2. Mouth parts - Cockroach/ Plant bug/ House fly / Mosquito. (Any Three)

Identification:
General identification & classification - The students are expected to identify, classify and describe the following Phylum -wise number of animals by their common names, generic names and 30% of these by their scientific names. Porifera-1, Coelenterata-3, Platyhelminthes-2, Annelida-2, Arthropoda-5, Mollusca-4, Echinodermata-3
Identification of (a) Parasitic protest – any 2 (b) larval forms of Fasciola- any 2 (c) Nematode parasites of man- any 3 (Slides/figures may be used for study)

Taxonomic identification with key:
Identification of insects up to the level of Order (any Four).

SEMESTER 111. ZY3CRT03
CORE COURSE 111: ANIMAL DIVERSITY –CHORDATA
54 Hrs
3 Credits

Objectives
- To acquire in depth knowledge on the diversity of chordates and their systematic position.
- To make them aware of the economic importance of some classes.
- To understand the evolutionary importance of selected chordate groups
MODULE I

Introduction  
1 Hr

General Characters and outline classification of Chordata up to class, Origin of Chordates – mention theories in brief

Protochordates: General characters and Classification  
2 Hrs

1. Sub phylum: Urochordata

Class I Larvacea  Eg. Oikopleura

Class II Asciidiacea Eg. Ascidia (Mention Retregressive Metamorphosis)

Class III Thaliacea  Eg: Doliolum

2. Sub phylum: Cephalochordata  
2 Hrs

Example - Amphioxus (Structure and affinities)

MODULE II

3. Sub phylum: Vertebrata General characters and Classification 2 Hrs

4. Division 1 – Agnatha

Class I Ostracodermi  Eg: Cephalaspis

Class II Cyclostomata  Eg: Petromyzon

Division 2 – Gnathostomata 10 Hrs

Super class Pisces  General Characters and Classification

Class: Chondrichthyes - General Characters

Sub class – ElasmobranchI Eg: Narcine

Sub class - Holocephali  Eg: Chimaera

Class: Osteichthyes - General Characters

Sub class – Choanichthyes

Order 1 Crossopterygii(Coelocanths)  Eg: Latimeria(Evolutionary Significance)

Order 2 Dipnoi  Eg: Lepidosiren - Distribution, affinities and systematic position of lung fishes.

Sub class: - Actinopterygii

Super order 1. Chondrostel Eg: Acipencer

Super order 2. Holostei  Eg: Amia

Super order 3. Teleostei  Eg: Sardine

General topics

1. Accessory respiratory organs in fishes.
2. Parental care in fishes.
4. Migration in fishes

**MODULE III**

**Super class: Tetrapoda** General characters, Classification up to Orders  

**Class Amphibia - Type Frog (Euphlyctis hexadactylus)**
- Order I Anura  Eg: *Hyla*
- Order II Urodela  Eg: *Amblystoma* (mention axolotl larva and Paedomorphosis/neotony)
- Order III Apoda  Eg: *Ichthyophis.*

**Class Reptilia**  

**Sub class I: Anapsida**
- Order Chelonia  Eg: *Chelone*

**Sub class II: Parapsida**
- Order Rhynchocephalia  Eg: *Sphenodon*
- Order II Squamata  Eg: *Chamaleon*
- Order III. Crocodilia  Eg: *Crocodile*

**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**
1. Migrations in birds
2. Flight adaptations in birds

**MODULE IV**

**Class Mammalia  Type: Rabbit (Oryctolagus cuniculus)**  
Brief mention of general characters and classification up to order with example. (Mention any five salient features of each order, detailed accounts of examples are not necessary)
Sub class I: Prototheria  
Eg: Echidna, *Ornithorhynchus*

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: *Rhinoceros*

- **Order 12 Artiodactyla**  
  Eg: *Camelus*-mention ruminant stomach

- **Order 13 Lagomorpha**  
  Eg: *Oryctolagus*

- **Order 14 Rodentia**  
  Eg: *Hystrix* (Porcupine)

- **Order 15 Tubulidentata**  
  Eg: *Orycteropus*

- **Order 16 Cetacea**  
  Eg: *Delphinus*

**General topics**

1. Dentition in Mammals
2. Aquatic Mammals and their adaptations.

**References**

2. Jhingran (1977), Fish and Fisheries of India, Hindustan Publishing Co.
   Zoological Society of Kerala, Kottayam
   Meerut.— 250 002.
PRACTICAL

ANIMAL DIVERSITY - CHORDATA

36 Hrs
Credit 1

1. 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

3. Mounting of placoid scales; study of cycloid and ctenoid scales

4. Osteology

Frog vertebrae - typical, atlas, 8th and 9th
Rabbit – Atlas, Axis and typical vertebra
Pectoral and pelvic girdles of Frog and Rabbit
Bird - Keel and Synsacrum
Turtle/Tortoise - plastron and carapace

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

6. Identification:-

**General identification**-
Identify, classify and describe the following animals by their generic names and 30 % of them by their scientific names.


**Taxonomic identification with key:-**
i) Identification of fishes up to the level of order.
ii) Identification of snakes up to family.

**SEMESTER IV. ZY4CRT04**

**CORE COURSE IV**

**RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS**

54 Hrs

3 Credits

**Objectives**

1. To familiarise the learner the basic concept of scientific method in research process.

2. To have a knowledge on various research designs.

3. To develop skill in research communication and scientific documentation.

4. To create awareness about the laws and ethical values in biology.

5. To equip the students with the basic techniques of animal rearing collection and preservation

6. To help the student to apply statistical methods in biological studies.
RESEARCH METHODOLOGY

Module I 13 Hrs

Basic concepts of research: Meaning, Objectives, Approaches, Types of research.
Research Process: Scientific method in research (eight steps).
Importance of literature reviewing in defining a problem,
Identifying gap areas from literature review.
Research Communication and scientific documentation: Project proposal writing,
Research report writing, (Structure of a scientific paper), Thesis, dissertation, research article.
Presentation techniques: Oral presentation, Assignment, Seminar, Debate, Workshop,
Colloquium, Conference
Sources of Information: Primary and secondary sources. Library- Books, Journals,
Periodicals, Reviews, Internet.
Plagiarism

Module II 12 Hrs

Animal Collection – Tools & techniques

Sampling techniques
  Quadrate
  Line transect

Measurements
  Density
  Abundance
  Frequency

Biodiversity indices – concepts
  Simpson index

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

Units of measurements- units, SI system, Equivalent weight, normality, molarity

BIOPHYSICS

Module III 14 Hrs

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

BIOETHICS

Module IV 5 Hrs

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 Board of India, CPCSEA, ethical commitment. Working with human: Consent,harm, risk and benefits.

BIOSTATISTICS 10 Hrs

Module V
Sample & Sampling techniques: Collection of data, classification of data, frequency distribution tables, graphical representation: - Bar diagrams, Histogram, Pie diagram and Frequency curves - Ogives.

Measures of Central Tendency: Mean, Median, Mode (Problem - Direct method only)

Measures of dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Standard error. (Merits & demerits and problems on SD).

Correlation: Definition, Types of correlation.(mention in brief)

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.

References


CORE COURSE IV
RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS
(PRACTICAL) 2 credits

PART A. RESEARCH METHODOLOGY

Animal collection Tools, Techniques & Estimation

1. Quadrature study
2. Transect study
3. Sampling Methods
4. Species area curve
5. Simpson index

PART B - BIOPHYSICS

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

PART C - BIOSTATISTICS

1. MS Excel: To create mean and median, Construction of bar diagram, Pie diagram and Line graphs.
2. MS Access: To create grade of students
4. Frequency distribution of the given samples to find out arithmetic mean, median, mode.
5. Range and standard deviation for a biological data
6. Correlation using any biological data.
Objectives

To instill the basic concepts of Environmental Sciences, Ecosystems, Natural Resources, Population, Environment and Society

To make the students aware of natural resources, their protection, conservation, the factors polluting the environment, their impacts and control measures.

To teach the basic concepts of toxicology, their impact on human health and remedial measures

To create a consciousness regarding Biodiversity, environmental issues & conservation strategies

To develop the real sense of Human rights – its concepts & manifestations

MODULE 1  ECOSYSTEM  12 Hrs

**Basic concepts of ecosystem** **Components of ecosystem:** Abiotic (Sunlight, temperature, soil, water, atmosphere) and Biotic components (Producers, consumers, decomposers), Ecological pyramid - number, biomass, energy, **Functions of ecosystem:** Productivity-Food chain-Food web-Energy flow-Laws of Thermodynamics. Types of Ecosystem: Terrestrial-Forest-Grassland-Desert, Aquatic-Marine-Fresh water, Wetland &Biome **Concept of limiting factors:** Liebig’s and Shelford’s laws of limiting factors.

**Biogeochemical cycles:** Concept, gaseous and sedimentary cycles, Carbon cycle, Nitrogen cycle. **Renewable resources** (solar, wind, hydroelectric, biomass and geothermal) and **Non renewable resources** (mineral and metal ore, fossil fuels)
Concept of population: Population attributes- Population growth forms, Basic concepts of growth rates, density, natality, mortality, growth curves
Animal interactions: Positive- Commensalism- Mutualism-Protocooperation, Negative-Predation-Parasitism-Competition-Antibiosis

MODULE 3          BIODIVERSITY AND ENVIRONMENTAL ISSUES         16 Hrs

Introduction to Biodiversity: Types of biodiversity- Alpha, Beta and Gamma diversity. Concept and importance of Biodiversity: Levels of Biodiversity-Species diversity, Genetic diversity, Microbial, Ecosystem diversity, India as a mega-diversity nation, Biodiversity hotspots

Global Environmental Issues: Ozone depletion, Greenhouse effect, Global warming, Climate change, Carbon trading, carbon credit; Carbon sequestration, Acid rain, Oil spills, Nuclear accidents, IPCC/UNFCC.
National Environmental Issues: Deforestation, forest fire, pollution(air, water, soil, noise thermal, nuclear- brief account only) solid waste management, sewage, drinking water crisis and water logging,
Toxic products and disaster: Types of toxic substances – degradable, non degradable, Impact on human – case studies: Endosulphan tragedy, Bhopal disaster
Flood, drought, cyclone, earthquake and landslide (Management and mitigation)
Local Environmental Issues: Landscape alteration, sand mining, quarrying, changing crop pattern, conversion of paddy lands,
Threats to water resources of Kerala: Degrading Mangrove and wetland ecosystems of Kerala, RAMSAR sites, Marine ecosystem crisis- pollution, overfishing etc. Impact of tourism on Environment.
MODULE 4 CONSERVATION OF BIODIVERSITY 12 Hrs

Protected area concept – Sanctuary, National Park, Biosphere reserve, Core Zone, Buffer Zone, Corridor concept. Conservation reserves

Concept of threatened fauna – IUCN categories - extinct, extinct in the wild, critically endangered, endangered, vulnerable, near threatened, least concern and data deficient. Red and Green Data Books.

Man–animal conflict (Tiger, Elephant, Dog, Monkey) – causes and concern

Water conservation- rainwater harvesting, watershed management


MODULE 5 HUMAN RIGHTS 6 Hrs


References


**PRACTICAL**

**ENVIRONMENTAL BIOLOGY & TOXICOLOGY**

36 HRS

**CREDIT 1**

1. Estimation of dissolved Oxygen
2. Estimation of carbon di oxide
3. Estimation of soil organic carbon (Demonstration only)
4. Identification of marine/ fresh water planktons
5. Counting of plankton using plankton counting chamber
6. Study of equipments - Sechi disc, Plankton net
7. Study of sandy shore fauna, rocky shore fauna.
8. Study of animal Association
   Field study (compulsory)
SEMESTER V. ZY5CRT06

CORE COURSE VI
CELL BIOLOGY AND GENETICS

54 Hrs
Credits 3

Objectives
1. To understand the structure and function of the cell as the fundamentals for understanding the functioning of all living organisms.
2. To make aware of different cell organelles, their structure and role in living organisms.
3. To develop critical thinking, skill and research aptitudes in basic and applied biology
4. To emphasize the central role of genes and their inheritance in the life of all organisms.

CELL BIOLOGY

Module I


Module II


Module III  

**Cell Communication**: Basic principles of cell communications, Cell signaling (in brief), Types of signaling. Mention signaling molecules (neurotransmitters, hormones, Growth Factors, Cytokines, Vitamin A and D derivatives).

**Cell Division**: Cell cycle - G1, S, G2 and M phases, Mitosis and Meiosis. The difference between Mitosis and Meiosis.

**References**


GENETICS

Module I 10 Hrs
Mendelian Genetics: Mendel’s experiments- Monohybrid Cross, Dihybrid Cross, Mendel’s Laws, Test Cross, Back Cross and Reciprocal Cross. Chromosome Theory of Inheritance

Interaction of genes: Allelic: Incomplete Dominance (Four O Clock Plant). Co-Dominance (Skin colour in Cattle) Lethal Alleles: Dominant lethal gene [Creeper chicken] and recessive lethal gene [cystic fibrosis].

Non Allelic: Complementary (Flower colour in Sweet Pea), Supplementary (Coat colour in mice), Epistasis - dominant (Plumage in poultry) and recessive (Coat colour in mice). Polygenes (Skin colour inheritance in man), Pleiotropism (Vestigial wing gene in Drosophila).

Multiple alleles – ABO Blood group system, Rh group and its inheritance. Erythroblastosis foetalis.

Module II 12 Hrs
Sex determination: Chromosome theory of sex determination (Autosome and Sex chromosomes), male heterogamy and female heterogamy, (xx-xy, xx-xo, ZZ-ZW, ZZ-ZO), Genic Balance theory of Bridges. Barr bodies, Lyon’s hypothesis, Gynandromorphism, sex mosaics, intersex (Drosophila), Hormonal [free martin in calf] and Environmental (Bonelia) influence on Sex determination

Recombination and Linkage: Linkage and recombination of genes based on Morgan’s work in Drosophila, Linked genes, Linkage groups, Chromosome theory of Linkage. Types of linkage- complete and incomplete. Recombination, cross over value, chromosome mapping.

[Definition]

Sex Linked inheritance: Characteristics of Sex Linked inheritance, X Linked inheritance of man (Hemophilia), Y linked inheritance [Hollandric genes], Incompletely Sex Linked genes...
or pseudoautosomal genes (Bobbed bristles in *Drosophila*), Sex limited genes (Beard in man) and Sex influenced genes (inheritance of baldness in man).

**Module III**

**Mutation:** Types of mutations - Somatic, germinal, spontaneous, induced, autosomal and allosomal, chromosomal mutations, structural and numerical changes. Gene mutations.

[Addition, Deletion and substitution].

**Human Genetics:** Karyotyping, Normal Human chromosome Complement, Pedigree analysis, Aneuploidy and Non- disjunction. Autosomal abnormalities (Down syndrome, Cry du chat syndrome) Sex chromosomal abnormalities (Klinefelter's syndrome, Turner's syndrome) Single gene disorder (Brief mention) Autosomal single gene disorder [sickle cell anaemia], Inborn errors of metabolism such as phenylketonuria, alkaptonuria, , Albinism. Multifactorial traits – polygenic disorder- cleft lip and cleft palate.

**Genetic Counseling, Eugenics and Euthenics** - Brief account only

**References**

SEMESTER V

CORE COURSE VI

CELL BIOLOGY AND GENETICS

(PRACTICAL)

36 Hrs

2 Credits

PART A: CELL BIOLOGY

1. Squash preparation of onion root tip for mitotic stages
2. Mounting of polytene chromosome (Drosophila/Chironomous.) Demonstration
3. Tissues (permanent slides of epithelial tissues, striated muscle, smooth muscle, cartilage, bone)
4. Identification of cell organelles
5. Preparation of temporary whole mount.
6. Preparation of permanent whole mount (demonstration)
7. Preparation of human blood smear and identification of Leucocytes

PART B: GENETICS

1. Genetic problems on Monohybrid, Dihybrid Crosses and Blood group inheritance
2. Study of normal male and female human karyotype (use photographs or Xerox copies)
3. Abnormal human karyotypes - Down, Edwards, Klinefelter and Turner syndromes (use photographs or Xerox copies)
5. Study of Barr body in human buccal epithelium
SEMESTER V. ZY5CRT07
CORE COURSE - V11: EVOLUTION, ETHOLOGY & ZOOGEOGRAPHY

Objectives:
- To acquire knowledge about the evolutionary history of earth - living and nonliving
- To acquire basic understanding about evolutionary concepts and theories
- 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

PART I - EVOLUTION

Module I - Origin of life
- Theories - Panspermia theory or Cosmozoic theory, Theory of spontaneous generation (Abiogenesis or Autogenesis), Special creation, Biogenesis, Endosymbiosis.
- Chemical evolution - Haldane and Oparin theory, Miller-Urey experiment;

Module II - Theories of organic evolution
- Lamarckism and its Criticism, Weismann’s Germplasm theory, Darwinism and its Criticism, Neo-Darwinism, Theory of De Vries,
- Population genetics and evolution: Hardy-Weinberg Equilibrium, gene pool, gene frequency. Factors that upset Hardy-Weinberg Equilibrium, Effects of genetic drift on population: Bottleneck effect and founder effect

Module III – Nature of evolution
- Species and Speciation: Species concept, subdivisions of species (sub species, sibling species, cline and deme), Speciation: Types of speciation, Phyletic speciation (autogenous
and allogenous transformations), True speciation, Instantaneous and gradual speciation, allopatric and sympatric speciation
Isolation: Types of isolating mechanisms-Geographic isolation (mention examples) and Reproductive isolation. Role of isolating mechanisms in evolution
Microevolution, Macroevolution (Adaptive radiation -Darwin finches) Mega evolution, Punctuated equilibrium, Geological time scale, and Mass extinction (brief account only).
Evolution of Horse

**PART II- ETHOLOGY**

**Module IV – Introduction**
Definition, History and scope of ethology

**Module V – Learning, imprinting and behaviour**
Types of learning with examples; patterns of behaviors – types of rhythms, navigation, homing instinct, hibernation, aestivation; pheromones- types and their effect on behavior, hormones and their action on behavior (aggressive and parental behavior)

**Module VI – Social organization**
Social organization in insects (ants) and mammals (monkey), Courtship behaviour and reproductive strategies

**PART III- ZOOGEOGRAPHY**

**Module VII – General Topics**
Continental drift theory, Types and means of animal distribution, Factors affecting animal distribution; insular fauna – oceanic islands and continental islands,

**Module VIII - Zoogeographical realms**
Palaeartic region, Nearctic region, Neotropical region, Ethiopian region, Oriental region, Australian region (brief account with physical features and fauna, Wallace’s line, Weber’s line, Biogeography of India with special reference to Western Ghats

**References:**

**EVOLUTION**

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54

ETHOLOGY

ZOOGEOGRAPHY


**PRACTICAL**

**EVOLUTION, ETHOLOGY AND ZOOGEOGRAPHY**

36 Hrs

Credit 1

1. Identification of Zoogeographical realms using map
2. Study on endemic species of each realm
3. Show the discontinuous distribution of (lung fishes, camel, elephant)
4. Providing a map trace the route of HMS Beagle
5. Providing a map mark any two continental/oceanic islands.: Greenland, Madagascar, New Zealand, New Guinea, Maldives, Iceland, Hawaii – any two
6. Contributions of scientists (showing photos) - Any four
7. Identification of different stages of horse evolution
8. Study on Homology and Analogy
10. Pheromone traps
11. Skinner box & T Maze
12. Experiment to demonstrate phototaxis and chemotaxis using Drosophila/House fly
13. Identification of behaviour (Grooming/courtship dance of flamingos/stickle back fish/ Tail wagging dance/ Aggressive behaviour/ Auto/Allo grooming, Flehmen response) showing pictures (Any five)

SEMESTER V. ZY5CRT08

CORE COURSE VIII

HUMAN PHYSIOLOGY, BIOCHEMISTRY, 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.

**HUMAN PHYSIOLOGY**

<table>
<thead>
<tr>
<th>Module I</th>
<th>8 Hrs</th>
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<tbody>
<tr>
<td><strong>Digestion:</strong></td>
<td>Anatomy and histology of digestive glands (liver, pancreas, salivary, gastric and intestinal). Digestion and absorption of carbohydrates, proteins and fats. Nervous and hormonal control of digestion.</td>
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<th>Module II</th>
<th>8 Hrs</th>
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<tr>
<td><strong>Circulation:</strong></td>
<td>ESR, Haemopoiesis, blood pressure, ECG. Haemostasis (blood coagulation) – clotting factors, intrinsic and extrinsic pathways, anticoagulants and its mechanism of action. Cardiovascular diseases (Jaundice, Atherosclerosis, Myocardial infarction, Thrombus, Stroke). Angiogram and angioplasty.</td>
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<th>Module III</th>
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<th>Module IV</th>
<th>10 Hrs</th>
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**Nerve physiology:** Ultra structure of neuron. Nerve impulse production (resting membrane potential, action potential), transmission of impulse along the nerve fiber, interneuron (synaptic) transmission, neuromuscular junction and transmission of impulses. Neurotransmitters (acetyl choline, adrenalin, dopamine). EEG. Memory, Neural disorders (brief account on Dyslexia, Parkinson’s disease, Alzheimer’s disease, Epilepsy).

**Muscle physiology:** Ultra structure of striated muscle, muscle proteins (myosin, actin, tropomyosin, troponin), Muscle contraction and relaxation-Sliding Filament Theory, cross bridge cycle, biochemical changes and ATP production in muscle, Cori cycle. Kymograph, Simple muscle twitch, muscle fatigue, tetanus, rigor mortis.

**BIOCHEMISTRY**

**Module V**

**Carbohydrates:** Basic structure, biological importance and classification of monosaccharides, oligosaccharides, polysaccharides with examples.

**Proteins:** Basic structure and classification of amino acids; structure, biological importance and classification of proteins with examples.

**Lipids:** Structure of fatty acid, saturated and unsaturated fatty acid, biological importance and classification of lipids with examples.

**Vitamins and minerals:** Major fat soluble and water soluble vitamins. Important minerals and trace elements required for living organisms. Biological importance of vitamins and minerals.

**Enzymes:** Chemical nature of enzymes, enzyme activation, enzyme inhibition, allosteric enzymes, isoenzymes, co-enzymes. Michaelis–Menten enzyme kinetics.

**Module VI**

**Carbohydrate metabolism:** Glycogenesis, Glycogenolysis, Gluconeogenesis, Hexose monophosphate Shunt, Glycolysis, Citric Acid Cycle, Electron Transport Chain and ATP synthesis. Ethanol metabolism.

**Protein metabolism:** Deamination, Transamination, Transmethylation, Decarboxylation, Ornithine cycle.
Lipid metabolism: Biosynthesis of fatty acids, Beta oxidation, physiologically important compounds synthesized from cholesterol.

ENDOCRINOLOGY

Endocrinology and reproduction

Module VII

Endocrine physiology: Hormones – classification and mechanism of hormone action. Major endocrine glands (Histology is not included) their hormones, functions and disorders (hypothalamus, pituitary gland, pineal gland, thyroid gland, parathyroid gland, islets of Langerhans, adrenal gland),. Homeostasis and feedback mechanism.

References


Arthur C. Guyton and John E. Hall; 2016; Text Book of Medical Physiology: Guyton, 13th edition; Elsevier


Bhagavan, N.V.. 2007. Medical biochemistry, fourth edition Academic Press,


Jain, A K.; 2016; Textbook of Physiology,. Avichal Publishing Company


Melmed, Shlomo, Williams, Robert Hardin; 2011; Textbook of Endocrinology: Elsevier, 12th edition

PRACTICAL

HUMAN PHYSIOLOGY, BIOCHEMISTRY, AND ENDOCRINOLOGY

36 Hrs
Credit 1

HUMAN PHYSIOLOGY
1). Determination of haemoglobin content of blood
2). Total RBC count using Haemocytometer
3). Total WBC count using Haemocytometer
4). Estimation of microhaematocrit
5). Effect of hypertonic, hypotonic and isotonic solutions on the diameter of RBC.
6). Instruments: Kymograph, Sphygmomanometer and Stethoscope (principle and use)
7). Measurement of blood pressure using sphygmomanometer (demonstration only)

BIOCHEMISTRY
1. Qualitative analysis of protein, glucose, starch and lipids.
2. Chromatography – Determination of Rf value of amino acids and identification of amino acids (Identify the Amino Acids using different solvent front and solute front)

ENDOCRINOLOGY
1. Cockroach – Corpora cardiaca & Corpora allata (Demonstration)
2. Effect of adrenalin on heart beat of Cockroach (Demonstration)
SEMESTER VI. ZY6CRT09

CORE COURSE IX

DEVELOPMENTAL BIOLOGY

54 Hrs
3 Credits

Objectives:

1. To achieve a basic understanding of the experimental methods and designs that can be used for future studies and research.
2. To provide the students with the periodic class discussions of current events in science which will benefit them in their future studies in the biological/physiological sciences and health-related fields.
3. To contribute to the critical societal goal of a scientifically literate citizenry.

Module 1

Introduction: Definition, Scope of developmental biology, sub-divisions (descriptive, comparative, experimental and chemical), historical perspectives, basic concepts and theories.


Egg types: Classification of eggs based on the amount, distribution and position of yolk. Mosaic and regulative, cleidoic and noncleidoic eggs. Polarity and symmetry of egg.

Fertilization: Mechanism of fertilization-(Encounter of spermatozoa and Ova, Approach of the Spermatozoon to the Egg, Acrosome Reaction and Contact of Sperm and Ovum, Activation of Ovum, Migration of Pronuclei and Amphimixis, ), Significance of fertilization, Polyspermy, Parthenogenesis- Different types and significance.

Module II

Blastulation: Morula, blastula formation, types of blastula with examples.

Fate maps: Concept of fate maps, construction of fate maps (artificial and natural), structure of a typical chordate fate map. Significance of fate map.


Module III


Module IV

Experimental embryology: Spemann’s constriction experiments, Organizers and embryonic induction. Embryo transfer technology, cloning, stem cell research. Ethical issues.

Teratology / Dysmorphology, Developmental defects: Teratogenesis, important teratogenic agents. (Radiations, chemicals and drugs, infectious diseases) genetic teratogenesis in human beings.


Module V

5 Hrs
General topics: Classification and functions of placenta in mammals. Prenatal diagnosis (Amniocentesis, Chorionic villi sampling, Ultra sound scanning, Foetoscopy, Maternal serum alpha-fetoprotein, Maternal serum beta-HCG). Regeneration in animals.

References


Chruch Livingston 17th Ed.

Balnisky B.I.; 1981 An Introduction to Embryology, W.B. Saunders and Co.


Dutta 2007 Obstrestics , Church Livingston 17 Ed

Majundar N. N -1985 Vetebrate embryology; Tata McGraw-Hill, New Delhi

Melissa A & Gibbs, 2006; A practical Guide to Developmental Biology, Oxford university press (Int. student edition)


Vijayakumarn Nair, K. & George, P. V. 2002. A manual of developmental biology,

Continental publications , Trivandrum


PRACTICAL

DEVELOPMENTAL BIOLOGY

36 Hrs

Credit 1

Model/Chart/ Slide may be used
1. Embryological studies- Blastula (frog, chick)
2. Embryo transfer, cloning, gastrula (frog, chick)
3. Amniocentesis
4. Embryotransfer technology, cloning
5. Study of placenta- pig and man
6. 18 hour, 24 hour, 33 hour and 48 hour chick embryo.
7. Candling method.
9. Male and female reproductive organs in cockroach
10. Calculate the fecundity of fish.
11. Calculate the gonado-somatic index of given fish.

**SEMESTER VI. ZY6CRT10**

**CORE COURSE X. MICROBIOLOGY AND IMMUNOLOGY**

3 Credits

**MICROBIOLOGY**

**Module I**

10 Hrs

(bacteria, fungus & virus)

Methods in Microbiology: Sterilization and disinfection - physical and chemical methods.

Culture media – selective media, enrichment media, differential media. Plating techniques and isolation of pure colony. Culture preservation techniques: refrigeration, deep freezing, freezing under liquid nitrogen, lyophilization.

**Module II**

15 Hrs

Morphology and fine structure of bacteria: Size, shape, cilia, pili, flagella, capsule, cell wall and its composition. Cytoplasmic membrane, protoplast, spheroplast, intracellular membrane systems, cytoplasm, vacuoles, genetic material, cell inclusions, bacterial spores.
Bacterial growth Curve, Staining techniques – gram staining.


**Module III**

8 Hrs

Infections & Diseases: Types of infections – primary, secondary and nosocomial infections. 

(Brief Account only) Contagious diseases – epidemic, endemic and pandemic, mode of Transmission – food, water, air, vectors and carriers.

Diseases: Epidemiology, symptomology, diagnosis and treatment. Bacterial - Clostridium tetany (tetanus), Viral – HIV virus (AIDS), fungal –*Candida albicans* (candidiasis).

**IMMUNOLOGY**

**Module IV**

9 Hrs

Introduction to Immunology: Innate and acquired immunity, passive (natural and artificial) and active immunity (Natural and Artificial). Mechanisms of innate immunity - barriers, inflammation, phagocytosis.

Lymphoid organs: Primary (Thymus, Bone marrow) and secondary lymphoid organs (lymph nodes, spleen).

Lymphocytes: T and B cells, Natural killer cells, memory cells, macrophages.

**Module V**

9 Hrs

Antigens, Types of antigens, haptens, adjuvants, immunoglobulin structure, classes and functions of immunoglobulins.

Types of Immunity- , humoral & cell mediated immunity Monoclonal & polyclonal antibodies

Antigen – antibody reactions, Precipitation test, Agglutination test, VDRL WIDAL, ELISA.

66
Auto immune diseases: Pernicious Anemia, Rheumatoid Arthritis. Immunodeficiency - AIDS. Hyper sensitivity- Type I, (E.g. Anaphylaxis) II( Transfusion reaction) , III (Arthus reaction) and IV (Mantaux Test) (in brief).

**Vaccines**

Introduction Types of vaccines, Current Vaccines, Recent trends in vaccine preparation

**References**

5. Susan Panicker & George Abraham (Editors) (2008), Micro Biology and Immunology, Zoological Society of Kerala, Kottayam.
6. Colemen: (2002). Fundamentals of Immunology
8. Hans G. Sch, Legal General Microbiology, Seventh Ed. Cambridge Low Price Ed.
1. Instruments – Autoclave, Hot air oven, Bacteriological incubator – Laminar air flow
2. Preparation of solid and liquid media for microbial cultures.
   (Ingradients, 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.
3. Culture methods (Demonstration)
   (a) Streak plate technique and isolation of pure colonies.
   (b) Lawn culture (c) Pour plate culture (d) Liquid culture
4. Examination of microbes in living condition
   Hanging drop method for demonstrating motility of bacteria.
6. Antibiotic sensitivity test (demonstration only)
7. Streak plating (individual performance)
8. Preparation of a fungal smear – Lactophenol cotton blue staining and mounting
9. Determination of ABO blood groups and Rh factor (Antigen – antibody Reaction)
10. Study through photographs/ illustration, the primary immune (Bone marrow and thymus) and secondary immune (spleen and lymph nodes) organs in Rat/Man

SEMESTER VI. ZY6CRT11
CORE COURSE XI.
BIOTECHNOLOGY, BIOINFORMATICS AND MOLECULAR BIOLOGY

BIOTECHNOLOGY 20 Hrs
Module I

Introduction: Scope, Brief History, Scope and Importance

Tools and Techniques in Biotechnology: Enzymes (restriction endonucleases, ligases, linkers & adapters), Vectors-[ Plasmids, Phage vectors, Cosmids, Artificial Chromosomes] Host cells. Basic steps & techniques in rDNA technology


Module II

Animal Cell Culture: Brief account on methods, substrates, media and procedure of animal cell culture, Stem Cells, types and potential use, Organismal Cloning- reproductive & therapeutic- brief account only.

Applications of Biotechnology: Applications in Medicine (insulin, growth hormone, gene therapy), Agriculture (GM plants and biopesticides), Environment (bioremediation), Industry (Single Cell Protein) and applications of Fermentation Technology- lactic acid, vitamins, food and beverages.

Potential Hazards of Biotechnological Inventions: Risks related to genetically modified organisms (GMO) and biologically active products, Biological warfare & Biopiracy. Protection of biotechnological inventions. Intellectual Property Rights, Patenting and patent protection.

