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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&examination: i. Theory

ii. Practical

b. Syllabus – Theory and Practical

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 three days with two months vaccation during April and May. (The commencement of first semester may be delayed owing to the finalization of the admission processes.)

A student may be permitted to complete the Programme,onvalid reasons, withinaperiod of 12 continuous semesters from the date of commencement of the first semester of the programme.

4. PROGRAMME STRUCTURE - B.Sc Model I

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	22
d	Credits required from Common Course II	16
e	Credits required from Core course and Complementary courses including Project	79
f	Open course	3

g	Minimum attendance required	75%

B.Sc Model II

A	Programme Duration	6 Semesters
B	Total Credits required for successful completion of the Programme	120
C	Credits required from Common Course I	16
D	Credits required from Common Course II	8
E	Credits required from Core + Complementary + Vocational Courses including Project	93
F	Open course	3
G	Minimum attendance required	75%

B.Sc Model III

A	Programme Duration	6 Semesters
B	Total Credits required for successful completion of the Programme	120
C	Credits required from Common Course I	8
D	Credits required from Core + Complementary + Vocational Courses including Project	109
E	Open course	3
F	Minimum attendance required	75%

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

Assignments are to be done from 1st to 4th Semesters. 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 on **performing arts** where students have to take 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.)

Semester 1

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English - 1	Common Course I	5	4	1	4
2		English - 2	Common Course II	4	3	1	4
3		Second Language – 1	Common Course III	4	4	1	4
4	ZY1CRT01	General perspectives in Science & Protistan Diversity	Core Course I : Theory	2	2	1	4
5		Practical : General perspectives in Science & Protistan Diversity	Core Course I : Practical	2	0	0	0
6		Chemistry 1/ Biochemistry 1	Complementary Course I : Theory	2	2	1	4
7		Chemistry 1	Complementary Course I : Practical	2	0	0	0
8		Botany 1	Complementary Course II : Theory	2	2	1	4
9		Botany 1	Complementary Course II : Practical	2	0	0	0
Total				**25 hrs**	**17**		

Semester 2

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English 3	Common Course	5	4	1	4

			IV				
2		English 4	Common Course V	4	3	1	4
3		Second Language -2	Common Course VI	4	4	1	4
4	ZY2CRT02	Animal Diversity- Non Chordata	Core Course II : Theory	2	2	1	4
5	ZY2CRP01	Animal Diversity – Non Chordata	Core Course II : Practical	2	2	1	4
6		Chemistry – II / Biochemistry - II	Complementary Course I : Theory	2	2	1	4
7		Chemistry – II / Biochemistry - II	Complementary Course I : Practical	2	2	1	4
8		Botany – II	Complementary Course II : Theory	2	2	1	4
9		Botany – II	Complementary Course II : Practical	2	2	1	4
Total				**25 hrs**	**23**		

Semester 3

No	**Course Code**	**Course Title**	**Course Category**	**Hrs per week**	**Credits**	**Marks ratio**	
						Intl	**Extl**
1		English 5	Common Course VII	5	4	1	4
2		Second Language 3	Common Course VIII	5	4	1	4
3	ZY3CRT03	Animal Diversity - Chordata	Core Course III : Theory	3	3	1	4
4	ZY3CRPO3	Animal Diversity- Chordata	Core Course III : Practical	2	0	0	0
5		Chemistry – III / Biochemistry - III	Complementary Course I : Theory	3	3	1	4
6		Chemistry – III / Biochemistry - III	Complementary Course I : Practical	2	0	0	0

7		Botany III	Complementary Course II : Theory	3	3	1	4
8		Botany III	Complementary Course II : Practical	2	0	0	0
Total				**25 hrs**	**17**		

Semester 4

No	**Course Code**	**Course Title**	**Course Category**	**Hrs per week**	**Credits**	**Marks ratio**	
						Intl	**Extl**
1		English - 6	Common Course IX	5	4	1	4
2		Second language - 4	Common Course X	5	4	1	4
3	ZY4CRT04	Research methodology, Biophysics & Biostatistics	Core Course IV : Theory	3	3	1	4
4	ZY4CRP02	Research methodology, Biophysics & Biostatistics	Core Course IV : Practical	2	2	1	4
5		Chemistry – IV / Biochemistry - IV	Complementary Course I : Theory	3	3	1	4
6		Chemistry – IV / Biochemistry - IV	Complementary Course I : Practical	2	2	1	4
7		Botany - IV	Complementary Course II : Theory	3	3	1	4
8		Botany - IV	Complementary Course II : Practical	2	2	1	4
Total				**25 hrs**	**23**		

Semester 5

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZY5CRT05	Environmental Biology & Human rights	Core Course V : Theory	3	3	1	4
2	ZY5CRPO5	Environmental Biology & Human rights	Core Course V : Practical	2	0	0	0
3	ZY5CRT06	Cell Biology & Genetics	Core Course VI : Theory	3	3	1	4
4	ZY5CRPO6	Cell Biology & Genetics	Core Course VI : Practical	2	0	0	0
5	ZY5CRT07	Evolution, Ethology & Zoogeography	Core Course VII : Theory	3	3	1	4
6	ZY5CRPO7	Evolution, Ethology & Zoogeography	Core Course VII : Practical	2	0	0	0
7	ZY5CRT08	Human Physiology, Biochemistry & Endocrinology	Core Course VIII : Theory	3	3	1	4
8	ZY5CRPO8	Human Physiology, Biochemistry & Endocrinology	Core Course VIII : Practical	2	0	0	0
9	ZY5OPT01	1 – Vocational Zoology (Apiculture, Vermiculture, Ornamental fish culture)	Open Courses for other streams *(Select any one out of three)*	4	3	1	4
	ZY5OPT02	2 – Public health and Nutrition					
	ZY5OPT03	3 – Man, nature & Sustainable Development					
10	ZY6CRPRP	Project work (Credit 2 will be given in 6th semester with investigatory project).	Project	1	0		
Total				**25 hrs**	**15**		

Semester 6

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZY6CRT09	Developmental Biology	Core Course IX : Theory	3	3	1	4
2	ZY6CRP09	Developmental Biology	Core Course IX : Practical	2	2	1	4
3	ZY6CRT10	Microbiology & Immunology	Core Course X : Theory	3	3	1	4
4	ZY6CRP10	Microbiology & Immunology	Core Course X : Practical	2	2	1	4
5	ZY6CRT11	Biotechnology, Bioinformatics and Molecular Biology	Core Course XI : Theory	3	3	1	4
6	ZY6CRP11	Biotechnology, Bioinformatics and Molecular Biology	Core Course XI : Practical	2	2	1	4
7	ZY6CRT12	Occupational Zoology (Aquaculture, Apiculture, Vermiculture & Quail farming)	Core Course XII : Theory	3	3	1	4
8	ZY6CRP12	Occupational Zoology (Aquaculture, Apiculture, Vermiculture & Quail farming)	Core Course XII : Practical	2	2	1	4
9	ZY6CBT01	Elective 1: Ecotourism & Sustainable Development	Choice Based Core Elective Courses *(Select any one out of four)*	4	3	1	4
	ZY6CBT02	Elective 2: Agricultural pest management					
	ZY6CBT03	Elective 3: Vector & Vector borne Diseases					
	ZY6CBT04	Elective 4: Nutrition, Health & life style management					
10	ZY6CRPRP	Project Work	Project	1	2		
Total				**25 hrs**	**25**		

7. SCHEME OF DISTRIBUTION OF INSTRUCTIONAL HOURS

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

Name of semester	Theory	Practical
First semester	2	2
Second semester	2	2
Third semester	3	2
Fourth semester	3	2
Fifth semester	16	8
Field study & group activity	1	
Sixth semester	16	8
Project work (in sixth sem.), Visit to research institute	1	
Total	**44**	**24**

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

Semester	Title of the Course	Hrs	Inst Hrs/week	Credit
1	General perspectives in Science & Protistan Diversity	36	2	2
1	General perspectives in Science & Protistan diversity (Practical)	36	2	0
2	Animal Diversity – Non Chordata	36	2	2
2	Animal Diversity – Non Chordata (Practical)	36	2	2
3	Animal Diversity - Chordata	54	3	3
3	Animal Diversity - Chordata (Practical)	36	2	0
4	Research Methodology, Biophysics and Biostatistics	54	3	3
4	Research Methodology, Biophysics and Biostatistics (Practical)	36	2	2
5	Environmental Biology & Human rights	54	3	3
5	Environmental Biology & Human rights (Practical)	36	4	0
5	Cell Biology & Genetics	54	3	3
5	Cell Biology & Genetics (Practical)	36	2	0
5	Evolution, Ethology & Zoogeography	54	3	3
5	Evolution, Ethology & Zoogeography (Practical)	36	2	0
5	Human Physiology, Biochemistry & Endocrinology	54	3	3

5	Human Physiology, Biochemistry & Endocrinology (Practical)	36	2	0
6	Developmental Biology	54	3	3
6	Developmental Biology (Practical)	36	2	2
6	Microbiology & Immunology	54	3	3
6	Microbiology & Immunology (Practical)	36	2	2
6	Biotechnology, Bioinformatics & Molecular biology	54	3	3
6	Biotechnology, Bioinformatics &Molecular Biology (Practical)	36	4	2
6	Occupational Zoology (Aquaculture, Apiculture,Vermiculture & Quail farming)	54	3	3
6	Occupational Zoology(Aquaculture, Apiculture,Vermiculture & Quail farming) (Practical)	36	2	2

9. SCHEME OF DISTRIBUTION OF HOURS AND CREDITS :

OPEN COURSES (FOR OTHER STREAMS) & ELECTIVES

Seme ster	Course No	**Title of the Course (Select any one from each group)**	**Hrs**	**Inst Hrs/ week**	**Cre dit**
5	Open course - 1	Vocational Zoology (Apiculture,Vermiculture & Ornamental Fish Culture)	72	4	3
5	Open course-2	Public Health & Nutrition			
5	Open course-3	Man, Nature & Sustainable Development			
6	Choice Based Core Elective - 1	Ecotourism & Sustainable Development	72	4	3
6	Choice Based Core Elective - 2	Agricultural Pest Management			
6	Choice Based Core Elective - 3	Vector & Vector Borne Diseases			
6	Choice Based Core Elective - 4	Nutrition, Health & Life Style Management			

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)

Sem	Course Code	Course Title	Course Category	Duration	Marks ratio		Credits
				Hrs	Internal (I)	External (E)	
1	ZY1CRT01	General perspectives in Science & Protistan Diversity	1	2	1	4	2
2	ZY2CRT02	Animal Diversity – Non Chordata	2	2	1	4	2
3	ZY3CRT03	Animal Diversity-Chordata	3	3	1	4	3
4	ZY4CRT04	Research Methodology, Biophysics and Biostatistics	4	3	1	4	3
5	ZY5CRT05	Environmental Biology & Human rights	5	3	1	4	3
5	ZY5CRT06	Cell Biology & Genetics	6	3	1	4	3
5	ZY5CRT07	Evolution, Ethology & Zoogeography	7	3	1	4	3
5	ZY5CRT08	Human Physiology, Biochemistry & Endocrinology	8	3	1	4	3
6	ZY6CRT09	Developmental Biology	9	3	1	4	3
6	ZY6CRT10	Microbiology and Immunology	10	3	1	4	3
6	ZY6CRT11	Biotechnology, Bioinformatics & Molecular Biology	11	3	1	4	3
6	ZY6CRT12	Occupational Zoology (Aquaculture, Apiculture,Vermiculture	12	3	1	4	3

		& Quail farming)					
Zoology Open Course Sem 5 *(Select any 1 from 3)*	ZY5OPT01	Vocational Zoology (Apiculture, Vermiculture, & Ornamental Fish Culture)	Open course (for other streams)-1	4	1	4	3
	ZY5OPT02	Public Health & Nutrition	Open course -2				
	ZY5OPT03	Man, Nature & Sustainable Development	Open course -3				
Sem 6 *(Select any 1 from the four)*	ZY6CBT01	Ecotourism & Sustainable Develpoment	Choice Based Course-1	4	1	4	3
	ZY6CBT02	Agricultural Pest Management	Choice Based Course-2				
	ZY6CBT03	Vector & Vector Bourne Diseases	Choice Based Course-3				
	ZY6CBT03	Nutrition,Health & Life Style Management	Choice Based Course -4				

b. SCHEME OF PRACTICAL EXAMINATIONS

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

Semester	**Code**	**Practical No.**	**Course Title**	**Duration**	**Marks ratio**		**Credits**
				Hrs	**Internal (I)**	**External (E)**	
2	ZY2CRP01	I	General Perspectives in Science, Protistan Diversity Biodiversity & Animal Diversity – Non Chordata	3 Hrs	1	4	2
4	ZY4CRP02	II	Animal Diversity – Chordata, Research methodology, Biophysics &	3 Hrs	1	4	2

			Biostatistics				
6	ZY6CRP03	III	Environmental Biology, Toxicology, Cell Biology & Genetics	3 Hrs	1	4	2
6	ZY6CRP04	IV	Evolution, Ethology, Zoogeography, Human Physiology, Biochemistry & Endocrinology	3 Hrs	1	4	2
6	ZY6CRP05	V	Developmental Biology, Microbiology & Immunology	3 Hrs	1	4	2
6	ZY6CRP06	VI	Biotechnology, Bioinformatics, Molecular Biology & Occupational Zoology	3 Hrs	1	4	2

c. Total Credits for Core Course

Theory	
Core + Choice Based Core (Elective)	37
Open course	3
Practical	12
Project	2
Total	**54**

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

Marks Maximum 100

	Internal Assessments (I)	External Assessments (E)
Project:- Log book showing the progress of project work duly signed by the supervising teacher & HOD	**20**	**Project report – 50 marks** Title- 2 Marks Abstract- 3 Marks Introduction & Review of literature- 10 Marks Methodology- 10 Marks Results- 10 Marks Discussion & Conclusion - 10 Marks Neat presentation and Novelty- 5 Marks **Presentation & Viva- 30Marks** (Student can present the project using OHP or LCD, in 7 Minutes) Viva Voce.
Total	**20**	**80**

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)

Semester	Code	Title of the Course	Hrs	Inst Hrs/week	Credit
1	ZY1CMT01	Non Chordate Diversity	36	2	2
1		Non Chordate Diversity (Practicals)	36	2	0
2	ZY2CMT02	Chordate Diversity	36	2	2
2		Chordate Diversity (Practicals)	36	2	0
2	ZY2CMP01	**Practical 1** Non Chordate Diversity + Chordate Diversity (Practicals)			2
3	ZY3CMT03	Physiology and Immunology	54	3	3
3		Physiology and Immunology (Practicals)	36	2	0
4	ZY4CMT04	Applied Zoology	54	3	3
		Applied Zoology (Practicals)	36	2	
4	ZY4CMP02	**Practical 2** Physiology and Immunology + Applied Zoology (Practical)			2

12. SYLLABUS:

B.Sc ZOOLOGY PROGRAMME

MODEL – I

THEORY & PRACTICALS

SEMESTER 1. ZY1CRT0I. 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

Systematic, Taxonomy, Phylogeny [Brief account] , Approaches to taxonomy, Molecular taxonomy, .Bar coding. Zoological nomenclature, International Code of Zoological Nomenclature (ICZN), Law of Priority. Five Kingdom Classification; Linnaean classification, Basis for Animal kingdom classification [Levels of organization, Symmetry, Coelom]

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 KingdomProtista **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*
16. Phylum Rhodophyta :Eg. Red Alga

(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 .

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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 Protiatans 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 **7 Hrs**

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:

1. Coral and coral reefs with special reference to conservation of reef fauna.

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: Aphasmidia Eg. *Trichinella*

General Topic

Pathogenic nematodes in man. (*Wuchereria bancrofti, Ascaris lubricoides, Ancylostoma duodenale, Trichinella).*

Phylum Annelida: 2 Hrs

Salient features, Classification upto classes.

Class I- Archiannelida Eg. *Polygordius*

Class II -Polychaeta Eg. *Chaetopterus*

ClassIII- Oligochaeta Eg. *Megascolex.*

Class IV- Hirudinea Eg. *Ozobranchus, Hirudinaria*

MODULE III 14 Hrs

Phylum Onychophora

Eg. Peripatus (Mention its affinities).

Phylum Arthropoda Salient features, Classification upto 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. *Speleonectes* (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*

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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 Ascidiacea Eg: *Ascidia* (Mention Retrogressive 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 Crossopterigii(Coelocanths) Eg: *Latimeria*(Evolutionary Significance)

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

Sub class: - Actinopterygii

Super order 1. ChondrosteI Eg: *Acipencer*

Super order 2. Holostei Eg: *Amia*

Super order 3. Teleostei Eg: Sardine

General topics

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

MODULE III

Super class: Tetrapoda General characters, Classification up to Orders **11 Hrs**

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 **4 Hrs**

Sub class I: Anapsida

Order Chelonia Eg: *Chelone*

Sub class II: Parapsida Eg: *Ichthyosaurus*

Sub class III: Diapsida

Order I Rhynchocephalia Eg: *Sphenodon*

Order II Squamata Eg: *Chamaleon*

Order III. Crocodilia Eg..*Crocodylus*

Sub class IV: Synapsida Eg: *Cynognathus*

General topic

Identification of poisonous and non-poisonous snakes

Class Aves **5 Hrs**

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

Sub class II: Neornithes

Super order I: Palaeognathe Eg: *Struthio*

Super order II: Neognathe Eg: Brahminy kite

General topics

1. Migrations in birds
2. Flight adaptations in birds

MODULE IV

Class Mammalia Type: Rabbit (*Oryctolagus cuniculus*) **17 Hrs**

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, *Ornithorhychus*

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 Hydracoidea	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.

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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 9^{th}& 1^{st} 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 9^{th}

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.

Protochordata-1, Pisces-5, Amphibia-5, Reptilia- 5, Aves-2, Mammalia-2.

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.
Search engines Online libraries, e-Books, e-Encyclopedia, Institutional Websites.
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, Polorization 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**

Bioethics : Introduction, Animal rights and animal laws in India, Prevention of cruelty to animals Act 1960, Biodiversity Act 2003.

Concept of 3 R – conservation (Refined- to minimize suffering, Reduced – to minimize animals, Replaced – modern tools and alternate means), Animal use in research and education.

Laboratory animal use, care and welfare, Animal protection initiatives- Animal Welfare 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.

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CORE COURSE IV

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
3. Internet: Access a web page on any biological topic.
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.

7. Graphical representation of data. Construction of bar diagrams, Histograms, Pie diagram and Line graphs.

SEMESTER V. ZY5CRT05

CORE COURSE V

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

Characteristics of a community: Species diversity- richness, eveness, stratification, dominance, ecological indicators, Ecotone and Edge effect, Keystone species, Concepts of Ecological Niche and Guild, Ecological succession, community evolution- climax.

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 harvestiong, watershed management

Environment education

Environmental laws (Brief account only): The Water (Prevention and Control of Pollution) Act, 1974, The Air (Prevention and Control of Pollution) Act, 1981, Indian Forests Act (Revised) 1982. The Environment (Protection) Act, 1986, Hazardous Wastes (Management and Handling) Rules, 1989, The Forest (Conservation) Act, 1980, The Wildlife Protection Act, 1972, Biodiversity Act, 2002.

MODULE 5 HUMAN RIGHTS 6 Hrs

Introduction, main concepts associated with Human Rights, Different types of human rights, Manifestations & phenomena, Role of agencies in promoting human rights, Mechanisms for checking violations of human rights, National human right commission, Constitutional provisions related to Human rights.

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9. Sharma P.D. (2005)Environmental biology and Toxicology, Rastogi publication
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14. Stiling Peter (2002). Ecology: Theories and applications. Prentice Hall of India pvt.Ltd. New Delhi.
15. Landis, Wayne and Hing-hoYu, Baca Raton, 1995. Introduction to Environmental Toxicology: Impacts of chemicals upon Ecological systems: Lewis Publishers.

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
9. Visit to any two important areas of bio diversity: 1. Forest, 2.Sea shore, 3. Mangrove, 3.

Wet lands, 4. Bird sanctuary, 5. Wild life sanctuary, 6. Sacred groves

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 22 HRS

Module I **6 Hrs**

Introduction of cell and Diversity of cells: History, Cell theory, Prokaryotes, Eukaryotes, Mycoplasmas, Virus, Virions and Viroids, Prions.

Cell membrane & Permeability: Molecular models of cell membrane (Sandwich model, Unit membrane model, Fluid mosaic model). Cell properties - permeability, Transport [Diffusion, Osmosis, Passive transport, Active transport, bulk transport], Cell coat and Cell recognition.

Module II **10 Hrs**

Cell Organelles : Structure and functions of following cell organelles: Endoplasmic reticulum - Structure and functions. Ribosomes (Prokaryotic and Eukaryotic) Golgi complex - Structure and functions. Lysosomes - Polymorphism - GERL concept, functions.