References


**BIOINFORMATICS** 14 Hrs

**Module III** 8 Hrs

Introduction: Definition, importance and role of bioinformatics in life sciences. Computational Biology.

Biological databases: Nucleotide sequence databases (NCBI- GENBANK, DDBJ and EMBL). Protein databases - structure and sequence databases (PDB, SWISSPROT and UNIPROT). Introduction to Sequences alignments: Local alignment and Global alignment, Pair wise alignment (BLAST and FASTA] and multiple sequence alignment. Phylogenetic Tree construction and Analysis

**Module IV** 6 Hrs

Molecular visualization software - RASMOL. Basic concepts of Drug discovery pipe line, computer aided drug discovery and its applications. Human Genome Project.

**MOLECULAR BIOLOGY** 20 Hrs

**Module V** 8 Hrs

Nature of Genetic Materials: Discovery of DNA as genetic material – Griffith’s transformation experiments. Avery Macarty and Macleod, Hershey Chase Experiment of Bacteriophage infection, Prokaryotic genome; Eukaryotic genome. Structure and types of
DNA & RNA. DNA replication. Modern concept of gene (Cistron, muton, recon, viral genes). Brief account of the following—Split genes (introns and exons), Junk genes, Pseudogenes, Overlapping genes, Transposons.

Module VI

12 Hrs

Gene Expressions: Central Dogma of molecular biology and central dogma reverse, one gene-one enzyme hypothesis, One gene-one polypeptide hypothesis Characteristics of genetic code, Contributions of Hargobind Khorana.

Protein synthesis [prokaryotic]: Transcription of mRNA, Reverse transcription, post transcriptional modifications, Translation, Post translational modifications.

Gene regulations: Prokaryotic (inducible & repressible systems) Operon concept - Lac operon and Tryptophan operon, Brief account of Eukaryotic gene regulation.

References


PRACTICAL.

BIOTECHNOLOGY, BIOINFORMATICS & MOLECULAR BIOLOGY

BIOTECHNOLOGY
1. Identify and comment on the item provided: (Western blotting / Southern blotting / Northern blotting / PCR)
2. Write down the procedure involved in DNA isolation

BIOINFORMATICS

1. Download/use print out/pictures of genome sequences of any 2 organisms. Identify and mention the characteristic features of both.
2. Download/ use print out/pictures of a protein sequence, identify it & comment on its amino acid composition
3. Download / use print out/pictures of a macromolecule. Write a brief note on the bioinformatics tool used to visualize its structure.

MOLECULAR BIOLOGY

1. Identify and comment on its molecular composition / structural orientation / functional significance (Any tissue / Cell organelles/ DNA, DNA replication, RNA different types using models or diagrams)

V1 SEMESTER. ZY6CRT12

CORE COURSE XII

OCCUPATIONAL ZOOLOGY .
(APICULTURE, VERMICULTURE, QUAIL FARMING & AQUACULTURE)

54 Hrs
Credits 3

Objectives:

1. To equip the students with self employment capabilities.
2. To provide scientific knowledge of profitable farming.
3. To make the students aware of cottage industries.

Module 1. APICULTURE 18 Hrs

Activity: Visit to an apiculture unit.
Field visit and report submission - 10 Hrs
Field visit and report submission on any two items are taken for internal evaluation.

MODULE: 2. VERMICULTURE 
8 Hrs


Activity: Submission of a report after preparing a vermiculture unit or visiting a vermicomposting unit.

MODULE: 3. 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.

MODULE: 4. AQUACULTURE. 
24 Hrs

Advantages and salient features of aquaculture, Types of Aquaculture, Biotic and abiotic features of water, Importance of algae in aquaculture, Common cultivable fishes of Kerala, Fish diseases, Composite fish culture, Integrated fish culture, Carp culture, Prawn culture, Mussel culture, Pearl culture. Processing & Preservation.
Aquarium management - Setting up of an aquarium, Biological filter & Aeration, Breeding of gold fish, gourami (Osphronemus), fighter and Guppy (live bearer). Nutrition and types of feed for aquarium fishes, Establishment of commercial ornamental fish culture unit. Fish Transportation - Live fish packing and transport Common diseases of aquarium fishes and their management. Aquaponics (a brief introduction only).
Activity – Setting up of an Aquarium
Field visit – Visiting an Aquaculture farm

References

NPCS Board, The complete book on Bee keeping and honey processing, NIIR Project consultancy services, 106E, Kamala nagar, Delhi- 110007.
Pradip.V.Jabde , Text book of applied zoology, 2005
Applied Zoology, Study Material Zoological Society of Kerala , CMS college Campus
Chauhan, H.V.S. Poultry, Disease, diagnosis and treatment, Wiley eastern Ltd Delhi.
Otieno.F.O 2014. Quail farming: markets & market strategies
Pillai T.V.R., Aquaculture, principles and practices.
Farm made aquafeeds. FAO fisheries Technical paper, 343.
MPEDA, A hand Book on AquafarmingOrnamentalfishes, MPEDA, Kochi.
Amber Richards. 2014. Aquaponics at home.
Addison Webb, Bee Keepingfor profit and pleasure, Agrobios Ltd.
Applied Zoology, Study Material Zoological Society of Kerala , CMS college Campus
George cust& Peter Bird, Tropical Fresh water Aquaria, Hamlyn London.
Verreth J. Fish larval nutrition, Chapman & Hall Publ.
Bone Packer. 2014. Aquaponic system
PRACTICAL
OCCUPATIONAL ZOOLOGY

36 Hrs
Credit 1

1. General Identification, Economic importance, Morphology, scientific names and common names of the following

   a) Economic important and morphology of culturable fishes (Catla, Rohu, Grass carp, Common carp, Silver carp, *Etroplus suratensis*, *Oreochromis* /Tilapia*, *Mugil cephalus* and *Anabas Testudineus* )

   b) Identification and morphology of ornamental fishes (gold fish, fighter, Gourami, Angel fish, Guppy)

   c) Two species of earthworms used in Vermiculture

   d) Four species of honey bees

   e) Economic importance and morphology of shell fishes (Any three species of prawn, two marine mussels, two oysters one rock oyster - *Crasostria* and pearl oyster - *Pinctada fucata* and freshwater mussel - *Lamellidens marginalis*).

2. Castes of bees

3. Principle & uses of - Aquarium filters, Aquarium aerator, Aquarium plants, Oven, Pelletiser, Screw Press, die plate

4. Identification and study of fish parasites and diseases (five numbers each) using slides/pictures

5. Bee keeping equipments, Beehive, Smoker, honey extractor, Queen Cage,

6. Bees wax, Honey, Vermicompost (Identification-Uses)

7. Formulation of artificial feed for aquarium fishes – demonstration

8. Tests for determining the adulteration in honey.

9. Mounting of pollen basket

10. Mounting of mouth parts of honey bee

11. Separation of cocoon from worm castings.
SEMESTER V. OPEN COURSES (FOR OTHER STREAMS)

ZY5OPT01

1. VOCATIONAL ZOOLOGY

72 Hrs

4 Hrs/Week, Credits 3

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
➢ To acquire basic knowledge and skills in aquarium management, Quail farming, vermicomposting and apiculture for self-employment
➢ To learn the different resources available and to develop an attitude towards sustainability
➢ Give awareness to society about need for waste management and organic farming

Module 1  Aquarium management 12 Hrs

General introduction to Aquarium, Aims and types of aquarium (material, size and shape), Requirements of an aquarium- filtration of waste, physical, chemical and biological; Setting an aquarium (self-sustainable with biological filters), Major indigenous aquarium fishes of Kerala.

Activity: Setting up of a freshwater aquarium and rearing of aquarium fishes

Module 2  Ornamental Fish Culture 20 Hrs

Introduction to ornamental fishes: Present status of ornamental fish culture in India with special reference to Kerala, Breeding of Gold fish, Fighter, Gourami (Osphroneus), and Guppy (live bearer). Nutrition and types feed for aquarium fishes, Use of live fish feed organisms in Ornamental fish culture. Methods and techniques involved in the formulation of fish feed. Fish Transportation: Live fish packing and transport, Common diseases of
aquarium fishes and their management. Establishment of commercial ornamental fish culture unit,

**Activity:** field visit to an ornamental fish breeding Centre to understand breeding practices of various aquarium fishes.

**Module 3 Quail farming** (*Coturnix coturnix*) **10 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.

**Activity:** Visit to a quail farm or viewing a quail documentary to familiarize the quail farming practices

**Module 5 Vermiculture and composting** **12 Hrs**
Introduction, ecological classification of earth worms, Life history, Species of earth worms used for vermiculture, Preparation of vermi-bed; Preparation of vermicompost, Preparation of vermi-wash, Maintenance and management of vermicomposting unit, Role of vermiculture in solid waste management.

**Activity:** - Preparation of a vermiculture unit or visit to a vermicomposting unit.

**Module 6 Apiculture** **18 Hrs**
Definition, Uses of bees, species 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, Death period, Enemies of bees, Bee diseases, uses of honey and wax, Apitherapy, Propolis, Royal jelly, Agencies supporting apiculture.

**Activity:** Identify different types of honey bees and rearing equipments

**Field visit and report Submission**
Field visit and report writing on any two items are taken for internal evaluation, instead of assignment and seminar. Conduct a workshop on various cultural practices and the preparation of byproducts.

**References**

2. *Addison Webb (1947), Bee Keeping- for profit and pleasure, Museum Press, agro bios India Ltd.*
OPEN COURSE (FOR OTHER STREAMS)

ZY5OPT02

2. PUBLIC HEALTH AND NUTRITION

72 Hrs

4hrs/Week

Credits 3

Objectives:

- To inculcate a general awareness among the students regarding the real sense of health.
- To understand the role of balanced diet in maintaining health.
- To motivate them to practice yoga and meditation in day-to-day life.

PART I HEALTH, EXERCISE & NUTRITION

Module 1 Definition and Meaning of Health 10 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

Module 2 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

Module 3 Safety Education in Health promotion 8 Hrs

Principles of Accident prevention
Health and Safety in daily life.
Health and Safety at work.
First aid and emergency care.
Common injuries and their management.
Modern life style and hypokinetic diseases.
Diabetes, Cardiovascular disorders-Prevention and Management.

**Module 4  Life Skill Education** 8 Hrs
Life skills, emotional adjustment and well being,. Yoga, Meditation and Relaxation, Psychoneuroimmunology

**PART II PUBLIC HEALTH AND SANITATION**

**Module 5  Public health and water quality.** 11 Hrs
Potable water, Health and Water quality
Faecal bacteriae and pathogenic microorganisms transmitted by water. Determination of sanitary quality of drinking water, water purification techniques

**Module 6  Public health and diseases** 15 Hrs
Food borne diseases and Prevention
Botulinum, Salmenellosis, Hepatitis A
Vector borne diseases & Control measures
Chikungunya, Filariasis and Dengue fever
Zoonotic disease-Leptospirosis & its control
   Emerging diseases - Swine flue (H1N1), bird flue (H5N1), SARS, Anthrax
Re-emerging diseases –TB, Malaria

**Health Centre visit & Report Presentation** 10 Hrs

**References:**

SEMESTER V.

OPEN COURSE (FOR OTHER STREAMS)

ZY5OPT03

3. MAN, NATURE AND SUSTAINABLE DEVELOPMENT

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

Module I. Man in Nature

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

Module II. The Biosphere

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  

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

**Module IV.Natural Resources**  
7 Hrs  
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  

**Module V.Global Environmental Issues Threatening Natural Resources and Human Life**  
10 Hrs  
Deforestation, Landscape alterations, Soil erosion, Flood and Drought, Desertification, Overexploitation, Pollution (Air, Water and Soil- Pollutants and Consequences only), Acid rain, Ozone depletion, Greenhouse 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
Module VI. Man’s Perspective on Nature  
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

Module VII. Global Strategies for Conservation  
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

Module VIII Sustainable Development  
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

References
Encyclopedia Britannica Inc.UK


Gandhi, M.K. - *Writings on Ecology*


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**SEMESTER VI.**

**ZOOOLOGY CORE CHOICE BASED COURSES**

**FOR B.Sc. ZOOLOGY PROGRAMME**

**ZY6CBT01. ELECTIVE COURSE.**

1. **ECOTOURISM & SUSTAINABLE DEVELOPMENT**

    72 Hrs
    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
4. To equip the students with basic knowledge for the emerging ecotourism industry

**Module I. Fundamentals of Tourism** 12 Hrs
Introduction - Tourism, concepts and definitions
History, types, Characteristics
The facilitating sectors
Attractions
Geography, heritage
Wildlife, nature
Quality Control

**Module II. Major areas of eco-tourism** 10 Hrs
Concepts, practices and case studies for each:
Marine tourism
Wildlife tourism
Adventure tourism

**Module III. Emerging trends in eco-tourism** 10 Hrs
Cultural tourism
Pilgrimage tourism
Farm tourism
Backwater tourism
Health tourism

**Module IV. Problems and prospects of eco-tourism** 10 Hrs
Economics and benefits of ecotourism
Cultural issues and negative aspects of ecotourism
Environmental Impacts of Tourism

**Module V. Sustainable tourism** 12 Hrs
Quality, Standards
Systems of sustainable tourism: environmental, sociocultural, Economical
Environment and conservation: basic principles
Current practices of eco-conservation in tourism industry
Sustainable tourism and society
Community based ecotourism
Eco-development committee (EDC) of Periyar Tiger Reserve
People initiatives
Module VI. Eco-tourism guides

Ecotourism guiding and case studies

Activity

Field visit to Ecologically relevant places & Report writing

References


ELECTIVE COURSE . ZY6CBT02

2. AGRICULTURAL PEST MANAGEMENT

4 Hrs/week - 3 Credits

Objectives

1. To acquire basic skills in the observation and study of nature.

2. To impart basic awareness regarding pest problem and crop loss due to their dominance.

3. To inculcate interest in adopting biological control strategies for pest control.

4. To understand various pests affecting our local crops and select the best method for their control
5. To acquire basic knowledge and skills in agriculture management to enable the learner for self-employment.

**Module I**

5 Hrs


**Module II**

15 Hrs

**Pest categories:** Types of pests- insect pest and non-insect pest.

**Insect pest:** insect structure and function-external features (body parts), mouth parts of phytophagous insects, internal anatomy, growth, development, reproduction, life cycle and metamorphosis (one example each from ametabolous, hemimetabolous and holometabolous insect), diapause. types of insect pests-key pests, occasional pests, potential pests.

**Non insect pests:** General features, different types-Rodents(mention the nature of crop loss by them). Mites-Main types of mites; plant injury caused by mite, millipedes and centipedes, slugs and snails (mention the damage of invasive Giant African Snail).

**Activity:** Identify a minimum of 5 invasive species (plant / animal) in your locality and make a report on their ecological impact.

**Module III**

7 Hrs

**Pest and plants:** Plant feeding insects-plant host range, types of injury, relationship of pest injury and yield.

**Host plant resistance:** Characterization of resistance, mechanism of resistance (antixenosis, antibiosis, tolerance), biophysical, biochemical and genetic bases of resistance.

**Module IV**

20 Hrs

**Pest control-principles and practices:** Types of control-cultural control, biological control, chemical control, integrated pest management, miscellaneous control.
Cultural control: Water management, tillage, sanitation, plant diversity, crop rotation, planting time, harvesting practices etc

Biological control: Parasitoids and predators, control by insect pathogens. Techniques in biological control-conservation, introduction and augmentation. Biopesticides

Chemical control: Origin of chemical control, chemistry, mode of action and nomenclature (organochlorines, organophosphates, carbamates, synthetic pyrethroids, miscellaneous group) of pesticides, pesticide formulations and pesticide appliances (sprayers and dusters). Brief mention of attractants, repellents, chemosterilants and pheromones

Activity 1: Conduct a workshop on preparation of biopesticides of various types suitable for kitchen garden and agricultural fields.

Integrated Pest Management (IPM)

Miscellaneous control: Mechanical (hand picking, exclusion by screens and barriers, trapping, clipping, pruning etc), physical (hot and cold treatment, moisture, light traps etc), sterility principle

Module V

Bionomics and control of major pests of crops and stored grains: Biology, life cycle and nature of damage by different pests of following crops and their control

Pests of paddy: Leptocorisa acuta, Scirpophaga incertulas, Spodoptera mauritia, Orseolia oryzae, Nilaparvata lugens

Pests of coconut: Oryctes rhinoceros, Rhyncophorus ferrugineus, Opisina arenosella, Aceria guerreronis

Pests of Banana: Cosmopolites sordidus, Pentalonianigneronvosa

Pests of vegetables - Brinjal: Leucinodesorbonalis, Euzopheraperticella, Henosepilachnavigintioctopunctata, Urentiushystricellus

Gourds -Bactoceracucurbitae, Anadevidiapeponis, Epilachna spp. Raphidopalpafoveicollis, Baristrichosanthis
**Pest of stored grains:** Sitophilusoryzae, Corcyra cephalonica Triboliumcastraneum, Trogodermagranarium, Callasobruchuschinensis

**Activity 2:** Conduct a poster exhibition on various types of pests of paddy, coconut, banana and vegetable varieties of Kerala.

**Activity 3:** Collect different types of pest of stored grains from the local provision shops or houses and make a taxonomic study and prepare a powerpoint presentation on them.

**Activity 4:** Visit a minimum of 5 kitchen gardens in the neighborhood and enlist the common traditional pest control measures used in them.

**Activity 5:** Organise awareness classes on the ill effects of chemical pesticides and manure on human health with the support of local examples.

**References**


ELECTIVE COURSE. ZY6CBT03.

3. VECTOR AND VECTOR BORNE DISEASES

72 Hrs

3 Credits

Objectives:

Module I


Insect vectors: Mosquitoes, flies, fleas, lice, ticks and bugs- General account of ecology morphology and mouth parts

Module II

Salient features and distribution of mosquito species: Anopheles, Aedes, Culex, and Mansonia.

Module III


Module IV

Introduction to Vector control: Aims, objectives and advantages. History and background, recent trends, alternatives to the use of insecticides (chemical & microbial), types of vector control - selective, integrated and comprehensive vector control.

Control measures of mosquitoes, sand fly, tsetse fly and domestic flies

Module V

8 Hrs

Introduction to epidemiology: History, Definition, scope and uses of epidemiology. Epidemiology and public health. Achievements in epidemiology: Smallpox Methyl mercury
poisoning Rheumatic fever and rheumatic heart disease Iodine deficiency diseases Tobacco use, asbestos and lung cancer, Hip fractures. HIV/AIDS, SARS.

Field report on two case studies of epidemiology in India. 10 Hrs

References


ELECTIVE COURSE. ZY6CBT04

4. NUTRITION, HEALTH AND LIFESTYLE MANAGEMENT

72 Hrs.
3 Credits

Objectives:

1. To provide students with a general concept of health and the parameters that define health and wellness.

2. To understand principles of nutrition and its role in health.

3. To familiarize the students regarding food safety, food laws & regulations.

4. To provide knowledge and understanding regarding life style diseases.

5. To promote an understanding of the value of good life style practices, physical fitness and healthy food habits for life style disease management.

Module I

15 Hrs

Nutrition and health: Nutritional requirements of man, classification of major nutrients
including protein, vitamins and minerals, water, role of fibre, biological value of food components, food groups and sources, balanced diet, RDA, BMI, BMR, Calorie intake and expenditure, Healthy eating pyramid, Nutrition in infancy, preschool, school, adolescent, pregnancy, lactation and old age. Nutrition in diseases and special conditions. Food safety: Nutrition education, food sanitation and hygiene, food adulteration and consumer protection.

**Module II**

**18 Hrs**


**Module III**

**15 Hrs**

Introduction to Life style diseases

Common life style diseases: Alzheimer’s disease and other neural disorders, asthma, cancer, cardio vascular diseases - including hypertension, Atherosclerosis and stroke, chronic obstructive pulmonary disease, Diabetes Mellitus or Type 2 Diabetes, kidney disorders and chronic renal failure, constipation, depression, gastro-intestinal disturbances including diarrhoea and peptic ulcer, liver cirrhosis and other liver diseases, obesity, osteoporosis, occupational lifestyle diseases.

Modern lifestyle disorders: sleeping habits, junk food, poor eating habits, anxiety, food poisoning

**Module IV**

**10 Hrs**

Causes of lifestyle diseases: Defects of modern food habits and unbalanced diet options, food adulteration, environmental pollution, poor life style choices, drug abuse, tobacco smoking, alcohol and drug consumption, lack of adequate exercise, wrong body posture,
disturbed biological clock, stressful environmental conditions

**Module V**  
14 Hrs

Prevention and control of life style diseases:

Healthy life style habits and practices, healthy eating habits, exercise and fitness, good sleep patterns, a strict no to alcohol, drugs, and other illegal drugs. Uncontrollable factors like age, gender, heredity and race.

Healthy diet: disease prevention through appropriate diet and nutrition, avoiding foods that are high in fats, salt and refined products. Avoid junk food and replace by natural food/organic food.

Physical exercise: Moderate exercise for fitness of body, walking, stretching, right postures of sitting & standing, relaxation and cutting down of stress, sports, aerobic exercise and yoga.

Health literacy as a public health goal: Awareness programs in schools, colleges and through mass media.

**References**


13. COMPLEMENTARY ZOOLOGY COURSES OFFERED BY ZOOLOGY DEPARTMENT FOR - MODEL I – BSc BOTANY / BSc HOME SCIENCE

MODEL II – BSc BOTANY, BSc (AQUACULTURE)

MODEL III – BSc (BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION)
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99
COMPLEMENTARY COURSE : ZOOLOGY –MODEL I

SEMESTER I. ZY1CMT01.

COMPLEMENTARY COURSE 1
NON CHORDATE DIVERSITY

36 hrs
Credits 2

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 unity of life with rich diversity of organisms & evolutionary significance of certain invertebrate fauna.
4. To stimulate the curiosity of students’ in the biota living around them.

Module I

10 Hrs

Introduction:  Five kingdom classification

Kingdom Protista: Salient features (any five important salient features) of each phylum with one example each (detailed account of example is not necessary).

- Phylum Rhizopoda (eg: Amoeba)
- Phylum Actinopoda (eg: Actinophrys)
- Phylum Dinoflagellata (eg: Noctiluca)
- Phylum Parabasalia (eg: Trychonympha)
- Phylum Metamonda (eg: Giardia)
- Phylum Kinetoplasta (eg: Trypanosoma)
- Phylum Euglenophyta (eg: Euglena)
- Phylum Cryptophyta (eg: Cryptomonas)
- Phylum Opalinata (eg: Opalina)
- Phylum Bacillariophyta (eg: Diatoms)
- Phylum Chlorophyta (eg: Volvox)
- Phylum Choanoflagellata (eg: Proterospongia)
- Phylum Ciliophora (eg: Paramecium)
- Phylum Sporozoa (eg: Plasmodium)
- Phylum Microsporidia (eg: Nosema)
- Phylum Rhodophyta (eg: Red algae)
General Topic: Pathogenic Protists – Plasmodium, Entamoeba

**Module II**

**Phylum Porifera:** Salient features (eg: Leucosolenia)

**Phylum Coelenterata:** Salient features and classification up to class.
- Class 1: Hydrozoa (eg: Physalia)
- Class 2: Schizophoza (eg: Aurelia)
- Class 3: Anthozoa (eg: Adamsia)

General Topic: Corals and Coral reefs.

**Module III**

**Phylum Platyhelminthes:** Salient features and classification up to class.
- Class 1: Turbellaria (eg: Planaria)
- Class 2: Trematoda (eg: Fasciola)
- Class 3: Cestoda (eg: Taenia solium)

**Phylum Nematoda:** Salient features and classification up to class.
- Class 1: Phasmida (eg: Wuchereria)
- Class 2: Aphanasmida (eg: Trichinella)

**Phylum Annelida:** Salient features and classification up to class.
- Class 1: Polychaeta (eg: Nereis)
- Class 2: Oligochaeta (eg: Pheretima)
- Class 3: Hirudinomorpha (eg: Hirudinaria)

**Module IV**

**Phylum Arthropoda:** Salient features. Type study – *Fenneropenaeus* (Penaeus) - habitat, morphology, appendages, sexual dimorphism, digestive system, respiratory system, circulatory system, excretory system, nervous system, sense organs, reproductive system, larval stages.

Classification up to class with one example each

**Subphylum Trilobitomorpha**
- Class 1: Trilobita (Extinct) (eg: Dalmanites)

**Subphylum Chelicerata**
- Class 1: Merostoma (eg: Limulus)
- Class 2: Arachnida (eg: Spider)
- Class 3: Pycnogonida (eg: Nymphon)

**Subphylum Mandibulata**
- Class 1: Crustacea (eg: Daphnia)
- Class 2: Chilopoda (eg: Centipede)
- Class 3: Symphyla (eg: Scutigerella)
Class 4: Diplopoda (eg: Millipede)
Class 5: Pauropoda (eg: Pauropus)
Class 6: Insecta (eg: Butterfly)

Module V

6 Hrs

Phylum Mollusca: Salient features and classification up to class

Class 1: Aplacophora (eg: Neomenia)
Class 2: Monoplacophora (eg: Neopilina)
Class 3: Polyplacophora (eg: Chiton)
Class 4: Bivalvia (eg: Perna)
Class 5: Gastropoda (eg: Xancus)
Class 6: Cephalopoda (eg: Sepia)
Class 7: Scaphopoda (eg: Dentalium)

Phylum Echinodermata : Salient features and classification up to class.

Class 1: Asteroidea (eg: Astreopecten)
Class 2: Ophiuroidea (eg: Ophiothrix)
Class 3: Echinoidea (eg: Echinus)
Class 4: Holothuroidea (eg: Holothuria)
Class 5: Crinoidea (eg: Antedon)

Phylum Hemichordata : Salient features (eg: Balanoglossus.)

References:
Animal Diversity (2002). Published by Zoological Society of Kerala.
SEMESTER I

COMPLEMENTARY COURSE 1 - PRACTICAL

NON CHORDATE DIVERSITY

36 Hrs

Credit 1

1. Scientific drawing - 5 specimens
2. Simple identification - 10 invertebrates, out of which 5 by their scientific names
4. Dissection - Nervous system of Prawn
5. Dissection - Nervous system of Cockroach
6. Mounting - Prawn Appendages
SEMESTER II. ZY2CMTO2.

COMPLEMENTARY COURSE 2

CHORDATE DIVERSITY

Objectives
1. To make the student observe the diversity in chordates and their systematic position.
2. To make the student aware of the economic importance of some chordates.
3. To learn the physiological and anatomical peculiarities of some vertebrate species through type study.
4. To stimulate the students’ curiosity in vertebrates living associated with them.

Module I 4 Hrs

Phylum Chordata: Fundamental characters and outline classification upto class.

Sub phylum Urochordata: General characters,
Classification:
   Class 1: Larvacea (eg: Oikopleura)
   Class 2: Asciidae (eg: Ascidia), Retrogressive metamorphosis.
   Class 3: Thaliacea (eg: Salpa)

Sub phylum Cephalochordata: Salient features (eg: Branchiostoma)

Module II 6 Hrs

Sub phylum Vertebrata: Salient features

Division Agnatha: salient features and classification
   Class 1: Cyclostoma (eg: Petromyzon)
   Class 2: Class Ostracodermi (eg: Cephalapsis)

Division Gnathostomata: Salient features
   Super class Pisces
   Super class Tetrapoda.

Super class Pisces: Salient features and classification
   Class 1: Chondrichthyes (eg: N arcine)
   Class 2: Osteichthyes (eg: Latimeria)

General Topic: Accessory respiratory organs in fishes.
Module III

Super class Tetrapoda: Salient features

Class 1: Amphibia : Salient features. Type study: *Euphlyctis hexadactyla* - Habitat, morphology, sexual dimorphism, coelom and viscera, skeletal system, digestive system, respiratory system, circulatory system, excretory system, nervous system, sense organs, reproductive system, development..

Classification up to order:
- Order 1: Urodela (eg: Amblystoma)
- Order 2: Anura (eg: Bufo)
- Order 3: Apoda (eg: Ichthyophis)

Module IV

Class Reptilia: Salient features and classification up to subclass

- Sub class 1: Anapsida (eg: Chelone)
- Sub class 2: Diapsida (eg: Chamaeleon)
- Sub class 3: Parapsida (eg: Ichthyosaurus)

General Topics: Poisonous and non poisonous snakes of Kerala.

Class Aves: Salient features and classification up to subclass

- Sub class Archeornithes (eg: Archaeopteryx)
- Sub class Neornithes (eg: Struthio)

General Topics: Flight adaptation of birds

Module V

Class Mammalia: Salient features and classification up to subclass

- Sub class 1: Protheria (eg: Echidna)
- Sub class 2: Metatheria (eg: Macropus)
- Sub class 3: Eutheria (eg: Elephas)

General Topic: General adaptation of aquatic mammals with example.

References

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

Deoras, P.J. (1981). Snakes of India (National Book Trust of India.)


Induchoodan, (1986). Kweralathile Pakshikal (Kerala Sahitya Academy, Trichur).


SEMESTER II

COMPLEMENTARY COURSE 2- PRACTICAL

CHORDATE DIVERSITY

36 Hrs
Credit I

1. Simple identification of 10 chordates, out of which 5 by their scientific names
2. Osteology - Vertebrae and girdles of Frog
3. Snake identification - 3 poisonous and 3 non poisonous snakes with key
4. Mounting of placoid scales of shark
5. Dissections: Frog: Photographs/Diagrams/models may be used for the study.
   1. Frog - Viscera
   2. Frog - Digestive System
   3. Frog - Arterial System
   4. Frog - Brain
Objectives
1. To appreciate the correlation between structure and function of organisms.
2. To make the student aware of the health-related problems, their origin and treatment.
3. To understand how efficiently our immune system work in our body.
4. To acquire knowledge about preventing common diseases rather than curing.

Module I
14 Hrs

Nutrition: Types of nutrition – autotrophy, heterotrophy. Nutritional requirements – carbohydrates, proteins, lipids, minerals (Ca, Fe, I), vitamins (sources and deficiency disorders), nutritional disorders.


Module II
14 hrs


Neurophysiology: Structure of a neuron. Myelinated and non myelinated nerve fibre, nerve impulse production (resting membrane potential, action potential), Impulse propagation, All or none law, saltatory conduction, synaptic transmission. Neurotransmitters (acetyl choline, adrenalin, dopamine), brain waves, EEG. Neural disorders - Parkinson’s disease, Alzheimer’s disease.

Muscle physiology: Types of muscles: striated, non striated and cardiac. Ultra structure of striated muscle, Mechanism of muscle contraction, cori cycle and muscle relaxation. Muscle fatigue, oxygen debt, Rigor mortis.
Module III  8 hrs


Module IV  12 Hrs

Immunology: Introduction to immunology, types of immunity – innate, acquired, passive, active, mechanism of innate immunity (barriers, inflammation, phagocytosis). Types of antigens. Basic structure of immunoglobulins, Classes of immunoglobulins and functions. Antigen antibody reactions, Precipitation test, agglutination test, WIDAL, VDRL, HIV test (ELISA),

Module V  6 Hrs

Immune response system: (Brief accounts of the followings)
Primary and secondary lymphoid organs, Cells of Immune system - T&B lymphocytes, natural killer cells, macrophages, plasma cells , memory cells, Monoclonal antibodies, Hybridoma technology.


REFERENCES
Chakrabarti B K, Ghosh H N & Sahana S N 1984: Human Physiology, the New Book Stall, Calcutta, India
Roger Eckert; D Randall; George Augustine1988: Animal Physiology, Mechanism and Adaptations, W.H Freeman, NewYork
Zoological Society of Kerala, Study material 2002. Biochemistry, Physiology and Developmental Biology Published by Zoological Society of Kerala
SEMESTER III

COMPLEMENTARY COURSE - 3 PRACTICAL

PHYSIOLOGY AND IMMUNOLOGY

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 & uses) - Sphygmomanometer, Stethoscope
SEMESTER IV. ZY4CMT04.