Mitochondria - Structure and functions. Nucleus: Structure and functions of interphase nucleus, Nuclear membrane, pore complex, structure and functions of nucleolus

Chromosomes – Structure & organization, Heterochromatin, Euchromatin, Nucleosomes, Polytene chromosomes-Balbiani rings, Endomitosis, Lamp brush chromosomes.

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 - G_1, S, G_2 and M phases,.Mitosis and Meiosis.The difference between Mitosis and Meiosis.

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15. Ariel G Loewy Philip Sickevitz, John R. Menninger and Jonathan A.N. Gallants (1991) cell structure and function. Saunder's College Publication

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GENETICS **32 Hrs**

Module I **10 Hrs**

MendelianGenetics: 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 **10 Hrs**

Mutation: Types of mutations - Somatic, germinal, spontaneous, induced, autosomal and allosomal, chromosomal mutations, structural and numerical changes. Gene mutations. [Addition, Deletion and substitution].

HumanGenetics: 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

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SEMESTER V

CORE COURSE VI
CELL BIOLOGY AND GENETICS
(PRACTICAL)

36 Hrs

2 Credits

PART A: CELLBIOLOGY

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)

4. Sexing of Drosophila.

5. Study of Barr body in human buccal epithelium

SEMESTER V. ZY5CRT07

CORE COURSE - V11: 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;

Direct evidences of evolution – Recapitulation Theory of Haeckel, Fossilization, Kinds of fossils, fossil dating, Homologous organs and analogous organs.

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

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 **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

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ETHOLOGY

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American Scientist 3rd Edn. Sinauer Associates Inc. MA,USA. (Module 10 & 11).

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ZOOGEOGRAPHY

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2. Chandran Subash M.D. (1997). On the ecological history of the Western Ghats.Current Science, Vol.73, No.2.146-155.
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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
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. 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 **31 Hrs**

Module I **8 Hrs**

Nutrition: Nutritional requirements – carbohydrates, proteins, lipids, minerals (Ca, P, Fe, I), vitamins (sources and deficiency disorders). Importance of dietary fibre and antioxidants.Balanced diet, Recommended Dietary Allowance (RDA). Nutrition during pregnancy and lactation, Infant nutrition, Malnutrition(PEM).

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**

Respiration: Phases of respiration (external respiration, gas transport and internal respiration). Respiratory pigments: Haemoglobin, Myoglobin (Structure and Function). Transport of respiratory gases - transport of oxygen, oxyhaemoglobin curve, factors affecting oxyhaemoglobin curve, transport of carbon dioxide,(chloride shift). Control of respiration.Respiratory disturbances (Hypoxia, Hypercapnia, Asphyxia).Physiological effect of smoking, carbon monoxide poisoning, Oxygen therapy and artificial respiration.

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 **5 Hrs**

Excretion: **H**istology of Bowman's capsule and tubular part. Urine formation – glomerular filtration, tubular reabsorption, tubular secretion.Urine concentration – counter current mechanism. Acid – base balance, hormonal regulation of kidney function. Renal disorders (kidney stone, acute and chronic renal failure, and dialysis). Homeostasis: Definition,

concept and importance in biological system. Thermal regulation and thermal adaptation in homeotherms.

Module IV **10 Hrs**

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 **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

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Sarada Subramanyam and K. Madhavankutty; 2014; Textbook of human physiology., S.Chand & Company Ltd,

Satyanarayana U. and Chakrapani, U.; 2013. Biochemistry Elsevier; 4 edition

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. 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 periodicclass discussions of current events in science which will benefitthem in their future studies in the biological/physiological sciences and health-related fields
3. To contribute tocritical societal goal of a scientifically literate citizenry.

Module 1 **10 Hrs**

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

Reproductive Physiology: Gonads- anatomy of testis and ovary, spermatogenesis, oogenesis, gonadal hormones and their functions. Hormonal control of human reproduction - Female reproductive cycles (Estrous cycle, Menstrual cycle). Structure of mammalian sperm and egg, Pregnancy, parturition and lactation.Reproductive health and importance of sex education.

.**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**

Cleavage: Types, planes and patterns of cleavage, Cell lineage of Planaria. Influence of yolk on cleavage.

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.

Gastrulation: Major events in gastrulation. Morphogenetic cell movements. Influence of yolk on gastrulation. Exogastrulation.Concept of germ layers and derivatives.

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 **20Hrs**

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

Embryology of chick: Structure of egg, fertilization, cleavage, blastulation, fate map, gastrulation. Development and role of Primitive streak, Salient features of 18hour, 24 hour, 33 hour & 48 hour chick embryo.Extra embryonic membranes in chick.

Human development: Fertilisation, cleavage, blastocyst, implantation, placenta. Gestation, parturition and lactation.Human intervention in reproduction, contraception and birth control. Infertility, Invitro fertilization (test tube baby)

Module IV **5Hrs**

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,

Developmental defects: Prenatal death (miscarriage and still birth). Intrauterine Growth Retardation (IUGR).

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.

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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)

Scott F. Gilbert; 2003; Developmental biology; Sinauer Associates Inc.,U.S.; 7th Revised edition.

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

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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.
8. Vital staining- demonstration.
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

54 Hrs

3 Credits

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.

Bacterial Reproduction Sexual – (conjugation, transduction)and Asexual (budding,, fragmentation). Virology: Structure of virus; Human, animal, and bacterial virus. Viral replication, cultivation of animal viruses.

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 **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 **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. 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

1. Ananthanarayan R & Jayaram Paniker C K. (2009) Text Book of Microbiology Orient Longman Private Ltd.

2. Gladys Francis & Mini K.D., (Editors) (2012), Microbiology, Zoological Society of Kerala, Kottayam.

3. Kuby J, Kindt T., Goldsby R. and Osborne B. (2007). Kuby immunology

4. Sharma K. (2005) Manual of Microbiology: Tools and Techniques, Ane books

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

6. Colemen: (2002). Fundamentals of Immunology

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

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

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

10. Heritage, J, E.G.V. Evaus and R.A.Killungten (2007): Introductory Microbiology Cambridge University Press 6. Ivan Roitt I (2002) Essentials of Immunology ELBS.

PRACTICAL

MICROBIOLOGY AND IMMUNOLOGY

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.
5. Gram staining – preparation, procedure, identification of Gram + ve and Gram –ve 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 **11Hrs**

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

Gene Libraries, Construction of genomic library and cDNA Library. PCR technique and DNA amplification, Brief description of screening methods – Probes, Nucleic Acid hydridization, In situ Hybridization, Fluorescence in situ Hybridization (FISH), Colony hybridization. Methods of transfer of desired gene into target cell.Blotting Techniques-Southern, Northern, Western blotting.DNA Finger printing (DNA Profiling) and its application. Molecular markers - RFLP

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

1. Singh B.D Biotechnology 2002. Kalyan Publishers New Delhi.

2. Brown C.H., Campbell I & Priest F, G. 1987. Introduction of Biotechnology (Blackwell scientific publishers Oxford).

3. Colin Ratledge Bijorn Kristiansesn, 2008. Basic Biotechnology 3 rd ed. Cambridge University.

4. Janarathanan S & Vincent S. 2007. Practical Biotechnology, Method of Protocols. University Press.

5. John E. Smith. Biotechnology Cambridge Low priced ed. (Third Ed) 2005 Madingan, Martinko and Parker 2002, Biology of Microorganisms, Brock Eighth Ed. Prentice Hall.

6. Singh B.D. Biotechnolgy 2002, Kalyan Publishers New Delhi.

7. Sudha Gangal 2007. Biotechnology Principles and & practice of Animal Tissue culture, Universities Press.

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

1. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006).Cell and Molecular Biology.VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Gupta, P. K (2002) Cell and Molecular Biology, (2ed), , Rastogi Publications., Meerut
4. James Darnell. (1998) Molecular Biology. Scientific American Books Inc
5. Thomas AP(Editor). 2011 Cell &Molecular Biology The Fundamentals. Green leaf publications .TIES Kottayam
6. Zoological Society of Kerala Study material. (2011) Cell and Molecular Biology

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 profitablefarming.

3. To make the students aware of cottage industries.

Module 1. APICULTURE **18 Hrs**

Definition, Different species of honey bees, Organization of honey bee colony, Social life and adaptation of honey bees. Communication among honey bees. Bee keeping methods and equipments, Management and maintenance of an apiary, Growth period, honey flow period and dearth period Division of the colony, uniting two colonies, , replacing old queen with new queen, swarming management, monsoon management. Enemies of bees. Diseases of bees,.Bee pasturage. Uses of honey bees, By-products of honey bees, Honey and wax composition. Testing the quality of honey.Extraction of wax, Uses of honey and wax.Royal jelly, Propolis. Apitherapy, Agencies supporting apiculture.

Activity :Visitto 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**

Introduction, Ecological classification of earth worms. Species of earth worms used for vermicultre, Reproduction & life cycle, Role of earth worm in solid waste management, in agriculture, in medicine etc. Preparation of vermibed, Maintenance & monitoring, Preparation of vermicompost, Preparation of vermiwash.

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.

Shukla G.S, & Updhyay V.B, Economic zoology ,Rastogi Publ. Meerut.

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

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

Clive. A Edwards, Norman. Q. & Rhonda. 2011. Vermitechnology: earthworms, organic waste & environmental management.

Chauhan, H.V.S. Poultry, Disease, diagnosis and treatment, Wiley eastern Ltd Delhi.

Otieno.F.O 2014. Quail farming: markets & market strategies

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Amber Richards. 2014. Aquaponics at home.

Pradip.V.Jabde. 1993. Text book of applied zoology

Venkitaraman, P.R,1983, Text book of Economic zoology(SudharsanaPuubl. Kochi)

Addison Webb, Bee Keepingfor profit and pleasure, Agrobios Ltd.

Edwards.C.A.&Lafty, J.R.1972 Biology of earthworms(Chapman & Hall Led.London)

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 *Ana*b*as 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 aquariumand 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 vermicultre, 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

1. Applied Zoology, Study Material Zoological Society of Kerala, CMS College Campus, Kottayam.
2. Addison Webb (1947), Bee Keeping- for profit and pleasure, Museum Press, agro bios India Ltd.

3. Alka Prakash (2011), Laboratory Manual of Entomology, New age International, New Delhi.
4. Arumugan N. (2008) Aquaculture, Saras publication.
5. Biju Kumar A and Harishanker J Alappat (1995) A Complete Guide To Aquarium Keeping. Published by Books For All, New Delhi.
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12. Herbert R. and Leonard P. Schultz Axelrod (1955) Handbook of Tropical Aquarium Fishes, McGraw-Hill, 1955.
13. Joy P.J., George Abraham K., Aloysius M. Sebastian and Susan Panicker (Eds) (1998) Animal Diversity, Zoological Society of Kerala, Kottayam
14. Michael B. New; Alber G.J. Tacon (1994) Farm made aquafeeds FAO fisheries technical paper No.343, Rome, FAO. 1994
15. Nalina Sundari, M.S and Santhi, R (2006) Entomology. MJP Publishers
16. NPCS Board of Consultants & Engineers, Chennai.(2015) The complete book on Bee keeping and honey processing, 2nd Edition, NIIR Project consultancy services, 106- E kamala Nagar Delhi – 110007.
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OPEN COURSE (FOR OTHER STREAMS)

ZY5OPT02

2. PUBLIC HEALTH AND NUTR

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.

Diabetese, Cardiovasculard 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

Water borne dseases-Cholera and Typhoid.Prevention of Water borne diseases.

Food borne diseases and Prevention

Botulinum, Salmenellosis, 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:

1. Gladys Francis & Mini K.D., (Editors) (2012), Microbiology, Zoological Society of Kerala, Kottayam.
2. Greenberg, Jerol S and Dintiman George B (1997) Wellness Creating a life of Health and Fitness , London Allyn and Bacon Inc.
3. K Park, (2008) Park's Text Book of Preventive and Social Mediine 18th Edition. Banarasidass Bhenot Publication
4. Norman Bezzaant HELP First Aid for everyday emergencies. Jaico Publishing House, Bombay, Delhi

5. Tom Sanders and Peter Emery. (2004) Molecular basis of human nutrition: Taylor & Francis Publishers Ane Book
6. Pelczar M.J. Jr. E.C.S. Chane & N.R. Krieg, Microbiology (Concept & Applications). 5th edition. Tata McGraw Publishing Company Ltd.

SEMESTER V.

OPEN COURSE (FOR OTHER STREAMS)

ZY5OPT03

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 **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 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 **10 Hrs**

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** **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

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SEMESTER VI.

ZOOLOGY 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

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 **10Hrs**

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 Rerserve

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**

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ELECTIVE COURSE . ZY6CBT02

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 **5 Hrs**

Pest and crop loss: Introduction, historical perspective-origin of pest, Evolution of pest. Causes of pest outbreak- biotic, abiotic and genetic factors.Modern agricultural practices and pest problem - high yielding varieties, monoculture, fertilizers, pesticides, irrigation, and cultural practices.

Module II **15Hrs**

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.

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ELECTIVE COURSE. ZY6CBT03.

3. VECTOR AND VECTOR BORNE DISEASES

72 Hrs

3 Credits

Objectives:

Module I **10Hrs**

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 I1 **6 Hrs**

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

Module II1 **25 Hrs**

Study of Vector Borne disease[Life cycle and pathology]: Mosquito-borne diseases – Malaria, Dengue, Chikungunya, Filariasis. Sand fly-borne diseases – Leishmaniasis, Phlebotomus fever. Tse- tse fly – sleeping sickness. House fly borne diseases :typhoid fever, cholera, dysentery, anthrax, Myiasis, . Flea-borne diseases – Plague, Typhus fever. Louse-borne diseases –Relapsing fever, Trench fever, Vagabond's disease, Phthiriasis.

Module IV **13 Hrs**

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

ModuleV

8Hrs

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**

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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**

Understanding of health: Define health, basic concepts, dimensions of health, basic parameters of health care. (Health Parameters: Individual normal standards, devices.1. Blood pressure, 2. Brain activities and sleep, 3.Focus or attention, 4.Pulse, 5. Body temperature, 6. Daily physical activities, 7. Electrocardiogram (ECG), 8.Cardiac fitness 9. Stress, 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

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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)

Semester	Code	Title of the Course	Hrs	Inst Hrs/week	Credit
1	ZY1CMT01	Non Chordate Diversity	36	2	2
1		Non Chordate Diversity (Practicals)	36	2	0
2	ZY2CMT02	Chordate Diversity	36	2	2
2		Chordate Diversity (Practicals)	36	2	0
2	ZY2CMP01	**Practical 1** Non Chordate Diversity + Chordate Diversity (Practicals)			2
3	ZY3CMT03	Physiology and Immunology	54	3	3
3		Physiology and Immunology (Practicals)	36	2	0
4	ZY4CMT04	Applied Zoology	54	3	3
		Applied Zoology (Practicals)	36	2	
4	ZY4CMPO2	**Practical 2** Physiology and Immunology + Applied Zoology (Practical)			2

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 **3 Hrs**

Phylum Porifera: Salient features (eg: Leucosolenia)

Phylum Coelenterata: Salient features and classification upto class.

Class 1: Hydrozoa (eg: Physalia)

Class 2: Schyphozoa (eg: Aurelia)

Class 3: Anthozoa (eg: Adamsia)

General Topic: Corals and Coral reefs.

Module III **6 Hrs**

Phylum Platyhelminthes: Salient features and classification up to class.

Class 1: Turbelleria (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: Aphasmida (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 **11 Hrs**

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: Astropecten)

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.)

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SEMESTER I

COMPLEMENTARY COURSE 1 - PRACTCAL

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
3. T.S - Earthworm, T.S Fasciola
4. Dissection - Nervous system of Prawn
5. Dissection - Nervous system of Cockroach
6. Mounting - Prawn Appendages

SEMESTER II. ZY2CMTO2.

COMPLEMENTARY COURSE 2

CHORDATE DIVERSITY

36 Hrs
Credits 2

Objectives

1. To make the student observe the diversity in chordates and their systematic position.
2. To make the a student ware 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: Ascidiacea (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 **14 Hrs**

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: Icthyophis)

Module IV **6 Hrs**

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: Icthyosaurus)

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 **6 Hrs**

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.

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SEMESTER II

COMPLEMENTARY COURSE 2- PRACTCAL

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

SEMESTER III. ZY3CMT03.

COMPLEMENTARY COURSE -3

PHYSIOLOGY AND IMMUNOLOGY

54 hrs
Credits 3

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

Respiration: Transport of respiratory gases in blood - transport of oxygen, transport of carbon dioxide, chloride shift. Respiratory disturbances – Hypoxia, Hypercapnia, Asphyxia, physiological effect of smoking, carbon monoxide poisoning.

Circulation: Composition and functions of blood. Plasma and formed elements - WBC, RBC and platelets, Mechanism of blood coagulation – clotting factors, intrinsic and extrinsic pathways, anticoagulants. ECG, Blood pressure, Arteriosclerosis, Heamophilia, cerebral and pulmonary thrombosis.

Module II **14 hrs**

Excretion: Structure of a nephron. Urine formation – glomerular filteration, tubular reabsorption, tubular secretion. Urine concentration – counter current mechanism. Composition of urine – normal and abnormal constituents. Hormonal regulation of kidney function. Kidney stone, dialysis.

Neuro physiology: 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**

Endocrinology: Introduction to Endocrine system. Mechanism of hormone action, Endocrine glands - hypothalamus, pituitary gland, pineal gland, thyroid gland, parathyroid gland, endocrine pancreas, adrenal gland, thymus gland, testis and ovary. Physiological role of hormones, Hormonal disorders.

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.

Immune disorders: Hypersensitivity, Auto immunity (rheumatoid arthritis) & Immunodeficiency (AIDS), Vaccines - BCG, DPT, Polio vaccine.

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SEMESTER III

COMPLEMENTARY COURSE - 3 PRACTCAL

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
Credits 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 **24 Hrs**

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 **12 Hrs**

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

Module III **6 Hrs**

Vermiculture: Species of earthworms, ecological classification of earthworms, life cycle and reproduction of earthworm. Physical & chemical effects of earthworms on soil, Vermicomposting – site selection, preparation of pit, maintenance, monitoring and harvesting of vermicompost.

Module IV **12Hrs**

Apiculture: Species of honey bees, organization of honey bee colony. Bee keeping methods and equipments. Apiary management and maintenance. Bee pasturage, byproducts of honey bees and their uses. Diseases, pests of honey bees and control measures.