COMPLEMENTARY COURSE - 4

APPLIED ZOOLOGY

54 hrs
Credit 3

Objectives

1. To acquire basic knowledge and skills in applied branches of zoology.

2. To understand the technology for utilising ecofriendly organisms around them for beneficial purpose.

3. To equip the students for self employment opportunities with scientific knowledge to perform profitably & confidently.

Module I

Aquaculture: Advantages of aquaculture, Traditional methods of aquaculture, Biotic and abiotic factors in water, Pond culture – construction and maintenance. Types of aquaculture, composite fish culture, integrated fish culture, induced breeding of carp & prawn, Importance of algae in aquaculture. Aquarium management - Setting up of an aquarium, biological filter and aeration. Common cultivable fishes of Kerala. Fish diseases, Prawn culture, mussel culture, pearl culture, Fish processing and preservation.

Module II

Sericulture: Four species of silkworms, life history of silkworm, silk worm rearing techniques, Mounting of silkworm - Chandrika, defective cocoons, harvesting and stifling of cocoons. Silkworm diseases and pest, preventive and control measures.

Module III


Module IV

References:
Alikunhi, K., H, Fish Culture in India (ICAR, New Delhi)Andhra Pradesh Agricultural University, Hydrabad)
Applied Zoology; (2002) Published by Zoological Society Of Kerala
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)
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)
Kurien, C.V. & Sebastian V.C., Prawn Fisheries in India (Hindustan Publ. Corporation, New Delhi)
Lee, K. E., 1985 Earthworms, Their Ecology and relationships with Soils and Land use. Academicals
Press.
Menon, K.N., 1970 Malsyakrishi (State Institute of language, Trivandrum)
Mysore Silk Association, 1986, Silkworm rearing and Diseases of Silkworms
account of the Oligochaeta of the Travancore
Shukla G.S., & Updhyay V.B., Economic Zoology (Rastogi Publ. Meerut)
Singh, S., 1962 Bee keeping in India (ICAR, New Delhi
Sinh, V.R.P. & Ramachandran, V., 1985, Fresh water Fish Culture (ICAR, New Delhi)

SEMESTER IV

COMPLEMENTARY COURSE - 4 PRACTICAL

APPLIED ZOOLOGY

2 Hrs/week
36 Hrs
Credit 1

1. General identification, economic importance, morphology, scientific names and common
   names of the following
   a. Economic importance and morphology of culturable fishes (Catla, Rohu, Grass carp,
      Common carp, Silver carp, Etroplus, Tilapia)
   b. Two species of earthworms used in Vermiculture
c. Two species of honey bees
d. Silkworm. Cocoon/Adult

2. Castes of honey bees
3. Bee keeping equipments - Bee hive, Smoker, honey extractor
4. Identification and uses - Bee wax, Honey, Silk, Vermicompost
5. Chandrika / Natrika used in sericulture
14. MODEL II
VOCATIONAL COURSES
MODEL II

B.Sc. PROGRAMME
(VOCATIONAL COURSES)

1. B.Sc. (Aquaculture)
2. B.Sc. (Food Microbiology)
3. B.Sc. (Medical Microbiology)
## A. VOCATIONAL COURSES (MODEL II)

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### b. CONSOLIDATED DISTRIBUTION OF HOURS FOR BSc. (MODEL II VOCATIONAL COURSES)

**COURSE STRUCTURE**

- Total Credits: 120
- Total Instructional Hours: 150
- 3 Vocational Programmes: Aquaculture (A) / Food Microbiology (F)/ Medical Microbiology (M)

#### SEMESTER I

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**Total** 25 hrs 16

**SEMESTER II**

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| Total  |                          | 25 hrs | 14   |

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Model II 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 for Theory and at the end of even semester for Practical. Duration of examination is 3 hrs and Internal-External marks ratio is 1:4. The main objective of ‘on the job training’ is to acquaint the students formally to a real life workplace environment. This will help to explore the relationship between knowledge and skill acquired in the college with those required in the working situations. Students are expected to do the OJ in their respective vocational subject related field.

C. SCHEME OF EXAMINATION - VOCATIONAL SUBJECTS

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**(VOCAATIONAL SUBJECT – AQUACULTURE)**

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### SCHEME OF PRACTICAL EXAMINATION (AQUACULTURE)

**Practical Exams at the end of 2nd & 4th semesters**

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### ii. SCHEME OF EXAMINATION - THEORY
(VOCATIONAL SUBJECT – FOOD MICROBIOLOGY)

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### SCHEME OF PRACTICAL EXAMINATION (FOOD MICROBIOLOGY)
Practical Exams at the end of 2nd & 4th semesters

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(VOCATIONAL SUBJECT – MEDICAL MICROBIOLOGY)

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### Scheme of Distribution of Hours and Credit (Vocational Subject – Medical Microbiology)

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e. SYLLABUS
(VOCATIONAL SUBJECTS)
– MODEL II

THEORY & PRACTICAL

1. AQUACULTURE
SEMESTER 1

VOCATIONAL COURSE 1

PRINCIPLES AND METHODS IN AQUACULTURE

Objectives:

1. To make the student understand the basic concepts of the science and practice of aquaculture.
2. To introduce the student to the diverse practices of culturing of aquatic organisms.
3. To encourage the student to take up aquaculture practices as a vocation.

Module 1 4 Hrs

Scope and importance of Aquaculture. Significance of aquaculture compared to other agricultural systems and commercial fisheries. Types of aquaculture – Freshwater, Brackish water and Mariculture. Shell fish culture, Finfish culture, Monoculture, Polyculture.

Module 2 3 Hrs


Module 3 7 Hrs


Module 4 10 Hrs


Module 5 10 Hrs
Fresh water cultivable fishes and their external characters-Indian Major Carps, Catfish, Eel, Tilapia, Ethroplus, Trouts, Mahseer, Channa, Clarius, Anabas, Larvivorous and Weed fishes.
Cultivable species of crustaceans and mulluscs: Identification and external characters. Shrimp, freshwater prawn, crab, lobster, pearl oyster, edible oyster, mussel and clams.

Module 6  
2 Hrs
Brackish water aquaculture-Introduction, the tidal range, salinity and biota.
Major reservoirs of India and their fishery-Constarints in reservoir fisheries.

References


SEMESTER I

VOCATIONAL COURSE 2

HATCHERY AND CULTURE TECHNIQUES

36 hrs
Credits 2

Objectives

1. Introduce the student to the culture practices of various indigenous edible and ornamental finfishes and edible shellfishes.
2. To create an understanding of the different technologies of seed production of common cultivable species.
3. Introduce the student to various live feeds available for aquatic organisms and understand their culture methods.

Module 1 6 Hrs
Hatchery systems – Different types- fin fish (Carp), Mollusc (Edible oyster)- Seed collection, Spat collectors. Crustacean (Penaeid prawn)- Different Components and operation, Description of Larval stages.

Module 2 8 Hrs
Culture of Tilapia and Milk Fish, (Mention lablab and its preparation) production of Monosex in Tilapia.
Culture of Trouts.

Module 3 8 Hrs
Culture of Crustaceans - Penaeid prawns- Seed resources, prawn filtration practices, (Pokkali, Bheries Ghazan lands) ,extensive, semi intensive and intensive, prawn farming.
Crab culture- Crab fattening and growout.

Module 4 8 Hrs
Culture of Bivalve mollusks.- Mussels, Pearl oysters, Edible oysters, Clams. On Bottom and Off bottom culture methods- Stake culture (Bouchot culture), Rack culture (Rack and ren, Rack and tray), Long Line culture and Raft culture.

Module 5 6 Hrs
Culture of ornamental fishes- Types of Aquaria, Aquarium accessories. Setting up and maintenance of Aquaria. Filtration of Aquarium water- Mechanical, Chemical and Biological filtration. Breeding techniques of Aquarium fishes; gold fish (Egg scatterer) and Fighter fish (Bubble nest builder)
Culture of sea weeds and holothurians.
Culture of live feeds- micro algae, artemia, rotifer, daphnia.

References


3. Handbook of Fisheries and Aquaculture Indian Council of Agricultural Research.

4. Hatchery techniques and culture of the Sea cucumber *Holothuria scabra*


8. MPEDA - A Manual on Shrimp Farming

9. MPEDA - Hand book on Shrimp Farming


12. MPEDA Handbook on Aquafarming Live Feed .


SEMESTER II

VOCATIONAL COURSE 3

CAPTURE FISHERY

36 hrs
Credits 2

Objectives:
1. Introduce the student to the fishery potential of Indian waters - marine and inland.
2. To study the major groups of finfishes and shellfishes contributing to the commercial fishery.
3. Introduction to fishing gears and diverse fish catching methods of tropical waters.
4. To develop the concept of fishery as a renewable resource to be managed and study of population dynamics and different management techniques in commercial fisheries.

Module 1
8 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.

Module 2
8 Hrs

Module 3
6 Hrs
Inland capture fishery resources of India – Riverine fisheries, Cold water fisheries resources, Lacustrine fisheries (Estuarine or brackish water fisheries and fisheries of fresh water lakes)- Important species and gears.

Module 4
8 Hrs
Marine Fishery Resources of India- Pelagic fishery- Fisheries of oil sardine, lesser sardine, anchovies, mackerel, ribbon fishes. Demersal fisheries. Fisheries of elasmobranchs, Bombay duck, cat fishes, silver bellies, sciaenids, pomfrets, threadfins, threadfin breams and other perches, Flatfishes, Prawns, Lobsters, Crabs, Mussels, Oysters and Clams – Fishing seasons, abundance and major gears for each group.

Module 5
6 Hrs

References

10. FAO species identification sheets for the western Indian ocean.
SEMESTER II

VOCATIONAL COURSE 4

BIOLOGY OF FISHES

Objectives:
1. To create an understanding about the morphological and anatomical organization of finfishes and shellfishes.
2. Introduce the student to the basic principles of Taxonomy of cultivable organisms.
3. To have an awareness of the fundamental biological aspects of food and feeding, age and growth and reproductive biology.

Module 1 4 Hrs
Need for taxonomy, binomial nomenclature, Data requirements for classification of fishes, Methods for collection of taxonomic data- Morphologic and Meristic data., Study of external morphology of a typical elasmobranch and a typical teleost, Variations in form and structures used in taxonomic studies.

Module 2 12 Hrs
Internal anatomy of fish- Alimentary canal and associated structures. Gills, Swim bladder, Accessory respiratory organs, Heart and circulatory system, skeletal system (Visceral arches, Vertebral column and skeleton of fins only) Nervous and lateral line system, sense organs (eye, ear, olfactory organs)

Module 3 6 Hrs

21. Von Brandt. Fishing gears of the world
22. Website: www.fishbase.org

**Module 4**  
6 Hrs  
Natural food of fishes. Feeding habits and types of feeding in fishes- Carnivorous, Herbivorous and Omnivorous, Predators, Grazers, Suckers, Strainers and parasites.. Feeding habits and method of feeding in prawn, bivalve and cephalopod.

**Module 5**  
8 Hrs  

**References**

2. CMFRI (2005) Winter School on Recent advances in Mussel and Edible Oyster farming & Pearl Production Compiled and edited by Appukuttan K.K.


17. Parihar.R.P. A textbook of Fish Biology and Indian Fisheries.


SEMESTER III

VOCATIONAL COURSE 5

FISHERIES ENVIRONMENT

36 hrs

Credits 2

Objectives
1. To study the environment and their effect on fish populations.

2. Study the use of Remote sensing techniques for the assess fish stocks

3. Introduction to the ancillary marine resources like seaweeds, echinoderms and corals.

4. To understand the different techniques and equipments for the study of environmental parameters and different fish finding devices.

Module 1

Module 2
10 Hrs
Basic marine meteorology- weather, air-sea interactions. Monsoons, seasonal changes, Circulation of water masses, Waves, Tides and sediment transportation.

Module 3
7 Hrs

Module 4
4 Hrs

Module 5
10 Hrs

References


8. Laevatsu and Hayes. Fisheries oceanography


13. Sverdrup et al. The Oceans.

SEMESTER III

VOCATIONAL COURSE 6

FISH NUTRITION

Objectives:
1. To create an understanding on the nutritional needs of aquatic organisms in culture.

2. To make the student have a basic concept of energy budgeting, food additives and varieties of feed ingredients used in Aquafeeds.

3. To have a basic understanding of the principles of feed formulation and equipments used in feed manufacture.

Module 1
Digestive system of fish, Digestive Glands and their secretions. Digestive physiology of fish- Digestion of Carbohydrates, Proteins and Fats. Proteins, carbohydrates, fats, vitamins and minerals in fish nutrition- Classification, Structure and functions.

Module 2
Nutritional Bioenergetics- Gross energy, Digestible energy (Digestibility co-efficient and measurement of digestible energy), Metabolisable energy,Heat increment (Specific Dynamic action) Net energy, Retained energy, Protein utilization. (Protein Efficiency Ratio, Protein
conversion ratio, Productive protein value) . Proximate Analysis- Moisture, Crude protein, Crude Lipid, Crude Fibre, Ash and, Nitrogen free extract- Methods of analysis of each component.

**Module 3**
8 Hrs

**Module 4**
5 Hrs

**Module 5**
10 Hrs

**References**


**SEMESTER IV**

**VOCATIONAL COURSE 7**

**REPRODUCTIVE PHYSIOLOGY AND ENDOCRINOLOGY**

36 hrs

Credits 2

**Objectives:**

1. To have an understanding of the variety of reproductive techniques in finfishes and shellfishes and the factors controlling reproduction.

2. To study the endocrine and neurosecretory system of finfishes and shellfishes.

3. To understand the principles and techniques of induced breeding, and cryopreservation of fish gametes.

**Module 1**

6 Hrs


**Module 2**

6 Hrs
Organisation, structure and Functions of Neurosecretory and endocrine systems in fin fishes.
Pituitary, Thyroid, Chromaffin tissue, Interrenal tissue, Pancreatic islets, Corpuscles of Stannius,
Ultimobranchial Glands, Gonads, Gastro-intestinal Hormones, Pineal organ, Caudal
neurosecretory system or Urophysis. Neuroendocrine control of reproduction. Role of
Hypothalamus - Pituitary – Gonadal axis in control of maturation in fishes. Gonadotropin
releasing hormones, gonadotropins and sex steroids.

Module 3 6 Hrs
Neuroendocrine systems in crustaceans and control of reproduction. Sinus gland complex and
X- organs. Pericardial and Post-commisural organs. True Endocrine organs-Y- organs,
androgenic gland and Mandibular organs. Hormones produced by the neuroendocrine and true
endocrine glands and their role in the control of reproduction and moulting in Crustaceans.
Parasitic castration.

Module 4 10 Hrs
Principles of induced maturation and spawning in fishes and crustaceans. Levels of control in
induced breeding and maturation in fishes. Environmental control of reproduction in fishes and
prawns. Use of hormones and hormone analogues in fishes- Gonadotropin releasing hormones,
Gonadotropins and Sex steroids. Methods of hormonal administration. Hypophysation. Linpe
Method. Ovaprim. Use of Anaesthetics. Eyestalk ablation- Its principle and application in
crustacean hatcheries. Use of hormones for producing monosex population and sex reversal in

Module 5 8 Hrs
Types of eggs in fishes – Pelagic, Demersal and according to yolk content. Embryonic
development- Cleavage, fate map of Blastula, gastrulation- Invagination, Involution,
Delamination, Convergence, Epiboly. Hatching, Post Embryonic development and Larval
development.

References


SEMESTER IV

VOCATIONAL COURSE 8

MICROBIOLOGY, PATHOLOGY AND POST HARVEST TECHNOLOGY

36 Hrs
Credits 2

Objectives
1. To have a clear understanding of the bacterial fauna associated with fish sanitation.

2. To have a basic idea of the factors associated with fish spoilage and the variety of fish preservation techniques.

3. To clearly understand the symptoms, diagnostic and remedial measures of fish diseases and have an idea of the Critical Control Points in seafood industry.

Module 1 8 Hrs

Bacteriology- Classification of bacteria based on temperature and oxygen requirements, Bacterial growth curve, growth phasesSterilization techniques, preparation of culture media, Estimation of total plate count, Staining techniques (Gram’s Staining). Important bacteria of sanitary significance-Staphylococcus aureus, Vibrio cholerae, salmonella. Faecal Indicator organisms- E.coli and Faecal streptococcus.

Module 2 8 Hrs

Biochemical composition of fish- Moisture, Protein, Fats, NPN compounds and Minerals. Spoilage of fish - Post mortem changes and Rigor mortis. Causes of spoilage - Enzymatic, microbial, Biochemical (rancidity). Indices of spoilage - organoleptic, chemical (Total Volatile
Basic Nitrogen, Hypoxanthine content, Peroxide value and microbial (direct count and Total Plate Count).

**Module 3**
8 Hrs

**Module 4**
6 Hrs
Curing- Types of Curing- Simple, Sun drying, dry and wet curing, Monacuring, Pit Curing, Colombo curing, Smoke curing. Special cured products- Masmine and Marinade. Common defects in curing- Dun, Rust, Pink, Maggots. Value added products. Fishery byproducts- Fish oil, Shark liver oil, Chitin, Chitosan, Isinglass, Fish meal , Shark fin rays.

**Module 5**
6 Hrs

**References**


### AQUACULTURE PRACTICALS

**PRINCIPLES AND METHODS IN AQUACULTURE, HATCHERY AND CULTURE TECHNIQUES**

**36 hrs**

1. Identification and major biological characteristics of cultivable organisms
2. Gut content analysis.
3. Study of common weed and predatory fishes in aquaculture ponds
4. Study of aquatic insects and aquatic weeds.
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

**PRACTICAL – II CAPTURE FISHERY & BIOLOGY OF FISHES**

**36 Hrs**

1. Identification of commercially important fishes, crustaceans and molluscs.
2. Fish- Study of external morphology and scales..
3. Dissection of Alimentary canal.
4. Dissecting and identification of internal organs of a fish.
5. Prawn - Study of external morphology and nervous system
7. Gill structure of a prawn - Dissection
8. Molluscs - Study of morphology, and Dissection of Gills of bivalves

SEMESTER III

PRACTICAL – III FISHERIES ENVIRONMENT 54 Hrs
Credit 2

1. Determination of salinity, dissolved oxygen, pH, total alkalinity, hardness, nitrate, nitrite and ammonia and phosphate.
2. Determination of soil pH
3. Study of common marine phytoplankton, zooplankton.
4. Quantitative evaluation of phytoplankton and zooplankton in culture ponds
5. Identification of the common Ancillary Marine Resources – Corals, Sea cucumber and Sea weeds
6. Equipments and Instruments used for the collection of Environmental Data – Plankton samplers and Counters including haemocytometer, Digital pH meter, Salinometer, Spectrophotometer, Colorimeter etc.
7. Study of Ecological sub-divisions of the sea, Principles of Remote sensing and software used (Wikimapia.org)
SEMESTER III

PRACTICAL – IV FISH NUTRITION 54 Hrs

Credit 2

1. Comparative study of Digestive system of Herbivorous and Carnivorous fishes
2. Qualitative estimation of proteins, Polysaccharides and lipids
3. Formulation of artificial feed for aquarium fishes and prawns with locally available ingredients.
4. 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)
5. Use of Pearson’s square method in balancing feed ingredients.
6. Study of equipments used in feed preparation (Oven, Pelletiser, Feed Press and Die Plate, Extruders etc.)
7. Study of non-conventional feed stuffs eg. Spirulina etc. and Feed Additives (Binders, Antibiotics etc).

SEMESTER IV

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.
6. Estimation of maturity stages and fecundity in fish
7. Equipments used in cryopreservation (Cryocan, French straws etc)
SEMESTER IV

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.)
ZOOLEGY - MODEL II

VOCATIONAL SUBJECT:
2. FOOD MICROBIOLOGY
SYLLABUS -
THEORY & PRACTICALS
SEMMESTER 1
ZF1V0T01 - VOCATIONAL COURSE 1
GENERAL MICROBIOLOGY

Objectives
1. To introduce students to the fascinating world of microbes
2. To describe the differences in prokaryotic and eukaryotic cell morphology and structure
3. To impart knowledge on major categories of microorganisms and analyze their classification and diversity.

Module I 8 Hrs
The historical development of microbiology, Prokaryotes and Eukayotes,Principles of microbial taxonomy, Classification of bacteria according to Bergy’s manual, classification based on molecular techniques-G+C % and RNA,DNA hybridization.

Module II 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.

Module III 10 Hrs
Morphology and fine structure of virus, size, shape capsid and capsomeres.Capsid symmetry-helical, icosahedral and complex, Structure of TMV.Viral multiplication-lytic and lysogenic cycle.

Module IV 5 Hrs
General characters, Morphology and fine structure of fungi.

Module IV 3 Hrs
General characters of algae and protozoa
References
1. Alcamo Fundamentals of microbiology, 5th Edition,
3. David Freifelder, Molecular biology, Narosa Publishing House

SEMESTER 1
ZF1VOT02 - VOCATIONAL COURSE 2
BIOLOGICAL TECHNIQUES
36 Hrs
2 Credits

Objectives
1. To describe the parts and working principle of instruments used in microbiology
2. To introduce other techniques used in microbiology
3. To learn the applications of the instruments and techniques in the bio-medical field.

Module I

Module II
Module III

Introduction to immunology Techniques - Tests for Antigen Antibody reactions, Immuno diffusion, Radio Immuno Assay, ELISA, Flow cytometer
DNA/RNA Amplification techniques- Polymerase Chain Reaction(PCR) and RT-PCR; principle, procedure and application.

Module IV

Control of microorganisms- Sterilization and disinfection - physical (moist and dry heat, by filtration, by irradiation) & chemical methods (alcohols, phenol, detergents, halogens, dyes);

Module V


References
1. Janis Kuby, Immunology
2. Beacker & Deamer, The World of cell,
6. M.A. Subramanian Biophysics principles and techniques, MJP Publishers
7. P.K. Bajpai, Biological instrumentation and methodology, S. Chand & Company

COURSE TITLE- GENERAL MICROBIOLOGY & BIOLOGICAL TECHNIQUES

PRACTICAL 1

36 hrs

1. Cleaning and sterilization of glassware
2. Bacterial Staining Method
   a. Simple Staining
   b. Gram’s staining
c. Spore staining
d. Negative staining

3. Examination of microbes in Living condition
   a. Wet mount
   b. Hanging drop method

4. Measurement of bacterial growth by optical density method

5. Instrumentation and working principle of
   a. Laminar air flow Bench
   b. Autoclave
   c. Hot air oven
   d. Colony counter

6. Antibiotic sensitivity test

SEMESTER 2

ZF2VOT03 - VOCATIONAL COURSE 3

MICROBIAL PHYSIOLOGY AND GENETICS

36 Hrs
2 Credits

Objectives
1. To understand the fundamentals of Physiology of microorganisms.
2. To define the science of microbiology and describe some of the general methods used in the study and culture of microorganisms
3. To study mutation and genetics in microorganisms.

Module I 8 Hrs
Microbial Nutrition- Nutritional requirements and nutritional grouping of microbe. Bacterial growth, Bacterial growth curve (Batch), Fed batch, continuous culture of microbes, Influence of environmental factors on microbial growth.

Module II 7 Hrs
Culture Media & Cultivation of Bacteria (Aerobic & Anaerobic culture methods).

Module III 5 Hrs
Measurement of microbial size and numbers.

Module IV 8 hrs
Mutation:- Type of mutation-Point and Frame shift mutation. Chemical and physical mutatgens.

**Module V**  
8 Hrs  
Bacterial Genetics- Plasmids, cosmid, Bacterial recombination- conjugation, transformation and transduction.

**References**

**SEMESTER 2**  
**ZF2VOT04 - VOCATIONAL COURSE 4**  
**APPLIED MICROBIOLOGY**  
36 Hrs  
2 Credits

**Objectives**
1. To describe the roles and importance of microbes in various environments
2. To develop an understanding of beneficial activities of microorganisms and the application of this understanding to benefit mankind.
3. To study the various interactions that exists among microbes and also between microbes and plants
4. To describe the roles and importance of microbes in various areas of agriculture

**Module I**  
8 Hrs  
Microbiology of soil- soil profile, microbial flora, factor affecting flora, biogeochemical cycle- carbon and, nitrogen and its importance Microbial interrelationship of microorganisms, mutualism, synergism (protocooperation) commensalisms, Amensalism, Parasitism, and Predation. Interaction of microbes with plants- Microbes with plant roots- Rhizosphere concept, mycorrhizae, ecto, endo, VAM, actinomycorrhizae, phyllosphere concept.

**Module II**  
8 Hrs
Aquatic microbiology; Microbiology of water, Purification and disinfection of water. Waterborne pathogens, Sewage microorganism, BOD and COD, Sewage (waste water) treatment: primary treatment, secondary treatment (Oxidation Pond Trickling Filter, the Activated sludge, Anaerobic digesters), Tertiary treatment.

Bacteriological examination of drinking water- membrane filtration, MPN, plate count, (pour, spread), ONPG-MUG.

**Module III**

8 Hrs

Role of microorganism in agriculture- Biofertilizer Bacterial- biological Nitrogen fixers- Symbiotic and free living nitrogen fixers, phosphate solubilizers, Algal biofertilizers- Azolla.

**Module IV**

8 Hrs

Phytopathogens- Causative organism, mode of transmission, symptoms and control measures of Bacterial (soft rot, canker, wilt, crown gall), fungal (Blight, rot, wilt and mildew) and viral (TMV, Bunchy top disease of banana) plant diseases.

Control measures- Biopesticides (Bacterial, viral, fungal).

**Module IV**

4 Hrs

Biogas, Role of microbes in biodegradation, bioremediation (natural organic compound, plastics, pesticides and petroleum pollutants).

Role of microbes in bioleaching, biomining.

**References**

1. B.P. Pandey Plant pathology, S. Chand & Company
2. G. Rangaswami, Agricultural Microbiology, Prentice Hall of India Pvt. Ltd.
5. Joseph C. Daniel, Environmental aspects of Microbiology, Bright Sun publication
COURSE TITLE - MICROBIAL PHYSIOLOGY & GENETICS AND
APPLIED MICROBIOLOGY
PRACTICAL 2

36 hrs 2 Credit

1. Preparation of Solid and liquid media for microbial cultures.
   a. Liquid media - Peptone water, Nutrient broth
   b. Solid media - Nutrient agar
   c. Semi Solid agar
2. Culture methods
   a. Streak culture
   b. Lawn culture
   c. Stab culture
3. Demonstration of selective and differential media
   a. Mac Conkey agar
   b. Blood agar
4. Isolation and enumeration of bacteria from rhizosphere & non-rhizosphere soil.
5. Standard plate count technique for the isolation and enumeration of microorganisms in water
6. Water quality analysis by MPN method
7. Isolation and identification of Rhizobium from root nodule
8. Basic idea about
   a. Trickling filter
   b. Membrane filter system
   c. Anaerobic sludge digester
SEMESTER 3

ZF3VOT05 - VOCATIONAL COURSE 5

DAIRY MICROBIOLOGY

36 Hrs
2 Credits

Objectives

1. To provide a scientific background to dairy microbiology by re-examining the basic concepts of general food microbiology and the microbiology of raw milk.
2. The role of dairy starter cultures in manufacturing fermented dairy products, developing novel functional dairy products through the incorporation of probiotic strains

Module I 10 Hrs

Module II 6 Hrs
Contamination and spoilage of milk and milk products.

Module III 6 Hrs
Bacteriological examination of milk. Preservation of milk – Pasteurization (different methods and advantages), sterilization (ultra high temperature processed milk) dehydration.

Module IV 8 Hrs
Type of milk and milk products: whole milk, low fat milk, toned milk, skim milk, vitamin D milk, low sodium milk, homogenized milk, concentrated milk, sweetened condensed milk evaporated milk, dry milk, low lactose milk. Lactic starter cultures. Probiotic role of lactic acid bacteria. Fermented milk products - curd, cream, butter, butter milk, lassie, Kefir and Kumiss, cheese, yoghurt.

Module IV 6 Hrs
Milk borne disease, microbial diseases of dairy cattle and its control measures.
References

5. Shakuntala N, Manay, M. Shadaksharaswamy, Food facts and Principles 2nd ed. New Age International publishers
7. W.C. Frasier & Westhoff, Food Microbiology,
8. Winton and Winton, Milk and Milk Products.

PRACTICAL-3

COURSE TITLE – DAIRY MICROBIOLOGY

54 hrs 0 Credit

1. Qualitative analysis of milk by standard plate count method.
2. Isolation of coliforms from milk.
3. Detection of number of bacteria in milk by breed count.
4. Quality testing of milk by rezazurin test
5. Methylene blue reduction test for microbial contamination of milk.
6. Determination of phosphatase activity of milk
7. Detection of mastitis through milk test.
8. Isolation of Lactobacilli and Staphylococcus from curd
9. Fermented Dairy products
SEMMESTER 3
ZF3VOT06 - VOCATIONAL COURSE 6
INDUSTRIAL MICROBIOLOGY

Objectives
1. Discuss the genetic manipulation of microorganism to construct strains that better meet the needs of an industrial or biotechnological process
2. Discuss the preservation of microorganisms
3. To study the major products or uses of industrial microbiology and biotechnology

Module I 6 Hrs
History, development and scope of industrial microbiology, Screening of industrially important microorganisms- Primary and Secondary Screening. Strain Improvement – Mutation, Recombination, and protoplast Fusion.

Module II 8 Hrs
Differentiate solid state and Basic Design & instrumentation of Fermenter, types of fermentation (solid state & submerge), types of fermenter - airlift fermenter, CSTR, tubular Fermenter, fluidized bed Fermenter.

Module III 8 Hrs
Development of inoculum for industrial fermentation. Fermentation media, Carbon source, nitrogenous materials and antifoams.
Industrial sterilization- batch and continuous sterilization.

Module IV 6 Hrs
Primary and secondary metabolites. Preservation of microbes - serial subculture, preservation by overlying culture with mineral oil, lyophilization, storage of microbes at a very low temperature or in liquid nitrogen. Methods for preservation of fungi.

Module V 8 Hrs
Fermentation process: Surface, Submerged and solid state fermentation. Production of organic acids; acetic acid, citric acid, lactic acid. Production of amino acids: lysine and glutamic acid, production of enzymes: proteases and amylases. Production of antibiotics: Penicillin, Streptomycin, Production of vitamins- Vitamin B12 & riboflavin
References
1. A.H. Patel, Industrial microbiology, Mac Millan India Ltd.
2. K. Sukesh, M.M. Joe&P K Sivakumar- An Introduction to Industrial Microbiology,
6. Peter F. Stanbury, Principles of fermentation technology, Elsevier Publicatio

PRACTICAL 4

COURSE TITLE – INDUSTRIAL MICROBIOLOGY

54 hrs 0 Credits
1. Crowded plate technique for screening microbial antibiotics.
2. Solid state fermentation –Mushroom production
3. Submerged fermentation- Study of alcoholic fermentation of fruit juice by yeast.
4. Immobilization of yeast cells
5. Preservation techniques:
   a. Serial sub culturing
   b. Over laying with mineral oil
   c. Lyophilization
   d. Liquid nitrogen storage.
   e. Methods for the storage of Fungi
SEMESTER 4

ZF4VOT07 - VOCATIONAL COURSE 7

BASIC FOOD MICROBIOLOGY

36 Hrs
2 Credits

Objectives
1. To study interaction between micro-organisms and food.
2. To discusses the factors affecting the presence of micro-organisms in foods and their capacity to survive and grow.
3. To study recent developments in procedures used to assay and control the microbiological quality of food.

Module I
8 Hrs
Food as a substrate for microorganisms. Factors affecting microbial growth in food, extrinsic – Temperature, Relative humidity and concentration of gases and intrinsic - hydrogen ion concentration (pH), water activity, oxidation reduction potential, nutrient content, inhibitory substances and biological structure.

Module II
7 Hrs
Microorganisms - important in food microbiology, Bacterial - morphological, cultural and physiological characteristics important in food bacteriology, Important groups of bacteria associated with various foods. Molds and yeast associated with different foods.

Module III
7 Hrs
Source of contamination of food:-Preharvest - from green plants and fruits, animals, soil, air, sewage, water and Post harvest:-processing equipment, transport, workers, during handling and processing General principles underlying spoilage of food; Chemical changes caused by microorganisms: Causes of spoilage, classification of food by ease of spoilage.