References:

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SEMESTER IV

COMPLEMENTARY COURSE - 4 PRACTCAL

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)

Semester	Course No.	AQUACULTURE	FOOD MICROBIOLOGY	MEDICAL MICROBIOLOGY
1	I	Principles and Methods in Aquaculture	General Microbiology	Fundamentals of Microbiology
1	II	Hatchery and Culture Techniques	Biological Techniques	Basics of Microbial Physiology & Genetics
1	Practical - I	Principles and Methods in Aquaculture & Hatchery and Culture Techniques	General Microbiology & Biological Techniques	Fundamentals of Microbiology and Basics of Microbial Physiology & Genetics
2	III	Capture Fishery	Microbial physiology & Genetics	Parasitology
2	IV	Biology of Fishes	Applied Microbiology	Medical Virology
2	Practical - II	Capture Fishery & Biology of Fishes	Microbial physiology Genetics &Applied Microbiology	Parasitology & Medical Virology
3	V	Fisheries Environment	Dairy Microbiology	Medical Mycology
3	Practical - III	Fisheries Environment	Dairy Microbiology	Medical Mycology
3	VI	Fish Nutrition	Industrial Microbiology	Diagnostic Microbiology
3	Practical - IV	Fish Nutrition	Industrial Microbiology	Diagnostic Microbiology
4	VII	Reproductive Physiology and Endocrinology	Basic Food Micro biology	Medical Bacteriology
4	Practical - V	Reproductive Physiology and Endocrinology	Basic Food Micro biology	Medical Bacteriology
4	VIII	Microbiology, Pathology and Post Harvest Technology	Food Microbiology and Fermented Food	Clinical Microbiology

4	Practical - VI	Microbiology, Pathology and Post Harvest Technology	Food Microbiology and Fermented Food	Clinical Microbiology

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

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English - 1	Common Course	5	4	1	4
2		Second Language – 1	Common Course	5	4	1	4
3	ZY1CRT01	General perspectives in Science & Protistan Diversity	Core Course I : Theory	2	2	1	4
4		General perspectives in Science & Protistan Diversity	Core Course I : Practical	2	0	0	0
5		Principles and Methods in Aquaculture (A) / General Microbiology (F)/Fundamentals of Microbiology(M)	Vocational Course I : Theory	2	2	1	4
6		Hatcery & Culture techniques (A) / Biological technique (F)/Basics of Microbial physiology & Genetics (M)	Vocational Course II:	2	2	1	4
7		Principles and Methods in Aquaculture, Hatchery and Culture techniques (A)/ General	Vocational Course : Practical	2	0	0	0

		Microbiology and Biological technique (F)/Fundamentals of Microbiology,Basics of Microbial physiology &Genetics(M)					
8		Complementary Course – I	Complementary Course: Theory	3	2		
9		Practical	Practical	2	0		
Total				**25 hrs**	**16**		

SEMESTER II

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English 2	Common Course	5	4	1	4
2		Second Language -2	Common Course	5	4	1	4
3	ZY2CRT02	Animal Diversity- Non Chordata	Core Course II : Theory	2	2	1	4
4	ZY2CRP01	Animal Diversity – Non Chordata	Core Course II : Practical	2	2	1	4
5		Capture Fishery (A) /Microbial physiology & Genetics(F)/Parasitology (M)	Vocational Course III : Theory	2	2	1	4
6		Biology of Fishes (A) / Applied Microbiology (F)/Medical virology(M)	Vocational Course III : Theory	2	2	1	4
7		Capture Fishery &Biology of Fishes(A)/Microbial physiology &Applied Microbiology(F)/Parasitology&MedicalVirology (M)	Vocational Course IV : Practical	2	2	1	4
8		Complementary Course – II	Complementary Course: Theory	3	2		
9		Practical	Practical	2	2		

Total	**25 hrs**	**22**	

SEMESTER III

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English 3	Common Course	5	4	1	4
2	ZY3CRT03	Animal Diversity – Chordata	Core Course III : Theory	3	3	1	4
3		Animal Diversity- Chordata	Core Course III : Practical	2	0	0	0
4		Fisheries Environment (A) / Dairy Microbiology (F) / Medical mycology(M)	Vocational Course V : Theory	2	2	1	4
5		Fisheries Environment (A) / Dairy Microbiology (F) / Medical mycology(M)	Vocational Course : Practical	3	0	0	0
6		Fish nutrition (A) / Industrial Microbiology (F)/ Diagnostic Microbiology (M)	Vocational Course VI : Theory	2	2	1	4
7		Fish nutrition (A) / Industrial Microbiology (F)/Diagnostic Microbiology	Vocational Course : Practical	3	0	0	0
8		Complementary Course – III	Complementary Course: Theory	3	3	1	4
9		Practical	Practical	2	0	0	0
Total				**25 hrs**	**14**		

SEMESTER IV

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English - 4	Common Course	5	4	1	4
2	ZY4CRT04	Research methodology, Biophysics & Biostatistics	Core Course IV : Theory	3	3	1	4
3	ZY4CRP02	Research methodology, Biophysics & Biostatistics	Core Course IV : Practical	2	2	1	4
4		Reproductive Physiology and Endocrinology (A)/ Medical Bacteriology (M) / Basic Food Microbiology (F)	Vocational Course VII : Theory	2	2	1	4
5		Reproductive Physiology and Endocrinology (A)/ Medical Bacteriology (M) / Basic Food Microbiology (F)	Vocational Course : Practical	3	4	1	4
6		Microbiology , Pathology and Post Harvest Technology (A)/ Clinical Microbiology (M) / Food Microbiology and Fermented Food (F)	Vocational Course VIII : Theory	2	2	1	4
7		Microbiology , Pathology and Post Harvest Technology (A)/ Clinical Microbiology (M) / Food Microbiology and Fermented Food (F)	Vocational Course : Practical	3	4	1	4
8		Complementary Course – IV	Complementary Course: Theory	3	3	1	4
9		Practical	Practical	2	2	1	4
Total				**25 hrs**	**26**		

SEMESTER V

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZY5CRT05	Environmental Biology & Human rights	Core Course V : Theory	3	3	1	4
2	ZY5CRPO5	Environmental Biology & Human rights	Core Course V : Practical	2	0	0	0
3	ZY5CRT06	Cell Biology & Genetics	Core Course VI : Theory	3	3	1	4
4	ZY5CRPO6	Cell Biology & Genetics	Core Course VI : Practical	2	0	0	0
5	ZY5CRT07	Evolution, Ethology & Zoogeography	Core Course VII : Theory	3	3	1	4
6	ZY5CRPO7	Evolution, Ethology & Zoogeography	Core Course VII : Practical	2	0	0	0
7	ZY5CRT08	Human Physiology, Biochemistry & Endocrinology	Core Course VIII : Theory	3	3	1	4
8	ZY5CRPO8	Human Physiology, Biochemistry & Endocrinology	Core Course VIII : Practical	2	0	0	0
9	ZY5OPT01	1 – Vocational Zoology (Apiculture, Vermiculture, Ornamental fish culture)	Open Courses for other streams *(Select any one out of three)*	4	3	1	4
	ZY5OPT02	2 – Public health and Nutrition					
	ZY5OPT03	3 – Man, nature & Sustainable Development					
10		Group activity and Field Study - Report to be submitted in 6th Semester along with Project and Practical Exam		1	0		
Total				**25 hrs**	**15**		

Semester VI

No.	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZY6CRT09	Developmental Biology	Core Course IX : Theory	3	3	1	4
2	ZY6CRP09	Developmental Biology	Core Course IX : Practical	2	2	1	4
3	ZY6CRT10	Microbiology & Immunology	Core Course X : Theory	3	3	1	4
4	ZY6CRP10	Microbiology & Immunology	Core Course X : Practical	2	2	1	4
5	ZY6CRT11	Biotechnology, Bioinformatics and Molecular Biology	Core Course XI : Theory	3	3	1	4
6	ZY6CRP11	Biotechnology, Bioinformatics and Molecular Biology	Core Course XI : Practical	2	2	1	4
7	ZY6CRT12	Occupational Zoology (Aquaculture, Apiculture, Vermiculture & Quail farming)	Core Course XII : Theory	3	3	1	4
8	ZY6CRP12	Occupational Zoology (Aquaculture, Apiculture, Vermiculture & Quail farming)	Core Course XII : Practical	2	2	1	4
9	ZY6CBT01	Elective 1: Ecotourism & Sustainable Development	Choice Based Core Elective Courses *(Select any one out of four)*	4	3	1	4
	ZY6CBT02	Elective 2: Agricultural pest management					
	ZY6CBT03	Elective 3: Vector & Vector borne Diseases					
	ZY6CBT04	Elective 4: Nutrition, Health & life style management					
10	ZY6CRPRP	Project Work	Project	1	2		
11		OJT (On Job Training for 14 days)	OJT		2		
Total				**25 hrs**	**27**		

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 work place 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 OJT in their respective vocational subject related field.

C. SCHEME OF EXAMINATION - VOCATIONAL SUBJECTS

Semester	Course	Weightage ratio			
		Theory		Pract.	
		Ext.	Int.	Ext.	Int.
1	1	4	1	4	1
1	2	4	1		
2	3	4	1		
2	4	4	1		
3	5	4	1	4	1
3	6	4	1		
4	7	4	1	4	1
4	8	4	1		

i. SCHEME OF EXAMINATION - THEORY
(VOCATIONAL SUBJECT – AQUACULTURE)

Semester	Code	Course No.	Course	Hrs	Internal External ratio	
					Internal	External
1	ZA1VOT01	1	Principles and Methods in Aquaculture	3	1	4
1	ZA1VOT02	2	Hatchery and Culture Techniques	3	1	4
2	ZA2VOT03	3	Capture Fishery	3	1	4
2	ZA2VOT04	4	Biology of Fishes	3	1	4
3	ZA3VOT05	5	Fisheries Environment	3	1	4
3	ZA3VOT06	6	Fish Nutrition	3	1	4
4	ZA4VOT07	7	Reproductive Physiology and Endocrinology	3	1	4
4	ZA4VOT08	8	Microbiology, Pathology and Post Harvest Technology.	3	1	4

SCHEME OF PRACTCAL

EXAMINATION (AQUACULTURE)

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

Semester	Code	Course	Exam duration	Internal External ratio	
				Internal	External
2	ZA2VOP01	**Practical 1 & 2** Principles and Methods in Aquaculture, Hatchery and Culture Techniques & Capture Fishery and Biology of Fishes	3 hrs	1	4
4	ZA4VOP02	**Practical 3 & 4** Fisheries Environment & Fish nutrition.	3 hrs	1	4
	ZA4VOP03	**Practical 5 & 6** Reproductive physiology, Endocrinology& Microbiology, Pathology and Post Harvest	3 hrs	1	4

		Technology			

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

Semester	Code	Course No.	Course	Hrs	Internal External ratio	
					Internal	External
1	ZF1VOT01	1	General Microbiology	3	1	4
1	ZF1VOT02	2	Biological Techniques	3	1	4
2	ZF2VOT03	3	Microbial Physiology & Genetics	3	1	4
2	ZF2VOT04	4	Applied Microbiology	3	1	4
3	ZF3VOT05	5	Dairy Microbiology	3	1	4
3	ZF3VOT06	6	Industrial Microbiology	3	1	4
4	ZF4VOT07	7	Basic Food Microbiology	3	1	4
4	ZF4VOT08	8	Food Microbiology and Fermented Food	3	1	4

SCHEME OF PRACTICAL EXAMINATION (FOOD MICROBIOLOGY)

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

Semester	Code	Course	Exam duration	Internal External ratio	
				Internal	External
2	ZF2VOP01	**Practical 1 & 2** General Microbiology & Biological Techniques,Microbial Physiology, Genetics & Applied Microbiology	3 hrs	1	4

4	ZF4VOP02	**Practical 3 & 4** Dairy Microbiology & Industrial microbiology	3 hrs	1	4
	ZF4VOP03	**Practical 5 & 6** Basic Food Microbiology, Food Microbiology and Fermented Food	3 hrs	1	4

iii. SCHEME OF EXAMINATION - THEORY (VOCATIONAL SUBJECT – MEDICAL MICROBIOLOGY)

Sem.	Code	Course No.	Course	Hrs	Internal External ratio	
					Internal	**External**
1	ZF1VOT01	1	Fundamentals of Microbiology	3	1	4
1	ZF1VOT02	2	Basics of Microbial Physiology & Genetics	3	1	4
2	ZF2VOT03	3	Parasitology	3	1	4
2	ZF2VOT04	4	Medical Virology	3	1	4
3	ZM3VOT05	5	Medical Mycology	3	1	4
3	ZM3VOT06	6	Diagnostic Microbiology	3	1	4
4	ZM4VOT07	7	Medical Bacteriology	3	1	4
4	ZM4VOT08	8	Clinical Microbiology	3	1	4

SCHEME OF PRACTICAL EXAMINATION (MEDICAL MICROBIOLOGY)

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

Sem.	Code	Course	Exam duration	Internal External ratio	
				Internal	**External**

2	ZF2VOP01	**Practical 1 & 2** Fundamentals of Microbiology, Basics of Microbial Physiology & Genetics, Parasitology & Medical virology	3 hrs	1	4
4	ZM4VOP02	**Practical 3 & 4** Medical Mycology & Diagnostic Microbiology	3 hrs	1	4
	ZM4VOP03	**Practical 5 & 6** Medical Bacteriology and Clinical Microbiology	3 hrs	1	4

d. SCHEME OF DISTRIBUTION OF HOURS AND CREDITS
(VOCATIONAL SUBJECT – AQUACULTURE)

Semester	Code	Course No.	Title of vocational course	Hrs	Inst. Hrs/Wk	Credit
1	ZA1VOT01	1	Principles and Methods in Aquaculture	36	2	2
1	ZA1VOT02	2	Hatchery and Culture Techniques	36	2	2
1		Practical -1	Principles and Methods in Aquaculture, Hatchery and Culture Techniques.	36	2	0
2	ZA2VOT03	3	Capture Fishery	36	2	2
2	ZA2VOT04	4	Biology of Fishes	36	2	2
2	ZA2VOP01	Practical - 2	Capture Fishery and Biology of Fishes	36	2	2
3	ZA3VOT05	5	Fisheries Environment	36	2	2
3		Practical - 3	Fisheries Environment	54	3	0
3	ZA3VOT06	6	Fish Nutrition	36	2	2
3		Practical - 4	Fish Nutrition	54	3	0
4	ZA4VOT07	7	Reproductive Physiology and Endocrinology	36	2	2
4	ZA4VOP02	Practical – 5	Reproductive Physiology and Endocrinology	54	3	4
4	ZA4VOT08	8	Microbiology, Pathology and Post Harvest Technology.	36	2	2
4	ZA4VOP03	Practical - 6	Microbiology, Pathology and Post Harvest Technology	54	3	4
			TOTAL		**32**	**26**

SCHEME OF DISTRIBUTION OF HOURS AND CREDIT
(VOCATIONAL SUBJECT –
FOOD MICROBIOLOGY)

Semester	Code	Course No.	Title of vocational course	Hrs	Inst. Hrs/Wk	Credit
1	ZF1VOT01	1	General Microbiology	36	2	2
1	ZF1VOT02	2	Biological Techniques	36	2	2
1		Practical -1	General Microbiology & Biological Techniques	36	2	0
2	ZF2VOT03	3	Microbial Physiology & Genetics	36	2	2
2	ZF2VOT04	4	Applied Microbiology	36	2	2
2	ZF2VOP01	Practical - 2	Microbial physiology, Genetics & Applied Microbiology	36	2	2
3	ZF3VOT05	5	Dairy Microbiology	36	2	2
3		Practical - 3	Dairy Microbiology	54	3	0
3	ZF3VOT06	6	Industrial Microbiology	36	2	2
3		Practical - 4	Industrial Microbiology	54	3	0
4	ZF4VOT07	7	Basic Food Microbiology	36	2	2
4	ZF4VOP02	Practical – 5	Basic Food Microbiology	54	3	4
4	ZF4VOT08	8	Food Microbiology and Fermented Food	36	2	2
4	ZF4VOP03	Practical - 6	Food Microbiology and Fermented Food	54	3	4
			TOTAL		**32**	**26**

SCHEME OF DISTRIBUTION OF HOURS AND CREDIT
(VOCATIONAL SUBJECT – MEDICAL MICROBIOLOGY)

Semester	Code	Course No.	Title of vocational course	Hrs	Inst. Hrs/Wk	Credit
1	ZF1VOT01	1	Fundamentals of Microbiology	36	2	2
1	ZF1VOT02	2	Basics of Microbial Physiology & Genetics	36	2	2
1		Practical -1	Fundamentals of Microbiology, Basics of Microbial Physiology & Genetics	36	2	0
2	ZF2VOT03	3	Parasitology	36	2	2
2	ZF2VOT04	4	Medical Virology	36	2	2
2	ZF2VOP01	Practical - 2	Parasitology &Medical Virology	36	2	2
3	ZM3VOT05	5	Medical Mycology	36	2	2
3		Practical - 3	Medical Mycology	54	3	0
3	ZM3VOT06	6	Diagnostic Microbiology	36	2	2
3		Practical - 4	Diagnostic Microbiology	54	3	0
4	ZM4VOT07	7	Medical Bacteriology	36	2	2
4	ZM4VOP02	Practical – 5	Medical Bacteriology	54	3	4
4	ZM4VOT08	8	Clinical Microbiology	36	2	2
4	ZM4VOP03	Practical - 6	Clinical Microbiology	54	3	4
			TOTAL		**32**	**26**

e. SYLLABUS
(VOCATIONAL SUBJECTS)

– MODEL II

THEORY & PRACTICAL

1. AQUACULTURE

SEMESTER 1

VOCATIONAL COURSE 1

PRINCIPLES AND METHODS IN AQUACULTURE

36 Hrs
Credits 2

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. The 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**

Integrated farming – The concept of recycling of organic waste for maximum production. Rice cum fish culture. Culture practices of duck cum fish, poultry cum fish and pig cum fish culture. Sewage fed Fish Culture.

Module 3 **7 Hrs**

Site selection parameters for a pond site. Soil quality parameters –physical, soil type, porosity, percolation, shear strength, rate of compassion etc. Chemical –salinity, pH, nutrients, toxic gases etc. Water quality parameters-Chemical- salinity, pH, dissolved oxygen, Carbon dioxide, Nutrients, Ammonia. Physical – Temperature, suspended solids, . Biological parameters-presence of juveniles/seedlings, predators/ competitors, plankton, nekton .

Module 4 **10 Hrs**

Pond construction – Selection of site. Preparation of bunds and dykes. Calculation of earth works, sluice gates- Different types and fixing of sluice gates.**Pond preparation**-Drying, elimination of pests and predators. Preparation of nursery and stocking ponds.Manuring, Production of plankton. Stocking and acclimatization. Use of hapa. Stocking density. Harvesting and Harvesting methods

Module 5 **10 Hrs**

Fresh water cultivable fishes and their external characters-Indian Major Carps, Catfish, Eel, Tilapia, Etroplus, 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.

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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 Practices of major groups of finfishes. Indian Major Carps- Nursery, Rearing and stocking ponds. Preparation of ponds. Stocking and post stocking management. Harvesting.

Culture of air breathing fishes(eg. Channa) .

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.

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

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5. Hand book on Indian sea cucumbers.

6. CMFRI Spl Publn: No. 59, 48 pp, 1994Manual of Freshwater Aquaculture
R.Santhanam,N.Sukumaran& P. Natarajan, (1990)
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Editors : James Lester and Arlo .W. Fast.

8. MPEDA - A Manual on Shrimp Farming

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11. Matsya Alankar ’99 Souvenier .Department of Fisheries,Government of Kerala &Matsyafed.

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CMFRI. Bulletin No: 38, 1987

14. Seaweed resources of India
CMFRI Bulletin, No. 41, 1987

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**

Craft and gear-Types of fishing craft in India –Traditional, Motorised and Mechanized. Classification of fishing gear. Fishing gear material- Synthetic and natural. Properties of fishing gear, floats, sinkers and accessories. Major fishing gears and their operation. Static gear –Gill nets, Long line and Fish traps. Mobile gear-Drag nets-Trawl nets. Seine nets-Purse seine,Shore seines.

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**

Fishery management- Concept of population, Yield and Recruitment. Factors affecting fish stocks. Population dynamics. Problems of over fishing- Growth overfishing and Recruitment overfishing.Fishery. Management practices- Input and output controls. Maximum Sustainable Yield.

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SEMESTER II

VOCATIONAL COURSE 4

BIOLOGY OF FISHES

36 hrs
Credits 2

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**

Excretion, osmotic and ionic regulation in marine and freshwater fishes. Swimming activity. Types of locomotion- Anguilliform, Carangiform and Ostraciform. Muscles in locomotion. Parental care, Social behaviour- Aggregation and shoaling. Migration of fishes.

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**

Growth of fishes- Absolute and relative growth, isometric growth and allometric growth. The cube law. Methods for determination of growth checks. Length frequency analysis. Analysis of growth using hard parts like scales, otoloiths and vertebrae. Estimation of growth by direct methods. Marking and tagging of fish for growth studies. Methods of studying reproduction- Maturity Stages, Gonadosomatic Index, Ova Diameter Frequency studies. Detemination of size at first maturity and spawning season, Fecundity and its determination.

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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 **5 Hrs**

Habitat Ecology. Freshwater Habitat- Lentic (Pond, Lake), Lotic (Riffles, Pools). Marine Habitat- Zonation, Biota and adaptations. Principles of limiting factors- Shelford's law of tolerance, Liebig's law of minimum, Combined concept. Ecological succession and Ecological indicators. Photosynthetic and saprophytic food chain.

Module 2

10 Hrs

Basic marine metereology- weather, air-sea interactions. Monsoons, seasonal changes, Circulation of water masses, Waves, Tides and sediment transportation.

Module 3 **7 Hrs**

Physical and chemical parameters of Aquatic environments- temperature, salinity, oxygen, nutrition, Microelements and Macroelements. Phytoplankton and primary production- Methods of Estimation (Dark and Light bottle method, C14 Method, Chlorophyll Technique). Estimation of Zooplankton and secondary production.

Module 4

4 Hrs

Ecology of estuaries and mangroves- Soil , Water and Biota. Biogeochemical cycles- Nitrogen, Phosphorus and Sulphur cycle.

Module 5

10 Hrs

Ancillary marine resources-Sea weeds, corals, Echinoderms and their commercial importance. Aquatic pollution- Causes and Remedial Measures. Instruments used for Biological sampling- Plankton International Indian Ocean Expedition Net, Hardy's continuous plankton recorder), Nekton (Isaac Kidd's Midwater trawl), Benthos (Dredges, Grabs, Agassiz trawl). Fish finding devices- Echo sounder, Sonar and net sonde . Remote sensing techniques and application.. Satellite remote sensing of fish stocks- Ocean colour maps, Sea surface Temperature Contour Maps. Potential Fishing Zone (PFZ). Deep Scattering or Sonic Scattering Layer.

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SEMESTER III

VOCATIONAL COURSE 6

FISH NUTRITION

36 hrs
Credits 2

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 **5 Hrs**

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 **8 Hrs**

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**

Factors affecting digestibility, Nitrogen balance index, Food additives- Binders, Antioxidants, Chemo-attractants and feeding stimulants, Pigments, Antimicrobial agents and Anabolic agents. Non conventional feed stuffs. Food growth equation. Feed ingredients of plant and animal origin.

Module 4 **5 Hrs**

Feed preparation techniques. Factors affecting the energy requirement of fish. Non nutrient constituents of the diet. Measurement of calorific value- Component Analysis, Wet oxidation, Bomb Calorimetry. Types of feeds (Wet, Moist and Dry feeds-advantages and disadvantages) Larval feeds- Minced diets, Microparticulate diets, Spray dried diets,Microbound diets, Microcoated diets and Microencapsulated diets.