Module IV
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.

Module V
7 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

References
1. George J. Banwart, Basic Food Microbiology
2. James M. Jay, Modern food microbiology, Van Nostrand Reinhold Company
5. W.C. Frazier and Westhoff, Food Microbiology.

COURSE TITLE – BASIC FOOD MICROBIOLOGY
PRACTICAL 5
54 hrs 4 Credits

I. Isolation and Enumeration of bacteria from spoiled food (vegetables, meat, fish).

II. Biochemical tests used for identification of Bacteria.
   a. IMVIC Test
   b. Sugar Fermentation tests (GLSM)
   c. Urease test
   d. Catalase test
   e. Oxidase test
   f. Litmus milk reaction
   g. TSI test

III. Identification of bacteria from spoiled food samples.

IV. Selective isolation and identification of
   a) Staphylococcus
   b) Salmonella
   c) Vibrio
Objectives
1. To study interaction between micro-organisms and food – spoilage.
2. To study Foodborne illness
3. Production of different fermented Foods.

Module 1
10 Hrs
Microbiology of cereal grains, flours and bread. Contamination, preservation and spoilage of vegetables and fruits, egg, meats and fish.

Module II
10 Hrs
Fermented foods: oriental fermented foods- Tempeh, soysause, miso, idli, natto, Minchin and poi. Fermented vegetables - sauerkraut and Kimchi. Fermented meat and fish. Microbial role in production of Bread, wine and malt beverages, single cell protein Mushroom production.

Module III
7 Hrs
Food borne Diseases- Food poisoning, Bacterial food born infections (Clostridium perfringens, Salmonella, Shigella, Campylobacter, Listeria, Vibrio, E.coli and Streptococcus faecalis) and intoxication (Staphylococcus aureus and Clostridium botulinum). Mycotoxins-Aflatoxin, Patulin, Ochratoxin, Luteoskyrin and ATA.

Module IV
5 Hrs
Food sanitation:- Principles of food sanitation, hygiene and safety. Sanitising equipments, cleaning agents and sanitising chemicals.

Module V
4 Hrs
Hazard Analysis Critical Control Points (HACCP).

References
1. Banwart, Basic Food Microbiology,
2. Khetarpaul, Neelam, Food Microbiology.
COURSE TITLE – BASIC FOOD MICROBIOLOGY
FOOD MICROBIOLOGY AND FERMENTED FOODS
PRACTICAL 6

54 hrs 4 Credits

1. Isolation and enumeration of fungi from spoiled food samples (vegetables, meat, fish)
2. Identification of fungi from spoiled food.
3. Lactophenol cotton blue staining of fungi.
4. Slide culture technique for identification of fungi.
5. Effect of incubation temperature on microbial growth.
6. Measurement of TDP
7. Measurement of TDT
8. Estimation of total and volatile acidity in alcoholic beverages.
9. Fermented food products
MODEL II VOCATIONAL COURSE

3. MEDICAL MICROBIOLOGY

SYLLABUS –

THEORY & PRACTICALS
VOCATIONAL SUBJECT: MEDICAL MICROBIOLOGY

VOCATIONAL COURSES

COURSE I : Fundamentals of Microbiology
ZMIV0T01

COURSE II : Basics of Microbial Physiology & Genetics
ZM1V0T02

Practical I : Fundamentals of Microbiology and Basics of Microbial Physiology & Genetics

COURSE III : Parasitology
ZM2V0T03

COURSE IV : Medical Virology
ZM2V0T04

Practical II : Parasitology & Medical Virology

COURSE V : Medical Mycology
ZM3V0T05

COURSE VI : Diagnostic Microbiology
ZM3V0T06

Practical III : Medical Mycology

Practical IV : Diagnostic Microbiology

COURSE VII : Medical Bacteriology
ZM4V0T07

COURSE VIII : Clinical Microbiology
ZM4V0T08

Practical V: Medical Bacteriology

Practical VI: Clinical Microbiology
SEMESTER I

COURSE I – FUNDAMENTALS OF MICROBIOLOGY

36 Hrs

Credits 2

Objectives

1. To introduce students to the fascinating world of microbes
2. Give an understanding of the scope of Microbiology
3. To impart knowledge on major categories of microorganisms and understand their classification and appreciate their diversity.
4. To impart an awareness on how microbes can be controlled
5. To describe the parts and working principle of different microscopes and specimen preparation.

Module I

6 Hrs

Definition of Microbiology, History: Early observation of microorganisms-Leewenhoek and Robert Hook; Spontaneous generation theory and refutation of spontaneous generation theory; Contributions of Robert Koch, Louis Pasteur, Lister, Edward Jenner, Beijernick and Winogradsky, discovery of antibiotics. Scope of microbiology

Module II

10 Hrs


Module III

10 Hrs

Control of microorganisms- Sterilization and disinfection. Control agents physical (moist and dry heat, by filtration, by irradiation) & chemical methods (alcohols, phenol, detergents, halogens, dyes); Antibiotics– classification based on mode of action with eg. Instruments used microbial control – autoclave, hot air oven, laminar air flow

Module IV

10 Hrs

References
Alcamo, Fundamentals of microbiology, 5th Edition,
Joanne M. Willey, Prescott, Harley & Klein’s Microbiology, 7th Edition by McGraw & Hill Publisher

SEMESTER I
BASICS OF MICROBIAL PHYSIOLOGY AND GENETICS
36 Hrs
Credits 2

Objectives
1. To describe the differences in procaryotic and eukaryotic cell morphology and structure
2. To give a brief understanding of microbial physiology
3. To describe some of the general methods used in the study and culture of microorganisms
4. To introduce microbial genetics

Module I

10 Hrs
Morphology and fine structure of bacteria, size, shape and arrangements. Flagella, pili, capsule – Indian ink staining, cell wall and its composition- Gram’s staining, acid fast staining, Cytoplasmic membrane, protoplasts, spheroplasts, intracellular membrane systems, cytoplasm, vacuoles, nuclear material, bacterial spores- spore staining, cell inclusions.

Module II 8 Hrs
Microbial Nutrition- Classification based on nutritional requirements. Uptake of nutrients- active and passive transport. Bacterial growth, Bacterial growth curve. Batch, Fed batch, continuous culture of microbes, Influence of environmental factors on microbial growth. Instruments involved in growth studies- Instruments- Incubator, colony counter
Measurement of microbial size- micrometry; Measurement of microbial numbers –viable and non viable counts 8 Hrs.

Module III
Culture Media- definition, types of media- solid semi-solid and liquid media, Basal media, differential, selective, enrichment, enriched and transport media. Cultivation of Bacteria – Aerobic methods- streak plate, lawn culture, pour plate, spread plate, stab, liquid culture & Anaerobic culture methods-displacement O2 with other gases, Pyrogallic acid and NaOH (chemical/biological method), anaerobic jar, Gaspak

Module IV 9 Hrs
Bacterial genetics -Introduction and history-Discovery of DNA as genetic material, DNA double helix-structure; Extrachromosomal genetic element- Plasmids-episome, compatible and incompatible, F factor, R plasmids (resistance transfer factor), Col plasmids. Reasons for variation- Bacterial recombination- conjugation (F+ x F- mating), transformation, transduction, transposons; Mutation (in brief) ; Transposable genetic element

References
Joanne M. Willey, Prescott, Harley & Klein’s Microbiology, 7th Edition by McGraw & Hill Publisher
M.A. Subramanian, Biophysics principles and techniques, MJP Publishers
SEMESTER I

**PRACTICAL I- FUNDAMENTALS OF MICROBIOLOGY & BASICS OF MICROBIAL PHYSIOLOGY & GENETICS**

**36 Hrs**

1. Cleaning and sterilization of glassware, Autoclave, hot air oven, incubator and laminar air flow (3 Hrs)

2. Instrumentation and working principle of Laminar air flow Bench, Autoclave, Hot air oven, Colony counter (2 Hrs)

3. Preparation of Solid and liquid media for microbial cultures.
   - a. Liquid media (1) peptone water/Glucose broth (2) Nutrient broth (4 Hrs)
   - b. Solid media (1) Nutrient agar (2) Mac Conkey’s agar (3) Blood agar
   - c. Semi Solid agar

4. Culture methods (a) streak culture (b) Lawn culture (c) Stab culture (d) Pour & spread plate culture (e) Liquid culture. (7 Hrs)

5. Isolation of pure colonies (a) streak plate method (b) pour plate method (c) spread plate method (8 Hrs)

6. Bacterial Staining Method - Simple Staining, Gram’s staining (4 Hrs)

7. Examination of microbes in Living condition (4 Hrs)
   - (a) wet mount (b) Hanging drop method for demonstrating motility of bacteria

8. Measurement of bacterial growth by optical density method (4 Hrs)

SEMESTER II

**COURSE III PARASITOLOGY**

**36 Hrs**

**Credits 2**

**Objectives**

1. To understand the basic science of medial parasitology
2. To define the role of vectors in parasitology
3 To study the morphology, life cycle and pathogenesis of protozoan parasites
4 To study the morphology, life cycle and pathogenesis of protozoan parasites
5 To recognize the general outlines of parasite identification, control and prevention

**MODULE I**  
8 Hrs
General Introduction to parasitology- Type of parasites, types of host, sources & modes of parasitic infection. Classification of protozoan and helminthes. Collection and preservation of specimens for parasitological examination, transport of specimens, Examination of blood parasites thick and thin smears for malarial, filarial and other parasites

**MODULE II**  
6 Hrs
Common Vectors in Parasitology
Classification of arthropods of public health importance, Role of Arthropods in the transmission of disease and their control measures (Mosquito-Aedes, Anopheles, Culex), Ticks, Flea)

**MODULE III**  
10 Hrs
Morphology, life cycle & pathogenesis (in brief), laboratory diagnosis of Protozoa: *Entamoeba, Trichomonas, Trypanosoma, Leishmania, Giardia, Plasmodium, Toxoplasma.*

**MODULE IV**  
12 Hrs
Morphology, life cycle & pathogenesis (in brief), laboratory diagnosis each of the helminthes: a) Platyhelminthes: *Taenia, Echinococcus, Schistosoma, Fasciola,* (b) Nemathelminthes: *Ascaris, Ancylostoma, Trichinella, Enterobius, Trichurias, Wuchereria, Dracunculus*

**References**
C. H. Parija Text book of medical parasitology
K. P. Srivastava, A Text book of applied entomology, Kalyani Publishers
Park’s text book of preventive and social medicine, 22nd edition, Banasirdas Bhanot Publishers
Objectives

1. To develop a basic knowledge of virus morphology, classification and replication
2. To introduce the methods of cultivation of virus
3. To promote understanding of pathogenesis, diagnosis, prevention and control of human viruses

Module I

8 Hrs

Module II

10 Hrs
Cultivation of Animal Viruses-animal inoculation, embryonated eggs, Tissue culture-organ culture, explants culture and cell culture a) primary cell culture, b) diploid cell culture d)continuous culture. Detection of growth of virus in cell culture-cytopathic effect (CPE), metabolic inhibition, hemadsorption, interference, transformation, immunofluorescence. Viral assay- electron microscopy and hemagglutination, assay of infectivity. Bacteriophage-plaque assay-PFU. Antiviral agents-based on action with examples

Module III

13 Hrs
Morphology, Pathogenicity, clinical features (in brief), lab diagnosis and treatment of each of these viruses:
Herpes virus (HSV, Varicella Zoster), Orthomyxovirus (influenza), Paramyxoviruses, (mumps, measles) Rubella virus, Hepatitis virus (A, B, C), Rhabdo virus, AIDS virus, Polio virus, Papiloma, Rota viruses, Corona virus-SARS

Module IV

5 Hrs
Arboviruses. Definition, Pathogenesis- 3 main syndromes: fever with and without rash and arthraglia, encephalitis, hemorrhagic fever (Brief mention of Chikungunya, dengue, yellow fever, Zika, Ebola).

Oncogenic viruses-Definition and mechanism in brief, Examples of DNA oncogenic virus – Papova, Pox, Herpes and hepatitis B virus, RNA-retovirus (discussed in brief).

References

Gabriel Virella, B.I. Microbiology and Infectious diseases, 3rd ed. Waery Publications
Philip A. Thomas, Clinical Microbiology, Orient Longman Pvt. Ltd.

Practical II PARASITOLOGY AND MEDICAL VIROLOGY

36 hrs

1. Detection of parasite by Iodine mount preparation (5 Hrs)

2. Detection of parasite by Concentration technique (floatation-Zinc Sulphate method, sedimentation-formol ether ) (6 Hrs)

3. Examination of blood for parasites- Thin blood film (8 Hrs)

4. Identification of Vectors of clinical importance- Mosquito( Anopheles, Culex), Fleas, Ticks (2 Hrs)

5. Identification of helminthic parasite- Ascaris, Ancylostoma, Taenia (2 Hrs)

6. Introduction to cultivation techniques used in virology laboratory (3 Hrs)

7. Method of cultivation of virus using embryonated eggs – Chorio Alantoic Membrane (CAM) (6 Hrs)

8. Demonstration of haemagglutination (4 Hrs)

References

1. N.Kannan, Laboratory manual in general microbiology, Palani Paramount Publications
2. Subash Chandra pariya textbook of practical microbiology, Ahuja Publishing House, First edition
SEMESTER III

COURSE V  MEDICAL MYCOLOGY

Objectives

1. To study the classification of fungus
2. To familiarize with routine mycological techniques, culture media and identification procedures
3. To promote understanding of pathogenesis, diagnosis, prevention and control of medically important fungus

MODULE I 9 Hrs
Classification of fungi; collection & transport of specimens, Examinations of fungus-mounting fluids and stains, Routine mycological techniques & Culture Media used for cultivation (Sabouraud’s Dextrose Agar, Potato Dextrose Agar, Brain Heart Infusion broth & agar, Czapek Dox Agar, Corn meal agar, Bird Seed agar), Maintenance of fungus culture.

MODULE II 10 Hrs
Superficial, Cutaneous & subcutaneous mycoses:
Superficial- distribution, etiological agents, clinical features, diagnosis, treatment of Tinea versicolor, Tinea nigra, piedra (Black & White),
Cutaneous- Dermatophytoses (Causative agent, pathogenesis, lab diagnosis & treatment)
Subcutaneous: distribution, etiological agents, clinical features, diagnosis, treatment of Mycetoma, Sporotrichosis, Chromoblastomycosis,

MODULE III 9 Hrs
Systemic mycoses- Causative agent, pathogenicity, clinical features, lab diagnosis & treatment of - Blastomycoses, Paracoccidiodiomyces, Coccidiodiomyces

MODULE IV 8 Hrs
**Opportunistic mycoses** - Causative agent, pathogenesis, clinical features, lab diagnosis & treatment of - Aspergillosis, Penicilliosis, Zygomycoses (Mucor, Rhizopus). Candidiasis

**References**
Jagadish Chander Text book of Medical mycology
Medical Mycology by Rippon
P.Sivamani, Medical Mycology, 1st edition  Siva Publications

**Practical III  MEDICAL MYCOLOGY**

54 Hrs

1. Microbiology laboratory safety  (2 Hrs)
2. Collection of samples for fungal infections.  (2 Hrs)
3. Slide culture method for cultivation of fungus  (15 Hrs)
4. Study of cultural characteristics of fungi on SDA- *Aspergillus, Penicillium*,
   *Rhizopus, Mucor*  (6 Hrs)
5. Study of morphology of fungi by lactophenol cotton blue - *Aspergillus*,
   *Penicillium, Rhizopus,Mucor*  (15 Hrs)
6. Study of morphology of fungi by cellophane tape method  (4 Hrs)
7. Germ tube test for the identification of *Candida albicans*  (4 Hrs)
8. Demonstration of hair bait technique  (6 Hrs)

**References**
1. N.Kannan, Laboratory manual in general microbiology, Palani Paramount Publications
2. Subash Chandra parija textbook of practical microbiology, Ahuja Publishing House, First edition
SEMESTER III

COURSE VI DIAGNOSTIC MICROBIOLOGY

36 Hrs  Credits 2

Module I  5 Hrs
Laboratory safety-Good lab hygiene, Personal barrier protection-gloves, outerwear, respiratory protection, eyes & face. Warning signage. Microbiological hazards-Biological Safety cabinet: Class I, II & III, Biosafety levels, Universal precautions, Decontamination, Hazardous waste-Infectious waste, Sharp waste and waste disposal.

Module II  5 Hrs
Microbiological methods- Morphology, Cultural characteristics, Biochemical characteristic- Indole, Methyl red, Voges Prauskauer, Citrate, Sugar fermentation, TSI, Oxidase, Catalase, Coagulase, DNAase, Urease, Gelatinase, Cellulase. H₂S production. Bacitracin, Optochin sensitivity, Antibiotic susceptibility assay- Kirby –Bauer method of Disk Diffusion, Tube dilution technique

Module III  7 Hrs
Immunological/ Serological diagnosis- Definition of antigen, antibody, Ag-Ab reaction- precipitation and agglutination. Immunological detection methods- Immunodiffusion- Ouchterlony technique, Immunoelectrophoresis- Couter Immuno Electrophoresis (CIA), RadioImmuno Assay, ELISA, WIDAL, VDRL, ASO Coombs Test, Haemmagglutination inhibition, Quellung reaction, Mantoux test, Weil-Felix test

Module IV  12 Hrs
Module V

Molecular techniques: DNA probes, Blotting techniques-Western blotting, PCR, Emerging techniques in microbiology laboratory- MALDI-TOF Mass Spectrometry –description of this technique in brief.

Core Readings
Shanson D.C., Speller D.C. E. Microbiology in clinical practice,III edition, Butterworth & Heinemann Publication
Kenneth D M Clatchey Clinical Laboratory Medicine 2nd Edition
Carry-Ann D Burnham . Automation and Emerging Technology in Clinical Microbiology

Practical IV DIAGNOSTIC MICROBIOLOGY

Biochemical tests for the identification of microbes

1. Fermentation of carbohydrates (Glucose, lactose, Mannitol)  (4 Hrs)
2. IMViC tes  (6 Hrs)
3. Urease test  (2 Hrs)
4. Catalase test  (4 Hrs)
5. Oxidase test  (4 Hrs)
6. Coagulase test  (4 Hrs)
7. Triple sugar iron agar test for the identification of E. coli, Klebsiella, Proteus and Pseudomonas  (4 Hrs)

Serological tests for identification of microbes

8. VDRL  (6 Hrs)
Module I  
Gram Positive & Negative cocci  
Morphology, cultural& biochemical characteristics, antigenic properties,  
toxins/virulence factors(in brief), pathogenecity, lab diagnosis, prophylaxis & treatment  
- Staphylococcus aureus, Streptococci (Str. pyogenes and Str. pneumonia), Neisseriae (  
N. meningitides and N. gonorrhoeae )

Module II  
Gram Positive Rods  
Morphology, cultural& biochemical characteristics, antigenic properties,  
toxins/virulence factors(in brief), pathogenecity, lab diagnosis, prophylaxis & treatment  
Bacillus anthracis, Corynebacterium diphtheriae, Clostridium tetani

References

1. N.Kannan, Laboratory manual in general microbiology, Palani  
   Paramount Publications
2. Subash Chandra parija textbook of practical microbiology, Ahuja  
   Publishing House, First edition
Module III 12 Hrs

Gram Negative Rods
Morphology, cultural & biochemical characteristics, antigenic properties, toxins/virulence factors (in brief), pathogenicity, lab diagnosis, prophylaxis & treatment

*Escherichia coli, Klebsiella pneumoniae, Salmonella typhi, Shigella, Bordetella pertussis, Pseudomonas aeruginosa, Vibrio cholerae*

Module IV 12 Hrs

Branching, Spiral, Pleomorphic & cell wall less bacteria-
*Mycobacterium tuberculosis, Actinomycetes, Treponema pallidum, Haemophilus influenza type B, Rickettsiae (Typhus fever & Spotted fever group), Mycoplasma pneumoniae.*

References

Chakrabortory P., A textbook of Microbiology, 1st edition, , New Central Book Agency (P) Ltd.

Gabriel Virella, B.I. Microbiology and Infectious diseases, 3rd ed. Waery Publications

Practical V SEMESTER MEDICAL BACTERIOLOGY 54 hrs

Identification of bacteria based on morphology
1. Differential staining- Spore staining for endospore (10 Hrs)

2. Negative staining for capsulated organism (8 Hrs)

3. Metachromatic granule staining for granules (10 Hrs)

Identification of bacteria based on colony morphology
4. Cultural characteristics on NA and Mac Conkey agar (4 Hrs)

5. Demonstration of haemolytic property on Blood agar (4 Hrs)

6. Antimicrobial susceptibility test (8 Hrs)

7. Identification of Gram positive bacteria (*Staphylococcus aureus*) (5 Hrs)
8. Identification of Gram negative bacteria (*Escherichia coli, Klebsiella pneumoniae*)

(5 Hrs)

References

1. N.Kannan, Laboratory manual in general microbiology, Palani Paramount Publications
2. Subash Chandra parija textbook of practical microbiology, Ahuja Publishing House, First edition

SEMESTER IV

COURSE VIII CLINICAL MICROBIOLOGY

36 Hrs

Credits 2

Objectives

1. To develop a basic understanding of laboratory safety, specimen collection and transport
2. To describe the epidemiology, clinical manifestations, pathogenesis, and laboratory diagnosis of the following diseases caused by different microbial pathogens

Module 1

4 Hrs

Microbiology laboratory safety, General concepts for specimen collection and transport of clinical specimens. Diagnostic methods in clinical microbiology and recent advances in diagnosis (in brief)

Module 2

10 Hrs

Symptoms, Causative agents, clinical features, epidemiology and treatment of important Respiratory tract infections: Infections of the upper and lower respiratory tract-

**Bacterial**- Strep throat, Diphtheria, pneumonia (pneumococcal, *Klebsiella, Mycoplasma*), Pertussis, tuberculosis

**Viral**- Common cold- rhinovirus, Adenoviral pharyngitis, influenza, Respiratory Syncytial virus infections, Corona virus (SARS)

**Fungal**- Oral thrush

Module 3

8 Hrs

Symptoms, Causative agents, clinical features, epidemiology and treatment of important gastrointestinal tract infections;
**Bacterial**- Cholera, Shigellosis, *E. coli* gastroenteritis, Salmonellosis, Campylobacteriosis

**Viral**- Rota viral gastroenteritis, Hepatitis A, B, C

**Protozoan**- Giardiasis, Amoebiasis

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**Module 4**  
10 Hrs
Symptoms, Causative agents, clinical features, epidemiology and treatment of important Urinary tract infection- Bacterial- bacterial cystitis, (*E. coli, Klebsiella, Proteus, Staphylococcus, Pseudomonas*), Fungal- Candida

Symptoms, Causative agents, clinical features, epidemiology, lab diagnosis and treatment of **Sexually transmitted diseases Non veneral**- bacterial vaginosis, vulvo vaginal Candidiasis; **Veneral**- Bacterial- Gonorrhoea, syphilis, Chlamydial genital system infection; **Viral**- AIDS, Papilloma virus, Genital Herpes Simplex

**Module 5**  
4 Hrs
Important Infections of the nerve system- **Bacterial**- meningococcal meningitis, Hansen’s disease (leprosy), Botulism
Viral- Viral meningitis (HSV, Mumps), Polio (infantile paralysis), rabies

**References**
Elmer W. Koneman Color Atlas & Textbook of Diagnostic Microbiology 5th edition, Lippincott Publication
Gabriel Virella, B.I. Microbiology and Infectious diseases, 3rd edition, Waverly Publications
Patricia M. Tille, Bailey & Scott’s Diagnostic Microbiology 13th edition, Elsevier Publication
Philip A. Thomas, Clinical Microbiology, Orient Longman Pvt. Ltd.
Richard V Goering, Mim’s Medical Microbiology 5th edition, Elsevier Publication
1. Microbiology of laboratory safety (1 Hr)
2. General concept for specimen collection & handling (3 Hrs)
3. Semi quantitative method for analysis of urine (8 Hrs)
4. Examination of clinical sample - urine
   a. Examination of specimen microscopically - wet mount, Gram staining (4 Hrs)
   b. Culturing of specimen (4 Hrs)
   c. Biochemical identification of pathogen (4 Hrs)
   d. Antibiotic susceptibility test (4 Hrs)
5. Examination of clinical sample - Sputum
   a. Examination of specimen microscopically - wet mount, Gram staining (4 Hrs)
   b. Culturing of specimen (4 Hrs)
   c. Biochemical identification of pathogen (4 Hrs)
   d. Antibiotic susceptibility test (4 Hrs)
6. Identification of normal flora of skin (5 Hrs)
7. Identification of normal flora of mouth (5 Hrs)

References
1. N. Kannan, Laboratory manual in general microbiology, Palani Paramount Publications
2. Subash Chandra parija textbook of practical microbiology, Ahuja Publishing House, First edition
15. B.Sc. ZOOLOGY PROGRAMME - MODEL – III

1. B.Sc. (BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION) (B.Sc. BT & SP)
2. INDUSTRIAL MICROBIOLOGY (DOUBLE CORE)
1. B.Sc. BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION (B.Sc. BT & SP)

Total Credits 120
Total Instructional Hours 150

a. SCHEME OF DISTRIBUTION OF HOURS & EXAMINATION

i. THEORY:

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 ratio =1:4)

**SEMESTER 1**

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<th>Course Code</th>
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### ii. SCHEME FOR PRACTICAL EXAMINATION
FOR BSc (Biological Techniques and Specimen Preparation)
BSc (BT&SP)

University Practical Examinations will be conducted at the end of even semesters (Semester II, IV and VI).

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<td><strong>Practical 7</strong> (Core 13 &amp; 17)</td>
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<td>ZY6CRP04</td>
<td><strong>Practical 8</strong> (Core 14 &amp; 18)</td>
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<td>ZY6CRP05</td>
<td><strong>Practical 9</strong> (Core 15 &amp; 19)</td>
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<td>ZY6CRP06</td>
<td><strong>Practical 10</strong> (Core 16 &amp; 20)</td>
<td>3 hrs</td>
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b. SYLLABUS
THEORY & PRACTICALS

(BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION) (B.Sc. BT & SP)
INTRODUCTION TO BIOLOGICAL SCIENCES

OBJECTIVES
1. To develop proper scientific mind, culture and work habits
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

Module 1
What is biology: Salient features of life; Importance of biology on the frontiers of science and technology, History of Biology, Biology in ancient times, Landmarks in the progress of Biology, Branches of Biology

Module 2
Introduction to the world of living organisms: Outline classification of living organism, levels of biological organization, Broad overview of life on earth; history and evolution of life on earth, Theories of evolution, origin and progression of life on earth.

Module 3
Chemicals of life: Elements found in living organisms, acids and bases, An overview of Carbohydrates, proteins, lipids, nucleic acids, vitamins and minerals including functions, physical, chemical properties, basic units, types, Physical chemistry and significance of water, interactions between molecules.

Module 4
Homeostasis: Definition, Concept and importance in biological system. Control systems in biology, general idea of biological negative feedback mechanisms and temperature regulation.

Module 5
References

12. Taylor et al., (2008) Biological Science Cambridge University Press,
SEMESTER I

CORE COURSE 1
INTRODUCTION TO BIOLOGICAL SCIENCES
(PRACTICAL)

36 Hrs
0 Credit

1. Simple identification of any 5 vertebrates and 5 invertebrates up to species and differences in classification of vertebrates and invertebrates 6 Hrs
2. Identification of a) plant cell b) animal cell (cheek cell) (5 hrs)
3. Study on food chain and food web 5 Hrs
4. Physiological Measurements: Blood Pressure (normal & under stress) and Temperature 8 Hrs
5. pH measurements 6 Hrs
   a) Measurement of pH of different solutions, like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter
   b) Determination of pH of water
7. Titration experiments: estimation of acids and bases 6 Hrs

SEMESTER I

ZB1CRT02 - CORE COURSE 2
COLLECTION AND PRESERVATION OF BIOLOGICAL SPECIMEN 1 (PLANTS)

36 Hrs
2 Credits

Objectives

1. To introduce the student to some of the collection and preservation of plant specimens
2. To develop critical thinking skill and research aptitude among students, by introducing the frontier areas of the biological science

Module 1 12 Hrs

Broad classification of plants: where and how to collect plants, Overview of economically important plants, preparation and storage of herbarium sheets; preparation of dry specimens for
display boxes; preparation of museum specimens. Modelling materials: characteristics of teaching models, proportions, durability, attractiveness, innovativeness.

Module 2  
**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 3  
**Cell division stages**: Stages of Mitosis and Meiosis in Plants; Sources of materials; Preparation of permanent slides showing stages of division; Use of chemicals to arrest division; Special stains and their preparation.

Module 4  
**Distribution of plants**: methods of survey, different approaches of sampling, determination of frequency dominance

References


SEMESTER 1

**CORE COURSE 2**

**COLLECTION AND PRESERVATION OF BIOLOGICAL SPECIMEN 1(PLANTS)**

**(PRACTICALS)**

36 Hrs  
0 Credit

1. Preparation of herbarium sheets  
2. Identification of mitotic stages: onion root tip
3. Preparation of museum specimens  (5 Hrs)
4. Preparation of display boxes of dry plant and plant product mounts  (5 Hrs)
5. Preparation of whole mounts  (4 Hrs)
6. Collection and preservation of materials for anatomical and cytological studies  (2 Hrs)
7. Preparation of teaching models [Plaster of Paris, Epoxy Resin, Clay]  (10 Hrs)

SEMESTER 1

ZB1CRT03 - CORE COURSE 3
COLLECTION AND PRESERVATION OF BIOLOGICAL SPECIMEN 2 (ANIMALS)

36 Hrs
2 Credits

Objectives

1. To introduce the student to some of the collection and preservation of animal specimens
2. To develop critical thinking skill and research aptitude among students, by introducing the frontier areas of the biological science

Module 1 10 Hrs
Collection and preservation of invertebrates: (Protista, porifera, coelenterata, ctenophora, Platyhelminthes, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata, hemichordata

Module 2 6 Hrs
Collection and preservation of vertebrates: Pisces, aves, amphibians, reptiles and mammals

Module 3 8 Hrs
Life cycles: study on life cycle of a selected animal from each phylum (Protista, porifera, coelenterata, ctenophora, Platyhelminthes, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata, hemichordate, Pisces, aves, amphibians, reptiles and mammals)

Module 4 6 Hrs
Preparation of specimens: Preparation of museum specimens, articulated skeletons, Dermestid technique, Alizarin preparation and resin-embedded specimens, Preparation of sections involving microtome and cryostat, Taxidermy.
Module 5

Demographic Techniques and Population Patterns of animals: Techniques Used to Quantify Population Density, Patterns of Spacing, Fragmented Habitats, Spatial Arrangement of Habitats and Organisms.

References


SEMESTER I

CORE COURSE 3
COLLECTION AND PRESERVATION OF BIOLOGICAL SPECIMEN 2 (ANIMALS) (PRACTICALS)

36 Hrs
0 Credit

1. Whole mount preparation of small animals and parts of animals (9 Hrs)
2. Alizarin preparation of small invertebrates (4 Hrs)
3. Preparation of articulated skeletons (6 Hrs)
4. Preparation of resin embedded specimens (4 Hrs)
5. Demonstration of Taxidermy (5 Hrs)
6. Preparation of specimens by each student from a given phylum (4 Hrs)
7. Frequency distribution of animals in a specific area of campus (4 Hrs)
SEMESTER 2  

ZB2CRT04 - CORE COURSE 4  

GENERAL BIOLOGICAL TECHNIQUES  

36 Hrs  

2 Credits  

Objectives  

1. To impart a knowledge and understanding of biological experimental techniques, including practical laboratory skills  
2. To familiarize with the basic tools and techniques of scientific study with emphasis on biological sciences  

Module 1  

12 Hrs  

Microscopy: Magnification and Resolution, bright field, dark field, phase contrast, stereoscopic, fluorescence, polarization microscopy, electron microscopy-SEM, TEM.  
Ocular and stage micrometers; Hemocytometer; Camera lucida  

Module 2  

6 Hrs  

Separation techniques: Centrifuge, chromatography, electrophoresis  

Module 3  

6 Hrs  

Analytical techniques: Colorimeter, pH meter, Spectrophotometer, x-ray crystallography.  

Module 4  

12 Hrs  

Microbiological Techniques: Identification of common microorganisms, culture techniques; Types of solid and liquid culture media for bacteria, fungi, algae and protozoa (at least 2 for each); Sterilization methods, Cell counting and methods for measuring microbial growth; Storage and maintenance of Stock cultures.  

References  

SEMESTER 2

ZB2CRP01 - CORE COURSE 4
GENERAL BIOLOGICAL TECHNIQUES
(PRACTICALS)

36 Hrs
Credit 2

1. Light microscope: its parts and their description (3 Hrs)
2. Use of ocular and stage micrometers for measurement of width of hair etc. (5 Hrs)
3. Camera lucida (4 Hrs)
4. Chromatography (10 Hrs)
5. Instrumentation-pH meter, Colorimeter, centrifuge, electrophoresis (8 Hrs)
6. Counting cells in hemocytometer; Growth Curve (6 Hrs)

SEMESTER 2

ZB2CRT05 - CORE COURSE 5
TEACHING LABORATORY TECHNIQUES

36 Hrs
Credits 2

Objectives
1. To impart a knowledge and understanding of biological experimental techniques, including practical laboratory skills.
2. To learn about laboratory techniques, water, soil and air analyses.

Module 1
10 Hrs

Organization of a teaching laboratory: equipment, reagents, glass wares, specimens, purchase and maintenance of stock register

Module 2
8 Hrs

Distillation of water: Types of distillation stills [metal, solar, glass still], Cleaning agents for glassware, Methods of sterilization and storage of glassware.

Module 3
6 Hrs
**Water pollution:** Abiotic and biotic pollutants of water and their indicators; Assay techniques (any 5).

**Module 4**

**Air pollution:** Introduction to air pollution, various factors contributing to air pollution, common air pollutants and sources of air pollutants, technology for air pollution control, Assay techniques (any 5).

**Module 5**

**Soil pollution:** Introduction to soil pollution, types and sources, main causes and effects, control measures of soil pollution. Assay techniques (any 5).

**References**

3. Joseph C. Daniel (1999), Environmental aspects of Microbiology, Bright Sun publication

**SEMESTER 2**

**ZB2CRP02 - CORE COURSE 5**

**GENERAL LABORATORY TECHNIQUES**

**(PRACTICALS)**

36 Hrs

2 Credits

1. Components of distillation stills and ion exchanger (2 Hrs)
2. Cleaning of dirty glass wares using various cleaning agents. (4 Hrs)
3. Sterilization of glass wares [using hot air oven and autoclave (4 Hrs)
4. Analysis of water pollutants:
   - Determination of hardness of water (3 Hrs)
   - Determination of residual chlorine of water (3 Hrs)
Estimation of COD (3 Hrs)
Estimation of BOD (3 Hrs)
Bacteriological examination of water by MPN method (6 Hrs)

5. Analysis of soil pollutants: Determination of total bacterial populations from soil (4 Hrs)
6. Analysis of air pollutants: Enumeration of microorganisms from air (4 Hrs)

SEMESTER 2

ZB2CRT06 - CORE COURSE 6
FOOD MICROBIOLOGY & BIOTECHNOLOGY

36 Hrs
2 Credits

OBJECTIVES
1. To make aware of different useful microorganisms, their role in food processing and preservation.
2. To understand the factors and predict microorganisms, which can cause food spoilage.
3. To understand the causes of foodborne diseases.
4. To give a brief outline of food production through biotechnology

Module 1 8 Hrs
Roles of microbes in food production: Bread, wine, curd, yoghurt, cheese, food and fodder yeast. Mushroom production.

Module 2 8 Hrs
Preservation and spoilage of food: Principles underlying spoilage of food, causes of spoilage, classification of food by ease of spoilage.
Control of microbes in food; Sterilization - Preservation by the use of high temperature, low temperature, drying. Aseptic packaging, Canning

Module 3 8 Hrs

Module 4 6 Hrs
Food additives and adulteration: Uses of food additives: Non preservative, preservative.
Food adulterants & Prevention of Food Adulteration: common adulterants for foods like milk and milk products, atta, edible oils, cereals, condiments and curry powder.
Module 5  


References

4. W.C. Frazier and Westhoff, Food Microbiology.

SEMESTER 2

ZB2CRP03 - CORE COURSE 6
FOOD MICROBIOLOGY & BIOTECHNOLOGY
(PRACTICALS)

36 Hrs
2 Credits

1. Preparation of fermented foods: curd, yogurt. (6 Hrs)
2. Isolation and Enumeration of bacteria from spoiled food (vegetables, meat and fish). (8 Hrs)
3. Identification of bacteria from spoiled food samples. (6 Hrs)
4. Qualitative analysis of milk by standard plate count method. (6 Hrs)
5. Methylene blue reduction test for microbial contamination of milk. (5 Hrs)
6. Food adulteration detection by physical and chemical tests. (5 Hrs)
   Physical tests: Tea leaves, Black pepper, Cumin seeds, Cloves, Arhar dal (Toor dal)
   Chemical tests: Coffee powder, Turmeric powder, Coconut oil, Ghee, Jaggery, Sugar

SEMESTER 3

ZB3CRT07 - CORE COURSE 7
PHYSIOLOGY WITH CLINICAL CORRELATION

54 Hrs
3 Credits

Objectives
1. To inspire the students in learning the frontier areas of biological sciences
2. To appreciate the correlation between structure and function of organisms
3. To make them aware of the different body systems and the need for maintaining good health through appropriate life style.
Module 1

**Basics of human physiology:** levels of structural organisation- chemical level, cellular level (in brief), tissue level- epithelial tissue, connective tissue, membranes.

Module 2

**Muscular system:** types of muscular tissue, ultrastructure of myofibril, sliding filament mechanism, neuromuscular junction, muscle metabolism, common clinical abnormalities (any 8).

**Respiratory system:** functional organization, common clinical abnormalities

Module 3

**Nervous system:** structure of neuron, electrical signals in neuron, signal transmission, anatomy of brain and anatomy of spinal cord, spinal cord physiology, common clinical abnormalities (any 8).

Module 4

**Endocrine system:** anatomy of endocrine glands, hormone activity, mechanism of hormone action, functions and common clinical abnormalities (any 8).

Module 5

**Cardiovascular system:** anatomy of Heart and circulation of blood, cardiac conducting system, ECG, cardiac cycle, cardiac output, composition of blood, blood clotting and blood groups, blood pressure and Common clinical abnormalities (any 8)

References

SEASON 3

CORE COURSE 7

PHYSIOLOGY WITH CLINICAL CORRELATION
(PRACTICALS)

36 Hrs
0 Credit

1. Determination of O\textsubscript{2} uptake by cockroach [Respirometer] \hspace{1cm} (3 Hrs)
2. Effect of adrenalin and noradrenalin on the heart beat of frog (demo) \hspace{1cm} (2 Hrs)
3. Preparation of human blood smear and identification of leucocytes \hspace{1cm} (6 Hrs)
4. Determination of differential WBC count \hspace{1cm} (6 Hrs)
5. Estimation of haemoglobin \hspace{1cm} (4 Hrs)
6. Demonstration of hemin crystals \hspace{1cm} (3 Hrs)
7. ESR \hspace{1cm} (4 Hrs)
8. Blood grouping (ABO, Rh). \hspace{1cm} (2 Hrs)
9. Bleeding time and Clotting time \hspace{1cm} (6 Hrs)

SEASON 3

ZB3CRT08 - CORE COURSE 8

CLINICAL CHEMISTRY AND CLINICAL MICROBIOLOGY

54 Hrs
3 Credits

Objectives

1. To inspire the students in learning the frontier areas of biological sciences
2. To expose the students to fundamentals in clinical chemistry and to make them appreciate the relevance of the subject in biological studies.
3. To make them aware of the pathogens, health related problems, their origin and treatment.

Module 1 \hspace{1cm} 12 Hrs

Lifestyle diseases: AIDS, Diabetes Mellitus, Obesity, Cancer, Cardiovascular diseases, kidney disorders, liver disorders.

Module 2 \hspace{1cm} 12 Hrs
Functions of various organs and their clinical assessment (Brief treatment only but emphasizing the biochemical aspect): e.g., liver, kidney, heart, pancreas, endocrine glands, lung, brain. Biochemical changes in the organs under pathological conditions.

Module 3 4 Hrs
Routine biochemical tests of blood sugar, cholesterol and NPN.

Module 4 14 Hrs
Microorganisms of medical importance — Symptoms, causative agents, clinical features, laboratory diagnosis and treatment of important

Bacterial diseases — Diphtheria, Pneumonia, Cholera, Tuberculosis, Salmonellosis, Typhoid

Viral diseases — Common cold, Respiratory Syncytial virus infections, Corona virus (SARS), AIDS

Fungal diseases — Oral thrush, Aspergillosis

Module 5 12 Hrs
Parasitic diseases — Symptoms, causative agents, clinical features, laboratory diagnosis and treatment of Malaria, Filariasis, Giardiasis, Amoebiasis,

References
SEMESTER III

CORE COURSE 8
CLINICAL CHEMISTRY AND CLINICAL MICROBIOLOGY
(PRACTICALS)

36 Hrs
0 Credit

1. Estimation of: blood glucose, total protein in serum, serum albumin, bloodurea, creatinine in blood, serum bilirubin, serumcholesterol, serum alkaline phosphatase, serum acid phosphatase. (14 Hrs)
2. Media preparation, Inoculation, and maintenance of bacteria. (7 Hrs)
3. Gram staining (2 Hrs)
4. Acid fast staining (2 Hrs)
5. Widal Test (2 Hrs)
6. Identification of microorganisms (bacteria, fungi) ofclinical significance (9 Hrs)

SEMESTER 3

ZB3CRT09 - CORE COURSE 9
TISSUE CULTURE & GENE MANIPULATION

54 Hrs
3 Credits

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

Module 1 12 Hrs

Manipulating DNA: in microbes, plants and animals – overviews

Restriction endonucleases, ligases, cloning vectors [plasmids & phage DNA]

Isolation of genomic DNA, Mechanism of gene transfer and methods, Identification and selection of recombinants.
Recombinant DNA technology and its applications.

Module 2  
12 Hrs  
**Gene Cloning:** Introduction and overview of Gene cloning; Techniques, principles and applications

Module 3  
8 Hrs  
**Plant tissue culture:** media and composition. Characteristic of plant cells in culture, callus, meristem, anther, embryo, ovule, ovary and endosperm culture

Module 4  
12 Hrs  
**Germ plasm:** Storage, somatic hybridization

Module 5  
10 Hrs  
**Animal cell culture:** growth media and maintenance of culture. Characteristics of animal cells in culture, hybridoma technology.

References

SEMESTER 3

CORE COURSE 9
TISSUE CULTURE AND GENE MANIPULATION
(PRACTICALS)

36 Hrs
0 Credit

1. Media formulation for plant tissue culture (4 Hrs)
2. Surface sterilization. (2 Hrs)
3. Callus induction. (2 Hrs)
4. Auxillary bud culture. (2 Hrs)
5. Isolation of protoplast. (4 Hrs)
6. Isolation of genomic DNA and its quantification. (10 Hrs)
7. Isolation of plasmid DNA. (6 Hrs)
8. Restriction digestion, ligation, bacterial transformation. (6 Hrs)

SEMESTER 4

ZB4CRT10 - CORE COURSE10
RADIOLOGY AND ADVANCED INSTRUMENTATION TECHNIQUES

54 Hrs
3 Credits

Objectives
1. To introduce the student to some of the radiological techniques and its applications
2. To develop an awareness about the harmful effects of radiation

Module 1
7 Hrs


Module 2
10 Hrs
**Isotopes:** Definition, isotopes of common biological use, techniques for detection of isotopes and applications - [Autoradiography, Geiger counting technique, liquid scintillation, Gamma counter]

Use of radio isotopes in biological research, auto-radiography- pulse chase experiment.

Isotope dilution technique

**Module 3**  
**10 Hrs**

**Management of radioactive wastes:** waste disposal and cleaning of contaminated glassware. Precautions for handling, safety in use of radiation sources and radio isotopes.

**Module 4**  
**12 Hrs**

**Newer techniques in microscopy:** Confocal, Scanning probe microscopy, Flowcytometry & cell sorting.

**Module 5**  
**15 Hrs**

**Chromatographic techniques:** Theory, methods and application of paper, gas, affinity, ion exchange chromatography, TLC, HPLC, Gel filtration.

**Electrophoresis:** Theory, methods and applications of gelelectrophoresis: AGE, PAGE, Polymerase chain reaction, DNA sequencing, DNA fingerprinting.

**References**

SEMESTER 4

ZB4CRP04 - CORE COURSE 10
RADIOLOGY AND ADVANCED
INSTRUMENTATION TECHNIQUES
(PRACTICALS)

36 Hrs
2 Credits

1. Types and effects of various radiations. Isotope dilution techniques. (Visit
to a radioisotope lab.) (14 Hrs)
2. Problems in radiology [on half cycle, quantity, disposal] (14 Hrs)
3. Agarose gelelectrophoresis: AGE (8 Hrs)

SEMESTER 4

ZB4CRT11 - CORE COURSE 11
ENTREPRENEURSHIP DEVELOPMENT AND
MARKETING

54 Hrs
3 Credits

Objectives

1. To understand the importance of marketing strategies and effects on entrepreneurial
development.

Module 1

Institutions, financing procedure and financial incentives. (8 Hrs)

Module 2

Resource management: man, machine and materials, quality control/ quality assurance and
testing of products (10 Hrs)

Module 3

Elements of marketing & sales management [ Nature of product and market strategy, packaging
and advertising, after sales service] (12 Hrs)

Module 4

Income tax, sales tax and excise rules (12 Hrs)

Module 5

(12 Hrs)
Need, scope and approaches for project formulation, structure of project reports. Project implementation, project report and appraisal. Network analysis – PERT, CPM

Entrepreneur traits of entrepreneur

References

SEMESTER 4

CORE COURSE 11
ENTREPRENEURSHIP DEVELOPMENT AND MARKETING
(PRACTICALS)

36 Hrs
2 Credits

1. Preparation and analysis of a project (14 Hrs)
2. Entrepreneurial motivation training through games, role playing, discussions and exercises (8 Hrs)
3. Preparation of report on an industry/firm (14 Hrs)
SEMESTER IV

CORE COURSE 12

RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS

54 Hrs

3 Credits

Objectives

1. To familiarise the learner the basic concept of scientific method in research process.

2. To have a knowledge on various research designs.

3. To develop skill in research communication and scientific documentation.

4. To create awareness about the laws and ethical values in biology.

5. To equip the students with the basic techniques of animal rearing collection and preservation

6. To help the student to apply statistical methods in biological studies.

RESEARCH METHODOLOGY

Module I 13 Hrs

Basic concepts of research: Meaning, Objectives, Approaches, Types of research.
Research Process: Scientific method in research (eight steps).
Importance of literature reviewing in defining a problem,
Identifying gap areas from literature review.
Research Communication and scientific documentation: Project proposal writing,
Research report writing, (Structure of a scientific paper), Thesis, dissertation, research article.
Presentation techniques: Oral presentation, Assignment, Seminar, Debate, Workshop,
Colloquium, Conference
Sources of Information: Primary and secondary sources. Library- Books, Journals,
Periodicals, Reviews, Internet.

Plagiarism

**Module II** 12 Hrs

**Animal Collection – Tools & techniques**

Sampling techniques
- Quadrate
- Line transect

Measurements
- Density
- Abundance
- Frequency

Biodiversity indices – concepts
- Simpson index

Collection methods, techniques and equipments
- Plankton
- Insects
- Fish
- Bird

Preservation techniques – Taxidermy

Rearing techniques

Laboratory and field.

Units of measurements- units, SI system, Equivalent weight, normality, molarity

**Biophysics**

**Module III** 14 Hrs

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

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**BIOETHICS**

**Module IV**


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 Board of India, CPCSEA, ethical commitment. Working with human: Consent, harm, risk and benefits.

**BIOSTATISTICS**

**Module V**

Sample & Sampling techniques: Collection of data, classification of data, frequency distribution tables, graphical representation: - Bar diagrams, Histogram, Pie diagram and Frequency curves - Ogives.

Measures of Central Tendency: Mean, Median, Mode (Problem - Direct method only)

Measures of dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Standard error. (Merits & demerits and problems on SD).

Correlation: Definition, Types of correlation.(mention in brief)

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.
References:


PRACTICAL

RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS

2 credits

PART A. RESEARCH METHODOLOGY

Animal collection Tools, Techniques & Estimation

1. Quadrate study
2. Transect study
3. Sampling Methods
4. Species area curve
5. Simpson index

PART B - BIOPHYSICS

6. Study of simple and compound light microscopes
7. Micrometry –calibration and measurement of microscopic objects –low power
8. Camera Lucida (draw a few diagrams using Camera Lucida)
9. Paper chromatography (demonstration only)
10. Instrumentation – demonstration (write notes on principle, equipment and its use)

  pH Meter
  Colorimeter/ Spectrophotometer
CENTRIFUGE

PART C  BIOSTATISTICS

1. MS Excel: To create mean and median, Construction of bar diagram, Pie diagram and Line graphs.
2. MS Access: To create grade of students
4. Frequency distribution of the given samples to find out arithmetic mean, median, mode.
5. Range and standard deviation for a biological data
6. Correlation using any biological data.

SEMESTER V.

CORE COURSE 13
ENVIRONMENTAL BIOLOGY AND HUMAN RIGHTS
(54 Hrs)

Objectives

To instill the basic concepts of Environmental Sciences, Ecosystems, Natural Resources, Population, Environment and Society

To make the students aware of natural resources, their protection, conservation, the factors polluting the environment, their impacts and control measures.

To teach the basic concepts of toxicology, their impact on human health and remedial measures

To create a consciousness regarding Biodiversity, environmental issues & conservation strategies

To develop the real sense of Human rights – its concepts & manifestations
MODULE 1  ECOSYSTEM  12 Hrs

Basic concepts of ecosystem Components of ecosystem: Abiotic (Sunlight, temperature, soil, water, atmosphere) and Biotic components (Producers, consumers, decomposers), Ecological pyramid- number, biomass, energy, Functions of ecosystem: Productivity-Food chain-Food web-Energy flow-Laws of Thermodynamics. Types of Ecosystem: Terrestrial-Forest-Grassland-Desert, Aquatic-Marine-Fresh water, Wetland &Biome Concept of limiting factors: Liebig’s and Shelford’s laws of limiting factors.

Biogeochemical cycles: Concept, gaseous and sedimentary cycles, Carbon cycle, Nitrogen cycle.

Renewable resources (solar,wind, hydroelectric, biomass and geothermal) and Non renewable resources (mineral and metal ore, fossil fuels)

MODULE 2  CONCEPTS OF POPULATION AND COMMUNITY  8 Hrs

Concept of population: Population attributes- Population growth forms, Basic concepts of growth rates, density, natality, mortality, growth curves

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


MODULE 3  BIODIVERSITY AND ENVIRONMENTAL ISSUES  16 Hrs

Introduction to Biodiversity: Types of biodiversity- Alpha, Beta and Gamma diversity. Concept and importance of Biodiversity: Levels of Biodiversity-Species diversity, Genetic diversity, Microbial, Ecosystem diversity, India as a mega-diversity nation, Biodiversity hotspots
Global Environmental Issues: Ozone depletion, Greenhouse effect, Global warming, Climate change, Carbon trading, carbon credit; Carbon sequestration, Acid rain, Oil spills, Nuclear accidents, IPCC/UNFCC.

National Environmental issues: Deforestation, forest fire, pollution (air, water, soil, noise thermal, nuclear- brief account only) solid waste management, sewage, drinking water crisis and water logging.

Toxic products and disaster: Types of toxic substances – degradable, non degradable, Impact on human – case studies: Endosulphan tragedy, Bhopal disaster

Flood, drought, cyclone, earthquake and landslide (Management and mitigation)

Local Environmental issues: Landscape alteration, sand mining, quarrying, changing crop pattern, conversion of paddy lands,

Threats to water resources of Kerala: Degrading Mangrove and wetland ecosystems of Kerala, RAMSAR sites, Marine ecosystem crisis- pollution, overfishing etc. Impact of tourism on Environment.

MODULE 4 CONSERVATION OF BIODIVERSITY 12 Hrs

Protected area concept – Sanctuary, National Park, Biosphere reserve, Core Zone, Buffer Zone, Corridor concept. Conservation reserves

Concept of threatened fauna – IUCN categories - extinct, extinct in the wild, critically endangered, endangered, vulnerable, near threatened, least concern and data deficient. Red and Green Data Books.

Man–animal conflict (Tiger, Elephant, Dog, Monkey) – causes and concern

Water conservation- rainwater harvesting, watershed management

Environment education


MODULE 5 HUMAN RIGHTS 6 Hrs

Introduction, main concepts associated with Human Rights, Different types of human rights,

References

J.B Sharma (2009), Environmental studies’ - 3rd Ed. University science Press

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


Sharma P.D. (2005) Environmental biology and Toxicology, Rastogi publication

MeeraAsthana and Astana D.K.1990 Environmental pollution and Toxicology Alka printers.


SEMESTER 5 PRACTICAL

ENVIRONMENTAL BIOLOGY & TOXICOLOGY

36 HRS CREDIT 1

1. Estimation of dissolved Oxygen
2. Estimation of carbon di oxide
3. Estimation of soil organic carbon (Demonstration only)
4. Identification of marine/ fresh water planktons
5. Counting of plankton using plankton counting chamber
6. Study of equipments – Secchi disc, Plankton net
7. Study of sandy shore fauna, rocky shore fauna.
8. Study of animal Association
10. Field study (compulsory)

SEMESTER V.

CORE COURSE 14

CELL BIOLOGY AND GENETICS

54 Hrs
Credits 3

Objectives
1. To understand the structure and function of the cell as the fundamentals for understanding the functioning of all living organisms.
2. To make aware of different cell organelles, their structure and role in living organisms.
3. To develop critical thinking, skill and research aptitudes in basic and applied biology
4. To emphasize the central role of genes and their inheritance in the life of all organisms.
CELL BIOLOGY

Module I 6 Hrs


Module II 10 Hrs


Module III 6 Hrs

Cell Communication: Basic principles of cell communications,Cell signaling(in brief), Types of signaling, Mention signaling molecules (neurotransmitters, hormones, Growth Factors, Cytokines Vitamin A and D derivatives),

Cell Division: Cell cycle - G1, S, G2 and M phases,.Mitosis and Meiosis. The difference between Mitosis and Meiosis.

References:
1 Zoological Society of Kerala Study material. 2002. Cell Biology, Genetics and Biotechnology

John Wiley and Sons, Inc.


**GENETICS**

**Module I**


**32 Hrs**

- **10 Hrs**
**Interaction of genes:** Allelic: Incomplete Dominance (Four O Clock Plant). Co-Dominance (Skin colour in Cattle) Lethal Alleles: Dominant lethal gene [Creeper chicken] and recessive lethal gene [cystic fibrosis].

Non Allelic: Complementary (Flower colour in Sweet Pea), Supplementary (Coat colour in mice), Epistasis - dominant (Plumage in poultry) and recessive (Coat colour in mice). Polygenes (Skin colour inheritance in man), Pleiotropism (Vestigial wing gene in Drosophila).

**Multiple alleles** – ABO Blood group system, Rh group and its inheritance. Erythroblastosis foetalis.

**Module II**

**Sex determination:** Chromosome theory of sex determination (Autosome and Sex chromosomes), male heterogamy and female heterogamy, (xx-xy, xx-xo, ZZ-ZW, ZZ-ZO), Genic Balance theory of Bridges. Barr bodies, Lyon’s hypothesis, Gynandromorphism, sex mosaics, intersex (Drosophila), Hormonal [free martin in calf] and Environmental (Bonelia) influence on Sex determination.

**Recombination and Linkage:** Linkage and recombination of genes based on Morgan’s work in Drosophila, Linked genes, Linkage groups, Chromosome theory of Linkage, Types of linkage- complete and incomplete. Recombination, cross over value, chromosome mapping.

**Sex Linked inheritance:** Characteristics of Sex Linked inheritance, X Linked inheritance of man (Hemophilia), Y linked inheritance [Holandric genes], Incompletely Sex Linked genes or pseudoautosomal genes (Bobbed bristles in Drosophila), Sex limited genes (Beard in man) and Sex influenced genes (inheritance of baldness in man).

**Module III**

**Mutation:** Types of mutations - Somatic, germinal, spontaneous, induced, autosomal and allosomal, chromosomal mutations, structural and numerical changes. Gene mutations.

[Addition, Deletion and substitution].

**Human Genetics:** Karyotyping, Normal Human chromosome Complement, Pedigree analysis, Aneuploidy and Non-disjunction. Autosomal abnormalities (Down syndrome, Cry du chat syndrome) Sex chromosomal abnormalities (Klinefelters syndrome, Turner’s syndrome) Single gene disorder (Brief mention) Autosomal single gene disorder [sickle cell anaemia], Inborn errors of metabolism such as phenylketonuria, alkaptonuria, , Albinism. Multifactorial traits – polygenic disorder- cleft lip and cleft palate.
Genetic Counseling, Eugenics and Euthenics - Brief account only

References:

SEMESTER V

PRACTICAL

CELL BIOLOGY AND GENETICS

36 Hrs

2 Credits

PART A: CELL BIOLOGY

1. Squash preparation of onion root tip for mitotic stages
2. Mounting of polytene chromosome (Drosophila/Chironomous.) Demonstration
3. Tissues (permanent slides of epithelial tissues, striated muscle, smooth muscle, cartilage, bone)
4. Identification of cell organelles
5. Preparation of temporary whole mount.
6. Preparation of permanent whole mount (demonstration)
7. Preparation of human blood smear and identification of Leucocytes

PART B : GENETICS

1. Genetic problems on Monohybrid, Dihybrid Crosses and Blood group inheritance
2. Study of normal male and female human karyotype (use photographs or Xerox copies)
3. Abnormal human karyotypes - Down, Edwards, Klinefelter and Turner syndromes (use photographs or Xerox copies)
5. Study of Barr body in human buccal epithelium

SEMESTER V.
CORE COURSE - 15: EVOLUTION, ETHOLOGY & ZOOGEOGRAPHY

54 Hrs
Credits 3

Objectives:
- To acquire knowledge about the evolutionary history of earth - living and nonliving
- To acquire basic understanding about evolutionary concepts and theories
- 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

PART I - EVOLUTION

30 Hrs
Module I - Origin of life  
8 Hrs
Theories - Panspermia theory or Cosmozoic theory, Theory of spontaneous generation (Abiogenesis or Autogenesis), Special creation, Biogenesis, Endosymbiosis.
Chemical evolution - Haldane and Oparin theory, Miller-Urey experiment;

Module II - Theories of organic evolution  
9 Hrs
Lamarckism and its Criticism, Weismann’s Germplasm theory, Darwinism and its Criticism, Neo-Darwinism, Theory of De Vries,
Factors that upset Hardy-Weinberg Equilibrium, Effects of genetic drift on population:
Bottleneck effect and founder effect

Module III – Nature of evolution  
13 Hrs
Species and Speciation: Species concept, subdivisions of species (sub species, sibling species, cline and deme), Speciation: Types of speciation, Phyletic speciation (autogenous and allogenous transformations), True speciation, Instantaneous and gradual speciation, allopatric and sympatric speciation
Isolation: Types of isolating mechanisms-Geographic isolation (mention examples) and Reproductive isolation. Role of isolating mechanisms in evolution
Microevolution, Macroevolution (Adaptive radiation -Darwin finches) Mega evolution, Punctuated equilibrium, Geological time scale, and Mass extinction (brief account only).
Evolution of Horse

PART II - ETHOLOGY  
14 Hrs
Module IV– Introduction  
1 Hr
Definition, History and scope of ethology

Module V – Learning, imprinting and behaviour  
9 Hrs
Types of learning with examples; patterns of behaviors – types of rhythms, navigation, homing instinct, hibernation, aestivation; pheromones- types and their effect on behavior, hormones and their action on behavior (aggressive and parental behavior)

Module VI – Social organization  
4 Hrs
Social organization in insects (ants) and mammals (monkey), Courtship behaviour and reproductive strategies

PART III - ZOOGEOGRAPHY  
10 Hrs
Module VII – General Topics
Continental drift theory, Types and means of animal distribution, Factors affecting animal
distribution; insular fauna – oceanic islands and continental islands,

Module VIII - Zoogeographical realms
Palaearctic region, Nearctic region, Neotropical region, Ethiopian region, Oriental region,
Australian region (brief account with physical features and fauna, Wallace’s line, Weber’s line,
Biogeography of India with special reference to Western Ghats

References:

EVOlution
   Evolution.Cold Spring, Harbour Laboratory Press.
   Press, U.K.
   Cummings.
   Ltd. Kolkata, India.
   Simon & Schuster, NY,USA.
   Publishers.
    about Ourselves. Texas A&M University Press, USA.

Ethology

ZOOGEOGRAPHY

PRACTICAL

EVOLUTION, ETHOLOGY & ZOOGEOGRAPHY

36 Hrs
Credit 1

1. Identification of Zoogeographical realms using map
2. Study on endemic species of each realm
3. Show the discontinuous distribution of (lung fishes, camel, elephant)
4. Providing a map trace the route of HMS Beagle
5. Providing a map mark any two continental/oceanic islands.: Greenland, Madagascar, New Zealand, New Guinea, Maldives, Iceland, Hawaii – any two
6. Contributions of scientists (showing photos) - Any four
7. Identification of different stages of horse evolution
8. Study on Homology and Analogy
9. Study on connecting links (Peripatus, Archaeopteryx, Protopterus, Echidna)
10. Pheromone traps
11. Skinner box & T Maze
12. Experiment to demonstrate phototaxis and chemotaxis using Drosophila/House fly
13. Identification of behaviour (Grooming/courtship dance of flamingos/stickle back fish/ Tail wagging dance/ Aggressive behaviour/ Auto/Allo grooming, Flehmen response) showing pictures (Any five)

SEMESTER V.

CORE COURSE VIII
HUMAN PHYSIOLOGY, BIOCHEMISTRY 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.

**HUMAN PHYSIOLOGY**

**31 Hrs**

**Module I**


**Digestion:** Anatomy and histology of digestive glands (liver, pancreas, salivary, gastric and intestinal). Digestion and absorption of carbohydrates, proteins, and fats. Nervous and hormonal control of digestion.

**Module II**


**Circulation:** ESR, Haemopoiesis, blood pressure, ECG. Haemostasis (blood coagulation) – clotting factors, intrinsic and extrinsic pathways, anticoagulants and its mechanism of action. Cardiovascular diseases (Jaundice, Atherosclerosis, Myocardial infarction, Thrombus, Stroke). Angiogram and angioplasty.

**Module III**

**Excretion:** Histology of Bowman’s capsule and tubular part. Urine formation – glomerular filtration, tubular reabsorption, tubular secretion. Urine concentration – counter current

Module IV 10 Hrs


Muscle physiology: Ultra structure of striated muscle, muscle proteins (myosin, actin, tropomyosin, troponin), Muscle contraction and relaxation-Sliding Filament Theory, cross bridge cycle, biochemical changes and ATP production in muscle, Cori cycle. Kymograph, Simple muscle twitch, muscle fatigue, tetanus, rigor mortis.

BIOCHEMISTRY 15 Hrs

Module V 5 Hrs

Carbohydrates: Basic structure, biological importance and classification of monosaccharides, oligosaccharides, polysaccharides with examples.

Proteins: Basic structure and classification of amino acids; structure, biological importance and classification of proteins with examples.

Lipids: Structure of fatty acid, saturated and unsaturated fatty acid, biological importance and classification of lipids with examples.

Vitamins and minerals: Major fat soluble and water soluble vitamins. Important minerals and trace elements required for living organisms. Biological importance of vitamins and minerals.

Enzymes: Chemical nature of enzymes, enzyme activation, enzyme inhibition, allosteric enzymes, isoenzymes, co-enzymes. Michaelis–Menten enzyme kinetics.

Module VI 10 Hrs

Protein metabolism: Deamination, Transamination, Transmethylation, Decarboxylation, Ornithine cycle.