Module 5 **10 Hrs**

Growth promoters. Principles of feed formulation (Pearson's Square and Linear programming). Different systems of fish feeding or Fish feeding devices. Equipments used in Feed mills- Weighing Scales, Grinders, Mincers, Mixers, Elevators, Extruders, Coolers/Dryers, Fat sprayer, Crumbler, Sifter and Bag seamer. Food Conversion Ratio and Food efficiency ratio. Economics of feed preparation.

References

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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**

Reproductive systems and Sexual dimorphism in fish, crab and prawn. Types of reproduction- Viviparity, ovoviviparity, oviparity in Teleosts and Elasmobranchs. Classification of maturity stages of ovary and testes in fishes and prawns. Oogenesis and spermatogenesis in fishes. Hermaphroditism- different types. Sex reversal and sex determination in fishes.

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 maturationin 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 fishes. Principles and methods ofcryopreservation of gametes.

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

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Chapter 19- Principles of Biological cryopreservation.
Chapter 20- Live preservation of fish gametes.

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Vol. I. Metabolism and growth

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(1969). Vol 3. Reproduction and Growth, Bioluminiscence, Pigments and Poisons.
(1983). Vol. 9. Part A. Reproduction, Endocrine tissues and hormones.
(1983). Vol.9. Part B. Reproductive Behaviour and Fertility control.

21. Hoar.W.S. (1966). General and Comparative Physiology. Prentice-Hall

22. Yadav.B.N. (1995). Fish endocrinology.Daya Books.

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**

Processing and Preservation of fish – Chilling and Freezing- Slow freezing, and quick freezing-critical temperature. Freezer burn, thawing, drip loss and glazing. Types of Freezers- Plate Freezer, Tunnel (Air Blast) Freezer, Immersion Freezer, Fluidised bed Freezer (IQF), Cryogenic Freezing, Accelerated Freeze drying , Irradiation. Canning- Principle and Procedure. Common defects in canning- Struvite formation, Panelling, Flipper, Springer, Soft swell and Hard swell.

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**

Diseases of fin fishes and prawns.-Protozoan, Bacterial, viral, fungal, Crustacean, Leech, Helminth diseases. Symptoms and Remedial measures. Nutritional deficiency diseases - Pin head, Rickets, Soft Shell Syndrome, Lipoid hepatic degeneration, Vitaminosis A. Hazard analysis and critical control points in seafood industry.

References

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9. Srivastava.C.B.L (2006). *A text book of Fishery Science and Indian Fisheries*. Kitab Mahal.

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11. Snieszko.S.F. and Herbert.R.Axelrod. (1970). *Diseases of Fishes*. T.F.H.Publications.

AQUACULTURE PRACTICALS

ZA1V02U (P) PRINCIPLES AND METHODS IN AQUACULTURE, HATCHERY AND CULTURE TECHNIQUES

36 hrs **Credit 1**

1. Identification and major biological characteristics of cultivable organisms
2. Gut content analysis.
3. Study of common weed and predatory fishes in aquaculture ponds
4. Study of aquatic insects and aquatic weeds.
4. Identification of different larval stages and hatchery operations of prawn
6 Setting up and keeping of aquariums
7 Visit to carp and prawn hatcheries.

SEMESTER II

ZA2V04U (P) PRACTICAL – II CAPTURE FISHERY & BIOLOGY OF FISHES

36 Hrs **Credit 1**

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
6. Gill structure- Herbivorous, carnivorous and omnivorous fishes.
7. Gill structure of a prawn - Dissection
8. Molluscs- Study of morphology, and Dissection of Gills of bivalves
9. Visit to marine fish landing centre.

SEMESTER III

ZA3V05U(P) 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

ZA3V06U (P) 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

ZA4V07U(P) PRACTICAL – V REPRODUCTIVE PHYSIOLOGY AND ENCOCRINOLOGY

54 Hrs **Credit 2**

1. Dissection of reproductive organs of Teleost fish.
2. Dissection of reproductive organs of Prawn and Crab.
3. Eyestalk ablation technique and electrocautery apparatus(Demonstration)
4. Methods of hormone injection in fish.
5. Observation of larval and embryonic stages in fish egg development.
6. Estimation of maturity stages and fecundity in fish
7. Equipments used in cryopreservation (Cryocan, French straws etc)

SEMESTER IV

ZA4V08U(P) PRACTICAL – VI MICROBIOLOGY , PATHOLOGY AND POST HARVEST TECHNOLOGY

54 Hrs **Credit 2**

1. Sterilisation techniques, preparation of culture media (TGBE and Nutrient Agar Media), nutrient agar slants, staining techniques.(Gram staining)
2. Determination of total plate count
3. Types of bacterial colonies
4. Instruments used in bacteriological Studies (Inoculation chamber, Autoclave, Colony counter etc.)
5. Examination of internal and external organs of diseased fish and shell fishes.
6. Identification of parasites in fishes and shell fishes.
7. Materials used in fish processing and packaging (Cans, Retortable pouches etc.)

ZOOLOGY - MODEL II

VOCATIONAL SUBJECT:
2. FOOD MICROBIOLOGY
SYLLABUS -
THEORY & PRACTICALS

SEMESTER 1

ZF1VOT01 - VOCATIONAL COURSE 1

GENERAL MICROBIOLOGY

36 Hrs

2 Credits

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, Srtucture of TMV.Viral multiplication-lytic and lysogenic cycle.

Module IV **5 Hrs**

General characters, Morphology and fine structure of of fungi.

Module IV **3 Hrs**

General characters of algae and protozoa

References

1. Alcamo Fundamentals of microbiology, 5th Edition,.
2. Ananthanarayan&Paniker.Text book of Microbiology, 7th Edition, Orient Longman.
3. David Freifelder, Molecular biology, Narosa Publishing House
4. Jacquelyn G. Black, Microbiology: Principles and Explorations, 9th Edition, Willey Publication
5. M.J. Pelczar, E.C.S Chan & N.R. Kreig, Microbiology, 5th Edition, Tata McGraw Hill Edition.
6. Michael T. Madigan, Brock Biology of Microorganisms,13th Edition, Amazon Publication
7. R.P. Singh, Microbiology, 1st Edition, Kalyani Publishers.
8. GeraldJ.Tortora,Berdell.R.Funke,ChristineL.case,Microbiology–An Introduction.Pearson Publication.

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 **8 Hrs**

Specimen preparation for light microscopy – wet mount preparation, hanging drop method, smear preparation. Bacterial staining -simple staining, Differential staining:- Gram's staining, acid fast staining, Special staining:- capsule staining, spore staining, negative staining – Indian ink staining. Specimen preparation for Electron microscopy.

Module II **8 Hrs**

Microscopy: - light microscopy, bright field, Dark field, phase contrast microscopy, fluorescence, Electron microscopy- SEM, TEM, STEM, Newer techniques in microscopy- confocal, scanning probe microscopy.

Module III **8 Hrs**

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 **6 Hrs**

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

Module V **6 Hrs**

Chemotherapeutic agents-antibacterial-Antibiotic, antiviral-interferon, antifungal. Tests for antibiotics-Kirby bauer and tube dilution.

References

1. Janis Kuby, Immunology
2. Beacker&Deamer, The World of cell,
3. Benson, Microbiological application laboratory manual in general microbiology, 8th Edition, McGraw Hill Publication.
4. Jacquelyn G. Black, Microbiology: Principles and Explorations, 9th Edition, Willey Pub.
5. Joanne M. Willey, Prescott, Harley & Klein's Microbiology, 7th Edition by McGraw & Hill Pub.
6. M.A. Subramanian Biophysics principles and techniques, MJP Publishers
7. P.K. Bajpai, Biological instrumentation and methodology, S. Chand & Company
8. Upadhyay, Upadhyay, Nath, Biophysical Chemistry Principles & techniques, 4th Edition 2007, Himalaya Publishing House.
9. Gerald J.Tortora, Berdell.R. Funke, Christine L.case, Microbiology – An Introduction. Pearson Publication.

COURSE TITLE- GENERAL MICROBIOLOGY& BIOLOGICAL TECHNIQUES PRACTICAL 1

36 hrs **0 Credit**

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

1. Alcamo Fundamentals of microbiology, 5th Edition,.
2. Ananthanarayan&Paniker.Text book of Microbiology, 7th Edition, Orient Longman.
3. Ronald M. Atlas and Richard Bartha, Microbial ecology, Fundamentals & applications 4th edition, Pearson Publication.
4. GeraldJ.Tortora, Berdell.R.Funke, ChristineL.case, Microbiology – An Introduction. Pearson Publication

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.
3. R. P. Singh, Microbiology, KalyaniPublishers .
4. Joanne M. Willey, Prescott, Harley & Klein's Microbiology, 7th Edition by McGraw & Hill Publisher
5. Joseph C. Daniel, Environmental aspects of Microbiology, Bright Sun publication
6. Pelzar E. C. S. Chan and Noel R. Krieg Microbiology, Fifth edition, Michael.; Tata McGraw-Hill publishing company Ltd.
7. R.C.Dubey and D. K. Maheshwari, A Text book of microbiology, First Edition, S. Chand & company Ltd.

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**

Introduction, composition and properties of milk, Nutritional importance of milk. Milk processing sequences. Source of microorganism in milk. Classification of microorganism in milk , biochemical types, temperature characteristics and pathogenicity.

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

1. Blank F.C., Hand book of food nutrition
2. Elmer H. Marth ,Marth H. Marth , Elmer H. Marth -Applied Dairy Microbiology, Second Edition.
3. James M. Jay , Modern food microbiology, 4th ed.
4. Rameshwar Singh, S.K.Tomar&GunjanGoel, Applied Dairy and Food Microbiology Robinson -Dairy Microbiology Handbook, Third Edition: The Microbiology Of Milk And Milk Products .
5. Shakuntala N, Manay, M. Shadaksharaswamy, Food facts and Principles 2nd ed. New Age International publishers
6. 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

SEMESTER 3

ZF3VOT06 - VOCATIONAL COURSE 6

INDUSTRIAL MICROBIOLOGY

36 Hrs

2 Credits

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 & submerged), 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, lypohilization, 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,
3. L.E. Cesida, Industrial Microbiology, New Age International Publishers.
4. Michael J. Waites, Neil L. Morgan, John S. RockeyIndustrial Microbiology: An Introduction
5. Prescott, Harley & Klein Microbiology, 7th edition, Mac Graw Hill International edition.
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 Nostand Reinhold Company
3. M.R. Adams, M.O. Moss, Food microbiology, New Age International (P) Ltd. Publishers
4. Prescott, Harleg, Klein, Microbiology, 7th ed. Mac Graw Hill International edition.
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

SEMESTER 4

ZF4VOT08 - VOCATIONAL COURSE 8

FOOD MICROBIOLOGY AND FERMENTED FOODS

36 Hrs

2 Credits

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, Campylobactor, Listeria, Vibrio, E.coli and Streptococcus faecalis)* and intoxication (*Staphylococcus aureus* and *Clostridium botulinm*). 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.
3. M.R. Adams, M.O. Moss, Food microbiology, New Age International (P) Ltd.
4. Prescott, Harleg, Klein, Microbiology, 7th ed. Mac Graw Hill International edition.
5. W.C. Frazier and Westhoff, Food Microbiology
6. W.M. Foster, 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
ZM2V01U

COURSE II : Basics of Microbial Physiology & Genetics
ZM2V02U

Practical I : Fundamentals of Microbiology and Basics of Microbial Physiology & Genetics
ZM2V02U (P)

COURSE III : Parasitology
ZM2V03U
COURSE IV : Medical Virology
ZM2V04U
Practical II : Parasitology & Medical Virology
ZM2V04U (P)

COURSE V : Medical Mycology
ZM3V05U
COURSE VI : Diagnostic Microbiology
ZM3V06U
Practical III : Medical Mycology
ZM3V05U (P)
Practical IV : Diagnostic Microbiology
ZM3V06U (P)

COURSE VII : Medical Bacteriology
ZM4V07U
COURSE VIII : Clinical Microbiology
ZM4V08U
Practical V: Medical Bacteriology
ZM4V07U (P)
Practical VI : Clinical Microbiology
ZM4V08U (P)

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 Microbiobiology
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**

Microbial systematics –evolution of diverse microbial taxonomy as classification-taxonomic hierarchies- classical approach, numerical taxonomy, molecular based classification (16s rRNA-bacteria , Cytochrome oxidae I gene (COI), mitochondrial gene, ITS- in other protists **in brief**). Phylogenetic groups of bacteria- Archeae, Eukaryae-Bacterial taxonomy and nomenclature-Bergey's Manual

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**

Microscopy: - light microcopy, bright field, Dark field, phase contrast microscopy, fluorescence, Electron microscopy- SEM, TEM, STEM, Newer techniques in microscopy-

confocal, scanning probe microscopy, Specimen preparation for light microscopy – wet mount preparation, hanging drop method, smear preparation. Bacterial staining – types positive and negative staining, simple and differential staining,. Specimen preparation for electron microscopy.

References

Alcamo, Fundamentals of microbiology, 5th Edition,

Ananthanarayan & Panicker. Text book of Microbiology, 7th Edition, Orient Longman.

Jacquelyn G. Black, Microbiology: Principles and Explorations, 9th Edition, Willey Publication

Joanne M. Willey, Prescott, Harley & Klein's Microbiology, 7th Edition by McGraw & Hill Publisher

M.J. Pelczar, E.C.S Chan & N.R. Kreig, Microbiology, 5th Edition, Tata McGraw Hill Edition.

Michael T. Madigan, Brock Biology of Microorganisms, 13th Edition, Amazon Publication

R.P. Singh, Microbiology, 1st Edition, Kalyani Publishers.

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 O_2 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

Benson, Microbiological application laboratory manual in general microbiology, 8th Edition, McGraw Hill Publication.

Joanne M. Willey, Prescott, Harley & Klein's Microbiology, 7th Edition by McGraw & Hill Publisher

Jacquelyn G. Black, Microbiology: Principles and Explorations, 9th Edition, Willey Publication

M.A. Subramanian , Biophysics principles and techniques, MJP Publishers

Microbiology, 5th Edition, M. J. Pelczar, E.C.S Chan & N.R. Kreig, Tata McGraw Hill Edition

David Freifelder, Molecular biology, Narosa Publishing House

Michael T. Madigan, Brock Biology of Microorganisms, 13th Edition, Amazon Publication

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

Panicker's Text book of medical parasitology, 7th edition C.K.Jayaram Panicker, Jaypee brother's medical publishers (p) Ltd.

Park's text book of preventive and social medicine, 22nd edition, Banasirdas Bhanot Publishers

Subash C. Parija Text Book of Medical parasitology All India Publishers & Distributors Publisher

Monica Cheesbrough, Medical Laboratory manual for Tropical Countries Microbiology

Vol.I & II ELEBS.

SEMESTER II

COURSE IV MEDICAL VIROLOGY

36 Hrs **Credits2**

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**

Viruses- Introduction. General characteristics of Viruses, Morphology-Size, structure & shape. Chemical properties. Bacteriophage-structure. Classification and nomenclature of viruses. Viroids & Prions. Steps in replication of Viruses. One-step growth curve. Lytic and lysogenic cycle.

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, immunoflurescence. 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 Chikun gunya, 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

Ananthanarayan R. and C. K. J. Paniker. Text book of Microbiology, Sixth edition

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 parija textbook of practical microbiology, Ahuja Publishing House, First edition

SEMESTER III

COURSE V MEDICAL MYCOLOGY

36 Hrs

Credits2

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 versicolar, Tinea nigra, piedra (Black &White),*

Cutaneous- Dermatophytoses (Causative agent, pathogensesity, 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, Paracoccidioidomycoses, Coccidioidomycoses

MODULE IV **8 Hrs**

Opportunistic mycoses- Causative agent, pathogensesity, clinical features, lab diagnosis & treatment of - Aspergillosis, Penicilliosis, Zygomycoses (Mucor, Rhizopus). Candidiasis

References

Jagadish Chander Text book of Medical mycology

Ananthanarayan R. and C.K.J. Paniker. Text book of Microbiology, Sixth edition

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. H_2S 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**

Automated Methods for Diagnostic microbiology: Principles employed by common automated systems for detection and identification of viable pathogens - Turbidity as an indicator of growth, Colorimetric and pattern recognition methods for microbial identification – Vitek bacterial identification system, Flurophore- labelled/ oxidation-reduction substrate metabolism as indicator of growth & substrate utilization-Biolog identification, API 20 E strips, measurement of CO_2 as product of metabolic activity- BACTEC system, analysis of Fatty acid profile – using GLC-MIDI Sherloch Microbial Identification Systems, Bioluminescence assay, electrical impedance.

Module V **7 Hrs**

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

Paul G. Engelkirk, Janet L. Duben-Engelkirk Diagnosis of infectious diseases: Essentials of diagnostics

Practical IV DIAGNOSTIC MICROBIOLOGY
54 Hrs

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)
9. Widal (12 Hrs)
10. Demonstration of immunodiffusion method (4 Hrs)
11. Perform ASO (4 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 VII MEDICAL BACTERIOLOGY

36 hrs
Credits 2

Objectives

1 To develop a knowledge of medically important bacteria and their relevance of infectious diseases;
2.To understand the principles of prevention and treatment of pathogenic microorganism infection in humans.

Module I **6 Hrs**

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 **6 Hrs**

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*

Module III **12 Hrs**

Gram Negative Rods

Morphology, cultural& biochemical characteristics, antigenic properties, toxins/virulence factors(in brief), pathogenecity, 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

Ananthanarayan R. and C.K.J. Paniker. Text book of Microbiology, Sixth edition

Chakraborthy 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, Shigelllosis, *E. coli* gastroenteritis, Salmonellosis, Campylobacteriosis

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

Protozoan- Giardiasis, Amoebiasis

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

Ananthanaryanan R. and C.K.J. Paniker Text book of Microbiology, 9th edition, University Press (India) Pvt. Ltd. Publisher

Elmer W. Koneman Color Atlas & Textbook of Diagnostic Microbiology 5th edition, Lippincott Publication

Eugene W. Nester, Microbiology a Human perspective, 4th edition McGraw Hill 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

Practical VI CLINICAL MICROBIOLOGY

54 Hrs

1. Microbiology of laboratory safety (1Hr)
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

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English- *(From Board of studies - English)*	Common Course	5	4	1	4
2	ZB1CRT01	Introduction to Biological Sciences	Core Course 1 : Theory	2	2	1	4
3		Introduction to Biological Sciences	Core Course 1 : Practical	2	0	0	0
4	ZB1CRT02	Collection and Preservation of Biological Specimen 1 (Plants)	Core Course 2 : Theory	2	2	1	4
5		Collection and Preservation of Biological Specimen 1 (Plants)	Core Course 2 : Practical	2	0	0	0
6	ZB1CRT03	Collection and Preservation of Biological Specimen 2 (Animals)	Core Course 3 : Theory	2	2	1	4
7		Collection and Preservation of Biological Specimen 2 (Animals)	Core Course 3 : Practical	2	0	0	0
8		Biochemistry-1 (From Board of Studies“ Biochemistry)	Complementary I : Theory	2	2	1	4
9		Practical	Complementary I :	2	0	0	0

			Practical				
		Zoology -1 (From Board of Studies- Zoology)	Complementary II : Theory	2	2	1	4
		Practical	Complementary II : Practical	2	0	0	0
Total				**25 hrs**	**16**		

SEMESTER 2

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English *(From Board of studies – English*	Common Course	5	4	1	4
3	ZB2CRT04	General Biological Techniques	Core Course 4 : Theory	2	2	1	4
4		General Biological Techniques	Core Course 4 : Practical	2	2	1	4
5	ZB2CRT05	Teaching Laboratory Techniques	Core Course 5 : Theory	2	2	1	4
6		Teaching Laboratory Techniques	Core Course 5 : Practical	2	2	1	4
7	ZB2CRT06	Food Microbiology & Biotechnology	Core Course 6 : Theory	2	2	1	4
8		Food Microbiology & Biotechnology	Core Course 6 : Practical	2	2	1	4
8		Biochemistry-2 (From Board of Studies - Biochemistry)	Complementary I : Theory	2	2	1	4
9		Practical	Complementary I : Practical	2	2	1	4
		Zoology -2 (From Board Of Studies- Zoology**)**	Complementary II : Theory	2	2	1	4
		Practical	Complementary II : Practical	2	2	1	4
Total				**25 hrs**	**24**		

SEMESTER 3

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZB3CRT07	Physiology With Clinical Correlation	Core Course 7 : Theory	3	3	1	4
2		Physiology With Clinical Correlation	Core Course 7 : Practical	2	0	0	0
3	ZB3CRT08	Clinical Chemistry an Clinical Microbiology	Core Course 8 : Theory	3	3	1	4
4		Clinical Chemistry and Clinical Microbiology	Core Course 8 : Practical	2	0	0	0
5	ZB3CRT09	Tissue Culture and Gene Manipulation	Core Course 9 : Theory	3	3	1	4
6		Tissue Culture and Gene Manipulation	Core Course 9 : Practical	2	0	0	0
7		Biochemistry-3(From Board Of Studies“ Biochemistry)	Complementary I : Theory	3	3	1	4
8		Practical	Complementary I : Practical	2	0	0	0
9		Zoology -3 (From Board Of Studies Zoology	Complementary II : Theory	3	3	1	4
10		Practical	Complementary II : Practical	2	0	0	0
Total				**25 hrs**	**15**		

SEMESTER 4

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZB4CRT10	Radiology and Advanced Instrumentation Techniques	Core Course 10 : Theory	3	3	1	4
2		Radiology and Advanced Instrumentation Techniques	Core Course 10 : Practical	2	2	1	4
3	ZB4CRT10	Entrepreneurship Development and Marketing	Core Course 11 : Theory	3	3	1	4
4		Entrepreneurship Development and Marketing	Core Course 11 : Practical	2	2	1	4
5	ZY4CRT04	Research methodology,Biophysics & Biostatistics *(*Core Course IVof *Board of Studies - Zoology)*	Core Course 12 : Theory	3	3	1	4
6		Research methodology, Biophysics &Biostatistics	Core Course 12 : Practical	2	2	1	4
7		Biochemistry - 4 (From Board of Studies - Biochemistry)	Complementary I : Theory	3	3	1	4
8		Practical	Complementary I : Practical	2	2	1	4
9		Zoology - 4 (From Board of Studies – Zoology	Complementary II : Theory	3	3	1	4
10		Practical	Complementary II : Practical	2	2	1	4
Total				**25 hrs**	**25**		

SEMESTER 5

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZY5CRT05	Environmental Biology & Human rights	Core Course 13 : Theory	3	3	1	4
2	ZY5CRPO5	Environmental Biology & Human rights	Core Course 13 : Practical	2	0	0	0
3	ZY5CRT06	Cell Biology & Genetics	Core Course 14 : Theory	3	3	1	4
4	ZY5CRPO6	Cell Biology & Genetics	Core Course 14 : Practical	2	0	0	0
5	ZY5CRT07	Evolution, Ethology & Zoogeography	Core Course 15 : Theory	3	3	1	4
6	ZY5CRPO7	Evolution, Ethology & Zoogeography	Core Course 15 : Practical	2	0	0	0
7	ZY5CRT08	Human Physiology, Biochemistry & Endocrinology	Core Course 16 : Theory	3	3	1	4
8	ZY5CRPO8	Human Physiology, Biochemistry & Endocrinology	Core Course 16 : Practical	2	0	0	0
9	ZY5OPT01	1 – Vocational Zoology (Apiculture, Vermiculture, Ornamental fish culture)	Open Courses for other streams *(Select any one out of three)*	4	3	1	4
	ZY5OPT02	2 – Public health and Nutrition					
	ZY5OPT03	3 – Man, nature & Sustainable Development					
		Project work & Field Visit/Study Tour, Visit to research institutes , Group activity	Project work	1	0		
Total				**25 hrs**	**15**		

SEMESTER 6

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZY6CRT09	Developmental Biology	Core Course 17 : Theory	3	3	1	4
2	ZY6CRP09	Developmental Biology	Core Course 17 : Practical	2	2	1	4
3	ZY6CRT10	Microbiology & Immunology	Core Course 18 : Theory	3	3	1	4
4	ZY6CRP10	Microbiology & Immunology	Core Course 18 : Practical	2	2	1	4
5	ZY6CRT11	Biotechnology, Bioinformatics and Molecular Biology	Core Course 19 : Theory	3	3	1	4
6	ZY6CRP11	Biotechnology, Bioinformatics and Molecular Biology	Core Course 19 : Practical	4	2	1	4
7	ZY6CRT12	Occupational Zoology (Aquaculture, Apiculture, Vermiculture & Quail farming)	Core Course 20 : Theory	3	3	1	4
8	ZY6CRP12	Occupational Zoology (Aquaculture, Apiculture, Vermiculture & Quail farming)	Core Course 20 : Practical	2	2	1	4
9	ZY6CBT01	Elective 1: Ecotourism & Sustainable Development	Choice Based Core Elective Courses *(Select any one out of four)*	3	2	1	4
	ZY6CBT02	Elective 2: Agricultural pest management					
	ZY6CBT03	Elective 3: Vector & Vector bourne Diseases					
	ZY6CBT04	Elective 4: Nutrition, Health & life style management					
10	ZY6CRPRP	Project work & Field Visit/Study Tour, Visit to research institutes , Group activity	Project		1		
11	ZB6OJT01	OJT 64 Hours (MOC) + 36 hours (Tissue Culture training)	OJT		2		
Total				**25 hrs**	**25**		

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).

Semester	Code	Course	Exam duration	Marks-ratio		Credits
				Internal (I)	External (E)	
2	ZB2CRP01	**Practical 1** (Core 1 & 4)	3 hrs	1	4	2
	ZB2CRP02	**Practical 2** (Core 2 & 5)	3 hrs	1	4	2
	ZB2CRP03	**Practical 3** (**C**ore 3 & 6)	3 hrs	1	4	2
		Complimentary 1 Biochemistry	3 hrs	1	4	2
		Complimentary 2 Zoology	3hrs	1	4	2
4	ZB4CRP04	**Practical 4** (Core 7 & 10)	3 hrs	1	4	2
	ZB4CRP05	**Practical 5** (Core 8 & 11)	3 hrs	1	4	2
	ZB4CRP06	**Practical 6** (**C**ore 9 & 12)	3 hrs	1	4	2
		Complimentary 1 Biochemistry	3 hrs	1	4	2
		Complimentary 2 Zoology	3hrs	1	4	2
6	ZY6CRP03	**Practical 7** (**C**ore 13 & 17)	3 hrs	1	4	2
	ZY6CRP04	**Practical 8** (**C**ore 14 & 18)	3 hrs	1	4	2
	ZY6CRP05	**Practical 9** (**C**ore 15 & 19)	3 hrs	1	4	2
	ZY6CRP06	**Practical 10** (**C**ore 16 & 20)	3 hrs	1	4	2

b. SYLLABUS
THEORY & PRACTICALS

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

SEMESTER I

ZB1CRT01 - CORE COURSE 1
INTRODUCTION TO BIOLOGICAL SCIENCES

36 hrs

Credits 2

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 **6 Hrs**

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 **8 Hrs**

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 **10 Hrs**

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 **6 Hrs**

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

Module 5 **6 Hrs**

Nature and Scope of biology: Branches of biology- Botany, Zoology, Cell biology, Molecular biology, Developmental biology, Marine biology, Ecology, Physiology, Anatomy, Morphology, Genetics, Biochemistry, Microbiology, Biotechnology

Rferences

1. Debbies Holmes, Peter Moody and Diana Dine (2006) Research methods for the Biosciences. International student Edition: Oxford University Press. P. 288-299.
2. Bowler Peter J. And Iwan Rhys Morus (2005) Making Modern Science: A Historical Survey. University of Chicago Press, Chicago, IL:
3. N. Campbell and J. Reece (2005) Principles of Biology: Interactive textbook from Nature Education Biology: 7th edition, Pearson, Benjamin,Cummings
4. Chakrabarti B K, Ghosh H N & Sahana S N (1984): Human Physiology, The New Book Stall, Calcutta, India
5. Ernst Mayr (1982) The Growth of Biological Thought: Diversity, Evolution and Inheritance.Published by Harvard University Press.
6. Ernst Myer. (1997). This is Biology: The Science of the living World.University Press, Hyderabad, India
7. Kuhn, Thomas. (1996) The Structure of Scientific Revolutions3rd ed.: University of Chicago Press, Chicago, IL
8. Knudsen, J.W (1966)*Biological Techniques* Harper InternationalEdition by Harper & Row
9. Marie, M (2005) Animal Bioethics: Principles and Teaching Methods Wageningen Academic Publishers
10. D.E. Metzler (2003) Biochemistry: The chemical reactions of living cells: Volumes I & II, 2nd edition, Academic Press
11. Roger Eckert; D Randall; George Augustine (1988) *Animal Physiology, Mechanism and Adaptations*, W.H Freeman, NewYork
12. Taylor et al., (2008) Biological Science Cambridge University Press,
13. Thomas, A.P (2009) Biology – Perspectives and Methods. Green Leaf Publishers, Kottayam.
14. K. Vijayakumaran Nair & Biju Dharmapalan (2010) Methodology and Perspectives of Science; Publisher: Trivandrum: Academica.

SEMESTER I

CORE COURSE 1
INTRODUCTION TO BIOLOGICAL SCIENCES
(PRACTICAL)

36 Hrs

0 Credit

1. Simple identification of any 5 vertebrates and 5 invertebrates upto species and differences in classification of vertebrates and invertebrates **6 Hrs**
2. Identification of a) plant c
3. ell (onion cell) b) animal cell (cheek cell) (5 hrs)
4. Study on food chain and food web **5 Hrs**
5. Physiological Measurements: Blood Pressure (normal & under stress) and Temperature **8 Hrs**
6. 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, byintroducing 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 **9 Hrs**

Anatomy of Plants: Special features of anatomical sections of monocot and dicot stems and roots; Double staining methods; Special staining methods; Preparation and storage of permanent slides.

Module 3 **9 Hrs**

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 **6 Hrs**

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

References

1. Aggarwal S.K (2009)Foundation Course in Biology Ane's Students Edition
2. Cappucchino J.G., and Sherman, N. Microbiology – A Laboratory Manual3rd Ed. The Benjamin/Cummings Publishing Co.
3. Dubey, R.C. and Maheshwari, D.K. (2002) Practical Microbiology S.Chand& Company Ltd.
4. Eldon D. Enger, Frederick C. Ross and David Bailey (2008)(Eleventh Edition)Concepts in Biology. Tata – McGraw Hill, New Delhi
5. Talaro, K.P., and Talaro, A. 2002. Foundations in Microbiology 4th Ed. McGraw Hill.
6. Taylor, Green, Stout (2008) Biological Science, Cambridge University press.

SEMESTER 1

CORE COURSE 2

COLLECTION AND PRESERVATION OF BIOLOGICAL SPECIMEN 1(PLANTS)

(PRACTICALS)

36 Hrs

0 Credit

1. Preparation of herbarium sheets **(5 Hrs)**
2. Identification of mitotic stages: onion root tip **(5 Hrs)**

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, byintroducing 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 **6 Hrs**

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

1. Blamire, J. (1994)Exploring Life- The Principles of Biology,Wm. C.Brown Publishers
2. Campbell, N.A., and Reece, J.B (2005)Biology. 7th (International) Ed. Pearson-Benjamin-Cummings
3. Green, N.P.O., Stout, G. W. & Taylor, D.J (1990) Biological Science2nd Ed. Cambridge Low Price Edition, Cambridge University Press.
4. Knudsen, J.W (1966) Biological TechniquesHarper InternationalEdition by Harper & Row
5. Hickman, C.P., Roberts, L.S. and Larson, A (2003) Animal Diversity3rd Ed. Mc Graw Hill
6. Miller, S.A., and Harley J.P. (2005)Zoology. 6th Ed. Mc Graw Hill

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, includingpractical 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**

Seperation techniques: Centrifuge, chromatography, electrophoresis

Module 3 **6 Hrs**

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

Module 4 **12 Hrs**

Micrbiological 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

1. Bhaskaran, K.K (1986) Microtechnique and Histochemistry.EvershinePress, Vellangalloor
2. Cappucchino, J.G., and Sherman N. *Microbiology – A Laboratory Manual*3rd Ed. The Benjamin/Cummings Publishing Co
3. Dubey, R.C. and Maheshwari, D.K (2002) Practical Microbiology S.Chand& Company Ltd.
4. Junqueira, L.C., and Carneiro, J (2005)Basic Histology11th Ed. Mc GrawHill
5. Talaro ,K.P., and Talaro, A (2002)Foundations in Microbiology4th Ed. McGraw Hill.

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 **6 Hrs**

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 **6 Hrs**

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

References

1. Arms, K. (1990)Environmental Science,Saunders College Publishing
2. Christopher.F Forster, D.A.John Wase, (1987) Environmental Biotechnology, Ellis Harwood.
3. Joseph C. Daniel(1999),Environmental aspects of Microbiology, Bright Sun publication
4. Khopkar, S.M (1993) Environmental Pollution Analysis, New Age International (P) Limited Publishers
5. Robert Jennings Heinsohn, Robert Lynn Kabe(1999) Sources and Control of Air Pollution, Prentice Hall
6. Sharma, P.D (1994)Ecology and Environment6th ed. Rastogi Publications
7. R. P. Singh (2012) Microbiology, Kalyani Publishers

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 foodspoilage.
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**

Food borne diseases: Important groups of bacteria associated with various foods. Food poisoning , food borne infections and intoxication. Brief description on *Clostridium botulinum, Vibrio, Salmonella, Hepatitis A, E. coli* 0157:H7,*Listeria*.

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 **6 Hrs**

Biotechnology in food production: Transgenic plants-Flavr- savr tomatoes; Nutritionally enriched foods:Golden rice, "heart healthy" canola oil.GM foods- advantages and disadvantages. Single cell protein, algae as food. Biotechnological potential of microalgae, food, feed and fuel production of pharmaceutically valuable microalgae.

References

1. M.R. Adams, M.O. Moss, Food microbiology, New Age International (P) Ltd. Publishers .
2. Bala Subramanian D., C.F & Bryle & K. Dharmarajan J. Green Kunthala Jayaraman (2007)Concept in Biotechnology. University Press
3. Colin Ratledge & Bijorn Kristiansen (2008)Basic Biotechnology 3 rd ed. Cambridge University
4. W.C. Frazier and Westhoff, . Food Microbiology.
5. Lindsay, (1988) Willis Biotechnology, Challenges for the flavour and food industries", Elsevier Applied Science.
6. George J.B., (1987) Basic Food Microbiology, CBS Publishers & Distributors,
7. Gavin Brooks (1998) Biotechnology in Healthcare: An Introduction to Biopharmaceuticals Pharmaceutical Press.
8. Janarthanan S & Vincent S (2007) Practical Biotechnology, Method of Protocols. University Pres .
9. John E. Smith(2005) Biotechnology Cambridge Low priced ed. (ThirdEd)
10. Prescott, Harleg, Klein, Microbiology, 7th ed. Mac Graw Hill International edition.
11. Roger A., Gorden B., and John T., (1989). Food Biotechnology Cambridge University Press
12. Ronald H. Schmidt and Gary E. Rodrick. (2002). Food Safety Handbook. Wiley; 1st edition. Part 1: Definition of food safety and characterization of food hazards.
13. Ronald H. Schmidt and Gary E. Rodrick (2002) Food Safety Handbook. Wiley; 1st edition. Part 2: Prevalence of foodborne pathogens
14. Singh B.D. (2002) Biotechnology Kalyan Publishers Nw Delhi.
15. N Shakuntala Manay, M. Shadakshara Swamy Food-Facts and Principles II Ed. New Age International Pub.

16. Som Nath Mahindru (2009). Food additives: characteristics, detection and estimationNew Delhi APH Publ. Corp.

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 **2 Hrs**

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

Module 2 **6 Hrs**

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

Respiratory system:functional organization, common clinicalabnormalities

Module 3 **10 Hrs**

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 **8 Hrs**

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

Module 5 **10 Hrs**

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

1. Fox, S.I.(2006) Human Physiology9th ed. McGraw Hill International Edition
2. Guyton and Hall (2006) Text book of Medical Physiology
3. Seeley, R.R., Stephens, T.D., and Tate, P(2006) Anatomy and Physiology7th ed. McGraw Hill International Edition
4. Thibodeau, G.A., and Patton, K.T(2007)Anthon's Textbook of Anatomy and Physiology. 18th ed. Mosby
5. Tortora, G.J., and Derrickson, B (2006) Principles of Anatomy and Physiology11th ed. John Wiley & Sons, Inc.

SEMESTER 3

CORE COURSE7
PHYSIOLOGY WITH CLINICAL CORRELATION
(PRACTICALS)

36 Hrs
0 Credit

1. Determination of O_2 uptake by cockroach [Respirometer] **(3 Hrs)**
2. Effect of adrenalin and noradrenalin on the heart beat of frog (demo) **(2 Hrs)**
3. Preparation of human blood smear and identification of leucocytes (6 Hrs)
4. Determination of differential WBC count **(6 Hrs)**
5. Estimation of haemoglobin **(4 Hrs)**
6. Demonstration of hemin crystals **(3 Hr)**
7. ESR **(4 Hrs)**
8. Blood grouping (ABO, Rh). **(2 Hrs)**
9. Bleeding time and Clotting time **(6 Hrs)**

SEMESTER 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 **12 Hrs**

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

Module 2 **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

1. Ananthanaryanan R. and C.K.J. Paniker (2009) Text book of Microbiology, 9th edition, University Press (India) Pvt. Ltd. Publisher
2. Elmer W. Koneman (2006) Color Atlas & Textbook of Diagnostic Microbiology 5th edition, Lippincott Publication
3. Cheesbrough, M. (1998) District Laboratory Practice in Tropical CountriesPart 1. Cambridge Low Price Edition. Cambridge University Press
4. Cheesbrough, M. (1998) District Laboratory Practice in Tropical CountriesPart 2. Cambridge Low Price Edition. Cambridge University Press
5. Mukherjee, K.L. (ed,) (1988) Medical Laboratory Technology Vol. 1. TataMcGraw Hill
6. Mukherjee, K.L. (ed,)(1988) Medical Laboratory Technology Vol. 2. TataMcGraw Hill
7. Mukherjee, K.L. (ed,)(1988) Medical Laboratory Technology Vol. 3. TataMcGraw Hill
8. Philip A. Thomas (2007) Clinical Microbiology, Orient Longman Pvt. Ltd.
9. Talaro, K.P., and Talaro, A. (2002). Foundations in Microbiology4th ed. McGraw Hill

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 technologyand 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:mediaand 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

1. Brown, T.A (2007)Genomes 3. GS Garland Science
2. Glick B.R., Pasternak, J.J. and Patten, C.L (2010) Molecular Biotechnology: Principles and Applications of Recombinant DNA 4th ed., ASM Press (Washington DC).
3. James D. Watson (1993) Recombinant DNA: 2nd Edition
4. Prakash, M., and Arora, C.K. (1998) Cell and Tissue CultureAnmol Publications Pvt. Ltd.
5. Rema, L.P (2006). Applied BiotechnologyMJP Publishers
6. Surzycki, S. (2003) Human Molecular Biology Laboratory Manual, Blackwell Publishing
7. Watson, J.D., Caudy, A.A., Myers, R.M. and Witkowski, J.A., (2007) Recombinant DNA:Genes and Genomes- A Short Course , Cold SpringHarbor Laboratory Press

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**

Radioactive materials: Types and sources of radiation. Effect of various types of radiation on biological systems. Radioactive emissions.

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

1. Jones, M., Jones, Geoff, G. and Marchington, P (1999) Physics 2nd ed. Cambridge University Press
2. Jones, M., Jones, Geoff, G, and Acaster D. (1999)Chemistry 2nd ed. Cambridge University Press
3. Blei, I and Odian, G (2006)General, Organic and Biochemistry- Connecting Chemistry to your Life 2nd Ed. W.H. Freeman and Company
4. Kotz, J.C., and Treichel, P(1999) Chemistry and Chemical Reactivity 4th ed. Saunders College Publishing
5. Wilson, K., and Walker, J (2000) Practical Biochemistry- Principles and Techniques5th ed. Cambridge Low Price Editions, Cambridge University Press

SEMESTER 4

ZB4CRP04 - CORE COURSE10
RADIOLOGY AND ADVANCED INSTRUMENTATIONTECHNIQUES
(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 **8 Hrs**

Institutions, financing procedure and financial incentives.

Module 2 **10 Hrs**

Resource management: man, machine and materials, quality control/ quality assurance and testing of products

Module 3 **12 Hrs**

Elements of marketing & sales management [Nature of product and marketstrategy, packaging and advertising, after sales service]

Module 4 **12 Hrs**

Income tax, sales tax and excise rules

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

1. Khanna, O.P. and Sarup A.(1999)Industrial Engineering and Management, Dhanpat Rai Publications (P) Ltd.
2. Khanna, O.P (1999). Work Study,Dhanpat Rai Publications (P) Ltd.
3. Khanna, O.P (1999)Textbook of Mecahnical Estimating and Costing, Dhanpat Rai Publications (P) Ltd.

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.

Search engines Online libraries, e-Books, e-Encyclopedia, Institutional Websites.

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, Polorization 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**

Bioethics : Introduction, Animal rights and animal laws in India, Prevention of cruelty to animals Act 1960, Biodiversity Act 2003.

Concept of 3 R – conservation (Refined- to minimize suffering, Reduced – to minimize animals, Replaced – modern tools and alternate means), Animal use in research and education.

Laboratory animal use, care and welfare, Animal protection initiatives- Animal Welfare 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 :

1. Gupta K.C, Bhamrah, H.S and G.S.Sandhu (2006) Research Techniques in Biological Sciences. Dominant Publishers and Distributors, New Delhi.