Lipid metabolism: Biosynthesis of fatty acids, Beta oxidation, physiologically important compounds synthesized from cholesterol.

ENDOCRINOLOGY

Endocrinology and reproduction 8 Hrs
Module VII 8 Hrs

Endocrine physiology: Hormones – classification and mechanism of hormone action. Major endocrine glands (Histology is not included) their hormones, functions and disorders (hypothalamus, pituitary gland, pineal gland, thyroid gland, parathyroid gland, islets of Langerhans, adrenal gland), Homeostasis and feedback mechanism.

References:


Arthur C. Guyton and John E. Hall; 2016; Text Book of Medical Physiology: Guyton, 13th edition; Elsevier


Bhagavan, N.V.. 2007. Medical biochemistry, fourth edition Academic Press,


PRACTICAL

HUMAN PHYSIOLOGY, BIOCHEMISTRY AND ENDOCRINOLOGY

36 Hrs
Credit1

HUMAN PHYSIOLOGY

1). Determination of haemoglobin content of blood
2). Total RBC count using Haemocytometer
3). Total WBC count using Haemocytometer
4). Estimation of microhaematocrit
5). Effect of hypertonic, hypotonic and isotonic solutions on the diameter of RBC.
6). Instruments: Kymograph, Sphygmomanometer and Stethoscope (principle and use)
7). Measurement of blood pressure using sphygmomanometer (demonstration only)

BIOCHEMISTRY

1. Qualitative analysis of protein, glucose, starch and lipids.
2. Chromatography – Determination of Rf value of amino acids and identification of amino acids (Identify the Amino Acids using different solvent front and solute front)

ENDOCRINOLOGY

1. Cockroach – Corpora cardiaca & Corpora allata (Demonstration)
2. Effect of adrenalin on heart beat of Cockroach (Demonstration)
SEMESTER VI.

CORE COURSE 17
DEVELOPMENTAL BIOLOGY

54 Hrs
3 Credits

Objectives:

1. To achieve a basic understanding of the experimental methods and designs that can be used for future studies and research.

2. To provide the students with the periodic class discussions of current events in science which will benefit them in their future studies in the biological/physiological sciences and health-related fields.

3. To contribute to critical societal goal of a scientifically literate citizenry.

Module I

10 Hrs

Introduction: Definition, Scope of developmental biology, sub-divisions (descriptive, comparative, experimental and chemical), historical perspectives, basic concepts and theories.


Egg types: Classification of eggs based on the amount, distribution and position of yolk. Mosaic and regulative, cleidoic and noncleidoic eggs. Polarity and symmetry of egg.

Fertilization: Mechanism of fertilization-(Encounter of spermatozoa and Ova, Approach of the Spermatozoon to the Egg, Acrosome Reaction and Contact of Sperm and Ovum, Activation of Ovum, Migration of Pronuclei and Amphimixis, ), Significance of fertilization, Polyspermy, Parthenogenesis- Different types and significance.

Module II

14 Hrs


Blastulation: Morula, blastula formation, types of blastula with examples.
Fate maps: Concept of fate maps, construction of fate maps (artificial and natural), structure of a typical chordate fate map. Significance of fate map.


Cell differentiation and gene action: Potency of embryonic cells (Totipotency, Pleuripotency, Unipotency of embryonic cells). Determination and differentiation in embryonic development, Gene action during development with reference to Drosophila (maternal effect genes), Zygotic genes.

Module III

Embryology of Frog: Gametes, fertilization, cleavage, blastulation, fatemap, gastrulation, neurulation, notogenesis. Differentiation of Mesoderm and Endoderm, Development of eye. Metamorphosis of frog, Hormonal and environmental control.


Module IV

Experimental embryology: Spemann’s constriction experiments, Organizers and embryonic induction. Embryo transfer technology, cloning, stem cell research. Ethical issues.

Teratology / Dysmorphology, Developmental defects: Teratogenesis, important teratogenic agents. (Radiations, chemicals and drugs, infectious diseases) genetic teratogenesis in human beings,


Module V

General topics: Classification and functions of placenta in mammals. Prenatal diagnosis (Amniocentesis, Chorionic villi sampling, Ultra sound scanning, Foetoscopy, Maternal serum alpha-fetoprotein, Maternal serum beta-HCG). Regeneration in animals.
References:


Balnisky B.I.; 1981 An Introduction to Embryology, W.B. Saunders and Co.


Dutta 2007 Obstrestics , Church Livingston 17 Ed

Majumdar N. N -1985 Vetebrate embryology; Tata McGraw-Hill, New Delhi

Melissa A & Gibbs, 2006; A practical Guide to Developmental Biology, Oxford university press ( Int. student edition)


PRACTICAL

DEVELOPMENTAL BIOLOGY

36 Hrs

Credit 1

Model/Chart/ Slide may be used

12. Embryological studies- Blastula (frog, chick)
13. Embryo transfer, cloning, gastrula (frog, chick)
14. Amniocentesis
15. Embryotransfer technology, cloning
16. Study of placenta- pig and man
17. 18 hour, 24 hour, 33 hour and 48 hour chick embryo.
18. Candling method.
20. Male and female reproductive organs in cockroach
21. Calculate the fecundity of fish.
22. Calculate the gonado-somatic index of given fish.

SEMESTER VI.

CORE COURSE 18. MICROBIOLOGY & IMMUNOLOGY

54 Hrs

MICROBIOLOGY

Module I 10 Hrs

Introduction: History and scope of microbiology. Outline classification of Microbes. (bacteria, fungus & virus)

Methods in Microbiology: Sterilization and disinfection - physical and chemical methods.
Culture media – selective media, enrichment media, differential media. Plating techniques and isolation of pure colony. Culture preservation techniques: refrigeration, deep freezing, freezing under liquid nitrogen, lyophilization.

Module II 15 Hrs

Morphology and fine structure of bacteria: Size, shape, cilia, pili, flagella, capsule, cell wall and its composition. Cytoplasmic membrane, protoplast, spheroplast, intracellular membrane systems, cytoplasm, vacuoles, genetic material, cell inclusions, bacterial spores.

Bacterial growth Curve, Staining techniques – gram staining.


Module III 8 Hrs

Infections & Diseases: Types of infections – primary, secondary and nosocomial infections.
Contagious diseases – epidemic, endemic and pandemic, mode of
Transmission – food, water, air, vectors and carriers.
Diseases: Epidemiology, symptomology, diagnosis and treatment. Bacterial - Clostridium
tetany (tetanus), Viral – HIV virus (AIDS), fungal – Candida albicans (candidiasis).

IMMUNOLOGY

Module IV 9Hrs
Introduction to Immunology: Innate and acquired immunity, passive (natural and artificial)
and active immunity (Natural and Artificial). Mechanisms of innate immunity - barriers,
inflammation, phagocytosis.
Lymphoid organs: Primary (Thymus, Bone marrow) and secondary lymphoid organs (lymph
nodes, spleen).
Lymphocytes: T and B cells, Natural killer cells, memory cells, macrophages.

Module V 9Hrs
Antigens, Types of antigens, haptens, adjuvants, immunoglobulin structure, classes and
functions of immunoglobulins.
Types of Immunity- humoral & cell mediated immunity Monoclonal & polyclonal antibodies
Antigen – antibody reactions, Precipitation test, Agglutination test, VDRL WIDAL, ELISA.
Auto immune diseases: Pernicious Anemia, Rheumatoid Arthritis. Immunodeficiency -
AIDS. Hyper sensitivity- Type I, (E.g. Anaphylaxix) II( Transfusion reaction) , III (Arthus
reaction) and IV (Mantaux Test) (in brief).

Vaccines 3 Hrs
Introduction Types of vaccines, Current Vaccines, Recent trends in vaccine preparation

References
Longman Private Ltd.


5. Susan Panicker & George Abraham (Editors) (2008), Micro Biology and Immunology, Zoological Society of Kerala, Kottayam.

6. Colemen: (2002). Fundamentals of Immunology


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


MICROBIOLOGY AND IMMUNOLOGY

PRACTICAL

72 Hrs

2 Credits

1. Instruments –Autoclave, Hot air oven, Bacteriological incubator – Laminar air flow

2. Preparation of solid and liquid media for microbial cultures.
   (Ingradients, 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.

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

4. Examination of microbes in living condition
   Hanging drop method for demonstrating motility of bacteria.


6. Antibiotic sensitivity test (demonstration only)

7. Streak plating (individual performance)

8. Preparation of a fungal smear – Lactophenol cotton blue staining and mounting

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

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

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**SEMESTER VI.**

**CORE COURSE 19**

**BIOTECHNOLOGY, BIOINFORMATICS & MOLECULAR BIOLOGY**

**BIOTECHNOLOGY**

20 HRS

**Module I**

11 Hrs

Introduction: Scope, Brief History, Scope and Importance

Tools and Techniques in Biotechnology: Enzymes (restriction endonucleases, ligases, linkers & adapters), Vectors-[ Plasmids, Phage vectors, Cosmids, Artificial Chromosomes] Host cells.

Basic steps & techniques in rDNA technology


**Module II**

9 Hrs
Animal Cell Culture: Brief account on methods, substrates, media and procedure of animal cell culture, Stem Cells, types and potential use, Organismal Cloning- reproductive & therapeutic—brief account only.

Applications of Biotechnology: Applications in Medicine(insulin, growth hormone, gene therapy), Agriculture(GM plants and biopesticides), Environment(bioremediation), Industry (Single Cell Protein) and applications of Fermentation Technology- lactic acid, vitamins, food and beverages.

Potential Hazards of Biotechnological Inventions: Risks related to genetically modified organisms (GMO) and biologically active products, Biological warfare & Biopiracy. Protection of biotechnological inventions. Intellectual Property Rights, Patenting and patent protection.

References


BIOINFORMATICS 14 Hrs

Module III 8 Hrs
Introduction: Definition, importance and role of bioinformatics in life sciences. Computational Biology.

Biological databases: Nucleotide sequence databases (NCBI- GENBANK, DDBJ and EMBL). Protein databases - structure and sequence databases (PDB, SWISSPROT and UNIPROT). Introduction to Sequences alignments: Local alignment and Global alignment, Pair wise alignment (BLAST and FASTA) and multiple sequence alignment. Phylogenetic Tree construction and Analysis

Module IV 6 Hrs

Molecular visualization software - RASMOL. Basic concepts of Drug discovery pipe line, computer aided drug discovery and its applications. Human Genome Project.

MOLECULAR BIOLOGY 20 Hrs

Module V 8 Hrs

Nature of Genetic Materials: Discovery of DNA as genetic material – Griffith’s transformation experiments. Avery Macarty and Macleod, Hershey Chase Experiment of Bacteriophage infection, Prokaryotic genome; Eukaryotic genome. Structure and types of DNA & RNA. DNA replication. Modern concept of gene (Cistron, muton, recon, viral genes), Brief account of the following-- Split genes (introns and exons), Junk genes, Pseudogenes, Overlapping genes, Transposons.

Module VI 12 Hrs

Gene Expressions: Central Dogma of molecular biology and central dogma reverse, one gene-one enzyme hypothesis, One gene-one polypeptide hypothesis Characteristics of genetic code, Contributions of Hargobind Khorana.

Protein synthesis [prokaryotic]: Transcription of mRNA, Reverse transcription, post transcriptional modifications, Translation, Post translational modifications.

Gene regulations: Prokaryotic( inducible & repressible systems) Operon concept -Lac operon and Tryptophan operon, Brief account of Eukaryotic gene regulation.
References


PRACTICAL SYLLABUS.

(BIOTECHNOLOGY, BIOINFORMATICS & MOLECULAR BIOLOGY)

BIOTECHNOLOGY
1. Identify and comment on the item provided: (Western blotting / Southern blotting / Northern blotting / PCR)
2. Write down the procedure involved in DNA isolation

BIOINFORMATICS
1. Download/use print out/pictures of genome sequences of any 2 organisms. Identify and mention the characteristic features of both.
2. Download/ use print out/pictures of a protein sequence, identify it & comment on its amino acid composition
3. Download / use print out/pictures of a macromolecule. Write a brief note on the bioinformatics tool used to visualize its structure.

MOLECULAR BIOLOGY
1. Identify and comment on its molecular composition / structural orientation / functional significance (Any tissue / Cell organelles/ DNA, DNA replication, RNA different types using models or diagrams)

V1 SEMESTER.
CORE COURSE 20.
OCCUPATIONAL ZOOLOGY .
(APICULTURE, VERMICULTURE, QUAIL FARMING & AQUACULTURE)

54 Hrs
Credits 3

Objectives:

1. To equip the students with self employment capabilities.
2. To provide scientific knowledge of profitable farming.
3. To make the students aware of cottage industries.

Module 1. APICULTURE 18 Hrs


Activity :Visit to an apiculture unit.
Field visit and report submission - 10 Hrs
Field visit and report submission on any two items are taken for internal evaluation.

MODULE: 2. VERMICULTURE 8 Hrs

Activity : Submission of a report after preparing a vermiculture unit or visiting a vermicomposting unit.

**MODULE: 3. 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.

**MODULE: 4. AQUACULTURE.**

24 Hrs

Advantages and salient features of aquaculture, Types of Aquaculture, Biotic and abiotic features of water, Importance of algae in aquaculture, Common cultivable fishes of Kerala, Fish diseases, Composite fish culture, Integrated fish culture, Carp culture, Prawn culture, Mussel culture, Pearl culture. Processing & Preservation.

Aquarium management - Setting up of an aquarium, Biological filter & Aeration, Breeding of gold fish, gourami (Osphronemus), fighter and Guppy (live bearer). Nutrition and types of feed for aquarium fishes, Establishment of commercial ornamental fish culture unit. Fish Transportation - Live fish packing and transport Common diseases of aquarium fishes and their management. Aquaponics (a brief introduction only).

Activity – Setting up of an Aquarium
Field visit – Visiting an Aquaculture farm

**References:**

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


Pradip. V.Jabde, Text book of applied zoology, 2005

Applied Zoology, Study Material Zoological Society of Kerala, CMS college Campus
PRACTICAL

**Occupational Zoology**

36 Hrs

Credit 1

1. General Identification, Economic importance, Morphology, scientific names and common names of the following

f) Economic important and morphology of culturable fishes (Catla, Rohu, Grass carp, Common carp, Silver carp, *Etroplus suratensis*, *Oreochromis*/*Tilapia*, *Mugil cephalus* and *Anabas Testudineus*)

   g) Identification and morphology of ornamental fishes (gold fish, fighter, Gourami, Angel fish, Guppy)

   h) Two species of earthworms used in Vermiculture
i) Four species of honey bees

j) Economic importance and morphology of shell fishes (Any three species of prawn, two marine mussels, two oysters one rock oyster - *Crasostria* and pearl oyster - *Pinctada fucata* and freshwater mussel - *Lamellidens marginalis*).

2. Castes of bees

3. Principle & uses of - Aquarium filters, Aquarium aerator, Aquarium plants, Oven, Pelletiser, Screw Press, die plate

4. Identification and study of fish parasites and diseases (five numbers each) using slides/pictures

5. Bee keeping equipments, Beehive, Smoker, honey extractor, Queen Cage,

6. Bees wax, Honey, Vermicompost (Identification-Uses)

7. Formulation of artificial feed for aquarium fishes – demonstration

8. Tests for determining the adulteration in honey.

9. Mounting of pollen basket

10. Mounting of mouth parts of honey bee

11. Separation of cocoon from worm castings.

**SEMESTER V. OPEN COURSES (FOR OTHER STREAMS)**

1. VOCATIONAL ZOOLOGY  
   **72 Hrs**
   4hrs/Week, Credits 3

**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
➢ To acquire basic knowledge and skills in aquarium management, Quail farming, vermicomposting and apiculture for self-employment
➢ To learn the different resources available and to develop an attitude towards sustainability
➢ Give awareness to society about need for waste management and organic farming

**Module 1 Aquarium management** 12 Hrs
General introduction to Aquarium, Aims and types of aquarium (material, size and shape), Requirements of an aquarium - filtration of waste, physical, chemical and biological; Setting an aquarium (self-sustainable with biological filters), Major indigenous aquarium fishes of Kerala.

**Activity:** Setting up of a freshwater aquarium and rearing of aquarium fishes

**Module 2 Ornamental Fish Culture** 20 Hrs
Introduction to ornamental fishes: Present status of ornamental fish culture in India with special reference to Kerala, Breeding of Gold fish, Fighter, Gourami (*Osphronemus*), and Guppy (live bearer). Nutrition and types feed for aquarium fishes, Use of live fish feed organisms in Ornamental fish culture. Methods and techniques involved in the formulation of fish feed. Fish Transportation: Live fish packing and transport, Common diseases of aquarium fishes and their management. Establishment of commercial ornamental fish culture unit,

**Activity:** field visit to an ornamental fish breeding Centre to understand breeding practices of various aquarium fishes.

**Module 3 Quail farming (Coturnix coturnix)** 10 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.

**Activity:** Visit to a quail farm or viewing a quail documentary to familiarize the quail farming practices

**Module 5 Vermiculture and composting** 12 Hrs
Introduction, ecological classification of earth worms, Life history, Species of earth worms used for vermiculitre, Preparation of vermibed; Preparation of vermicompost, Preparation of vermiwash, Maintenance and management of vermicomposting unit, Role of vermiculture in solid waste management.

**Activity:** - Preparation of a vermiculture unit or visit to a vermicomposting unit.

**Module 6 Apiculture** 18 Hrs
Definition, Uses of bees, species 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, Death period, Enemies of bees, Bee diseases, uses of honey and wax, Apitherapy, Propolis, Royal jelly, Agencies supporting apiculture.

Activity: Identify different types of honey bees and rearing equipments

Field visit and report Submission

Field visit and report writing on any two items are taken for internal evaluation, instead of assignment and seminar. Conduct a workshop on various cultural practices and the preparation of byproducts.

References:

Applied Zoology, Study Material Zoological Society of Kerala, CMS College Campus, Kottayam.

Addison Webb (1947), Bee Keeping- for profit and pleasure, Museum Press, agro bios India Ltd.


George Cust and & Peter Bird. (1978). Tropical Fresh water Aquaria, Published by Hamlyn London. illustrated by George Thompson.

Open Course (for other streams)

2. Public Health and Nutrition

72 Hrs

4hrs/Week

Credits 3

Objectives:

- To inculcate a general awareness among the students regarding the real sense of health.
- To understand the role of balanced diet in maintaining health.
- To motivate them to practice yoga and meditation in day-to-day life.

Part I  Health, Exercise & Nutrition

Module 1  Definition and Meaning of Health  10 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
Module 2  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

Module 3  Safety Education in Health promotion  8 Hrs
Principles of Accident prevention
Health and Safety in daily life.
Health and Safety at work.
First aid and emergency care.
Common injuries and their management.
Modern life style and hypokinetic diseases.
Diabetes, Cardiovascular disorders-Prevention and Management.

Module 4  Life Skill Education  8 Hrs
Life skills, emotional adjustment and well being, Yoga, Meditation and Relaxation, Psychoneuroimmunology

PART II PUBLIC HEALTH AND SANITATION

Module 5  Public health and water quality.  11 Hrs
Potable water, Health and Water quality
Faecal bacteriae and pathogenic microorganisms transmitted by water.
Determination of sanitary quality of drinking water, water purification techniques

Module 6  Public health and diseases  15 Hrs
Food borne diseases and Prevention
Botulinum, Salmenellosis, Hepatitis A
Vector borne diseases & Control measures
Chikungunya, Filariasis and Dengue fever
Zoonotic disease-Leptospirosis & its control
Emerging diseases - Swine flue (H1N1), bird flue (H5N1),
SARS, Anthrax

Re-emerging diseases – TB, Malaria

Health Centre visit & Report Presentation 10 Hrs

References:

SEMESTER V.

OPEN COURSE (FOR OTHER STREAMS)

3. MAN, NATURE AND SUSTAINABLE DEVELOPMENT

72 Hrs
4Hrs/Week
Credits 3

Objectives:
8. To understand how Man originated and attained present status
9. To learn the basic concepts of Ecosystems and its functioning
10. To study the use and abuse of nature by Man
11. To learn the different resources available on earth
12. To study global environmental problems and its impact on human well being
13. To appreciate the perspectives of Man on nature and learn the strategies for conservation
14. To familiarize with sustainable development and develop an attitude for sustainability

Module I. Man in Nature 10 Hrs

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

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

Module III. Dominance of Man on Earth 7 Hrs

- Industrial Revolution
- Human Population Growth
- Resource Utilization
  - Environmental Consequences
- Modern Agriculture and Green Revolution
  - Environmental Impacts
- Imperialism and its Ecological Root

Module IV. Natural Resources 7 Hrs

- Renewable and Non-renewable
- Biodiversity
Importance of Biodiversity -the Six ES
Hotspots of Biodiversity

Biotic Richness of India
Monoculture and loss of Genetic Diversity
Extinction Crisis, IUCN and Red Data Book

Module V. Global Environmental Issues Threatening Natural Resources and Human Life

10 Hrs
Deforestation, Landscape alterations, Soil erosion, Flood and Drought, Desertification, Overexploitation, Pollution (Air, Water and Soil- Pollutants and Consequences only), Acid rain, Ozone depletion, Greenhouse 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

Module VI. Man’s Perspective on Nature

10 Hrs
Eco Spirituality, Eco-theology and Eco-feminism
Community initiatives
Indigenous People’s Perspective (tribal and traditional communities)

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
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

References:
Encyclopedia Britannica Inc.UK


Encyclopedia Britannica Inc., UK.


Gandhi, M.K. - Writings on Ecology


SEMESTER VI.

ZOOLOGY CORE CHOICE BASED COURSES
FOR B.Sc. ZOOLOGY PROGRAMME
ELECTIVE COURSE  I
ECOTOURISM & SUSTAINABLE DEVELOPMENT

72 Hrs
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 12 Hrs
Introduction- Tourism, concepts and definitions
History, types, Characteristics
The facilitating sectors
Attractions
Geography, heritage
Wildlife, nature
Quality Control

Module II. Major areas of eco-tourism 10 Hrs
Concepts, practices and case studies for each:
- Marine tourism
- Wildlife tourism
- Adventure tourism

Module III. Emerging trends in eco-tourism 10 Hrs
Cultural tourism
Pilgrimage tourism
Farm tourism
Backwater tourism
Health tourism

**Module IV. Problems and prospects of eco-tourism** 10 Hrs
Economics and benefits of ecotourism
Cultural issues and negative aspects of ecotourism
Environmental Impacts of Tourism

**Module V. Sustainable tourism** 12 Hrs
Quality, Standards
Systems of sustainable tourism: environmental, sociocultural, Economical
Environment and conservation: basic principles
Current practices of eco-conservation in tourism industry
Sustainable tourism and society
Community based ecotourism
Eco-development committee (EDC) of Periyar Tiger Reserve
People initiatives

**Module VI. Eco-tourism guides** 8 Hrs
Ecotourism guiding and case studies

**Activity**
Field visit to Ecologically relevant places & Report writing 10 Hrs

**References:**


ELECTIVE COURSE

2. AGRICULTURAL PEST MANAGEMENT  72 Hrs

4 Hrs/week - 3 Credits

Objectives

1. To acquire basic skills in the observation and study of nature.
2. To impart basic awareness regarding pest problem and crop loss due to their dominance.
3. To inculcate interest in adopting biological control strategies for pest control.
4. To understand various pests affecting our local crops and select the best method for their control.
5. To acquire basic knowledge and skills in agriculture management to enable the learner for self-employment.

Module I  10 Hrs


Module II  10 Hrs

Pest categories: Types of pests- insect pest and non-insect pest.

Insect pest: insect structure and function-external features (body parts), mouth parts of phytophagous insects, internal anatomy, growth, development, reproduction, life cycle and metamorphosis (one example each from ametabolous, hemimetabolous and holometabolous insect), diapause. types of insect pests-key pests, occasional pests, potential pests.
Non insect pests: General features, different types-Rodents(mention the nature of crop loss by them), Mites-Main types of mites; plant injury caused by mite, millipedes and centipedes, slugs and snails (mention the damage of invasive Giant African Snail).

Activity: Identify a minimum of 5 invasive species (plant / animal) in your locality and make a report on their ecological impact.

Module III 7 Hrs

Pest and plants: Plant feeding insects-plant host range, types of injury, relationship of pest injury and yield.

Host plant resistance: Characterization of resistance, mechanism of resistance (antixenosis, antibiosis, tolerance), biophysical, biochemical and genetic bases of resistance.

Module IV 20 Hrs

Pest control-principles and practices: Types of control-cultural control, biological control, chemical control, integrated pest management, miscellaneous control.

Cultural control: Water management, tillage, sanitation, plant diversity, crop rotation, planting time, harvesting practices etc

Biological control: Parasitoids and predators, control by insect pathogens. Techniques in biological control-conservation, introduction and augmentation. Biopesticides

Chemical control: Origin of chemical control, chemistry, mode of action and nomenclature (organochlorines, organophosphates, carbamates, synthetic pyrethroids, miscellaneous group) of pesticides, pesticide formulations and pesticide appliances (sprayers and dusters). Brief mention of attractants, repellents, chemosterilants and pheromones

Activity 1: Conduct a workshop on preparation of biopesticides of various types suitable for kitchen garden and agricultural fields.

Integrated Pest Management (IPM)

Miscellaneous control: Mechanical (hand picking, exclusion by screens and barriers, trapping, clipping, pruning etc), physical (hot and cold treatment, moisture, light traps etc), sterility principle
Module V

**Bionomics and control of major pests of crops and stored grains:** Biology, life cycle and nature of damage by different pests of following crops and their control

**Pests of paddy:** *Leptocorisa acuta, Scirpophaga incertulas, Spodoptera mauritia, Orseolia oryzae, Nilaparvata lugens*

**Pests of coconut:** *Oryctes rhinoceros, Rhyncophorus ferrugineus, Opisina arenosella, Aceria guerreronis*

**Pests of Banana:** *Cosmopolites sordidus, Pentalonianigronervosa*

**Pests of vegetables - Brinjal:** *Leucinodesorbonalis, Euzopheraperticella, Henosepilachnaavigintioctopunctata, Urentiuhashystricellus*

**Gourds -** Bactoceracucurbitae, Anadevidiapeponis, Epilachna spp. *Raphidopalpafoveicollis, Baristrichosanthis*

**Pest of stored grains:** *Sitophilusoryzae, Corcyra cephalonica Triboliumcastraneum, Trogodermagranarium, Callasobruchuschinensis*

**Activity 2:** Conduct a poster exhibition on various types of pests of paddy, coconut, banana and vegetable varieties of Kerala.

**Activity 3:** Collect different types of pest of stored grains from the local provision shops or houses and make a taxonomic study and prepare a powerpoint presentation on them.

**Activity 4:** Visit a minimum of 5 kitchen gardens in the neighborhood and enlist the common traditional pest control measures used in them.

**Activity 5:** Organise awareness classes on the ill effects of chemical pesticides and manure on human health with the support of local examples.

**References**


**ELECTIVE COURSE**

**3. VECTOR AND VECTOR BORNE DISEASES**

72 Hrs

3 Credits

**Objectives:**

**Module I**

**Introduction:** Vector: mechanical and biological vector, Reservoirs, Host-vector relationship, Vectorial capacity, Host Specificity.

**Insect vectors:** Mosquitoes, flies, fleas, lice, ticks and bugs- General account of ecology, morphology and mouth parts

**Module II**

**Salient features and distribution of mosquito species:** *Anopheles, Aedes, Culex, and Mansonia.*

**Module III**


**Module IV**

**Introduction to Vector control:** Aims, objectives and advantages. History and background, recent trends, alternatives to the use of insecticides (chemical & microbial), types of vector control - selective, integrated and comprehensive vector control.
Control measures of mosquitoes, sand fly, tsetse fly and domestic flies

Module V 8Hrs


Field report on two case studies of epidemiology in India. 10 Hrs

References:
and Publishing co.

ELECTIVE COURSE

4. NUTRITION, HEALTH AND LIFESTYLE MANAGEMENT

72 Hrs.
3 Credi

Objectives:

1. To provide students with a general concept of health and the parameters that define health and wellness.

2. To understand principles of nutrition and its role in health.

3. To familiarize the students regarding food safety, food laws & regulations.

4. To provide knowledge and understanding regarding life style diseases.
5. To promote an understanding of the value of good life style practices, physical fitness and healthy food habits for life style disease management.

Module I  15 Hrs
Nutrition and health: Nutritional requirements of man, classification of major nutrients including protein, vitamins and minerals, water, role of fibre, biological value of food components, food groups and sources, balanced diet, RDA, BMI, BMR, Calorie intake and expenditure, Healthy eating pyramid, Nutrition in infancy, preschool, school, adolescent, pregnancy, lactation and old age. Nutrition in diseases and special conditions. Food safety: Nutrition education, food sanitation and hygiene, food adulteration and consumer protection.

Module II  18 Hrs

Module III  15 Hrs
Introduction to Life style diseases
Common life style diseases: Alzheimer’s disease and other neural disorders, asthma, cancer, cardiovascular diseases - including hypertension, Atherosclerosis and stroke, chronic obstructive pulmonary disease, Diabetes Mellitus or Type 2 Diabetes, kidney disorders and chronic renal failure, constipation, depression, gastro-intestinal disturbances including diarrhoea and peptic ulcer, liver cirrhosis and other liver diseases, obesity, osteoporosis, occupational lifestyle diseases.
Modern lifestyle disorders: sleeping habits, junk food, poor eating habits, anxiety, food poisoning
Module IV 10 Hrs

Causes of lifestyle diseases: Defects of modern food habits and unbalanced diet options, food adulteration, environmental pollution, poor life style choices, drug abuse, tobacco smoking, alcohol and drug consumption, lack of adequate exercise, wrong body posture, disturbed biological clock, stressful environmental conditions

Module V 14 Hrs

Prevention and control of life style diseases:

Healthy life style habits and practices, healthy eating habits, exercise and fitness, good sleep patterns, a strict no to alcohol, drugs, and other illegal drugs. Uncontrollable factors like age, gender, heredity and race.

Healthy diet: disease prevention through appropriate diet and nutrition, avoiding foods that are high in fats, salt and refined products. Avoid junk food and replace by natural food/organic food.

Physical exercise: Moderate exercise for fitness of body, walking, stretching, right postures of sitting & standing, relaxation and cutting down of stress, sports, aerobic exercise and yoga.

Health literacy as a public health goal: Awareness programs in schools, colleges and through mass media.

References:

MODEL III
B.Sc INDUSTRIAL MICROBIOLOGY
&ZOOLOGY (DOUBLE MAIN)
# B.Sc. (INDUSTRIAL MICROBIOLOGY & ZOOLOGY)
## MODEL –III DOUBLE MAIN – INDUSTRIAL MICROBIOLOGY.
### B.Sc. INDUSTRIAL MICROBIOLOGY & ZOOLOGY

**Total Credits** 120  
**Total Instructional Hours** 150

### a. SCHEME OF DISTRIBUTION OF HOURS, CREDITS & EXAMINATIONS
#### i. THEORY
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 ratio =1:4)

#### SEMESTER 1

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### ii. SCHEME FOR PRACTICAL EXAMINATION

**FOR BSc (Industrial Microbiology & Zoology) Double Main**

University Practical Examinations will be conducted at the end of even semesters (Semester II, IV and VI).