2. Khan and Khanum, (1990) Fundamentals of biostatistics.Press, Chicago,

3. Rastogi, V.B (2009) Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.

4. Ackoff, R.L. (1962) Scientific Method, New York : John Wiley Press.

5. Aggarwal. S.K.(2009) Foundation Course in Biology, 2nd Ed.. Ane's Student Edition. Ane Books Pvt. Ltd.

6. Anderson, J, Durston, B.H. and Poole, M. (1992). Thesis and assignment writing. Wiley Eastern Ltd.

7. Best, J.W.and K.V. James, (1986) Research in Education.5th Edn. Prentice- Hall of India Pvt.Ltd.

8. Campell, R. (1990). Statistics for biologists. CBS Publishers and distributors.

9. Day, R.A. (1993). How to write and publish a scientific paper. Cambridge University Press.

10. Day, R.A. (2000) Scientific English: A guide for Scientists and other Professionals. Universities Press.

11. Fischer, R.A.(1960)The Design of Experiment. 7th rev.edn. New York: Hafner Publishing Co.,

12. Hawkins C. and Sorgi, M. (1987). Research: How to plan, speak and write about it. Narosa Publishing House.

13. Killick, H.J. (1971). Beginning ecology. Ibadan University Press.

14. Kleinbaum, D.G. and M.Klein (2009) Survival analysis-Statistics for Biology & Health 2nd Ed. Springer International ed.

15. Knudsen J. W (1966) Biological Techniques: Collecting,Preserving, and Illustrating Plants and Animals.

16. Kothari, C.R. and G.Garg. (2014) Research Methodology. Methods and Techniques. 3rd edn.

17. Marie, M. (2005). Animal Bioethics: Principles and Teaching Methods Wageningen Academic Publishers.

18. Norman T.J. (2007) Bailey Statistical methods in biology, Cambridge University press.

19. Roberts, M. T. King and M. Reiss.(1994) Practical Biology for Advance Level. Thomas Nelson and Sons Ltd. Surrey, UK.

20. Ruxton, G.D. and Colegrave, N. (2006), Experinmental design for the life sciences. Oxford University Press.

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

22. Taylor D.J. Green N.P.O and Stout G.W. (2008). Biological science (3rd edition- R.S. Oper Ed). Cambridge University press.

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
3. Internet: Access a web page on any biological topic.
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.
7. Graphical representation of data. Construction of bar diagrams, Histograms, Pie diagram and Line graphs.

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

Characteristics of a community: Species diversity- richness, eveness, stratification, dominance, ecological indicators, Ecotone and Edge effect, Keystone species, Concepts of Ecological Niche and Guild, Ecological succession, community evolution- climax.

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 harvestiong, watershed management

Environment education

Environmental laws (Brief account only): The Water (Prevention and Control of Pollution) Act, 1974, The Air (Prevention and Control of Pollution) Act, 1981, Indian Forests Act (Revised) 1982. The Environment (Protection) Act, 1986, Hazardous Wastes (Management and Handling) Rules, 1989, The Forest (Conservation) Act, 1980, The Wildlife Protection Act, 1972, Biodiversity Act, 2002.

MODULE 5 HUMAN RIGHTS 6 Hrs

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

Manifestations & phenomena, Role of agencies in promoting human rights, Mechanisms for checking violations of human rights, National human right commission, Constitutional provisions related to Human rights.

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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
9. Visit to any two important areas of bio diversity: 1. Forest, 2.Sea shore, 3. Mangrove, 3. Wet lands, 4. Bird sanctuary, 5. Wild life sanctuary, 6. Sacred groves
10. Field study (compulsory)

SEMESTER V.

CORE COURSE 14

CELL BIOLOGYAND 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 **22 HRS**

Module I **6 Hrs**

Introduction of cell and Diversity of cells: History, Cell theory, Prokaryotes, Eukaryotes, Mycoplasmas, Virus, Virions and Viroids, Prions.

Cell membrane & Permeability: Molecular models of cell membrane (Sandwich model, Unit membrane model, Fluid mosaic model). Cell properties - permeability, Transport [Diffusion, Osmosis, Passive transport, Active transport, bulk transport], Cell coat and Cell recognition.

Module II **10 Hrs**

Cell Organelles : Structure and functions of following cell organelles: Endoplasmic reticulum - Structure and functions. Ribosomes (Prokaryotic and Eukaryotic) Golgi complex - Structure and functions. Lysosomes - Polymorphism - GERL concept, functions. Mitochondria - Structure and functions. Nucleus: Structure and functions of interphase nucleus, Nuclear membrane, pore complex, structure and functions of nucleolus

Chromosomes – Structure & organization, Heterochromatin, Euchromatin, Nucleosomes, Polytene chromosomes-Balbiani rings, Endomitosis, Lamp brush chromosomes.

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 - G_1, S, G_2 and M phases,.Mitosis and Meiosis.The difference between Mitosis and Meiosis.

References:

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GENETICS **32 Hrs**

Module I **10 Hrs**

MendelianGenetics: 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 **10 Hrs**

Mutation: Types of mutations - Somatic, germinal, spontaneous, induced, autosomal and allosomal, chromosomal mutations, structural and numerical changes. Gene mutations. [Addition, Deletion and substitution].

HumanGenetics: 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

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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)

4. Sexing of Drosophila.

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;

Direct evidences of evolution – Recapitulation Theory of Haeckel, Fossilization, Kinds of fossils, fossil dating, Homologous organs and analogous organs.

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

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 **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

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ETHOLOGY

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5. Dunbar, R. (1988). Primate Social Systems. Croom Helm, London.
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2. Chandran Subash M.D. (1997). On the ecological history of the Western Ghats.Current Science, Vol.73, No.2.146-155.
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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 **8 Hrs**

Nutrition: Nutritional requirements – carbohydrates, proteins, lipids, minerals (Ca, P, Fe, I), vitamins (sources and deficiency disorders). Importance of dietary fibre and antioxidants.Balanced diet, Recommended Dietary Allowance (RDA). Nutrition during pregnancy and lactation, Infant nutrition, Malnutrition(PEM).

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**

Respiration: Phases of respiration (external respiration, gas transport and internal respiration). Respiratory pigments: Haemoglobin, Myoglobin (Structure and Function). Transport of respiratory gases - transport of oxygen, oxyhaemoglobin curve, factors affecting oxyhaemoglobin curve, transport of carbon dioxide,(chloride shift). Control of respiration.Respiratory disturbances (Hypoxia, Hypercapnia, Asphyxia).Physiological effect of smoking, carbon monoxide poisoning, Oxygen therapy and artificial respiration.

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 **5 Hrs**

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

mechanism. Acid – base balance, hormonal regulation of kidney function. Renal disorders (kidney stone, acute and chronic renal failure, and dialysis). Homeostasis: Definition, concept and importance in biological system. Thermal regulation and thermal adaptation in homeotherms.

Module IV **10 Hrs**

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 **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:

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

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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 periodicclass discussions of current events in science which will benefitthem in their future studies in the biological/physiological sciences and health-related fields
3. To contribute tocritical societal goal of a scientifically literate citizenry.

Module1 **10 Hrs**

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

Reproductive Physiology: Gonads- anatomy of testis and ovary, spermatogenesis, oogenesis, gonadal hormones and their functions. Hormonal control of human reproduction - Female reproductive cycles (Estrous cycle, Menstrual cycle). Structure of mammalian sperm and egg, Pregnancy, parturition and lactation.Reproductive health and importance of sex education.

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**

Cleavage: Types, planes and patterns of cleavage, Cell lineage of Planaria. Influence of yolk on cleavage.

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.

Gastrulation: Major events in gastrulation. Morphogenetic cell movements. Influence of yolk on gastrulation. Exogastrulation.Concept of germ layers and derivatives.

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**

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

Embryology of chick: Structure of egg, fertilization, cleavage, blastulation, fate map, gastrulation. Development and role of Primitive streak, Salient features of 18hour, 24 hour, 33 hour & 48 hour chick embryo.Extra embryonic membranes in chick.

Human development: Fertilisation, cleavage, blastocyst, implantation, placenta. Gestation, parturition and lactation.Human intervention in reproduction, contraception and birth control. Infertility, Invitro fertilization (test tube baby)

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,

Developmental defects: Prenatal death (miscarriage and still birth). Intrauterine Growth Retardation (IUGR).

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:

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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)

Scott F. Gilbert; 2003; Developmental biology; Sinauer Associates Inc.,U.S.; 7th Revised edition.

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

Taylor D J, Green NPO & G W Stout. (2008) Biological Science third edition. Cambridge university press. Ref pp 748 biology 755

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.
19. Vital staining- demonstration.
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.

Bacterial Reproduction Sexual – (conjugation, transduction)and Asexual (budding,, fragmentation). Virology: Structure of virus; Human, animal, and bacterial virus. Viral replication, cultivation of animal viruses.

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 **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

1. Ananthanarayan R & Jayaram Paniker C K. (2009) Text Book of Microbiology Orient

Longman Private Ltd.

2. Gladys Francis & Mini K.D., (Editors) (2012), Microbiology, Zoological Society of Kerala, Kottayam.

3. Kuby J, Kindt T., Goldsby R. and Osborne B. (2007). Kuby immunology

4. Sharma K. (2005) Manual of Microbiology: Tools and Techniques, Ane books

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

6. Colemen: (2002). Fundamentals of Immunology

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

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

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

10. Heritage, J, E.G.V. Evaus and R.A.Killungten (2007): Introductory Microbiology Cambridge University Press 6. Ivan Roitt I (2002) Essentials of Immunology ELBS.

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.

5. Gram staining – preparation, procedure, identification of Gram + ve and Gram –ve 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.

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

Gene Libraries, Construction of genomic library and cDNA Library. PCR technique and DNA amplification, Brief description of screening methods – Probes, Nucleic Acid hydridization, In situ Hybridization, Fluorescence in situ Hybridization (FISH), Colony hybridization. Methods of transfer of desired gene into target cell.Blotting Techniques- Southern, Northern, Western blotting.DNA Finger printing (DNA Profiling) and its application. Molecular markers - RFLP

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

1. Singh B.D Biotechnology 2002. Kalyan Publishers New Delhi.

2. Brown C.H., Campbell I & Priest F, G. 1987. Introduction of Biotechnology (Blackwell scientific publishers Oxford).

3. Colin Ratledge Bijorn Kristiansesn, 2008. Basic Biotechnology 3 rd ed. Cambridge University.

4. Janarathanan S & Vincent S. 2007. Practical Biotechnology, Method of Protocols. University Press.

5. John E. Smith. Biotechnology Cambridge Low priced ed. (Third Ed) 2005 Madingan, Martinko and Parker 2002, Biology of Microorganisms, Brock Eighth Ed. Prentice Hall.

6. Singh B.D. Biotechnolgy 2002, Kalyan Publishers New Delhi.

7. Sudha Gangal 2007. Biotechnology Principles and & practice of Animal Tissue culture, Universities Press.

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

1. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.

2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006).Cell and Molecular Biology.VIII Edition. Lippincott Williams and Wilkins, Philadelphia.

3. Gupta, P. K (2002) Cell and Molecular Biology, (2ed), , Rastogi Publications., Meerut

4. James Darnell. (1998) Molecular Biology. Scientific American Books Inc

5. Thomas AP(Editor). 2011 Cell &Molecular Biology The Fundamentals. Green leaf publications .TIES Kottayam

6. Zoological Society of Kerala Study material. (2011) Cell and Molecular Biology

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 profitablefarming.
3. To make the students aware of cottage industries.

Module 1. APICULTURE **18 Hrs**

Definition, Different species of honey bees, Organization of honey bee colony, Social life and adaptation of honey bees. Communication among honey bees. Bee keeping methods and equipments, Management and maintenance of an apiary, Growth period, honey flow period and dearth period Division of the colony, uniting two colonies, , replacing old queen with new queen, swarming management, monsoon management. Enemies of bees. Diseases of bees,.Bee pasturage. Uses of honey bees, By-products of honey bees, Honey and wax composition. Testing the quality of honey.Extraction of wax, Uses of honey and wax.Royal jelly, Propolis. Apitherapy, Agencies supporting apiculture.

Activity :Visitto 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**

Introduction, Ecological classification of earth worms. Species of earth worms used for vermicultre, Reproduction & life cycle, Role of earth worm in solid waste management, in agriculture, in medicine etc. Preparation of vermibed, Maintenance & monitoring, Preparation of vermicompost, Preparation of vermiwash.

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.

Shukla G.S, & Updhyay V.B, Economic zoology ,Rastogi Publ. Meerut.

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

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

Clive. A Edwards, Norman. Q. & Rhonda. 2011. Vermitechnology: earthworms, organic waste & environmental management.
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.
Ronald j. Roberts (1978) Fish pathology , Cassel Ltd London.
Cowey C. B. *et. al*. (1985) Nutrition and feeding in fishes, academy press.
Farm made aquafeeds. FAO fisheries Technical paper, 343.
Harisankar J. Alappat& A. Bijukumar, Aquarium Fishes. B. R. Publ. Corporation, Delhi.
MPEDA, A hand Book on AquafarmingOrnamentalfishes, MPEDA, Kochi.
Amber Richards. 2014. Aquaponics at home.
Pradip.V.Jabde. 1993. Text book of applied zoology
Venkitaraman, P.R,1983, Text book of Economic zoology(SudharsanaPuubl. Kochi)
Addison Webb, Bee Keepingfor profit and pleasure, Agrobios Ltd.
Edwards.C.A.&Lafty, J.R.1972 Biology of earthworms(Chapman & Hall Led.London)
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

   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 1Aquarium 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 aquariumand rearing of aquarium fishes

Module 2Ornamental 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 3Quail 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 5Vermiculture and composting 12 Hrs

Introduction, ecological classification of earth worms, Life history, Species of earth worms used for vermicultre, 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.

Alka Prakash (2011), Laboratory Manual of Entomology, New age International, New Delhi.

Arumugan N. (2008) Aquaculture, Saras publication.

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Herbert R. and Leonard P. Schultz Axelrod (1955) Handbook of Tropical Aquarium Fishes, McGraw-Hill, 1955.

Joy P.J., George Abraham K., Aloysius M. Sebastian and Susan Panicker (Eds) (1998) Animal Diversity, Zoological Society of Kerala, Kottayam

Michael B. New; Alber G.J. Tacon (1994) Farm made aquafeeds FAO fisheries technical paper No.343, Rome, FAO. 1994

Nalina Sundari, M.S and Santhi, R (2006) Entomology. MJP Publishers

NPCS Board of Consultants & Engineers, Chennai.(2015) The complete book on Bee keeping and honey processing, 2nd Edition, NIIR Project consultancy services, 106- E kamala Nagar Delhi – 110007.

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Vijayakumaran Nair, K, Manju, K.G. and Minimol, K. C.(2015) Applied Zoology, Academia press, Thiruvananthapuram

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.

Diabetese, Cardiovasculard 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

Water borne dseases-Cholera and Typhoid.Prevention of Water borne diseases.

Food borne diseases and Prevention

Botulinum, Salmenellosis, 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:

7. Gladys Francis & Mini K.D., (Editors) (2012), Microbiology, Zoological Society of Kerala, Kottayam.
8. Greenberg, Jerol S and Dintiman George B (1997) Wellness Creating a life of Health and Fitness , London Allyn and Bacon Inc.
9. K Park, (2008) Park's Text Book of Preventive and Social Mediine 18th Edition. Banarasidass Bhenot Publication
10. Norman Bezzaant HELP First Aid for everyday emergencies. Jaico Publishing House, Bombay, Delhi
11. Tom Sanders and Peter Emery. (2004) Molecular basis of human nutrition: Taylor & Francis Publishers Ane Book
12. Pelczar M.J. Jr. E.C.S. Chane & N.R. Krieg, Microbiology (Concept & Applications). 5th edition. Tata McGraw Publishing Company Ltd.

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 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 **10 Hrs**

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 **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

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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 Rerserve

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:

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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 I0 Hrs

Pest and crop loss: Introduction, historical perspective-origin of pest, Evolution of pest. Causes of pest outbreak- biotic, abiotic and genetic factors.Modern agricultural practices and pest problem - high yielding varieties, monoculture, fertilizers, pesticides, irrigation, and cultural practices.

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 **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.

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ELECTIVE COURSE

3. VECTOR AND VECTOR BORNE DISEASES

72 Hrs

3 Credits

Objectives:

Module I **10 Hrs**

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 I1 **6 Hrs**

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

Module II1 **25 Hrs**

Study of Vector Borne disease[Life cycle and pathology]: Mosquito-borne diseases – Malaria, Dengue, Chikungunya, Filariasis. Sand fly-borne diseases – Leishmaniasis, Phlebotomus fever. Tse- tse fly – sleeping sickness. House fly borne diseases :typhoid fever, cholera, dysentery, anthrax, Myiasis, . Flea-borne diseases – Plague, Typhus fever. Louse-borne diseases –Relapsing fever, Trench fever, Vagabond's disease, Phthiriasis.

Module IV **13 Hrs**

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**

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:

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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**

Understanding of health: Define health, basic concepts, dimensions of health, basic parameters of health care. (Health Parameters: Individual normal standards, devices.1. Blood pressure, 2. Brain activities and sleep, 3.Focus or attention, 4.Pulse, 5. Body temperature, 6. Daily physical activities, 7. Electrocardiogram (ECG), 8.Cardiac fitness 9. Stress, 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:

1. AAPHERD (1980). Health Related Physical Fitness Test Manual. Published by Association drive Reston Virginia.

2. ACSM (2005). Health Related Physical Fitness Assessment Manual Lippincott Williams and Wilkins USA, 3. Begum, M.R. (2006).A Text Book of Foods, Nutrition and Dietetics. 2nd Edn. Sterling Low Price Edition.Sterling Publishers Private Ltd., New Delhi.

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MODEL III

B.Sc. *(INDUSTRIAL MICROBIOLOGY & ZOOLOGY)*

(DOUBLE MAIN)

B.Sc. *(INDUSTRIAL MICROBIOLOGY & ZOOLOGY)*
(DOUBLE MAIN)

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

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English- *(From Board of studies - English)*	Common Course	5	4	1	4
2	1ZICRT01	Fundamentals of microbiology	Core Course 1 : Theory	2	2	1	4
3		Fundamentals of microbiology	Core Course 1 : Practical	2	0	0	0
4	IZ1CRT02	Microbial Diversity	Core Course 2 : Theory	2	2	1	4
5		Microbial Diversity	Core Course 2 : Practical	2	0	0	0
6	IZ1CRT03	Microbial physiology	Core Course 3 : Theory	2	2	1	4
7		Microbial physiology	Core Course 3 : Practical	2	0	0	0
8		Biochemistry-1 (From Board of Studies Biochemistry)	Complementary I : Theory	2	2	1	4
9		Practical	Complementary I : Practical	2	0	0	0
		‘Computer Science -I (From Board of Studies	Complementary II : Theory	2	2	1	4

		- Computer Science)					
		Practical	Complementary II : Practical	2	0	0	0
Total				**25 hrs**	**16**		

SEMESTER 2

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1		English *(From Board of studies – English*	Common Course	5	4	1	4
3	IZ2CRT04	Microbial waste management	Core Course 4 : Theory	2	2	1	4
4		Microbial waste management	Core Course 4 : Practical	2	2	1	4
5	IZ2CRT05	Medical microbiology	Core Course 5 : Theory	2	2	1	4
6		Medical microbiology	Core Course 5 : Practical	2	2	1	4
7	IZ2CRT06	Agricultural microbiology	Core Course 6 : Theory	2	2	1	4
8		Agricultural microbiology	Core Course 6 : Practical	2	2	1	4
8		Biochemistry-2 (From Board of Studies - Biochemistry)	Complementary I : Theory	2	2	1	4
9		Practical	Complementary I : Practical	2	2	1	4
		Computer Science – 2 (From Board of Studies – Computer Science)	Complementary II : Theory	2	2	1	4
		Practical	Complementary II : Practical	2	2	1	4
Total				**25 hrs**	**24**		

SEMESTER 3

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	IZ3CRT07	Microbial Genetics and Recombinant DNA Technology	Core Course 7 : Theory	3	3	1	4
2		Microbial Genetics and Recombinant DNA Technology	Core Course 7 : Practical	2	0	0	0
3	IZ3CRT08	Industrial Microbiology	Core Course 8 : Theory	3	3	1	4
4		Industrial Microbiology	Core Course 8 : Practical	2	0	0	0
5	IZ3CRT09	Fermentation Technology	Core Course 9 : Theory	3	3	1	4
6		Fermentation Technology	Core Course 9 : Practical	2	0	0	0
7		Biochemistry-3(From Board Of Studies“ Biochemistry)	Complementary I : Theory	3	3	1	4
8		Practical	Complementary I : Practical	2	0	0	0
9		Computer science-3 (From Board Of studies, Computer Science)	Complementary II : Theory	3	3	1	4
10		Practical	Complementary II : Practical	2	0	0	0
Total				**25 hrs**	**15**		

SEMESTER 4

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	IZ4CRT10	Food microbiology	Core Course 10 : Theory	3	3	1	4
2		Food microbiology	Core Course 10 : Practical	2	2	1	4
3	IZ4CRT11	Diary microbiology	Core Course 11 : Theory	3	3	1	4
4		Diary microbiology	Core Course 11 : Practical	2	2	1	4
5	ZY4CRT04	Research methodology,Biophysics & Biostatistics *(*Core Course IVof *Board of Studies - Zoology)*	Core Course 12 : Theory	3	3	1	4
6		Research methodology, Biophysics &Biostatistics	Core Course 12 : Practical	2	2	1	4
7		Biochemistry - 4 (From Board of Studies - Biochemistry)	Complementary I : Theory	3	3	1	4
8		Practical	Complementary I : Practical	2	2	1	4
9		Computer Science - 4 (From Board of Studies – Computer Science)	Complementary II : Theory	3	3	1	4
10		Practical	Complementary II : Practical	2	2	1	4
Total				**25 hrs**	**25**		

SEMESTER 5

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZY5CRT05	Environmental Biology & Human rights	Core Course 13 : Theory	3	3	1	4
2	ZY5CRPO5	Environmental Biology & Human rights	Core Course 13 : Practical	2	0	0	0
3	ZY5CRT06	Cell Biology & Genetics	Core Course 14 : Theory	3	3	1	4
4	ZY5CRPO6	Cell Biology & Genetics	Core Course 14 : Practical	2	0	0	0
5	ZY5CRT07	Evolution, Ethology & Zoogeography	Core Course 15 : Theory	3	3	1	4
6	ZY5CRPO7	Evolution, Ethology & Zoogeography	Core Course 15 : Practical	2	0	0	0
7	ZY5CRT08	Human Physiology, Biochemistry & Endocrinology	Core Course 16 : Theory	3	3	1	4
8	ZY5CRPO8	Human Physiology, Biochemistry & Endocrinology	Core Course 16 : Practical	2	0	0	0
9	ZY5OPT01	1 – Vocational Zoology (Apiculture, Vermiculture, Ornamental fish culture)	Open Courses for other streams *(Select any one out of three)*	4	3	1	4
	ZY5OPT02	2 – Public health and Nutrition					
	ZY5OPT03	3 – Man, nature & Sustainable Development					
		Project work & Field Visit/Study Tour, Visit to research institutes , Group activity	Project work	1	0		
Total				**25 hrs**	**15**		

SEMESTER 6

No	Course Code	Course Title	Course Category	Hrs per week	Credits	Marks ratio	
						Intl	Extl
1	ZY6CRT09	Developmental Biology	Core Course 17 : Theory	3	3	1	4
2	ZY6CRP09	Developmental Biology	Core Course 17 : Practical	2	2	1	4
3	ZY6CRT10	Immunology	Core Course 18 : Theory	3	3	1	4
4	ZY6CRP10	Immunology	Core Course 18 : Practical	2	2	1	4
5	ZY6CRT11	Biotechnology, Bioinformatics and Molecular Biology	Core Course 19 : Theory	3	3	1	4
6	ZY6CRP11	Biotechnology, Bioinformatics and Molecular Biology	Core Course 19 : Practical	4	2	1	4
7	ZY6CRT12	Occupational Zoology (Aquaculture, Apiculture, Vermiculture & Quail farming)	Core Course 20 : Theory	3	3	1	4
8	ZY6CRP12	Occupational Zoology (Aquaculture, Apiculture, Vermiculture & Quail farming)	Core Course 20 : Practical	2	2	1	4
9	ZY6CBT01	Elective 1: Ecotourism & Sustainable Development	Choice Based Core Elective Courses *(Select any one out of four)*	3	2	1	4
	ZY6CBT02	Elective 2: Agricultural pest management					
	ZY6CBT03	Elective 3: Vector & Vector bourne Diseases					
	ZY6CBT04	Elective 4: Nutrition, Health & life style management					
10	IZY6PR01	Project work & Field Visit/Study Tour, Visit to research institutes , Group activity	Project		1		
11	ZB6OJT01	OJT 64 Hours (MOC) + 36 hours (Tissue Culture training)	OJT		2		
Total				**25 hrs**	**25**		

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).

Semester	Code	Course	Exam duration	Marks-ratio		Credits
				Internal (I)	External (E)	
II	IZ2CRP01	**Practical 1** (Core 1 & 4)	3 hrs	1	4	2
	IZ2CRP02	**Practical 2** (Core 2 & 5)	3 hrs	1	4	2
	IZ2CRP03	**Practical 3** (**C**ore 3 & 6)	3 hrs	1	4	2
		Complimentary 1 Biochemistry	3 hrs	1	4	2
		Complimentary 2 Computer Science	3hrs	1	4	2
IV	IZ4CRP04	**Practical 4** (Core 7 & 10)	3 hrs	1	4	2
	IZ4CRP05	**Practical 5** (Core 8 & 11)	3 hrs	1	4	2
	IZ4CRP06	**Practical 6** (**C**ore 9 & 12)	3 hrs	1	4	2
		Complimentary 1 Biochemistry	3 hrs	1	4	2
		Complimentary 2 Computer Science	3hrs	1	4	2
VI	ZY6CRP03	**Practical 7** (**C**ore 13 & 17)	3 hrs	1	4	2
	ZY6CRP04	**Practical 8** (**C**ore 14 & 18)	3 hrs	1	4	2
	ZY6CRP05	**Practical 9** (**C**ore 15 & 19)	3 hrs	1	4	2
	ZY6CRP06	**Practical 10** (**C**ore 16 & 20)	3 hrs	1	4	2

b. SYLLABUS
THEORY & PRACTICALS

SEMESTER I
IZ1CRT01 - 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
Spontaneous generation theory, Contributions of Leuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Joseph Lister, Alexander Fleming, John Tyndall.

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

8Hrs

Sterilization and disinfection
Sterilization-Principles and methods, physical and chemical methods.,Antibiotics - classification and mechanism of action. Drug resistance, Antibiotic sensitivity tests..

Module 4

8Hrs

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, ,

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SEMESTER I

CORE COURSE 1
FUNDAMENTALS OF MICROBIOLOGY
(PRACTICAL)

36 Hrs

0 Credit

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.

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Lammert, J. M. 2006. *Techniques for Microbiology: A Student Handbook*. Benjamin Cummings.

Aneja, K. R. 2003. *Experiments in Microbiology, Plant Pathology and Biotechnology*. 4th Edition. New Age International (P) Limited, New Delhi.

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Dubey, R. C. and Maheswari, D. K. 2002. *Practical Microbiology*. 2nd Edition, S. Chand & Co., New Delhi.

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Goldman, E. and Green, L. H. 2008. *Practical Handbook of Microbiology*.2nd Edition. CRP Press.

SEMESTER I

IZ1CRT02 - 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 1 **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

Topley, W. W. C., Wilson, G. S., Parker, T. and Collier, L. H. 1990. *Topley and Wilson's Principles of Bacteriology, Virology and Immunology*. 8th Edition. Edward Arnold, London.

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Madigan, M., Martinko, J., Buckley, D. and Stahl, D. 2014. *Brock Biology of Microorganisms*, 14th Edition. Benjamin Cummings, New York.

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

Lammert , J. M. 2006. *Techniques for Microbiology: A Student Handbook.* Benjamin Cummings.

Aneja, K. R. 2003. *Experiments in Microbiology, Plant Pathology and Biotechnology*. 4th Edition. New Age International (P) Limited, New Delhi.

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Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.

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Cappuccino, J. and Sherman, N. 2013. *Microbiology: A Laboratory Manual*. 10th Edition. Benjamin-Cummings Publishing Company, Subs Of Addison Wesley Longman, Inc.

SEMESTER 1

IZ1CRT03 - 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 elucidatephysiological processes.
2. To get a better understanding of how microbes grow, how they respond and in turn influence their environments.

Module 1 **4 Hrs**

Microbial Nutrition -Nutritional requirements - C, N, P, S, and minerals, Nutritional classification of bacteria. Uptake of nutrients - passive diffusion, facilitated diffusion, Active transport, Group translocation .

Module 2 **10 Hrs**

Bacterial Growth, Bacterial growth curve and generation time.Continuous culturing of bacteria- chemostat, turbidostat,. Effect of Temperature, pH, Oxygen concentration and Radiation on bacterial growth.Enumeration methods of bacteria- SPC, Direct microscopic count, turbidometric estimation. Reproduction and Growth: Modes of cell division- binary fission, budding, and Spore formation.

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 hetro-lacticacid fermentation.

Module 5 **6 Hrs**

Nitrogen metabolism -Nitrogen Cycle, nitrification, denitrification and ammonification. Transamination and deamination reactions, Nitrogen fixation in symbiotic, associative and free living system, oxygen regulation of nitrogen fixation.

References

Doelle, H. W. 1975. *Bacterial Metabolism*. 2nd Edition. Academic Press.

Moat, A. G. and Foster, J. W. 1988. *Microbial physiology*. 2nd Edition. Springer Verlag.

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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

1. Lammert, J. M. 2006. *Techniques for Microbiology: A Student Handbook*. Benjamin Cummings.
2. Aneja, K. R. 2003. *Experiments in Microbiology, Plant Pathology and Biotechnology*. 4th Edition. New Age International (P) Limited, New Delhi.
3. Aneja, K. R. 2001. *Experiments in microbiology, plant pathology, tissue culture and mushroom production technology*. 3rd Edition. New Age International (P) Limited.
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5. Kannan, N. 2002. *Laboratory manual in general microbiology*. 2nd Edition, Panima Publishing Co., New Delhi.

6. Gunasekaran, P. 2002. *Laboratory manual in microbiology*. 2nd Edition, New Age International (P) Limited, New Delhi.
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8. Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.
9. Goldman, E. and Green, L. H. 2008. *Practical Handbook of Microbiology*. 2nd Edition. CRP Press.
10. Cappuccino, J. and Sherman, N. 2013. *Microbiology: A Laboratory Manual*. 10th Edition. Benjamin-Cummings Publishing Company, Subs Of Addison Wesley Longman, Inc.
11. Chakraborty, P. and Chakraborty, G. 2005. *Practical pathology*. Vol. 33. Kolkata: New Central Book Agency (P) Ltd.

SEMESTER II

IZ2CRT04 -MICROBIAL WASTE MANAGEMENT

36 Hrs

2 Credits

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.**

Disinfections- chlorination – methods of chlorination- break point chlorination, super chlorination, chloramines, and chlorine dioxide.UV and Ozone treatment.

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 **10 Hrs.**

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

Odum, E. P. and Barrett, G. W. 2005. *Fundamentals of Ecology*. 5th Edition. Thomson Brooks/Cole, Belmont, CA.

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Singh, A., Kuhad R. C. and Ward, O. P. 2009. *Advances in Applied Bioremediation*. Springer.

SEMESTER 1I

IZ2CRT04- 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

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SEMESTER 2

IZ2CRT05 - 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, Vibriocholerae.*

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

Cann, A. J. 2005. *Principles of Molecular Virology*. 4th Edition. Elsevier Academic Press.

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SEMESTER 2

IZ2CRP02 - CORE COURSE 5
MEDICAL MICROBIOLOGY

(PRACTICALS)

36 Hrs

2 Credits

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, Lacto phenol cotton blue staining, Slide culture technique etc.
6. Study of normal microbial flora of human being

References

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SEMESTER 2

IZ2CRT06 - 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 **12 Hrs**

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 **5 Hrs**

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 **8 Hrs**

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 **7 Hrs**

Bio fertilizers: Types and importance. Production and quality control: *Rhizobium, Azotobacter, Azospirillum*, Cyanobacteria, mycorrhizae: vesicular arbuscular mycorrhizae. phosphate solubilizing bacteria.

Module 5 **4 Hrs**

BioPesticides: bacterial, viral and fungal pesticides.Biological control of plant diseases.

References

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Hull, R. 2002. *Matthew's Plant Virology*. 4th Edition, Academic Press.

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SEMESTER 2

IZ2CRP03 - CORE COURSE 6
AGRICULTURAL MICROBIOLOGY
(PRACTICALS)

36 Hrs

2 Credits

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

Aneja, K. R. 2003. *Experiments in Microbiology, Plant Pathology and Biotechnology*. 4th Edition. New Age International (P) Limited, New Delhi.

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SEMESTER 3

IZ3CRT07 - 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 **8Hrs**

Bacterial chromosome, DNA replication in prokaryote. Meselson and Stahl experiment, modes of replication- rolling circle model.

Module 2 **8 Hrs**

Mutagenesis, Spontaneous and induced mutatagenesis, transition, transversion, silent, missense, non-sense, neutral, frame shift and conditional mutations. Forward and reverse mutations.

Module 3 **8 Hrs**

Recombination methods in bacteria: transformation, transduction and conjugation

Module 4. **8 Hrs**

Plasmids, plasmid as cloning vector, brief account on pBR 322, pUC 8, phage vectors- M13, lamda and cosmids

Module 5 **12 Hrs**

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:

Primrose, S., Twyman, R. and Old, B. 2001. *Principles of Gene Manipulation*, 6th Edition, Blackwell Science Ltd.

Chakravarty, A. K. 2013. Introduction to Biotechnology. OUP India.

Chaudhuri, K. 2012. Microbial Genetics. The Energy and Resources Institute, TERI.

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SEMESTER 3

CORE COURSE7

MICROBIAL GENETICS AND RECOMBINANT DNA TECHNOLOGY

(PRACTICALS)

36 Hrs
0 Credit

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

Aneja, K. R. 2001. *Experiments in microbiology, plant pathology, tissue culture and mushroom production technology*. 3rd Edition. New Age International (P) Limited.

Dubey, R. C. and Maheswari, D. K. 2002. *Practical Microbiology*. 2nd Edition, S. Chand & Co., New Delhi.

Kannan, N. 2002. *Laboratory manual in general microbiology*. 2nd Edition, Panima Publishing Co., New Delhi.

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Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.

Janarthanan, S.and Vincent, S. 2007. Practical Biotechnology: Methods and Protocols. Orient BlackSwan/Universities Press.

Jane, M., Valan Arasu, M. and Duraipandiyan, V. 2012. Practical Handbook in Microbial Biotechnology. Lambert Academic Publishing.

SEMESTER 3

IZ3CRT08 - CORE COURSE 8
INDUSTRIAL MICROBIOLOGY

54 Hrs
3 Credits

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**

Preservation and storage of microorganisms.Development of inoculum for industrial fermentation. Fermentation media, formulation of media, saccharine materials, starchy materials, cellulosic materials, nitrogenous materials, enhancers and precursors, antifoams.

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**

Fermentation process: Surface, Submerged and Continuous fermentation .Computer control of fermentation process.

Module 5 **12 Hrs**

Downstream Processing, Intra cellular and extra cellular product recovery.Physical and chemical methods.Cell disruption- methods, solvent extraction, and purification. Product recovery. Drying, Packing and labeling. Market Potential, Good Manufacturing Practices.

References

1. Whitaker, A., Stanbury, P. F. and Hall, S. J. 2009. *Principles of Fermentation Techniques*. Elsevier.
2. Demain, A. L. and Solomon, N. A. 1986. *Manual of Industrial Microbiology*. Oxford University Press, Oxford.
3. Waites, M. J., Morgan, N. L., Rockey, J. S. and Higton, G. 2001. Industrial Microbiology: An Introduction. Blackwell Science Ltd.
4. Prescott, S. C., Dunn, C. G., and Reed, G. 1982. *Prescott and Dunn's Industrial Microbiology*, 4th Edition. AVI Pub. Co., Westport, Conn.
5. Waites, M. J. 2001. *Industrial Microbiology*. Blackwell Science, Oxford.
6. McNeil, B. and Harvey, L. M. 1990. *Fermentation: A Practical Approach.*Oxford; New York: IRL Press.
7. Enfors, S. O. and Häggström, L. 2000. *Bioprocess Technology: Fundamentals and Applications*. Royal Institute of technology, Stockholm, Sweden.
8. Crueger, W., Crueger, A., and Brock, T. D. 1990. *Biotechnology: A Textbook of Industrial Microbiology*. Sinauer Associates.
9. Casida, L. E. 1968. *Industrial Microbiology*. Wiley, New York; London.
10. Okafor, N. 2007. *Modern Industrial Microbiology and Biotechnology*. CRC Press.

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

Aneja, K. R. 2003. *Experiments in Microbiology, Plant Pathology and Biotechnology*. 4th Edition. New Age International (P) Limited, New Delhi.

Aneja, K. R. 2001. *Experiments in microbiology, plant pathology, tissue culture and mushroom production technology*. 3rd Edition. New Age International (P) Limited.

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Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.

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Baltz, R. H., Davies, J. E. and Demain, A. L. 2012. *Manual of Industrial Microbiology and Biotechnology*. 3rd Edition. Washington DC: American Society of Microbiology.

SEMESTER 3

IZ3CRT09 - CORE COURSE 9
FERMENTATION TECHNOLOGY

54 Hrs
3 Credits

Objectives

1. To study the major products or uses of industrial microbiology and biotechnology
2. To understand aout fermentation and subsequent processing approaches available for themanufacture of biological products and the design and operation of these systems.

Module 1 **10 Hrs**

Fermentative production of Pharmaceuticals, production of penicillin and streptomycin. Production of vitamins and growth stimulants, riboflavin, cyanocobalamines and gibberellins

Module 2 **10 Hrs**

Fermentative production of Alcohol, Acetic acid, citric acid, lactic acid, Lysine and glutamic acid, Protease and amylase, Ethanol and Glycerol

Module 3 **15 Hrs**

Production of biofuels – Hydrogen and Methane
Production of Beverages- Beer and Wine
Production of Single cell Protein- Baker's Yeast and Spirullina

Module 4 **9 Hrs**

Industrial applications of enzymes, Enzyme immobilization- methods and applications .

Module 5 **10Hrs**

Microbial recovery of metals- bioleaching of copper, gold and uranium
Microbially enhanced oil recovery (MEOR)

References

Whitaker, A., Stanbury, P. F. and Hall, S. J. 2009. *Principles of Fermentation Techniques*. Elsevier.

Demain, A. L. and Solomon, N. A. 1986. *Manual of Industrial Microbiology*. Oxford University Press, Oxford

Prescott, S. C., Dunn, C. G., and Reed, G. 1982. *Prescott and Dunn's Industrial Microbiology*, 4th Edition. AVI Pub. Co., Westport, Conn.

Hui, Y. H., Meunier-Goddik, L., Hansen, A. L., Josephsen, J., Nip, W.-K., Stanfield, P. S. and Toldra, F. 2004. *Handbook of Food and Beverage Fermentation Technology*. New York : Marcel Dekker Incorporated.

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Casida, L. E. 1968. *Industrial Microbiology*. Wiley, New York; London.

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

Aneja, K. R. 2003. *Experiments in Microbiology, Plant Pathology and Biotechnology*. 4th Edition. New Age International (P) Limited, New Delhi.

Aneja, K. R. 2001. *Experiments in microbiology, plant pathology, tissue culture and mushroom production technology*. 3rd Edition. New Age International (P) Limited.

Dubey, R. C. and Maheswari, D. K. 2002. *Practical Microbiology*. 2nd Edition, S. Chand & Co., New Delhi.

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Gunasekaran, P. 2002. *Laboratory manual in microbiology*. 2nd Edition, New Age International (P) Limited, New Delhi.

Kalaichelvan, P. T. 2005. *Microbiology and Biotechnology Laboratory manual*. MJP Publishers, Chennai.

Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.

McNeil, B. and Harvey, L. M. 2008.*Practical Fermentation Technology*. John Wiley & Sons, Ltd, Chichester.

. Kulandaivelu, S. and Janarthanan, S. 2012.Practical Manual on FermentationTechnology.International Publishing House Pvt. Limited.

SEMESTER 4

IZ4CRT10 - CORE COURSE10
FOOD MICROBIOLOGY

54 Hrs
3 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.

Module1 **10 Hrs**

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 **12 Hrs**

Principles of food preservation - asepsis, removal of microorganisms, anaerobic conditions, high and low temperatures, drying, radiation. Chemical preservatives -food additives.Principles of canning.

Module 3 **12 Hrs.**

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 **12 Hrs.**

Bacteriological examination of milk.Preservation of milk, pasteurization - different methods. Fermented dairy products- cheese, yoghurt, kefir, butter and butter milk.

Module 5 **8 Hrs.**

Food borne Diseases- Food poisoning and food born infections and intoxication. Mycotoxins - Aflatoxins.Hazard Analysis Critical Control Points (HACCP)

References

Casida, L. E. 1968. *Industrial Microbiology*. Wiley, New York; London.

Doyle, M. P., Beuchat, L. R. and Montville, T. J. 2001. *Food Microbiology: Fundamentals and Frontiers*. 2nd Edition. ASM Press, Washington, D.C.

Frazier, W. C. and Westhoff, D. C. 2004. *Food Microbiology*. Tata McGraw Hills Publishing Company Limited.

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Ayres, J. C., Mundt, J. O. and Sandine, W. E. 1980. *Microbiology of foods*. Freeman, SanFrancisco.

Robinson, R. K. 1990. *Dairy Microbiology*. 2nd Edition. Elsevier Science Pub. Co., London; New York.

Adams, M. R. and Moss, M. O. 2008. *Food Microbiology*, 3rd Edition. RSC Publishers.

Ray, B. 2003. Fundamentals of Food Microbiology. Boca Raton, FL: CRC Press.

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Waites, M. J. 2001. *Industrial Microbiology*. Blackwell Science, Oxford.

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Jay, J. M., Loessner, M. J. and Golden, D. A. 2005. Modern Food Microbiology. Springer Science & Business Media.

SEMESTER 4

IZ4CRP04 - CORE COURSE10
FOOD MICROBIOLOGY

(PRACTICALS)

36 Hrs
2 Credits

1. Microbiological examination of food
2. Isolation of bacteria from idli batter &curd.
3. Microbiological examination of soft drinks.
4. Standard plate count of milk.
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.
8. Determination of phosphatase activity of milk.
9. Detection of mastitis through milk test.
10. Cultivation of Edible mushroom (Demo)

References

Aneja, K. R. 2003. *Experiments in Microbiology, Plant Pathology and Biotechnology*. 4th Edition. New Age International (P) Limited, New Delhi.

Aneja, K. R. 2001. *Experiments in microbiology, plant pathology, tissue culture and mushroom production technology*. 3rd Edition. New Age International (P) Limited.

Dubey, R. C. and Maheswari, D. K. 2002. *Practical Microbiology*. 2nd Edition, S. Chand & Co., New Delhi.

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Gunasekaran, P. 2002. *Laboratory manual in microbiology*. 2nd Edition, New Age International (P) Limited, New Delhi.

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Murugalatha, N. *et al*. 2012. *Microbiological techniques*. MJP Publishers, Chennai.

Harrigan, W. F. 1998. Laboratory Methods in Food Microbiology. 3rd Edition.Gulf Professional Publishing.

Yousef, A. E. and Carlstrom, C. 2003. Food Microbiology: A Laboratory Manual, John Wiley and Sons.

Roberts, D. and Greenwood, M. 2003. Practical Food Microbiology. 3rd Edition, Blackwell publishers.

SEMESTER 4

IZ4CRT11 - 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**

Milk –introduction, composition, microorganisms in milk- bacteria, yeast, mold. Nutritive value of milk.Starter cultures and their biochemical activities- *Streptococcus thermophiles* and *Lactobacillus bulgaricus.*Starter culture preparation.Dairy processing unit operations- clarification, separation, standardization, toning of milk, homogenization.

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**

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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

Prajapati, J. B.1995. *Fundamentals of Dairy Microbiology*. Akta Prakashal Nadiad, Gujarat.

Robinson, R. K. 1990. *Dairy Microbiology*. Volume II and I. Elsevier AppliedScience, London.

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Milk and Milk Products - Fourth edition - clarence henry eckles, Tata McGraw Hillpublishing company Limited, New Delhi, 1957

Dey, S. 1994. *Outlines of Dairy Technology*. Oxford Univ. Press, New Delhi.

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Law,B. A. 1997. Microbiology and Biochemistry of Cheese and Fermented Milk. 2nd edition. Blackie Academic & Professional, London.

SEMESTER 4

IZ4CRP05 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.
6. Determination of phosphatase activity 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.

Search engines Online libraries, e-Books, e-Encyclopedia, Institutional Websites.

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, Polorization 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**

Bioethics : Introduction, Animal rights and animal laws in India, Prevention of cruelty to animals Act 1960, Biodiversity Act 2003.

Concept of 3 R – conservation (Refined- to minimize suffering, Reduced – to minimize animals, Replaced – modern tools and alternate means), Animal use in research and education.

Laboratory animal use, care and welfare, Animal protection initiatives- Animal Welfare 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.

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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
3. Internet: Access a web page on any biological topic.
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.
7. Graphical representation of data. Construction of bar diagrams, Histograms, Pie diagram and Line graphs.

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

Characteristics of a community: Species diversity- richness, eveness, stratification, dominance, ecological indicators, Ecotone and Edge effect, Keystone species, Concepts of Ecological Niche and Guild, Ecological succession, community evolution- climax.

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 harvestiong, watershed management

Environment education

Environmental laws (Brief account only): The Water (Prevention and Control of Pollution) Act, 1974, The Air (Prevention and Control of Pollution) Act, 1981, Indian Forests Act (Revised) 1982. The Environment (Protection) Act, 1986, Hazardous Wastes (Management and Handling) Rules, 1989, The Forest (Conservation) Act, 1980, The Wildlife Protection Act, 1972, Biodiversity Act, 2002.

MODULE 5 HUMAN RIGHTS 6 Hrs

Introduction, main concepts associated with Human Rights, Different types of human rights, Manifestations & phenomena, Role of agencies in promoting human rights, Mechanisms for checking violations of human rights, National human right commission, Constitutional provisions related to Human rights.

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Arun kumar Palai(1999) National Human Rights Commission of India, Atlantic publishers
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MeeraAsthana and Astana D.K.1990 Environmental pollution and Toxicology Alka printers.
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Alan Beeby, 2006 Anne – Maria Brennan First Ecology, Ecological principles and Environmental issues . International students edition Sec. edition Oxford University Press.
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Landis, Wayne and Hing-hoYu, 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
9. Visit to any two important areas of bio diversity: 1. Forest, 2.Sea shore, 3. Mangrove, 4. Wet lands, 5. Bird sanctuary, 6. Wild life sanctuary, 7. Sacred groves
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 **22 HRS**

Module I **6 Hrs**

Introduction of cell and Diversity of cells: History, Cell theory, Prokaryotes, Eukaryotes, Mycoplasmas, Virus, Virions and Viroids, Prions.

Cell membrane & Permeability: Molecular models of cell membrane (Sandwich model, Unit membrane model, Fluid mosaic model). Cell properties - permeability, Transport [Diffusion, Osmosis, Passive transport, Active transport, bulk transport], Cell coat and Cell recognition.

Module II **10 Hrs**

Cell Organelles : Structure and functions of following cell organelles: Endoplasmic reticulum - Structure and functions. Ribosomes (Prokaryotic and Eukaryotic) Golgi complex - Structure and functions. Lysosomes - Polymorphism - GERL concept, functions. Mitochondria - Structure and functions. Nucleus: Structure and functions of interphase nucleus, Nuclear membrane, pore complex, structure and functions of nucleolus

Chromosomes – Structure & organization, Heterochromatin, Euchromatin, Nucleosomes, Polytene chromosomes-Balbiani rings, Endomitosis, Lamp brush chromosomes.

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 - G_1, S, G_2 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*

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GENETICS **32 Hrs**

Module I **10 Hrs**

MendelianGenetics: 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 **10 Hrs**

Mutation: Types of mutations - Somatic, germinal, spontaneous, induced, autosomal and allosomal, chromosomal mutations, structural and numerical changes. Gene mutations. [Addition, Deletion and substitution].

HumanGenetics: 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:

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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)
4. Sexing of Drosophila.
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;

Direct evidences of evolution – Recapitulation Theory of Haeckel, Fossilization, Kinds of fossils, fossil dating, Homologous organs and analogous organs.

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

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 1V – 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 **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

1. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution.Cold Spring, Harbour Laboratory Press.
2. Barnes, C.W. (1988). Earth, Time and Life. John Wiley &Sons, NewYork
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13. Strickberger, M.W.2000. Evolution. Jones and Bartlett, Boston.

ETHOLOGY

1. Agarwal. V. K. (2009). Animal Behaviour.S.Chand and Company Pvt. Ltd., New Delhi.
2. Bonner, J.T. (1980). The Evolution of Culture in Animals. Princeton University Press.NJ, USA.
3. David McFarland. (1999). Animal Behaviour. Pearson Education Ltd. Essex, England.
4. Dawkins, M.S. (1995).Unravelling Animal Behaviour. Harlow: Longman.
5. Dunbar, R. (1988). Primate Social Systems. Croom Helm, London.
6. Gundevia J.S. and Singh H.G. (1996), A Text Book of Animal Behaviour. S. Chand and Company Pvt. Ltd., New Delhi.
7. Aubrey M. and Dawkins M.S. (1998). An Introduction to Animal Behaviour. Cambridge University Press,UK.
8. Sherman P.W and Alcock J., (2001) Exploring Animal Behaviour- Readings from American Scientist 3rd Edn. Sinauer Associates Inc. MA,USA. (Module 10 & 11).
9. Wilson, E.O. (1975). Sociobiology.Harvard University Press, Cambridge, Mass. USA.(Module 9).

ZOOGEOGRAPHY

1. Briggs, J.C. (1996). Global Biogeography. Elsevier Publishers.(Module VI and VII).
2. Chandran Subash M.D. (1997). On the ecological history of the Western Ghats.Current Science, Vol.73, No.2.146-155.
3. Chundamannil Mammen.1993, History of Forest management in Kerala. Report No.89. Kerala Forest Research Institute, Peechi, India.

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5. Mani, M.S. (1974). Ecology and Biogeography of India; The Hague: .Dr. W. Junk b.v. Publishers,
6. Nair, C.S. (1991). The Southern Western Ghats: A Biodiversity Conservation Plan. INTACH, New Delhi.
7. Ramesh, B.R and R Gurukkal (2007), Forest Landscapes of the Southern Western Ghats, India- Biodiversity, Human Ecology and management Strategies. (French Institute of Pondicherry) India.
8. Tiwari, S. (1985), Readings in Indian Zoogeography (vol.1). Today & Tomorrow Printers & Publishers

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 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**

Nutrition: Nutritional requirements – carbohydrates, proteins, lipids, minerals (Ca, P, Fe, I), vitamins (sources and deficiency disorders). Importance of dietary fibre and antioxidants.Balanced diet, Recommended Dietary Allowance (RDA). Nutrition during pregnancy and lactation, Infant nutrition, Malnutrition(PEM).

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**

Respiration: Phases of respiration (external respiration, gas transport and internal respiration). Respiratory pigments: Haemoglobin, Myoglobin (Structure and Function). Transport of respiratory gases - transport of oxygen, oxyhaemoglobin curve, factors affecting oxyhaemoglobin curve, transport of carbon dioxide,(chloride shift). Control of respiration.Respiratory disturbances (Hypoxia, Hypercapnia, Asphyxia).Physiological effect of smoking, carbon monoxide poisoning, Oxygen therapy and artificial respiration.

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 **5 Hrs**

Excretion: **H**istology of Bowman's capsule and tubular part. Urine formation – glomerular filtration, tubular reabsorption, tubular secretion.Urine concentration – counter current mechanism. Acid – base balance, hormonal regulation of kidney function. Renal disorders (kidney stone, acute and chronic renal failure, and dialysis). Homeostasis: Definition, concept and importance in biological system. Thermal regulation and thermal adaptation in homeotherms.

Module IV **10 Hrs**

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 **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:

Biochemistry by U.Satyanarayana and U Chakrapani**.**Elsevier; 4 edition (2013)

Outlines of Biochemistry by S.C.Rastogi. CBSPublishers (4)

Medical biochemistry by N.V. Bhagavan, fourth edition Academic Press, 2002

Introduction to Biological chemistryby Awapara J. Prentice Hall.1968

Harper's Illustrated Biochemistry by Harper. 29th edition (Lange basic science.)

Biochemistry by Lehninger.Palgrave - Macmillan (2007)

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

Textbook of Medical Physiology : Geetha N. Paras Medical Publishers, 3rd edition.

Textbook of human physiology : Sarada Subramanyam and K. Madhavankutty, S. Chand & Company Ltd, 2014

Textbook of Endocrinology : Williams, R.H.Elsevier, 12th edition.

General and Comparative Endocrinology: Barrington, E.J.W. Oxford University Pres

Endocrine Physiology : Martin, C.R.Oxford University 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 periodicclass discussions of current events in science which will benefitthem in their future studies in the biological/physiological sciences and health-related fields
3. To contribute tocritical societal goal of a scientifically literate citizenry.

Module1 **10 Hrs**

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

Reproductive Physiology: Gonads- anatomy of testis and ovary, spermatogenesis, oogenesis, gonadal hormones and their functions. Hormonal control of human reproduction - Female reproductive cycles (Estrous cycle, Menstrual cycle). Structure of mammalian sperm and egg, Pregnancy, parturition and lactation.Reproductive health and importance of sex education.

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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**

Cleavage: Types, planes and patterns of cleavage, Cell lineage of Planaria. Influence of yolk on cleavage.

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.

Gastrulation: Major events in gastrulation. Morphogenetic cell movements. Influence of yolk on gastrulation. Exogastrulation.Concept of germ layers and derivatives.

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**

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

Embryology of chick: Structure of egg, fertilization, cleavage, blastulation, fate map, gastrulation. Development and role of Primitive streak, Salient features of 18hour, 24 hour, 33 hour & 48 hour chick embryo.Extra embryonic membranes in chick.

Human development: Fertilisation, cleavage, blastocyst, implantation, placenta. Gestation, parturition and lactation.Human intervention in reproduction, contraception and birth control. Infertility, Invitro fertilization (test tube baby)

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,

Developmental defects: Prenatal death (miscarriage and still birth). Intrauterine Growth Retardation (IUGR).

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

Taylor D J, Green NPO & G W Stout. Biological Science, third edition.Cambridge university press.

Dutta, Obstrestics , Church Livingston 17 Ed

Harrison ,Harriosns 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.
8. Vital staining- demonstration.
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

1. Ananthanarayan R & Jayaram Paniker C K. (2009) *Text Book of Microbiology* Orient Longman Private Ltd.
2. Kuby J, Kindt T., Goldsby R. and Osborne B. (2007). *Kuby immunology*
3. Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala
4. Sharma K. (2005) *Manual of Microbiology: Tools and Techniques*, Ane books

References

1. Colemen: (2002). *Fundamentals of Immunology*
2. Darla J. Wise & Gordon R. Carter: (2004): *Immunology A Comprehensive Review Iowa state University Press*. A Blackwell science company,
3. Hans G. Sch, *Legal General Microbiology*, Seventh Ed. Cambridge Low Price Ed.
4. Helen Hapel, Maused Harney Siraj Misbah and Next Snowden: (2006) *Essentials of Clinical Immunology* Fifth Ed. Blackwell Publishing Company,
5. Heritage, J, E.G.V. Evaus and R.A.Killungten (2007): *Introductory Microbiology* Cambridge University Press

6. Ivan Roitt I (2002) *Essentials of Immunology* ELBS.

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

Gene Libraries, Construction of genomic library and cDNA Library. PCR technique and DNA amplification, Brief description of screening methods – Probes, Nucleic Acid hydridization, In situ Hybridization, Fluorescence in situ Hybridization (FISH), Colony hybridization. Methods of transfer of desired gene into target cell.Blotting Techniques- Southern, Northern, Western blotting.DNA Finger printing (DNA Profiling) and its application. Molecular markers - RFLP

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

1. Singh B.D Biotechnology 2002. Kalyan Publishers New Delhi.

2. Brown C.H., Campbell I & Priest F, G. 1987. Introduction of Biotechnology (Blackwell scientific publishers Oxford).

3. Colin Ratledge Bijorn Kristiansesn, 2008. Basic Biotechnology 3 rd ed. Cambridge University.

4. Janarathanan S & Vincent S. 2007. Practical Biotechnology, Method of Protocols. University Press.

5. John E. Smith. Biotechnology Cambridge Low priced ed. (Third Ed) 2005 Madingan, Martinko and Parker 2002, Biology of Microorganisms, Brock Eighth Ed. Prentice Hall.

6. Singh B.D. Biotechnolgy 2002, Kalyan Publishers New Delhi.

7. Sudha Gangal 2007. Biotechnology Principles and & practice of Animal Tissue culture, Universities Press.

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

1. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006).Cell and Molecular Biology.VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Gupta, P. K (2002) Cell and Molecular Biology, (2ed), , Rastogi Publications., Meerut
4. James Darnell. (1998) Molecular Biology. Scientific American Books Inc
5. Thomas AP(Editor). 2011 Cell &Molecular Biology The Fundamentals. Green leaf publications .TIES Kottayam
6. Zoological Society of Kerala Study material. (2011) Cell and Molecular Biology

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 profitablefarming.
3. To make the students aware of cottage industries.

Module 1. APICULTURE **18 Hrs**

Definition, Different species of honey bees, Organization of honey bee colony, Social life and adaptation of honey bees. Communication among honey bees. Bee keeping methods and equipments, Management and maintenance of an apiary, Growth period, honey flow period and dearth period Division of the colony, uniting two colonies, , replacing old queen with new queen, swarming management, monsoon management. Enemies of bees. Diseases of bees,.Bee pasturage. Uses of honey bees, By-products of honey bees, Honey and wax composition. Testing the quality of honey.Extraction of wax, Uses of honey and wax.Royal jelly, Propolis. Apitherapy, Agencies supporting apiculture.

Activity :Visitto 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**

Introduction, Ecological classification of earth worms. Species of earth worms used for vermicultre, Reproduction & life cycle, Role of earth worm in solid waste management, in agriculture, in medicine etc. Preparation of vermibed, Maintenance & monitoring, Preparation of vermicompost, Preparation of vermiwash.

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.

Shukla G.S, & Updhyay V.B, Economic zoology ,Rastogi Publ. Meerut.

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

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

Clive. A Edwards, Norman. Q. & Rhonda. 2011. Vermitechnology: earthworms, organic waste & environmental management.

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.

Ronald j. Roberts (1978) Fish pathology , Cassel Ltd London.

Cowey C. B. *et. al*. (1985) Nutrition and feeding in fishes, academy press.

Farm made aquafeeds. FAO fisheries Technical paper, 343.

Harisankar J. Alappat& A. Bijukumar, Aquarium Fishes. B. R. Publ. Corporation, Delhi.

MPEDA, A hand Book on AquafarmingOrnamentalfishes, MPEDA, Kochi.

Amber Richards. 2014. Aquaponics at home.

Pradip.V.Jabde. 1993. Text book of applied zoology
Venkitaraman, P.R,1983, Text book of Economic zoology(SudharsanaPuubl. Kochi)
Addison Webb, Bee Keepingfor profit and pleasure, Agrobios Ltd.
Edwards.C.A.&Lafty, J.R.1972 Biology of earthworms(Chapman & Hall Led.London)
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)

1. VOCATIONAL ZOOLOGY 72 Hrs

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 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 aquariumand 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 3Quail 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 5Vermiculture and composting 12 Hrs

Introduction, ecological classification of earth worms, Life history, Species of earth worms used for vermicultre, 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 6Apiculture 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.

Alka Prakash (2011), Laboratory Manual of Entomology, New age International, New Delhi.

Arumugan N. (2008) Aquaculture, Saras publication.

Biju Kumar A and Harishanker J Alappat (1995) A Complete Guide To Aquarium Keeping. Published by Books For All, New Delhi.

Chauhan, H.V.S. and S. Roy, (2008). Fungal Diseases. In: Poultry Diseases, Diagnosis and Treatment, Chauhan, H.V.S. and S. Roy (Eds.). 3rd Ed., New Age International (P) Ltd., New Delhi

Cowey C. B. Mackie, A.M. and Bell, J. G (1985) Nutrition and feeding in fishes. Academy press.

David Alderton (2008). Encyclopedia of Aquarium and Pond fish. Published by Dorling Kindersley, DK Books.

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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.

Diabetese, Cardiovasculard 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

Water borne dseases-Cholera and Typhoid.Prevention of Water borne diseases.

Food borne diseases and Prevention

Botulinum, Salmenellosis, 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

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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 **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 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 **10 Hrs**

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 **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

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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 Rerserve

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:

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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 **I5 Hrs**

Pest and crop loss: Introduction, historical perspective-origin of pest, Evolution of pest. Causes of pest outbreak- biotic, abiotic and genetic factors.Modern agricultural practices and pest problem - high yielding varieties, monoculture, fertilizers, pesticides, irrigation, and cultural practices.

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.

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ELECTIVE COURSE

3. VECTOR AND VECTOR BORNE DISEASES

72 Hrs

3 Credits

Objectives:

Module I **10Hrs**

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 I1 **6 Hrs**

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

Module II1 **25 Hrs**

Study of Vector Borne disease[Life cycle and pathology]: Mosquito-borne diseases – Malaria, Dengue, Chikungunya, Filariasis. Sand fly-borne diseases – Leishmaniasis, Phlebotomus fever. Tse- tse fly – sleeping sickness. House fly borne diseases :typhoid fever, cholera, dysentery, anthrax, Myiasis, . Flea-borne diseases – Plague, Typhus fever. Louse-borne diseases –Relapsing fever, Trench fever, Vagabond's disease, Phthiriasis.

Module IV **13 Hrs**

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**

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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**

Understanding of health: Define health, basic concepts, dimensions of health, basic parameters of health care. (Health Parameters: Individual normal standards, devices.1. Blood pressure, 2. Brain activities and sleep, 3.Focus or attention, 4.Pulse, 5. Body temperature,

6. Daily physical activities, 7. Electrocardiogram (ECG), 8.Cardiac fitness 9. Stress,

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.

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