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b. SYLLABUS -

THEORY & PRACTICALS
SEMESTER I
Z11CRT01 - CORE COURSE 1
FUNDAMENTALS OF MICROBIOLOGY

36 Hrs
2 Credits

Objectives

1. To introduce students to the fascinating world of microbes
2. To define the science of microbiology and describe some of the general methods used in the study and culture of microorganisms
3. To impart awareness on how microbes can be controlled

Module 1
4 Hrs

History and Scope of Microbiology

Module 2
8 Hrs

Morphology and Structure of bacteria.
Size, shape and arrangements of bacteria. Structure and arrangement of bacterial flagella, pili, capsule, structure and composition of Gram positive and Gram negative cell wall. Cytoplasmic membrane, protoplasts, spheroplasts, intracellular membrane systems, mesosomes, cytoplasm, vacuoles, nuclear material, endospores and cysts, cell inclusions

Module 3
8 Hrs

Sterilization and disinfection

Module 4
8 Hrs

Culture media and methods.
Culture media-Definition Media components : Peptone, yeast extract, beef extract, agar, blood/serum – Types : Selective media, Enriched media, Enrichment media, Indicator media, and Differential media, Transport media, Anaerobic media. Aerobic and Anaerobic culture methods. Culture preservation techniques - Stains – Acidic, Basic and neutral stains - Staining techniques- Simple staining, differential staining (Gram stain and acid fast stain), Structural staining (spore, flagella, capsule and granule)
Module 5  8 Hrs

Microscopy - principles and application – Bright field, Dark field, Phase contrast, Fluorescence, SEM and TEM, ,

References
1. General rules in microbiology laboratory
2. Instrumentation
   a. Microscopy
   b. Incubator
   c. Hot air oven
   d. Autoclave
   e. Quebec colony counter
   f. Water bath
3. Sterilization of glass wares
4. Preparation of cotton plug
5. Preparation of media
   Solid media- Nutrient agar, Mac Conkey agar, Blood agar, Chocolate agar, SDA, PDA (for fungi)
   Liquid media- Nutrient broth and Glucose broth
6. Isolation methods.
   a. Serial dilution
   b. Pour plate
   c. Spread plate
   d. Streak plate
   e. Stab culture
7. Antibiotic sensitivity tests.
References


SEMESTER I

Z11CRT02 - CORE COURSE 2
MICROBIAL DIVERSITY

36 Hrs
2 Credits

Objectives

1. To impart knowledge on major categories of microorganisms and analyze their classification and diversity
2. To describe the differences in prokaryotic and eukaryotic cell morphology and structure

Module I  6 Hrs

Principles of Classification, classification based on morphological characteristics, biochemical characteristics, staining reactions, genetic and molecular characteristics, principles of bacterial taxonomy, Outline classification of Bacteria according to Bergey’s manual.

Module II  8 Hrs

Archaebacteria and extremophiles, brief account on characteristics. Mycoplasma- general properties, structure, cultural characteristics and classification. Actinomycetes – General characteristics and classification, Rickettsiae -Classification, Morphology and distinguishing characteristics

Module III  8 Hrs

Viruses - general properties, Structure and Replication of Bacteriophages, TMV, HIV. Cultivation of Viruses, Virions, Viroids and Prions

Module IV  6 Hrs

Fungi –morphological features, classification, reproduction and economic importance, ascomycota, basidiomycota, zygomycota, deuteromycota. Cultivation of fungi, Distinguishing characteristics of Rhizopus, Mucor, Aspergillus, Penicillium and Fusarium. Yeasts – a brief account on Candida and Saccharomyces.

Module V  8 Hrs
Algae—characteristics, morphology and structure. Algal pigments, motility, reproduction, classification and economic importance of algae. Cyanobacteria—distribution, characteristics and classification, Ultra structure of Cyanobacterial cell.

References
SEMESTER 1

CORE COURSE 2
MICROBIAL DIVERSITY
(PRACTICALS)

36 Hrs
0 Credit

I. Staining techniques
   1. Simple staining
   2. Differential staining
      a. Gram’s staining,
      b. Acid fast staining
   3. Structural staining
      a. Endospore staining
      b. Capsule staining
      c. Negative staining
   4. Fungal staining
      Lacto phenol cotton blue mounting

II Bacterial motility analysis
   Hanging drop technique

References


SEMESTER 1

Z11CRT03 - CORE COURSE 3
MICROBIAL PHYSIOLOGY

36 Hrs
2 Credits

Objectives

1. To gain a fundamental understanding of cellular composition, membrane transport, energy generation, diversity of metabolic processes, growth and cell death, and techniques used to elucidate physiological processes.
2. To get a better understanding of how microbes grow, how they respond and in turn influence their environments.

Module 1

4 Hrs


Module 2

10 Hrs


Module 3

8 Hrs

Photosynthesis - Photosynthetic microorganisms, Photosynthetic apparatus in prokaryotes and eukaryotes, photosynthetic pigments, Mechanism of cyclic and non-cyclic photophosphorylation, Calvin cycle.

Module 4

8 Hrs
Microbial Metabolism- Glycolysis, Krebs’s cycle, Pentose Phosphate Pathway, gluconeogenesis, ED pathway. Fermentation -Alcoholic fermentation, Homo and hetero-lactic acid fermentation.

Module 5 6 Hrs


References
SEMESTER I

CORE COURSE 3

MICROBIAL PHYSIOLOGY

(PRACTICALS)

36 Hrs
0 Credit

1. Effect of pH on the growth of bacteria on solid media
2. Effect of salts on the growth of microorganisms.
3. Effect of temperature on growth of microorganisms.
4. Effects of antibiotics on bacterial growth.
5. Measurement of size – Micrometer
6. Measurement of cell number- Haemocytometer

7. Biochemical test:
   a. IMVIC Test
   b. Triple sugar iron agar test
   c. Urease test
   d. Catalase test
   e. Oxidase
8. Determination of growth curve of E.coli

References


Module 1
8 Hrs.

Solid waste- types and sources of solid waste,
Solid waste disposal; sanitary landfills, composting; static pile, aerated pile, and feed reactor, role of microorganisms in composting.
Vermicomposting –biomethanation.

Module 2
8 Hrs.

Liquid waste- sources of liquid waste, components of industrial waste water, treatment of liquid waste; microbiology of municipal sewage;
Sewage treatment - primary treatment- screening, sedimentation, floatation, coagulation and flocculation, secondary treatment - trickling filter, activated sludge, oxidation pond and tertiary treatments;
Anaerobic sludge digestion process

Module 3
4 Hrs.

Disposal of treated sewage

Module 4
6 Hrs.

Microbiology of water pollution
Microbial indicators of water pollution, BOD, COD, eutrophication.Microbiological water quality standards.Aspects of water pollution- biofilm, bio corrosion, bio augmentation.Bacteriological techniques for the examination of water – total count, most probable number, membrane filter technique.Water borne diseases
Module 5

Biodegradation - biodegradation of xenobiotic compounds; stimulating biodegradation, hospital waste management, bioremediation, bio sorption. Bioremediation of hazardous waste, dyes, oil, pesticides; Biodegradation of lignin, cellulose and plastics.

References


SEMESTER 11
Z12CRT04- MICROBIAL WASTE MANAGEMENT
PRACTICAL -11

36 Hrs
1 Credit

1. Bacterial examination of water by MPN technique and IMVIC test.
2. Bacterial examination of water by membrane filter technique
3. Analysis of water by standard plate count
4. Determination of dissolved oxygen
5. Estimation of BOD water, raw / treated sewage
6. Estimation of COD from water, raw / sewage
7. Determination of total alkalinity of water

References
SEMESTER 2

Z12CRT05 - CORE COURSE 5
MEDICIAL MICROBIOLOGY

36 Hrs
2 Credits

Objectives

1. To develop a knowledge of medically important microorganisms and their relevance of infectious diseases
2. To promote understanding of pathogenesis, diagnosis, prevention and control of medically important microorganisms

Module 1. 8 Hrs
Normal microbial flora of Human body, A systematic study of Staphylococcus aureus, Streptococcus pyogenes, Escherichia coli, Klebsiella pneumonia, Pseudomonas aeruginosa, Vibrio cholerae.

Module 2 9 Hrs
Structure and clinical importance of hepatitis B virus, HIV, influenza virus, polio virus.
Etiology, Epidemiology, Symptomology, Pathogenesis, Diagnosis and treatment of Tuberculosis, Syphilis, Actinomycosis.

Module 3 8 Hrs
A brief account on air borne diseases, Respiratory tract infections - Infections of the upper and lower respiratory tract

Module 4 6 Hrs
Urinary tract infections, Genital tract infections, sexually transmitted diseases, and nosocomial infections

Module 5 5 Hrs
Fungal diseases - Superficial and deep mycoses
Protozoan Diseases: Malaria, amoebic dysentery, Sleeping sickness.
References


1. Microbiology of laboratory safety, General concept for specimen collection, handling.
2. Study of the morphology, staining characters, cultural characters and identification of Staphylococci, Streptococci, E.coli, Klebsiella, Pseudomonas and Vibrio,
3. Test for hemolytic property of bacteria.
4. Isolation and identification of bacteria from clinical samples
5. Culture methods for isolation and identification of fungi- KOH mount preparation, Lactophenol cotton blue staining, Slide culture technique etc.
6. Study of normal microbial flora of human being

References

SEMESTER 2

Z12CRT06 - CORE COURSE 6
AGRICULTURAL MICROBIOLOGY

36 Hrs
Credits 2

Objectives
1. To study the various interactions that exists among microbes and also between microbes and plants
2. To describe the roles and importance of microbes in various areas of agriculture

Module 1

Distribution of microorganisms in soil. Soil microorganisms and microbial interactions mutualism, synergism (protocooperation), commensalisms. Amensalism, competition, parasitism, predation, neutralism. Role of microorganisms in cycling of elements- nitrogen, carbon, sulfur, phosphorus cycles

Module 2

Plant – microbe Interaction - Microorganisms of rhizosphere, rhizoplane, phylloplane and myccorhizae- ectomycorrhizae, endomycorrhizae and vesicular arbuscular myccorrhizae Biological nitrogen fixation- Biochemistry and physiology of nitrogen fixation, nif genes.

Module 3

Microbial diseases of plants
Bacterial diseases: Bacterial leaf blight of rice, Citrus canker
Fungal diseases: Root rot of pepper, Downy mildew of grapes, and Tikka disease of groundnut.
Mycoplasmal diseases - Sandal spike, Grassy shoot disease of sugar cane
Viral Disease – TMV

Module 4

Module 5  

BioPesticides: bacterial, viral and fungal pesticides. Biological control of plant diseases.

References


1. Isolation & enumeration of microorganism from soil.
2. Isolation & Cultivation of rhizobium
3. Morphological observation of rhizobium from root nodules
4. Isolation of microorganism from rhizosphere, and calculation of R: S Ratio
5. Study of antagonism between soil microorganisms.
6. Study of symptoms of various plant diseases
   a. Downy mildew of grapes.
   b. Citrus canker
   c. Bacterial leaf blight of rice

References
SEMESTER 3

Z13CRT07 - CORE COURSE 7
MICROBIAL GENETICS AND RECOMBINANT DNA TECHNOLOGY

54 Hrs
3 Credits

Objectives
1. To learn about bacterial genetics, recombinant DNA, and molecular genetics
2. To understand about the biological processes, using mechanisms of gene regulation as the model.

Module 1

Bacterial chromosome, DNA replication in prokaryote. Meselson and Stahl experiment, modes of replication- rolling circle model.

Module 2

Mutagenesis, Spontaneous and induced mutagenesis, transition, transversion, silent, missense, non-sense, neutral, frame shift and conditional mutations. Forward and reverse mutations.

Module 3

Recombination methods in bacteria: transformation, transduction and conjugation

Module 4

Plasmids, plasmid as cloning vector, brief account on pBR 322, pUC 8, phage vectors- M13, lambda and cosmids

Module 5

Basic steps involved in Recombinant DNA Technology, Isolation of DNA, isolation of vector, enzymes in recombinant DNA technology- type II restriction endonucleases, ligases, S1
nuclease, alkaline phosphatase, terminal transferase, DNA polymerase I, reverse transcriptase.

Production of Recombinant DNA, Transformation,

**Module 6 10 Hrs**

Molecular biological techniques, polymerase chain reaction and types, DNA Sequencing- Maxam and Gilbert method, Sangers chain termination method Blotting techniques- southern, northern, and western blotting

**References:**


Chakravarty, A. K. 2013. Introduction to Biotechnology, OUP India.

Chaudhuri, K. 2012. Microbial Genetics. The Energy and Resources Institute, TERI.


SEMESTER 3

CORE COURSE 7

MICROBIAL GENETICS AND RECOMBINANT DNA TECHNOLOGY
(PRACTICALS)

1. Isolation of chromosomal DNA from *E.coli*
2. Bacterial transformation
3. Immobilization of yeast cells by sodium alginate method
4. Polymerase chain reaction
5. Blotting techniques
6. Western blotting (Only demonstration)

References


SEMESTER 3

Z13CRT08 - CORE COURSE 8
INDUSTRIAL MICROBIOLOGY

Objectives
1. To study the sources of microorganisms for use in industrial microbiology and biotechnology
2. Discuss the genetic manipulation of microorganism to construct strains that better meet the needs of an industrial or biotechnological process
3. Discuss the preservation of microorganisms
4. Describe the design or manipulation of environments in which desired processes will be carried out
5. Discuss the management of growth characteristics to produce the desired product

Module 1 14 Hrs
History, development and scope of industrial microbiology, Industrially important microbes, Strain improvement and selection, Screening of industrially important microorganisms-Primary and Secondary Screening. Strain development.

Module 2 10 Hrs
Industrial sterilization- batch and continuous sterilization.

Module 3 12 Hrs
Fermenter, Structure of a typical Batch fermenter, Parts, function of each part, probes, valves, agitators, aerators, baffles, Types of bioreactors, Types of fermenters: Batch Fermenter, Continuous Stirred Tank Fermenter, Fluidized Bed Fermenter, Solid State Fermenter, Air Lift Fermenter, Tubular Fermenter.

Module 4 6 Hrs

**Module 5**

12 Hrs

References
SEMESTER III

CORE COURSE 8
INDUSTRIAL MICROBIOLOGY
(PRACTICALS)

36 Hrs
0 Credit

1. Crowded plate technique for screening microbial production of enzymes and antibiotics
2. Solid state fermentation
3. Submerged fermentation
4. Preservation techniques:
   a. Serial sub culturing
   b. Over laying with mineral oil
   c. Lyophilization
   d. Liquid nitrogen storage.
   e. Methods for the storage of Fungi
5. Estimation of lactic acid from milk.

References
Objectives

1. To study the major products or uses of industrial microbiology and biotechnology
2. To understand about fermentation and subsequent processing approaches available for the manufacture of biological products and the design and operation of these systems.

Module 1

Fermentative production of Pharmaceuticals, production of penicillin and streptomycin.
Production of vitamins and growth stimulants, riboflavin, cyanocobalamines and gibberellins

Module 2

Fermentative production of Alcohol, Acetic acid, citric acid, lactic acid, Lysine and glutamic acid, Protease and amylase, Ethanol and Glycerol

Module 3

Production of biofuels – Hydrogen and Methane
Production of Beverages- Beer and Wine
Production of Single cell Protein- Baker’s Yeast and Spirullina

Module 4

Industrial applications of enzymes, Enzyme immobilization- methods and applications.

Module 5

Microbial recovery of metals- bioleaching of copper, gold and uranium
Microbially enhanced oil recovery (MEOR)
References


SEMESTER 3

CORE COURSE 9
FERMENTATION TECHNOLOGY
(PRACTICALS)

36 Hrs
0 Credit

1. Study of alcoholic fermentation of fruit juice by yeast.
2. Production of citric acid by Aspergillus niger
3. Estimation of citric acid.

References
Objectives
1. To study interaction between micro-organisms and food.
2. To discuss the factors affecting the presence of micro-organisms in foods and their capacity to survive and grow.
3. To study recent developments in procedures used to assay and control the microbiological quality of food.

Module 1
A brief account of micro-organisms important in food industry - molds, yeasts and bacteria. Factors affecting microbial growth in food, extrinsic, intrinsic, implicit and processing factors.

Module 2

Module 3
A brief account of microbiological basis of spoilage of vegetables, fruits, milk, egg, meat and fish. Microbial role in production of Bread, vinegar, sauerkraut, beer, and wine. Cultivation of mushrooms.

Module 4

Module 5
Food borne Diseases- Food poisoning and food born infections and intoxication. Mycotoxins - Aflatoxins. Hazard Analysis Critical Control Points (HACCP)

References


SEMESTER 4

Z14CRP04 - CORE COURSE10
FOOD MICROBIOLOGY

(PRACTICALS)

1. Microbiological examination of food
2. Isolation of bacteria from idli batter & curd.
3. Microbiological examination of soft drinks.
5. Determination of quality of milk sample by methylene blue reduction test.
6. Detection of number of bacteria in milk by breed count.
7. Quality testing of milk by resazurin test.
10. Cultivation of Edible mushroom (Demo)

References


SEMESTER 4

Z14CRT11 - CORE COURSE 11

DAIRY MICROBIOLOGY

54 Hrs
3 Credits

1. To provide a scientific background to dairy microbiology by re-examining the basic concepts of general food microbiology and the microbiology of raw milk.

2. The role of dairy starter cultures in manufacturing fermented dairy products, developing novel functional dairy products through the incorporation of probiotic strains.

3. Offer a practical approach to the following aspects: well-known and newfound pathogens that are of major concern to the dairy industry.

Module I

14 Hrs


Module II

10 Hrs

Bacteriological examination of milk. Preservation of milk, pasteurization - different methods and advantages, sterilization, dehydration, bacteriological standards and grading of milk.

Module III

8 Hrs

General principles underlying spoilage of milk and milk products, sources for contamination of milk, milk borne diseases, antimicrobial systems in milk.

Module IV

12 Hrs

Fermented dairy products - cheese, cultured buttermilk, bulgarian butter milk, ice cream, lassie, condensed and dry milk products, yoghurt; low lactose milk, kefir and kumiss.

Module V

10 Hrs
Hygiene in manufacturing milk products, cleaning of dairy equipment’s, dairy processing plant sanitation, probiotic role of lactic acid bacteria and fermented milk products, utilization and disposal of dairy byproduct- whey

References

SEMESTER 4

Z14CRP05 CORE COURSE 11
DAIRY MICROBIOLOGY
(PRACTICALS)

36 Hrs
2 Credits

1. Qualitative analysis of milk by standard plate count method.
2. Isolation of coliforms from milk.
3. Detection of number of bacteria in milk by breed count.
4. Quality testing of milk by rezazurin test.
5. Methylene blue reduction test for microbial contamination of milk.
7. Detection of mastitis through milk test.
8. Isolation of Lactobacilli and Staphylococcus from curd.

SEMESTER IV

CORE COURSE 12
RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS

54 Hrs
3 Credits

Objectives

1. To familiarise the learner the basic concept of scientific method in research process.
2. To have a knowledge on various research designs.
3. To develop skill in research communication and scientific documentation.
4. To create awareness about the laws and ethical values in biology.
5. To equip the students with the basic techniques of animal rearing collection and preservation.
6. To help the student to apply statistical methods in biological studies.
RESEARCH METHODOLOGY

Module I 13 Hrs

Basic concepts of research: Meaning, Objectives, Approaches, Types of research.
Research Process: Scientific method in research (eight steps).
Importance of literature reviewing in defining a problem,
Identifying gap areas from literature review.
Research Communication and scientific documentation: Project proposal writing,
Research report writing, (Structure of a scientific paper), Thesis, dissertation, research article.
Presentation techniques: Oral presentation, Assignment, Seminar, Debate, Workshop,
Colloquium, Conference
Sources of Information: Primary and secondary sources. Library- Books, Journals,
Periodicals, Reviews, Internet.
Plagiarism

Module II 12 Hrs

Animal Collection – Tools &techniques
Sampling techniques
    Quadrat
    Line transect
Measurements
    Density
    Abundance
    Frequency
Biodiversity indices – concepts
    Simpson index

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

Units of measurements- units, SI system, Equivalent weight, normality, molarity

BIOPHYSICS

Module III 14 Hrs
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

BIOETHICS

Module IV 5 Hrs
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 Board of India, CPCSEA, ethical commitment. Working with human: Consent,harm, risk and benefits.

BIOSTATISTICS 10 Hrs
Module V

Sample & Sampling techniques: Collection of data, classification of data, frequency distribution tables, graphical representation: - Bar diagrams, Histogram, Pie diagram and Frequency curves - Ogives.

Measures of Central Tendency: Mean, Median, Mode (Problem - Direct method only)

Measures of dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Standard error. (Merits & demerits and problems on SD).

Correlation: Definition, Types of correlation.(mention in brief)

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.

References


RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS

(PRACTICAL)  2 credits

PART A. RESEARCH METHODOLOGY

Animal collection Tools, Techniques & Estimation

1. Quadrate study
2. Transect study
3. Sampling Methods
4. Species area curve
5. Simpson index

PART B - BIOPHYSICS

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

PART C BIOSTATISTICS

1. MS Excel: To create mean and median, Construction of bar diagram, Pie diagram and Line graphs.
2. MS Access: To create grade of students
4. Frequency distribution of the given samples to find out arithmetic mean, median, mode.
5. Range and standard deviation for a biological data
6. Correlation using any biological data.
SEMESTER V.

CORE COURSE 13
ENVIRONMENTAL BIOLOGY AND HUMAN RIGHTS
54 Hrs

Objectives

To instill the basic concepts of Environmental Sciences, Ecosystems, Natural Resources, Population, Environment and Society

To make the students aware of natural resources, their protection, conservation, the factors polluting the environment, their impacts and control measures.

To teach the basic concepts of toxicology, their impact on human health and remedial measures

To create a consciousness regarding Biodiversity, environmental issues & conservation strategies

To develop the real sense of Human rights – its concepts & manifestations

MODULE 1 ECOSYSTEM 12 Hrs

Basic concepts of ecosystem Components of ecosystem: Abiotic (Sunlight, temperature, soil, water, atmosphere) and Biotic components (Producers, consumers, decomposers), Ecological pyramid- number, biomass, energy, Functions of ecosystem: Productivity-Food chain-Food web-Energy flow-Laws of Thermodynamics.Types of Ecosystem: Terrestrial-Forest-Grassland-Desert, Aquatic-Marine-Fresh water, Wetland &Biome Concept of limiting factors: Liebig’s and Shelford’s laws of limiting factors.

Biogeochemical cycles: Concept, gaseous and sedimentary cycles, Carbon cycle, Nitrogen cycle.
Renewable resources (solar, wind, hydroelectric, biomass and geothermal) and Non renewable resources (mineral and metal ore, fossil fuels)
MODULE 2  CONCEPTS OF POPULATION AND COMMUNITY  8 Hrs

Concept of population: Population attributes- Population growth forms, Basic concepts of growth rates, density, natality, mortality, growth curves

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


MODULE 3  BIODIVERSITY AND ENVIRONMENTAL ISSUES  16 Hrs

Introduction to Biodiversity: Types of biodiversity- Alpha, Beta and Gamma diversity. Concept and importance of Biodiversity: Levels of Biodiversity-Species diversity, Genetic diversity, Microbial, Ecosystem diversity, India as a mega-diversity nation, Biodiversity hotspots

Global Environmental Issues: Ozone depletion, Greenhouse effect, Global warming, Climate change, Carbon trading, carbon credit; Carbon sequestration, Acid rain, Oil spills, Nuclear accidents, IPCC/UNFCC.

National Environmental issues: Deforestation, forest fire, pollution(air, water, soil, noise thermal, nuclear- brief account only) solid waste management, sewage, drinking water crisis and water logging,

Toxic products and disaster: Types of toxic substances – degradable, non degradable, Impact on human – case studies: Endosulphan tragedy, Bhopal disaster

Flood, drought, cyclone, earthquake and landslide (Management and mitigation)

Local Environmental issues: Landscape alteration, sand mining, quarrying, changing crop pattern, conversion of paddy lands,

Threats to water resources of Kerala: Degrading Mangrove and wetland ecosystems of Kerala, RAMSAR sites, Marine ecosystem crisis- pollution, overfishing etc. Impact of tourism on Environment.
MODULE 4  CONSERVATION OF BIODIVERSITY  12 Hrs

Protected area concept – Sanctuary, National Park, Biosphere reserve, Core Zone, Buffer Zone, Corridor concept. Conservation reserves

Concept of threatened fauna – IUCN categories - extinct, extinct in the wild, critically endangered, endangered, vulnerable, near threatened, least concern and data deficient. Red and Green Data Books.

Man–animal conflict (Tiger, Elephant, Dog, Monkey) – causes and concern

Water conservation- rainwater harvesting, watershed management

Environment education


MODULE 5  HUMAN RIGHTS  6 Hrs


References:


J.B Sharma (2009), Environmental studies’ - 3rdEd. University science Press

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


Sharma P.D. (2005) Environmental biology and Toxicology, Rastogi publication
Meera Asthana and Astana D.K. 1990 Environmental pollution and Toxicology Alka printers.
Alan Beeby, 2006 Anne – Maria Brennan First Ecology, Ecological principles and
Landis, Wayne and Hing-ho Yu, Baca Raton, 1995. Introduction to Environmental Toxicology:
Impacts of chemicals upon Ecological systems: Lewis Publishers.

SEMESTER 5
PRACTICAL
ENVIRONMENTAL BIOLOGY & TOXICOLOGY
36HRS CREDIT 1

1. Estimation of dissolved Oxygen
2. Estimation of carbon di oxide
3. Estimation of soil organic carbon (Demonstration only)
4. Identification of marine/ fresh water planktons
5. Counting of plankton using plankton counting chamber
6. Study of equipments - Sechi disc, Plankton net
7. Study of sandy shore fauna, rocky shore fauna.
8. Study of animal Association
10. Field study (compulsory)

SEMESTER V.

CORE COURSE 14
CELL BIOLOGY AND GENETICS
Objectives
1. To understand the structure and function of the cell as the fundamentals for understanding the functioning of all living organisms.
2. To make aware of different cell organelles, their structure and role in living organisms.
3. To develop critical thinking, skill and research aptitudes in basic and applied biology
4. To emphasize the central role of genes and their inheritance in the life of all organisms.

CELL BIOLOGY

Module I


Module II


Module III

Credits 3
**Cell Communication:** Basic principles of cell communications, Cell signaling (in brief), Types of signaling. Mention signaling molecules (neurotransmitters, hormones, Growth Factors, Cytokines Vitamin A and D derivatives).

**Cell Division:** Cell cycle - G1, S, G2 and M phases, Mitosis and Meiosis. The difference between Mitosis and Meiosis.

**References:**
1. Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology*

**GENETICS 32 Hrs**

**Module I 10 Hrs**

**Mendelian Genetics**: Mendel’s experiments- Monohybrid Cross, Dihybrid Cross, Mendel’s Laws, Test Cross, Back Cross and Reciprocal Cross. Chromosome Theory of Inheritance

**Interaction of genes**: Allelic: Incomplete Dominance (Four O Clock Plant). Co-Dominance (Skin colour in Cattle) Lethal Alleles: Dominant lethal gene [Creeper chicken] and recessive lethal gene [cystic fibrosis].

Non Allelic: Complementary (Flower colour in Sweet Pea), Supplementary (Coat colour in mice), Epistasis - dominant (Plumage in poultry) and recessive (Coat colour in mice). Polygenes (Skin colour inheritance in man), Pleiotropism (Vestigial wing gene in Drosophila).

**Multiple alleles** – ABO Blood group system, Rh group and its inheritance. Erythroblastosis foetalis.

**Module II 12 Hrs**

**Sex determination**: Chromosome theory of sex determination (Autosome and Sex chromosomes), male heterogamy and female heterogamy, (xx-xy, xx-xo, ZZ-ZW, ZZ-ZO), Genic Balance theory of Bridges. Barr bodies, Lyon’s hypothesis, Gynandromorphism, sex mosaics, intersex (Drosophila), Hormonal [free martin in calf] and Environmental (Bonelia) influence on Sex determination

**Recombination and Linkage**: Linkage and recombination of genes based on Morgan’s work in Drosophila, Linked genes, Linkage groups, Chromosome theory of Linkage, Types of linkage- complete and incomplete. Recombination, cross over value, chromosome mapping. [Definition]

**Sex Linked inheritance**: Characteristics of Sex Linked inheritance, X Linked inheritance of man (Hemophilia), Y linked inheritance [Holandric genes], Incompletely Sex Linked genes or pseudoautosomal genes (Bobbed bristles in *Drosophila*), Sex limited genes (Beard in man) and Sex influenced genes (inheritance of baldness in man).
Module III  

Mutation: Types of mutations - Somatic, germinal, spontaneous, induced, autosomal and allosomal, chromosomal mutations, structural and numerical changes. Gene mutations.

[Addition, Deletion and substitution].

Human Genetics: Karyotyping, Normal Human chromosome Complement, Pedigree analysis, Aneuploidy and Non- disjunction. Autosomal abnormalities (Down syndrome, Cry du chat syndrome) Sex chromosomal abnormalities (Klinefelters syndrome, Turner’s syndrome) Single gene disorder (Brief mention) Autosomal single gene disorder [sickle cell anaemia], Inborn errors of metabolism such as phenylketonuria, alkaptonuria, Albinism. Multifactorial traits – polygenic disorder- cleft lip and cleft palate.

Genetic Counseling, Eugenics and Euthenics - Brief account only

References:

SEMESTER V

PRACTICAL

CELL BIOLOGY AND GENETICS

36 Hrs

2 Credits

PART A: CELL BIOLOGY

1. Squash preparation of onion root tip for mitotic stages
2. Mounting of polytene chromosome (Drosophila/Chironomous.) Demonstration
3. Tissues (permanent slides of epithelial tissues, striated muscle, smooth muscle, cartilage, bone)
4. Identification of cell organelles
5. Preparation of temporary whole mount.
6. Preparation of permanent whole mount (demonstration)
7. Preparation of human blood smear and identification of Leucocytes

PART B: GENETICS

1. Genetic problems on Monohybrid, Dihybrid Crosses and Blood group inheritance
2. Study of normal male and female human karyotype (use photographs or Xerox copies)
3. Abnormal human karyotypes - Down, Edwards, Klinefelter and Turner syndromes (use photographs or Xerox copies)
5. Study of Barr body in human buccal epithelium

SEMESTER V

CORE COURSE - 15: EVOLUTION, ETHOLOGY & ZOOGEOGRAPHY

54 Hrs

Credits 3
Objectives:
- To acquire knowledge about the evolutionary history of earth - living and nonliving
- To acquire basic understanding about evolutionary concepts and theories
- 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

PART I - EVOLUTION 30 Hrs
Module I - Origin of life 8 Hrs
Theories - Panspermia theory or Cosmozoic theory, Theory of spontaneous generation (Abiogenesis or Autogenesis), Special creation, Biogenesis, Endosymbiosis.
Chemical evolution - Haldane and Oparin theory, Miller-Urey experiment;

Module II - Theories of organic evolution 9 Hrs
Lamarckism and its Criticism, Weismann’s Germplasm theory, Darwinism and its Criticism, Neo-Darwinism, Theory of De Vries,
**Population genetics and evolution:** Hardy-Weinberg Equilibrium, gene pool, gene frequency.
Factors that upset Hardy-Weinberg Equilibrium, Effects of genetic drift on population:
Bottleneck effect and founder effect

Module III – Nature of evolution 13 Hrs
Species and Speciation: Species concept, subdivisions of species (sub species, sibling species, cline and deme), Speciation: Types of speciation, Phyletic speciation (autogenous and allogenous transformations), True speciation, Instantaneous and gradual speciation, allopatric and sympatric speciation
Isolation: Types of isolating mechanisms-Geographic isolation (mention examples) and Reproductive isolation. Role of isolating mechanisms in evolution
PART II - ETHOLOGY
Module IV – Introduction 1 Hr
Definition, History and scope of ethology
Module V – Learning, imprinting and behaviour 9 Hrs
Types of learning with examples; patterns of behaviors – types of rhythms, navigation, homing instinct, hibernation, aestivation; pheromones- types and their effect on behavior, hormones and their action on behavior (aggressive and parental behavior)
Module VI – Social organization 4 Hrs
Social organization in insects (ants) and mammals (monkey), Courtship behaviour and reproductive strategies

PART III - ZOOGEOGRAPHY
Module VII – General Topics 4 Hrs
Continental drift theory, Types and means of animal distribution, Factors affecting animal distribution; insular fauna – oceanic islands and continental islands,
Module VIII - Zoogeographical realms 6 Hrs
Palaearctic region, Nearctic region, Neotropical region, Ethiopian region, Oriental region, Australian region (brief account with physical features and fauna, Wallace’s line, Weber’s line, Biogeography of India with special reference to Western Ghats

References:
EVOLUTION

**ETHOLOGY**

**ZOOGEOGRAPHY**

PRACTICAL
EVOLUTION, ETHOLOGY & ZOOGEOGRAPHY

36 Hrs
Credit 1

1. Identification of Zoogeographical realms using map
2. Study on endemic species of each realm
3. Show the discontinuous distribution of (lung fishes, camel, elephant)
4. Providing a map trace the route of HMS Beagle
5. Providing a map mark any two continental/oceanic islands.: Greenland, Madagascar, New Zealand, New Guinea, Maldives, Iceland, Hawaii – any two
6. Contributions of scientists (showing photos) - Any four
7. Identification of different stages of horse evolution
8. Study on Homology and Analogy
9. Study on connecting links (Peripatus, Archaeopteryx, Protopterus, Echidna)
10. Pheromone traps
11. Skinner box & T Maze
12. Experiment to demonstrate phototaxis and chemotaxis using Drosophila/House fly
13. Identification of behaviour (Grooming/courship dance of flamingos/stickle back fish/ Tail wagging dance/ Aggressive behaviour/ Auto/Allo grooming, Flehmen response) showing pictures (Any five)
SEMESTER V.

CORE COURSE 16.

HUMAN PHYSIOLOGY BIOCHEMISTRY, 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.

HUMAN PHYSIOLOGY 31 Hrs

Module I 8 Hrs

Digestion: Anatomy and histology of digestive glands (liver, pancreas, salivary, gastric and intestinal). Digestion and absorption of carbohydrates, proteins and fats. Nervous and hormonal control of digestion.

Module II 8 Hrs


Module III 5 Hrs

Module IV 10 Hrs

Muscle physiology: Ultra structure of striated muscle, muscle proteins (myosin, actin, tropomyosin, troponin), Muscle contraction and relaxation - Sliding Filament Theory, cross bridge cycle, biochemical changes and ATP production in muscle, Cori cycle. Kymograph, Simple muscle twitch, muscle fatigue, tetanus, rigor mortis.
BIOCHEMISTRY 15 Hrs

Module V 5 Hrs

**Carbohydrates**: Basic structure, biological importance and classification of monosaccharides, oligosaccharides, polysaccharides with examples.

**Proteins**: Basic structure and classification of amino acids; structure, biological importance and classification of proteins with examples.

**Lipids**: Structure of fatty acid, saturated and unsaturated fatty acid, biological importance and classification of lipids with examples.

**Vitamins and minerals**: Major fat soluble and water soluble vitamins. Important minerals and trace elements required for living organisms. Biological importance of vitamins and minerals.

**Enzymes**: Chemical nature of enzymes, enzyme activation, enzyme inhibition, allosteric enzymes, isoenzymes, co-enzymes. Michaelis–Menten enzyme kinetics.

Module VI 10 Hrs

**Carbohydrate metabolism**: Glycogenesis, Glycogenolysis, Gluconeogenesis, Hexose monophosphate Shunt, Glycolysis, Citric Acid Cycle, Electron Transport Chain and ATP synthesis. Ethanol metabolism.

**Protein metabolism**: Deamination, Transamination, Transmethylation, Decarboxylation, Ornithine cycle.

**Lipid metabolism**: Biosynthesis of fatty acids, Beta oxidation, physiologically important compounds synthesized from cholesterol.

ENDOCRINOLOGY

**Endocrinology and reproduction** 8 Hrs

Module VII 8 Hrs

**Endocrine physiology**: Hormones – classification and mechanism of hormone action. Major endocrine glands (Histology is not included) their hormones, functions and disorders (hypothalamus, pituitary gland, pineal gland, thyroid gland, parathyroid gland, islets of Langerhans, adrenal gland), Homeostasis and feedback mechanism.
References:


Outlines of Biochemistry by S.C.Rastogi. CBSPublishers (4)

Medical biochemistry by N.V. Bhagavan, fourth edition Academic Press, 2002

Introduction to Biological chemistry by Awapara J. Prentice Hall.1968

Harper’s Illustrated Biochemistry by Harper. 29th edition (Lange basic science.)


Text Book of Medical Physiology: Guyton, 13th edition; Elsevier

Comparative Animal Physiology: Prosser and Brown, Saunders (1962)

Textbook of Physiology: Prof. A K Jain, Publisher: Avichal Publishing Company


General and Comparative Endocrinology: Barrington, E.J.W. Oxford University Press

Endocrine Physiology: Martin, C.R. Oxford University Press.

PRACTICAL

HUMAN PHYSIOLOGY, BIOCHEMISTRY AND ENDOCRINOLOGY

36 Hrs

Credit 1

HUMAN PHYSIOLOGY

1). Determination of haemoglobin content of blood

2). Total RBC count using Haemocytometer

3). Total WBC count using Haemocytometer

4). Estimation of microhaematocrit

5). Effect of hypertonic, hypotonic and isotonic solutions on the diameter of RBC.

6). Instruments: Kymograph, Sphygmomanometer and Stethoscope (principle and use)
7). Measurement of blood pressure using sphygmomanometer (demonstration only)

BIOCHEMISTRY

1. Qualitative analysis of protein, glucose, starch and lipids.
2. Chromatography – Determination of Rf value of amino acids and identification of amino acids (Identify the Amino Acids using different solvent front and solute front)

ENDOCRINOLOGY

1. Cockroach – Corpora cardiaca & Corpora allata (Demonstration)
2. Effect of adrenalin on heart beat of Cockroach (Demonstration)

SEMESTER VI.

CORE COURSE 17
DEVELOPMENTAL BIOLOGY

Objectives:

1. To achieve a basic understanding of the experimental methods and designs that can be used for future studies and research.
2. To provide the students with periodic class discussions of current events in science which will benefit them in their future studies in the biological/physiological sciences and health-related fields
3. To contribute to critical societal goal of a scientifically literate citizenry.

Module 1

Introduction: Definition, Scope of developmental biology, sub-divisions (descriptive, comparative, experimental and chemical), historical perspectives, basic concepts and theories.

Egg types: Classification of eggs based on the amount, distribution and position of yolk. Mosaic and regulative, cleidoic and noncleidoic eggs. Polarity and symmetry of egg.

Fertilization: Mechanism of fertilization—(Encounter of spermatozoa and Ova, Approach of the Spermatozoon to the Egg, Acrosome Reaction and Contact of Sperm and Ovum, Activation of Ovum, Migration of Pronuclei and Amphimixis, ), Significance of fertilization, Polyspermy, Parthenogenesis- Different types and significance.

Module II  14 Hrs


Blastulation: Morula, blastula formation, types of blastula with examples.

Fate maps: Concept of fate maps, construction of fate maps (artificial and natural), structure of a typical chordate fate map. Significance of fate map.


Cell differentiation and gene action: Potency of embryonic cells (Totipotency, Pleuripotency, Unipotency of embryonic cells). Determination and differentiation in embryonic development, Gene action during development with reference to Drosophila (maternal effect genes), Zygotic genes.

Module III  20 Hrs


Module IV  5 Hrs

Experimental embryology: Spemann’s constriction experiments, Organizers and embryonic induction. Embryo transfer technology, cloning, stem cell research. Ethical issues.
Teratology / Dysmorphology, Developmental defects: Teratogenesis, important teratogenic agents. (Radiations, chemicals and drugs, infectious diseases) genetic teratogenesis in human beings,


Module V  
5 Hrs
General topics: Classification and functions of placenta in mammals. Prenatal diagnosis (Amniocentesis, Chorionic villi sampling, Ultra sound scanning, Foetoscopy, Maternal serum alpha-fetoprotein, Maternal serum beta-HCG). Regeneration in animals.

References:

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
Dutta, Obstrestics, Church Livingston 17 Ed
Harrison, Harrisons Book of Internal Medicine Chruch Livingston 17th Ed.
Berril, N.J and Kars G. Developmental biology, Mc Graw Hills
Gibbs. Practical guide to developmental biology.
Gilbert S. F - Developmental biology

PRACTICAL

DEVELOPMENTAL BIOLOGY

36 Hrs
Credit 1

Model/Chart/ Slide may be used
1. Embryological studies- Blastula (frog, chick)
2. Embryo transfer, cloning, gastrula (frog, chick)
3. Amniocentesis
4. Embryotransfer technology, cloning
5. Study of placenta - pig and man
6. 18 hour, 24 hour, 33 hour and 48 hour chick embryo.
7. Candling method.
9. Male and female reproductive organs in cockroach
10. Calculate the fecundity of fish.
11. Calculate the gonado-somatic index of given fish.

SEMESTER VI.

3 Credits

ZY6CRT11 - CORE COURSE 18
IMMUNOLOGY

54 hrs
3 Credits

Objectives
1. Microbiology is designed to introduce graduate students to the basics of bacteria, fungus and virus their outline classification.
2. To provide pathogens that are the etiological agents of the significant infectious diseases worldwide.
3. The course will focus on the basic mechanisms of microbial pathogenesis with emphasis on the host-microbe interactions and the treatments to combat these diseases.
4. Immunology is designed to provide a basis of terminology relevant to the basic concepts of immunology. It commences with the important components (cell, tissues; antibodies; immunoglobulins) involved in host defense against infectious agents.

IMMUNOLOGY

Module I 14 Hrs

Introduction to Immunology: Innate and acquired immunity, passive (natural and artificial) and active immunity (natural and artificial). Mechanisms of innate immunity - barriers, inflammation, phagocytosis.

Lymphoid organs: Primary (thymus, bone marrow) and secondary lymphoid organs (lymph nodes, spleen).

Lymphocytes: T and B cells, Natural killer cells, memory cells, macrophages.
Module 2  
12 Hrs
Types of antigen, immunoglobulin structure, classes and functions of immunoglobulins.

**Monoclonal & polyclonal Antibodies** Antibody mediated immune response (humoral immunity), Cell mediated immune response.

Module 3  
8 Hrs
Antigen – antibody reactions, precipitation test, agglutination test, VDRL WIDAL, ELISA., Complement Fixation Test

Module 4  
12 Hrs
**Auto immune diseases:** Pernicious Anemia, Rheumatoid Arthritis. Immunodeficiency - AIDS. Hyper sensitivity- Type I, (E.g. Anaphylaxix) II( Transfusion reaction) , III ( Arthus reaction) and IV (Mantaux Test) (in brief).

Module 5  
8 Hrs

**Vaccines**
Brief history of vaccination, Types of vaccines (BCG,DPT,Polio vaccine and TAB vaccine, DNA vaccines, Toxoids ,adjuvants

3. Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala

**References**
1. Colemen: (2002). *Fundamentals of Immunology*
SEMESTER VI

IMMUNOLOGY
(PRACTICAL)

72 hrs
2 Credits

1. Determination of ABO blood groups and Rh factor (Antigen – antibody Reaction)
2. Widal Test (Slide)
3. VDRL (Slide)
SEMESTER VI.

CORE COURSE 19
BIOTECHNOLOGY, BIOINFORMATICS & MOLECULAR BIOLOGY,

BIOTECHNOLOGY 20 Hrs

Module I 11 Hrs
Introduction: Scope, Brief History, Scope and Importance

Tools and Techniques in Biotechnology: Enzymes (restriction endonucleases, ligases, linkers & adapters), Vectors-[ Plasmids, Phage vectors, Cosmids, Artificial Chromosomes] Host cells. Basic steps & techniques in rDNA technology


Module II 9 Hrs
Animal Cell Culture: Brief account on methods, substrates, media and procedure of animal cell culture, Stem Cells, types and potential use, Organismal Cloning- reproductive & therapeutic- brief account only.

Applications of Biotechnology: Applications in Medicine (insulin, growth hormone, gene therapy), Agriculture (GM plants and biopesticides), Environment (bioremediation), Industry (Single Cell Protein) and applications of Fermentation Technology- lactic acid, vitamins, food and beverages.

Potential Hazards of Biotechnological Inventions: Risks related to genetically modified organisms (GMO) and biologically active products, Biological warfare & Biopiracy. Protection of biotechnological inventions. Intellectual Property Rights, Patenting and patent protection.
References


BIOINFORMATICS

Module III

Introduction: Definition, importance and role of bioinformatics in life sciences. Computational Biology.

Biological databases: Nucleotide sequence databases (NCBI- GENBANK, DDBJ and EMBL).
Protein databases - structure and sequence databases (PDB, SWISSPROT and UNIPROT).
Introduction to Sequences alignments: Local alignment and Global alignment, Pair wise alignment (BLAST and FASTA] and multiple sequence alignment. Phylogenetic Tree construction and Analysis

Module IV

Molecular visualization software - RASMOL. Basic concepts of Drug discovery pipe line, computer aided drug discovery and its applications. Human Genome Project.
MOLECULAR BIOLOGY

Module V

Nature of Genetic Materials: Discovery of DNA as genetic material – Griffith’s transformation experiments. Avery Macarty and Macleod, Hershey Chase Experiment of Bacteriophage infection, Prokaryotic genome; Eukaryotic genome. Structure and types of DNA & RNA. DNA replication. Modern concept of gene (Cistron, muton, recon, viral genes), Brief account of the following – Split genes (introns and exons), Junk genes, Pseudogenes, Overlapping genes, Transposons.

Module VI

Gene Expressions: Central Dogma of molecular biology and central dogma reverse, one gene-one enzyme hypothesis, One gene-one polypeptide hypothesis Characteristics of genetic code, Contributions of Hargobind Khorana.

Protein synthesis [prokaryotic]: Transcription of mRNA, Reverse transcription, post transcriptional modifications, Translation, Post translational modifications.

Gene regulations: Prokaryotic (inducible & repressible systems) Operon concept -Lac operon and Tryptophan operon, Brief account of Eukaryotic gene regulation.

References

PRACTICAL

BIOTECHNOLOGY, BIOINFORMATICS & MOLECULAR BIOLOGY

BIOTECHNOLOGY
1. Identify and comment on the item provided: (Western blotting / Southern blotting / Northern blotting / PCR)

BIOINFORMATICS
1. Download/use print out/pictures of genome sequences of any 2 organisms. Identify and mention the characteristic features of both.

2. Download/use print out/pictures of a protein sequence, identify it & comment on its amino acid composition

3. Download/use print out/pictures of a macromolecule. Write a brief note on the bioinformatics tool used to visualize its structure.

MOLECULAR BIOLOGY
1. Identify and comment on its molecular composition / structural orientation / functional significance (Any tissue / Cell organelles / DNA, DNA replication, RNA different types using models or diagrams)

2. Write down the procedure involved in DNA isolation

V1 SEMESTER.
CORE COURSE 20
OCCUPATIONAL ZOOLOGY.
(APICULTURE, VERMICULTURE, QUAIL FARMING & AQUACULTURE)

54 Hrs
Credits 3

Objectives:

1. To equip the students with self employment capabilities.
2. To provide scientific knowledge of profitable farming.
3. To make the students aware of cottage industries.

Module 1. APICULTURE 18 Hrs


Activity: Visit to an apiculture unit.
Field visit and report submission - 10 Hrs
Field visit and report submission on any two items are taken for internal evaluation.

MODULE: 2. VERMICULTURE 8 Hrs


Activity: Submission of a report after preparing a vermiculture unit or visiting a vermicomposting unit.

MODULE: 3. 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.

**MODULE: 4. AQUACULTURE.**

24 Hrs

Advantages and salient features of aquaculture, Types of Aquaculture, Biotic and abiotic features of water, Importance of algae in aquaculture, Common cultivable fishes of Kerala, Fish diseases, Composite fish culture, Integrated fish culture, Carp culture, Prawn culture Mussel culture Pearl culture. Processing & Preservation.

Aquarium management - Setting up of an aquarium, Biological filter & Aeration, Breeding of gold fish, gourami (Osphronemus), fighter and Guppy (live bearer). Nutrition and types of feed for aquarium fishes, Establishment of commercial ornamental fish culture unit. Fish Transportation - Live fish packing and transport Common diseases of aquarium fishes and their management. Aquaponics (a brief introduction only).

Activity – Setting up of an Aquarium

Field visit – Visiting an Aquaculture farm

**References:**

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


Pradip.V.Jabde , Text book of applied zoology, 2005

Applied Zoology, Study Material Zoological Society of Kerala , CMS college Campus


Chauhan, H.V.S. Poultry, Disease, diagnosis and treatment, Wiley eastern Ltd Delhi.

Otieno.F.O 2014. Quail farming: markets & market strategies

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


Farm made aquafeeds. FAO fisheries Technical paper, 343.


MPEDA, A hand Book on AquafarmingOrnamentalfishes, MPEDA, Kochi.

Amber Richards. 2014. Aquaponics at home.
PRACTICAL

**Occupational Zoology**

**36 Hrs**

**Credit 1**

1. General Identification, Economic importance, Morphology, scientific names and common names of the following

   a. Economic important and morphology of culturable fishes (Catla, Rohu, Grass carp, Common carp, Silver carp, *Etroplus suratensis*, *Oreochromis/Tilapia*, *Mugil cephalus* and *Anabas Testudineus*)

   b. Identification and morphology of ornamental fishes (gold fish, fighter, Gourami, Angel fish, Guppy)

   c. Two species of earthworms used in Vermiculture

   d. Four species of honey bees

   e. Economic importance and morphology of shell fishes (Any three species of prawn, two marine mussels, two oysters one rock oyster - *Crasostria* and pearl oyster - *Pinctada fucata* and freshwater mussel - *Lamellidens marginalis*).

2. Castes of bees

3. Principle & uses of - Aquarium filters, Aquarium aerator, Aquarium plants, Oven, Pelletiser, Screw Press, die plate
4. Identification and study of fish parasites and diseases (five numbers each) using slides/pictures

5. Bee keeping equipments, Beehive, Smoker, honey extractor, Queen Cage,
6. Bees wax, Honey, Vermicompost (Identification-Uses)
7. Formulation of artificial feed for aquarium fishes – demonstration
8. Tests for determining the adulteration in honey.
9. Mounting of pollen basket
10. Mounting of mouth parts of honey bee
11. Separation of cocoon from worm castings.

SEMESTER V. OPEN COURSES (FOR OTHER STREAMS)

1. VOCATIONAL ZOOLOGY

4hrs/Week,  Credits 3

Objectives

➢ 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
➢ To acquire basic knowledge and skills in aquarium management, Quail farming, vermicomposting and apiculture for self-employment
➢ To learn the different resources available and to develop an attitude towards sustainability
➢ Give awareness to society about need for waste management and organic farming

Module 1  Aquarium management

General introduction to Aquarium, Aims and types of aquarium (material, size and shape), Requirements of an aquarium - filtration of waste, physical, chemical and biological; Setting an aquarium (self-sustainable with biological filters), Major indigenous aquarium fishes of Kerala.
**Activity:** Setting up of a freshwater aquarium and rearing of aquarium fishes

**Module 2 Ornamental Fish Culture**

20 Hrs

Introduction to ornamental fishes: Present status of ornamental fish culture in India with special reference to Kerala, Breeding of Gold fish, Fighter, Gourami (*Osphronemus*), and Guppy (live bearer). Nutrition and types feed for aquarium fishes, Use of live fish feed organisms in Ornamental fish culture. Methods and techniques involved in the formulation of fish feed. Fish Transportation: Live fish packing and transport, Common diseases of aquarium fishes and their management. Establishment of commercial ornamental fish culture unit,

**Activity:** field visit to an ornamental fish breeding Centre to understand breeding practices of various aquarium fishes.

**Module 3 Quail farming (*Coturnix coturnix*)**

10 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.

**Activity:** Visit to a quail farm or viewing a quail documentary to familiarize the quail farming practices

**Module 5 Vermiculture and composting**

12 Hrs

Introduction, ecological classification of earth worms, Life history, Species of earth worms used for vermiculture, Preparation of vermibed; Preparation of vermicompost, Preparation of vermiwash, Maintenance and management of vermicomposting unit, Role of vermiculture in solid waste management.

**Activity:** Preparation of a vermiculture unit or visit to a vermicomposting unit.

**Module 6 Apiculture**

18 Hrs

Definition, Uses of bees, species 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, Death period, Enemies of bees, Bee diseases, uses of honey and wax, Apitherapy, Propolis, Royal jelly, Agencies supporting apiculture.

**Activity:** Identify different types of honey bees and rearing equipments

**Field visit and report Submission**

Field visit and report writing on any two items are taken for internal evaluation, instead of assignment and seminar. Conduct a workshop on various cultural practices and the preparation of byproducts.
References:

Applied Zoology, Study Material Zoological Society of Kerala, CMS College Campus, Kottayam.

Addison Webb (1947), Bee Keeping- for profit and pleasure, Museum Press, agro bios India Ltd.


George Cust and & Peter Bird. (1978). Tropical Fresh water Aquaria, Published by Hamlyn London. illustrated by George Thompson.


OPEN COURSE (FOR OTHER STREAMS)

2. PUBLIC HEALTH AND NUTRITION

72 Hrs

4hrs/Week

Credits 3

Objectives:

- To inculcate a general awareness among the students regarding the real sense of health.
- To understand the role of balanced diet in maintaining health.
- To motivate them to practice yoga and meditation in day-to-day life.

PART I   HEALTH, EXERCISE & NUTRITION

Module 1  Definition and Meaning of Health  10 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

Module 2  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

Module 3  Safety Education in Health promotion  8 Hrs

Principles of Accident prevention
Health and Safety in daily life.
Health and Safety at work.
First aid and emergency care.
Common injuries and their management.
Modern life style and hypokinetic diseases.
Diabetes, Cardiovascular disorders-Prevention and Management.

Module 4  Life Skill Education  8 Hrs
Life skills, emotional adjustment and well being,. Yoga, Meditation and Relaxation, Psychoneuroimmunology

PART II PUBLIC HEALTH AND SANITATION

Module 5  Public health and water quality.  11 Hrs
Potable water, Health and Water quality
Faecal bacteriae and pathogenic microorganisms transmitted by water.
Determination of sanitary quality of drinking water, water purification techniques

Module 6  Public health and diseases  15 Hrs
Food borne diseases and Prevention
Botulinum, Salmonellosis, Hepatitis A
Vector borne diseases & Control measures
Chikungunya, Filariasis and Dengu fever
Zoonotic disease -Leptospirosis & its control
Emerging diseases - Swine flue (H1N1), bird flue (H5N1), SARS, Anthrax
Re-emerging diseases –TB, Malaria

Health Centre visit & Report Presentation  10 Hrs

References:
Norman Bezzaant HELP First Aid for everyday emergencies. Jaico Publishing House, Bombay, Delhi

SEMESTER V.

OPEN COURSE (FOR OTHER STREAMS)

3. MAN, NATURE AND SUSTAINABLE DEVELOPMENT

72 Hrs
4Hrs/Week
Credits 3

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

Module I. Man in Nature

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

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

Module III. Dominance of Man on Earth 7 Hrs

Industrial Revolution
Human Population Growth
Resource Utilization
Environmental Consequences
Modern Agriculture and Green Revolution
Environmental Impacts
Imperialism and its Ecological Root

Module IV. Natural Resources 7 Hrs

Renewable and Non-renewable
Biodiversity
Importance of Biodiversity - the Six Es
Hotspots of Biodiversity
Biotic Richness of India
Monoculture and loss of Genetic Diversity
Extinction Crisis, IUCN and Red Data Book

Module V. Global Environmental Issues Threatening Natural Resources and Human Life 10 Hrs

Deforestation, Landscape alterations, Soil erosion, Flood and Drought, Desertification,
Overexploitation, Pollution (Air, Water and Soil- Pollutants and Consequences only),
Acid rain, Ozone depletion, Greenhouse 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

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

Eco Spirituality, Eco-theology and Eco-feminism
Community initiatives
Indigenous People’s Perspective (tribal and traditional communities)

**Module VII. Global Strategies for Conservation**

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

**Module VIII. Sustainable Development**

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

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


Encyclopedia Britannica Inc. UK


Gandhi, M. K. - *Writings on Ecology*


**SEMESTER VI.**

**ZOOLOGY CORE CHOICE BASED COURSES**

FOR B.Sc. ZOOLOGY PROGRAMME

**ELECTIVE I**

**ECOTOURISM & SUSTAINABLE DEVELOPMENT**

72 Hrs

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**  
12 Hrs

Introduction - Tourism, concepts and definitions
History, types, Characteristics
The facilitating sectors
Attractions
Geography, heritage
Wildlife, nature
Quality Control

**Module II. Major areas of eco-tourism**  
10 Hrs

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

**Module III. Emerging trends in eco-tourism**  
10 Hrs

Cultural tourism
Pilgrimage tourism
Farm tourism
Backwater tourism
Health tourism

**Module IV. Problems and prospects of eco-tourism**  
10 Hrs

Economics and benefits of ecotourism
Cultural issues and negative aspects of ecotourism
Environmental Impacts of Tourism

**Module V. Sustainable tourism**  
12 Hrs

Quality, Standards
Systems of sustainable tourism: environmental, sociocultural, Economical
Environment and conservation: basic principles
Current practices of eco-conservation in tourism industry
Sustainable tourism and society
Community based ecotourism
Eco-development committee (EDC) of Periyar Tiger Reserve
People initiatives

**Module VI. Eco-tourism guides**  
Ecotourism guiding and case studies

**Activity**
Field visit to Ecologically relevant places & Report writing  
**10 Hrs**

**References:**


**ELECTIVE COURSE**

**2. AGRICULTURAL PEST MANAGEMENT**  
**72 Hrs**

**4 Hrs/week - 3 Credits**

**Objectives**

1. To acquire basic skills in the observation and study of nature.

2. To impart basic awareness regarding pest problem and crop loss due to their dominance.
3. To inculcate interest in adopting biological control strategies for pest control.

4. To understand various pests affecting our local crops and select the best method for their control

5. To acquire basic knowledge and skills in agriculture management to enable the learner for self-employment.

Module I

15 Hrs


Module II

5 Hrs

Pest categories: Types of pests- insect pest and non-insect pest.

Insect pest: insect structure and function-external features (body parts), mouth parts of phytophagous insects, internal anatomy, growth, development, reproduction, life cycle and metamorphosis (one example each from ametabolous, hemimetabolous and holometabolous insect), diapause. types of insect pests-key pests, occasional pests, potential pests.

Non insect pests: General features, different types-Rodents(mention the nature of crop loss by them).Mites-Main types of mites; plant injury caused by mite, millipedes and centipedes, slugs and snails (mention the damage of invasive Giant African Snail).

Activity: Identify a minimum of 5 invasive species (plant / animal) in your locality and make a report on their ecological impact.

Module III

7 Hrs

Pest and plants: Plant feeding insects-plant host range, types of injury, relationship of pest injury and yield.

Host plant resistance: Characterization of resistance, mechanism of resistance (antixenosis, antibiosis, tolerance), biophysical, biochemical and genetic bases of resistance.

Module IV

20 Hrs
**Pest control-principles and practices:** Types of control-cultural control, biological control, chemical control, integrated pest management, miscellaneous control.

**Cultural control:** Water management, tillage, sanitation, plant diversity, crop rotation, planting time, harvesting practices etc

**Biological control:** Parasitoids and predators, control by insect pathogens. Techniques in biological control-conservation, introduction and augmentation. Biopesticides

**Chemical control:** Origin of chemical control, chemistry, mode of action and nomenclature (organochlorines, organophosphates, carbamates, synthetic pyrethroids, miscellaneous group) of pesticides, pesticide formulations and pesticide appliances (sprayers and dusters). Brief mention of attractants, repellents, chemosterilants and pheromones

**Activity 1:** Conduct a workshop on preparation of biopesticides of various types suitable for kitchen garden and agricultural fields.

**Integrated Pest Management (IPM)**

Miscellaneous control: Mechanical (hand picking, exclusion by screens and barriers, trapping, clipping, pruning etc), physical (hot and cold treatment, moisture, light traps etc), sterility principle

**Module V 25 Hrs**

**Bionomics and control of major pests of crops and stored grains:** Biology, life cycle and nature of damage by different pests of following crops and their control

**Pests of paddy:** *Leptocorisa acuta, Scirpophaga incertulas, Spodoptera mauritia, Orseolia oryzae, Nilaparvata lugens*

**Pests of coconut:** *Oryctes rhinoceros, Rhyncophorus ferrugineus, Opisina arenosella, Aceria guerreronis*

**Pests of Banana:** *Cosmopolites sordidus, Pentalonianigronervosa*

**Pests of vegetables - Brinjal:** *Leucinodesorbonalis, Euzopheraperticella, Henosepilachnavigintioctopunctata, Urentiushystricellus*
Gourds - Bactoceracucurbitae, Anadevidiapeponis, Epilachna spp. Raphidopalpafoveicollis, Baristrichosanthis

Pest of stored grains: Sitophilusoryzae, Corcyra cephalonica Triboliumcastraneum, Trogodermagranarium, Callasobruchuschinensis

Activity 2: Conduct a poster exhibition on various types of pests of paddy, coconut, banana and vegetable varieties of Kerala.

Activity 3: Collect different types of pest of stored grains from the local provision shops or houses and make a taxonomic study and prepare a powerpoint presentation on them.

Activity 4: Visit a minimum of 5 kitchen gardens in the neighborhood and enlist the common traditional pest control measures used in them.

Activity 5: Organise awareness classes on the ill effects of chemical pesticides and manure on human health with the support of local examples.

References


ELECTIVE COURSE

3. VECTOR AND VECTOR BORNE DISEASES

72 Hrs
3 Credits

Objectives:
Module I


Insect vectors: Mosquitoes, flies, fleas, lice, ticks and bugs: General account of ecology morphology and mouth parts

Module II

Salient features and distribution of mosquito species: Anopheles, Aedes, Culex, and Mansonia.

Module III


Module IV

Introduction to Vector control: Aims, objectives and advantages. History and background, recent trends, alternatives to the use of insecticides (chemical & microbial), types of vector control - selective, integrated and comprehensive vector control.

Control measures of mosquitoes, sand fly, tsetse fly and domestic flies

Module V


Field report on two case studies of epidemiology in India.

References:
ELECTIVE COURSE

4. NUTRITION, HEALTH AND LIFESTYLE MANAGEMENT

72 Hrs.

3 Credits

Objectives:

1. To provide students with a general concept of health and the parameters that define health and wellness.
2. To understand principles of nutrition and its role in health.
3. To familiarize the students regarding food safety, food laws & regulations.
4. To provide knowledge and understanding regarding life style diseases.
5. To promote an understanding of the value of good life style practices, physical fitness and healthy food habits for life style disease management.

Module I

15 Hrs

Nutrition and health: Nutritional requirements of man, classification of major nutrients including protein, vitamins and minerals, water, role of fibre, biological value of food components, food groups and sources, balanced diet, RDA, BMI, BMR, Calorie intake and expenditure, Healthy eating pyramid, Nutrition in infancy, preschool, school, adolescent, pregnancy, lactation and old age. Nutrition in diseases and special conditions. Food safety: Nutrition education, food sanitation and hygiene, food adulteration and consumer protection.

Module II

18 Hrs

10. Haematological parameters, 11. BMI

Module III  
15 Hrs

Introduction to Life style diseases

Common life style diseases: Alzheimer’s disease and other neural disorders, asthma, cancer, cardio vascular diseases - including hypertension, Atherosclerosis and stroke, chronic obstructive pulmonary disease, Diabetes Mellitus or Type 2 Diabetes, kidney disorders and chronic renal failure, constipation, depression, gastro-intestinal disturbances including diarrhoea and peptic ulcer, liver cirrhosis and other liver diseases, obesity, osteoporosis, occupational lifestyle diseases.

Modern lifestyle disorders: sleeping habits, junk food, poor eating habits, anxiety, food poisoning

Module IV  
10 Hrs

Causes of lifestyle diseases: Defects of modern food habits and unbalanced diet options, food adulteration, environmental pollution, poor life style choices, drug abuse, tobacco smoking, alcohol and drug consumption, lack of adequate exercise, wrong body posture, disturbed biological clock, stressful environmental conditions

Module V  
14 Hrs

Prevention and control of life style diseases:

Healthy life style habits and practices, healthy eating habits, exercise and fitness, good sleep patterns, a strict no to alcohol, drugs, and other illegal drugs. Uncontrollable factors like age, gender, heredity and race.

Healthy diet: disease prevention through appropriate diet and nutrition, avoiding foods that are high in fats, salt and refined products. Avoid junk food and replace by natural food/
organic food.

Physical exercise: Moderate exercise for fitness of body, walking, stretching, right postures of sitting & standing, relaxation and cutting down of stress, sports, aerobic exercise and yoga.

Health literacy as a public health goal: Awareness programs in schools, colleges and through mass media.

References:


