MAHATMA GANDHI UNIVERSITY
PRIYADARSHINI HILLS, KOTTAYAM 686 560

RESTRUCTURED CURRICULUM AND SYLLABI IN CHOICE BASED COURSE & CREDIT AND SEMESTER SYSTEM

FOR

UNDERGRADUATE PROGRAMMES AND INTRODUCTION OF GRADING

IN

ZOOLOGY PROGRAMME

2009 ADMISSION ONWARDS

CONTENTS

B.Sc. ZOOLOGY PROGRAMME

Programme Objectives

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

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

Programme Outcomes

The graduate of this programme should be able to

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

Comments

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

Course structure:

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

Course coding:

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

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

ZOOLOGY CODES

Code	
ZY	Zoology
ZYB	Zoology Core Course
	Zoology Core, Choice Based (ZY6B13U/ZY6B14U/ZY6B14U)
ZYB (P)	Zoology Core Practical
ZYD	Zoology Open Course
	(ZY5D01U/ZY5DO2U/ZY5DO3U)
ZYC	Zoology Complementary Zoology
	(ZY1CO1U/ZY2CO2U/ZY3CO3U/ZY4CO4U)
ZYC (P)	Zoology Complementary Zoology Practical Model I
	(ZY1CO1U [P]/ZY2CO2U [P]/ZY3CO3U [P]/ZY4CO4U [P])
ZAV	Zoology Vocational Aquaculture
ZMV	Zoology Vocational Medical Microbiology
ZFV	Zoology Vocational Food Microbiology
ZBV	UGC Sponsored Vocational Biological Techniques and Specimen preparation.
ZY6BPVU	Zoology 6th semester core project viva undergraduate.
ZYCV	Zoology Complementary Zoology for Vocational (Model II)
	(ZY1CVO1U/ZY2CVO2U/ZY3CVO3U/ZY4CVO4U)

INVESTIGATORY PROJECT, FIELD STUDY/ (STUDY TOUR) AND GROUP ACTIVITY

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

Field study/study tours should be conducted for not less than 6 days (completed during the entire programme), preferably spreading the study in the first to sixth semesters. Students are expected to visit at least 3 research institutes and various places of zoological importance.

B. Group Activity

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

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

C. Project Work

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

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

Zero Credit Courses:

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

Examinations:

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

on 5-point scale as given below.

Letter Grade	Performance	Grade point (G)	Grade Range
A	Excellent	4	3.5 to 4.00
B	Very Good	3	2.5 to 3.49
C	Good	2	1.5 to 2.49
D	Average	1	0.5 to 1.49
E	Poor	0	0.00 to 0.49

The overall grade for a programme for certification shall be based on CGPA with a 7-point scale given below

CGPA	Grade
3.80 to 4.00	A+
3.50 to 3.79	A
3.00 to 3.49	B+
2.50 to 2.99	B
2.00 to 2.49	C+
1.50 to 1.99	C
1.00 to 1.49	D

A separate minimum of D grade for internal and external are required for a pass for a course. For a pass in a programme a separate minimum of Grade D is required for all the courses and must score a minimum CGPA of 2.00 or an overall grade of C+ and above.

Internal or In-Semester Assessment (IA):

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

Theory

Component	Weight
Attendance*	1
Assignment	1
Seminar	1
Best two test papers	2
Total	5

***Attendance**

% of Attendance	Grade
>90%	A
Between 85 and 90	B
Between 80 and 85	C
Between 75 and 80	D
< 75	E

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

Practical

Component	Weight
Attendance *	1
Laboratory Involvement **	2
Test	2
Record	2
Viva-Voce/Quiz	1

Total	8

Attendance & Laboratory Involvement *

Attendance *	Laboratory Involvement **
Attendance >90%= A	Punctuality +
89% to 85% = B	Handling Equipments +
84% to 80% = C	Skill in Laboratory work +
79% to 75% = D	Group Interaction = A
< 75 =E	

The evaluation of all components is to be published and is to be acknowledged by the candidate. All documents of internal assessments are to be kept in the institution for 2 years and shall be made available for verification by the university. The responsibility of evaluating the internal assessment is vested on the teacher(s) who teach the course.

External or End-Semester Assessment (EA):

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

Examinations (Practical):

The practical examinations for the core courses at the end of semester 1, semester 2, semester 3 and semester 4 should be conducted by the university with a common time-table and questions set by the university. One examiner shall be selected from a panel of experts published by the university and the other internally. The graded score sheet, duly certified by the head of the institution, should be sent to the university before the commencement of the end semester university examinations on theory courses. The practical examinations for the core courses at the end of semester 5 and semester 6 should be conducted externally by arranging two practical examinations in a session.

The practical examinations for the complementary courses at the end of semester 1, semester 2 and semester 3 should be conducted by the university with a common time-table and questions set by the university. One examiner shall be selected from a panel of experts published by the university and the other internally.. The graded score sheet, duly certified by the head of the institution, should be sent to the university before the commencement of the end semester university examinations on theory courses. The practical examinations for the complementary courses at the end of semester 4 should be conducted externally.

Pattern of Questions (Theory):

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

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

For all semesters:

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

Evaluation of problems in the grading system:

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

1. Correct formula with correct substitution and answer : **A**
2. Correct formula with correct substitution and

answer but wrong or no unit. : **B**

3. Correct formula with correct substitution and wrong answer : **C**
4. Formula alone is correct : **D**
5. Even formula is incorrect : **E**

Evaluation of practical examinations:

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

Student Strength for practical:

There shall be at least one teacher to supervise a batch of not more than 15 students in each laboratory session.

RESTRUCTURED CURRICULUM FOR
B.Sc. DEGREE IN ZOOLOGY PROGRAMME
COURSE STRUCTURE

SCHEME OF INSTRUCTIONAL HOURS AND CREDITS

(TOTAL CREDITS 120)

Semester I **Total Credits 20**

No	Course Title	Hrs/ Week	Credits
1	Common Course English - 1	5	4
2	Common Course English - 2	4	3
3	Common Course III Second Language - 1	4	4
4	Core Course I General Methodology and Perspectives in Science	2	2
5	Core Course I Practical General Methodology and Instrumentation	2	1
6	1st Complementary Course Chemistry I/Biochemistry I	2	2
7	1st Complementary Course Chemistry Practicals I	2	1
8	2nd Complementary Course Botany I	2	2
9	2nd Complementary Course Botany Practicals I	2	1
	Total	25 hrs	20

Semester 2 **Total Credits 20**

No	Course Title	Hrs/ Week	Credits
1	Common Course IV English 3	5	4
2	Common Course V English 4	4	3
3	Common Course VI Second Language -2	4	4
4	Core Course II Biodiversity and Modern Systematics	2	2
5	Core Course II Practical Biodiversity and Modern Systematics	2	1
6	1st Complementary Course Chemistry II/Biochemistry II	2	2
7	1st Complementary Course Practicals II	2	1
8	2nd Complementary Course Botany II	2	2
9	2nd Complementary Course Practicals II	2	1
	Total	25 hrs	20

Semester 3 **Total Credits 20**

No	Course Title	Hrs/ Week	Credits
1	Common Course VII English 5	5	4
2	Common Course VIII Second Language 3	5	4
3	Core Course III Animal Diversity - Non Chordata	3	3
4	Core Course III Practical Animal Diversity - Non Chordata	2	1
5	1st Complementary Course III Chemistry III/Biochemistry III	3	3
6	1st Complementary Course III Practicals III	2	1
7	2nd Complementary Course III Botany III	3	3
8	2nd Complementary Course III Practicals III	2	1
	Total	25 hrs	20

Semester 4 **Total Credits 20**

No	Course Title	Hrs/ Week	Credits
1	Common Course IX English -6	5	4

2	Common Course X Second language 4	5	4
3	Core Course IV Animal Diversity ◆Chordata	3	3
4	Core Course IV Practical Animal Diversity ◆Chordata	2	1
5	1st Complementary Course IV Chemistry IV/Biochemistry IV	3	3
6	1st Complementary Course IV Chem. Practicals.	2	1
7	2nd Complementary Course IV Botany IV	3	3
8	2nd Complementary Course IV Botany Practicals.	2	1
	Total	25 hrs	20

Semester 5

Total Credits 20

No	Course Title	Hrs/ Week	Credits
1	Core Course V Cell Biology and Molecular Biology	3	3
2	Core Course VI Environmental Biology, Toxicology and Disaster management	3	3
3	Core Course VII Evolution, Zoogeography and Ethology	3	3
4	Core Course VIII Biochemistry, Human Physiology and Endocrinology	3	3
5	Core Course Practicals (Core V, VI, VII &VIII)	8	4
6	Core Course Field Study , Study tour and Group activity (Credit 1 in 6th semester with investigatory project and visit to research institutes.)	1	
7	Open Course (For other streams)/ Own streams Elective 1 ◆ Man, Nature and Sustainable Development Elective 2 ◆ Human Genetics, Nutrition, Community health and Sanitation Elective 3 ◆ Management of Ornamental fish breeding , Rabbit farming , Poultry, Quail farming, Vermi culture, Beekeeping and Sericulture. Elective 4 Food Microbiology	4	4
	Total	25 hrs	20

Semester 6 **Total Credits 20**

No	Course Title	Hrs/ Week	Credits
1	Core Course IX Reproductive and Developmental Biology	3	3
2	Core Course X Genetics and Biotechnology	3	3
3	Core Course XI Microbiology and Immunology	3	3
4	Core Course XII ◆ General informatics, Bioinformatics and Biostatistics	3	3
6	Core Course Choice based (Electives) Elective I - Ecotourism Elective 2 -Nutrition, Community Health, and Sanitation Elective 3 Applied Entomology , Management of Ornamental Fish Breeding , Vermiculture and Bee keeping	4	3
7	Core Course Practicals (IX, X, XI & XII)	8	4
8	Project work & Field Visit/Study Tour, Visit to research institutes , Group activity	1	1
		25 hrs	20

B.Sc. ZOOLOGY PROGRAMME

CORE COURSES

SCHEME OF DISTRIBUTION OF INSTRUCTIONAL HOURS

Name of semester	Theory	Practical
First semester	2	2
Second semester	2	2
Third semester	3	2
Fourth semester	3	2
Fifth semester Field Study and Group activity	16 1	8
Sixth semester	16	8
Project work (in 6th semester), Visit to	1	

research institutes		

RECORDS

1. General Methodology and Instrumentation
2. Biodiversity and Modern Systematics
3. Animal Diversity - Non-Chordata
4. Animal Diversity - Chordata
5. Cell Biology and Molecular Biology
6. Environmental Biology, Toxicology and Disaster Management
7. Evolution, Zoogeography and Ethology
8. Biochemistry, Human Physiology and Endocrinology
9. Reproductive and Developmental Biology
10. Genetics and Biotechnology
11. Microbiology and Immunology
12. Computer Application, Bioinformatics and Biostatistics

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

CORE COURSES

SCHEME OF DISTRIBUTION OF HOURS AND CREDIT

Name of semester	Code	Name of core course	Hrs	Inst Hrs/week	Credit
1	ZY1B01U	General Methodology and perspectives in science	36	2	2
1	ZY1B01U [P]	(Practical)- General Methodology & instrumentation	36	2	1
2	ZY2B02U	Biodiversity & Modern systematics	36	2	2
2	ZY2B02U [P]	(Practical) Biodiversity & Modern systematics	36	2	1
3	ZY3B03U	Animal Diversity Non Chordata	54	3	3
3	ZY3B03U [P]	(Practical) Animal Diversity Non chordata	36	2	1
4	ZY4B04U	Animal Diversity Chordata	54	3	3
4	ZY4B04U [P]	(Practical) Animal Diversity Chordata	36	2	1
5	ZY5B05U	Cell Biology and Molecular Biology	54	3	3
5	ZY5B05U [P]	(Practical) Cell Biology and Molecular Biology	36	2	1
5	ZY5B06U	Environmental Biology, Toxicology and Disaster Management	54	3	3
5	ZY5B06U [P]	(Practical) Environmental Biology, Toxicology and Disaster Management	36	2	1
5	ZY5B07U	Evolution, Zoogeography and Ethology	54	3	3
5	ZY5B07U [P]	(Practical) Evolution, Zoogeography and Ethology	36	2	1
5	ZY5B08U	Biochemistry, Human Physiology and Endocrinology	54	3	3
5	ZY5B08U [P]	(Practical) - Biochemistry, Human Physiology & Endocrinology	36	2	1
6	ZY6B09U	Reproductive and Developmental Biology	54	3	3
6	ZY6BO9U[P]	(Practical) - Reproductive and Developmental Biology	36	2	1
6	ZY6B10U	Genetics and Biotechnology	54	3	3
6	ZY6B10U [P]	(Practical) Genetics & Biotechnology	36	2	1
6	ZY6B11U	Microbiology and Immunology	54	3	3
	ZY6B11U [P]	(Practical) Microbiology and Immunology	36	2	1
6	ZY6B12U	General informatics Bioinformatics and Biostatistics	54	3	3
6	ZY6B12U [P]	(Practical) Computer application Bio informatics and Bio statistics	36	2	1

CORE CHOICE BASED COURSE (6th SEMESTER) Core- Course Electives

The students of Zoology Programme of each college can select any of the three in consultation with the Faculty of the Department .					
6	ZY6B13U	Ecotourism	72	4	3
6	ZY6B14U	Nutrition, community health and Sanitation	72	4	3
6	ZY6B15U	Applied Entomology, Management of Ornamental fish breeding, Vermiculture and Bee keeping	72	4	3
Project 6	ZY6BPVU	Project and Viva (6th Semester) Visit to research institutes (6th Semester) Study tour/Field study , Group activity (5th Semester)	18 18	1 1	1

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

OPEN COURSES FOR OTHER STREAMS - Electives					
Vth semester	(Zoology Department can offer any one of the four open courses)				
5	ZY5D01U	Man , Nature and Sustainable Development	72	4	4
5	ZY5D02U	Human Genetics, Nutrition, Community health and Sanitation	72	4	4
5	ZY5D03U	Management of Ornamental fish breeding , Rabbit farming , Poultry, Quail farming, Vermiculture, Beekeeping and Sericulture	72	4	4
5	ZY5D04U	Food Microbiology	72	4	4

COMPLEMENTARY ZOOLOGY COURSES FOR BSc. BOTANY (MODEL I) /HOME SCIENCE / BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION					
Semester 1	ZY1C01U ZY1C01U [P]	Animal Diversity – Non-Chordata (Practical) - Animal Diversity – Non-Chordata	36 36	2 2	2 1
Semester 2	ZY2C02U ZY2CO2U [P]	Animal Diversity –Chordata (Practical) - Animal Diversity –Chordata	36 36	2 2	2 1
Semester 3	ZY3C03U ZY3C03U [P]	Human Physiology and Immunology (Practical) - Human Physiology and Immunology	54 36	3 2	3 1
Semester 4	ZY4C04U ZY4C04U [P]	Applied Zoology (Aquaculture, Sericulture, Vermiculture and Apiculture) (Practical) - Applied Zoology	54 36	3 2	3 1

COMPLEMENTARY ZOOLOGY COURSES FOR B.Sc BOTANY (MODEL II) OFFERED BY ZOOLOGY DEPARTMENT

Semester	Code	Course	Hrs	Hrs/ week	Credit
Semester 1	ZY1CVO1U ZY1CVO1U (P)	Animal Diversity-Non Chordata Animal Diversity-Non Chordata (Practical)	54 36	3 2	2 1
Semester 2	ZY2CVO2U	Animal Diversity-Chordata	54	3	2

	ZY2CVO2U (P)	Animal Diversity-Chordata (Practical)	36	2	1
Semester 3	ZY3CVO3U	Human physiology & Immunology	54	3	3
	ZY3CVO3U (P)	Human physiology & Immunology (Practical)	36	2	1
Semester 4	ZY4CVO4U	Applied Zoology	54	3	3
	ZY4CVO4U (P)	Applied Zoology (Practical)	36	2	1

SCHEME OF EXAMINATIONS

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

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

SCHEME OF EXAMINATION THEORY (CORE COURSE)

				Weightage ratio		
ME-ER	**CODE ZY**	**COURSE**	**HRS**	**INTE-RNAL**	**EXTE-RNAL**	**CREDITS**
I	ZY1B01U	General Methodology and Perspectives in Science	3	1	3	2
II	ZY2B02U	Biodiversity and Modern Systematics	3	1	3	2
III	ZY3B03U	Animal diversity -Non Chordata	3	1	3	3
IV	ZY4B04U	Animal Diversity Chordata	3	1	3	3
V	ZY5B05U	Cell Biology And Molecular Biology	3	1	3	3
	ZY5B06U	Environmental Biology Toxicology and Disaster Management	3	1	3	3
	ZY5B07U	Evolution Zoogeography and Ethology	3	1	3	3
	ZY5B08U	Biochemistry Human Physiology and Endocrinology	3	1	3	3
VI	ZY6B09U	Reproductive and Developmental Biology	3	1	3	3
	ZY6B10U	Genetics and Biotechnology	3	1	3	3
	ZY6B11U	Microbiology and Immunology	3	1	3	3
	ZY6B12U	General Informatics, Bioinformatics and Biostatistics	3	1	3	3
	ZY6B13U	Ecotourism				

			3	1	3	3
CTIVES OLOGY RE DICE SED	ZY6B14U	Nutrition, Community health And Sanitation	3	1	3	3
	ZY6B15U	Applied Entomology, Management of Ornamental fish breeding, Vermiculture and Bee keeping	3	1	3	3

EN COURSES FOR OTHER STREAMS / Own streams						
1 5 tives	ZY5D01U	Man, Nature and Sustainable Development	Exam hr 3	1	3	4
	ZY5D02U	Human Genetics, nutrition, community health and Sanitation	3	1	3	4
	ZY5D03U	Management of Ornamental fish breeding , Rabbit farming , Poultry, Quail farming, Vermiculture, Beekeeping and Sericulture	3	1	3	4
	ZY5D04U	Food Microbiology	3	1	3	4

SCHEME OF PRACTICAL EXAMINATIONS

University Practical Examinations will be conducted at the end of each semester

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

Weightage ratio 1:3

Code	Exam duration		Internal	External	Credit
ZY1B01U [P]	2Hrs	General Methodology & Instrumentation	1	3	1
ZY2B02U [P]	2Hrs	Biodiversity & Modern systematics	1	3	1
ZY3B03U [P]	2Hrs	Animal Diversity ◆ Non chordata	1	3	1
ZY4B04U [P]	2Hrs	Animal Diversity Chordata	1	3	1

B. Scheme of Practical Examinations at the end of 5th Semester

ZY5B05U [P]	Session (1) 3Hrs (Day1)	Cell Biology & Molecular Biology	1	3	1
Y5B06U [P]		Environmental Biology	1	3	1
Y5B07U [P]	Session (2) 3Hrs Day(2)	Evolution & Zoogeography	1	3	1
ZY5B08U [P]		Biochemistry , Human Physiology & Endocrinology	1	3	1

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

ZY6B09U [P]	Day 1	Reproductive and Developmental	1	3	1

	Session (1)	Biology			
ZY6B10U [P]	3Hrs	Genetics & Biotechnology	1	3	1
ZY6B11U [P]	Day 2 Session(2) 3Hrs	Microbiology and Immunology	1	3	1
ZY6B12U [P]		Computer application, Bio informatics and Biostatistics	1	3	1
ZY6BPVU	Day3 Session (3) 3Hrs	Project and Viva Study Tour, Field Study Report, Group activity	1	3	1
				Total	**13**

	TOTAL CREDIT	
	Theory	
	Core + Choice Based Core	37
	Open course	4
	Practical	
	Practical + Project and Viva + Field Study Report, Group activity	13
	Total	**54 credits**

SCHEME OF PRACTICAL CORE COURSES

(External exam)

External Weightage: **25**

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

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

Weightage

	Weightage (Internal)	Weightage (External)
Field Study report	**4**	
Group Activity	**2**	
Project	**2** Log book showing the progress of project work duly signed by the supervising teacher & HOD	Project report Title-**1** Abstract-**2** Introduction + Literature review-**2**
		Methodology-**4**
		Results-**4**
		Discussion & Conclusion-**4**
		Neat presentation and Novelty-**4** (Student can present the project using OHP

		or LCD, in 7 Minutes)
		Viva Voce-**4**
Total	**8**	**25**

B.Sc ZOOLOGY PROGRAMME

MODEL - I

SYLLABI

SEMESTER I

ZY1B01U Core Course I

GENERAL METHODOLOGY AND PERSPECTIVES IN SCIENCE

36 hrs
Credits 2

Objectives

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

Pre-requisite:

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

PART – I BIOLOGY - THE LIFE SCIENCE 25 Hrs

Module I. Science and Scientific Studies (4 hrs)

Types of knowledge: practical, theoretical, and scientific knowledge. Information.
What is science; what is not science; laws of science.
Basis for scientific laws and factual truths.
Science as a human activity, scientific temper, empiricism.
Vocabulary of science, science disciplines.
Revolutions in Science and Technology

Core Readings

Bowler Peter J. and Iwan Rhys Morus. 2005 *Making Modern Science: A Historical Survey.* University of Chicago Press, Chicago, IL:

Ernst Mayr 1982. *The Growth of Biological Thought: Diversity, Evolution and Inheritance.* Published by Harvard University Press.
Ervin Schrodinger 1944. What is life? Mind and Matter. Cambridge University Press.
Jacques Monod 1971. *Chance and Necessity: An Essay on the Natural Philosophy of Modern Biology.* Vintage Pub. NY
Kuhn, Thomas. 1996 *The Structure of Scientific Revolutions* 3rd ed.: University of Chicago Press, Chicago, IL
Taylor, Green, Stout (2008) Biological Science, Cambridge University, Press, p 951.
Thomas, A.P. (Editor) 2009. Biology – Perspectives and Methods. Green Leaf Pubslishers, Kottayam.

Module II. What is Biology? (4 hrs)

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

Core Readings

Bowler Peter J. and Iwan Rhys Morus. 2005 *Making Modern Science: A Historical Survey.* University of Chicago Press, Chicago, IL:

Ernst Mayr 1982. *The Growth of Biological Thought: Diversity, Evolution and Inheritance.* Published by Harvard University Press.
Ernst Myer. 1997. *This is Biology: The Science of the living World.* University Press, Hyderabad, India
Ernst Myer. 1997. *This is Biology: The Science of the living World.* University Press, Hyderabad, India
Kuhn, Thomas. 1996 *The Structure of Scientific Revolutions* 3rd ed.: University of Chicago Press, Chicago, IL
Thomas, A.P. (Editor) 2009. Biology – Perspectives and Methods. Green Leaf Pubslishers, Kottayam.

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

Scientific drawing -Purpose and principle
Basic understanding on principle and uses of the following:
Microscopy (a) Light microscopy,
Bright field (Compound Microscope), Phase contrast, Dark field microscopy, Fluorescence, 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

Core readings

Aggarwal S.K, 2009 *Foundation Course in Biology* Ane–s Students Edition P- 79-93.
Eldon D. Enger, Frederick C. Ross and David Bailey 2008(Eleventh Edition) *Concepts in Biology.* Tata – McGraw Hill, New Delhi
Taylor, Green, Stout (2008) Biological Science, Cambridge University, Press, p 161-163
Wilson & Walkar 2008 *Principles and Techniques of Biochemistry and Molecular Biology* Cambridge University Press. Chapters 9,10,11,15.

Zoological Society of Kerala Study Material 2002 – *Cell Biology, Genetics & Biotechnology*. Chapter- 2 Tools and Techniques.

Module IV. Animal Collection techniques (5 hrs)

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

Core Readings

Killick, H.J. 1971. Beginning ecology. Ibadan University Press.
Thomas, A.P. (Editor) 2009. Biology – Perspectives and Methods. Green Leaf Pubslishers, Kottayam.

PART II: BIOLOGY AND RESEARCH (11 hrs)

Module V. Bioethics (5 hrs)

Introduction
Animal rights and animal laws in India.
Prevention of cruelty to animals Act 1960
Wildlife protection act 1972 and Amendments
Biodiversity Act 2003.
Concept of 3 R – conservation (**R**efined- to minimize suffering, **R**educed – to minimize animals, **R**eplaced – modern tools and alternate means)
Animal use in research and education.
Laboratory animal use, care and welfare
Animal protection initiatives
Animal Welfare, Animal Welfare Board, India CPCSEA

Working with Humans, harm, risk, and benefits.Consent.
Special Cases: Children and Vulnerable people, Equality, Anonymity, Confidentiality, Information Storage and dissemination
Human Rights Act-1995, 1998.
Right to information- 2005.

Core Readings

Debbies Holmes, Peter Moody and Diana Dine 2006 Research methods for the Biosciences. International student Edition: Oxford University Press. P. 288-299.
Marie, M. 2005. Animal Bioethics: Principles and Teaching Methods Wageningen Academic Publishers

Module VI. Research Methodology (5 hrs)

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

Core Readings

Anderson, J, Durston, B.H. and Poole, M. 1992. Thesis and assignment writing. Wiley Eastern Ltd.
Debbies Holmes, Peter Moody and Diana Dine 2006 Research methods for the Biosciences. International student Edition: Oxford University Press. Chapters.1-8.
Hawkins C. and Sorgi, M. 1987. Research: How to plan, speak and write about it. Narosa Publishing House.
Ruxton, G.D. and Colegrave, N. 2006. Experimental design for the life sciences. Oxford University Press. Chapters 1-6.

Module VII. Units of measurements (1 hr)

Calculations and related conversions of each:
- Metric system- length; surface; weight
- Square measures
- Cubic measures (volumetric)
- Circular or angular measure
- Concentrations- percent volume; ppt; ppm
- Chemical ⊕ molarity, normality
- Temperature- Celsius, centigrade, Fahrenheit

Core readings

D.K. Illustrated Oxford Dictionary.2006 Chapter on Measurements p-968.
Knut Schimidt ⊕ Nielsen 2007 *Animal Physiology,* 5th Edition, Appendix -A
Taylor D.J. Green N.P.O, Stout G.W. Editor R. S. Oper, 2008 Biological science (Third edition Cambridge University press. P-960

Selected Further Readings

Aggarwal. S.K. 2009 Foundation Course in Biology, 2nd Ed.. Ane⊕s Student Edition. Ane Books Pvt. Ltd.
Anderson, J, Durston, B.H. and Poole, M. 1992. Thesis and assignment writing. Wiley Eastern Ltd.
Bowler Peter J., and Iwan Rhys Morus. 2005 *Making Modern Science: A Historical Survey*. University of Chicago Press, Chicago, IL:
Day, R.A. 1993. How to write and publish a scientific paper. Cambridge University Press. (Module VI)
Day, R.A. 2000. Scientific English: A guide for Scientists and other Professionals. Universities Press. (Module VI)
Debbies Holmes, Peter Moody and Diana Dine 2006 Research methods for the Biosciences. International student Edition : Oxford University Press .
Eldon D. Enger ,Frederick C. Ross and David Bailey 2008 (Eleventh Edition) *Concepts in Biology* .Tata-McGraw Hill , New Delhi.(Module VII, II & III)
Ernst Mayr 1982. *The Growth of Biological Thought: Diversity, Evolution, and Inheritance*. Published by Harvard University Press.
Ernst Myer .1997. *This is Biology: The Science of the Living World.* Universities Press, Hyderabad, India
Ervin Schrodinger 1944. What is life? Mind and Matter. Cambridge University Press
Gupta K.C, Bhamrah, H.S and G.S.Sandhu 2006.Research Techniques in Biological Sciences. Dominant Publishers and Distributors, New Delhi.
Hawkins C. and Sorgi, M. 1987. Research: How to plan, speak and write about it. Narosa Publishing House.
Jacques Monod 1971. *Chance and Necessity: An Essay on the Natural Philosophy of Modern Biology.* Vintage Pub. NY
Kuhn, Thomas. 1996 *The Structure of Scientific Revolutions*. 3rd ed.: University of Chicago Press, Chicago, ILMarie, M. 2005. Animal Bioethics: Principles and Teaching Methods Wageningen Academic Publishers
Michael Roberts,Tim King and Michael Reiss.1994.Practical Biology for Advance Level. Thomas Nelson and Sons Ltd. Surrey, UK.
Ruxton, G.D. and Colegrave, N. 2006. Experinmental design for the life sciences. Oxford University Press.
Sateesh, M.K. 2008 Bioethics and Biosafety; I.K. International Publishing House (Module V)
Taylor D.J. Green N.P.O, Stout G.W. Editor R. S. Oper, 2008 Biological science (Third edition Cambridge University press

ZY1B01U [P] Practical I: General Methodology and Instrumentation

36 hours
Credit 1

1. Study of simple and compound light microscopes

2. Micrometry ﷺcalibration and measurement of microscopic objects ﷺlow power
3. Camera Lucida (draw a few diagrams using Camera Lucida)
4. Paper chromatography (demonstration only)
5. Instrumentation ﷺ demonstration (write notes on principle, equipment and its use)
   - pH Meter
   - Colorimeter/ Spectrophotometer
   - Centrifuge
   - Electrophoresis
6. Scientific drawing (representatives from any five taxa)
7. Insect Preservation techniques (Group Activity)

SEMESTER II

ZY2B02U Core Course 2

BIODIVERSITY AND MODERN SYSTEMATICS

36 hrs

Credits 2

Objectives:

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

Pre requisite:

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

PART I: BIODIVERSITY (26 Hrs)

Module I ﷺ Introduction to Biodiversity (2 hrs)

Definition
Historical perspective
Concepts ﷺ
Nature ﷺ environment ﷺ biodiversity
Scope and importance

Core Readings

Chapman J.L. & M.J. Reiss 2006 Ecology, Principles and Applications. Sec Edition Cambridge University Press.
Supriyo Chakraborty.2004 *Biodiversity*. Pointer Publishers, Jaipur, India.
Wilson E.O., 1988 (Editor).*Biodiversity*. National Academy press, Washington DC, USA.

Module II ﷺ Levels of biodiversity (5 hrs)

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

Core Readings

Chapman J.L. & M.J. Reiss 2006 Ecology, Principles and Applications. Sec Edition Cambridge University Press.
Myers, Norman.1984. *The Primary Source: Tropical Forests and Our Future*. W.W. Nortan & Company, NY.
Myers,N., Mittermiere,R.A., Mittermeier,C.G., Dea Fonseca,G.A.B and J.Kent. 2000. Biodiversity hotspots for conservation priorities. *Nature*, 403:853-858.
Supriyo Chakraborty.2004 *Biodiversity*. Pointer Publishers, Jaipur, India.
Wilson E.O., 1988 (Editor).*Biodiversity*. National Academy press, Washington DC, USA.

Module III ﷺ Values of biodiversity (4 hrs)

Direct use value
Indirect use value
Non use value
Ecosystem services

Core Readings

Myers, Norman.1984. *The Primary Source: Tropical Forests and Our Future*. W.W. Nortan & Company, NY.
Myers,N., Mittermiere,R.A., Mittermeier,C.G., Dea Fonseca,G.A.B and J.Kent. 2000. Biodiversity hotspots for conservation priorities. *Nature*, 403:853-858.

Supriyo Chakraborty.2004 *Biodiversity*. Pointer Publishers, Jaipur, India.

Module IV – Threats to biodiversity (5 hrs)

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

Core Readings

Chapman J.L. & M.J. Reiss 2006 Ecology, Principles and Applications. Sec Edition Cambridge University Press.

Wilson E.O., 1988 (Editor).*Biodiversity*. National Academy press, Washington DC, USA.

Module V – Biodiversity conservation and management (6 hrs)

Conservation strategies
- *In situ, ex situ*
- National parks, Sanctuaries and Biosphere reserves

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

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

National biodiversity action plan
- People's participation – Peoples biodiversity register (PBR)
- Local initiatives

Core Readings

Andrew S. Pullin 2002. *Conservation Biology*. Cambridge University Press, Cambridge, UK.

Chapman J.L. & M.J. Reiss 2006 Ecology, Principles and Applications. Sec Edition Cambridge University Press.

Wilson E.O., 1988 (Editor).*Biodiversity*. National Academy press, Washington DC, USA

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

Sampling techniques -
- Quadrate
- Line transect

Measurements
- Density
- Abundance
- Frequency

Biodiversity indices – concepts
- Shannon-Weiner, Simpson

Core Readings

Anne E. Magurran 2004. *Measuring Biological Diversity* .Blackwell Publishing, MA, USA.

PART II – MODERN TAXONOMY (10 hrs)

Module VII – Taxonomical Principles (6 hrs)

Brief history

Concepts and definition

Approaches of taxonomy

Molecular taxonomy

Importance of classification

Phylogeny and Taxonomy– Tree of Life, bar coding of life

Zoological nomenclature
- International Code of Zoological Nomenclature (ICZN)

Core Readings

Kapoor ,V.C.1998. Theory and Practice of Animal Taxonomy. Oxford and IBH Pub.Co, New Delhi.

Module VIII – Tools and techniques (4 hrs)

Identification Keys
- Dichotomous keys (Single access key)
- Polytomous key
- Multi access key
- Advantages and disadvantages

Core Readings

Kapoor ,V.C.1998. Theory and Practice of Animal Taxonomy. Oxford and IBH Pub.Co, New Delhi.

Selected Further Readings

Andrew S. Pullin 2002. *Conservation Biology*. Cambridge University Press, Cambridge, UK.

Anne E. Magurran 2004. *Measuring Biological Diversity* .Blackwell Publishing, MA, USA.

Chapman J.L. & M.J. Reiss 2006 Ecology, Principles and Applications. Sec Edition Cambridge University Press.

Daily,G.C. (Ed.), 1997.*Nature's Services : Societal Dependence on Natural Ecosystems*. Island Press, Washington D C.

Forman, R.T and M. Gordaon. 1986. *Landscape Ecology*. John Wiley &Sons, NY, USA.

Kapoor ,V.C.1998. Theory and Practice of Animal Taxonomy. Oxford and IBH Pub.Co, New Delhi.

Kapoor ,V.C.1998. Theory and Practice of Animal Taxonomy. Oxford and IBH Pub.Co, New Delhi.

Karunakaran, C.K. 2003. Politics of vanishing forests in Kerala. Kerala Sastra Sahitya Parishat, Thiruvananthapuram.
Land resource based perspective plan for 2020 AD. Kerala State Land Use Board, Thiruvananthapuram
Myers, Norman.1984. *The Primary Source: Tropical Forests and Our Future*. W.W. Nortan & Company, NY.
Myers,N., Mittermiere,R.A., Mittermeier,C.G., Dea Fonseca,G.A.B and J.Kent. 2000. Biodiversity hotspots for conservation priorities. *Nature*, 403:853-858.
Nair, K.N.S and Parameswaran,P.1976. *Keralathinte Sampath (Wealth of Kerala).* Kerala Sastra Sahithya Parishad, Trivandrum, Kerala.
Nair, M.P., Pushpangathan, P., Rajasekharan, S.,Narayanan Nair.K. and Dan Mathew. *Jaivavaividhyam* (Biodiversity). State Institute of Languages, Thiruvananthapuram
State of the Environment Report, Kerala. (Annual Publication), Kerala State Council for Science, Technology and Environment, Thiruvananthapuram
Supriyo Chakraborty.2004 *Biodiversity*. Pointer Publishers, Jaipur, India.
Wilson E.O., 1988 (Editor).*Biodiversity*. National Academy press, Washington DC, USA.

Web Resources

http://www.ncbi.nlm.gov. http://tolweb.org

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

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

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

http://www.cbd.org

ZY2B02U [P] Practical 2

BIODIVERSITY AND MODERN SYSTEMATICS

36 hrs
Credit 1

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

Report should be submitted by each student

SEMESTER III

ZY3B03U CORE COURSE 3

ANIMAL DIVERSITY- NON CHORDATA

Objectives 54 hrs. Credits 3

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

MODULE I

Introduction: **Briefly mention the following** **(2 hrs)**

Classification Keys and Principles.
Nomenclature (Uninominal, Binomial, & Trinomial), Law of Priority.
Two kingdom and Five kingdom classification.

Symmetry - Asymmetry, Spherical, Radial, Biradial and Bilateral
Coelom – Acoelomates, Pseudocoelomates and Eucoelomates
Schizocoelom, Enterocoelom., Protostomia and Deuterostomia

Kingdom Protista Type: Paramecium (**10hrs)**

Salient features and classification up to phyla

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

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

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

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

Three branches - Mesozoa, parazoa, Eumetazoa.

Core Readings

Dhami.P.S. and Dhami J.K. 1979 Invertebrate Zoology. R. Chand and Co. Delhi.

Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

MODULE II

Mesozoa - Eg. Rhopalura.

Phylum Porifera. (3 hrs)

Classification upto classes.

Class I- Calcarea. Eg. Sycon., Class II – Hexactinellida . Eg. Euplectella.

Class III – Demospongia Eg. Cliona.

General Topics

1. Reproduction in sponges 2. Canal system in sponges.

Phylum Coelenterata Type: Obelia (6hrs)

Classification upto classes.

Class I - Hydrozoa Eg. Halistemma. Class II – Scyphozoa Eg. Rhizostoma. Class III- Anthozoa Eg. Fungia.

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

2. Polymorphism in Coelenterates

Core Readings

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

Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

MODULE III

Phylum Ctenophora. (**1 hr)**

Eg. Pleurobrachia.

Phylum Platyhelminthes (3hrs)

Classification upto classes.

Class I - Turbellaria. Eg. Planaria.

Class II – Trematoda Eg. Fasciola

Class III- Cestoda Eg. *Taenia saginata.*

General Topics-

1. Life history of *Fasciola hepatica.*

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

Phylum Nematoda (3hrs) Class phasmidia Eg. Enterobius, Ascaris

Class Aphasmidia Eg. Trichinella

General Topic-

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

Phylum Annelida (**2 hrs)**

Classification upto classes.

Class I- Archiannelida Eg. Polygordius

Class II – Polychaeta Eg. Chaetopterus

ClassIII- Oligochaeta Eg. Megascolex.

Class IV - Hirudinomorpha Eg. Ozobranchus,Hirudinaria

Core Readings

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

Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

MODULE IV **(12 hrs)**

Phylum- Onychophora

Eg. Peripatus (Mention its affinities).

Phylum Arthropoda

Type: Panaeus

Classification upto classes.

Divided into 4 subphyla.

1. Sub Phylum - Trilobitomorpha

Class - Trilobita (mention salient features).

2. Sub Phylum- Mandibulata

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

3. Sub Phylum - Chelicerata

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

General Topics

1. Vectorial Arthropods
2. Larval forms of Penaeus

Core Readings

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

Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

MODULE V

Phylum Mollusca **(4 hrs)**

Classification upto classes

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

General Topic-

Pearl formation and culture

Phylum Echinodermata **(4 hrs)**

Classification upto classes

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

General Topics

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

Minor Phyla (**2 hrs)**

1. Chaetognatha Eg. Sagitta
2. Sipunculida Eg. Sipunculus
3. Rotifera Eg. Brachionus

Phylum Hemichordata **(1 hr)**

Eg. Balanoglossus

Core Readings

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

Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

Selected Further Readings

Anderson D.T. 2001Invertebrate Zoology Sec Edition Oxford University Press
Barnes R.D. 1987. Invertebrate Zoology. W. B. Saunders. New York.
Dhami.P.S. and Dhami J.K. 1979 Invertebrate Zoology. R. Chand and Co. New Delhi.
Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.
Hyman L. H. The Invertebrate Volumes. Mc Graw Hill.
Jordan. E. L., and Verma P.S. 2000. Invertebrate zoology. S. Chand and Co. ltd., New Delhi.
Kotpal R. L, Agarval S. K. and R. P. Khetharpal 2002. Modern Textbook of Zoology.
Kotpal.R. L., 1988-92 (All series). Rastogi Publishers, Meerut.
Parker & Haswell. Textbook of Zoology. Invertebrate . Vol. I 7th Edition.

ZY3B03U [P] Practical 3

ANIMAL DIVERSITY- NON CHORDATA

36 hrs.
Credit 1

Scientific Drawing:-

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

Anatomy:-

Study of sections. (Any two)

1. Hydra.
2. Ascaris
3. Earthworm
4. Fasciola

Dissections

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

Mounting:-

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

Identification:-

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

Taxonomic identification with key:-

Identification of insects up to the level of order.

SEMESTER IV

ZY4B04U CORE COURSE 4

ANIMAL DIVERSITY CHORDATA

54 Hrs
3 Credits

Objectives

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

MODULE I

Introduction (**1 Hr)**

Phylum Chordata - General classification

(Classification up to order Sub phylum, Super class, Class, Subclass, Order)

1. **Sub phylum : Urochordata (3 Hrs)**

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**

Core Readings

Ekambaranatha Iyer 2000 A Manual of Zoology Vol. II .S. Viswanathan and Co.
Young J.Z, 1981, The Life of Vertebrates Oxford University Press.
Young J.Z. 2006 The life of Vertebrates Oxford University Press (Third Ed.) India Ed.

MODULE II

3. **Sub phylum: Vertebrata**
4. **Division 1 Agnatha** (**2 Hrs)**

Class I	Ostracodermi	Eg: Cephalaspis

Class II Cyclostomata Eg: Petromyzon

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

Super class Pisces

Class: Chondrichthyes

Sub class - Elasmobranchi Eg: Narcine

Sub class Holocephali Eg: Chimaera

Class: Osteichthyes

Sub class – Choanichthyes

Order 1 Crossopterigii Eg: Latimeria

Order 2 Dipnoi Eg: Lepidosiren

Sub class: - Actinopterygii

Super order 1. Chondrostei Eg: Acipencer

Super order 2. Holostei Eg: Amia

Super order 3. Teleostei Eg: Sardine

General topics

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

Core Readings

Ekambaranatha Iyer 2000 A Manual of Zoology Vol. !!.S. Viswanathan and Co.
Young J.Z. 2006 The life of Vertebrates Oxford University Press (Third Ed.) India Ed.
Jhingran 1977, Fish and Fisheries of India, Hindustan Publishing Co.

MODULE III

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

Class Amphibia

Type Frog

Order I Anura Eg: Hyla

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

Order III Apoda Eg: Ichthyophis.

Class Reptilia (**4 Hrs)**

Sub class I: Anapsida

Order Chelonia Eg: Chelone

Sub class II: Parapsida Eg: Ichthyosaurus

Sub class III: Diapsida

Order I Rhynchocephalia Eg: Sphenodon

Order II Squamata Eg: Chamaleon

Sub class IV: Synapsida Eg: Cynognathus

General topic

Identification of poisonous and non poisonous snakes

Class Aves **4 Hrs**

Sub class I: Archeornithes Eg: Archaeopteryx (Affinities)

Sub class II: Neornithes

Super order I: Palaeognathe Eg: Struthio

Super order II: Neognathe Eg; Brahminy kite

General topics

1. Migrations in birds
2. Flight adaptations in birds

Core Readings

Jordan E L and .P.S. Verma, 2002 Chordate Zoology S. Chand and Co. New Delhi.
Ekambaranatha Iyer 2000 A Manual of Zoology Vol.II S. Viswanathan and Co.

MODULE IV

Class Mammalia **(18 Hrs)**

Type: Rabbit

Sub class I: Prototheria Eg: Echidna

Sub class II: Metatheria Eg: Macropus

Sub class III: Eutheria

Order 1. Insectivora Eg: Talpa

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

General topics

1. Dentition in Mammals
2. Aquatic Mammals

Core Readings

Jordan E L and .P.S. Verma, 2002 Chordate Zoology S. Chand and Co. New Delhi.
Ekambaranatha Iyer 2000 A Manual of Zoology Vol. !!.S. Viswanathan and Co.
Zoological Society of Kerala Study material. *Animal Diversity* 2002

Selected Further Readings

Ekambaranatha Iyer 2000 A Manual of Zoology Vol. !!.S. Viswanathan and Co.
Jhingran 1977, Fish and Fisheries of India, Hindustan Publishing Co.
Jordan E L and .P.S. Verma, 2002 Chordate Zoology S. Chand and Co. New Delhi.
Kotpal R.L. 2000, Modern Text Book of zoology, Vertebrates, Rastogi Publications, Meerut.
Nigam and Sobti 2000, Functional Organization of Chordates. Shoban Lal Nagin Chand and Co. New Delhi.
Young J.Z, 1981, The Life of Vertebrates Oxford University Press.
Young J.Z. 2006 The life of Vertebrates Oxford University Press (Third Ed.) India Ed.

ZY4B04U [P] PRACTICAL 4

ANIMAL DIVERSITY CHORDATA

36hrs
Credit 1

1. **Morphology: Scientific Drawing**

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

2. **Dissections**

   Frog: Photographs/diagrams/one dissected & preserved specimen each/models may be used for study.

   1. Frog Viscera

   2. Frog Digestive System

   3. Frog Arterial System

   4. Frog 9^{th} & 1^{st} Spinal nerve

   5. Frog Sciatic Plexus

   6. Frog Brain

   Mounting of placoid scales/cycloid/ctenoid scales

3. **Osteology**

   Frog vertebrae

   Pectoral and pelvic girdles of Frog and Rabbit

   Skull of Rabbit (Diastema -dentition
   Turtle – plastron and carapace

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

5. **Identification:-**

General identification-

Identify all the animals by their generic names and 25 % of them by their specific names.

Protochordata-1, Pisces-4, Amphibia-3, Reptilia- 4, Aves-1,

Mammalia-2.

7. Taxonomic identification with key:-

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

ii) Identification of snakes up to family.

SEMESTER V

ZY5B05U CORE COURSE 5

CELL BIOLOGY AND MOLECULAR BIOLOGY

54 Hrs

Credits 3

Objectives:

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

PART I - CELL BIOLOGY (27 Hrs)

Module I History of cell and molecular biology (2 hrs)

Cell theory, Prokaryotes, Eukaryotes, Actinomycetes, Mycoplasmas, Virus, Virion and Viroids, Prions,

Core Readings

Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology* Chapter – 1

Zoological Society of Kerala Study material. 2008. *Microbiology and Immunology* Chapter – 1

Module II Cell membrane & Permeability (6 hrs)

Molecular models of cell membrane

(Sandwich model, Unit membrane model, Fluid mosaic model)

Modifications of plasma membrane. (Microvilli, tight junction, gap junction, desmosomes)

Cell permeability - Diffusion, Osmosis, Passive transport, Active transport, Cell coat and Cell recognition.

Core Readings

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

Gupta M.L. & M.L. Gangir. (1998) Cell Biology. Agrobotanica

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

Module III Ultrastructure of Cytoplasm (7 hrs)

Cytoskeleton - Microtubules, microfilaments, intermediate filaments.

Endoplasmic reticulum - Structure and functions

Ribosomes (Prokaryotic and Eukaryotic)

Golgi complex - Structure and functions.

Lysosomes - Polymorphism - GERL concept, functions

Mitochondria - Structure and functions

Symbiont hypothesis.

Core Readings

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

Module IV Nucleus (6 hrs)

Structure and functions of interphase nucleus, Nuclear membrane, pore complex, structure and functions of nucleolus Chromosomes – Structure; Heterochromatin, Euchromatin, Nucleosomes, Polytene chromosomes-Balbiani rings, Endomitosis, Lamp brush chromosomes.

Core Readings

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

Powar C.B. (1983) Cell Biology (Himalaya Pub. Company)
Rastogi S. C. (1998) Cell Biology. Tata Mc.Graw Hill Publishing Co., New Delhi

Module V Cell Division (3 Hrs.)

Cell cycle - G_1, S, G_2 and M phases

Mitosis and Meiosis (comparison)

Core Readings

Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology* Chapter • 6
Powar C.B. (1983) Cell Biology (Himalaya Pub. Company)
Rastogi S. C. (1998) Cell Biology. Tata Mc.Graw Hill Publishing Co., New Delhi

Module VI Cell Communication (3 Hrs.)

Cell signalling - Signal hypothesis, Signalling molelcules (neuro- transmitters, hormones, growth factors, cytokines, vitamin A and D derivatives) Role of cyclic AMP

Core Readings

Karp. G., 1996 *Cell and Moecular Biology, Concepts and Experiments*
John Wiley and Sons New York.

PART II - MOLECULAR BIOLOGY 27 Hrs.

Module VII Nature of Genetic Materials (7 Hrs)

Discovery of DNA as genetic material • Griffith•s transformation experiments. Hershey Chase Experiment of Bacteriophage infection .Types of DNA & RNA. Modern concept of gene (Cistron, muton, recon, viral genes). Prokaryotic genome,Eukaryotic genome, Split genes (introns and exons), Junk genes, Pseudogenes, Overlapping genes, Transposons

Core Readings

Veer Bala Rastogi. (2008). Fundamental of Molecular Biology, Ane•s Books, India Chapter -5 pp. 124-138.
Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology* Chapter • 9

Module VIII Gene Expressions (12 hrs)

Central Dogma of molecular biology, One gene-one enzyme hypothesis, One gene-one polypeptide hypothesis. Characteristics of genetic code, Contributions of Hargobind Khorana. Protein synthesis-Transcription (Prokaryotic and eukaryotic), Reverse transcription, post transcriptional modifications, Translation, Post translational modifications.

Core Readings

Veer Bala Rastogi. (2008). Fundamental of Molecular Biology, Ane•s Books, India Chapter -12 pp. 282-292, Chapter 13, pp293-318.
Sobti R.C. & G. Obe. (2000) Eukaryotic Chromosomes. Narosa Publishing House.
Taylor D.J. Green N.P.O and stout Biological Science 2009 3rd edition Chapter 23 pp.802-807.

Module IX Gene regulations (8 hrs)

Prokaryotic (inducible, repressible systems), Operon concept -Lac operon.Attenuation and tryptophan operon. Eukaryotic gene regulation, Global control • Stimulon and modulon, Catabolite repression (Glucose effect), Differences between prokaryotic and eukaryotic gene regulation

Core Readings

Madigan, Martinko and Parker 2002. *Biology of Microorganisms 8th edition Prentice Hall, Chapter 7 pges 226-245.*
Veer Bala Rastogi. (2008). *Fundamentals of Molecular Biology*, Ane•s Books, India Chapter 15, pp343--378.
Zoological Society of Kerala Study material. 2002. *Cell Biology, Genetics and Biotechnology* Chapter • 9

Selected Further Readings

Ariel G Loewy Philip Sickevitz, John R. Menninger and Jonathan A.N. Gallants (1991) Cell structure and function. Saunder's College Publication
Arthur & Tania. (1991) DNA Replication. W.H. Freeman & Co. New York.
Arthur M Lesk. (1990) Introduction to Genomics. Oxford University Press
Carraway K.L. & C.A.C. Carraway. (2002) Cyto skeleton signalling, Oxford University Press
Charlotte J Avers. (1986) Molecular Cell Biology. The Benjamin / Cummings Publishing Company Inc.
Cohn N.S. 1979 Elements of Cytology (Freeman Book Company).
Daniel & Elizabeth. (1996) Genetics-Principle and Analysis. Jones & Bartlett Publishers
David A Micklos & Greg A Freyer. (2006) DNA Science. Cold Spring Harbor Laboratory Press
David Latchman. (2006) Gene Regulation. London Unwin Hyman
David M. J. Lilley. (2003) DNA-Protein Structural Interactions. Frontiers in Molecular Biology.
De- Robertis E.D. and De Robertis Jr.E.M.F (2002) Cell and Molecular Biology (Lea & Febiger/Info-Med)
Earl R Stadtman & P. Boon Chock. (2000) Current Topics in Cellular Regulation. Academic Press
Edwards & Hassall. Mc.Graw Hill Publishing Co.Ltd., U.K.
Finean & Michell. (1998) Membrane Structure. Holland Bio-Medical Press, Netherland.
Gardner E.J. and Snustand D.P. Principles of Genetics. John Wiley & Sons, New York.
Gupta M.L. & M.L. Gangir. (1998) Cell Biology. Agrobotanica

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

Karp G. (1996) Cell and Molecular Biology: Concepts and Experiments John Wiley and Sons m, New York

Kimball J.W. 1984 Cell Biology (Addison - Wesley Pub. Co.)

Kwang W Jeon. (1997) A Survey of Cell Biology. Academic Press

Malcolm N. Jones & Dennis Chapman. (1991) Micelles, Monolayers and Biomembranes. John Willey & Sons Inc. Publication

Michael T.A. Michael, E.R. and Toya S.K. (1975) Electron Microscopy and Cell Structure. Cambridge University Press

Mitchison J.M. (1991) The Biology of the Cell Cycle, Cambridge University Press

Powar C.B. (1983) Cell Biology (Himalaya Pub. Company)

Rastogi S. C. (1998) Cell Biology. Tata Mc.Graw Hill Publishing Co., New Delhi

Sinnot Dunn & Dobzhanasky. (1991) Principles of Genetics. T.M.H. New Delhi.

Sobti R.C. & G. Obe. (2000) Eukaryotic Chromosomes. Narosa Publishing House.

Stanley G. Schultz. (2002) Basic Principles of Membrane Transport. Cambridge University Press

Stephen L Wolfe. (1981) Biology of the Cell. Wadsworth Publishing Co. Inc.

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

Varma P.S. and Agarwal V.K. (1988) Cytology (S.Chand & Co., New Delhi)

Varma P.S. and Agerwal V.K. (2008) Genetics (S.Chand & Co., New Delhi)

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

West I.C. (2002) Biochemistry of membrane transport. Chapman & Hall, London

William & Daphne. (2008) Biochemistry & Molecular Biology. Oxford University Press

ZY5B05U [P] PRACTICAL 5

CELL BIOLOGY AND MOLECULAR BIOLOGY

36 hrs
Credit 1

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

SEMESTER V

ZY5B06U CORE COURSE 6
ENVIRONMENTAL BIOLOGY, TOXICOLOGY AND DISASTER MANAGEMENT

54 hrs
Credits 3

Objectives

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

Pre-requisite:

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

PART I: ENVIRONMENTAL BIOLOGY (44 Hrs)

Module I – Introduction (2 hrs)

History, development
Scope, branches

Core Readings

Bharucha, E. 2005. *Textbook of Environmental Studies for Undergraduate Courses*. University Grants commission

Miller, Tyler. G. (Jr) 2005. Essentials of Ecology. Thomson Brooks/cole.

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

Odum, E.P. 1971.Fundamentals of Ecology.W.B. Saunders College Publishing, Philadelphia.

Rajagopalan,R. 2005.*Environmental Studies from Crisis to Cure*. Oxford University Press, New Delhi.

Module II – Ecosystems (20 hrs)

Concept, classification

Terrestrial ecosystem

Abiotic/ biotic components (Brief description only)
Interactions
Classification (Types)
Forest
Desert
Grassland
Causes of land degradation with special reference to Kerala

Freshwater ecosystem

Physico chemical nature (Brief description only)
Types
Lentic
Lotic
Ground water
Threat to freshwater resources of Kerala
Watershed management

Marine ecosystem

Physico chemical nature (Brief description only)

Intertidal zone
Rocky shore
Muddy shore
Sandy shore
Coral reefs
Open sea
Pelagic realm
Benthic realm
Wetland and mangroves
Estuaries

Convention on wetlands (Ramsar, 1971)
Ramsar sites in Kerala threats and conservation aspects

Core Readings

Bharucha, E. 2005. *Textbook of Environmental Studies for Undergraduate Courses*. University Grants commission

Miller, Tyler. G. (Jr) 2005. Essentials of Ecology. Thomson Brooks/cole.

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

Odum, E.P. 1971.Fundamentals of Ecology.W.B. Saunders College Publishing, Philadelphia.

Rajagopalan,R. 2005.*Environmental Studies from Crisis to Cure*. Oxford University Press, New Delhi.

Zoological Society of Kerala Study material. 2002. *Environmental Biology and Ethology* Published by Zoological Society of Kerala.

Module III Man and Environment (8 hrs)

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

Core Readings

Andrew S. Pullin 2002 *Conservation Biology*. Cambridge University Press, Cambridge, UK

Bharucha, E. 2005. *Textbook of Environmental Studies for Undergraduate Courses*. University Grants commission

Kaufman G.Donald and Cecilia M. Franz. 2000. *Biosphere 2000 Protecting Our Global Environment.* Kendall/Hunt Publishing Company. Iowa, US

Module IV Global environmental changes (9 hrs)

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

Core Readings

Bharucha, E. 2005. *Textbook of Environmental Studies for Undergraduate Courses*. University Grants commission

Miller, Tyler. G. (Jr) 2005. Essentials of Ecology. Thomson Brooks/cole.

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

Module V Municipal Solid Waste (3 hrs)

Plastic pollution
Types of plastics
Problems of plastics
Management strategies

e-waste
Major types and sources
Toxic ingredients
Effects on environment and human health
Management strategies

Core Readings

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

Odum, E.P. 1971.Fundamentals of Ecology.W.B. Saunders College Publishing, Philadelphia.

Module V Local environmental issues (2 hrs)

Impact of tourism on ecology
Landscape changes

Core Readings

Santra, S.C. 1994. *Ecology Basic and Applied*. M.D. Publications Pvt. Ltd. New Delhi.

PART II. DISASTER MANAGEMENT AND TOXICOLOGY (10 Hrs)

Module VI Disaster Management (5 hrs)

Definition
Classification
Natural
Anthropogenic
Hybrid
Earthquake

Landslide
Flood
Drought
Cyclone
Tsunami
Mitigation measures

Core Readings

Singh, S.R., 2008 *Disaster Management.* A.P.H Publishers

Module VII: Toxicology **5 hrs**

Definition
History of toxicology
Classification – occurrence/ source
Role of toxicology
Toxicants of biological origin
Afflatoxin
Botulinum toxin
Heavy metal toxicants
Food additives

Core Readings

Stiling Peter, 2002. Ecology: Theories and applications. Prentice Hall of India Pvt. Ltd. New Delhi

Pandey Kamleshwar , J.P.Shukla and S.P.Trivedi.2005. *Fundamentals of Toxicology*. New Central Book Agency (P) Ltd. Kolkata, India
Rajagopalan,R. 2005.*Environmental Studies from Crisis to Cure*. Oxford University Press, New Delhi.

Selected Further Readings

Ahuwalie V.K., Sunita Malhotra, 2009 Environmental science, Ane Books Pvt. Ltd.
Alan Beeby, 2006 Anne – Maria Brennan First Ecology, Ecological principles and Environmental issues . International students edition Sec. edition Oxford University Press.

Andrew S. Pullin 2002 *Conservation Biology*. Cambridge University Press, Cambridge, UK
Banerjee, L.K., Sastry, A.R.K. and Nayar, M.P. 1989. Mangroves in India: Identification manual. Botanical Survey of India.

Bharucha, E. 2005. *Textbook of Environmental Studies for Undergraduate Courses*. University Grants commission
Erach Bharucha 2008 (UGC).Test Book of Environmental Studies of Undergraduate course. University Press

Kaufman G.Donald and Cecilia M. Franz. 2000. *Biosphere 2000 Protecting Our Global Environment.* Kendall/Hunt Publishing Company. Iowa, US

Miller, Tyler. G. (Jr) 2005. Essentials of Ecology. Thomson Brooks/cole.
Misra S.P., Pandy S.N. 2009Essential Environmental Students , Ane books Pvt. Ltd.
Nambiar, K.R. 2008.*Textbook of Environmental Studies (For Undergraduate Courses as per the UGC Model Syllabus*. Scitech Publications (India) Pvt. Ltd. Chennai, India.

Odum, E.P. 1971.Fundamentals of Ecology.W.B. Saunders College Publishing, Philadelphia.

Pandey Kamleshwar , J.P.Shukla and S.P.Trivedi.2005. *Fundamentals of Toxicology*. New Central Book Agency (P) Ltd. Kolkata, India
Rajagopalan,R. 2005.*Environmental Studies from Crisis to Cure*. Oxford University Press, New Delhi.
Robert May & Angela Mc Lean 2007 Theoretical Ecology. Principles and Application , Oxford University press (India Ed.)

Santra ,S.C. 1994. *Ecology Basic and Applied*. M.D. Publications Pvt. Ltd. New Delhi.

Sharma, P.D. 2007. Ecology and Environment. Rastogi Publishers

Stern, Nicholas. 2006. The *Economics of Climate Change: The Stern Review*, Cambridge University Press, Cambridge, UK.

Stiling Peter, 2002. Ecology: Theories and applications. Prentice Hall of India pvt. Ltd. New Delhi

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

36 hrs
Credit 1

1. Estimation of oxygen
2. Estimation of carbon dioxide
3. Estimation of Soil Organic Carbon
4. Plankton count
5. Identification of freshwater/ marine plankton
6. Extraction of soil organism
7. Identification of minerals and rocks
8. Sechi disc, Plankton Net
9. Compulsory Field Study
10. Report on visit to one terrestrial and marine ecosystem

SEMESTER V

ZY5B07U CORE COURSE 7
EVOLUTION, ZOOGEOGRAPHY AND ETHOLOGY

54 hrs
Credits 3

Objectives:

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

Prerequisite:

- Basic knowledge on principles of inheritance and variation
- Knowledge on molecular basis of inheritance
- Basic understanding on the mechanism and factors affecting evolution
- Knowledge on origin and evolution of man

PART I – EVOLUTION (30 hrs)

Module I – Origin of life (5 hrs)

Introduction
Origin of universe
Chemical evolution
Miller-Urey experiment
Haldane and Oparin theory

Module II – Theories of organic evolution (7 hrs)

Lamarckism
Critical analysis of Lamarck's propositions
Darwinism
Critical analysis of Darwinism
Neo-Darwinism
Modern Synthetic theory
Weisman's germplasm theory
Mutation theory
Neutral theory of molecular evolution

Module III – Population genetics and evolution (6 hrs)

Genetic basis of variation
Hardy Weinberg equilibrium
Change in gene frequencies
Factors affecting gene frequencies (brief account only)

Module IV – Evolution above species level (8 hrs)

Adaptive radiation
Microevolution
Macroevolution
Evolution of horse
Mega evolution
Punctuated equilibrium
Speciation

Module V – Geological time scale (4 hrs)

Geological dating with radioactive elements
Mass extinction

Core Readings (Modules 1-5)

Barnes, C.W. 1988. *Earth, Time and Life*. John Wiley &Sons, NewYork (Module 2 & 3)
Bendall , D. S. (ed.)1983.*Evolution from Molecules to Man*. Cambridge University Press,U.K.(Module 2,3 and 5)
Bull J.J and H.A.Wichman.2001.Applied Evolution. *Annu.Rev.Ecol.Syst.* 32:183-217 (Visit the Annual Reviews home page at www.AnnulReviews.org.)
Chattopadhyay Sajib.2002. *Life Origin, Evolution and Adaptation*. Books and Allied (P) Ltd.Kolkata,India.
Goodwin,B. 1996. *How the Leopard Changed its Spots: The Evolution of Complexity*. Simon &Schuster, NY,USA. (Module 4 & 5)
Jerry A.Coyne and H.Allen Orr.2004. *Speciation*. Sinauer Associates (Module 4)
Rob Desalle and Ian Tattersall 2008.*Human Origins: What Bones and Genomes Tell Us about Ourselves*. Texas A&M University Press, USA. (Module 3 & 4)
Sean B. Carroll and David M. Kingsley .2005 *Evolution: Constant Change and Common Threads*. Holiday Lectures on Science. Webcast or DVD available at www.hhmi.org/biointeractive/evolution. (Module 3 & 4)
Strickberger, M.W.2000. *Evolution*. Jones and Bartlett, Boston. (Module 1-5)
Verma P.S. and Agarwal V.K 2007 *Cell biology, Genetics, Molecular Biology, Evalution and Ecology,* S. Chand & Company New Delhi (Moldule 1-5)

PART II – ZOOGEOGRAPHY AND ETHOLOGY (24 hrs)

Module VI – Zoogeography: Introduction (5 hrs)

Origin of oceans and continents
Platetectonics – continental drift
Zoogeographical realms
Insular fauna
Biogeography of India – with special reference to Western Ghats

Module VII – Animal distribution (5 hrs)

Types and means of animal distribution
Factors affecting distribution

Core Readings

Zoogeography

Andrews. M.I and Joy, K.P. 2003. *Environmental biology, evolution, ethology and Zoogegraphy.* St.Mary's press and book dept. (Module Vi, VII, VIII and IX)
Briggs, J.C. 1996. *Global Biogeography.* Elsevier Publishers. (Module VI and VII).
Chandran, Subash M .D.1997. On the ecological history of the Western Ghats. *Current Science*, Vol.73, No.2.146-155.
Chundamannil , Mammen.1993. *History of Forest management in Kerala*. Report number 89. Kerala Forest Research Institute, Peechi, India.
Daniels, R.J.R and J.Vencatesan .2008. *Western Ghats Biodiversity.People.Conservation*. Rupa &Co.New Delhi.India.
Mani, M.S. 1974.*Ecology and Biogeography of India*. Dr. W. Junk b..v. Publishers , The Hague.
Nair, C.S.1991. *The Southern Western Ghats : A Biodiversity Conservation Plan*. INTACH, New Delhi.
Ramesh,B.R and Rajan Gurukkal., 2007.*Forest Landscapes of the Southern Western Ghats, India Biodiversity, Human Ecology and management Strategies*. French Institute of Pondicherry, India.
Tiwari, S. 1985. *Readings in Indian Zoogeography, (*Module VI)

Module VIII – Ethology (1 hr)

Definition
History and scope of ethology

Module IX – Learning and imprinting (7 hrs)

Types of learning with examples
Experiments by K. Lorenz

Module X – Ethology of man (4 hrs)

Sociobiology and evolution of human behaviour
Primates and human socio groups
Human pheromones

Module XI- Ecology and behaviour (2 hrs)

Natural selection and behaviour
Ecology of relationship
Dominance, competition

Core Readings

Bonner, J.T. 1980. *The Evolution of Culture in Animals*. Princeton University Press..NJ,USA. (Module 10)
David McFarland. 1999. *Animal Behaviour*. Pearson Education Ltd . Essex, England. (Module 8 and 9)
Dawkins, M.S. 1995.*Unravelling Animal Behaviour*. Harlow:Longman. (Module 8, 9 and 10)
Dunbar,R. 1988. *Primate Social Systems*.Croom Helm,London. (Module 10 & 11)
Manning Aubrey and Marian Stamp Dawkins 1998*. An Introduction to Animal Behaviour*.Cambridge University Press,UK. (Module 8, 9 & 10)
Paul W. Sherman and John Alcock.,2001 Exploring Animal Behaviour- Readings from American Scientist 3rd Edn. Sinauer Associates Inc. MA,USA. (Module 10 & 11)
Wilson, E.O. 1975. Sociobiology. Harvard University Press, Cambridge, Mass. USA. (Module 9)
Zoological Society of Kerala Study material. 2002. *Environmental Biology and Ethology* Published by Zoological Society of Kerala (Module 6, 7, 8 & 9)

Selected Further Readings

Evolution

Barnes, C.W. 1988. *Earth, Time and Life*. John Wiley &Sons, NewYork
Bendall , D. S. (ed.)1983.*Evolution from Molecules to Man*. Cambridge University Press,U.K.
Bull J.J and H.A.Wichman.2001.Applied Evolution. *Annu.Rev.Ecol.Syst.* 32:183-217 (Visit the Annual Reviews home page at www.AnnulReviews.org.)
Chattopadhyay Sajib.2002. *Life Origin, Evolution and Adaptation*. Books and Allied (P) Ltd.Kolkata,India.
Goodwin,B. 1996. *How the Leopard Changed its Spots: The Evolution of Complexity*. Simon &Schuster, NY,USA.
Jerry A.Coyne and H.Allen Orr.2004. *Speciation*. Sinauer Associates
Rob Desalle and Ian Tattersall 2008.*Human Origins: What Bones and Genomes Tell Us about Ourselves*. Texas A&M University Press, USA.

Sean B. Carroll and David M. Kingsley .2005 *Evolution: Constant Change and Common Threads*. Holiday Lectures on Science. Webcast or DVD available at www.hhmi.org/biointeractive/evolution.

Strickberger, M.W.2000. *Evolution*. Jones and Bartlett, Boston.

Ethology

Bonner, J.T. 1980. *The Evolution of Culture in Animals*. Princeton University Press.NJ, USA.

David McFarland. 1999. *Animal Behaviour*. Pearson Education Ltd. Essex, England.

Dawkins, M.S. 1995.*Unravelling Animal Behaviour*. Harlow: Longman.

Dunbar, R. 1988. *Primate Social Systems*.Croom Helm, London.

Manning Aubrey and Marian Stamp Dawkins 1998*. An Introduction to Animal Behaviour*.Cambridge University Press,UK.

Paul W. Sherman and John Alcock.,2001 Exploring Animal Behaviour- Readings from American Scientist 3rd Edn. Sinauer Associates Inc. MA,USA.

Wilson, E.O. 1975. Sociobiology. Harvard University Press, Cambridge, Mass. USA.

ZY5B07U [P] PRACTICAL 7
EVOLUTION, ZOOGEOGRAPHY AND ETHOLOGY

36 hrs
Credit 1

1. Identification of Zoogeographical realms using map
2. Study on endemic species of each realm
3. Contributions of scientists (showing photos)
4. Identification of different stages of horse evolution
5. Identification of skull and facial features in human evolution
6. Study on Homology / Analogy
7. Study on connecting links
8. Pheromone traps
9. Skinner box
10. T Maze
11. Identification of behaviour showing pictures

SEMESTER V

ZY5B08U CORE COURSE 8
BIOCHEMISTRY, HUMAN PHYSIOLOGY AND ENDOCRINOLOGY

54 hrs
Credits 3

Objectives:

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

Part I. BIOCHEMISTRY **18 Hours**

Module 1 - GENERAL BIOCHEMISTRY, BIOELEMENTS AND BIOMOLECULES **4 hrs**

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

Core Readings

Harper's Illustrated Biochemistry, 27th Ed, Mc Graw Hill

Module -2 METABOLISM **9 hrs**

Carbohydrate metabolism- Glycolysis, glycogenolysis, gluconeogenesis, glycolysis &#65533;citric acid cycle, ATP synthesis, Hexose, monophosphate shunt
Lipid metabolism- Biosynthesis and oxidation of fatty acids- Beta oxidation, Physiologically important compounds synthesized from cholesterol.
Protein metabolism- Deamination, transamination, transmethylation, decarboxylation, ornithine cycle.
Nucleic acid metabolism- Degradation of purines and pyramidines.
Mineral metabolism- Role of Ca, Fe, Na, K and P

Core Readings

Harper&#65533;s Illustrated Biochemistry, 27th Ed, Mc Graw Hill

Module 3- ENZYMES **4 hrs**

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

Core Readings

Harper&#65533;s Illustrated Biochemistry, 27th Ed, Mc Graw Hill

Module 4 ANTIOXIDANTS **1 hr**

Antioxidants and functions

Core Readings

Harper&#65533;s Illustrated Biochemistry, 27th Ed, Mc Graw Hill

Part II. HUMAN PHYSIOLOGY **25 Hrs**

Module 5- NUTRITION **4 hrs**

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

Core Readings

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

Module 6 -RESPIRATION **5 hrs**

Factors affecting transport of respiratory gases through blood, oxy-hemoglobin curve, Bohr effect, reverse Bohr effect, Haldane effect, neural (voluntary and automatic) and chemical control (mention the role of carotid and aortic bodies) of respiration, smoking and its physiological effects, carbon monoxide poisoning, oxygen toxicity, nitrogen narcosis, dysbarism, oxygen therapy, artificial respiration, lung function test &#65533; Schafer&#65533;s method & Drinker&#65533;s method, respiratory disorders &#65533;hypoxia, hypocapnia, hypercapnia, asphyxia.

Core Readings

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

Module 7 &#65533;CIRCULATION **4 hrs**

Cerebral circulation, blood brain barrier and cerebrospinal fluid, haemodynamic principles, formation and fate of blood cells, blood clotting mechanism &#65533; intrinsic and extrinsic pathways, clotting factors, factors of anti clotting mechanism, blood transfusion (safety and security problems), mention haemostasis, haemolysis, jaundice, thrombosis, ESR.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.144-262, 382-429, 711-715.
Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 8 &#65533;EXCRETION **4 hrs**

Urea cycle (in detail), renal handling of individual substances eg. glucose, sodium, urea, water, factors affecting GFR, concept of plasma clearance, acid base balance and homeostasis, kidney disorders &#65533; acute renal failure, chronic renal failure- glomerular nephritis, pyelonephritis, nephrotic syndrome and kidney stones.

Core Readings

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

Module 9 -MUSCLE PHYSIOLOGY **3 hrs**

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

Core Readings

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

Module 10 &#65533;NEUROPHYSIOLOGY **3 hrs**

Regeneration of fibres, neurotrophins, synaptic transmission & properties of synapses, neurotransmitters, role of dopamine and serotonin. EEG, MRI, memory, short term and long term sleep, dream, Neural disorders- dyslexia, Parkinson&#65533;s disease, epilepsy, Alzheimer&#65533;s disease, schizophrenia.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.512-715
Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala

Module 11 -SPORTS PHYSIOLOGY **2hrs**

Muscular, Respiratory and cardiovascular changes during exercise, dope test, drug abuse.
Significance of exercise in body fitness. (Guyton pp 968-978)

Core Readings

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

Part III ENDOCRINOLOGY 11 hrs

Module 12 5 hrs

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

Core Readings

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

Module 13 6 hrs

Biosynthesis, Secretion, Regulation, Functions and Disorders of hormones of Hypothalamus, Hypophysis, Pineal, Thyroid, Parathyroid, Thymus, Islets of Langerhans, Adrenal, Gonads, Placenta, Intestinal endocrine glands and Tissues in Man.

Core Readings

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

Selected Further Readings

Human Physiology

Best and Taylor: Physiological basis of Medical practice
Chakrabarti, Ghosh &: Human Physiology, the New Book StallSchana.
Chatterjee C.C.: Human Physiology, Vol I & II Medical Allied Agency
Eckert & Randall : Animal Physiology, Mechanism and Adaptations , CBS publishers, New Delhi.
Ganong W F : Review of Medical Physiology, Mc Graw Hill, New Delhi.
Guyton : Text Book of Medical Physiology Saunders
Joshi : Nutrition and Dietetics , Tata Mc. Graw Hill
Knut Schmidt Nilesen 2007 Animal Physiology – Adaptation and environment. Cambridge University press 5 th ed.
Mackenna & Callander : Illustrated Physiology, Churchill Livingstone
Powar Human Physiology
Prosser & Brown : Comparative Animal Physiology
Sarada Subramanyam & K. Madhavankutty : Textbook of human physiology, S. Chand & Co Ltd, New Delhi.

Endocrinology

Barrington, E.J.W. General and Comparative Endocrinology, Oxford, Clarendon Press.
Bentley, P.J.Comparative Vertebrate Endocrinology, Cambridge University Press.
David O. Norris Vertebrate Endocrinology 3th Edition,
Gorbman ,A *et. al.* Comparative endocrinology, John Wiley &Sons.
Hadley, M.E. 2000. Endocrinology, 5th ed. Prentice Hall, Upper Saddle River, NJ. Martin, C.R. Endocrine Physiology, Oxford University Press
Norris, D.O. 1997. Vertebrate Endocrinology, 3rd ed. Academic Press, Sand Diego, CA.
Williams, R.H. Textbook of Endocrinology, W.B. Saunders

Biochemistry

Ackerman E, Biophysical Science, Prentice Hall Inc.
Awapara J, Introduction to Biological chemistry, Prentice-Hall of India
Cohn E E and Stumpf P K, outlines of Biochemistry, Wiley Eastern
Foster, R.L. Nature of Enzymology
Garett and Grisham. Biochemistry.
Harper's Illustrated Biochemistry, 27th Ed, Mc Graw Hill
Lehninger, Biochemistry , Kalyani Publications
Lodish et. al. Molecular Cell Biology
Rangnatha Rao K, Text Book of Biochemistry, Prentice-Hall of India
Roy K N, A Text Book of Biophysics, New Central Book Agency
Stryer, Biochemistry, W.H Freeman and Co., Newyork
Voet, D. and J.G. Voet. Biochemistry. J. Wiley & Sons

ZY5B08U [P] PRACTICAL 8
BIOCHEMISTRY HUMAN PHYSIOLOGY AND ENDOCRINOLOGY

36 hrs
Credit 1

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) Measurement of blood pressure using a sphygmomanometer (demonstration)

ENDOCRINOLOGY

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

BIOCHEMISTRY

1. Qualitative analysis of protein, glucose, starch and lipids.
2. Chromatography – Determination of Rf value of amino acids and identification of amino acids (demonstration only)

SEMESTER VI

ZY6B09U Core course 9
REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY

54 hrs
Credits 3

Objectives

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

Module 1 **10 hrs**

Introduction

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

Reproductive Organs and Gametogenesis.

Human reproductive organs and gametogenesis (brief account) significance.

Egg types.

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

Sexual cycle

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

Fertilization

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

Core Readings

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

Module II **18 hrs**

Cleavage

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

Blastulation

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

Fate maps

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

Gastrulation

Definition, Morphogenetic cell movements (brief account). Epiboly, Emboly (invagination, involution , delamination , convergence, divergence infiltration). Concept of germ layers (brief account) and its derivatives.

Cell differentiation and gene action

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

Core Readings

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

Module III **18 hrs**

Embryology of chick

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

Human development

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

Nature of contact.

Mode of implantation.

Histological intimacy of foetal and maternal tissue.

Functions of placenta.

Experimental embryology.

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

General Topics

1. Regeneration in animals
2. Transgenic animals
3. Functions of placenta
4. Human intervention in reproduction- contraception & birth control, Abortion – biological aspects, Ethical issues, Infertility, IVF, GIFT, & ZIFT (Intra fallopian transfer gamete/zygote)

Core Readings

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

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

Majumdar N. N - Vetebrate embryology

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

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

Module IV **8 hrs**

Teratology / Dysmorphology.

Definition, Teratogen / Teratogenic agents. Ionizing radiation, infection (herpes virus, parvo virus-B 19, rubella virus, syphilis, cytomegalovirus , toxoplasmosis).

Developmental defects

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

Congenital abnormalities (birth defects)

Structural defects (malformation, deformation, disruption) functional defects. (inborn errors of metabolism, mental retardation).

Causes of malformation. (brief accounts.)

Genetic disorders (single gene defects)

Chromosome aberration, aneuploidy (numerical abnormalities.

Structural abnormalities (deletion, insertion and re-arrangements)

Chromosomal mosaicisms

Environmental factors. (external factors)

Chemicals, drugs, hormones and vitamins.

Multifactorial and idiopathic disorders

Core Readings

Dutta 2007 Obstrestics , Church Livingston 17 Ed

Harrison , Harriosns Book of Internal Medicine Chruch Livingston 17th Ed.

Selected Further Readings

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

Berril, N.J and Kars G. 1986. Developmental biology, Mc Graw Hills

Berry A. K - An introduction to embryology.

Dutta 2007 Obstrestics , Chuch Livingston 17 Ed

Gibbs (2006). Practical guide to developmental biology.

Gilbert S. F - Developmental biology

Harrison , Harriosns Book of Internal Medicine Chruch Livingston 17th Ed.

Jain P. C - Elements of developmental biology.

John Rigo Fundamental Genetics Cambridge University Press. 2009

Julio Collado Vides & Relf Hofestadt Gene Regulation and Metabolism Post genomic Computated Approaches, Ane Book 2004

Majumdar N. N - Vetebrate embryology

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

Pattern M.B. and Carlson B.C. 1974 Foundations of Embryology, TMH, New Delhi.

Sobte R.C., Sharma V.L. Essentials of Modern Biology Press Book India 2008

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

Werne A Muller. Dev. Biology, Springer Verlay New York 2008

Arora M.P. Embryology. Himalaya Publishing House (Module I, Module II, Module III)

Suresh.C. Goel. *Principles of Animal Developmental Biology*. Himalaya Publishing House.

Arumugam. N. *Text Book of Embryology.* Saras Publication. (module I, Module II, Module III)

Sastry & Shukal. *Developmental biology.* Rastogi publications (Module I, Module II, Module III)

Web Resources

www.Wikipedia.com. (Module IV)

www.medpedia.com. (Module IV)

ZY6B09U [P] PRACTICAL 9

REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY

36 hrs
Credit 1

Practical

Model/Chart/ Slide may be used

1. Embryological studies- Blastula (frog, chick)
2. Embryo transfer, cloning, gastrula (frog, chick)
3. Amniocentesis
4. Study of placenta- pig and man
5. 18 hour, 24 hour, 33 hour and 48 hour chick embryo (18-48 hrs, any four slides).
6. Candling method.
7. Vital staining- demonstration.

SEMESTER VI

ZY6B10U CORE COURSE 10
GENETICS AND BIOTECHNOLOGY

54 hrs
Credits 3

Objectives of the Course

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

art I GENETICS		34 hrs
odule -I	Introduction: Scope and importance of genetics, Brief explanation of the following terms- gene, alleles, genotype, phenotype, genome, homozygous and heterozygous, wild type and mutant alleles, dominant and recessive traits, test cross and back cross, reciprocal cross, Mendelism – Mendal's laws , Mendelian traits in man Chromosome theory of heredity.	2 hrs

Core Readings

	Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology Chapter 1 &2.	
odule ◆II	**Interaction of genes:** Allelic and non Allelic. Allelic- incomplete dominance, Co-dominance Non allelic interactions, ◆ complementary, supplementary, epistasis ◆ dominant (feather colour in fowl) and recessive (coat colour in mice) Polygenes (Skin colour inheritance in man) pleiotropism, modifying genes, lethal genes (Brief account with one example each) Multiple allies (eg) Coat Colour in rabbits. Man ABO blood group Rh factor, Blood group and its inheritance (Genetic problems related to this topic are included in practicals) **Core Readings** Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology Chapter 3 &4.	5 hrs
odule-III	Linkage and recombination of genes based on Morgan◆s work in Drosophila (Complete and incomplete linkage) .Linkage map Chromosome mapping -two point and three point test cross- mapping - elementary knowledge of mapping principles. **Core Readings** Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology Chapter 5	3hrs
odule IV	Sex determination: Chromosome theory of sex determination (sex chromosomes and autosomes) chromosomal mechanism (XX-XO, XX-XY, ZW-ZZ) Barr bodies and Lyon hypotheses : Sex determination in man- role of Y chromosome. Sex determination in honey bees. Genic balance theory. Drosophila- intersex, gynandromorphs. Hormonal Influence on sex determination Environmental influence - Hermaphroditism **Core Readings** Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology Chapter 6	3hrs
odule V	Mutations, Types of Mutations. Germinal, Sex linked etc. Muller◆s CIB method for detecting sex linked recessive lethal mutations in drosophila - Chromosomal mutations - structural and numerical changes. Gene mutation (point mutation) Molecular basis of gene mutations ◆ tautomerism- Induced mutations Physical and chemical mutagens **Core Readings** Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology Gardner E.J. & Snustand D.P 1984. *Principles of Genetics* (John Wiley & Sons) New York	5 hrs
odule VI	Extra nuclear inheritance (Cytoplasmic inheritance Characteristics: Organella DNA (Mitochondrial and plastid DNA) Kappa particles in paramecium. **Core Readings** Vijayakumaran Nair 2006, *Genetics and Molecular Biology.* Continental Publications, Trivandrum.	2hrs
odule VII	**Bacterial genetics**; Bacterial genome Recombination in Bacteria ◆ Bacterial transformation. Transduction, conjugation F mediated sex duction. Resistance transfer factor (RTF) Mechanism of drug resistance in bacteria Transposable genetic elements in bacteria, basic components and mechanisms of transposition in bacteria. **Core Readings** Panicker S. Abraham G and Francis G. 2008. *Microbiology and Immunology* Published by Zoological Society of Kerala Chapter 10	5hrs

Ananthanarayanan & Jayaram Panicker, 2006. *A textbook of Microbiology*. Orient Longman pvt. Ltd.

odule VIII **Human Genetics:** Karyotyping- Normal human chromosome complement. Pedigree Analysis Aneuploidy and Non disjunction. Genetic disorders in Man Chromosomal anomalies Autosomal (eg. Down syndrome, Edward's syndrome and Cridu chat syndrome) Sex chromosomal anomalies (Kline felter's syndrome, and Turners syndrome) Single gene disorders Gene mutation and disorders (Brief mention) Autosomal single gene disorders (Sickle cell anaemia, brachydactyly; inborn errors of metabolism such as phenyle ketonuria, alkaptonuria). Sex linked inheritance. Definition - characteristics criss-cross inheritance. Haemophilia and colour blindness. Pseudoautosomal genes (incompletely sex-linked genes and holandric genes. Multifactorial disorders - Polygenic traits - Cleft lip and cleft palate. Sex limited and sex influenced traits in man with examples. Prenatal Diagnosis (Amniocentesis) and choriovillus sampling - Ultrasound scanning and Fetoscopy. Genetic counselling, Eugenics and Euthenics. — 9hrs

Core Readings

Stern C. 1973. Principles of Human Genetics (W.H. Freeman and Co.)
Veer Bala Rastogi • Fundamental of Mol. Biology Ane students Education 2008
Verma P.S. and Agarwal V.K. 1988 Genetics (S. Chand and Co. New Delhi)
Winchester A.M. 1966. Genetics (Oxford & IBH Publications.

art II BIOTECHNOLOGY — 20hrs

odule IX Definition and scope of Biotechnology — 1 hr

Core Readings

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

odule X Techniques in gene cloning : Identification of DNA, mRNA, and Protein, Southern Blotting, Northern Blotting and Western Blotting, PCR technique and DNA amplification, DNA hybridization, Fluorescence *insitu* Hybridizarion(FISH), Colony hybridization, DNA finger printing and its applications. RFLP- Applications Gene libraries, - Human DNA library, Construction of genomic library and cDNA library. — 5hrs

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

Core Readings

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

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

Wilson & Walker 2008 *Biochemistry and Molecular Biology* 6th edition, Cambridge University Press. Chapter -5

odule XI Genetic engineering and recombinant DNA technology — 6 hrs

Major steps - Cutting and joining of DNA Role of Restriction endonucleases, Ligases, and plasmid or phage vectors (characteristics and different types) Modern trends : Virus mediated gene transfer, DNA mediated gene transfer, gene therapy

Core Readings

John Ringo 2009 *Fundamental Genetics* Cambridge University Press, Chapter 29.

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

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

Wilson & Walker 2008 *Biochemistry and Molecular Biology* 6th edition, Camebridge University Press. Chapter -5

Veer Bala Rastogi Fundamental of Mol. Biology Ane students Education 2008 Chapter 16 p. 379-424.

odule XII Practical Applications of Biotechnology 5 hrs

Tissue culture Principle and uses Technology of mammalian and plant cell culture. Single cell protein (SCP) The economic implications of SCP. Biotechnology and Medicine: Pharmaceuticals and Biopharmaceuticals (insulin, somatostatin, interferon, Lymphokines) Antibiotics, Vaccines and monoclonal antibodies Biotechnology in agriculture and forestry Microbial insecticides, improved resistance to insect pest and microbial diseases. Production of transgenic plants Animal biotechnology Genetic Engineering for transgenic animals. Genetically engineered hormones and vaccines. Fermentation technology food and beverage fermentations

Core Readings

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

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

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

odule XIII Potential Hazards of Biotechnology 3 hrs

Advantages and hazards of genetic engineering Problems of biologically active biotechnology products.Problems of biotechnological inventions: Patent protection Trade secrets Plant breeder's rights. Biowar and biopiracy

Core Readings

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

Singh B.D. Biotechnology 2002, Kalyan Publishers Nw Delhi.

Selected Further Readings

Bala Subramanian D., C.F & Bryle & K. Dharmarajan J. Green Kunthala Jayaraman, Concept in Biotechnology. University Press 2007
Benjamin Lewin 2004 Gene VIII Oxford University Press
Brown C.H., Campbell I & Priest F, G. 1987. Introduction of Biotechnology (Blackwell scientific publishers Oxford)
C.W. Fox, J.B. Wolf Evolutionary Genetics Concept of Case Studies, Oxford university Press 2006
Colin Ratledge & Bijorn Kristiansen, Basic Biotechnology 3 rd ed. Cambridge University (2008)
De Robertis E.D. and De. Robertis E.M. 1987 cell & Molecular Biology (Lea & Febya / Info- Med)
Desmand S.T. Nicholi An introduction to Genetic Engineering Cambridge Sec, Ed. 2007.
Frank H, Stephenson Calculation for Molecular Biology and Biotechnology . Academic press 2006
Gardner E.J. and Snustand D.P. 1984. Principles of Genetcis (John Wiley & Sons New York.)
Gerhard Fuchs. Biotechnology & in Corporative Perspective. Study in global Competition series, Ane Book 2003
Jan Vijay Aging of the Genome The dual role of DNA in life and Deaths. Oxford university Press 2008
Janarthanan S & Vincent S., Practical Biotechnology, Method of Protocols. University Press . 2007
John E. Smith Biotechnology Cambridge Low priced ed. (Third Ed) 2005
Madingan , Martinko and Parker 2002, Biology of Microorganisms , Brock Eighth Ed. Prentice Hall
Powar. C.B. 1983. Cell biology (Himalaya Publishing company)
Prave D. Faustu and Sitting W and Subasten D.A (Eds) 1987 Fundamentals of Biotechnology (VCH publishers. Germany)
R.C. Sobte and Suparna. S. Pachauri. Essentials of Biotechnology Ane Book Pvt. Ltd. 2009
Singh B.D. Biotechnology 2002, Kalyan Publishers New Delhi.

Sinnat Dunn & Dobzhansky 1959. Principles of Genetics (T.M.H. New Delhi)
Stern C. 1973. Principles of Human Genetics (W.H. Freeman and Co.)
Strickberger W.M. 1990. Genetics (Mac Millan Publishing Co.)
Sudha Gangal Biotechnology Principles And & practice of Animal Tissue culture, Universities Press 2007
Susantha Gosnalibke Merged Evolution (Long term implication of Biotechnology and Information Technology) Gordon & Breech Pub. 2005
Veer Bala Rastogi Fundamental of Mol. Biology Ane students Education 2008
Verma P.S. and Agarwal V.K. 1988 Genetics (S. Chand and Co. New Delhi)
Winchester A.M. 1966. Genetics (Oxford & IBH Publications.

ZY6B10U [P] PRACTICAL 10

GENETICS AND BIOTECHNOLOGY

36 hrs
Credit 1

1. Genetic problems (Problems from each type)
   (a) Mono and Dihybrid ratio (b) Back cross (c) Multiple alleles.
2. Study of barr body in human buccal epithelium.
3. Study through photographs of the Karyotype- Turner's Syndrome , Klinefelters and Down's Syndrome.
4. Preparation of the karyotype and idiogram from the given photograph of somatic metaphase chromosome-(Human)
5. Study of Polymerase Chain Reaction (Demonstration)
6. Western blotting of proteins from SDS-polyacrylamide gel (Demonstration)
7. Southern blotting of DNA fragments from agarosegel (Demonstration)
8. Northern Blotting of RNA molecules (Demonstration)

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

Core Reading

S. Janardhanan and Vincent S.2008 *Practical Biotechnology Methods and protocols* Cambridge University Press.

SEMESTER VI

ZY6B11U CORE COURSE 11
MICROBIOLOGY AND IMMUNOLOGY

54 hrs
Credits 3

Objectives of the course

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

ART I MICROBIOLOGY 27 hrs

odule1 Introduction and Scope of Microbiology 1 hr

Outline classification of bacteria, fungi, viruses, actinomycets and mycoplasma

Core Readings

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

Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.

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

odule 2 Methods in Microbiology 5 hrs

Sterilization and disinfection. Different methods, physical and chemical. Sterilization by moist and dry heat, by filtration, by irradiation, preparation of culture media (aerobic and anaerobic cultivation) Selective media, enrichment media and differential media, Plating techniques and isolation of pure colonies, culture preservation techniques refrigeration, deep freezing, freezing under liquid nitrogen and lyophilization. Safety precautions in a clinical microbiology laboratory

Core Readings

	Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunoloy, Study Material Series published by Zoological Society of Kerala Chapter 5 p. 107-137 Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd. Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane's student Editions 2009	
odule 3	Morphology and fine structure of bacteria, size, shape and arrangements. Flagella, Pili, Capsule, cell wall and its composition, Cytoplasmic membrane, protoplast, spheroplast, intracellular membrane systems, cytoplasm, vacuoles, nuclear material , cell inclusions, Bacterial spores **Core Readings** Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 1 p. 1-36 Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd. Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane's student Editions 2009	5 hrs
odule 4	Bacterial Growth, Effect of various factors on bacterial growth. Eg (*E. coli)* Modes of cell division. New cell formation, Nutritional requirements.Bacterial growth curve **Core Readings** Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 3 Anthanarayan R & C.K. Jayaram Paniker. Textbook of Microbiology (2008) Orient Longman Private Ltd. Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane's student Editions 2009	2 hrs
odule 5	Microbial Metabolism Energy Production by Anaerobic processes Glycolysis, Pentose phosphate pathway, Fermentation, Energy production by Aerobic processes i.e. TCA Cycle , Glyoxylate cycle **Core Readings** Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 4 Anthanarayan R & C.K. Jayaram Paniker. Textbook of Microbiology (2008) Orient Longman Private Ltd. Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane's student Editions 2009	2 hrs
odule 6	Viruses -Structure of Viruses Human, Animal, Plant and Bacterial Viruses. Replication of viruses, cultivation of animal and plant viruses. Viral assay **Core Readings** Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 2 Anthanarayan R & C.K. Jayaram Paniker. Textbook of Microbiology (2008) Orient Longman Private Ltd. Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane's student Editions 2009	3 hrs
odule 7	**Infections** Types, Primary and secondary infections. Cross infection , nosocomial infection Infection, endogenous and exogenous infections, different sources of infections, contagious diseases (Epidemic, endemic and pandemic) modes of transmission of diseases (by food, water, air, vectors, and carriers. Mention different types of carriers, healthy carriers, convalescent carriers, temporary and chronic carriers, contact carriers, paradoxical carriers , bacteraemia, Septicaemia **Core Readings** Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunoloy, Study Material Series published by Zoological Society of Kerala Chapter 8. Park K., Park's Text Book of Preventive and Social Medicine ' 2002, 17t Ed. Banarasidass Bhenot Publications Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane's student Editions 2009	2 hr

odule 8 Diseases caused by different pathogens, epidemiology, symptomology, diagnosis and treatment Bacterial: Mycobacterium (*M. tuberculosis, M leprae*). (TB and leprosy) *Salmonella* (Typhoid) Clostridium (Tetanus and Botulism Spirochete disease (Leptospirosis, Syphilis) 7 hrs

Viral : Herpes virus (Chicken pox) HIV – AIDS virus, Poliovirus (Polio)

Fungal: Tinea or ringworm (Dermatophytoses,) *Candida* albicans (Candidiasis)

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 7

Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.

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

ART II IMMUNOLOGY 27 hrs

odule 9 Introduction to immunology 3 hrs

Types of immunity, innate immunity, acquired , passive , active Mechanism of innate immunity (eg. Barriers, Phagocytosis, inflammation. Complement system, biological effects of complements

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 1

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

odule 10 Antigens and Antibodies 5hrs

Types of Antigens, haptens, antigenic determinants. Basic structure of immunoglobulins. Different classes of immunoglobulins and functions

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 4

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

odule 11 Antigen-antibody reactions, Precipitation test, Agglutination Test, Clinical applications of antigen antibody reaction : Eg: Widal , VDRL , HIV test (ELISA) Complement fixation test, Coombs test 5 hrs

Core Readings

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

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

odule 12 Immune Response system 6 hrs

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

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 10.

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

odule 13 Immunopathology- immune disorders 5hrs

(Hypersensitivity, autoimmunity and immunodeficiency)

Different types of hypersensitivity reactions -

Mechanism of allergic reaction, Anaphylaxis and atopy, Mechanism of immune complex disease.

(Eg. Arthus reaction, Serum sickness)

Autoimmunity, Delayed hypersensitivity, Autoimmune diseases (A brief account)

Transplantation Immunity - Graft rejection , major histocompatibility, Human leukocyte antigen system - (HLA) immuno -suppression, Graft versus host reaction – Tumour immunity-Immune responses in malignancy, Immunotherapy, Immunohaematology, Immunology of blood transfusion, Erythroblastosis foetalis.

Immunodeficiency, AIDS

Core Readings

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

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

odule 14 Vaccines 3 hrs

Brief history of vaccination, principles of vaccines, major types of vaccines

(BCG, DPT, Polio vaccine and TAB vaccines) DNA vaccines, toxoides, adjuvants. Recent trends in vaccine preparation

Core Readings

Sobty & Sharma 2008 *Essentials of Modern Biology* Ane's Student edition p .463-468.

Panicker, S. Francis G., and Abraham G.K. 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 12.

Selected Further Readings

Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.
Colemen: 2002 Fundamentals of Immunology
Darla J. Wise & Gordon R. Carter: 2004:Immunology A Comprehensive Review Iowa state University Press. A Blackwell science company,
Hans G. Sch Legal General Microbiology Seventh Ed. Cambridge Low Price Ed.
Helen Hapel, Maused Harney Siraj Misbah and Next Snowden: 2006 Essentials of Clinical Immunology Fifth Ed. Blackwell Publishing Company,
Heritage, J ., E.G.V. Evaus & R.A.Killungten 2007: Introductory Microbiology Cambridge University Press
Ivan Roitt: 2002 Essentials of Immunology ELBS.
K. Park, Park's Text Book of Preventive and Social Medicine 2002, 17t Ed. Banarasidass Bhenot Publications
Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane's student Editions 2009
Keith Wilson and John Walker, 2009, Principles and Techniques of Biochemistry and Molecular Biology Sixth Ed. Cambridge University Press
Mangi, E.M.T El. C.F.A Bryca, A.L Demain, A.K. Allman Fermentation Microbiology & Biotechnology Sec. Ed. Taylor Framics London New York 2006
Michael J. Pelczar ECS,Chan & Noel. R. Kreig, Microbiology, Tata McGraw Hill 5th ed. 1996.
Monica Cheesbrough: Laboratory Manual for Tropical Countries. Vol.II Microbiology, ELBS Cambridge Ed. 1986.
Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala.
Prakesh Arora M. Anes Illustrated Dictionary of Immunology, Ane Book India. 2002
Prescott. Microbiology 2nd edition

ZY6B11U [P] Practical 11

MICROBIOLOGY AND IMMUNOLOGY

36 hrs
Credit 1

1. Instruments Autoclave, Hot air oven, Bacteriological incubator Working and use in Microbiology lab.
2. Cleaning and sterilization of glasswares
3. Preparation of solid and liquid media for microbial cultures (Ingredients, pH and method of preparation)
   (a) Solid media (1) Nutrient agar (2) Mac Conkey's agar
   (b) Liquid Media (1) Nutrient broth (2) Peptone water.
   (c) Semi solid agar
   (d) Firm agar
4. Culture methods
   (a) Streak plate technique and isolation of pure colonies.
   (b) Lawn culture (c) Stab culture
   (d) Pour plate culture
   (e) Liquid culture
5. Serial dilution and Standard Plate Count (SPC) calculation of
C fu /ml in well water sample (demonstration).
6. Examination of microbes in living condition
   (a) Wet mount
   (b) Hanging drop method for demonstrating motility of bacteria.
7. Gram staining preparation, procedure, identification of Gram + ve and Gram ve bacteria.
8. Antibiotic sensitivity test (demonstration).
9. Preparation of a fungal smear Lactophenol cottonblue staining and mounting
10. Determination of ABO blood groups and Rh factor (Antigen antibody
Reaction)
11. Study through photographs/ illustration, the primary immune (Bone marrow and thymus) and secondary immune (spleen and lymph nodes) organs in Rat/Man.

SEMESTER VI

ZY6B12U CORE COURSE 12
GENERAL INFORMATICS, BIOINFORMATICS AND BIOSTATISTICS

54 hrs
Credits 3

Objectives of the course

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

3. To equip the students with the knowledge of modern developments and recent trends in biological sciences

Part I GENERAL INFORMATICS 12 hrs

Module 1. Introduction

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

Core Readings

Sinha, Pradeep K. and Sinha, Priti. [2003], *Computer Fundamentals – concepts systems and applications,* Third Edition, BPB publications, New Delhi.

Module 2. Operating systems:

DOS, Windows, Linux (only basics), MS Office (MS word, Excel, Access and PowerPoint) computer programming, Networking (LAN, WAN), Internet, World Wide Web, Databases and information retrieval.

New technology in Internet

Core Readings

Gupta, Vikas [2002], *Comdex –computer course kit,* Eight Edition, Dramtech, New Delhi.

Part II BIOINFORMATICS 24 hours

Module 3 8 hrs

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

Core Readings

1. Claverie & Notredame, Bioinformatics - A Beginners Guide, Wiley-Dreamtech India Pvt Ltd, 2003
2. Dan E. Krane and Michael L. Raymer, Fundamental Concepts of Bio-informatics, Pearson Education.
3. Rastogi et. al., Bioinformatics: Methods and Applications, Prentice Hall of India.

Further Readings:

1. Introduction to Bioinformatics, Arthur M. Lesk, OXFORD publishers.
2. D. Mount, Bioinformatics: sequence & Genome Analysis, Cold spring Harbor press, USA.
3. Rashidi, Hooman H. and Buehler, Lukas K. [2001]. *Bioinformatics Basics applications in biological science and medicine,* CRC Press, Washington, D.C.

Module 4 8 hrs.

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

Core Readings

1. Claverie & Notredame, Bioinformatics - A Beginners Guide, Wiley-Dreamtech India Pvt Ltd, 2003
2. Dan E. Krane and Michael L. Raymer, Fundamental Concepts of Bio-informatics, Pearson Education.
3. Rastogi et. al., Bioinformatics: Methods and Applications, Prentice Hall of India.

Selected further Readings

1.Introduction to Bioinformatics, Arthur M. Lesk, OXFORD publishers.
2. D. Mount, Bioinformatics: sequence & Genome Analysis, Cold spring Harbor press, USA.
3. Rashidi, Hooman H. and Buehler, Lukas K. [2001]. *Bioinformatics Basics applications in biological science and medicine,* CRC Press, Washington, D.C.

Module 5 6 hrs.

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

Core Readings

1. Claverie & Notredame, Bioinformatics - A Beginners Guide, Wiley-Dreamtech India Pvt Ltd, 2003
2. Dan E. Krane and Michael L. Raymer, Fundamental Concepts of Bio-informatics, Pearson Education.
3. Rastogi et. al., Bioinformatics: Methods and Applications, Prentice Hall of India.

Slected further Readings

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

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

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

Module 6 Future Prospects: 2 hrs.

1. Human brain Project
2. Computer simulation and visualization of molecular structure
3. Protein structure prediction.

Core Readings

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

Part III BIOSTATISTICS Total- 18 hrs.

Module7. Sample & Sampling techniques 2 hrs

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

Core Readings

Dutta, Naren. [2002], *Fundamental of Biostatistics- Practical Approach,* Kanishka Publishers, New Delhi.
Rastogi, V.B .2009. Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.

Module 8. Measures of Central Tendency 3hrs

Mean, Median, Mode (Merits & demerits)

Core Readings

Dutta, Naren. [2002], *Fundamental of Biostatistics- Practical Approach,* Kanishka Publishers, New Delhi.
Rastogi, V.B .2009. Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.

Module 9. Measures of dispersion 4 hrs

Range, Quartile Deviation, Mean Deviation, Standard Deviation, Standard error. (Merits & demerits).

Core Readings

Dutta, Naren. [2002], *Fundamental of Biostatistics- Practical Approach,* Kanishka Publishers, New Delhi.
Rastogi, V.B .2009. Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.

Module 10. Probability Distributions 3 hrs

Normal, Binomial, Poisson distribution (Brief description only)

Core Readings

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

Module 11. Correlation and Regression 4 hrs

Definition, Types of correlation, Types of regression analysis.

Core Readings

Campbell, R.C. [2005], *Statistics for Biologists, Cambridge Universtiy Press,* New York.
Rastogi, V.B .2009. Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.

Module 12.Test of Hypothesis and Test of Significance 2 hrs

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

Core Readings

Campbell, R.C. [2005], *Statistics for Biologists, Cambridge Universtiy Press,* New York.
Rastogi, V.B .2009. Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.

Selected Further Readings

Campell, R. 1990. Statistics for biologists. CBS Publishers and distributors.
Chavali. L.N. 2009 Bioinformatics & Bioprogramming in Cambridge University press
David. G. Kleinbaum and Mitchel Klein 2009 Survival analysis Statistics for Biology & Health 2nd .Ed. Springer International ed.
Jin Xiang 2008 Essential Bioinformatics 1st Ed. Cambridge University Press.
Khan and Khanum, 1990 Fundamentals of biostatistics
Neil C.Jones and Pavel A.Pevzner. 2004An introduction to Bioinformatics Algorithms. Ane Book Pvt Ltd.
Nikolay Kolchamvov and Ralf Hofestaedt-2008 Bioinformatics of Genome Regulation and structure. Springer international Ed.
Norman T.J. Bailey Statistical methods in biology 2007 Cambridge University press.
Paul.G. Hegg□s and Teresa .K. Altwood- 2005., Bioinformatics and Molecular Evolution Blackwell publishers.
Pennington S.R. and M.J.Dunn.Proteomics.2005 Ane Books.
Rastogi, V.B .2009. Fundamentals of Biostatistics, Ane Books Pvt. Ltd. New Delhi.
Warren J.Ewens, Gregory .R.Grant. 2008. Statistical methods in Bioinformatics an Introduction

ZY6B12U [P] Core Course 12 Practical

General informatics, Bioinformatics and Biostatistics

36 hrs
Credit 1

1. MS Word: Mail merge□Preparing mark sheet of students
2. MS Excel : To create mean and median
3. MS Access: To create grade of students
4. Internet: Creating web page on any subject
5. Frequency distribution of the given samples to find out arithmetic mean, median, mode.
6. Range and standard deviation for a biological data
7. Correlation and regression using any biological data.
8. Download a specified sequence from NCBI and search with it in BLAST and report results with comments.
9. Download molecular structure data files of DNA, Sugar, Water etc and inspect them through Rasmol. Make one measurement each on these molecules (distance, angles etc).
10. Download a specified DNA sequence from NCBI and identify ORF & genes, if any, in it.
11. Download a specified AA sequence from NCBI and plot its hydrophobicity profile.
12. Demonstrate SNP prediction using GENSNIP.
13. Download and study at least two samples of genome sequences.
14. . . Spotters□copies of genome sequences and proteins.
15. Graphical representation of data. Construction of bar diagrams, Histograms, Pie diagram and Line graphs.

Model questions of Bioinformatics (Theory and Practicals)

1. Define bioinformatics. How is it different from computational biology?

2. Explain one standard file format for bio-sequences.
3. Explain important features of NCBI or PDB.
4. How does bioinformatics help comparative biology?
5. Explain how two DNA fragments ATTT and TTT can be compared?
6. What are scoring matrices? Why is it essential in sequence comparison?
7. Explain important features of BLAST.
8. What is multiple sequence alignment? Where is it useful?
9. What is the need for protein structure prediction?
10. Explain the concept of homology modeling.
11. Compare molecular phylogenetics with traditional phylogenetics.
12. Explain the process of Tree construction using molecular phylogenetics software.
13. Explain the basic drug discovery pipeline.
14. Explain the features of Rasmol.
15. Explain the use of GENSNIP.

CORE CHOICE BASED COURSES
MODEL – I/MODEL- II/Double Core/BT&SP

SEMESTER VI

Code ZY6B13U ZOOLOGY CORE CHOICE BASED COURSES
FOR B.Sc. ZOOLOGY PROGRAMME
ELECTIVE I
ECOTOURISM

72 hr
4hrs/week
Credits 3

Objectives:

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

Module I. Fundamentals of Tourism (5 hr)

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

Core Readings

Bruner, E.M. 2005. *Culture on tour: ethnographies of travel*. The University of Chicago Press.
Karan Singh. 1980. Indian Tourism: Aspects of great adventure. Department of tourism. New Delhi.
Ratandeep Sing. 2003. National Ecotourism and Wildlife tourism: Policies and guidelines. Kanishka Publishers, New Delhi

Module II. Ecotourism (12 hr)

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

Core Readings

Bruner, E.M. 2005. *Culture on tour: ethnographies of travel*. The University of Chicago Press.
Ghimire, K.B. and M. Pimbert. 1997. Social change and conservation: environmental politics and impacts of national parks and protected areas. London: Earthscan Publications.
Karan Singh. 1980. Indian Tourism: Aspects of great adventure. Department of tourism. New Delhi.
Ratandeep Sing. 2003. National Ecotourism and Wildlife tourism: Policies and guidelines. Kanishka Publishers, New Delhi
Whelan, T. 1991. Nature tourism: managing for the environment. Washington, D.C.: Island Press.

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

Concepts, practices and case studies for each:

Marine tourism

Wildlife tourism

Adventure tourism

Core Readings

Brian Garrod and Julie C. Wilson. 2002. Marine Ecosystem. Channel View Publications.

Ghimire, K.B. and M. Pimbert. 1997. Social change and conservation: environmental politics and impacts of national parks and protected areas. London: Earthscan Publications.

Ratandeep Sing. 2003. National Ecotourism and Wildlife tourism: Policies and guidelines. Kanishka Publishers, New Delhi

Module IV. Tourist destinations (10 hr)

Common characteristics of tourist destinations

Spatial strategies for destinations

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

Public sector initiatives

Private enterprises

Core Readings

Honey, M. 2002. Ecotourism & certification: setting standards in practice. Washington, D.C. Island Press.

Ratandeep Sing. 2003. National Ecotourism and Wildlife tourism:

Policies and guidelines. Kanishka Publishers, New Delhi

Module V. Problems and prospects of eco-tourism (8 hr)

Economics and benefits of ecotourism

Cultural issues and negative aspects of ecotourism

Environmental Impacts of Tourism

Core Readings

Bhattacharya, A.K. 2005. Ecotourism and livelihoods. Concepts publishing Co, New Delhi-

Rave Chauhan. 2006. Ecotourism: Trends and challenges. Vista International Publishing group, New Delhi.

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

Environment and conservation: basic principles

Current practices of eco-conservation in tourism industry

Sustainable tourism and society

Community based eco tourism

Eco-development committee (EDC) of Periyar Tiger Rerserve

People's initiatives

Core Readings

Ghimire, K.B. and M. Pimbert. 1997. Social change and conservation: environmental politics and impacts of national parks and protected areas. London: Earthscan Publications. Honey, M. 2002. Ecotourism & certification: setting standards in practice. Washington, D.C. Island Press.

Middleton, V. 1998. Sustainable tourism: a marketing perspective. Woburn, MA : Butterworth-Heinemann.

Rave Chauhan. 2006. Ecotourism: Trends and challenges. Vista International Publishing group, New Delhi.

Wearing S. and J. Neil. 1999. Ecotourism: impacts, potentials, and possibilities. Boston: Butterworth-Heinemann. Weaver, D. 1998. Ecotourism in the less developed world. New York : CAB International.

Wells, M. and Brandon, K. 1992. People and Parks: linking protected area management with local communities. Washington, D.C.: the World Bank.

West, P.C. and Brechin, S.R., eds. 1991. Resident Peoples and National Parks: social dilemmas and strategies in international conservation. University of Arizona Press.

Western, D. and Wright, R.M., eds. 1994. Natural Connections: perspectives in community-based conservation. Washington, D.C.: Island Press. (Module VI)

Module VII. Eco-tourism business (10 hr)

Ecotourism marketing

Who are eco-tourists? Ecotourism companies

Emerging trends in eco-tourism

Cultural tourism

Pilgrimage tourism

Farm tourism

Backwater tourism

Health tourism

Core Readings

Bhattacharya, A.K. 2005. Ecotourism and livelihoods. Concepts publishing Co, New Delhi-

Rave Chauhan. 2006. Ecotourism: Trends and challenges. Vista International Publishing group, New Delhi.

Wearing S. and J. Neil. 1999. Ecotourism: impacts, potentials, and possibilities. Boston: Butterworth-Heinemann.

Weaver, D. 1998. Ecotourism in the less developed world. New York : CAB International.

Module VIII. Eco-tourism guides (7 hr)

Ecotourism guiding and case studies

Core Readings

Weaver, D. 1998. Ecotourism in the less developed world. New York : CAB International.

Activities

Preparation of questionnaire

Field testing

Report writing on an ecotourism initiative

Selected Further Readings

Bhattacharya, A.K. 2005. Ecotourism and livelihoods. Concepts publishing Co, New Delhi

Brian Garrod and Julie C. Wilson. 2002. Marine Ecosystem. Channel View Publications.

Bruner, E.M. 2005. *Culture on tour: ethnographies of travel*. The University of Chicago Press.

Ghimire, K.B. and M. Pimbert. 1997. Social change and conservation : environmental politics and impacts of national parks and protected areas. London: Earthscan Publications.
Honey, M. 2002. Ecotourism & certification: setting standards in practice. Washington, D.C. Island Press.
Karan Singh. 1980. Indian Tourism: Aspects of great adventure. Department of toursm. New Delhi.
Middleton, V. 1998. Sustainable tourism: a marketing perspective. Woburn, MA: Butterworth-Heinemann.
Ratandeep Sing. 2003. National Ecotourism and Wildlife tourism: Policies and guidelines. Kanishka Publishers, New Delhi
Rave Chauhan. 2006. Ecotourism: Trends and challenges. Vista International Publishing group, New Delhi.
Wearing S. and J. Neil. 1999. Ecotourism: impacts, potentials, and possibilities. Boston: Butterworth-Heinemann.
Weaver, D. 1998. Ecotourism in the less developed world. New York : CAB International.
Wells, M. & Brandon, K. 1992. People and Parks: linking protected area management with local communities. Washington, D.C.: the World Bank.
West, P.C. & Brechin, S.R., eds. 1991. Resident Peoples and National Parks: social dilemmas and strategies in international conservation. University of Arizona Press.
Western, D. & Wright, R.M., eds. 1994. Natural Connections: perspectives in community-based conservation. Washington, D.C.: Island Press.
Whelan, T. 1991. Nature tourism: managing for the environment. Washington, D.C.: Island Press.

SEMESTER VI

Code ZY6B14U ZOOLOGY CORE CHOICE BASED COURSES
FOR B.Sc. ZOOLOGY PROGRAMME
ELECTIVE II
NUTRITION, COMMUNITY HEALTH AND SANITATION

72 hrs
4 hrs/week
Credits 3

Objectives of the Course

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

Course outline

	PART – I NUTRITION AND COMMUNITY HEALTH	36 hrs
odule -I	Definition and Meaning of Health Dimensions and Determination of Health Physical Activity and Health benefits Effect of exercise on body systems – Circulatory, Respiratory, Endocrine, Skeletal and Muscular Programmes on Community health promotion (Individual, Family and Society) Dangers of alcoholic and drug abuse, medico-legal implications **Core Readings** Fashey , Tomas D, Insel , Paul M and Roth Walt (2005) Fit and Well. New York; Mc Graw Hill Inc Greenberg, Jerol S and Dintiman George B (1997) Wellness Creating a life of Health and Fitness , London Allyn and Bacon Inc. Tom Sanders and Peter Emery. (2004) Molecular basis of human nutrition: Taylor & Francis Publishers Ane Book Rai. B.C. Health Education and Hygiene. Published by Prakashan Kendra, Lucknow	10 hrs
odule II	Nutrition and Health Concept of Food and Nutrition, Balanced diet Vitamins, Malnutrition, Deficiency Disease Determining Caloric intake and expenditure Obesity, causes and preventing measures – role of Diet and exercise, BMI **Core Readings** K Park, (2008) Park–s Text Book of Preventive and Social Mediine 18th Edition. Banarasidass Bhenot Publication Tom Sanders and Peter Emery. (2004) Molecular basis of human nutrition: Taylor & Francis Publishers Ane Book	10 hrs
odule III	Safety Education and Health Promotion Principles of Accident prevention, Health and Safety in daily life. Health and Safety at work. First aid and emergency care. Common injuries and their management. Modern life style and hypokinetic diseases. Diabetes, Cardiovascular diseases, Diet & Cancer - Prevention and Management, Ageing, Theories of Ageing. Cellular changes with ageing. **Core Readings** Norman Bezzaant HELP First Aid for everyday emergencies. Jaico Publishing House, Bombay, Delhi Tom Sanders and Peter Emery. (2004) Molecular basis of human nutrition: Taylor & Francis Publishers Ane Book	10 hrs
odule IV	Life Skills Education	6 hrs

Physical activity, emotional adjustment and well being, Yoga, Meditation and Relaxation, Psychoneuroimmunology

Core Readings

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

ART II COMMUNITY HEALTH AND SANITATION 36 hrs

odule V — 12 hrs

Public health and water quality. Prevention of Water borne diseases. Potable water quality monitoring and waste water management. Faecal bacteriae and pathogenic microorganisms transmitted by water. Cholera and Typhoid. Determination of sanitary quality of drinking water, water purification techniques • Methods of waste water treatment and disposal Physical and Biological treatment • Anaerobic digesting system Septic tank method, Aerobic process • Oxidation ponds, trickling filters, activated sludge processes • Vermi composting a method of solid waste management

Core Readings

Pelczar M.J. Jr. E.C.S. Chane & N.R. Krieg, Microbiology (Concept & Applications). 5th edition. Tata McGraw Publishing Company Ltd.

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

odule VI — 12 hrs

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

Core Readings

Pelczar M.J. Jr. E.C.S. Chane & N.R. Krieg, Microbiology (Concept & Applications). 5th edition. Tata McGraw Publishing Company Ltd.

Panicker S, Franis G And Abraham g. (2008) Microbiology & Immunology. Zoological Society Study Material Series. Published by Zoological Society of Kerala.

odule VII — 12 hrs

Public health and diseases

Emerging pathogens and diseases - Swine Flue (H1N1), Bird Flue (H5N1), SARS, Anthrax, Reemerging pathogens and diseases •TB, Chikungunya)

Vector borne (mosquito) diseases and their control measures (Chikungunya , Malaria, Filariasis and Dengu fever)

Mosquito eradication

Leptospirosis and preventive measures • Rodent control measures. Cancer • Types of cancers, Carcinogens, Causes of Cancer, Morphological Structural Biochemical & behavioural changes of cancer cells

Core Readings

Zoological Society of Kerala Study Material Series 2002• Cell Biology Genetics & Biotechnology published by Zoological Society of Kerala.

K Park, (2008) Park•s Text Book of Preventive and Social Medicine

Selected Further Readings

Fashey, Tomas D, Insel, Paul M and Roth Walt (2005) Fit and Well. New York; Mc Graw Hill Inc

Greenberg, Jerol S and Dintiman George B (1997) Wellness Creating a life of Health and Fitness , London Allyn and Bacon Inc.

Edlen Gordon Janes and Barttlet. Human Genatics a modern Synthesis. Published by Boston.

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

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

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

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

Tom Sanders and Peter Emery. (2004) Molecular basis of human nutrition: Taylor & Francis Publishers Ane Book

SEMESTER VI

Code ZY6B15U ZOOLOGY CORE CHOICE BASED COURSES FOR B.Sc. ZOOLOGY PROGRAMME

ELECTIVE III

APPLIED ENTOMOLOGY, MANAGEMENT OF ORNAMENTAL FISH BREEDING, VERMICULTURE AND BEE KEEPING

72 hrs
4 hrs/week
Credits 3

Objectives of the Course

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

Part I APPLIED ENTOMOLOGY 18 hrs

Module I Pests of common crops of Kerala (Paddy and Coconut)

Morphology, damages caused and control measures.

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

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

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

Insect pest management

1 Chemical control- Classification and chemical composition of pesticides Insecticides and their mode of action, trade names

2. Biological control methods – give examples, insects used in biological control programme Microbial insecticides

3. Autocidal control (sterile male technique)

4. IPM – Integrated Pest Management.

Core Readings

Nair M R G K- Insect pests of Crops of India

Vijayakumaran Nair – Protista & Animal Diversity. Academica Press. 2009

Nair K K. Ananthakrishnan, T N David, B V. 1976 – General & Applied Entomology

M S Mony – Applied Entomology

Larry P. pedigo, Entomology and Pest management, prentice hall of India Delhi.

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

Module 2

1 Ornamental Fish Breeding 15 hrs

Introduction. Present status of ornamental fish culture. Fresh water aquarium fish culture. Marine ornamental fishes. Breeding of gold fish, koei, tetra, barb, fighter, gourami, live bearers, clown fish, damsels, butterfly fish and sea horses. Nutrition and feed of aquarium fishes. Establishment of commercial ornamental fish culture unit. Common diseases of aquarium fishes and their m,anagement**.**

Core Readings

MPEDA A hand Book on Aquafarming- Ornamental fishes, MPEDA Kochin.

Applied Zoology, Study Material Published by Zoological Society of Kerala, CMS College Campus

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

Module 3 Aquarium management 3hrs

Aquarium,Aims of aquarium, Requirement of an aquarium, Setting an aquarium, Aquarium fishes

Core Readings

Applied Zoology , Study Material Published by Zoological Society Of Kerala , CMS college Campus

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

Part III – VERMICULTURE 8 hrs

Module 4 Vermiculture

Introduction, ecological classification of earth worms. Life history.

Species of earth worms used for vermicultre, role of earth worm in solid waste management, in agriculture, in medicine etc. preparation of vermibed, preparation of vermi compost, Preparation of vermiwash,

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

Core Readings

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

Part IV – APICULTURE 18 hrs

Module 5 Bee Keeping

Definition, Uses of bees. Sp.of bees cultured, organization of honey bee colony, Social life and adaptation of honey bees. Communication among honey bees. 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, dearth periodswarming management, monsoon management. Enemies of bees. Bee diseases. Bee pasturage. Honey and wax composition. Testing the quality of honey. Extraction of wax Uses of honey and wax. Apitherapy. Royal jelly , propolis. Agencies supporting apiculture.

Activity :- visit to an apiculture unit and prepare a note.

Field visit and report writing 10 hrs

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

Core Readings

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

Selected Further Readings

Addison Webb, Bee Keeping- for profit and pleasure, agrobios India Ltd.

Alka Prakash, Lab. Manual of entomology , New age International publ. Deilhi.

Ananthakrishnan T.N.Dimensions of Molecular Entomology. University

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

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

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

Dhooria M.S. - Ane's – Dictionary of General & Applied Entomology 2007

Farm made aquafeeds FAO fisheries technical paper, 343.

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

Harisankar J. Alappat & A. Bijukumar, Aquarium Fishes. B. R. Publ. Corporation, Delhi.
Larry P. pedigo, Entomology and Pest management, Prentice hall of India Delhi.
MPEDA A hand Book on Aquafarming- Ornamental fishes, MPEDA Kochin.
Nalina Sundari, R, santhi Entomology, MJP publ. Chennai.
NPCS Board, The complete book on Bee keeping and honey processing, NIIR Project consultancy services, 106- E kamala nagar Delhi – 110007.
Pillai T.V.R., Aquaculture , principles and practices.
Ronald j. Roberts (1978) Fish pathology , Cassel Ltd London.
Sukla. Upadhay, Economic Zoology
Tembhare, D.B. modern entomology, Himalaya Publ. House.
Verreth J. , Fish larval nutrition , Chapman & Hall Publ.

OPEN COURSES FOR OTHER STREAMS

SEMESTER V

OPEN COURSES FOR OTHER STREAMS/OWN STREAMS
ELECTIVE I
ZY5D01U MAN, NATURE AND SUSTAINABLE DEVELOPMENT

72 hrs
4hrs/Week
Credits 4

Objectives

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

Module I. Man in Nature **10 hrs**

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

Speech and Languages
Cultural Evolution
Altruism and Morality

Core Readings

Conroy,G.C. 1997.*Reconstructing Human Evolution: A Modern Synthesis*. Norton, NY,USA.
Encyclopedia Britannica .1987 .*Evolution.* Macropedia Vol.18 Knowledge in Depth pp930-979. Encyclopedia Britannica Inc.UK
Harrison, Lawrence E. and Samuel P. Huntington. 2000. *Culture Matters: How Values Shape Human Progress*. Basic Books. Perseus.
Rob DeSalle and Ian Tattersal.2008. *Human Origins:What Bones and Genomes Tell Us about Ourselves.* Texas A&MUniversity Press, USA.
Strickberger, M.W.2000. *Evolution*. Jones and Bartlett, Boston.

Module II. The Biosphere 10 hrs

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

Core Readings

Forman, R.T and M. Gordaon. 1986. *Landscape Ecology.* John Wiley &Sons, NY,USA.
Miller, Tyler. G. (Jr) 2005. *Essentials of Ecology*. Thomson Brooks/cole.
Khanna ,G.N.1993. *Global Environmental Crisis and Management*. Ashish Publishing House, New Delhi.
Ramesh,B.R and Rajan Gurukkal., 2007.*Forest Landscapes of the Southern Western Ghats, IndiaBiodiversity, Human Ecology and management Strategies*. French Institute of Pondicherry, India

Module III. Dominance of Man on Earth 7 hr

Industrial Revolution
Human Population Growth
Resource Utilization
Environmental Consequences
Modern Agriculture and Green Revolution
Environmental Impacts
Imperialism and its Ecological Root

Core Readings

Gregory Cochran and Henry Harpending.2009.*The 10,000 Year Explosion: How Civilization Accelerated Human Evolution*. Basic Books

Module IV. Natural Resources 5 hr

Renewable and Non- renewable
Biodiversity
Importance of Biodiversity -the Six E ^{S}
Hotspots of Biodiversity
Biotic Richness of India
Monoculture and loss of Genetic Diversity
Extinction Crisis, IUCN and Red Data Book

Core Readings

Joy A.Plamer (Edn.).2004. *Fifty Great Thinkers on the Environment*. Routledge, London and New York.

Module.V .Global Environmental Issues Threatening Natural Resources and Human Life 12 hr

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

Core Readings

Khanna ,G.N.1993. *Global Environmental Crisis and Management*. Ashish Publishing House, New Delhi.

Module VI. Man's Perspective on Nature 10 hr

Eco Spirituality, Eco-theology and Eco-feminism
Community initiatives
Indigenous People's Perspective (tribal and traditional communities)
Native American, Amazonian,. Australian Aborigines, Bishnoi
Contributions of -John Muir, Aldo Leopold, Thoreau, Rachel Carson Edward Abbey, Arne Ness, Carolyn Merchant, Vandana Shiva

Core Readings

Lester R. Brown. 2001. *Eco-Economy Building an Economy for the Earth*.W.W.Norton & Company, NY, USA.

Module VII. Global Strategies for Conservation 8 hrs

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

Silent Valley

Core Readings

Andrew S. Pullin 2002. *Conservation Biology*. Cambridge University Press, Cambridge, UK.

Donella H.Meadows et al.1972.*The Limits to Growth*. Universe Books Ny,USA.

Module VIII Sustainable Development **10 hrs**

Definition and Concept

Principles and Goals

Environment versus Development Debate

Johannesburg Conference -2002

Strategies for Sustainable development

Sustainable Development in the era of Globalization

Gandhian Environmentalism

Education for Sustainable Development (UNESCO-ESD)

Building a Sustainable society

Sustainable life styles

Core Readings

Richard T. Wright &Bernard J.Nebel.2002.*Environmental Science-Toward a Sustainable Future.*Pearson Education Inc.NY,USA.

Zimmerman, Michael. 2004a. *Integral Ecology: A Perspectival, Developmental, and Coordinating Approach to Environmental Problems*. World Futures.

Selected Further Readings

Agrawal, Arun and Clark C. Gibson. 1999. ﷿Enchantment and Disenchantment: The Role of Community in Natural Resource Conservation,﷿ World *Development* 27(4): 629-649.

Agrawal, Arun. 2001. ﷿Common Property Institutions and Sustainable Governance of Resources,﷿ *World Development*, 29(10): 1649-1672,

Alfred W.Crosby.1995.*Ecological Imperialism: The Biological Expansion of Eurpoe, 900-1900*. Cambridge University Press, MA. USA.

Andrew S. Pullin 2002. *Conservation Biology*. Cambridge University Press, Cambridge, UK.

Barnes, C.W. 1988. *Earth, Time and Life*. John Wiley &Sons, NewYork

Barry Commoner.1990.*Making Peace with the Planet*. Pantheon Books, New York,USA.

Berry Thomas.1988.*The Dream of the Earth*. Sierra Club Books, San Francisco.

Bickerton,D. 1995.*Language and Human Behaviour*. University of Washington Press, Seattle.

Carlos Hernandez and Rashmi Mayur.1999.*Pedagogy of the Earth:Education for a Sustainable Future*. Bharatiya Vidya Bhavan, Mumbai, India.

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

Chattopadhyay Sajib.2002. *Life Origin, Evolution and Adaptation*. Books and Allied (P) Ltd.Kolkata,India.

Conroy,G.C. 1997.*Reconstructing Human Evolution: A Modern Synthesis*. Norton, NY,USA.

Donella H.Meadows et al. 1992.*Beyond the Limits*.Chelesa Green Publishing Com.Vermont,USA.

Donella H.Meadows et al.1972.*The Limits to Growth*. Universe Books Ny,USA.

Encyclopedia Britannica .1987 .*Evolution.* Macropedia Vol.18 Knowledge in Depth pp930-979. Encyclopedia Britannica Inc.UK

Foley,R.1987.*AnotherUniqueSpecies:PatternsinHumanEvolutionary cology*.Longman,Harlow,UK.

Forman, R.T and M. Gordaon. 1986. *Landscape Ecology.* John Wiley &Sons, NY,USA.

Gandhi,M.K.-Writings on Ecology

Gore A.1993.*Earth in Balance*.Penguin Books, NY.USA.

Gregory Cochran and Henry Harpending.2009.*The 10,000 Year Explosion: How Civilization Accelerated Human Evolution*. Basic Books

Hardin, Garrett. 1968. ﷿The Tragedy of the Commons,﷿ *Science*, 162(1968): 1243-1248.

Harrison, Lawrence E. and Samuel P. Huntington. 2000. *Culture Matters: How Values Shape Human Progress*. Basic Books. Perseus.

Herman Daly. 1990.﷿Toward Some Operational Principles of Sustainable Development﷿.*Ecological Economics* 2:1-6.

IUCN-UNEP-WWF 1991. *Caring for the Earth: A Strategy for Sustainable Living*. Gland, Switzerland.

Joy A.Plamer (Edn.).2004.*Fifty Great Thinkers on the Environment*. Routledge, London and New York.

Khanna ,G.N.1993. *Global Environmental Crisis and Management*. Ashish Publishing House, New Delhi.

Lester R. Brown. 2001. *Eco-Economy Building an Economy for the Earth*.W.W.Norton &Company,NY,USA.

Lieberman,P.199..*Uniquely Human: The Evolution of Speech, Thought and Selfless Behaviour*.Harvard University Press,Cambridge,MA.

Miller, Tyler. G. (Jr) 2005. *Essentials of Ecology*. Thomson Brooks/cole.

Myers, Norman.1984. *The Primary Source: Tropical Forests and Our Future*. W.W. Nortan & Company, NY.

Orr,David,W.1992.*Ecological Literacy*.State University of New York Press, Albany.

Primack, R. 2002. *Essentials of Conservation Biology*. Sinauer Associates, Inc.; 3rd edition

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

Richard T. Wright &Bernard J.Nebel.2002.*Environmental Science-Toward a Sustainable Future.*Pearson Education Inc.NY,USA.

Rob DeSalle and Ian Tattersal.2008. *Human Origins:What Bones and Genomes Tell Us about Ourselves.* Texas A&MUniversity Press, USA.

Sapru,K.K.1987.*Environment Management in India*.Ashigh Publishing House, New Delhi.

Sharma P.D.1994. *Ecology and Environment*.Rastogi Publications, Meerut-2.

Shellenberger, Michael and Ted Nordhaus. 2005. *The Death of Environmentalism: Global Warming Policies in a Post-environmental World*. Grist Magazine. www.grist.org

Stiling Peter.2002. *Ecology: Theories and Applications.* Prentice Hall of India pvt. Ltd. New Delhi

Strickberger, M.W.2000. *Evolution*. Jones and Bartlett, Boston.

Wilber, Ken. 2001. *Theory of Everything*. Shambala.

Wilson, E.O.1975. *Sociobiology* Harvard University Press, Cambridge, Mass. USA.

World Commission on Environment and Development .1987. *Our Common Future*. Oxford University Press.

Zimmerman, Michael. 2004a. *Integral Ecology: A Perspectival, Developmental, and Coordinating Approach to Environmental Problems*. World Futures.

Web Resources

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

SEMESTER V

OPEN COURSES FOR OTHER STREAMS/ OWN STREAMS
ELECTIVE II
ZY5D02U HUMAN GENETICS, NUTRITION, COMMUNITY HEALTH AND SANITATION

72 hrs
4hrs/Week
Credits 4

Objectives of the Course

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

ART I HUMAN GENETICS 18 hrs

lodule I — 9 hrs

Human normal chromosome complement. Genetic disorders in man. Chromosomal anomalies. Eg. Down Syndrome and Cridu chat syndrome. Sex chromosomal anomalies Syndromes- Klinefelters Syndrome and Turners Syndrome. Single gene mutation disorders- Eg. Sickle Cell anaemia. Polygenic Cleft lip and palate. Sex linked inheritance Haemophilia and Colour blindness. Pre natal Diagnosis (Amniocentesis, and Chorionic Villus Sampling) Ultra sound scanning and Fetoscopy Genetic Counselling. Eugenics and Euthenics.

Core Readings

Zoological Society of Kerala Study Material Series 2002 Cell biology Genetics & Biotechnology published by Zoological Society of Kerala.

lodule II — 9 hrs

Human blood groups and their inheritance pattern. Rh factor Blood transfusion Universal Donor, Universal recipient Importance of Blood donation.

DNA finger printing and applications Probing for criminals Method to resolve paternity and maternity disputes.

Causes of human infertility a brief account. Human genome project a brief account.

Core Readings

Zoological Society of Kerala Study Material Series 2002 Cell biology Genetics & Biotechnology published by Zoological Society of Kerala.

ART II NUTRITION AND COMMUNITY HEALTH 18 hrs

lodule -III — 5 hrs

Definition and Meaning of Health
Dimensions and Determination of Health
Physical Activity and Health benefits
Effect of exercise on body systems Circulatory, Respiratory, Endocrine, Skeletal and Muscular

Programmes on Community health promotion (Individual, Family and Society) Dangers of alcoholic and drug abuse, medico-legal implications

Core Readings

Fashey , Tomas D, Insel , Paul M and Roth Walt (2005) Fit and Well. New York; Mc Graw Hill Inc

Greenberg, Jerol S and Dintiman George B (1997) Wellness Creating a life of Health and Fitness , London Allyn and Bacon Inc.

Tom Sanders and Peter Emery. (2004) Molecular basis of human nutrition: Taylor & Francis Publishers Ane Book

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

lodule IV	Nutrition and Health Concept of Food and Nutrition, Balanced diet Vitamins, Malnutrition, Deficiency Disease Determining Caloric intake and expenditure Obesity, causes and preventing measures • Role of Diet and Exercise, BMI **Core Readings** K Park, (2008) Park•s Text Book of Preventive and Social Mediine 18th Edition. Banarasidass Bhenot Publication Tom Sanders and Peter Emery. (2004) Molecular basis of human nutrition: Taylor & Francis Publishers Ane Book	5 hrs
lodule V	Safety Education and Health Promotion 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. Diabeties, Cardiovascular disorders - Prevention and Management. **Core Readings** Norman Bezzaant HELP First Aid for everyday emergencies. Jaico Publishing House, Bombay, Delhi Tom Sanders and Peter Emery. (2004) Molecular basis of human nutrition: Taylor & Francis Publishers Ane Book	5 hrs
lodule VI	Life Skills Education Physical activity, emotional adjustment and well being,. Yoga, Meditation and Relaxation, Psychoneuroimmunology **Core Readings** Edlen Gordon Janes and Barttlet. Human Genatics a modern Synthesis. Published by Boston. P 39, 266-270	3 hrs
'ART III	**COMMUNITY HEALTH AND SANITATION**	36 hrs
lodule VII	Public health and water quality. Prevention of Water borne diseases. Potable water quality monitoring and waste water management. Faecal bacteriae and pathogenic microorganisms transmitted by water. Cholera and Typhoid. Determination of sanitary quality of drinking water, water purification techniques. Vermi composting a method of solid waste management **Core Readings** Pelczar M.J. Jr. E.C.S. Chane & N.R. Krieg, Microbiology (Concept & Applications). 5th edition. Tata McGraw Publishing Company Ltd. Monica Cheesbrough, Laboratory Manual for Tropical Counties Vol.II LBS.	12 hrs
lodule VIII	Public Health and Food borne diseases and their prevention Food poisoning caused by toxins produced by microbes eg Staphylococcal food poisoning, Botulism, Salmonellosis Food infection caused by growth of microorganisms in the human body after the contaminated food has been eaten. Eg Food Infection hepatitis (hepatitis A) **Core Readings** Pelczar M.J. Jr. E.C.S. Chane & N.R. Krieg, Microbiology (Concept & Applications). 5th edition. Tata McGraw Publishing Company Ltd. Panicker S, Franis G And Abraham g. (2008) Microbiology & Immunology. Zoological Society Study Material Series. Published by Zoological Society of Kerala.	12 hrs
lodule IX	Public health and diseases (a) Emerging pathogens and diseases • Swine flue (H1N1), bird flue (H5N1), SARS, Anthrax Reemerging pathogens and diseases • TB, Chikungunya . (b) Vector borne diseases (mosquito) and their control measures (Chikungunya , Malaria, Filariasis and Dengu fever) Mosquito eradication (c) Leptospirosis and preventive measures • Rodent control measures (d) Cancer different types, causes of cancer, carcinogens, diet & cancer (e) HIV, AIDS • causes & preventive measures **Core Readings** Zoological Society of Kerala Study Material Series 2002• Cell biology Genetics & Biotechnology published by Zoological Society of Kerala. K Park, (2008) Park•s Text Book of Preventive and Social	12 hrs

Selected Further Readings

Fashey, Tomas D, Insel, Paul M and Roth Walt (2005) Fit and Well. New York; Mc Graw Hill Inc
Greenberg, Jerol S and Dintiman George B (1997) Wellness Creating a life of Health and Fitness , London Allyn and Bacon Inc.
Edlen Gordon Janes and Barttlet. Human Genatics a modern Synthesis. Published by Boston.

Monica Cheesbrough, Laboratory Manual for Tropical Counties Vol.II LBS.
Norman Bezzaant HELP First Aid for everyday emergencies. Jaico Publishing House, Bombay, Delhi
Pelczar M.J. Jr. E.C.S. Chane & N.R. Krieg, Microbiology (Concept & Applications)
Rai. B.C. Health Education and Hygiene. Published by Prakashan Kendra, Lucknow

SEMESTER V

OPEN COURSES FOR OTHER STREAMS/ OWN STREAMS

ELECTIVE III

ZY5D03U MANAGEMENT OF ORNAMENTAL FISH BREEDING, RABBIT FARMING, POULTRY, QUAIL FARMING, VERMICULTURE, BEE KEEPING & SERICULTURE

72 hrs
4hrs/Week
Credits 4

Objectives of the Course

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

Module 1 Ornamental Fish Breeding 10hrs

Introduction. Present status of ornamental fish culture. Fresh water aquarium fish culture. Marine ornamental fishes. Breeding of gold fish, koei, tetra, barb, fighter, gourami, live bearers, clown fish, damsels, butterfly fish and sea horses. Nutrition and feed of aquarium fishes. Establishment of commercial ornamental fish culture unit. Common diseases of aquarium fishes and their management**.**

Core Readings

George cust & Peter Bird, Tropical Fresh water Aquaria, Hamlyn London.
Harisankar J. Alappat & A. Bijukumar, Aquarium Fishes. B. R. Publ. Corporation, Delhi.
MPEDA A handbook on Aquafarming- Ornamental fishes, MPEDA Kochin.
Pillai T.V.R., Aquaculture , principles and practices.
Ronald j. Roberts (1978) Fish pathology , Cassel Ltd London .

Module 2 Aquarium management 3hrs

Aquarium, Aims of aquarium, Requirement of an aquarium, Setting an aquarium, Aquarium fishes

Core Readings

Applied Zoology, Study Material Zoological Society Of Kerala, published by Zoological Society of Kerala
George cust & Peter Bird, Tropical Fresh water Aquaria, Hamlyn London.
Harisankar J. Alappat & A. Bijukumar, Aquarium Fishes. B. R. Publ. Corporation, Delhi.
Pillai T.V.R., Aquaculture , principles and practices.
Ronald j. Roberts (1978) Fish pathology , Cassel Ltd London .

Module 3 Rabbit farming 6hrs

Attributes of rabbit as a live stock. Breeds of rabbits for farming. Housing. Feeding and feed formulation. Reproduction. Importance of record keeping. Handling of rabbit.

Sexing. Slaughter and skin processing. Diseases and treatment .Agencies supporting rabbit farming.Sources of good quality broiler rabbit in south India.

Activity:- visit a rabbit farm and make a report on the economics of rabbit faming.

Core Readings

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

Module 4 Poultry 13 hrs

Definition. Chicken (Gallus domesticus) rearing. A) Conditions for profitability, location, housing, automation in poultry houses, B) confinement rearing, Size of flock stock, Agencies and centres that supply chicks C) Care of chicks- artificial brooding, litter management, light, feed, disease control, vaccination programme for layer type chicken.D) care of growing chicks- Space requirement, feed for growers, feeding and watering, disease control, debeaking, dubbing E) care of laying birds- housing, light, feeding, cage layer management, Summer management. F)Broilers- definition, housing, feeding, watering, good management practices, trouble pointers, disease control guidelines, record keeping, project report guidelines

Activity: - visit a poultry farm and make report on the day today management practices

Core Readings

Applied Zoology, Study Material Zoological Society Of Kerala , published by Zoological Society of Kerala
H.V.S. Chauhan, Poultry, Disease, diagnosis and treatment, Wiley eastern Ltd Delhi.

Module 5 Quail farming (*Coturnix coturnix*) 4 hrs

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

Core Readings

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

Module 6 Vermiculture and composting 8 hrs

Species of earth worms used for vermicultre.. Preparation of vermibed, preparation of vermi compost, Preparation of vermiwash. Maintenance and management. Role of vermiculture in solid waste management.

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

Core Readings

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

Module 7 Bee Keeping 16 hrs

Definition, sp. Of bees cultured, organization of honey bee colony, bee keeping methods (modern method only) and equipments, management and maintenance of an apiary-growth period, dividing the colony, uniting two colonies, replacing old queen with new queen, honey flow period, Bee pasturage. Dearth period. Enemies of bees. Bee diseases. Uses of honey and wax. Apitherapy.Propolis Royal jelly. . Agencies supporting apiculture.

Activity :- visit to an apiculture unit and prepare a note.

Core Readings

Larry P. pedigo, Entomology and Pest management, Prentice hall of India Delhi.

Nalina Sundari, R, santhi Entomology, MJP publ. Chennai.

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

Module 8 Sericulture **12hrs**

Definition. Composition of silk. Sp. Of silk worms. Life history of Bombyx mori.

Rearing of silk worm- rearing house, Environmental conditions-temperature, light, humidity.Leaf feeding and feeding methods. Rearing of young age silk worm or chawki, paraffin paper rearing and box rearing. Silk work handling- brushing, feeding, bed cleaning, spacing. Rearing of late age larvae- shelf rearing and floor rearing. Mounting of worms- chandrika and natrika. Cocoon harvesting and sorting. Silk worm diseases and pest.control measures

Activity :-. Visit a sericulture unit and make report

Core Readings

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

Field visit and report writing

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

Selected Further Readings

Addison Webb, Bee Keeping- for profit and pleasure, agrobios India Ltd.

Alka Prakash, Lab. Manual of entomology , New age International publ. Deilhi.

Applied Zoology , Study Material Zoological Society Of Kerala , CMS college Campus Kottayam.

Armugan N. (2008) Aquaculture, Saras publ.

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

D.B. Tembhare, modern entomology, Himalaya Publ. House.

Farm made aquafeeds FAO fisheries technical paper, 343.

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

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

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

Larry P. pedigo, Entomology and Pest management, Prentice hall of India Delhi.

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

Munro ISR (1982) The marine and fresh water fishes, Sony reprints.

Nalina Sundari, R, santhi Entomology, MJP publ. Chennai.

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

Packages of Practices and Recommendations , Veterinary and Animal Husbandary 2001, Directorate of extension, Kerala Agriculture University, Mannuthy.

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

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

Sukla. Upadhay, Economic Zoology

Verreth J. , Fish larval nutrition , Chapman & hall Publ.

SEMESTER V

OPEN COURSE FOR OTHER STREAMS/ OWN STREAMS
ELECTIVE IV

ZY5D04U - FOOD MICROBIOLOGY

72 hrs
4 hrs / week
Credit 4

Module1. Food as a substrate for micro organisms, micro-organisms important in food microbiology- moulds, yeasts and bacteria; brief account of each group; general characteristics and importance; Principles of food preservation – asepsis – removal of micro organisms, anaerobic conditions – high and low temperatures – drying, chemical preservatives – food additives. - 15Hrs

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

Module 3. Dairy Microbiology - Bacteriological examination of milk. Preservation of milk – pasteurization , different methods and advantages, sterilization, dehydration, Bacteriological standards and grading of milk, Fermented dairy products- Cheese ,Buttermilk, lassie, cheese, cream, condensed and dry milk products, yoghurt; , low lactose milk, Kefis and Kumiss -10 Hrs

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

- 10 Hrs

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

MODULE 6 (Activity Oriented Study) **18 hrs**

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

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

Core Readings

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

ZOOLOGY COMPLEMENTARY COURSES FOR
MODEL I & II

ZOOLOGY COMPLEMENTARY COURSE FOR BOTANY

MODEL I AND SIMILAR PROGRAMMES (HOME SCIENCE/ BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION)

Semester I

ZY1C01U Animal Diversity – Non Chordata

2 hrs/week
36/hrs
Credit – 2

Objectives

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

Module 1

General Introduction 1 hr

5 Kingdom classification, Classification in general

Core Readings

Ekambaranatha Ayyer M (1990) A Manual of Zoology, Volume 1. Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007) Protista & Animal Diversity Academica Publications. Zoological Society of Kerala.

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

Module 2

Kingdom Protista 7 hrs

Salient features and classification up to phyla

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

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

Pathogenic protista Plasmodium, Entamoeba.

Core Readings

Ekambaranatha Ayyer M (1990) A Manual of Zoology, Volume 1. Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)
Protista & Animal Diversity Academica Publications.

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

Module 3

Mesozoa eg. Rhopalura (mention 5 salient features) 2 hrs

Parazoa

Phylum Porifera eg Leucosolenia

Phylum Placozoa e g. Trycoplax adherens.

Core Readings

Ekambaranatha Ayyer M (1990) A Manual of Zoology, Volume 1. Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)
Protista & Animal Diversity Academica Publications.

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

Module 4

Phylum : Coelenterata 3hrs

Salient features, Classification up to classes

1. Hydrozoa Physalia
2. Scyphozoa Aurelia
3. Anthozoa Adamsia

Corals and coral reefs.

Core Readings

Ekambaranatha Ayyer M (1990) A Manual of Zoology, Volume 1. Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)
Protista & Animal Diversity Academica Publications.

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

Module 5

Phylum - Platyhelminthes 2 hes

Salient features, classification upto classes

1. Turbellaria Planaria
2. Trematoda Fasciola
3. Cestoda Taenia solium

Core Readings

Ekambaranatha Ayyer M (1990) A Manual of Zoology, Volume 1. Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007)
Protista & Animal Diversity Academica Publications.

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

Module 6

Phylum Nematoda 2 hrs

Salient features, classification up to classes

1. Phasmidia - Wuchereria
2. Aphasmidia • Trichinella

Module 7

Phylum - Annelida 2 hrs

Salient features, classification upto classes

1. Polychaeta, - Nereis
2. Oligochaeta • Earthworm • Pheretima
3. Hirudinomorpha • Hirudinaria

Core Readings

Ekambaranatha Ayyer M (1990) A Manual of Zoology, Volume 1. Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007) Protista & Animal Diversity Academica Publications.

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

Module 8

Phylum Arthropoda 10 hrs

Salient features

Type - Prawn - Penaeus

Classification upto classes

Subphylum Chelicerata

Class 1. Merostoma • Limulus
2. Arachinida • Spider
3. Pycnogonida • Nymphon

Subphylum Mandibulata

Class 1. Crustacea • Daphnia
2. Chilopoda - Centepede
3. Symphyla - Scutigerella
4. Diplopoda - Millipede
5. Pauropoda - Pauropus
6. Insecta - Butterfly

(Detailed account of examples are not necessary)

Phylum Onychophora • eg. Peripatus (Mention its affinities)

Insect pests

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

Core Readings

Ekambaranatha Ayyer M (1990) A Manual of Zoology, Volume 1. Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007) Protista & Animal Diversity Academica Publications.

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

Module: - 9

Phylum • Mollusca 3 hrs

Salient features and classification upto classes

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

Core Readings

Ekambaranatha Ayyer M (1990) A Manual of Zoology, Volume 1. Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd

Vijayakumaran Nair, Jayakumar J & Paul P I (2007) Protista & Animal Diversity Academica Publications.

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

Module 10

Phylum - Echinodermata 3 hrs

Salient features , classification upto classes

Class 1. Asteroidea • Astropecten
2. Ophiuroidea - Ophiothrix
3. Echinoidea • Echinus

4. Holothuroidea – Cucumaria
5. Crinoidea – Antedon

Core Readings

Ekambaranatha Ayyer M (1990) A Manual of Zoology, Volume 1. Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd
Vijayakumaran Nair, Jayakumar J & Paul P I (2007) Protista & Animal Diversity Academica Publications. Zoological Society of Kerala.
Animal Diversity (2002). Published by Zoological Society of Kerala.

Module 11

Phylum Hemichordata 1 hr
Salient features eg: Balanoglossus

Core Readings

Ekambaranatha Ayyer M (1990) A Manual of Zoology, Volume 1. Invertebrate Part I and Part II S Viswanathan printers 7 Publishers Pvt.Ltd
Vijayakumaran Nair, Jayakumar J & Paul P I (2007) Protista & Animal Diversity Academica Publications.
Zoological Society of Kerala. Animal Diversity (2002). Published by Zoological Society of Kerala.

Selected Further Readings

Barnes, R.D. , 1987. Invertebrate Zoology (W.B. Saunders, New York).
Barrington, E.J.W., 1967. Invertebrate Structure and function (ELBS and Nelson , London).
Dhami, P.S. and Dhami, J.K. 1979. Invertebrate Zoology (R. Chand and Co. New Delhi).
Ekamberanatha Ayyar M. (1990) A Manual of Zoology, Volume I. Invertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.
Groove, A.J. and Newell, G.E. 1974. Animal Biology – Indian Reprint (University Book Stall, New Delhi).
Hyman, L.H. The Invertebrate vols. (McGraw-Hill) 1942. Comparative vertebrate Anatomy (The University of Chicago Press).
James R.D. (1987). Invertebrate Zoology, W.B. Saunders, New York.
Kapoor V.C. (1994). Theory and Practice of Animal Taxonomy.
Kapoor, V.C. 1994. Theory and Practice of Animal Taxonomy (Oxford and IBH Publishing Co., New Delhi.)
Kotpal R.L. Agarwal S.K. and R.P. Khetharpal (2002). Modern Text Book of Zoology.
Parker T.J and Haswell W.A. (1962). Text Book of Zoology Vol. I. Invertebrate (ELBS & Macmillan, London).
Marshall, A.J. and Williams, W.D. 1972. Text Book of Zoology Vol. Invertebrates (ELBS and Macmillan, London).
Mayer, E. 1980. Principles of Systematic Zoology (Tata McGraw Hill Publishing Co., New Delhi.)
Nair, K.K. Ananthakrishnan, T.N. David, B.V. 1976. General and Applied Entomology (T.M.H. New Delhi).

Practicals

ZY1C01U [P] ANIMAL DIVERSITY – NON CHORDATA

2 hr/week,
36 hrs
Credit – 1

1. Scientific drawing - 5 specimens
2. Simple identification – 20 invertebrates (Out of which 10 by their scientific names)
3. T.S - Earthworm, T.S Fasciola
4. Dissection - Prawn Nervous system
5. Dissection - Cockroach Nervous system
6. Mounting – Prawn Appendages
7. Mounting – Cockroach Mouth parts

SEMESTER II

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

ZY2C02U - ANIMAL DIVERSITY – CHORDATA

36 hrs
Credits 2

Objectives

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

Module I 7hrs

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

Core Readings

Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by Zoological Society of Kerala
Ekamberanatha Ayyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.
Young J.Z. 1981. The life of Vertebrate s (Oxford University Press).

Module II **3 hrs**

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

Core Readings

Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by Zoological Society of Kerala
Ekamberanatha Ayyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.
Young J.Z. 1981. The life of Vertebrate s (Oxford University Press).

Module III 16 hrs

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

Core Readings

Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by Zoological Society of Kerala
Ekamberanatha Ayyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.
Young J.Z. 1981. The life of Vertebrate s (Oxford University Press).

Module IV Class Reptilia **4 hrs**

General characters
Sub class I: Anapsida Eg. Chelone
Sub class II Diapsida Eg. Chameleon
Subclass III Parapsida eg. Icthyosaurus
Poisonous and non-poisonous snakes of India

Core Readings

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

Ekamberanatha Ayyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.
Young J.Z. 1981. The life of Vertebrate s (Oxford University Press).

Module V Class Aves **3 hrs**

General characters
Sub class I : Archeornithes Eg: Archaeopteryx
Sub class II. Neornithes Eg: Struthio
Flight adaptations of birds

Core Readings

Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by Zoological Society of Kerala
Ekamberanatha Ayyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.
Young J.Z. 1981. The life of Vertebrate s (Oxford University Press).

Module VI Class Mammalia **3 hrs**

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

Core Readings

Animal Diversity (2002). Zoological Society Of Kerala Study Material Series. Published by Zoological Society of Kerala
Ekamberanatha Ayyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.
Young J.Z. 1981. The life of Vertebrate s (Oxford University Press).

Selected Further Readings

Deoras, P.J. 1981. Snakes of India (National Book Trust of India.)
Ekamberanatha Ayyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.
Groove, A.J. and Newell, G.E. 1974. Animal Biology - Indian Reprint Universal Book Stall, New Delhi.
Induchoodan, 1986, Kweralathile Pakshikal (Kerala Sahitya Academy, Trichur).
Kapoor, V.C. 1994, Theory and Practice of Animal Taxonomy (Oxford and IBM Publishing Co. New Delhi.
Lagler, K.F. , Bardach, J.E. , Miller, R.R. Passino, D.R.M. 1977 Ichthyology (John Wiley and Sons).
Mayer, E. 1980. Principles of Systematic Zoology (Tata McGraw Hill Publishing Co. New Delhi.
Newman, H.H. 1939. Phylum Chordata, (Macmillan Pub. Co. New York)
Nigam H.C. 1978 , Zoology of Chordata (S. Chand and Co. New Delhi).
Parker, T.J. and Haswell W.A. 1962. Text Book of Zoology Col. II Vertebrates (ELBS and Macmillan , London).
Parter S.H. 1971. The Book of Indian Animals (Bombay Natural History Society).
Salim Ali, 1969. Birds of Kerala (Oxford University Press).
Sinha A.K. , Adhikari S. Ganguly, B.B. 1988. Biology of Animals Vol. II (New Central Book Agency, Calcutta.)
Whitaker, R. 1978 Common Indian Snakes A field Guide Macmillan and Co. of India Ltd.)
Young J.Z. 1981. The life of Vertebrate s (Oxford University Press).
Young J.Z. Life of mammals) Oxford University Press).

Practicals

ZY2C02U [P] - ANIMAL DIVERSITY CHORDATA

2 hrs/week
36 hrs
Credit I

1. Morphology
   Scientific drawing 5 specimens of chordates
2. Simple identification of 10 chordates (Out of which 5 by their scientific names)

3. Osteology • Vertebrae and girdles of Frog
4. Snake identification - 3 poisonous and
   3 non poisonous with key
5. Mounting of placoid scales of shark
6. Dissections:

Frog: Photographs/Diagrams/one dissected & preserved specimen each/ models may be used for the study.

1. Frog • Viscera
2. Frog • Digestive System
3. Frog • Arterial System
4. Frog • Sciatic plexus
5. Frog • Brain

SEMESTER III

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

ZY3C03U - HUMAN PHYSIOLOGY AND IMMUNOLOGY

3 hrs/week
54 hrs
Credits 3

Objectives

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

Part I HUMAN PHYSIOLOGY **36 hrs**

Module 1 : Nutrition **3 hrs**

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

Core Readings

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

Prosser & Brown 2006 : Comparative Animal Physiology

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

Module 2: Respiration **5 hrs**

Transport of O_2 and CO_2 in blood, respiratory disorders • Dyspnoea, Hypoxia, Asphyxia, Hypo and Hypercapnia, CO poisoning, smoking and its physiological effects.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp432-509

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

Module 3: Circulation **7 hrs**

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

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.144-262, 382-429, 711-715.

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

Module 4 Excretion **6 hrs**

Structure of human nephrone, composition of urine • normal and abnormal constituents, urine formation (ultra filtration , selective reabsorption, tubular secretion and counter current mechanism); Hormonal control of renal function, Kidney disorders • myeleonephritis, glomerular nephritis, nephrotic syndrome, Dialysis

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.264-379

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

Module 5 Neurophysiology **6 hrs**

Structure of typical neuron, myelenated and non myelenated nerve fibres; Nerve impulse – initiation and propagation of nerve impulse, All or none law, Saltatory conduction, Synaptic transmission, Neurotransmitters, Brian waves, Electroencephalogram, Neural disorders – Parkinson's disease, Epilepsy, Alzheimier's syndrome, Dyslexia.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.512-715

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

Module 6 Muscle Physiology **4 hrs**

Striated, Non striated and Cardiac muscle, Ultra structure of striated muscle fibre, Mechanism of muscle contraction, Threshold and spike potential, Fatigue, O_2 dept, Rigor mortis.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.52-86

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

Module 7 Endocrinology **5 hrs**

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

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.836-966

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

Part II IMMUNOLOGY **18 hrs**

Module 8 **3 hrs**

Introduction to immunology

Types of immunity, innate immunity , acquired, passive , active

Mechanism of innate immunity (eg. Barriers , phagocytosis , inflammation)

Complement System, biological effects of complements.

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 1

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 9 **5 hrs**

Antigens and antibodies

Types of antigens , haptens, antigenic determinants.

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

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 4

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 10 **5 hrs**

Antigen antibody reactions

Precipitation test, agglutination test ,

Clinical applications of antigen antibody reaction, Widal, VDRL, HIV test (ELISA), Complement Fixation Test, and Coombs test.

Core Readings

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

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 11 **5 hrs**

(Brief accounts of the followings)

Immune response system

Primary and secondary lymphoid organs,

Cells of Immune system – Leucocytes, lymphocytes, T&B cells, Macrophages, Plasma cells , Memory cells, MHC, Antibody synthesis, Monoclonal antibodies, Hybridoma technology

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

Vaccines - Major types of vaccines (BCG, DPT, Polio vaccine and TAB vaccines). Recent trends in vaccine preparation.

Core Readings

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

Kerala Chapter 10.
Ivan Roitt, 2002 *Essentials of Immunology ELBS*
Sobha & Sharma (2008) Essentials of Modern Biology One's Student edition PP 463-468.

Selected Further Readings

Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.
Colemen: Fundamentals of Immunology
Guyton, Medical Physiology
Ivan Roitt: Essentials of Immunology ELBS.
Madhavankutty, Medical Physiology
Mahupathra, Human Physiology, Current Books
Michael J. Pelczar ECS,Chan & Noel. R. Kreig, Microbiology, Tata McGraw Hill 5th ed. 1996.
Michael J. Gibuay, Ian A. Macdonald and Helen M. Roche, Nutrition and Metabolism.
Monica Cheesbrough: Laboratory Manual for Tropical Countries. Vol.II Microbiology, ELBS & Cambridge Ed. 1986.
Paniker S., Francis G. and Abraham G.K 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala.
Park, K. Park's Text Book of Preventive and Social Medicine & 2002, 17t Ed. Banarasidass Bhenot Publications
Prosser and Brown, Comparative Animal Physiology
Sebastian Prof. M.M., Animal Physiology
William S Hoar, Animal Physiology.

ZY3C03U[P] - HUMAN PHYSIOLOGY AND IMMUNOLOGY

2Hrs/Week
36Hrs
Credit 1

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

SEMESTER IV

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

ZY4C04U - APPLIED ZOOLOGY (AQUACULTURE, SERICULTURE, VERMICULTURE, APICULTURE)

3hrs/week
54 hrs
Credits 3

OBJECTIVES

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

Module 1: Aquaculture **24 hrs**

Traditional methods of aquaculture, Advantages and salient features of aquaculture, Types of aquaculture, Biotic and abiotic factors of water, Importance of Alga in aquaculture, Common Cultivable fishes of Kerala Pond culture (Construction and maintenance) Brief Description of Carp culture Composite fish culture. Integrated Fish Culture, Induced breeding in fishes, Important Fish Diseases. Fish preservation and processing
Aquarium management, Setting up of an Aquarium, Biological filter and Aeration . Common species of Aquarium fishes.
Prawn culture, Mussel culture , Pearl culture

Core Readings:

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

Module 2 Sericulture **12 hrs**

Four species of silkworms, Life history of silkworms, Silkworm Rearing Techniques. Diseases and Pests of silkworms. Mounting of worms. Harvesting and stiffling of cocoons. Silkworm diseases. Preventive and control measures.

Core Readings:

Applied Zoology; (2002) Published by Zoological Society Of Kerala
Sudheeran, M.S. & John P.C., 1989 Economic Zoology (Prathibha Publ., Kottayam)

Module 3 Vermiculture **6 hrs**

Species of Earthworms suitable for vermiculture. Reproduction and Life Cycle . Physical and Chemical effects of Vermiculture, Vermicomposting, Site Selection, Cement pit Soil pit . Preparation of pit. Maintenance and Monitoring

Core Readings:

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

Module 4 Apiculture 12 hrs

Species of Honey bees. Organization of honeybee colony. Bee keeping methods and equipments Apiary management and maintenance. Bee pasturage, Byproducts of honey bees and their uses. Diseases and pests of honey bees, control measures.

Core Readings:

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

Selected Further Readings

Alikunhi, K.h., Fish Cluture in India (ICAR, New Delhi)
Bhosh, C.C., 1949, Silk Production and Weaving in India (CSIR), New Delhi) Director. Zoological Survey of India, 1994, earthworms Resources and Vermiculture
Edwards, C.A. & Lafty, J.R. 1972 Biology of Earthworms (Chapman and Hall Led. London)
Jhingran, V.G., 1985 Fish and Fisheries of India (Hindustan Publ. Corporation, New Delhi)
Kurien, C.V. & Sebastian V.C., Prawn Fisheries in India (Hindustan Publ. Corporation, New Delhi)
Krishnaswami, S., 1986 Improved Method of Rearing Young age Silk worms (Central Silk board Bangalore)
Krishnaswami, S., 1986, New Technology of Silkworm Rearing (Central Silk Board Bangalore)
Lee, K. E., 1985 Earthworms, Their Ecology and relationships with Soils and Land use. Academics Press.
Menon, K.N., 1970 Malsyakrishi (State Institute of language, Trivandrum)
Mysore Silk Association, 1986, Silkworm rearing and Diseases of Silkworms
Padmanabha Aiyer, K.S., 1992, Records of the Indian Museum Vol. XXXI, Part I, PP. 13-76 An Account of the Oligochacta of the Travancore
Shiggene, K., 1969, Problems in Prawn Culture (American publ. Co., New Delhi)
Shukla G.S., & Updhyay V.B., Economic Zoology (Rastogi Publ. Meerut)
Andhra Pradesh Agricultural University, Hydrabad)
Sinhan, V.R.P. & Ramachandran, V., 1985, Fresh water Fish Culture (ICAR, New Delhi)
Singh, S., 1962 Bee keeping in India (ICAR, New Delhi)
Singh, V.P.P. and Ramachandran, V., 1985 Freshwater Fish Culture (ICAR, New Delhi)
Sudheeran, M.S. & John P.C., 1989 Economic Zoology (Prathibha Publ., Kottayam)
Ullal, S. R. and Narasimahanna, M.N., Handbook of Practical Sericulture (Central Silk Board Bombay.)
Venkitaraman, P.R., 1983, Text Book of Economic Zoology (Sudarsana Publ. Cochin)

Practicals

ZY4C04U [P] - APPLIED ZOOLOGY (AQUACULTURE, SERICULTURE, VERMICULTURE, APICULTURE)

2 hrs/week
1 credit
36 hrs

1. General Identification, Economic importance, Morphology, scientific names and common names of the following
   a. Economic important and morphology of culturable fishes
      (Catla, Rohu, Grass carp, Common carp, Silver carp, Etroplus

Tilapia)

b. 2 species of earthworms used in Vermiculture

c. Two species of honey bees

d. Silkworm. Cocoon/Adult

1. Castes of bees
2. Bee keeping equipments Beehive, Smoker, honey extractor
3. Beeswax, Honey, Silk, Vermicompost (Identification-Uses)
4. Chandrika /Natrika used in sericulture

SEMESTER I
ZY1CV01U

ZOOLOGY COMPLEMENTARY COURSE FOR BOTANY
(MODEL II) ANIMAL DIVERSITY- NON CHORDATA

Objectives 54 hrs. Credits 2

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

MODULE I

Introduction: **Briefly mention the following (2 hrs)**

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

Kingdom Protista Type: Paramecium (**10hrs)**

Salient features and classification up to phyla

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

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

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

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

Three branches - Mesozoa, parazoa, Eumetazoa.

Core Readings

Dhami.P.S. and Dhami J.K. 1979 Invertebrate Zoology. R. Chand and Co. Delhi.
Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

MODULE II

Mesozoa - Eg. Rhopalura.

Phylum Porifera. (3 hrs)

Classification upto classes.
Class I- Calcarea. Eg. Sycon., Class II – Hexactinellida . Eg. Euplectella.
Class III – Demospongia Eg. Cliona.

General Topics

1. Reproduction in sponges 2. Canal system in sponges.

Phylum Coelenterata Type: Obelia (6hrs)

Classification upto classes.

Class I - Hydrozoa Eg. Halistemma. Class II – Scyphozoa Eg. Rhizostoma. Class III- Anthozoa Eg. Fungia.

General Topics-

1. Coral and coral reefs with special reference to conservation of reef fauna.
2. Polymorphism in Coelenterates

Core Readings

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

Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

MODULE III

Phylum Ctenophora. (**1 hr)**

Eg. Pleurobrachia.

Phylum Platyhelminthes (3hrs)

Classification upto classes.

Class I - Turbellaria. Eg. Planaria.

Class II – Trematoda Eg. Fasciola

Class III- Cestoda Eg. *Taenia saginata.*

General Topics-

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

Phylum Nematoda (3hrs)

Class Phasmidia Eg. Enterobius, Ascaris

Class Aphasmidia Eg. Trichinella

General Topic-

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

Phylum Annelida (**2 hrs)**

Classification upto classes.

Class I- Archiannelida Eg. Polygordius

Class II – Polychaeta Eg. Chaetopterus

ClassIII- Oligochaeta Eg. Megascolex.

Class IV - Hirudinomorpha Eg. Ozobranchus, Hirudinaria

Core Readings

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

Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

MODULE IV (12 hrs)

Phylum- Onychophora

Eg. Peripatus (Mention its affinities).

Phylum Arthropoda

Type: Panaeus

Classification upto classes.

Divided into 4 subphyla.

1. Sub Phylum - Trilobitomorpha

Class - Trilobita (mention salient features).

2. Sub Phylum- Mandibulata

Class I – Crustacea Eg. Sacculina

Class II- Chilopoda Eg. Centipede (Scolopendra)

Class III Symphyla Eg. Scutigerella

Class IV – Diplopoda Eg. Millipede (Spirostreptus)

Class V - Insecta Eg. Dragon fly

Class VI – Pauropoda Eg. Pauropus

3. Sub Phylum - Chelicerata

Class - Merostomata Eg. Limulus

Class II – Arachnida Eg. Scorpion

General Topics

3. Vectorial Arthropods
4. Larval forms of Penaeus

Core Readings

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

Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

MODULE V

Phylum Mollusca (4 hrs)

Classification upto classes

Class I- Monoplacophora Eg. Neopilina

Class II- Amphineura Eg. Chiton

Class III- Gastropoda Eg. Aplysia

Class IV- Scaphopoda Eg. Dentalium

Class V- Pelecypoda Eg. Pinctada

Ciass VI- Cephalopoda Eg. Sepia

General Topic-

Pearl formation and culture

Phylum Echinodermata **(4 hrs)**

Classification upto classes

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

General Topics

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

Minor Phyla (**2 hrs)**

1. Chaetognatha Eg. Sagitta
2. Sipunculida Eg. Sipunculus
3. Rotifera Eg. Brachionus

Phylum Hemichordata **(1 hr)**

Eg. Balanoglossus

Core Readings

Zoological Society of Kerala Study material. *Animal Diversity* 2002.
Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.

Selected Further Readings

Anderson D.T. 2001Invertebrate Zoology Sec Edition Oxford University Press
Barnes R.D. 1987. Invertebrate Zoology. W. B. Saunders. New York.
Dhami.P.S. and Dhami J.K. 1979 Invertebrate Zoology. R. Chand and Co. New Delhi.
Ekambaranatha Ayyar M. 1990. A Manual of Zoology. Volume i. Invertebrate part I and part II. S. Viswanathan Printers & Publishers. Pvt. Ltd.
Hyman L. H. The Invertebrate Volumes. Mc Graw Hill.
Jordan. E. L., and Verma P.S. 2000. Invertebrate zoology. S. Chand and Co. ltd., New Delhi.
Kotpal R. L, Agarval S. K. and R. P. Khetharpal 2002. Modern Textbook of Zoology.
Kotpal.R. L., 1988-92 (All series). Rastogi Publishers, Meerut.
Parker & Haswell. Textbook of Zoology. Invertebrate . Vol. I 7th Edition.

ZY1CV01U [P] Practical 1
ANIMAL DIVERSITY- NON CHORDATA

36 hrs.
Credit 1

Scientific Drawing:-

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

Anatomy:-

Study of sections. (Any two)

1. Hydra.
2. Ascaris
3. Earthworm
4. Fasciola

Dissections

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

Mounting:-

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

Identification:-

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

Taxonomic identification with key:-

Identification of insects up to the level of order.

SEMESTER II

ZY2CV02U

ANIMAL DIVERSITY – CHORDATA

54 Hrs
Credits 2

Objectives

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

MODULE I

Introduction (**1 Hr)**

Phylum Chordata - General classification

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

5. **Sub phylum : Urochordata (3 Hrs)**

Class I Larvacea Eg. Oikopleura
Class II Ascidiacea Eg: Ascidia (Mention Retrogressive Metamorphosis)
Class III Thaliacea Eg: Doliolum

6. **Sub phylum: Cephalochordata** (**2 Hrs)**

Example - Amphioxus

Core Readings

Ekambaranatha Iyer 2000 A Manual of Zoology Vol. !!.S. Viswanathan and Co.
Young J.Z, 1981, The Life of Vertebrates Oxford University Press.
Young J.Z. 2006 The life of Vertebrates Oxford University Press (Third Ed.) India Ed.

MODULE II

7. **Sub phylum: Vertebrata**

8. **Division 1 – Agnatha** (**2 Hrs)**

Class I Ostracodermi Eg: Cephalaspis
Class II Cyclostomata Eg: Petromyzon

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

Super class Pisces

Class: Chondrichthyes

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

Class: Osteichthyes

Sub class – Choanichthyes
Order 1 Crossopterigii Eg: Latimeria
Order 2 Dipnoi Eg: Lepidosiren

Sub class: - Actinopterygii
Super order 1. Chondrostei Eg: Acipencer
Super order 2. Holostei Eg: Amia
Super order 3. Teleostei Eg: Sardine

General topics

7. Accessory respiratory organs in fish.
8. Parental care in fishes.
9. Scales in fishes.
10. Migration in fishes
11. Common culture fishes of Kerala
12. Lung fishes

Core Readings

Ekambaranatha Iyer 2000 A Manual of Zoology Vol. !!.S. Viswanathan and Co.
Young J.Z. 2006 The life of Vertebrates Oxford University Press (Third Ed.) India Ed.
Jhingran 1977, Fish and Fisheries of India, Hindustan Publishing Co.

MODULE III

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

Class Amphibia

Type – *Rana hexadactyla*

Order I Anura Eg: Hyla

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

Class Reptilia (**4 Hrs)**

Sub class I: Anapsida
Order Chelonia Eg: Chelone
Sub class II: Parapsida Eg: Ichthyosaurus
Sub class III: Diapsida
Order I Rhynchocephalia Eg: Sphenodon
Order II Squamata Eg: Chamaleon
Sub class IV: Synapsida Eg: Cynognathus

General topic

Identification of poisonous and non poisonous snakes

Class Aves **4 Hrs**

Sub class I: Archeornithes Eg: Archaeopteryx (Affinities)
Sub class II: Neornithes
Super order I: Palaeognathe Eg: Struthio
Super order II: Neognathe Eg; Brahminy kite

General topics

3. Migrations in birds
4. Flight adaptations in birds

Core Readings

Jordan E L and .P.S. Verma, 2002 Chordate Zoology S. Chand and Co. New Delhi.
Ekambaranatha Iyer 2000 A Manual of Zoology Vol.!S. Viswanathan and Co.

MODULE IV

Class Mammalia **(18 Hrs)**
Type: Rabbit

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

General topics

1. Dentition in Mammals
2. Aquatic Mammals

Core Readings

Jordan E L and .P.S. Verma, 2002 Chordate Zoology S. Chand and Co. New Delhi.
Ekambaranatha Iyer 2000 A Manual of Zoology Vol. !!.S. Viswanathan and Co.
Zoological Society of Kerala Study material. *Animal Diversity* 2002

Selected Further Readings

Ekambaranatha Iyer 2000 A Manual of Zoology Vol. !!.S. Viswanathan and Co.
Jhingran 1977, Fish and Fisheries of India, Hindustan Publishing Co.
Jordan E L and .P.S. Verma, 2002 Chordate Zoology S. Chand and Co. New Delhi.
Kotpal R.L. 2000, Modern Text Book of zoology, Vertebrates, Rastogi Publications, Meerut.
Nigam and Sobti 2000, Functional Organization of Chordates. Shoban Lal Nagin Chand and Co. New Delhi.
Young J.Z, 1981, The Life of Vertebrates Oxford University Press.
Young J.Z. 2006 The life of Vertebrates Oxford University Press (Third Ed.) India Ed.

ZY2CV02U [P] PRACTICAL 2

ANIMAL DIVERSITY CHORDATA

36hrs
Credit 1

1. **Morphology: Scientific Drawing**

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

2. **Dissections**

   Frog: Photographs/diagrams/one dissected & preserved specimensach/models may be used for study.

   1. Frog Viscera

   2. Frog Digestive System

   3. Frog Arterial System

   4. Frog 9^{th} 7 1^{st} Spinal nerve

   5. Frog Sciatic Plexus

   6. Frog Brain

   Mounting of placoid scales/cycloid/ctenoid scales

3. **Osteology**

   Frog vertebrae

   Pectoral and pelvic girdles of Frog and Rabbit

   Skull of Rabbit (Diastema -dentition
   Turtle plastron and carapace

4. **Study of sections.**
   Amphioxus T. S. through pharynx/T.S. through intestine
5. **Identification:-**
   General identification-
   Identify all the animals by their generic names and 25 % of them by their specific names.
   Protochordata-1, Pisces-4, Amphibia-3, Reptilia- 4, Aves-1,
   Mammalia-2.
6. **Taxonomic identification with key:-**
   i) Identification of fishes up to the level of order.
   ii) Identification of snakes up to family.

SEMESTER III

ZOOLOGY COMPLEMENTARY COURSE FOR BOTANY
(MODEL II) AND SIMILAR PROGRAMMES
ZY3CV03U - HUMAN PHYSIOLOGY AND IMMUNOLOGY

3 hrs/week
54 hrs

Credits 3

Objectives

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

Part I HUMAN PHYSIOLOGY **36 hrs**

Module 1 : Nutrition **3 hrs**

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

Core Readings

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

Prosser & Brown 2006 : Comparative Animal Physiology

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

Module 2: Respiration **5 hrs**

Transport of O_2 and CO_2 in blood, respiratory disorders – Dyspnoea, Hypoxia, Asphyxia, Hypo and Hypercapnia, CO poisoning, smoking and its physiological effects.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp432-509

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

Module 3: Circulation **7 hrs**

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

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.144-262, 382-429, 711-715.

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

Module 4 Excretion **6 hrs**

Structure of human nephrone, composition of urine – normal and abnormal constituents, urine formation (ultra filtration , selective reabsorption, tubular secretion and counter current mechanism); Hormonal control of renal function, Kidney disorders – myeleonephritis, glomerular nephritis, nephrotic syndrome, Dialysis

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.264-379

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

Module 5 Neurophysiology **6 hrs**

Structure of typical neuron, myelenated and non myelenated nerve fibres; Nerve impulse – initiation and propagation of nerve impulse, All or none law, Saltatory conduction, Synaptic transmission, Neurotransmitters, Brian waves, Electroencephalogram, Neural disorders – Parkinson–s disease, Epilepsy, Alzheimier–s syndrome, Dyslexia.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.512-715

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

Module 6 Muscle Physiology **4 hrs**

Striated, Non striated and Cardiac muscle, Ultra structure of striated muscle fibre, Mechanism of muscle contraction, Threshold and spike potential, Fatigue, O_2 dept, Rigor mortis.

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.52-86

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

Module 7 Endocrinology **5 hrs**

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

Core Readings

Guyton 2002: Text Book of Medical Physiology Saunders pp.836-966

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

Part II IMMUNOLOGY **18 hrs**

Module 8 **3 hrs**

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

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunoloy, Study Material Series published by Zoological Society of Kerala Chapter 1

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 9 **5 hrs**

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

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunoloy, Study Material Series published by Zoological Society of Kerala Chapter 4

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 10 **5 hrs**

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

Core Readings

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

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Module 11 **5 hrs**

(Brief accounts of the followings)
Immune response system
Primary and secondary lymphoid organs,
Cells of Immune system – Leucocytes, lymphocytes, T&B cells,
Macrophages, Plasma cells , Memory cells, MHC, Antibody synthesis,
Monoclonal antibodies, Hybridoma technology
Immune disorders – hypersensitivity, Auto immunity & Immunodeficiency, AIDS,
Vaccines - Major types of vaccines (BCG, DPT, Polio vaccine and TAB vaccines). Recent trends in vaccine preparation.

Core Readings

Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunoloy, Study Material Series published by Zoological Society of Kerala Chapter 10.

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Sobha & Sharma (2008) Essentials of Modern Biology One's Student edition PP 463-468.

Selected Further Readings

Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.
Colemen: Fundamentals of Immunology
Guyton, Medical Physiology
Ivan Roitt: Essentials of Immunology ELBS.
Madhavankutty, Medical Physiology
Mahupathra, Human Physiology, Current Books
Michael J. Pelczar ECS,Chan & Noel. R. Kreig, Microbiology, Tata McGraw Hill 5th ed. 1996.
Michael J. Gibuay, Ian A. Macdonald and Helen M. Roche, Nutrition and Metabolism.
Monica Cheesbrough: Laboratory Manual for Tropical Countries. Vol.II Microbiology, ELBS – Cambridge Ed. 1986.
Paniker S., Francis G. and Abraham G.K 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala.
Park, K. Park's Text Book of Preventive and Social Medicine – 2002, 17t Ed. Banarasidass Bhenot Publications
Prosser and Brown, Comparative Animal Physiology
Sebastian Prof. M.M., Animal Physiology
William S Hoar, Animal Physiology.

ZY3CV03U[P] - HUMAN PHYSIOLOGY AND IMMUNOLOGY

2Hrs/Week
36Hrs
Credit 1

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

SEMESTER IV

ZOOLOGY COMPLEMENTARY COURSE FOR BOTANY
(MODEL II) AND SIMILAR PROGRAMMES
ZY4CV04U - APPLIED ZOOLOGY (AQUACULTURE, SERICULTURE, VERMICULTURE, APICULTURE)

3hrs/week
54 hrs
Credits 3

OBJECTIVES

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

Module 1: Aquaculture **24 hrs**

Traditional methods of aquaculture, Advantages and salient features of aquaculture, Types of aquaculture, Biotic and abiotic factors of water, Importance of Alga in aquaculture, Common Cultivable fishes of Kerala Pond culture (Construction and maintenance) Brief Description of Carp culture Composite fish culture. Integrated Fish Culture, Induced breeding in fishes, Important Fish Diseases. Fish preservation and processing
Aquarium management, Setting up of an Aquarium, Biological filter and Aeration . Common species of Aquarium fishes.
Prawn culture, Mussel culture , Pearl culture

Core Readings:

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

Module 2 Sericulture **12 hrs**

Four species of silkworms, Life history of silkworms, Silkworm Rearing Techniques. Diseases and Pests of silkworms. Mounting of worms. Harvesting and stiffling of cocoons. Silkworm diseases. Preventive and control measures.

Core Readings:

Applied Zoology; (2002) Published by Zoological Society Of Kerala
Sudheeran, M.S. & John P.C., 1989 Economic Zoology (Prathibha Publ., Kottayam)

Module 3 Vermiculture **6 hrs**

Species of Earthworms suitable for vermiculture. Reproduction and Life Cycle . Physical and Chemical effects of Vermiculture, Vermicomposting, Site Selection, Cement pit Soil pit . Preparation of pit. Maintenance and Monitoring

Core Readings:

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

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

Module 4 Apiculture 12 hrs

Species of Honey bees. Organization of honeybee colony. Bee keeping methods and equipments Apiary management and maintenance. Bee pasturage, Byproducts of honey bees and their uses. Diseases and pests of honey bees, control measures.

Core Readings:

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

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

Selected Further Readings

Alikunhi, K.h., Fish Cluture in India (ICAR, New Delhi)
Bhosh, C.C., 1949, Silk Production and Weaving in India (CSIR), New Delhi) Director. Zoological Survey of India, 1994, earthworms Resources and Vermiculture
Edwards, C.A. & Lafty, J.R. 1972 Biology of Earthworms (Chapman and Hall Led. London)
Jhingran, V.G., 1985 Fish and Fisheries of India (Hindustan Publ. Corporation, New Delhi)
Kurien, C.V. & Sebastian V.C., Prawn Fisheries in India (Hindustan Publ. Corporation, New Delhi)
Krishnaswami, S., 1986 Improved Method of Rearing Young age Silk worms (Central Silk board Bangalore)
Krishnaswami, S., 1986, New Technology of Silkworm Rearing (Central Silk Board Bangalore)
Lee, K. E., 1985 Earthworms, Their Ecology and relationships with Soils and Land use. Academics Press.
Menon, K.N., 1970 Malsyakrishi (State Institute of language, Trivandrum)
Mysore Silk Association, 1986, Silkworm rearing and Diseases of Silkworms
Padmanabha Aiyer, K.S., 1992, Records of the Indian Museum Vol. XXXI, Part I, PP. 13-76 An Account of the Oligochacta of the Travancore
Shiggene, K., 1969, Problems in Prawn Culture (American publ. Co., New Delhi)
Shukla G.S., & Updhyay V.B., Economic Zoology (Rastogi Publ. Meerut)
Andhra Pradesh Agricultural University, Hydrabad)
Sinhan, V.R.P. & Ramachandran, V., 1985, Fresh water Fish Culture (ICAR, New Delhi)
Singh, S., 1962 Bee keeping in India (ICAR, New Delhi)
Singh, V.P.P. and Ramachandran, V., 1985 Freshwater Fish Culture (ICAR, New Delhi)
Sudheeran, M.S. & John P.C., 1989 Economic Zoology (Prathibha Publ., Kottayam)
Ullal, S. R. and Narasimahanna, M.N., Handbook of Practical Sericulture (Central Silk Board Bombay.)
Venkitaraman, P.R., 1983, Text Book of Economic Zoology (Sudarsana Publ. Cochin)

Practicals

ZY4CV04U [P] - APPLIED ZOOLOGY (AQUACULTURE, SERICULTURE, VERMICULTURE, APICULTURE)

2 hrs/week
1 credit
36 hrs

1. General Identification, Economic importance, Morphology, scientific names and common names of the following
   a. Economic important and morphology of culturable fishes (Catla, Rohu, Grass carp, Common carp, Silver carp, Etroplus Tilapia)
   b. 2 species of earthworms used in Vermiculture
   c. Two species of honey bees
   d. Silkworm. Cocoon/Adult
2. Castes of bees
3. Bee keeping equipments Beehive, Smoker, honey extractor
4. Beeswax, Honey, Silk, Vermicompost (Identification-Uses)
5. Chandrika /Natrika used in sericulture

UGC SPONSORED PROGRAMME

BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION

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

Total Credits 120
Total Instructional Hours 150

SCHEME

SEMESTER I

		Hrs/Week	Credit
1	*Common Course In English (From Board Ofstudies English)*	5	4
2	Core 1: General Methodology And Perspectives in Science *(From Board Of Studies Zoology)*	2	2
	Practical	2	1
3	Core 2: Preparation Of Biological Specimens: Plants	2	2
	Practical	2	1
4	Core 3: Preparation Of Biological Specimens: Animals	2	2
	Practical	2	1
5	Practial Trauining OJT 54 Hrs		1
6	*Complementary-1:Biochemistry-1(From Board Of Studies Biochemistry)*	2	2
	Practical	2	1
7	*Complementary- 2:Zoology -1 (From Board Of Studies-Zoology)*	2	2
	Practical	2	1
	Total	**25**	**20**

SEMESTER II

		Hrs/Week	Credit
1	*Common Course In English (From Board Ofstudies English*	5	4
2	Core 4: General Biological Techniques	2	2
	Practical	2	1
3	Core 5: Preparation Of Permanent Slides	2	2
	Practical	2	1
4	Core 6: Clinical Chemistry And Clinical Microbiology	2	2
	Practical	2	1
	Practial Training OJT 54 Hrs		1
5	*Complementary-1:Biochemistry-2(From Board Of Studies Biochemistry)*	2	2
	Practical	2	1
6	*Complementary- 2:Zoology -2 (From Board Of Studie-Zoology)*	2	2
	Practical	2	1
	Total	**25**	**20**

SEMESTER III

		Hrs/Week	Credit
1	Core 7: Physiology With Clinical Correlation-1	3	3
	Practical	2	1
2	Core 8: Physiology With Clinical Correlation- 2	3	3
	Pratical	2	1
3	Core 9: General Laboratory Techniques And Electronics	3	3
	Pratical	2	1
4	*Complementary-1:Biochemistry-3(From Board Of Studies Biochemistry)*	3	3
	Pratical	2	1
5	*Complementary- 2:Zoology -3 (From Board Of Studies Zoology*	3	3
	Practical	2	1
	Total	**25**	**20**

SEMESTER IV

		Hrs/Week	Credit
1	Core 10: Teaching Laboratory Techniques, And Water, Soil And Air Analysis Practical	3 2	3 1
2	Core 11: Tissue Culture And Gene Manipulation Pratical	3 2	3 1
3	Core 12: Production And Marketing Of Biological Specimens Pratical	3 2	3 1
4	*Complementary-1:*Biochemistry-4*(From Board Of Studies * Biochemistry)* Pratical	3 2	3 1
5	*Complementary- 2:*Zoology -4* (From Board Of Studies - Zoology* Practical	3 2	3 1
	Total	**25**	**20**

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

SEMESTER V

		Hrs/Week	Credit
1	Core 13 : Cell Biology And Molecular Biology *(From Board Of Studies- Zoology)* Practical	3 2	3 1
2	Core 14: Environmental Biology, Toxicology And Disaster Management *(From Board Of Studies - Zoology)* Pratical	3 2	3 1
3	Core 15: Radiological, Biochemical And Advanced Instrumentation Techniques Pratical	3 2	3 1
4	Core 16: Entrepreneurship Development And Marketing Pratical	4 2	3 1
5	*Open Course:* Human Genetics, Nutrition, Community Health And Sanitation * /Food Microbiology *(From Board Of Studies - Zoology**)***	4	4
	Total	**25**	**20**

SEMESTER VI

		Hrs/Week	Credit
1	Core 17: Genetics And Biotechnology *(From Board Of Studies - Zoology)* Practical	3 2	3 1
2	Core 18: Reproductive And Developmental Biology *(From Board Of Studies - Oology)* Pratical	3 2	3 1
3	Core 19:Microbiology And Immunology *(From Board Of Studies - Zoology)* Pratical	3 2	3 1
4	Core 20:General Informatics, Bioinformatics And Biostatistics *(From Board Of Studies * Zoology)* Pratical	4 2	3 1
5	*Core Choice-Based*: Nutrition, Community Health And Sanitation/ Ecotourism *(From Board Of Studies - Zoology)*	4	3
6	OJT Training BT & SP		1
	Total	**25**	**20**

SEMESTER I

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

36 hrs
2 credits

Module 1 (9 hrs)

Broad classification of plants; Plants of economic value; identification of common biological specimens for classroom use.

Module 2 (9 hrs)

Where and how to collect plants; preparation and storage of herbarium sheets; preparation of dry specimens for display boxes; preparation of museum specimens.

Module 3 (6 hrs)

Collection and preservation of specimens for anatomical and cytological studies.

Module 4 (12 hrs)

Modeling materials: characteristics of teaching models, proportions, durability, attractiveness, innovativeness.

Core Readings for Module 1, 2, 3, 4

1. Knudsen,J.W. 1966. *Biological Techniques* Harper International Edition by Harper & Row
2. Green, N.P.O., Stout, G. W. & Taylor, D.J. 1990. *Biological Science* 2nd Ed. Cambridge Low Price Edition, Cambridge University Press
3. Campbell, N.A., and Reece J.B. 2005. *Biology* . 7th (International) Edition. Pearson- Benjamin-Cummings
4. Blamire, J. *Exploring Life- The Principles of Biology* 1994. Wm. C. Brown Publishers

ZB1VB02U CORE 2 PRACTICALS

PREPARATION OF BIOLOGICAL SPECIMENS-1: PLANTS

36 hrs

1 credit

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

SEMESTER I

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

36 hrs

2 credits

Module 1 **(10 hrs)**

Where and how to collect animals (from Protozoa to Mammals)

Module 2 **(12 hrs)**

Life cycles of representative animals from each phylum.

Module 3 **(2 hrs)**

Preparation of museum specimens.

Module 4 **(2 hrs)**

Preparation of skeletons.

Module 5 **(2 hrs)**

Alizarin preparation and resin-embedded specimens

Module 6 **(8 hrs)**

Taxidermy

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

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

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

36 hrs

1 credit

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

SEMESTER II

ZB2VB04U CORE 4: GENERAL BIOLOGICAL TECHNIQUES

36 hrs

2 credits

Module 1 (9 hrs)

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

Module 2 (6 hrs)

Staining: Fixatives, mounting media, and sealing methods; stains for anatomy, histochemistry, cytology and microorganisms – the principles behind their uses.

Module 3 (9 hrs)

Special Techniques: Hanging drop culture; fixing and embedding of plant and animal materials; Preparation of blocks; microtome and its maintenance; Section cutting.

Module 4 (12 hrs)

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

Core Readings for Module 1, 2, 3, 4

1. Knudsen, J.W. 1966. *Biological Techniques* Harper International Edition by Harper & Row
2. Green, N.P.O., Stout, G. W. & Taylor, D.J. 1990. *Biological Science* 2nd Ed. Cambridge Low Price Edition, Cambridge University Press
3. Campbell, N.A., and Reece, J.B. 2005. *Biology* . 7th (International) Edition. Pearson- Benjamin-Cummings
4. Talaro, K.P., and Talaro, A. 2002. *Foundations in Microbiology* 4th Ed. Mc Graw Hill.
5. Dubey, R.C. and Maheshwari, D.K. *Practical Microbiology* 2002 S.Chand & Company Ltd.
6. Cappucchino J.G., and Sherman, N. *Microbiology – A Laboratory Manual* 3rd Ed. The Benjamin/Cummings Publishing Co.

ZB2VB04U CORE 4: PRACTICAL GENERAL BIOLOGICAL TECHNIQUES

36 hrs

1 credit

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

SEMESTER II

ZB2VB05U CORE 5: PREPARATION OF PERMANENT SLIDES

36 hrs

2 credits

Module 1 (9 hrs)

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

Module 2 (12 hrs)

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

Module 3 (6 hrs)

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

Module 4 (9 hrs)

Microorganisms: Identification of common microorganisms; their sources and culture techniques; Staining and preparation of permanent slides and their storage.

Core Readings for Module 1, 2, 3, 4

1. Dubey, R.C. and Maheshwari, D.K. *Practical Microbiology* 2002 S.Chand & Company Ltd.
2. Cappucchino, J.G., and Sherman N. *Microbiology – A Laboratory Manual* 3rd Ed. The Benjamin/Cummings Publishing Co
3. Talaro ,K.P., and Talaro, A. 2002. *Foundations in Microbiology* 4th Ed. Mc Graw Hill.
4. Bhaskaran, K.K. 1986. *Microtechnique and Histochemistry*.Evershine Press, Vellangalloor
5. Junqueira, L.C., and Carneiro, J.. 2005 *Basic Histology* 11th Ed. Mc Graw Hill

ZB2VB05U CORE 5: PRACTICAL PREPARATION OF PERMANENT SLIDES 36 hrs

1 credit

5. Preparation of double stained permanent slides of animals and plants. (12 hours)
6. Preparation of stained permanent slides of organs and tissues of animals. (12 hours)
7. Preparation of permanent slides of microorganisms. (12 hours)

SEMESTER II

ZB2VB06U CORE 6: CLINICAL CHEMISTRY AND CLINICAL MICROBIOLOGY 36hrs Credits 2

Module 1 (9 hrs)

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

Module 2 (6 hrs)

Biochemical changes in the organs under pathological conditions.

Module 3 (12 hrs)

Routine biochemical tests: e.g., Estimation of: blood glucose, Total protein in serum, serum albumin, blood urea, creatinine in blood, serum bilirubin, serum triglycerides, serum cholesterol, serum alkaline phosphatase, serum acid phosphatase.

Module 4 (4 hrs)

Microorganisms of medical importance: At least 4 examples each from clinically important bacteria, fungi, viruses, protista, helminthes, and others.

Module 5 (5 hrs)

Diagnostic characteristics of the examples given in item 4 above (culture characteristics, morphology etc).

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

1. Mukherjee, K.L. (ed,) 1988. Medical Laboratory Technology Vol. 1. Tata McGraw Hill
2. Mukherjee, K.L. (ed,) 1988. Medical Laboratory Technology Vol. 2. Tata McGraw Hill
3. Mukherjee, K.L. (ed,) 1988. Medical Laboratory Technology Vol. 3. Tata McGraw Hill
4. Cheesbrough, M. 1998. District Laboratory Practice in Tropical Countries Part 1. Cambridge Low Price Edition. Cambridge University Press
5. Cheesbrough, M. 1998. District Laboratory Practice in Tropical Countries Part 2. Cambridge Low Price Edition. Cambridge University Press
6. Talaro, K.P., and Talaro, A. 2002. *Foundations in Microbiology* 4th ed. Mc Graw Hill.

ZB2VB06U CORE 6: PRACTICAL CLINICAL CHEMISTRY AND CLINICAL MICROBIOLOGY **36 hrs**

Credit 1

2. Estimation of: blood glucose, total protein in serum, serum albumin, blood urea, creatinine in blood, serum bilirubin, serum triglycerides, serum cholesterol, serum alkaline phosphatase, serum acid phosphatase. (15 hours)
3. Media preparation, Inoculation, and maintenance of bacteria. (8 hours)
4. Gram staining (2 hours)
5. HIV spot test (2 hours)
6. Identification of microorganisms (bacteria, fungi, protista, helminthes) of clinical significance (9 hours)

SEMESTER III

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

Credits 3

Module 1 **(3 hours)**

Homeostasis

Module 2 **(12 hrs)**

Gastro-intestinal system: Anatomy and functional organization; common clinical abnormalities associated with nutrient metabolism.

Module 3 **(15 hrs)**

Cardiovascular system: Anatomy and functional organization; Composition of blood; Blood groups; Common clinical abnormalities

Module 4 **(9 hrs)**

Respiratory system: Anatomy and functional organization, common clinical abnormalities.

Module 5 **(15 hrs)**

Endocrine system: Major hormones, common clinical abnormalities.

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

1. Tortora, G.J., and Derrickson, B. 2006. *Principles of Anatomy and Physiology* 11th ed. John Wiley & Sons, Inc.
2. Thibodeau, G.A., and Patton, K.T. 2007. *Anthon&#65533;s Textbook of Anatomy and Physiology*. 18th ed. Mosby
3. Seeley, R.R., Stephens, T.D., and Tate, P. 2006. *Anatomy and Physiology* 7th ed. McGraw Hill International Edition
4. Fox, S.I.2006. *Human Physiology* 9th ed. McGraw Hill International Edition

ZB3VB07U 7 CORE 7: PRACTICALPHYSIOLOGY WITH CLINICAL CORRELATION-1

36hrs

Credit 1

1. Action of trypsin / pepsin on proteins. (2 hours)
2. Influence of concentration, pH and temperature on activity of salivary amylase. (4 hours)
3. Determination of O_2 uptake by cockroach [Respirometer] (3 hours)
4. Effect of adrenalin on the heart beat of frog. (2 hours)
5. Determination of rbc, wbc, differential wbc, and platelet counts (12 hours)
6. Estimation of haemoglobin (2 hours)
7. Demonstration of hemin crystals (1 hour)
8. ESR (2 hours)

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

10. Bleeding time and Clotting time (6 hours)

SEMESTER III

ZB3VB08U CORE 8: PHYSIOLOGY WITH CLINICAL CORRELATION-2

54 hrs

Credits 3

Module 1 (15 hrs)

Nervous system: Anatomy and functional organization, common clinical abnormalities.

Module 2 (15 hrs)

Sense organs: Anatomy and functional organization of the sense organs for vision, hearing, taste, smell and touch, common clinical abnormalities.

Module 3 (12 hrs)

Muscular system: Details of muscle contraction, common clinical abnormalities.

Module 4 (12 hrs)

Excretory system: Anatomy and functional organization, common clinical abnormalities.

Core Readings for Module 1, 2, 3, 4

4. Tortora, G.J., and Derrickson, B. 2006. *Principles of Anatomy and Physiology* 11th Ed. John Wiley & Sons, Inc.
5. Thibodeau, G.A., and Patton, K.T. 2007. *Anthon's Textbook of Anatomy and Physiology*. 18th ed. Mosby
6. Seeley, R.R., Stephens, T.D., and Tate, P. 2006. *Anatomy and Physiology* 7th ed. McGraw Hill International Edition
7. Fox, S.I.2006. *Human Physiology* 9th ed. McGraw Hill International Edition

ZB3VB08U CORE 8: PHYSIOLOGY WITH CLINICAL CORRELATION-2

36 hrs

Credits 2

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

SEMESTER III

ZB3VB09U CORE 9: GENERAL LABORATORY TECHNIQUES AND ELECTRONICS **54 Hrs**

Credits 3

Module 1 (6 hrs)

Distillation of water: Types of distillation stills [metal, solar, glass still].

Module 2 **(9 hrs)**

Ion exchangers and how they work, regeneration of ion exchangers.

Module 3 **(4 hrs)**

Cleaning agents for various types of dirty glass wares, pipette cleaners.

Module 4 **(4 hrs)**

Methods of sterilization and storage of glassware.

Module 5 **(6 hrs)**

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

Module 6 **(6 hrs)**

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

Module 7 **(12 hrs)**

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

Module 8 **(7 hrs)**

Temperature sensing control devices: thermometers, thermocouples, thermostats.

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

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

ZB3VB09U CORE 9: PRACTICAL GENERAL LABORATORY TECHNIQUES AND ELECTRONICS

36 Hrs
Credit 1

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

SEMESTER IV

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

54 Hrs
Credits 3

Module 1 **(9 hrs)**

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

Module 2 **(9 hrs)**

Maintenance of living organisms: aquarium, terrarium, animal houses, garden.

Module 3 **(9 hrs)**

Distribution of plants and animals, methods of survey, determination of frequency dominance

Module 4 **(9 hrs)**

Abiotic and biotic pollutants of water and their indicators; assay techniques.

Module 5 **(9 hrs)**

Air pollution-Assay techniques

Module 6 **(9 hrs)**

Soil pollution-Assay techniques.

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

1. Kuravamveli, S.J. 2002. *The Aquarium Handbook* Amity Aquatech Pvt. Ltd.
2. Shukla, G.S., and Upadhyay, V.B. 1995. *Economic Zoology* Rastogi Publications
3. Arms, K. 1990. *Environmental Science* Saunders College Publishing
4. Sharma, P.D.1994. *Ecology and Environment* 6th ed. Rastogi Publications
5. Khopkar, S.M. 1993. *Environmental Pollution Analysis* New Age International (P) Limited Publishers

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

36 Hrs
Credit 1

1. Maintenance of living organisms [aquarium and terrarium] common problems and their solutions. (9 hours)
2. Survey methods [quadrate, transect and point method] (12 hours)
3. Frequency distribution of animals in a specific area of campus.(3 hours)
4. Analysis of water pollutants [abiotic & biotic] (6 hours)
5. Analysis of soil pollutants [abiotic] (4 hours)
6. Analysis of air pollutants [abiotic] (2 hours)

SEMESTER IV

ZB4VB11U CORE 11: TISSUE CULTURE AND GENE MANIPULATION **54 Hrs**

Credits 3

Module 1 **(9 hrs)**

Plant and animal cell culture, growth media and maintenance of culture.

Module 2 **(15 hrs)**

Characteristics of plant cells in culture, meristem, anther, embryo, ovule, ovary and endosperm culture.

Module 3 **(9 hrs)**

Characteristics of animal cells in culture, hybridoma technology.

Module 4 **(6 hrs)**

Germ plasm storage, somatic hybridization.

Module 5 **(8 hrs)**

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

Module 6 **(4 hrs)**

Isolation of DNA, gene transfer methods, identification and selection of recombinants.

Module 7 **(3 hrs)**

An overview of a cloning experiment [from start to finish]

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

1. Prakash, M., and Arora, C.K. 1998. *Cell and Tissue Culture* Anmol Publications Pvt. Ltd.
2. Rema, L.P. 2006. *Applied Biotechnology* MJP Publishers
3. Watson, J.D., Caudy, A.A., Myers, R.M. and Witkowski, J.A., 2007. *Recombinant DN:Genes and Genomes- A Short Course* Cold Spring Harbor Laboratory Press
4. Surzycki, S. 2003. *Human Molecular Biology Laboratory Manual* Blackwell Publishing
5. Brown, T.A.2007. *Genomes 3*. GS Garland Science

ZB4VB11U CORE 11: PRACTICAL TISSUE CULTURE AND GENE MANIPULATION

36 Hrs
Credit 1

1. Media formulation for plant tissue culture (4 hours)
2. Surface sterilization. (2 hours)
3. Callus induction. (2 hours)
4. Auxillary bud culture. (2 hours)

5. Isolation of protoplast. (4 hours)
6. Isolation of genomic DNA and its quantification. (9 hours)
7. Isolation of plasmid DNA. (6 hours)
8. Restriction digestion, ligation, bacterial transformation. (5 hours)
9. PCR demonstration. (2 hours)

SEMESTER IV

ZB4 VB12U CORE 12: PRODUCTION AND MARKETING OF BIOLOGICAL SPECIMENS

54 Hrs
Credit 3

Module 1 **(3 hrs)**

Market survey techniques.

Module 2 **(6 hrs)**

Organization of a production centre, minimal requirements, stage-wise expansion, purchase, collection and storage of raw materials.

Module 3 **(12 hrs)**

Accounts, book keeping and quotations, storage and packing of finished products, recovery of waste materials.

Module 4 **(9 hrs)**

Need, scope and approaches for project formulation, structure of project reports.

Core Readings for Module 1, 2, 3, 4

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.

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

36 hrs
Credit 1

1. Conduct of mini market survey: Data collection through questionnaire and personal visits. (20 hours)
2. Break even analysis. (10 hours)
3. Business letters. (6 hours)

SEMESTER V

ZB5VB15U CORE 15: RADIOLOGICAL, BIOCHEMICAL AND ADVANCED INSTRUMENTATION TECHNIQUES

54 hrs
Credits 3

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

Module 2 (12 hrs)
Isotopes, definition, isotopes of common biological use, techniques for detection of isotopes [autoradiography, Geiger counting technique, liquid scintillation, Gamma counter]

Module 3 (7 hrs)
Isotope dilution technique; waste disposal and cleaning of contaminated glass ware.

Module 4 (5 hrs)
Safety in use of radiation sources and radio isotopes.

Module 5 (9 hrs)
Chromatography techniques- theory, methods and application of paper, gas, affinity, ion exchange chromatography, TLC, HPLC, Gel filtration.

Module 6 (6 hrs)
Electrophoresis: Theory, methods and applications, paper and gel electrophoresis

Module 7 (9 hrs)
Polymerase chain reaction, DNA sequencing, DNA fingerprinting.

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

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. Anblagan, K. 1999. *An Introduction to Electrophoresis* The Electrophoresis Institute, Biotech-Yercaud
6. Wilson, K., and Walker, J. 2000. *Practical Biochemistry- Principles and Techniques* 5th ed. Cambridge Low Price Editions, Cambridge University Press

ZB5VB15U CORE 15: PRACTICAL

36 hrs
Credit 1

1. Types and effects of various radiations. Isotope dilution techniques. (Visit to a radioisotope lab.) (5 hours)
2. Problems in radiology [on half cycle, quantity, disposal] (3 hours)
3. Paper chromatography, TLC (8 hours)
4. AGE, PAGE (10 hours)
5. Southern blotting (4 hours)
6. PCR (6 hours)

SEMESTER V

ZB5VB16U CORE 16: ENTREPRENEURSHIP DEVELOPMENT AND MARKETING

72 hrs
4hrs/week
Credits 3

Module 1 (18 hrs)
Institutions, financing procedure and financial incentives.

Module 2 (18 hrs)
Resource management: man, machine and materials, quality control/ quality assurance and testing of products

Module 3 (18hrs)
Elements of marketing & sales management [Nature of product and market strategy, packaging and advertising, after sales service]

Module 4 (18 hrs)
Income tax, sales tax and excise rules

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

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.

ZB5VB16U (P) CORE 16: PRACTICAL ENTREPRENEURSHIP DEVELOPMENT AND MARKETING

36 hrs
Credit 1

1. Preparation and analysis of a project (18 hours)
2. Entrepreneurial motivation training through games, role playing, discussions and exercises (8 hours)
3. Preparation of report on an industry/firm (10 hours)

MODEL II B.SC. ZOOLOGY PROGRAMME (VOCATIONAL)

1. Aquaculture (ZAV)
2. Food Microbiology (ZFV)
3. Medical Microbiology (ZMV)

VOCATIONAL SUBJECT – AQUACULTURE

VOCATIONAL COURSES

COURSE I : PRINCIPLES AND METHODS IN AQUACULTURE
ZA1V01U
COURSE II : HATCHERY AND CULTURE TECHNIQUES
ZA1V02 U
PRACTICAL-I : PRINCIPLES AND METHODS IN AQUACULTURE & ZA1V02 U (P) HATCHERY AND CULTURE TECHNIQUES
COURSE III

ZA2V03U : CAPTURE FISHERY
COURSE IV
ZA2V04U : BIOLOGY OF FISHES
PRACTICAL 2 : CAPTURE FISHERY & BIOLOGY OF FISHES
ZA2V04 U (P)
COURSE V
ZA3V05U : FISHERIES ENVIRONMENT
PRACTICAL 3 : FISHERIES ENVIRONMENT
ZA3V05U (P)
COURSE VI : FISH NUTRITION
ZA3V06U
Practical 4 : FISH NUTRITION
ZA3V06U (P)
COURSE VII : REPRODUCTIVE PHYSIOLOGY AND
ZA4V07U ENDOCRINOLOGY
Practical 5 : REPRODUCTIVE PHYSIOLOGY AND
ZA4V07U (P) ENDOCRINOLOGY
COURSE VIII : MICROBIOLOGY, PATHOLOGY AND POST
ZA4V08U HARVEST TECHNOLOGY

Practical 6 : MICROBIOLOGY, PATHOLOGY AND POST HARVEST TECHNOLOGY
ZA4V08U (P)

VOCATIONAL SUBJECT: FOOD MICROBIOLOGY

VOCATIONAL COURSES

COURSE I : GENERAL MICROBIOLOGY
ZF1V01U
COURSE II : BIOINSTRUMENTATION
ZF1V02U
Practical I : GENERAL MICROBIOLOGY
ZF1V02U (P) **&BIOINSTRUMENTATION**
COURSE III : GENERAL METHODOLOGY
ZF2V03U
COURSE IV : ENVIRONMENTAL AND AGRICULTURAL
ZF2V04U MICROBIOLOGY
Practical II : GENERAL METHODOLOGY, ENVIRONMENTAL AND ZF2V04U (P) AGRICULTURAL MICROBIOLOGY
COURSE V : DAIRY MICROBIOLOGY
ZF3V05U
Practical III : DAIRY MICROBIOLOGY
ZF3V05U (P)
COURSE VI : FOOD MICROBIOLOGY • MICROBIOLOGY OF
SPOILAGE OF FOOD, METHODS OF FOOD
ZF3V06U PRESERVATION AND MICROBIOLOGICAL
EXAMINATION OF FOOD
Practical IV : FOOD MICROBIOLOGY • MICROBIOLOGY OF
ZF3V06U(P) SPOILAGE OF FOOD, METHODS OF FOOD
PRESERVATION AND MICROBIOLOGICAL
EXAMINATION OF FOOD

COURSE VII : FOOD MICROBIOLOGY - MICROBIOLOGY OF
ZF4V07U CEREALS , BEVERAGES , EGG, MEAT AND
FERMENTED FOOD
Practical V : FOOD MICROBIOLOGY - MICROBIOLOGY OF ZF4V07U (P) CEREALS , BEVERAGES , EGG, MEAT AND
FERMENTED FOOD
COURSE VIII : INDUSTRIAL MICROBIOLOGY
ZF4V08U
Practical VI: INDUSTRIAL MICROBIOLOGY
ZF4V08U (P)

VOCATIONAL SUBJECT: MEDICAL MICROBIOLOGY

VOCATIONAL COURSES

COURSE I : GENERAL MICROBIOLOGY
ZM1V01U
COURSE II : BIOINSTRUMENTATION
ZM1V02U
Practical I : GENERAL MICROBIOLOGY
ZM1V02U (P) **&BIOINSTRUMENTATION**
COURSE III : GENERAL METHODOLOGY
ZM2V03U
COURSE IV : ENVIRONMENTAL AND AGRICULTURAL
ZM2V04U MICROBIOLOGY
Practical II : GENERAL METHODOLOGY, ENVIRONMENTAL AND ZM2V04U (P) AGRICULTURAL MICROBIOLOGY
COURSE V : PARASITOLOGY
ZM3V05U
Practical V : PARASITOLOGY

ZM3V05U (P)
COURSE VI : MEDICAL ENTOMOLOGY AMD MYCOLOGY
ZM3V06U
Practical VI : MEDICAL ENTOMOLOGY AMD MYCOLOGY
ZM3V06U (P)

COURSE VII : MEDICAL BACTERIOLOGY AND VIROLOGY
ZM4V07U
Practical VII : MEDICAL BACTERIOLOGY AND VIROLOGY
ZM4V07U (P)
COURSE VIII : MEDICAL MICROBIOLOGY
ZM4V08U
Practical VIII : MEDICAL MICROBIOLOGY

ZM4V08U (P)

RESTRUCTURED CURRICULUM FOR B.SC. (MODEL II VOCATIONAL) DEGREE IN ZOOLOGY PROGRAMME

COURSE STRUCTURE

Total Credits 120
Total Instructional Hours 150

3 Vocational Programmes
Aquaculture (A) / Food Microbiology (F)/ Medical Microbiology (M)

SEMESTER 1

Sl. No.	Course Title	Hrs/Week	Credit
1	Common Course English ◆ 1	5	4
2	Common Course Sec. Language ◆ 1	5	4
3	Core Course - 1 General Methodology and Perspectives in Science	2	2
	Practical- I - General Methodology and Instrumentation	2	1
4	Vocational Course ◆ 1 Principles and Methods in Aquaculture (A) / General Microbiology F/M	2	2
5	Vocational Course ◆ II Hatchery and Culture techniques (A)/ Bioinstrumentation (F/M)	2	2
	Practical 1	2	1
	Principles and Methods in Aquaculture, Hatchery and Culture techniques (A)/ General Microbiology and Bioinstrumentation (F/M)		
6	Complementary Course ◆ 1	3	2
	Practical	2	1
	Total	**25**	**19**

SEMESTER 1I

Sl. No.	Course Title	Hrs/Week	Credit
1	Common Course English ◆ 2	5	4
2	Common Course Sec. Language ◆ 2	5	4
3	Core Course - 2 Biodiversity and Modern Systematics	2	2
	Practical 2 - Biodiversity and Modern Systematics	2	1
4	Vocational Course ◆ 3 Capture Fishery (A) / General Methodology (F/M)	2	2

5	Vocational Course ◆ 4 Biology of Fishes (A) / Environmental and Agricultural l Microbiology (F/M)	2	2
	Practical 2 Capture Fishery and Biology of Fishes (A) / General Methodology, Environmental and Agricultural Microbiology (F/M)	2	1
6	On The Job Training (2 Weeks)		2
7	Complementary Course ◆ 2	3	2
	Practical	2	1
	Total	**25**	**21**

SEMESTER 1II

Sl. No.	Course Title	Hrs/Week	Credit
1	Common Course English ◆ 3	5	4
2	Core Course - 3 Animal Diversity Non-Chordata	3	3
	Practical 3 - Animal Diversity Non-Chordata	2	1
3	Vocational Course ◆ 5 Fisheries Environment (A)/Dairy Microbiology (F)/ Parasitology (M)	2	2
	Practical 3 Fisheries Environment (A)/Dairy Microbiology (F)/ Parasitology (M)	3	2
4	Vocational Course ◆ 6 Fish nutrition (A) / Medical Entomology and Mycology(M) / Microbiology of Spoilage of food , Methods of Preservation of food and Microbiological examination of food (F)	2	2
	Practical 4 Fish nutrition (A) / Medical Entomology and Mycology(M) / Microbiology of Spoilage of food , Methods of Preservation of food and Microbiological examination of food (F)	3	2
5	Complementary Course ◆ 3	3	3
	Practical	2	1
	Total	**25**	**20**

SEMESTER 1V

Sl. No.	Course Title	Hrs/Week	Credit

1	Common Course English ◆ 4	5	4
2	Core Course - 4 Animal Diversity Chordata	3	3
	Practical 4 - Animal Diversity Chordata	2	1
3	Vocational Course ◆ 7 Reproductive Physiology and Endocrinology (A)/ Medical Bacteriology and Virology (M) / Microbiology of cereals, beverages, Egg, Meat and Fermented food (F)	2	2
	Practical 5 Reproductive Physiology and Endocrinology (A)/ Medical Bacteriology and Virology (M) / Microbiology of cereals, beverages, Egg, Meat and Fermented food (F)	3	2
4	Vocational Course ◆ 8 Microbiology , Pathology and Post Harvest Technology (A)/ Clinical Microbiology (M) / Industrial Microbiology (F)	2	2
	Practical 6 Microbiology , Pathology and Post Harvest Technology (A)/ Clinical Microbiology (M) / Industrial Microbiology (F)	3	2
5	Complementary Course ◆ 4	3	3
	Practical	2	1
	Total	**25**	**20**

SEMESTER V

Sl. No.	Course Title	Hrs/Week	Credit
1	Core Course - 5 Cell Biology and Molecular Biology	3	3
	Practical 5 - Cell Biology and Molecular Biology	2	1
	Group activity and Field Study (Practical Hr 1) Report to be submitted in VIth Semester along with Project in Practical Exam	1	
2	Core Course 6 Environmental Biology , Toxicology and Disaster Management	3	3
	Practical 6 Environmental Biology , Toxicology and Disaster Management	2	1
3	Core Course 7 Evolution, Zoogeography and Ethology	3	3
	Practical 7 Evolution, Zoogeography and Ethology	2	1
4	Core Course ◆ 8 Biochemistry, Human Physiology and Endocrinology	3	3
	Practical 8 Biochemistry, Human Physiology and Endocrinology	2	1
5	Open Course: Man, Nature and Sustainable Development/ Human Genetics, Nutrition , Community Health and Sanitation/ Management of Ornamental fish breeding , Rabbit farming, Poultry, Quail farming, Vermiculture, Beekeeping and Sericulture /Food Microbiology	4	4
	Total	**25**	**20**

SEMESTER VI

Sl. No.	Course Title	Hrs/Week	Credit
1	Core Course - 9 Reproductive and Developmental Biology	3	3
	Practical 9 - Reproductive and Developmental Biology	2	1
2	Core Course 10 Genetics and Biotechnology	3	3
	Practical 10 Genetics and Biotechnology	2	1
3	Core Course11 Microbiology and Immunology	3	3
	Practical 11 Microbiology and Immunology	2	1
4	Core Course 12 General Informatics , Bioinformatics and Biostatistics	3	3
	Practical 12 General Informatics , Bioinformatics and Biostatistics	2	1
5	Core Choice based Courses	4	3
	Ecotourism/ Nutrition, Community Health and Sanitation/ Applied Entomology, Management of Ornamental fish breeding/ Vermiculture and Beekeeping		
6	Project		1
	Practical Field Study and Group Activity (as in Core) (1 hour)	1	
	Total	**25**	**20**

Model 2 Programmes in Zoology and Core Courses

Instructional Hours, Credit, Total Instructional Hours, University Examination, Weightage Internal and External Evaluation of Core Courses will follow the same pattern as in Model 1 Zoology Programme.

For Vocational Courses also University Examination will be conducted at the end of each Semester both for Theory and Practical . Duration of examination is 3 hrs and Internal External weightage rato is 1:3

C. SCHEME OF EXAMINATION COMPLEMENTARY SUBJECT

Semester	Course	Weightage ratio			
		Theory		Pract.	
		Ext.	Int.	Ext.	Int.
1	I	3	1	3	1
2	II	3	1	3	1
3	III	3	1	3	1
4	IV	3	1	3	1

SEMESTER I

MODEL II B.SC. ZOOLOGY PROGRAMME (VOCATIONAL)
AQUACULTURE
THEORY
ZA1V01U COURSE I PRINCIPLES AND METHODS IN AQUACULTURE

36Hrs
Credits 2

Module 1 **(1 hrs)**

History of aquaculture ﷺScope and importance. Significance of aquaculture compared to other agricultural systems and commercial fisheries.

Core Readings

1. Aquaculture ﷺ Principles and Practices
   T.V.R.Pillay
   Fishing News Books
2. Open sea Mariculture
   Hanson and Goodwin

Module 2 **(3 hrs)**

Types of aquaculture ﷺ Freshwater brackish water and Mari culture. Shell fish culture, Finfish culture, Monoculture, Polyculture.

Core Readings

1. Aquaculture ﷺ Principles and Practices
   T.V.R.Pillay
   Fishing News Books
2. Handbook of Fisheries and Aquaculture
   Indian Council of Agricultural Research.

Module 3 **(3 hrs)**

Integrated farming ﷺ The concept of recycling of organic waste for maximum production. Rice cum fish culture. Culture practices and economics of duck cum fish, poultry cum fish and pig cum fish culture.

Core Readings

1. Aquaculture ﷺ Principles and Practices
   T.V.R.Pillay
   Fishing News Books
2. Hanbook of Fisheries and Aquaculture
   Indian Council of Agricultural Research.

Additional Reading

3. Coastal Aquaculture in India
   R.Santhanam, N.Ramanathan and B. Jegadeesan
   CBS Publishers & distributors, New Delhi. 1990.

Module 4 **(7 hrs)**

Site selection procedures ﷺ study of topography of pond site. Soil quality parameters ﷺphysical, soil type, porosity, percolation, shear strength rate of compassion etc.Chemical ﷺsalinity, pH, nutrients, toxic gases etc.Water quality parameters-Chemical salinity, pH, dissolved oxygen, pollution,. Physical ﷺ suspended solids, availability. Biological parameters-presence of juveniles/seedlings, predators/ competitors, introduction to plankton, nekton and important groups.

Core Readings

1. Water quality in ponds for aquaculture.
   C.E.Boyd. 1990
   Agricultural experiment Station , Auburn University, Auburn, Alabama. 482 pages
2. Handbook on design, construction and Equipment in coastal aquaculture (Shrimp Farming).
   Anand.S. Upadhyay
   Allied publishers Ltd., Bombay

Additional reading

1. Water quality management in Aquaculture, 53 pages. 1985
   CMFRI Special Publication No. 22.
   CMFRI, Kochi.
2. Handbook on Aquafarming
   Aquaculture Engineering and Water quality Management
   The Marine Products Export Development Agency.
   MPEDA, Kochi.

Module 5 **(5 hrs)**

Pond construction ﷺ preparation of site plan. Measurements and calculation of area-total area and water area. Preparation of bunds and dykes.Calculation of earth works, sluice gates, types, fixing.

Core Readings

1. Handbook on design, construction and Equipment in coastal aquaculture (Shrimp Farming).
   Anand.S. Upadhyay
   Allied publishers Ltd., Bombay
2. A text book of fish culture- Breeding and cultivation of fish
   Marcel Huet
   Fishing News (Books) Ltd
   23 Rosemount Avenue, West Byfleet , Surrey, England
3. A guide to prawn farming in Kerala. 52 pages
   CMFRI Special publication No.21.
4. A Manual of Freshwater Aquaculture
   R.Santhanam,N.Sukumaran& P. Natarajan, (1990)
   Oxford &IBH Publishing Co. Pvt. Ltd. 193 pages.

Additional Reading

1. A Manual on shrimp farming
   The Marine products Export Development Agency, MPEDA

Module 6 **(5 hrs)**

Pond preparation-Drying, elimination of pests and predators. Preparation of nursery and stocking ponds.Manuring, Production of plankton. Stocking - acclimatization. Use of happa .Stocking density. Harvesting-Harvesting methods.

Core Readings

1. Principles of Aquaculture
   Robert.R.Stickney
   John Wiley and Sons Inc., 502 pages.

2. Encyclopedia of Aquaculture
   Robert R. Stickney
3. A Manual of Freshwater Aquaculture
   R.Santhanam,N.Sukumaran& P. Natarajan, (1990)
   Oxford &IBH Publishing Co. Pvt. Ltd. 193 pages.
4. Fish and Fisheries of India
   V.G.Jhingran

Additional Reading

1. A guide to prawn farming in Kerala. 52 pages
   CMFRI Special publication No.21.
2. Aquaculture Engineering
   Wheaton
3. Breeding and Seed production of finfish and shellfish
   P.C.Thomas, Suresh Ch. Rath and Kanta Das Mohapatra
   Daya Publishing House, New Delhi

Module 7 (5 hrs)

Fresh water cultivable fishes and their external characters-Indian Major Craps, Catfish, Eel, Tilapia, Trouts, Salmon ,Mahseer, Channa sps.Clarius, Anabas, Heteropnuestes. Fresh water resource of India-Rivers,Reservoirs,Lakes.

Core Readings

1. Fresh water fishes of India Vol I and II
   Arun Jhingran
2. Taxonomy of Freshwater fishes of India
   Jayaraman

Additional reading

1. Freshwater Fishes
   Handbook on Aquafarming
   The Marine Products Export Development Authority
2. Rath.R.K. 1993. Freshwater aquaculture. Scientific Publishers.Jodhpur. 493 pages.

Module 8 (5 hrs)

Cultivable species of crustaceans and mulluscs: Identification and external characters. Shrimp, freshwater prawn, crab, lobster, pearl oyster, edible oyster, mussel clams.

Core Readings

1. The commercial molluscs of India
   CMFRI Bulletin No. 25.
2. Winter School on Recent advances in Mussel and Edible oyster farming and Marine Pearl production
   CMFRI
   Compiled and Edited by K.K.Appukuttan, Director Winter School, CMFRI 2005.
3. Pearl Culture.
   CMFRI, Bulletin No. 39., 1987. 136 pages
4. Oyster Culture-Status and Prospects
   CMFRI, Bulletin No. 38., 1987. 78 pages
5. Coastal aquaculture: Mussel farming: Progress and Prospects.
   CMFRI Bulletin No. 29., 1980. 56 pages

Additional Reading

1. Handbook on Aquafarming
   Molluscs
   MPEDA

Module 9 (2 hrs)

Brackish water aquaculture-Introduction, the tidal range, salinity and the biota.

Core Readings

1. A text book of fish culture- Breeding and cultivation of fish
   Marcel Huet
   Fishing News (Books) Ltd
   23 Rosemount Avenue, West Byfleet , Surrey, England
2. A Manual of Freshwater Aquaculture
   R.Santhanam,N.Sukumaran& P. Natarajan, (1990)
   Oxford &IBH Publishing Co. Pvt. Ltd. 193 pages.
3. Coastal Aquaculture in India
   R.Santhanam, N.Ramanathan and B. Jegadeesan
   CBS Publishers & distributors, New Delhi. 1990.

Additional Reading

1. Handbook on design, construction and Equipment in coastal aquaculture (Shrimp Farming).
   Anand.S. Upadhyay
   Allied publishers Ltd., Bombay

Module 10 (1 hrs)

Reservoir fisheries management practices and present problems. Development of fisheries of Indian reservoirs.

Core Readings

1. FAO Fisheries Technical Paper 345. (1995)
   Reservoir Fisheries of India
   Sugunan.V.V.
2. Handbook of Fisheries and Aquaculture
   Indian Council of Agricultural ResearchAdditional Reading
3. Fish and Fisheries of India
   V.G.Jhingran.
   Hindustan Publishing House. Delhi.

Selected Further Readings

A text book of fish culture- Breeding and cultivation of fish,Marcel Huet
Fishing News (Books) Ltd,23 Rosemount Avenue, West Byfleet , Surrey, England

Principles of Aquaculture, Robert.R.Stickney, John Wiley and Sons Inc. 502 pages.Coastal Aquaculture in India
R.Santhanam, N.Ramanathan and B. Jegadeesan
CBS Publishers & distributors, New Delhi. 1990.

SEMESTER I

ZA1V02U COURSE II HATCHERY AND CULTURE TECHNIQUES

36 hrs
Credits 2

Module 1 **(2 hrs)**

Present status and future prospects of fin fish culture and shell fish culture.

Core Readings

1. Hanbook of Fisheries and Aquaculture
   Indian Council of Agricultural Research.
   Website:
   www.fao.org

Module 2 **(3 hrs)**

Hatcheries • Different types, fin fish (Carp, Mullet), Molluscan (Edible and pearl oyster), Crustacean (Prawn)

Core Readings

1. CRC Handbook of Mariculture
   Vol.I . Finfish culture
   Vol.II. Crustacean culture
2. Marine shrimp culture- Principles and Practices
   Editors : James Lester and Arlo .W. Fast
3. Aquaculture • Principles and Practices
   T.V.R.Pillay
   Fishing News Books
4. Aquaculture
   John.E.Bardach, John.H.Ryther and William O. McLarney

Additional Reading

5. MPEDA Handbook on aquaculture

Module 3 **(5 hrs)**

Culture of Indian Major Carps, Nursery, Rearing and stocking ponds. Preparation of ponds. Stocking and post stocking management. Harvesting. Culture of air breathing fishes, channa sps, Clarias.

Core Readings

1. Aquaculture • Principles and Practices
   T.V.R.Pillay
   Fishing News Books
2. Handbook of Fisheries and Aquaculture
   Indian Council of Agricultural Research.
3. Fish and Fisheries of India
   V.G.Jhingran
4, Coastal Aquaculture in India
   R.Santhanam, N.Ramanathan and B. Jegadeesan
   CBS Publishers & distributors, New Delhi. 1990
5. A Manual of Freshwater Aquaculture
   R.Santhanam,N.Sukumaran& P. Natarajan, (1990)

Oxford &IBH Publishing Co. Pvt. Ltd. 193 pages.

Module 4 **(4 hrs)**

Culture of Tilapia- Different species and culture techniques of Mullet, Milk fish

Core Readings

1. Water quality in ponds for aquaculture.
   Boyd C.E. 1990
   Agricultural Experiment station, Auburn University,Auburn
   Alabama.482pages.
2. Aquaculture- The farming and Husbandry of freshwater and Marine Organisms.
   John.E.Bardach, John.H.Ryther and William O. McLearney
3. Aquaculture • Principles and Practices
   T.V.R.Pillay
   Fishing News Books
4. A text book of fish culture- Breeding and cultivation of fish
   Marcel Huet
   Fishing News (Books) Ltd
   23 Rosemount Avenue, West Byfleet , Surrey, Engl
5. Handbook on Aquafarming
   Aquaculture Engineering and Water quality Management
   The Marine Products Export Development Agency.
   MPEDA, Kochi.
6. Handbook on Aquafarming
   Sea Fishes
   The Marine Products Export Development Agency.
   MPEDA, Kochi.

Module 5 **(3 hrs)**

Culture of cold water fishes in India. History, Practices followed and prospects

Core Readings

1.Cold water fisheries of India
Jhingran V.G. & K.L. Sehgal (1978)

Module 6 (4 hrs)

Culture of macrobrachium sps; Prawn and Crab. Present status and future prospects. Prawn culture-Seed resources, prawn filtration practices, shrimp farming-extensive, semi intensive and intensive.

Core Readings

1. Artificial reef &sea Farming Technologies
CMFRI bulletin No.48,(1996),126 pages.
2. Marine Shrimp Culture,Principles & Practices
Arlo W.Fast & James Lester
3. CRC Handbook of Mariculture Vol V • Crustacean Aquaculture.
4. Breeding & Seed Production of Finfish and Shell fish
P.C. Thomas , Suresh CH. Rath ,Kantha DasMAhapatra(2003)
Daya Publishing House , New Delhi.

Additional Reading

1. MPEDA
A Manual on Shrimp Farming
2. MPEDA
3. Hand book on Shrimp Farming
4. MPEDA
A Manual on Seed production and Farming of the giant Fresh water Prawn
Macrobrachium Rosenbergii
5. MPEDA
Hand book on Aquafarming
Shrimp Hatchery
6. CMFRI Special Publication No. 21(1985),52 pages
A guide to prawn Farming in Kerala.

Module 7 (4 hrs)

Culture of Mollusca- mussel, pearl oyster, edible oyster, clams.

Core Readings

1. Korringa P. 1976
Farming Marine Organisms Low in the food Chain
Elsevier Scientific Publishing Co.
` Amsterdam,Netherlands,264 pages.
2. Farming Bivalve Molluscs : Method for study &development
DB Quayle and G.F. Newkirk
World Aquaculature,Vol I.Published by the world Aquaculture Society in
Association with The IDRC. 294 pages.
1. CMFRI bulletin No. 29(1980)
Coastal Aquaculture, Mussel Farming ,Progress and prospects,56 pages
4. CMFRI (2005) Winter School on Recent advances in Mussel and Edible Oyster farming & Pearl Production Compiled and edited by Appukuttan K.K.
1. CMFRI Bulletin No.38.Oyster Culture- Status and Prospets (1987) 78 pages.
2. CMFRI: Bulletin No. 39, Pearl Culture(1987), 136 pages.

Module 8 (5 hrs)

Culture of ornamental fishes- setting up and maintenance of Aquaria. Breeding techniques of Aquarium fishes; gold fish, angel fish, gouramies.

Core Readings

1. Breeding and Seed production of finfish and shellfish
P.C.Thomas, Suresh Ch. Rath and Kanta Das Mohapatra
Daya Publishing House, New Delhi

2. Matsya Alankar •99 Souvenier .Department of Fisheries,Government of Kerala &Matsyafed
3. Breeding of Aquarium Fishes .Herbert R. Axelrod Vol.I &II

Module 9 (2 hrs)

Frog culture: Different species of edible frog, their biology, prospects and constraints, culture of sea weeds, culture of holothurians

Core Readings

1. Santhanam R. ,SukumaranN,and NatarajanP. (1990). A manual of Freshwater Aquaculture. Oxford & IBH publishing companyPVT. LTD. 193 pages.
2. Aquaculture
John.E.Bardach, John.H.Ryther and William O. McLarney
3. Robert R. Stickney. Encyclopedia of Aquaculture .John Wiley & Sons Inc.

Module 10 (2 hrs)

Culture of live feeds- micro algae, artemia, rotifer, daphnia.

Core Readings

1. CMFRI Spl. Publication No. 15,1984,Production and use of *Artemia* in Aquaculture.42 pages..
2. MPEDA Handbook on Aquafarming Live Feed .
3. CMFRI Bulletin No.48, 1996. Artificial reefs and Sea Farming Technologies.126 pages

Module 11 (2 hrs)

Fish culture in relation to public health. Larvivorous fishes and their biology.

Core Readings

1. Fish and Fisheries of India
V.G.Jhingran
2. Khanna S.S.

An Introduction to Fisheries ,Central Book Depot, Allahabad.

SEMESTER II

ZA2V03U COURSE III CAPTURE FISHERY

36 hrs
Credits 2

Module 1 **(5 hrs)**

Craft and gear-Types of fishing craft in India ﷺTraditional and Mechanized ﷺFishing gear material: Properties of fishing gear appurtenances,floats,sinkers-description. Major fishing gears and their operation.Static gear ﷺGill nets,Long line and Fish traps,Mobile gear-Drag nets-Trawl,Seine nets-Pure seine,Shore seines.

Core Readings

1. Sreekrishna.Y. and Latha Shenoy (2001). Fishing gear and craft technology..ICAR. New Delhi.
2. Von Brandt. Fishing gears of the world

Module 2 **(4 hrs)**

Commercially important orders, families, genera and species of elasmobranches and teleost of the Indian region and their identification. Identification of commercially important species of prawn, crab, lobster, bivalve, gastropod and cephalopods.

Core Readings

1. FAO species identification sheets for the western Indian ocean.
2. Talwar and Kakker. Commercial sea fishes of India
3. Kurien C.V. and Sebastian.V.C.. Prawns and prawn fisheries of India
4. Munro.I.S.R. The marine and freshwater fishes of Ceylon. Narendra Publishing House.New Delhi.
5. CMFRI. Bulletin No.14. Prawn fisheries of India.1969. 360 pages
6. CMFRI. 1974. Bulletin No,25. The Commercial mollusks of India.
7. Website: www.fishbase.org

Module 3 **(4 hrs)**

Inland capture fishery resources of India. Riverine fisheries. Fisheries of major carps and catfishes.

Core Readings

1. Jhingran.V.G. 19910 Fish and Fisheries of India. Hindustan Publishing Corporation. Delhi.
2. Handbook of Fisheries and aquaculture. Indian Council of agricultural research. New Delhi
3. Khanna .S.S. An Introduction to fisheries. Central Book Depot, Allahabad

Module 4 **(4 hrs)**

Cold water fisheries resources. Fisheries of trout, mahseer and other cold water species, Development and management

Core Readings

1. Jhingran V.G. and K.L.Sehgal. 1968. Coldwater fisheries of India
2. Handbook of Fisheries and aquaculture. Indian Council of agricultural research. New Delhi.
3. 3.Jhingran.V.G. 19910 Fish and Fisheries of India. Hindustan Publishing Corporation. Delhi.

Module 5 **(4 hrs)**

Lacustrine fisheries- Species, catches, potential and problems of development and management.

Core Readings

1. Jhingran.V.G. 19910 Fish and Fisheries of India. Hindustan Publishing Corporation. Delhi.
2. Handbook of Fisheries and aquaculture. Indian Council of agricultural research. New Delhi..

Module 6 **(4 hrs)**

Estuarine fisheries, Fisheries of clupeids, prawns, mollusks and other important groups. Problems confronting to brackish water fisheries and inland fisheries.

Core Readings

1. Jhingran.V.G. 19910 Fish and Fisheries of India. Hindustan Publishing Corporation. Delhi.

2. Handbook of Fisheries and aquaculture. Indian Council of agricultural research. New Delhi

Module 7 **(2 hrs)**

Marine fisheries resources of India. Historical background and recent trends. Fisheries resources of the continental shelf.

Core Readings

1. CMFRI.Bulletin No. 27. (1976). Exploited marine Fishery resources of India. A synoptic survey with comments on potential resources. 36 pages.
2. CMFRI. Status and Perspective sin Marine Fisheries Research in India. (2007). 404 pages.
3. CMFRI. (2003). Status of exploited Marine Fishery resources of India. 308 pages

Module 8 (2 hrs)

Pelagic fishery resources of India. Fisheries of oil sardine, lesser sardine, anchovies, mackerel, ribbon fishes.

Core Readings

1. CMFRI. (2003). Status of exploited Marine Fishery resources of India. 308 pages.
2. CMFRI. (2000). Marine Fisheries Research and Management. Ed: V.N.Pillai and N.G.Menon.
3. Bal D.V. and Rao.K.V. 1990. Marine Fisheries of India. Tata Mc Graw-Hill Publishing Company Ltd. New Delhi. 472 pages.

Module 9 (4hrs)

Demersal fisheries. Fisheries of elasmobranches, Bombay duck, cat fishes, silver bellies, sciaenids, pomfrets, threadfins, threadfin breams and other perches. Flatfishes, Prawns, Lobsters, Crabs, Mussels, Oysters and Clams.

Core Readings

1. CMFRI. (2003). Status of exploited Marine Fishery resources of India. 308 pages.
2. CMFRI. (2000). Marine Fisheries Research and Management. Ed: V.N.Pillai and N.G.Menon.
3. Bal D.V. and Rao.K.V. 1990. Marine Fisheries of India. Tata Mc Graw-Hill Publishing Company Ltd. New Delhi. 472 pages.
4. Kurien C.V. and Sebastian.V.C.. Prawns and prawn fisheries of India
5. CMFRI Bulletin No.47. (1994). Perch Fisheries in India.
6. MPEDA. Handbook on aquafarming. Molluscs.

Module 10 (3hrs)

Biological aspects of fishery management, Principles of conservation, concept and practice. Population dynamics. Concept of recruitment and yields, problems of over fishing, MSY.

Core Readings

1. Devaraj.M. Fish population Dynamics. Course Manual. CIFE .Mumbai.
2. FAO fisheries technical paper306/1. Per Sparre and Siebren .C. Venema. Introduction to tropical Fish Stock Assessment. Part I • Manual.
3. Bagenal. Methods for fish production in fresh waters.
4. Srivastava.C.B.L (2004). A text book of Fishery Science and Indian Fisheries.Kitab Mahal.

SEMESTER II

ZA2V04U COURSE IV BIOLOGY OF FISHES 36 hrs

Credits 2

Module 1 (3 hrs)

Need for taxonomy, binomial nomenclature, Data requirements for classification of fishes, Methods for collection of taxonomic data, Study of external morphology of a typical; elasmobranch and a typical teleost, Variations in form and structures used in taxonomic studies.

Core Readings

1. Srivastava.C.B.L (2004). A text book of Fishery Science and Indian Fisheries.Kitab Mahal,
2. Jayaram.K.C. (2002). Fundamentals of Fish Taxonomy. Narendra Publishing House . Delhi.
3. College of Fisheries , Tuticorin.(2006). Summer School on Advanced Fish taxonomical methods for Fisheries Professionals.
4. Lagler.K.F., Bardach.J.E. and Miller. Robert.R. Ichthyology. 506 pages.
5. Ricker.W.E. Hand book No.3. Methods for assessment of fish production in fresh waters. International Biological Programme. Blackwell scientific publications.

Module 2 (10hrs)

Internal anatomy of fish- Alimentary canal and associated structures. Gills, swim bladder, accessory respiratory organs, Heart and circulatory system, cranium and skeletal system Nervous and lateral line system, sense organs and Reproductive system. General organization of internal organs of prawn, crab, bivalve and cephalopod.

Core Readings

1. Karl.E.Bond. Biology of Fishes
2. Lagler.K.F., Bardach.J.E. and Miller. Robert.R. Ichthyology. 506 pages.

3. Khanna .S.S. An Introduction to fisheries. Central Book Depot, Allahabad
4. Harry.M.Kyle. The biology of fishes
5. Rajiv Tyagi and Arvind. N. Shukla. Anatomy of Fishes.
6. Parihar.R.P. A textbook of Fish Biology and Indian Fisheries.
7. Kurien C.V. and Sebastian.V.C.. Prawns and prawn fisheries of India
8. Barrington .E.J.W. Invertebrate structure and function.

Module 3 (5 hrs)

Excretion, osmotic and ionic regulation in marine and freshwater fishes. Swimming activity.

Core Readings

1. Lagler.K.F., Bardach.J.E. and Miller. Robert.R. Ichthyology. 506 pages.
2. Khanna .S.S. An Introduction to fisheries. Central Book Depot, Allahabad

Module 4 (5 hrs)

Visual behaviour, Reproductive behaviour and parental care, Social behaviour- Aggregation and shoaling. Migration of fish- anadromous and catadromous, Chemoreception and feeding behaviour.

Core Readings

5 William.S. Hoar and D.J.Randall. Fish Physiology. Vol II, III, and IX.
6 Nikolsky. Ecology of Fishes.
7 Norman.J.R. A History of fishes. Agro Botanical Publishers.
8 Harry M. Kyle. The biology of fishes.
9 Khanna .S.S. An Introduction to fisheries. Central Book Depot, Allahabad

Module 5 (5 hrs)

The habits of fishes. Natural food of fishes. Feeding habits in various groups of marine and fresh water fishes inhabiting contrasting habits. Feeding habits of prawn, crab, bivalve and cephalopod.

Core Readings

1. Norman.J.R. A History of fishes. Agro Botanical Publishers
2. Lagler.K.F., Bardach.J.E. and Miller. Robert.R. Ichthyology. 506 pages.
3. CMFRI Spl. Publn. No.3. (1978). Summer Institute in Breeding and rearing of marine prawns (129 pages)
4. CMFRI (2005) Winter School on Recent advances in Mussel and Edible Oyster farming & Pearl Production Compiled and edited by Appukuttan K.K.

Module 6 (8 hrs)

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

Core Readings

5. Lagler.K.F., Bardach.J.E. and Miller. Robert.R. Ichthyology. 506 pages.
6. Ed: Ricker.W.E. Hand book No.3. Methods for assessment of fish production in fresh waters. International Biological Programme. Blackwell scientific publications.
7. George.A. Rounsefell and W.Harry Everhart. Fishery Science. Its methods and applications. John Wiley & Sons Inc.
8. Bensam.P. 1999. Development of Marine Fisheries in India. Daya Publishing House. New Delhi.
5. Srivastava.C.B.L (2004). A text book of Fishery Science and Indian Fisheries.Kitab Mahal,

SEMESTER III

ZA3V05U COURSE V FISHERIES ENVIRONMENT 36 hrs

Credits 2

Module 1 (5 hrs)

General ecological concepts and ecology of a freshwater and brackish water ponds. Ecological subdivisions of the sea. Concepts in productivity. Micro and macro nutrients. Principles of limiting factor. Photosynthetic and saprophytic food chain.

Core Readings

3. Otto Kinne. Elements of ecology,
4. Sverdrup *et al*. The Oceans.
5. Nybakken. Marine Biology

Module 2 (10 hrs)

General introduction to aquatic environments such as lentic, lotic, Lacustrine etc. Basic marine metereology- weather, air-sea interactions. Monsoons, seasonal changes, circulation of water masses, Waves, Tides and sediment transportation.

Core Readings

1. Balakrishnan Nair and Thampy. Marine Ecology.
2. Laevatsu and Hayes. Fisheries oceanography

Module 3 (7 hrs)

Physical and chemical parameters such as temperature, salinity, oxygen, nutrition etc. of aquatic environment. Phytoplankton and primary production, Zooplankton and secondary production.

Core Readings

1. Santhanam, R., Ramanathan, N., Venketaramanujam.K and Jegatheesan G. 1987. Phytoplankton of the Indian Seas. Daya Publishing House.
2. Plaskitt.F.J.W. (1999). Microscopic Freshwater Life. Biotech Books. New Delhi.
3. Balakrishnan Nair and Thampy. Marine Ecology.

Module 4 (4 hrs)

Aquatic microbiology: Characteristics of freshwater and marine bacteria. Ecology of estuaries, mangroves and coastal zone.

Core Readings

1. Austen. Marine microbiology
2. Pelczar and Chang. Introduction to Microbiology.
3. CMFRI. (1996). Marine Biodiversity Conservation and Management. 205 pages.

Module 5 (10 hrs)

Ancillary marine resources-Sea weeds, corals. Echinoderms. Uses of sea weeds. Aquatic pollution, man made changes, conservation and management. Soils, sediment physicochemical features. Remote sensing techniques, application, Sampling techniques and instruments used in marine environment studies.

Core Readings

1. CMFRI. Bulletin No. 41. (1987). Seaweed Research and Utilisation in India. 116 pages.
2. CMFRI Bulletin No, 20. (1987)The economic seaweeds of India. 82 pages.
3. CMFRI Spl. Publn. No. 59 (1994). A handbook on Indian Sea cucumbers. 47 pages.
4. CMFRI Spl. Publn. No. 57. (1994). Hatchery techniques and culture of the sea cucumber, *Holothuria scabra*. 40 pages.

SEMESTER III

ZA3V06U COURSE VI FISH NUTRITION 36 hrs

Credits 2

Module 1 (5 hrs)

Digestive system of fish, Digestive physiology of fish- Proteins, carbohydrates, fats, vitamins and minerals in fish nutrition.

Core Readings

1. Lehninger. Biochemistry.
2. Sena.S.DeSilva Trevor.A.Anderson. Fish . 1995. Fish nutrition in Aquaculture. Chapman & Hall. London .
3. Lagler.K.F., Bardach.J.E. and Miller. Robert.R. Ichthyology. 506 pages.
4. Halver John.E. and Tiews Klaus.1979. Fish Nutrition and Fish Feed . Berlin.
5. Das.D. Biochemistry. Academic Publishers. Calcutta.
6. Webster, Carol.D and Chhorn Lim.2002. Nutrient requirementsand feeding of finfish for Aquaculture. CABI Publishing.
7. Garett,R.H. and Grisham, C.M. (1995). Biochemistry. Saunders College.New York.

Module 2 (8 hrs)

Gross energy, Digestive energy, metabolizable energy. Net energy, heat increment,Protein utilization. (Protein Efficiency Ratio, Protein conversion ratio, Productive protein value) Crude fibre, Nitrogen free extract and Ash. Food conversion ratio.

Core Readings

1. Halver John.E. and Tiews Klaus.1979. Fish Nutrition and Fish Feed . Berlin.
2. Rath.R.K. 1993. Freshwater aquaculture. Scientific Publishers.Jodhpur. 493 pages.
3. CMFRI. Proceedings of the Summer Institute in Recent Advances in Finfish and Shellfish nutrition.

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.

Core Readings

1. Sena.S.DeSilva Trevor.A.Anderson. Fish . 1995. Fish nutrition in Aquaculture. Chapman & Hall. London.
2. MPEDA Handbook on Aquaculture. Fish Nutrition.
3. CMFRI. Proceedings of the Summer Institute in Recent Advances in Finfish and Shellfish nutrition
4. Halver John.E. and Tiews Klaus.1979. Fish Nutrition and Fish Feed . Berlin.

Module 4 (5 hrs)

Feed preparation techniques. Factors affecting the energy requirement of fish. Non nutrient constituents of the diet. Steroid hormones in fish nutrition. Measurement of calorific value. Types of feeds (Wet Moist and Dry feeds-advantages and disadvantages)Larval feeds- Minced diets, Microparticulate diets, Spray dried and Microencapsulated diets.

Core Readings

1. Halver John.E. and Tiews Klaus.1979. Fish Nutrition and Fish Feed . Berlin.
2. MPEDA Handbook on Aquaculture. Fish Nutrition.
3. CMFRI. Proceedings of the Summer Institute in Recent Advances in Finfish and Shellfish nutrition
4. Tom Lovell. 1989. Nutrition and Feeding of fish.

Module 5 (10 hrs)

Growth promoters. Nutritional requirements of different species of cultivable carps at different stages of life histories. Principle of feed formulation. Different systems of fish feeding. Proximate composition of different feeds, Feed mills. Economics of feed preparation.

Core Readings

1. CMFRI. Proceedings of the Summer Institute in Recent Advances in Finfish and Shellfish nutrition
2. Halver John.E. and Tiews Klaus.1979. Fish Nutrition and Fish Feed. Berlin.
3. Tom Lovell. 1989. Nutrition and Feeding of fish.
4. FAO Fisheries Technical Paper. 343. Farm made Aquafeeds. Ed: Michael.B.New, Albert.G.J.Tacon, and Imre Csavas.

SEMESTER IV

ZA4V07U COURSE VII REPRODUCTIVE PHYSIOLOGY AND ENDOCRINOLOGY **36 hrs**

Credits 2

Module 1 **(6 hrs)**

Reproductive systems and sexual dimorphism in fish, crab and prawn. Types of reproduction- Viviparity, ovoviviparity, oviparity. Maturity and maturity stages-classification. Hermaphroditism- sex reversal and sex determination in fishes.

Core Readings

1. William.S. Hoar and D.J.Randall. Fish Physiology. Vol II, III, and IX.
2. Karl.E.Bond. The biology of fishes.
3. Lagler.K.F., Bardach.J.E. and Miller. Robert.R. Ichthyology. 506 pages.
4. Kotpal.R.L Modern Textbook of Zoology. Invertebrates. Rastogi Publications.
5. Proceedings of the symposium on the Reproductive Physiology of Fish, Wageningen, The Netherlands.2-6 August.
6. Adiyodi.K.G. and Rita. G. adiyodi. Reproductive biology of Invertebrates.

Module 2 **(6 hrs)**

Neurosecretary and endocrine systems in fin fishes- neuroendocrine control of reproduction, organisation and structure. Hypothalamus and pituitary in fishes-control of gonadal maturation-gonadotropin releasing hormones, gonadotropin and sex steroids.

Core Readings

1. William.S. Hoar and D.J.Randall. Fish Physiology. Vol II, III, and IX.
2. Matty .A.J. Fish endocrinology.
3. Turner, Daniel.C. and Bagnara, Joseph.T.General Endocrinology.
4. Yadav.B.N. Fish endocrinology.
5. William.S.Hoar. General and Comparative Physiology.
6. Ed: Tucker. Channel catfish culture. Elsevier Publications.
   Chapter 6. Reproductive Biology. John M.Grizzle.

Module 3 **(6 hrs)**

Neuroendocrine systems in crustaceans and control of reproduction. Sinus gland complex and X- organs. Pericardial and Post-commisural organs.Y- organs-androgenic gland. Mandibular organs- Hormones produced by Sinus gland-Role of endocrine glands- Hormonal control of molting and reproduction. Parasitic castration

Core Readings

1. Averett. S, Tombers. An introduction to Invertebrate endocrinology.
2. Kenneth.C. Highnam and Leonard Hill. The comparative endocrinology of Invertebrates.
3. Ed: Talbot. H. Waterman. The Physilogy of crustacea.
   Vol. I. Metabolism and growth
   Vol II. Sense organs, Integration and Behaviour.

Module 4 **(10 hrs)**

Principles of induced maturation and spawning-Environmental control of reproduction-Levels of control in induced breeding and maturation. Use of hormones and hormone analogues(methods of hormonal administration). HYPHOPHYSATION-ANAESTHETICS-OVAPRIM-LINPE METHOD-Eyestalk ablation its principle and application in crustacean hatcheries. Use of hormones or producing monosex population and sex reversal-cryopreservation of gametes.

Core Readings

1. Harvey and Hoar. Induced Breeding in Fish: Theory and Practice.
2. NBFGR Bulletin No.1. (1986). Genetic improvement of fish stock and resource conservation.
3. Chondar.S.L. Hypophysation of Indian major carps.
4. Indian National Science Academy. Delhi. Symposium on hormonal steroidsin fish (1978)
5. Ed: Sinha.V.R.P. Aquaculture Productivity. Use of hormones for sex manipulation and growth promotion in cultivable fishes. Varghese.T.J., Basavaraja.N, Nandeesha.M.C., Kesavanath,P., and Shetty.H.P.C.
6. Ed: James F.Muir and Ronald. J.Roberts. Recent advances in Aquaculture. Vol. .IV. Blackwell Scientific Publications.
7. Advance in Marine Biology. Vol 29,
8. CIBA bulletin No.10.
9. Jamieson. Fish Evolution and Systematics. Evidence from Spermatozoa
   Chapter 19- Principles of Biological cryopreservation.
   Chapter 20- Live preservation of fish gametes.

Module 5 **(8 hrs)**

Embryonic and early development-Types of egg and larvae- metamorphosis of larvae, larval life and feeding habits.

Core Readings

1. Khanna .S.S. An Introduction to fisheries. Central Book Depot, Allahabad
2. William.S. Hoar and D.J.Randall. Fish Physiology. Vol II, III, and IX.

SEMESTER IV

ZA4V08U COURSE VIII MICROBIOLOGY, PATHOLOGY AND POST HARVEST TECHNOLOGY

36hrs
Credits 2

Module 1 **(6 hrs)**

Post harvesting techniques-sorting, grading, processing, packing, storing and marketing.

Core Readings

1. Sreenivasa Gopal. Food Packaging Technology.

Module 2 **(8 hrs)**

Biochemical composition of fish, spoilage of fish-post mortem changes and rigor mortis-Enzymatic, microbial, rancidity. Indices of spoilage-organoleptic, chemical and microbial.

Core Readings

1. Srivastava.C.B.L (2004). A text book of Fishery Science and Indian Fisheries.Kitab Mahal.
2. Handbook of Fisheries and Aquaculture
   Indian Council of Agricultural Research.
2. Govindan T.K. Fish Processing Technology. Oxford and IBH Publishing Company. 252 pages.
3. Gopakumar.K. (Eds:). Text book of Fish Processing Technology. ICAR.New Delhi.

Module 3 **(6 hrs)**

Preservation of fish – Freezing, canning and curing-principle and techniques.

Core Readings

1. Govindan T.K. Fish Processing Technology. Oxford and IBH Publishing Company. 252 pages.
2. Gopakumar.K. (Eds:). Text book of Fish Processing Technology. ICAR.New Delhi.

Module 4 **(8hrs)**

Bacteriology-Important bacteria in spoilage, important bacteria of sanitary significance-staphylococcus, E-coli, Vibrio cholorae, salmonella. Sterilization techniques, preparation of different culture media, estimation of total plate count, staining techniques.

Core Readings

1. Bergey's Manual of Determinate Bacteriology.
2. Austen. Marine microbiology
   Pelczar and Chang. Introduction to Microbiology.

Module 5 **(6 hrs)**

Diseases of fin fish and shrimp-microbial, viral, fungal, parasitic, protozoan and nutritional diseases and remedial measures.

Core Readings

1. Sinderman.C.J. Principal diseases of marine fish and shellfish.
2. Sneisko,S.F. and Herbert.R.Axelrod. (1971). Diseases of Fishes. T.F.H.Publications
   Ronald J. Roberts. (1978).Fish Pathology. Cassell Ltd. London.

Module 6 **(2 hrs)**

Hazard analysis and critical control points in seafood industry.

Core Readings

1. Gopakumar.K. (Eds:). Text book of Fish Processing Technology. ICAR.New Delhi.

SEMESTER I

AQUACULTURE PRACTICALS

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

36 Hrs
Credit 1

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

SEMESTER II

ZA2V04U (P) PRACTICAL – II CAPTURE FISHERY & BIOLOGY OF FISHES **36 Hrs**
Credit 1

1. Identification of commercially important fishes, crustaceans and molluscs.
2. Fish- Study of external morphology, scales and alimentary canal.
3. Dissecting and identification of internal organs of a fish and Dissection of fish otoliths.
4. Prawn- Study of external morphology, digestive system and nervous system
5. Gill structure- Herbivorous, carnivorous and omnivorous fishes.
6. Gill structure of a prawn - Dissection
7. Molluscs- Study of morphology, and Dissection of Gills
8. Rate of oxygen consumption in relation to body weight of a fish or prawn
9. Visit to marine landing centre.

SEMESTER III

ZA3V05U(P) PRACTICAL – III FISHERIES ENVIRONMENT
54 Hrs
Credit 2

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

SEMESTER III

ZA3V06U (P) PRACTICAL – IV FISH NUTRITION

54 Hrs
Credit 2

1. Analysis of organic manure for determining organic matter.
2. Comparative study of Digestive system of Herbivorous (Mullet) and Carnivorous (Saurida sp) fishes
3. Estimation of proteins and Polysaccharides
4. Formulation of artificial feed for aquarium fishes and prawns with locally available ingredients.
5. Study of identification feed ingredients of plant origin and animal origin (oil cakes and meals eg: Groundnut oil cake, coconut oil cake, Mustard oil cake, Fish meal, Crustacean meals, Molluscan meals, Blood meal etc)
6. Use of Pearson–s square method in balancing feed Ingredients.
7. Study of equipments used in feed preparation (Oven, Pelletiser, Feed Press and Die Plate, Extruders etc.)
8. Study of non-conventional feed stuffs eg. Spirulina etc. and Feed Additives (Binders, Antibiotics etc)

SEMESTER IV
ZA4V07U(P) PRACTICAL – V REPRODUCTIVE PHYSIOLOGY AND ENCOCRINOLOGY

54 Hrs
Credit 2

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

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

54 Hrs
Credit 2

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

Selected Further Readings

A.J Matty Fish Endocrinology
Advances in harvest technology- ICAR Winter School 2003, Fishing technology division, CIFT, Cochin.
Artificial reefs and sea farming technologies. CMFRI Bull No. 48.
Bal and Rao, Marine fisheries.
Bardach, Rhyther & Mclarney : Aquaculture
Benegal, Methods of fish production in fresh waters.
Beveridge, M.C.M. (1987) Cage aquaculture. Fishing news.
Biswas, k. P. (1992). Prevention and control of fish and prawn diseases, Daya publishing House, Delhi.
Carl, J. Sinderman (1997), Disease diagnosis and control in North America, Aquaculture scientific publication, New York.
Chemistry and biochemistry of marine food products, Roy E. Martin AVI Publ. Co. West Port.
Chen, T.P. (1976). Aquaculture Practices in Taiwan.
CMFRI- Statistics of marine landings in India.
CMFRI-The commercial molluscs of India.
Collin E. Purdom (1993). Genetics and fish breeding. Chapman and Hall.
Cowey, c.B. et al. (eds.) 1985. Nutrition and feeding in fishes, Academic Press I
Das, D (20W), Biochemistry, Academic Publishers, Calcutta
Das, P. and Jhingran, A.G. (Eds.). Fish Genetics in India.
Development of marine fisheries in India-P. Bensam 1999. Daya publishing house, New Delhi.

E.J.W Barrington, Invertibrate structure and function.
Ed. T.V.R. Pillai: Advances in Aquaculture
Ed. T.V.R. Pillai: Coastal Aquaculture in the Indo Pacific.
Farber Jeffery, M. and Todd ewen C.D; Safe Handling of foods. New York Ma dekker, 2000. 552 pp.
Farm made aquafeeds, FAO Fisheries Technical Paper 343.
Garrett, R.H., and Grisham, C, M. (1995). Biochemistry. Saunders College New York.
Gopakumar, K. Text of fish processing technology, New Delhi, ICAR, 2002.
Gopakumar, K. Tropical fishery products, Oxford and IBH publishing Co. New Delhi.
Gopakumar. K. Fish packing technology Concept Pub. Co., New Delhi.
Gulland, J. A. Manual of sampling and statistical methods for fisheries. Biology Part I Sampling methods, FAO.
Haard, Norman, F and Simpson, Benjamine, K; Seafood enzymes. New York Madekker, 2000.
Halver John, E and Tiews Klaus, 1979. Finfish Nutrition and fish feed, Berlin.
Harvey & Hoar, Induced breeding in fish-Theory and practice.
Highnam & Hill, Comparitive Endocrinology of invertebrate.
Jeremiah Lester, E. Freezing effects on food quality, Marcel Dekker, New York, 1996.
Jinghran, V.C. Fish and fisheries of India.
Khanna, S.S (1993), Fish and fisheries, Daya publications house, Delhi.
Kurian C.V. and Sebastian V.C.: Prawn and prawn fisheries of India.
Manual on Pearl culture technique: CMFRI, Special publication No.20-1984.
Menon N.G. and Pillai, P.P. (Eds.) (2001). Prespectives in mariculture. The Marine Biological Association of India Publication.
Modern fishing gear technology M. Shahul hameed and Boopendranath, M.R (2000) Daya publishing house, New Delhi.
MPEDA Hand Book on aqua farming. Indian lobsters.
MPEDA Hand Book on aqua farming. Sea fishes
MPEDA Hand Book on aqua farming. Seaweed, sea urchin and sea cucumber.
Munro, Marine and Freshwater fishes of Ceylon.
Pillai, T.V.R. (1998). Aquaculture Principles and practices. Fishing news book.
Pillai, T.V.R. Aquaculture development progress and prospects.
Pillai, T.V.R. Aquaculture principles and practices.
Plummer, D.T. (1982). An introduction to practical Biochemistry, Tata Mc Grill Company, New Delhi.
Prawn farming in Kerala: C.M.F.I. Special publication No. 21-1984.
Roberts, R.J. Fish pathology.
Robertson, G.L. Food packaging, New York, Marcel Dekker, VII.
Ronald J. Roberts (1978) Fish pathology. Cassell Ltd., London.
S.L. Chondar, Hypophysation of Indian major Carp.
Saigal and Jinghran, Cold water fisheries of India
Sandhu, G.S (1990); Research techniques in biological Sciences. Anmol Publishing hose, Delhi
Santosh kumar and Manju Tembhre, (1996), Anatomy and physiology Publishing house.
Sindermann, C.J. Principal diseases of marine fish and shell fish.
Singh, R.P. (1990) Introductory biotechnology, Central Book Depot, Allahabad.
Snahotra, M.K Shrimp feed formulation and feed management, CMFRI Spl. Pub lications.
Sneisko, S.F. and Herbert R. Axelrod (1971). Diseases of Fishes, T.F.H. publications.
Srivastava, C.B.L. (1985), A text Book of Fishery Science India mahal, 22, sarojini naidu Mary
Status of research in marine fisheries and mariculture, CMFRI Spl. Publ. No. 67.
Strayer, L. (1995) Biochemistry. W.H. Freeman Co., New York.
Summer Institute in Breeding and rearing of Marine Prawns: C.I.F.R.I Special publication. No. 3-1978.
Talwar, P.S. K and R.K. Kakkar (1984) Commercial sea fishes of India
Thomas P.C. (Ed.0 (1998) Shrimp seed production and farming. Cosmo Publication.
Transportation of live fin fishes and shell fishes, CMFRI Spl. Publ. No.66.
Turner & Bagnara, General Endocrinology.
Verreth, J. Fish larval nutrition. Chapman and Hall, Pub.
Water quality management in aquaculture, CMFRI Spl. Publ. No. 22.

VOCATIONAL SUBJECT FOOD MICROBIOLOGY

SEMESTER I

ZF1V01U COURSE I – GENERAL MICROBIOLOGY

36 Hrs

Credits 2

Module 1 (7 hrs)

The historical development of microbiology, classification of micro organisms – Two types of cellular organization – Prokaryotic & Eukaryotic, Principles of microbial taxonomy, classification of bacteria according to Bergy's manual, classification based on molecular techniques.

Core Readings

Ananthanarayan & Panicker. Text book of Microbiology, 2006. 7th Edition, Orient Longman.

Microbiology, 5th Edition, M.J. Pelczar, E.C.S Chan & N.R. Kreig, 2002 Tata McGraw Hill Edition.

Module 2 (5 hrs)

Sterilization & disinfection – Definition, different methods of sterilization, physical & chemical methods. Sterilization by moist and dry heat, by filtration, by irradiation. Culture of micro organisms – Types of media, culture techniques.

Core Readings

Ananthanarayan & Panicker. Text book of Microbiology, 2006. 7th Edition, Orient Longman.

Microbiology, 5th Edition, M.J. Pelczar, E.C.S Chan & N.R. Kreig, 2002 Tata McGraw Hill Edition.

Module 3 (5 hrs)

Morphology and fine structure of bacteria, size, shape and arrangements. Flagella, pili, capsule, cell wall and its composition. Cytoplasmic membrane, protoplasts, spheroplasts, intracellular membrane systems, cytoplasm, vacuoles, nuclear material, Bacterial spores, cell inclusions.

Core Readings

Ananthanarayan & Panicker's text book of Microbiology, 2006. 7th Edition, Orient Longman.

Microbiology, 5th Edition, M.J. Pelczar, E.C.S Chan & N.R. Kreig, 2002 Tata McGraw Hill Edition.

Module 4 (5 hrs)

Study of morphology of bacteria – Bacterial staining – simple staining, gram's staining, acid fast staining, capsule staining, flagella staining, spore staining, negative staining – Indian ink staining. Measurement of microbial size and numbers.

Core Readings

Ananthanarayan & Panicker's text book of Microbiology, 2006. 7th Edition, Orient Longman.

Microbiology, 5th Edition, M.J. Pelczar, E.C.S Chan & N.R. Kreig, 2002 Tata McGraw Hill Edition.

Module 5 (3 hrs)

Bacterial growth (eg: *E.coli*). Modes of cell division, new cell formation,Factors affecting microbial growth nutritional requirements and nutritional grouping of microbes. Bacterial growth curve. Cultivation of bacteria. Culture media and methods, Anaerobic methods

Core Readings

Ananthanarayan & Panicker. Text book of Microbiology, 2006. 7th Edition, Orient Longman.

Microbiology, 5th Edition, M.J. Pelczar, E.C.S Chan & N.R. Kreig, 2002 Tata McGraw Hill Edition.

Module 6 (6 hrs)

Bacterial genetics – Transformation, Transduction and conjugation. Extra chromosomal genetic material, plasmids, cosmids, transposons, insertion sequences, overlapping genes, silent genes, exon and intron, evolutionary significance of silent gene, ribonuleoprotein, genetic recombination and its prospects, basics of recombinant RNA and recombinal DNA technology. (Brief account only)

Core Readings

Ananthanarayan & Panicker. Text book of Microbiology, 2006. 7th Edition, Orient Longman.

Microbiology, 5th Edition, M.J. Pelczar, E.C.S Chan & N.R. Kreig, 2002 Tata McGraw Hill Edition.

Selected Further Readings

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

Essentials of Microbiology by Purohit & Singh.

Fundamentals of microbiology, 5th Edition, Alcamo.

Fundamentals of microbiology, 6th Edition, Frobisher, W.B. Saunders Company.

General Microbiology – Vol –II, Powar & Daginawala, Himalaya Publishing House.

Manual of Microbiology, Tools and Techniques by Kanika Sharma.

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

Microbiology, 5th Edition, M.J. Pelczar, E.C.S Chan & N.R. Kreig, 2002 Tata McGraw Hill Edition.

Microbiology, 6th Edition, Prescott, Harley, Klein, International Edition.

SEMESTER I

ZF1V02U COURSE II – BIOINSTRUMENTATION

36 Hrs

Credits 2

Module 1 (7 hrs)

Microscopy: - light microcopy, bright field, Dark field, phase contrast microscopy, fluorescence, transmission and scanning electron microscopy. Specimen preparation for light and electron microscopy.

Core Readings

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

Kanika Sharma,Manual of Microbiology, Tools and Techniques, 2nd Edition, Ane Books Pvt. Ltd.

Upadhyay, Upadhyay, Nath, Biophysical Chemistry Principles & techniques, 4th revised Edition 2007, Himalaya Publishing House.

Module 2 (4 hrs)

pH meter – different methods of pH measurements. Colorimetry, spectrophotometry (UV, visible and infrared) – Principle, instrumentation and application.

Core Readings

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

Kanika Sharma,Manual of Microbiology, Tools and Techniques, 2nd Edition, Ane Books Pvt. Ltd.

Upadhyay, Upadhyay, Nath, Biophysical Chemistry Principles & techniques, 4th revised Edition 2007, Himalaya Publishing House.

Module 3 (15 hrs)

Centrifugation – Principle, instrumentation, methods and types of centrifugation, application biological science.

Core Readings

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

Kanika Sharma,Manual of Microbiology, Tools and Techniques, 2nd Edition, Ane Books Pvt. Ltd.
Upadhyay, Upadhyay, Nath, Biophysical Chemistry Principles & techniques, 4th revised Edition 2007, Himalaya Publishing House.

Module 4 **(10 hrs)**

Basic idea of biological safety cabinets, laminar air flow, incubator, colony counter, micrometer, autoclave, hot air oven.

Core Readings

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

Kanika Sharma,Manual of Microbiology, Tools and Techniques, 2nd Edition, Ane Books Pvt. Ltd.
Upadhyay, Upadhyay, Nath, Biophysical Chemistry Principles & techniques, 4th revised Edition 2007, Himalaya Publishing House.

Selected Further Readings

Beacker & Deamer The World of cell.

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

Harley Klein. Microbiology, 6th Edition by Prescott,

Kanika Sharma,Manual of Microbiology, Tools and Techniques, 2nd Edition, Ane Books Pvt. Ltd.

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

Rodney Boyer Modern experimental biochemistry, 3rd Edition, , Pearson education.
Upadhyay, Upadhyay, Nath, Biophysical Chemistry Principles & techniques, 4th revised Edition 2007, Himalaya Publishing House.

SEMESTER II

ZF2V03U COURSE III: GENERAL METHODOLOGY

36 Hrs
Credits 2

Module 1 **(10 hrs)**

Chromatography techniques: Paper chromatography, thin layer chromatography, column chromatography, gas chromatography, affinity chromatography, gel filtration.

Core Readings

Kanika Sharma,Manual of Microbiology, Tools and Techniques, 2nd Edition, Ane Books Pvt. Ltd.
Kllittaker.Fermentation technology

Module 2 **(10 hrs)**

Electrophoresis: Principle & applications. Types of Electrophoresis: 1. Free electrophoresis – moving boundary electrophoresis. 2. Zone electrophoresis – paper or gel. Immuno electrophoresis, isoelectric focusing.

Core Readings

Kanika Sharma,Manual of Microbiology, Tools and Techniques, 2nd Edition, Ane Books Pvt. Ltd.
Kllittaker.Fermentation technology

Module 3 **(10 hrs)**

Fermentation techniques: Factors involved in Fermenter design, differences between biochemical reactions, rate process, operational consideration, local conditions within a Fermenter. Fermenter configurations, the batch Fermenter, continuous stirred tank Fermenter, the tubular Fermenter, the fluidized bed Fermenter, solid state Fermenter.

Core Readings

Kanika Sharma,Manual of Microbiology, Tools and Techniques, 2nd Edition, Ane Books Pvt. Ltd.
Kllittaker.Fermentation technology

Module 4 **(6 hrs)**

Introduction to tracer techniques: Fluorescent tracer, Isotope, ELISA.

Core Readings

Kanika Sharma,Manual of Microbiology, Tools and Techniques, 2nd Edition, Ane Books Pvt. Ltd.
Kllittaker.Fermentation technology

Selected Further Readings

A.H. Patel.Industrial Microbiology
Jayaram Pamilees & Ananthanarayan, Microbiology,.
Kanika Sharma Manual of Microbiology, Tools & Techniques
Kllittaker.Fermentation technology
Swaroop Pathalc & Arora Laboratory in Biology
Welson & Goulding Tools & Techniques in Biology

SEMESTER II

ZF2V04U COURSE IV ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY 36 hrs

Credit 2

MODULE 1 10Hrs

Microorganisms in soil, Factors affecting soil microflaura, biological interrelationship of microorganisms: mutalism, synergism (protocooperation) commensalisms, Amensalism, Parasitism, Predation. Interaction of microbes with plants (mycorrhizae : Ectomycorrhizae and vesicular Arbuscular mycorrhizae).

Core Readings

Pekzar E.C.S.Chan and Noel .R.Krieg Microbiology, Fifth edition, Michael.; Tata Mc Graw-Hill publishing company Ltd.

Philip.L.Carpenter, Microbiology, Second Edition, W.B.Saunders company.

MODULE 2 10 Hrs

Sewage (waste water)treatment: Bacteriological examination of drinking water. Purification and disinfection of water. Sewage microorganism, BOD and COD, primary treatment, secondary treatment(Oxidation Pond Trickling Filter, the Activated sludge, Anaerobic digesters),Tertiary treatment.

Core Readings

Pekzar E.C.S.Chan and Noel .R.Krieg Microbiology, Fifth edition, Michael.; Tata Mc Graw-Hill publishing company Ltd.

Philip.L.Carpenter, Microbiology, Second Edition, W.B.Saunders company.

MODULE 3 10 Hrs

Role of microorganisms in Agriculture: Biofertilizer (Bacterial, Algae, Mycorrhizae), Biopesticides (Bacterial, viral, fungal). Common bacterial, fungal and viral plant diseases

Core Readings

Pekzar E.C.S.Chan and Noel .R.Krieg Microbiology, Fifth edition, Michael.; Tata Mc Graw-Hill publishing company Ltd.

Philip.L.Carpenter, Microbiology, Second Edition, W.B.Saunders company.

MODULE 4 6 Hrs

Biodegradation :Definition ,Role of microorganisms in biogeochemical cycles. Carbon and nitrogen cycles, bacterial nitrogen fixation. Brief account on biodegradation of natural organic compound, plastics, pesticides and petroleum pollutants.

Core Readings

Pekzar E.C.S.Chan and Noel .R.Krieg Microbiology, Fifth edition, Michael.; Tata Mc Graw-Hill publishing company Ltd.

Philip.L.Carpenter, Microbiology, Second Edition, W.B.Saunders company.

Selected Further Readings

Pekzar E.C.S.Chan and Noel .R.Krieg Microbiology, Fifth edition, Michael.; Tata Mc Graw-Hill publishing company Ltd.

Philip.L.Carpenter, Microbiology, Second Edition, W.B.Saunders company.

R.C.Dubey and D.K.Maheshwari, A Text book of microbiology, First Edition, S. Chand & company Ltd.

R.P Singh,Microbiology, First edition 2005 by Kalayani publishers.

SEMESTER III

ZF3V05U COURSE V DAIRY MICROBIOLOGY 36 hours

Credits 2

Module 1 10 hrs

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

Core Readings

W.C. Frasier & Westhoff , Food Microbiology,

Shakuntala N, Manay, M. Shadaksharaswamy, Food facts and Principles 2nd ed. New Age International publishers

Module 2 10 hrs

Bacteriological examination of milk. Preservation of milk pasteurization , different methods and advantages, sterilization, dehydration, Bacteriological standards and grading of milk

Core Readings

W.C. Frasier & Westhoff , Food Microbiology,

Shakuntala N, Manay, M. Shadaksharaswamy, Food facts and Principles 2nd ed. New Age International publishers

Module 3 30 hrs

Type of milk and milk products: whole milk, low fat milk, skim milk, vitamin D milk, ultra high temperature processed milk, low sodium milk, homogenized milk, toned milk, concentrated milk, sweetened condensed milk evaporated milk, dry milk, low lactose milk, Kefis and Kumiss , fermented milks lahior curd, cream butter milk, lassie, butter , ghee, chees, yoghurt, frozen disserts, contamination , spoilage and preservation . Lactic starter cultures

Core Readings

W.C. Frasier & Westhoff , Food Microbiology,

Shakuntala N, Manay, M. Shadaksharaswamy, Food facts and Principles 2nd ed. New Age International publishers

Module 4 6hrs

Milk borne disease, microbial diseases of dairy cattle and its control measures.

Core Readings

W.C. Frasier & Westhoff , Food Microbiology,

Shakuntala N, Manay, M. Shadaksharaswamy, Food facts and Principles 2nd ed. New Age International publishers

Selected Further Readings

W.C. Frasier & Westhoff , Food Microbiology,

James M. Jay , Modern food microbiology, 4th ed.

Shakuntala N, Manay, M. Shadaksharaswamy, Food facts and Principles 2nd ed. New Age International publishers

Marion Bennion, Introductory foods, 10th edition,.

Winton and Winton , Milk and Milk Products

Norman N, Potter, Joseph H Hotchkis, Food Science, 5th ed.

Ahmed, M,.N., Food Science an d Nutrition

Sivasankar B., Food Processing and Preservation

Subha Lakshmi and Sobha , A. Udipi, Food Processing and Preservation

Blank F.C., Hand book of food nutrition

SEMESTER III

ZF3V06U COURSE VI FOOD MICROBIOLOGY - MICROBIOLOGY OF SPOILAGE OF FOOD, METHODS OF FOOD PRESERVATION AND MICROBIOLOGICAL EXAMINATION OF FOOD

36 hrs

Credits 2

Module 1 6 hrs

Food as a substrate for microorganisms. Types of food. Important parameters of food that affect their microbiology – hydrogen ion concentration (pH) , water activity, oxidation reduction potential, nutrient content, inhibitory substances and biological structure.

Core Readings

M.R. Adams, M.O. Moss, Food Microbiology

W.C. Frazier and Westhoff, . Food Microbiology

Module 2 10 hrs

Microorganisms - important in food microbiology, Bacterial – morphological , cultural and physiological characteristics important in food bacteriology, Important groups of bacteria associated with various foods. Moulds and yeast associated with different foods. Source of contamination of food – from green plants and fruits, animals, soil , air, sewage, water and during handling and processing.

Core Readings

M.R. Adams, M.O. Moss, Food Microbiology

W.C. Frazier and Westhoff, . Food Microbiology

Module 3 7 hrs

General principles underlying spoilage of food; Chemical changes caused by microorganisms: Causes of spoilage, classification of food by case of spoilage: factors affecting kinds and number of growth of microorganisms

Core Readings

M.R. Adams, M.O. Moss, Food Microbiology

W.C. Frazier and Westhoff, . Food Microbiology

Module 4 7 hrs

Principles of food preservation, Asepsis, removal of microorganism, maintenance of anaerobic conditions, preservation by the use of high temperature, low temperature, drying, food additives and irradiation.

Core Readings

M.R. Adams, M.O. Moss, Food Microbiology

W.C. Frazier and Westhoff, . Food Microbiology

Module 5 6 hrs

Methods for the microbiological examination of foods: indicator organisms, direct examination , culture techniques, Enumeration methods – plate counts, most probable number counts: dye reduction test. Rapid methods for the detection of specific organism and toxins – immunological methods

Core Readings

M.R. Adams, M.O. Moss, Food Microbiology

W.C. Frazier and Westhoff, . Food Microbiology

SEMESTER IV

ZF4V07U COURSE VII • FOOD MICROBIOLOGY - MICROBIOLOGY OF CEREALS , BEVERAGES , EGG, MEAT AND FERMENTED FOOD

36hrs

Credits 2

Module 1 **12 hrs**

Microbiology of cereal grains, flours, bread , cakes and other bakery products, bottled beverages , wines, fruits, and vegetables spices & other condiments.

Core Readings

M.R. Adams, M.O. Moss, Food microbiology, New Age International (P) Ltd. Publishers

Prescott, Harleg, Klein, Microbiology, 7th ed. Mac Graw Hill International edition.

Module 2 **12 hrs**

Microbiology of egg, meat and meat products. Contamination, preservation and spoilage of egg, meats, of different origin, fish and prawns

Core Readings

M.R. Adams, M.O. Moss, Food microbiology, New Age International (P) Ltd. Publishers

Prescott, Harleg, Klein, Microbiology, 7th ed. Mac Graw Hill International edition.

Module 3 **12 hrs**

Fermented foods: oriental fermented foods, fermented vegetables • sauerkraut and Kinchi, Olives, cucumbers, fermented meat and fish. Bread, wine and malt beverages, single cell protein, food and folder yeast, algae as food. Mushroom production food borne diseases - food infection and intoxication. Microbiology of food plant sanitation • Hazard Analysis Critical Control Points (HACCP) Microbiological criteria for food.

Core Readings

M.R. Adams, M.O. Moss, Food microbiology, New Age International (P) Ltd. Publishers

Prescott, Harleg, Klein, Microbiology, 7th ed. Mac Graw Hill International edition.

Selected Further Readings

M.R. Adams, M.O. Moss, Food microbiology, New Age International (P) Ltd. Publishers

James M. Jay, Modern food microbiology, Van Nostand Reinhold Company

Prescott, Harleg, Klein, Microbiology, 7th ed. Mac Graw Hill International edition.

SEMESTER IV

ZF4V08U COURSE VIII • INDUSTRIAL MICROBIOLOGY

36 hrs

Credits 2

Module 1 **(12 hrs)**

General introduction, historical developments of industrial microbiology, scope of indusial microbiology , discovery of the microbial world, experiments of Pasteur, Era of discovery of antibiotics, the discovery of anaerobic life. Industrial fermentation, Submerged and solid fermentation, Fermentors fermenter design, Sterilization, process control.

Core Readings

A.H. Patel, Industrial microbiology, Mac Millan India Ltd.

L.E. Cesida, Industrial Microbiology, New Age International Publishers.

Module 2 **(12 hrs)**

Biological and bio chemical fundamental. Microorganism and biotechnology. Properties of a useful industrial microorganism. Primary and secondary metabolites. Culture preservation and stability . 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 the storage of fungi. Screening of microbes for industrial use.

Core Readings

A.H. Patel, Industrial microbiology, Mac Millan India Ltd.

L.E. Cesida, Industrial Microbiology, New Age International Publishers

Module 3 (12 hrs)

Production of organic acids; acetic acid, citric acid, lactic acid, gibberlllic acid, oxalic acid. Production of amino acids: lysine and glutamic acid , production of enzymes: porteases and amylases. Production of antibiotics: Penicillin, Streptomycin, Production of vitamins, Vitamin B12 & riboflavin, Production of fuels: ethanol and methane.

Core Readings

A.H. Patel, Industrial microbiology, Mac Millan India Ltd.

L.E. Cesida, Industrial Microbiology, New Age International Publishers

Selected Further Readings

A.H. Patel, Industrial microbiology, Mac Millan India Ltd.

L.E. Cesida, Industrial Microbiology, New Age International Publishers.

T. Madigan & John M. Martinko Brock Biology of Microorganism, International edition.

Jeffrey C. Pommerville, Aeamo's Fundamentals of Microbiology, 7th edition, Jones & Bartlett Publishers

Prescott, Harley & Klein Microbiology, 7th edition, Mac Graw Hill International edition.

SEMESTER I

ZF1V02U (P) PRACTICAL I GENERAL MICROBIOLOGY & BIOINSTRUMENTATION

36 hrs
Credit 1

1. Cleaning and sterilization of glassware, Autoclave, hot air oven, incubator and Laminar air flow bench.
2. Preparation of Solid and liquid media for microbial cultures.
   a. Liquid media (1) peptone water/Glucose broth (2) Nutrient broth
   b. Solid media (1) Nutrient agar (2) Mac Conkey's agar (3) Blood agar
      (4) Chocolate agar
   c. Semi Solid agar (d) Firm agar (e) Biphasic media
3. Culture methods (a) streak culture (b) Lawn culture
   (c) Stab culture
   (d) pour plate culture (e) Liquid culture.
1. Demonstration of selective and differential media
2. Isolation of pure colonies (a) streak plate method (b) pour plate method
   (c) subculturing (picking off) technique (d) Broth cultures.

6Calibration of an ocular micrometer for different objectives of a microscope.
Measurement of microorganisms by the use of an ocular micrometer.

7 Bacterial Staining Method (a)Simple Staining (b)Gram's staining
(c) Acid-fast staining (d) capsule staining (e) flagella staining (f) spore staining (g) Negative staining 'Indian ink preparation.

8 Examination of microbes in Living condition
(a) wet mount (b) Hanging drop method for demonstrating motility of bacteria

9 Instrumentation and working principle
(a) pH meter (b) colorimeter (c) Laminar air flow Bench (d) Autoclave
(e) Hot air oven (f) Colony counter.

SEMESTER II

ZF2V04U(P) - PRACTICAL II GENERAL METHODOLOGY, ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY
36 hrs

Credit 1

1. Introduction to chromatographic techniques.
2. Paper chromatographic separation of aminoacids.

   Paper chromatographic separation of carbohydrates.
3. pH measurement of culture media.
4. Measurement of bacterial growth by optical density method.
5. Biofermentor, its parts and function.
6. Isolation and enumeration of bacteria from soil.

   Isolation and enumeration of fungi from soil.
7. Enumeration of micro organisms in air by open plate method.
8. Standard plate count count technique for the isolation and enumeration of microorganisms in water.
9. Basic idea about (a) Trickling filter (b) membrance filter system

   (c)Anaerobic sludge digester

SEMESTER III

ZF3V05U(P) PRACTICAL-III DAIRY MICROBIOLOGY

54 hrs
Credit 2

1. Qualitative analysis of milk by standard plate count method
2. Quality testing of milk by rezazurin test
3. Methylene blue reduction test for microbial contamination of milk.
4. Litmus milk reaction
5. Detection of mastitis through milk test

SEMESTER III

ZF3V06U(P) PRACTICAL- IV FOOD MICROBIOLOGY - MICROBIOLOGY OF SPOILAGE OF FOOD, METHODS OF FOOD PRESERVATION AND MICROBIOLOGICAL EXAMINATION OF FOOD

54hrs
Credit 2

1. Isolation of Lactobacilli and Staphylococcus from curd
2. Enumeration of bacterial from spoiled food.
3. Enumeration of fungi from spoiled food
4. Isolation and identification of bacteria from spoiled food samples (vegetables, meat, fish) Biochemical tests for microbes used for identification. Fermentation of carbohydrates IMV i C test , Urease catalase and oxidase test

SEMESTER IV

ZF4V07U(P) PRACTICAL V – FOOD MICROBIOLOGY - MICROBIOLOGY OF CEREALS , BEVERAGES , EGG, MEAT AND FERMENTED FOOD

54 hrs
Credit 2

1. Isolation and identification of fungi from spoiled food samples (vegetables, meat, fish)
2. Isolation of *Aspergillus flavus* from spoiled food
3. Inhibitory effect of low temperature on microbial growth

SEMESTER IV

ZF4V08U(P) PRACTICAL VI– INDUSTRIAL MICROBIOLOGY

54 hrs
Credit 2

1. Determination of fermentation by using yeast
2. Wine production
3. Cultivation of edible mushrooms
4. Isolation and maintenance of industrially important microbes from soil/environment (a) bacteria, (b) algae (c) bacteriophage (d) Fungi

Selected Further Readings

A.H.Patel Industrial Microbiology , Macmillan India.

A.H.Patel.Industrial Biotechnology

Ananthanarayan & Jayaram Panicker Text book of Microbiology.

H.A.Moddy Environment Microbiology

J.R.Norriz, D.J Road, A.K.Varma Methods in Microbiology – Vol.XXIV by

K. R.Aneja Experiments in Microbiology, Plant pathology and Biotechnology by. New age international publishers.

Monica Cheesbrough, Medical Laboratory manual for Tropical Countries Microbiology – Vol.I & II ELEBS.

R.C Dubey & D.K.Maheshwari A text book of microbiology, S.Chand & Company Ltd.

R.C.Dubey, D.K.Maheshwari, Practical microbiology, S.Chand & Company Ltd.

R.Cruickshank et al.Medical Microbiology

Swaroop, Pathak and Arora Laboratory Techniques in Biology

Welson and Goulding Tools and Techniques in Biology

VOCATIONAL SUBJECT MEDICAL MICROBIOLOGY

SEMESTER I

ZM1V01U COURSE I – GENERAL MICROBIOLOGY

36 Hrs
Credits 2

Module 1 **(7 hrs)**

The historical development of microbiology, classification of micro organisms – Two types of cellular organization – Prokaryotic & Eukaryotic, Principles of microbial taxonomy,Classification of bacteria according to Bergy–s manual, classification based on molecular techniques.

Core Readings

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

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

Module 2 **(5 hrs)**

Sterilization and disinfection – Definition, different methods of sterilization, physical & chemical methods. Sterilization by moist and dry heat, by filtration, by irradiation. Culture of micro organisms – Types of media, culture techniques.

Core Readings

Ananthanarayan & Panicker–s text book of Microbiology, 7th Edition, Orient Longman.

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

Module 3 **(10 hrs)**

Morphology and fine structure of bacteria, size, shape and arrangements. Flagella, pili, capsule, cell wall and its composition. Cytoplasmic membrane, protoplasts, spheroplasts, intracellular membrane systems, cytoplasm, vacuoles, nuclear material, bacterial spores, cell inclusions.

Core Readings

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

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

Module 4 **(5 hrs)**

Study of morphology of bacteria – Bacterial staining – simple staining, gram–s staining, acid fast staining, capsule staining, flagella staining, spore staining, negative staining – Indian ink staining. Measurement of microbial size and numbers.

Core Readings

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

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

Module 5 **(3 hrs)**

Bacterial growth (eg: *E.coli*). Modes of cell division, new cell formation.Factors influencing microbial growth. Nutritional requirements and nutritional grouping of microbes. Bacterial growth curve. Cultivation of Bacteria. Culture Media and methods. Anaerobic culture methods

Core Readings

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

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

Module 6 **(6 hrs)**

Bacterial genetics – Transformation , Transduction and conjugation. Extrachromosomal genetic material, plasmids, cosmids, transposons, insertion sequences, overlapping genes, silent genes, exon and intron, evolutionary significance of silent gene, ribonuleoprotein, genetic recombination and its prospects, basics of recombinant RNA and recombinal DNA technology. (Brief account only)

Core Readings

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

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

Selected Further Readings

Ananthanarayan & Paniker Text book of Microbiology, 7th Edition, Orient Longman.
Essentials of Microbiology by Purohit & Singh.
Fundamentals of microbiology, 5th Edition, Alcamo.
Fundamentals of microbiology, 6th Edition, Frobisher, W.B. Saunders Company.
General Microbiology – Vol –II, Powar & Daginawala, Himalaya Publishing House.
Manual of Microbiology, Tools and Techniques by Kanika Sharma.
Microbiology, 1st Edition, R.P. Singh, Kalyani Publishers.
Microbiology, 5th Edition, M.J. Pelczar, E.C.S Chan & N.R. Kreig, Tata McGraw Hill Edition.
Microbiology, 6th Edition, Prescott, Harley, Klein, International Edition.

SEMESTER I

ZM1V02U COURSE II – BIOINSTRUMENTATION

36 Hrs
Credits 2

Module 1 (7 hrs)

Microscopy: - light microcopy, bright field, Dark field, phase contrast microscopy, fluorescence, transmission and scanning electron microscopy. Specimen preparation for light and electron microscopy.

Core Readings

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

Kanika Sharma,Manual of Microbiology, Tools and Techniques, 2nd Edition, Ane Books Pvt. Ltd.

Module 2 (4 hrs)

pH meter – different methods of pH measurements. Colorimetry, spectrophotometry (UV, visible and infrared) – Principle, instrumentation and application.

Core Readings

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

Kanika Sharma,Manual of Microbiology, Tools and Techniques, 2nd Edition, Ane Books Pvt. Ltd.

Module 3 (15 hrs)

Centrifugation – Principle, instrumentation, methods and types of centrifugation, application biological science.

Core Readings

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

Kanika Sharma,Manual of Microbiology, Tools and Techniques, 2nd Edition, Ane Books Pvt. Ltd.

Module 4 (10 hrs)

Basic idea of biological safety cabinets, laminar air flow, incubator, colony counter, micrometer, autoclave, hot air oven.

Core Readings

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

Kanika Sharma,Manual of Microbiology, Tools and Techniques, 2nd Edition, Ane Books Pvt. Ltd.

Selected Further Readings

Beacker & Deamer The World of cell.
Benson,Microbiological application laboratory manual in general microbiology, 8th Edition, McGraw Hill Publication.
Harley Klein. Microbiology, 6th Edition by Prescott,
Kanika Sharma,Manual of Microbiology, Tools and Techniques, 2nd Edition, Ane Books Pvt. Ltd.
M.J. Pelczar,Microbiology, 5th Edition, E.C.S. Chan and N.R. Kreig, McGraw Hill Publications.
Rodney Boyer Modern experimental biochemistry, 3rd Edition, , Pearson education.
Upadhyay, Upadhyay, Nath, Biophysical Chemistry Principles & techniques, 4th revised Edition 2007, Himalaya Publishing House.

SEMESTER II

ZM2V03U COURSE III: GENERAL METHODOLOGY

36 Hrs
Credits 2

Module 1 (10 hrs)

Chromatography techniques: Paper chromatography, thin layer chromatography, column chromatography, gas chromatography, affinity chromatography, gel filtration.

Core Readings

Jayaram Paniker & Ananthanarayan, Microbiology,.
Kanika Sharma Manual of Microbiology, Tools & Techniques

Module 2 (10 hrs)

Electrophoresis: Principle & applications. Types of Electrophoresis: 1. Free electrophoresis – moving boundary electrophoresis. 2. Zone electrophoresis – paper or gel. Immuno electrophoresis, isoelectric focusing.

Core Readings

Jayaram Paniker & Ananthanarayan, Microbiology,.
Kanika Sharma Manual of Microbiology, Tools & Techniques

Module 3 (10 hrs)

Fermentation techniques: Factors involved in Fermenter design, differences between biochemical reactions, rate process, operational consideration, local conditions within a Fermenter. Fermenter configurations, the batch Fermenter, continuous stirred tank Fermenter, the tubular Fermenter, the fluidized bed Fermenter, solid state Fermenter.

Core Readings

Jayaram Paniker & Ananthanarayan, Microbiology,.
Kanika Sharma Manual of Microbiology, Tools & Techniques

Module 4 (6 hrs)

Introduction to tracer techniques: Fluorescent tracer, Isotope, ELISA.

Core Readings

Jayaram Paniker & Ananthanarayan, Microbiology,.
Kanika Sharma Manual of Microbiology, Tools & Techniques

Selected Further Readings

A.H. Patel.Industrial Microbiology
Jayaram Paniker & Ananthanarayan, Microbiology,.
Kanika Sharma Manual of Microbiology, Tools & Techniques
Kllittaker.Fermentation technology
Swaroop Pathalc & Arora Laboratory in Biology
Welson & Goulding Tools & Techniques in Biology

SEMESTER II

ZM2V04U COURSE IV ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

36 hrs
Credits 2

MODULE 1 10Hrs

Microorganisms in soil. Factors influencing soil micro flora, biological interrelationship of microorganisms: mutualism, synergism (protocooperation) commensalisms, Amensalism, Parasitism, Predation. Interaction of microbes with plants (mycorrhizae : Ectomycorrhizae and vesicular Arbuscular mycorrhizae).

Core Readings

Pekzar E.C.S.Chan and Noel .R.Krieg Microbiology, Fifth edition, Michael.; Tata Mc Graw-Hill publishing company Ltd.
R.C.Dubey and D.K.Maheshwari, A Text book of microbiology, First Edition, S. Chand & company Ltd.

MODULE 2 10 Hrs

Bacteriological examination of drinking water. Purification and disinfection of water. Sewage (waste water)treatment: Sewage microorganism, BOD and COD, primary treatment, secondary treatment(Oxidation Pond Trickling Filter, the Activated sludge, Anaerobic digesters),Tertiary treatment.

Core Readings

Pekzar E.C.S.Chan and Noel .R.Krieg Microbiology, Fifth edition, Michael.; Tata Mc Graw-Hill publishing company Ltd.

R.C.Dubey and D.K.Maheshwari, A Text book of microbiology, First Edition, S. Chand & company Ltd.

MODULE 3 **6 Hrs**

Role of microorganisms in Agriculture: Rhizosphere concept, Biofertilizer (Bacterial, Algae, Mycorrhizae), Biopesticides (Bacterial, viral, fungal). Common bacterial, fungal and viral plant diseases.

Core Readings

Pekzar E.C.S.Chan and Noel .R.Krieg Microbiology, Fifth edition, Michael.; Tata Mc Graw-Hill publishing company Ltd.
R.C.Dubey and D.K.Maheshwari, A Text book of microbiology, First Edition, S. Chand & company Ltd.

MODULE 4 **10 Hrs**

Role of microorganisms in biogeochemical cycles. Carbon and Nitrogen cycle, Biological Nitrogen Fixation. Biodegradation :Definition , Brief account on biodegradation of natural organic compound, plastics, pesticides and petroleum pollutants.

Core Readings

Pekzar E.C.S.Chan and Noel .R.Krieg Microbiology, Fifth edition, Michael.; Tata Mc Graw-Hill publishing company Ltd.
R.C.Dubey and D.K.Maheshwari, A Text book of microbiology, First Edition, S. Chand & company Ltd.

Selected Further Readings

Pekzar E.C.S.Chan and Noel .R.Krieg Microbiology, Fifth edition, Michael.; Tata Mc Graw-Hill publishing company Ltd.
Philip.L.Carpenter, Microbiology, Second Edition, W.B.Saunders company.
R.C.Dubey and D.K.Maheshwari, A Text book of microbiology, First Edition, S. Chand & company Ltd.
R.P Singh,Microbiology, First edition 2005 by Kalayani publishers.

SEMESTER III

ZM3V05U COURSE V PARASITOLOGY

36 Hrs
Credits 2

MODULE I **6 Hrs**

An elementary study of the types of animal association, parasitisim, commensalisms and symbiosis. Type of parasites, classification of protozoan and helminthes.

Core Readings

Text book of medical parasitology,fifth edition C.K.Jayaram Panicker,Jaypee brothers medical publishers.
Medical parasitology,Third Edition,R.L.Ichupujani and Rajesh Bhatia,Jaypee Brothers medical publishers

MODULE II **10 Hrs**

An elementary knowledge of the structure, life history of the parasites belonging to the following genera with references to the forms seen in human pathological material and methods used to identify them. Protozoa: Entamoeba, Trichomonas, Chilomastix, Enteromonas, Trypanosoma, Leishmania, Giardia, Plasmodium, Isospora, Eimeria and Balantidium, Toxoplasma.

Core Readings

Text book of medical parasitology,fifth edition C.K.Jayaram Panicker,Jaypee brothers medical publishers.
Medical parasitology,Third Edition,R.L.Ichupujani and Rajesh Bhatia,Jaypee Brothers medical publishers.

MODULE III **10 Hrs**

Morphology, life cycle, laboratory diagnosis of helminthes:(a) Platyhelminthes: Diphyllobothrium, sparganum, Taenia, Echinococcus Hymnnolep**s, Schistosoma, Fasciola, Fasciolosis, colonorchis, paragonimus (b) Nemathelminthes: Ascaris, Ancylostoma, Necator, Strongyloides, Trichinella, Enterobius, Trichurias, Wuchereria, Brugia, Dracunculus

Core Readings

Text book of medical parasitology,fifth edition C.K.Jayaram Panicker,Jaypee brothers medical publishers.
Medical parasitology,Third Edition,R.L.Ichupujani and Rajesh Bhatia,Jaypee Brothers medical publishers.

MODULE IV **10 Hrs**

Collection and preservation of specimens for parasitological examination, transport of specimens, detection of intestinal parasites; Detection and identification of amoeba and other intestinal protozoa and other parasites. Examination of blood parasites thick and thin smears for malarial, filarial and other parasites

Core Readings

Text book of medical parasitology,fifth edition C.K.Jayaram Panicker,Jaypee brothers medical publishers.
Medical parasitology,Third Edition,R.L.Ichupujani and Rajesh Bhatia,Jaypee Brothers medical publishers.

Selected Further Readings

An introduction to parasitology by A.C.Chandler.
Animal parasites in man by Geoffrey lanage.
Clinical parasitology by E.C.Faust and P.F ,Russel(sections I,II&V)
Human protozoalogy and Helminthology by IRC Macfarlene
Medical parasitology by N.C.Dey
Medical Helminthology by J.K.Watson
Medical parasitology,Third Edition,R.L.Ichupujani and Rajesh Bhatia,Jaypee Brothers medical publishers.
Outline of medical parasitology by John Larsh
Text book of medical parasitology,fifth edition C.K.Jayaram Panicker,Jaypee brothers medical publishers.
Text book of medical parasitology by C.H.Parija.

SEMESTER III

ZM3V06U COURSE VI MEDICAL ENTOMOLOGY AND MYCOLOGY

36 Hrs

Credits2

MODULE I 6 Hrs

Classification of arthropods of public health importance, role of Arthropods in the transmission of disease, insecticides used for the control of arthropods of public health importance.

Core Readings

Medical Entomology including Epidemiology of Vectroer - borend diseases by Dr. A.P. Pandya

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

MODULE II 10 Hrs

Mosquito: Morphology and Bionomics of Anopheles , culex, Ades and mansonia. mosquito control: various methods mosquito borne diseases and their control. Phelebotomus (Sand fly): morphology, life history and control Housefly : morphology, life cycle, disease transmitted and control.

Xenopsylla cheopis, morphology, life cycle and disease transmitted

Louse: morphology, life cycle, disease transmitted and control. Bed bug: Life cycle and control. Ticks: Morphology, Life cycle, public health importance and control Cyclops and public health importance.

Core Readings

Medical Entomology including Epidemiology of Vectroer - borend diseases by Dr. A.P. Pandya

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

MODULE III 5 Hrs

Classification of fungi; collection of specimens, Examinations of fungus culture technique, mounting fluids and stains media used in medical mycology Routine mycological techniques, general consideration, maintenance of fungus culture.

Core Readings

Medical Entomology including Epidemiology of Vectroer - borend diseases by Dr. A.P. Pandya

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

MODULE IV 10 hrs

Superficial mycoses: General characters, disease and etiological agents of *Tinea versicolar, Black piedra, White piedra*, *Tinea nigra* subcutaneous: General characters, disease and etiological agents of Sporotrichosis, Chromoblastomycosis, Maduromycosis, Systemic mycoses.

Core Readings

Medical Entomology including Epidemiology of Vectroer - borend diseases by Dr. A.P. Pandya

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

MODULE V 5hrs

Opportunistic fungal infections due to Aspergillus and mucor. Mycotoxins, Aflatoxicosis.

Core Readings

Medical Entomology including Epidemiology of Vectroer - borend diseases by Dr. A.P. Pandya

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

Selected Further Readings

A guide to Medical Entomology by W.W. Service

Laboratory Technique for the Study of Malaria by Percy Shate and Maljorke Maryson

Medical Entomology including Epidemiology of Vectroer - borend diseases by Dr. A.P. Pandya

Morphology and Taxonomy of Fungi by Bassey B.A.

Manual of Clinical Mycology by Conant N. F., Smith D.T. and Baker R

Medical Mycology by Rippon

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

SEMESTER IV

ZM4V07U COURSE VII MEDICAL BACTERIOLOGY AND VIROLOGY

36 hrs
Credits 2

Module I **12 hrs**

A systematic study of *Staphylococcus aureus*, Streptococci (*Str. pyogenes* and *Str. pneumonia*) Neisseriae (*N. meningitides* and *N. gonorrhoeae*) , *Corynebacterium diphtheriae*, *Bacillus anthracis*, *Escherichia coli, Klebsiella pneumoniae, Shigella, Bordatella Pertussis, Pseudomonas aeruginosa, Vibrio cholerae,*

Core Readings

Gabriel Virella, B.I. Microbiology and Infectious diseases, 3rd ed. Waery Publications
Ananthanarayan R. and C.K.J. Paniker. Text book of Microbiology, Sixth edition

Module 2 **12 hrs**

Diseases caused by different pathogens; epidemiology, symptamology, diagnosis and treatment of Tuberculosis, Syphylis Actinomycosis, Rickettsial diseases, chlamydial infections , Mycoplasmal diseases.

Core Readings

Gabriel Virella, B.I. Microbiology and Infectious diseases, 3rd ed. Waery Publications
Ananthanarayan R. and C.K.J. Paniker. Text book of Microbiology, Sixth edition

Module 3 **12 hrs**

Viral diseases: Herpes virus, Orthomyxovirus (influenza) , Paramyxoviruses, (mumps, measles) Rubella, Hepatitis, Rhabdo viruses, AIDS Viruses , Polio, Arboviruses, Oncogenic viruses

Core Readings

Gabriel Virella, B.I. Microbiology and Infectious diseases, 3rd ed. Waery Publications
Ananthanarayan R. and C.K.J. Paniker. Text book of Microbiology, Sixth edition

Selected Further Readings

Ananthanarayan R. and C.K.J. Paniker. Text book of Microbiology, Sixth edition ,
Cruikshank R., Medical Microbiology
David Greenwood Richard C.B. Slack and John F. Pentherer, Medical Microbiology, A Guide to Microbial infections. Pathogenesis, immunity laboratory diagnosis and control. 16th edition, Chuchill Lingstone Publications
Gabriel Virella, B.I. Microbiology and Infectious diseases, 3rd ed. Waery Publications
Monica Cheesbrough, Medical Laboratory Manual for Tropical Countiesd , Vol. I & II Microbiology

SEMESTER IV

ZM4V08U COURSE VIII CLINICAL MICROBIOLOGY

36 hrs
Credits 2

Module 1 **9 hrs**

Microbiology laboratory safety, General concepts for specimen collection and handling, General procedures in the laboratory, diagnosis of infectious diseases, Antimicrobial chemotherapy.

Core Readings

Ananthanaryanan R. and C.K.J. Paniker Text book of Microbiology , Sixth edition, , Orient Longman Publishers.
Chakraborthy P., A textbook of Microbiology, 1st edition, , New Central Book Agency (P) Ltd.

Module 2 **10 hrs**

Respiratory tract infections: infections of the upper and lower respiratory tract

Core Readings

Ananthanaryanan R. and C.K.J. Paniker Text book of Microbiology , Sixth edition, , Orient Longman Publishers.
Chakraborthy P., A textbook of Microbiology, 1st edition, , New Central Book Agency (P) Ltd.

Module 3 **5 hrs**

Aetiology, Pathogenesis, clinical features, lab diagnosis and treatment of gastrointestinal tract infections.

Core Readings

Ananthanaryanan R. and C.K.J. Paniker Text book of Microbiology , Sixth edition, , Orient Longman Publishers.
Chakraborthy P., A textbook of Microbiology, 1st edition, , New Central Book Agency (P) Ltd.

Module 4 **7 hrs**

Infections of the genitourinary system. Sexually transmitted diseases : Aetiology ,Pathogenesis, clinical features, lab diagnosis and treatment.

Core Readings

Ananthanaryanan R. and C.K.J. Paniker Text book of Microbiology , Sixth edition, , Orient Longman Publishers.

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

Module 5 **5 hrs**

Infections of the nerve system. Aetiology, Pathogenesis And clinical features. Systemic infections-(A brief account). Infections of the body surfaces

Core Readings

Ananthanaryanan R. and C.K.J. Paniker Text book of Microbiology , Sixth edition, , Orient Longman Publishers.

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

Selected Further Readings

Ananthanaryanan R. and C.K.J. Paniker Text book of Microbiology , Sixth edition, , Orient Longman Publishers.

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

Gabriel Virella, B.I. Microbiology and Infectious diseases , 3rd edition , Waverly Publications

Shanson. D.C. Microbiology in Clinical Practice, 3rd ed.

SEMESTER I

ZM1V01U(P) PRACTICAL I GENERAL MICROBIOLOGY & BIOINSTRUMENTATION

36 hrs
Credit 1

1. Cleaning and sterilization of glassware, Autoclave, hot air oven, incubator and Laminar air flow bench.

2 Preparation of Solid and liquid media for microbial cultures.

d. Liquid media (1) peptone water/Glucose broth (2) Nutrient broth

e. Solid media (1) Nutrient agar (2) Mac Conkey's agar (3) Blood agar

(4) Chocolate agar

f. Semi Solid agar (d) Firm agar (e) Biphasic media

3. Culture methods (a) streak culture (b) Lawn culture (c) Stab culture

(d) pour plate culture (e) Liquid culture.

4Demonstration of selective and differential media

5 Isolation of pure colonies (a) streak plate method (b) pour plate method

(c) subculturing (picking off) technique (d) Broth cultures.

6 Calibration of an ocular micrometer for different objectives of a microscope.

Measurement of microorganisms by the use of an ocular micrometer.

7 Bacterial Staining Method (a)Simple Staining (b)Gram's staining

(c) Acid-fast staining (d) capsule staining (e) flagella staining (f) spore staining (g) Negative staining Indian ink preparation.

8 Examination of microbes in Living condition

(a) wet mount (b) Hanging drop method for demonstrating motility of bacteria

9 Instrumentation and working principle

(a) pH meter (b) colorimeter (c) Laminar air flow Bench (d) Autoclave

(e) Hot air oven (f) Colony counter.

SEMESTER II

ZM2V04U(P) - PRACTICAL II GENERAL METHODOLOGY ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

36 hrs
Credit 1

1. Introduction to chromatographic techniques.

2. Paper chromatographic separation of aminoacids.
3. pH measurement of culture media.
4. Measurement of bacterial growth by optical density method.
5. Biofermentor, its parts and function.

6 Isolation and enumeration of bacteria from soil.

Isolation and enumeration of fungi from soil.

a. Enumeration of micro organisms in air by open plate method.

8 Standard plate count count technique for the isolation and enumeration of microorganisms in water.

a. Basic idea about (a) Trickling filter (b) membrance filter system

(c)Anaerobic sludge digester

SEMESTER III

ZM3V05U(P) PARASITOLOGY **54 hrs**

Credit 2

1. Introduction to parasitology - Collection and processing of clinical specimens for parasites.
2. Examination of faeces for parasites.
3. Examination of blood for parasites.

a) Preparation of thick smear

b) Preparation of thin smear

4. Identification of Protozoan and Helminthic parasites

SEMESTER III

ZM3V06U(P) PRACTICAL-IV MEDICAL ENTOMOLOGY AND MYCOLOGY

54 hrs
Credit 2

1. Identification of Vectors of clinical importance
   a. Mosquito
   b. Fleas
   c. Ticks and Mites
   d. Louse
   e. Bed bug
2. Introduction and general principles for the lab diagnosis of fungal infections. Collection of samples
3. Slide culture method for cultivation of fungus
4. Study of morphology of fungi

   Fungal staining, lactophenol cotton blue mounting
5. Identification of fungal pathogens

   a) Aspergillus b) Penecillium c0 Rhizopus d)Mucor

SEMESTER IV

ZM4V07U(P) PRACTICAL-V MEDICAL BACTERIOLOGY AND VIROLOGY

54 hrs
Credit 2

1. Biochemical tests for the identification o f microbes
   a. Fermentation of carbohydrates
   b. IMViC test
   c. Urease test
   d. Catalase test
   e. Oxidase test

2. Antibiotic sensitivity test
3. Carbohydrate utilization test for the identification of *E. coli* Salmonalla , Shiegella and Proteus (Triple sugar iron test)
4. Test for hemolytic property of bacteria
5. Method of cultivation of virus

SEMESTER IV

ZM4V08U(P) PRACTICAL-VI CLINICAL MICROBIOLOGY

54 hrs
Credit 2

1. Microbiology of laboratory safety, General concept for specimen collection, handling . General procedures in the laboratory diagnosis of infectious diseases.
2. VDRL
3. Widal
4. Enumeration of bacteria from urine by Pour Plate method.

Selected Further Reference

A.H.Patel Industrial Microbiology , Macmillan India.
A.H.Patel.Industrial Biotechnology
Ananthanarayan & Jayaram Panicker Text book of Microbiology.
H.A.Moddy Environment Microbiology
J.R.Norriz, D.J Road, A.K.Varma Methods in Microbiology Vol.XXIV by
K. R.Aneja Experiments in Microbiology, Plant pathology and Biotechnology by. New age international publishers.
Monica Cheesbrough, Medical Laboratory manual for Tropical Countries Microbiology Vol.I & II ELEBS.
R.C Dubey & D.K.Maheshwari A text book of microbiology, S.Chand & Company Ltd.
R.C.Dubey, D.K.Maheshwari, Practical microbiology, S.Chand & Company Ltd.
R.Cruickshank et al.Medical Microbiology
Swaroop, Pathak and Arora Laboratory Techniques in Biology
Welson and Goulding Tools and Techniques in Biology

MAHATMA GANDHI UNIVERSITY
PRIYADARSHINI HILLS
KOTTAYAM 686 560

CURRICULUM AND SYLLABI

FOR

B.Sc INDUSTRIAL MICROBIOLOGY AND ZOOLOGY

DOUBLE CORE

[VOCATIONAL EDUCATIONAL PROGRAMME]

COURSE, CREDIT AND

SEMESTER SYSTEM AND GRADING

2009 ONWARDS

THE BOARD OF STUDIES ZOOLOGY PROGRAMME

PROGRAMME OBJECTIVES

The programme is designed to help the students to: -

- Impart basic knowledge of Industrial Microbiology, Zoology and related subjects meant both for a graduate terminal course and for higher studies.
- Acquire basic knowledge and skills for employment in the field of Microbiology especially Industrial Microbiology.
- Inculcate interest and love of nature with its myriad living creatures.
- Understand the unity of life with the rich diversity of microbes and other organisms.

- Acquire basic skills for the utilization of microbes for human welfare.
- Impart awareness of the conservation of the biosphere.

CODES

B	Core
C	Complementary
EDP	Entrepreneur Development Programme
IA	Internal Assessment
ZY	Zoology Core
IMZ	Industrial Microbiology and Zoology Programme
IT	Instructional Time
OJT	On the Job Training
P	Practical
S	Semester
T	Theory
U	Under graduate
UE	University Examination
VE	Vocational Education

ZY1B01U- Zoology Semester I Core Course I Undergraduate

IMZ1B01U- Industrial Microbiology(Zoology) Semester I Core Course I Undergraduate.

ZY6B11(a)U-Zoology Semester 6 Core Course 11(a) [Immunology] Undergraduate

	Courses	**Credits**	**Total Credit**
1	Common Course English	4+4	8
2	Complementary I Biochemistry	3+3+4+4	14
3	Complementary II Computer Science	3+7+3+6	19
4	Open Course	4	4
5	Core Industrial Microbiology	7+3+10+7+4	29
6	Core Zoology	3+3+4+4+16+16	46
		Grand Total	120 Credits

RESTRUCTURED CURICULUM FOR BSc INDUSTRIAL MICROBIOLOGY AND ZOOLOGY PROGRAMME(DOUBLE CORE)
COURSE STRUCTURE AND SCHEME
Total Credits- 120
Total Instructional hours- 150

INSTRUCTIONAL TIME & CREDIT ALLOCATION
[COURSE WISE]
SEMESTER I

	Course Title	**No of hours/ Week**	**Number of Credits**	**Total Credits**	**Total Hrs/ Sem**	**Univ. Exam Hrs**	**IA**	**EA**
	ENCN1 Common Course Communication skills in English [Board of studies English]	**5**	**4**	**4**	**90**	**3**	**1**	**3**
	Core I Industrial Microbiology Course I IMZ1 B 01 U	**3**	**3**	**4**	**54**	**3**	**1**	**3**

	Fundamentals of Microbiology **Practical**	**2**	**1**		**36**			
	Core I Industrial Microbiology Course II IMZ 1 B 02 U Biostatistics & Bioinstrumentation	**3**	**3**	**3**	**54**	**3**	**1**	**3**
	Core II Zoology CourseI ZY 1 B 01 U General Methodology & Perspectives in Science **Practical** (Zoology Board syllabus)	**2** **2**	**2** **1**	**3**	**36** **36**	**3**	**1**	**3**
	Complementary I Biochemistry CourseI Elementary Biochemistry I [Biochemistry Board syllabus] **Practical**	**2** **2**	**2** **1**	**3**	**36** **36**	**3**	**1**	**3**
	Complementary II Computer Science Course I Computer Fundamentals and Office Automatioon (Computer Science Board Syllabus) **Practical**	**2** **2**	**2** **1**	**3**	**36** **36**	**3**	**1**	**3**
	TOTAL	**25 Hrs**	**20 Credit**	**20 Credit**				

SEMESTER II

	Course Title	No of hours/ Week	Number of Credits	Total Credits	Total Hrs/ Sem	Univ. Exam Hrs	IA	EA
	Common Course in English II Critical Thinking, Academic writing & Presentation. [Board of studies English]	**5**	**4**	**4**	**90**	**3**	**1**	**3**
	Core I Industrial Microbiology CourseIII IMZ 2 B 03U Microbial physiology **Practical**	**4** **4**	**2** **1**	**3**	**72** **72**	**3**	**1**	**3**
	Core II Zoology CourseII ZY 2 B 02 U Biodiversity & Modern Systematics **Practical**	**2** **2**	**2** **1**	**3**	**36** **36**	**3**	**1**	**3**
	Complementary I Biochemistry CourseII Elementary Biochemistry II [Biochemistry Board syllabus] **Practical**	**2** **2**	**2** **1**	**3**	**36** **36**	**3**	**1**	**3**
	Complementary II Computer Science Course II Programming with C Language (Computer Science Board Syllabus) **Practical**	**2** **2**	**4** **3**	**7**	**36** **36**	**3**	**1**	**3**
	TOTAL	**25 Hrs**	**20 Credit**	**20 Credit**				

SEMESTER III

	Course Title	No of hours/ Week	Number of Credits	Total Credits	Total Hrs/ Sem	Univ. Exam Hrs	IA	EA
	Core I Industrial Microbiology Course IV IMZ 3 B 04 U Medical Microbiology and Virology	**2**	**2**	**2**	**36**	**3**	**1**	**3**
	Core I Industrial Microbiology							

	CourseV IMZ 3 B 05U Molecular Biology and Microbial Biotechnology	**2**	**2**	**3**	**36**	**3**	**1**	**3**
	Practical	**2**	**1**		**36**			
	Core I Industrial Microbiology CourseVI IMZ 3 B 06U Basics of Industrial Microbiology	**3**	**3**	**4**	**54**	**3**	**1**	**3**
	Practical	**2**	**1**		**36**			
	Core II Zoology CourseIII ZY 3 B 03 U Animal Diversity – Non chordata (Zoology Board syllabus)	**3**	**3**	**4**	**54**	**3**	**1**	**3**
	Practical	**2**	**1**		**36**			
	Complementary I Biochemistry CourseIII Enzymology & Metabolism-(1) [Biochemistry Board syllabus]	**3**	**3**	**4**	**54**	**3**	**1**	**3**
	Practical	**2**	**1**		**36**			
	Complementary II Computer Science Course III Web technology and Programming (Computer Science Board Syllabus)	**2**	**3**	**3**	**36**	**3**	**1**	**3**
	Practical	**2**	**0**		**36**			
	TOTAL	**25 Hrs**	**20 Credit**	**20 Credit**				

SEMESTER IV

L O	Course Title	No of hours/ Week	Number of Credits	Total Credits	Total Hrs/ Sem	Univ. Exam Hrs	IA	EA
	Core I Industrial Microbiology Course VII IMZ 4 B 07U Fermentation Technology	**3**	**2**	**3**	**54**	**3**	**1**	**3**
	Practical	**2**	**1**		**36**			
	Core I Industrial Microbiology Course VIII IMZ 4B 08U Agricultural Microbiology & Biofertilizers	**3**	**2**	**3**	**54**	**3**	**1**	**3**
	Practical	**2**	**1**		**36**			
	Project Core I Enterprenurship Development Programme and OJT 1 week	**1**	**Credit to be given in VI sem**		**18**			
	Core II Zoology CourseIV ZY 4 B 04 U Animal Diversity- Chordata Practical	**3**	**3**	**4**	**54**	**3**	**1**	**3**
		2	**1**		**36**	**2**		
	Complementary I Biochemistry CourseIV Biochemistry Metabolism (2) [Biochemistry Board syllabus]	**3**	**3**	**4**	**54**	**3**	**1**	**3**
	Practical	**2**	**1**		**36**			
	Complementary II Computer Science Course IV Visual Programming Techniques	**2**	**3**	**6**	**36**	**3**	**1**	**3**
	Software lab IV Practical	**2**	**3**		**36**			
	TOTAL	**25 Hrs**	**20 Credit**	**20 Credit**				

SEMESTER V

L O	Course Title	No of hours/	Number of Credits	Total Credits	Total Hrs/	Univ. Exam	IA	EA

		Week			**Sem**	**Hrs**		
	Open course ZY5D04U Food Microbiology/ Any open course offerd by the Institution	**4**	**4**	**4**	**72**	**3**	**1**	**3**
	Core II Zoology Project work and group activity (Credit I in 6th Semester	**1**			**18**			
	Core II Zoology CourseV ZY 5 B 05 U Cell Biology & Molecular Biology **Practical**	**3** **2**	**3** **1**	**4**	**54** **36**	**3**	**1**	**3**
	Core II Zoology CourseVI ZY 5 B 06 U Environmental Biology, Toxicology & Disaster Management **Practical**	**3** **2**	**3** **1**	**4**	**54** **36**	**3**	**1**	**3**
	Core II Zoology CourseVII ZY 5 B 07 U Evolution, Zoo geography & Ethology **Practical**	**3** **2**	**3** **1**	**4**	**54** **36**	**3**	**1**	**3**
	Core II Zoology CourseVIII ZY 5 B 08 U Biochemistry, Human physiology &Endocrinology **Practical**	**3** **2**	**3** **1**	**4**	**54** **36**	**3**	**1**	**3**
	TOTAL	**25 Hrs**	**20 Credit**	**20 Credit**				

SEMESTER VI

L O	Course Title	No of hours/ Week	Number of Credits	Total Credits	Total Hrs/ Sem	Univ. Exam Hrs	IA	EA
	Core I Industrial Microbiology Course IX IMZ 6 B 09 U Microbial Waste Management **Practical**	**2** **2**	**2** **1**	**3**	**36** **36**	**3**	**1**	**3**
	Core I project Enterprenurship Developmetn programme & OJT 1 week	**1**	**1**	**1**	**18**		**1**	**3**
	Core II Zoology CourseIX ZY 6 B 09 U Reproductive & Developmental Biology **Practical**	**3** **2**	**3** **1**	**4**	**54** **36**	**3**	**1**	**3**
	Core II Zoology CourseX ZY 6 B10U Genetics &Biotechnology **Practical**	**3** **2**	**3** **1**	**4**	**36** **36**	**3**	**1**	**3**
	Core II Zoology CourseXI(a) ZY 6 B 11(a) U Immunology (Zoology Core syllabus modified**)** **Practical**	**2** **2**	**2** **1**	**3**	**36** **36**	**3**	**1**	**3**
	Core II Zoology Course 12 ZY6B12 U General Informatics, Bioinformatics and Biostatistics **Practical**	**3** **2**	**3** **1**	**4**	**54** **36**	**3**	**1**	**3**
	Core II Zoology Project work and field visit Group activity	**1**	**1**	**1**	**18**		**1**	**3**

	TOTAL	**25 Hrs**	**20 Credit**	**20 Credit**				

TOTAL CREDITS – 120 **150 Hrs**

	Common Course	Complementary		Core I	Core II	
SEME-STER	**ENGLISH**	**BIO-CHEMISTRY**	**COMPU-TER SCIENCE**	**INDUS-TRIAL MICRO-BIOLOGY**	**ZOOLOGY**	**OPEN COURSE**
I	**4**	**3**	**3**	**7**	**3**	
II	**4**	**3**	**7**	**3**	**3**	
III		**4**	**3**	**9**	**4**	
IV		**4**	**6**	**6**	**4**	
V					**16**	**4**
VI				**4**	**16**	
TOTAL	**8**	**14**	**19**	**29**	**46**	**4**

RECORDS CORE I– INDUSTRIAL MICROBIOLOGY

1. Fundamentals of Microbiology
2. Microbial Physiology
3. Molecular Biology, Microbial Bio technology
4. Basics of Industrial Microbiology
5. Fermentation Technology
6. Agricultural Microbiology & Bio fertilizers
7. Microbial Waste Management
8. Project Record- Entrepreneurship Development Programme
9. Report of the OJT assignments

RECORDS – CORE II ZOOLOGY

1. General Methodology and Instrumentation
2. Biodiversity and Modern Systematics
3. Animal Diversity - Non-Chordata
4. Animal Diversity - Chordata
5. Cell Biology and Molecular Biology
6. Environmental Biology, Toxicology and Disaster Management
7. Evolution, Zoogeography and Ethology
8. Biochemistry, Human Physiology and Endocrinology
9. Reproductive and Developmental Biology
10. Genetics and Biotechnology
11. Immunology
12. General Informatics, Bioinformatics and Compute r Applications
13. Project Report & Group Activity report

MODE OF TRANSACTION

An optimum combination of classroom lectures, demonstrations, practical work, assignments, seminars, classroom test, entrepreneurship development programme, On – the – Job training programme will be used for the transaction of the curriculum.

ON THE JOB TRAINING PROGRAMME [OJT] AND PROJECT OF CORE I [CREDIT 1]

The On-The-Job Training programme is intended to bring the curriculum to the reality of the world of work.

This programme enables the students to apply their classroom knowledge to live situations under the joint supervision of the tutor and a mentor.

The OJT has two components namely OJT-1 and OJT-2, each of one week duration, implemented during the semester IV and Semestrer VI

At the end of the each OJT programme students are expected to produce a detailed report of the OJT assignments, which must necessarily be those of direct interest to the host organization. (Internal Evaluation only)

ENTREPRENEURSHIP DEVELOPMENT PROGRAMME [EDP]

(Total 36 Hrs IV Sem 18 Hrs And VI Sem 18 Hrs)

This programme will help the students to develop entrepreneurial capabilities with the local/regional, production/service establishments in industrial Microbiology. The programme will expose the students to design and develop an industry/organization related to industrial microbiology for a small-scale production/service sector.

Project and OJT Credit 1

IA OJT	EA Project
Weight	Weight
(4+4) = 8	25

Project report have to be submitted in VIth semester
External assessment , Project report and Viva Voce – Weight 25

Project Report:

Scope and relevance:	weight 1
Methodology:	weight 4
Data analysis:	weight 4
Economic viability:	weight 4
Language, Literature & Bibliography:	weight 4
Presentation of the project report:	weight 4
Viva-voce:	weight 4
Total	weight 25

EVALUATION OF OJT

A system of continuous evaluation will be followed during the OJT programme.

As the educational process in the OJT programme seeks out and the Mentor at the training organisation/institute and the tutor will jointly assess focuses attention on many latent attributes, which do not surface in the normal classroom situation the OJT programme of the student.

Mentor Assessment of OJT

The mentor at the training organization will assess the performance of the student for 50% of the total weight and according to the following scheme.

Attendance and punctuality & Observation of TO's etiquette	Weight 1
Technical competence:	Weight 1
Responsibility/dependability:	Weight 1
Group-interpersonal skills:	Weight 1

	Total Weight 4

Tutor Assessment of OJT

The tutor will assess the performance of the candidate for the rest 50% of the total weight on the basis of the consolidated OJT assignment report signed by the student's mentor and according to the following scheme.

Methodology &Content	Weight 1
Presentation style:	Weight 1
Technical exposure:	Weight 1
Language of the report	Weight 1

	Total Weight 4

Examinations:

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

Internal or In-Semester Assessment (IA):

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

Theory

Component	Weight
Attendance*	1
Assignment	1

Seminar	1
Best two test papers	2

***Attendance**

% of Attendance	Grade
>90%	A
Between 85 and 90	B
Between 80 and 85	C
Between 75 and 80	D
< 75	E

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

Internal Assessment of Practical

Component	Weight
Attendance *	1
Laboratory Involvement **	2
Test	2
Record	2
Viva-Voce/Quiz	1
Total	8

Attendance *	Laboratory Involvement **
Attendance >90%= A	Punctuality +
89% to 85% = B	Handling Equipments +
84% to 80% = C	Skill in Laboratory work +
79% to 75% = D	Group Interaction = A
< 75 =E	

The evaluation of all components is to be published and is to be acknowledged by the candidate.

External or End-Semester Assessment (EA):

The external examination of all semesters shall be conducted by the university on the close of each semester except for EDP (Course XI-Ind.Microbiology). There will be no supplementary exams. For reappearance/ improvement as per university rules, students can appear along with the next batch.

Pattern of Questions (Theory):

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

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

For all semesters:

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

SCHEME OF PRACTICAL ON CORE COURSES

(External exam)

External Weight : **25**

	Record	**4**
Part-A	Major practical	a) **4**+ b) **4** = **8**
Part-B	Minor practical	a) **2**+ b) **1** = **3**

Part-C	Spotters/problem a) 5 items of **2** weightage each 5✕2 = **10**	
	Total	**2**

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

Weightage

	Weight (Internal)	Weight (External)
Field Study report	**4**	
Group Activity	**2**	
Project	**2** Log book showing the progress of project work duly signed by the supervising teacher & HOD	Project report Title-**1** Abstract-**2** Introduction + Literature review-**2**
		Methodology-**4**
		Results-**4**
		Discussion & Conclusion-**4**
		Neat presentation and Novelty-**4** (Student can present the project using OHP or LCD, in 7 Minutes)
		Viva Voce-**4**
Total	**8**	**25**

Double Core ✕ Industrial Microbiology and Zoology

- Double Core programme is exempted from Core choice Board Courses (Electives) thast is designed for Model I and Model II (VIth Semester) However they have open courses in Vth Semester as other Model I and Model II progammes.
- Syllabus for Core II Zoology follows the same pattern of Instructional Hrs, University exams credits, Practicals , IA and EA as in Model I Zoology Programme.
- Course I to XII (1-12) are the same as that of Zoology Core Model I except Course XI (11)
- Course XI is ZY6B11 (a) U Immunology as given in scheme.
- The Syllabus of ZY6B11 (a) U Theory and ZYB 11 (a) U(P) Practical is gvien below

SYLLABUS FOR
B.Sc ZOOLOGY CORE

(Course I to course XII are the same as that of Zoology Core Model I except Course XI. Course XI is given below)

Y 6 B 11(a)U - IMMUNOLOGY 36 hrs
Credit 2

odule 1 Introduction to immunology 5 hrs

	Types of immunity, innate immunity, acquired , passive , active Mechanism of innate immunity (eg. Barriers, Phagocytosis, inflammation. **Core Readings** Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 1 Ivan Roitt, 2002 *Essentials of Immunology ELBS*	
odule 2	Antigens and Antibodies Types of Antigens,Factors influencing antigenicity,Epitopes, haptens, antigenic determinants. Basic structure of immunoglobulins. Different classes of immunoglobulins and functions **Core Readings** Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 4 Ivan Roitt, 2002 *Essentials of Immunology ELBS*	8hrs
odule 3	Antigen-antibody reactions, Precipitation test, Agglutination Test, Clinical applications of antigen antibody reaction Complement system and its biological importance: Eg: Widal , VDRL , HIV test (ELISA) Complement fixation test, Coombs test. **Core Readings** Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Ivan Roitt, 2002 *Essentials of Immunology ELBS*	7 hrs
odule 4	Immune Response system Primary and secondary lymphoid organs. Cells of the immune system • Leucocytes, Lymphocytes T & B cells, Macrophages, Plasma cells, Memory cells, MHC Antibody synthesis, primary and secondary responses, Monoclonal antibodies • Hybridoma technology , uses, Polyclonal antibodies. Cytokines **Core Readings** Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 10. Ivan Roitt, 2002 *Essentials of Immunology ELBS*	8 hrs
odule 5	Immunopathology- immune disorders (Hypersensitivity, autoimmunity and immunodeficiency) Different types of hypersensitivity reactions - Mechanism of allergic reaction, Anaphylaxis and atopy, Mechanism of immune complex disease. (Eg. Arthus reaction, Serum sickness) Autoimmunity, Delayed hypersensitivity, Autoimmune diseases (A brief account) Transplantation Immunity - Graft rejection , major histocompatibility, Human leukocyte antigen system - (HLA) immuno -suppression, Graft versus host reaction • Tumour immunity-Immune responses in malignancy, Immunotherapy, Immunohaematology, Immunology of blood transfusion, Erythroblastosis foetalis. Immunodeficiency, AIDS **Core Readings** Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Ivan Roitt, 2002 *Essentials of Immunology ELBS*	5hrs
odule 6	Vaccines Brief history of vaccination, principles of vaccines, major types of vaccines (BCG, DPT, Polio vaccine and TAB vaccines) DNA vaccines, toxoides, adjuvants. Recent trends in vaccine preparation **Core Readings** Sobty & Sharma 2008 *Essentials of Modern Biology* Ane•s Student edition p .463-468. Panicker, S. Francis G., and Abraham G.K. 2008, Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 12.	3 hrs

Selected Further Readings

Anthanarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.
Colemen: 2002 Fundamentals of Immunology
Darla J. Wise & Gordon R. Carter: 2004:Immunology A Comprehensive Review Iowa state University Press. A Blackwell science company,
Hans G. Sch Legal General Microbiology Seventh Ed. Cambridge Low Price Ed.
Helen Hapel, Maused Harney Siraj Misbah and Next Snowden: 2006 Essentials of Clinical Immunology Fifth Ed. Blackwell Publishing Company,
Heritage, J ., E.G.V. Evaus & R.A.Killungten 2007: Introductory Microbiology Cambridge University Press
Ivan Roitt: 2002 Essentials of Immunology ELBS.
K. Park, Park•s Text Book of Preventive and Social Medicine • 2002, 17t Ed. Banarasidass Bhenot Publications
Kanika Sharema. Manual of Microbiology tools techniques 2nd Ed. Ane•s student Editions 2009

ZY 6 B 11(a)U (P) PRACTICAL IMMUNOLOGY

36 hrs
Credit 1

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1. Antibiotic sensitivity test.

2 Determination of ABO blood groups and Rh factor (Antigen ◆antibody Reaction)

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

4. ELISA

5. RIA

6. WIDAL Test

SYLLABUS FOR CORE I

INDUSTRIAL MICROBIOLOGY
SEMESTER I
IM Z 1 B 01 U - FUNDAMENTALS OF MICROBIOLOGY

54Hrs

Credit 3

Module 1. The historical development and scope of Microbiology - 5 hrs

Module 2. Diversity of Microbial world- Principle of Classification- Outline classification of Bacteria according to Bergy◆s manual(including Cyanobacteria), Fungi, Viruses, Actinomycetes and Mycoplasma . Two types of cellular organization ◆ Prokaryotic & Eukaryotic -7hrs

Module 3. Ultra structure of Microbes:

a) Morphology and fine structure of bacteria, size, shape and arrangements of Flagella, Pili, capsule, cell wall and its composition. Cytoplasmic membrane, protoplasts, spheroplasts, intracellular membrane systems, cytoplasm, vacuoles, nuclear material, spores and cysts, endospores, cell inclusions. Modes of cell division.

b) Viruses- General structure (Plant virus & Animal Virus) - properties-viral envelope-capsid ◆virions,prions◆ Nucleic acid ◆ Replication of Virus

c) Morphology and ultra structure of Cyanobacteria, Mycoplasma, Actinomycetes, and Fungi (*Rhizopus*, *Pencillium*, *Aspergillus*, *Mucor* and *Fusarium*) - 20 hrs

Module 4. Methods in Microbiology: Sterilization and disinfections ◆ Different methods of sterilization- physical and chemical methods- sterilization by moist and dry heat, by filtration, by irradiation. - 10 hrs

Module5 Preparation of culture media (aerobic and anaerobic cultivation) Selective media, erichment media and differential media plating techniques- Techniques and isolation of pure colonies. Culture preservation techniques (Refrigeration, Freezing and liquid nitrogen and lyophilization). Methods of staining ◆ simple stain, differential stain (Gram stain, acid fast stain), Structural stain (spore staining, flagellar staining, capsule staining). Measurement of microbial size and number. - 12 hrs

IM Z 1 B 01 U (P) PRACTICAL - FUNDAMENTALS OF MICROBIOLOGY

36 hrs
Credit 1

1. Preparation of Media-(Liquid media, Solid media, Semisolid media)
2. Cleaning and Sterilization of glassware
3. Maintenance of culture room
4. Isolation methods
   - Serial dilution
   - Spread Plate
   - Streak Plate , Pour Plate methods , Stab culture method , Lawn Culture.
5. Staining techniques
   - Simple staining
   - Differential staining ◆ Gram staining, Acid fast staining
   - Capsule staining, Flagella staining, Spore staining, Negative Staining-Indian ink Preperation
6. Lacto phenol cotton blue mounting of fungi
7. Haemocytometry

8. Motility of Bacteria
   - Hanging drop method ,Wet mount

Core Readings

1. Y K Parsher - Modern microbiology
2. Y K Parsher - Microbiology
3. S N Prasad - Applied microbiology
4. S. S Purohit - Microbiology, fundamentals and application 6th edition
5. Pelzar Reid and Chan - Microbiology ; McGraw Hill
6. Prescott - Microbiology
7. Daniel Lim - Microbiology
8. Jeffrey C Pommervil – Fundamentals microbiology
9. K R Aneja - Experiments in Microbiology
10. R C Dubey - Practical Microbiology.

SEMESTER I

IM Z 1 B 02 U - BIOSTATISTICS & INSTRUMENTATION

54Hour

Credit 3

Module 1 Biostatistics:Basic idea of Probability-Distribution patterns-Normal Binomial and poisson distribution –Sampling methods –Mean, Mode,and Median chi-square and Problems.

-10 hrs

NSTRUMENTATION

Module 2 Instruments – Basic principles & usage: -
Microscopy: Light microscopy, Dark field microscopy, Phase contrast microscopy, Fluorescence and Electron microscopy. Specimen preparation for light and electron microscopy.

– 10hrs

Module 3 Micrometers (Ocular and Stage) - Camera Lucida (Prism and Mirror type)
General Instruments: Refrigerator, Deep-freezer, Cryocan - pH meter- Colorimeter- Spectrophotometer (UV,Visible,& Infrared) – Hot air oven- Centrifuges –Types of Centrifugation. Autoclave - Incubators –
Chromatography (Paper, Thin layer and column, gas,affinity chromatography,gel filtration)-
Electrophoresis –types of electrophoresis,Free Electrophoresis, Zone Electrophoresis -paper and gel..
Filtration apparatus: Laminar air flow (filtration of air), Seitz filter (filtration of liquids), Sintered Glass Filter, Membrane filter.

-16 hrs Module 4 Activity

1) Paper chromatography for the identification of amino acids

2) Colorimetric estimation of Amino acids (Any Two)

18 hrs

SEMESTER II

IM Z 2 B 03 U COURSE III MICROBIAL PHYSIOLOGY
72 Hours
Credit-2

Module 1. Nutrition: Nutritional types, Nutritional requirements – C, N, P, S, and minerals – Phototrophs, chemotrophs, autotrophs, heterotrophs; Uptake of nutrients – passive diffusion, Active transport group translocation 8 hrs

Module 2. Growth: Factors affecting growth, bacterial growth curves; Continuous culturing of bacteria- chemostat generation time; Counting of bacteria- viable and non-viable counts, SPC, Direct microscopic count, turbidometric estimation 10 hrs

Module 3. Photosynthesis: Photosynthetic apparatus in prokaryotes- Photosynthetic microbes – oxygenic / non-oxygenic reaction centres- electron transport-photophosphorylation - Calvin cycle. 18 hrs

Module 4. Respiratory pathways: Breakdown of carbohydrates through glycolysis, Kerb–s cycle & its significance, fermentation, pentose phosphate pathway, oxidative and substrate level phosphorylation, gluconeogenesis 8 hrs

Module 5. Nitrogen metabolism: Nitrogen fixation in symbiotic and free living system, Photosynthetic and non-photosynthetic systems, oxygen regulation of nitrogen fixation, nitrification, denitrification and ammonifying bacteria, pathway of nitrate assimilation in photosynthetic and non-photosynthetic

systems, transamination and deamination reactions, Carbon cycle
. 18 hrs

Module 6. Introduction to Antibiotics:-Classification of Antibiotics Antibiotic Sensitivity test (Qualitative and Quantitative) Examples- Structure & mode of actio (Penicillin Chloramphenicol.)

10 hrs

IM Z 2 B 03U (P) PRACTICAL - MICROBIAL PHYSIOLOGY 54 hrs

Credit 1

1. Effect of pH on the growth of bacteria on solid media
2. Effect of salt on the growth of Microorganisms
3. Effect of antibiotics on bacterial growth by paper disc method
4. Biochemical Tests
   - Triple sugar iron agar test
   - IMVIC tests
   - Starch hydrolysis
   - Gelatine liquefaction
   - Catalase test
   - Urease test
5. Determination of growth phase of *E. coli* by measurement of O.D.

CORE READINGS

1. Moat and Foster - Microbial physiology
2. Pelzar Reid and Chan - Microbiology
3. Comprehensive Biotechnology - Vol I, II, III,IV
4. Prescott Microbiology
5. Ananthanarayan and Jayaram Panicker -Text book of Microbiology
6. Jaquelyin G Black - Microbiology
7. DR. N.Kannan - Laboratory manual of General Microbiology

SEMESTER III

IM Z 3 B 04 U MEDICAL MICROBIOLOGY AND VIROLOGY

36 Hrs

Credit-2

Module 1. Normal microbial flora of Human body, A systematic study of *Staphylococcus aureus*, Streptococci (*Str. pyogenes* and *Str. Pneumonia)* , *Bacillus anthracis*, *Escherichia coli, Klebsiella pneumoniae, Shigella, Pseudomonas aeruginosa, Vibrio cholerae.*
10hrs

Module2. Urinary tract infections, Genital tract infections,Sexually transmitted disease, and Nosocomial infections
5 hrs

Module 3. Diseases caused by different pathogens; epidemiology, symptamology, diagnosis and treatment of Tuberculosis, Syphylis, Actinomycosis.
6 hrs

Module 4. Respiratory tract infections: infections of the upper and lower respiratory tract
5 hrs

Module 5. Viral diseases: Herpes virus, Orthomyxovirus (influenza) , Paramyxoviruses, (mumps, measles) Rubella, Hepatitis, Rhabdo viruses, AIDS Viruses , Polio, Arboviruses, Oncogenic viruses
10hrs

Module 6. Activity 5 hrs

1. Test for hemolytic property of bacteria
2. Identification of Bacteria

CORE READINGS:

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

2. Cruikshank R. - Medical Microbiology
3. Monica Cheesbrough - Medical Laboratory Manual for Tropical Countiesd , Vol. I & II Microbiology
4. Topley and Wilson ♦Principles of Bacteriology,Virology and Immunity,Vol.3
5. Dalton and Nottebart (Eds) --Interpretative Medical Microbiology
6. Baron , Peterson and Finegold - Bailey and Scott♦s Diagnostic Microbiology.

SEMESTER III

IM Z 3 B 05U - MOLECULAR BIOLOGY & MICROBIAL BIOTECHNOLOGY

36Hours

Credit 2

Module 1. Function of macromolecules: Early observation on the mechanism of heredity, DNA as the genetic material, Exons and Introns, Transposons, IS elements, DNA replication, protein synthesis, and regulation of gene expression in microbes.-Overlapping genes, Silent genes

10 hrs

Module 2. Structural Organization of genomes in prokaryotes 3 hrs

Module 3. Mutation: Molecular mechanism of mutation, forward and reverse mutation, transition, transversion, and chemical induced mutations 5 Hrs

Module 4. Genetic recombination in bacteria: Transformation, transduction and conjugation. Use of transformation, transduction and conjugation in genetic mapping, preparation of genetic maps.

6 Hrs

Module 5. rDNA Technology ♦ Principles, techniques & Application: Restriction enzymes ♦ types, properties & use, Vectors: Plasmid, cosmids, bacteriophages, M13, Ti plasmid, pBR 322,SV 40. Steps in gene cloning ♦ cDNA library & genomic library; Integration of DNA insert into the vector ♦ Introduction of the vector into a suitable host- Selection analysis of recombinant clones ♦ DNA sequencing. Colony hybridisation, blotting techniques, Polymerase chain reaction, Finger printing Vaccines, Monoclonal antibodies, Recombinant proteins

6 Hrs

Module 6**.** Antibiotics ♦ Industrial production of β Lactam antibiotics (Penicillin and its relatives) Amino glycosides and tetracylines 6 hrs

IM Z 3 B 05U (P) PRACTICAL - MOLECULAR BIOLOGY & MICROBIAL BIOTECHNOLOGY
36 HRS

Credit 1

1. Isolation of Chromosomal DNA
2. Immobilization technique using *Yeast cells* by alginate beads
3. Study of Transformation, Transduction & Conjugation
4. Detection of blood groups
5. PCR demonstration
6. DNA finger printing steps illustrations

CORE READINGS

1. E. J. Gardner - Principles of genetics
2. Levin - Genes
3. Davis and Harper - General Microbiology
4. Old and Primrose - Biotechnology
5. Glick Molecular - Biotechnology
6. Ananthanaraynan and Jayaram Panicker - Text Book of Microbiology
7. Davis - Immunology
8. Roitt ELBS - Essential Immunology
9. Blair J.et al - Manual of Clinical Microbiology
10. Monica Cheesebrough ♦ Medical Laboratory Manual.

SEMESTER III

IM Z 3 B 06 U -BASICS OF INDUSTRIAL MICROBIOLOGY
54 Hours
Credit 3

Module1. General introduction: History and development of Industrial Microbiology - Scope of industrial microbiology • Discovery of microbial world • The experiments of Pasteur • The era of the discovery of Antibiotic - the discovery of anaerobic life • The physiological significance of fermentation. 12 Hrs

Module 2. Production Strains • screening techniques • strain development and preservation • serial subculture • preservation by over layers • culture with mineral oil • lyophylization or freeze drying • principles of storage of microbes at low temperatures or in liquid nitrogen.
Methods for the storage of fungi.
15 Hrs

Module 3. Structure of a typical fermentor: pH, temperature, aeration, agitation, and antifoams. Principle type of Fermenters: Batch fermenter • continuous stirred tank fermenter • fabular fermenter • fluidised bed fermenter • solid state fermenter.Submerged fermentor. Fermentation media, sterilization, inoculums preparation, recovery; Computer control of fermentation process.
20 hrs

Module 4 Fermentation process:Suface,Submerged and Continuous fermentation
7 hrs

IM Z 3 B 06 U (P) Practical - BASICS OF INDUSTRIAL MICROBIOLOGY
36 hrs
Credit 1

1. Study of alcoholic fermentation of fruit juice by yeast
2. Production of citric acid by *Aspergillus niger*
3. Estimation of citric acid

CORE READINGS

1. R. A. Atlas, McMillan - Microbiology, Fundamentals and Application
2. Pelzar, Reid and Chew - Microbiology
3. A H Patel - Industrial Microbiology, Macmillan India
4. Casida - Industrial Microbiology
5. Whittaker - Fermentation Technology
6. P F Stanbury - Principles of Fermentation Technology

SEMESTER IV

IM Z 4 B 07 U -FERMENTATION TECHNOLOGY
54Hours
Credit 2

Module1. Production of Various compounds
Pharmaceuticals: Antibiotics (Penicillin, Streptomycin),
Vitamins : Riboflavin, Cyanocobalamine
Steroids
Organic acids: Acetic acid, citric acid, lactic acid, and Gibberlic acid.
Amino acids: Lysine, glutamic acid
Enzymes: Protease, amylase, peptidase
Solvents: Ethanol, Glycerol
Fuel Methane - 30Hrs

Module 2. Microbial Recovery of Metals- Bioleaching of copper ,Gold & Uranium -9 hrs

Module 3. Microbially enhanced oil recovery(MEOR). - 15 Hrs

IM Z 4 B 07 U (P) PRACTICAL - FERMENTATION TECHNOLOGY 36 hrs
Credit 1

1. Cultivation of mushroom
2. Estimation of Lactic acid

CORE READINGS

1. Whittaker - Fermentation Technology
2. Casida - Industrial Microbiology
3. A.H. Patel - India Industrial Microbiology
4. Comprehensive Biotechnology Vol., I, II, III, IV.
5. Prescott - Industrial Microbiology
6. Purohit S.S. - Pharmaceutical Microbiology
7. P F Stanbury - Principles of Fermentation Technology.

SEMESTER IV

IM Z 4 B 08 U AGRICULTURAL MICROBIOLOGY & BIO FERTILIZERS

54 Hours

Credit 3

Module1. Soil Microorganisms: biological interrelationship of microorganisms: mutualism, synergism (protocooperation) commensalisms, Amensalism, Parasitism, Predation .Interaction between plants and microorganism – microorganisms of rhizosphere, rhizoplane, phylloplane and mycorhyza. 10 Hrs

Module 2. Microorganisms in Agriculture: Nitrogen fixation, symbiotic and non-symbiotic associations 10 Hrs

Module 3. Plant Pathogens: Study of microbes as plant pathogens.

- Downy mildew of grapes
- Tikka disease of groundnut
- Citrus canker
- Bacterial leaf blight of rice
- Mycoplasmal diseases – sandal spik
- Grassy shoot disease of sugar cane
- Viral disease – TMV 15 Hrs

Module 4. Bio fertilizers: Production and Quality control: *Rhizobium*, *Acetobacter*, *Cyanobacteria.* Interaction of microbes with plants (mycorrhizae : Ectomycorrhizae and vesicular Arbuscular mycorrhizae). Phosphate Solubilizing Bacillus 12 Hrs

Module 5. Bio pesticides: *B. thuringensis*, Nuclear Polyhedrosis Virus 7 Hrs

IM Z 4 B 08 U (P) PRACTICAL - AGRICULTURAL MICROBIOLOGY & BIO FERTILIZERS

36 hrs

Credit 1

1. Isolation and enumeration of micro organisms in soil
2. Study of Rhizobium from root nodules
3. Study of antagonism between soil micro organisms
4. Study of Rhizophane and Phylloplane micro organisms
5. Study of plant pathogens

EFERENCES

1. Martin - Soil Microbiology
2. Hill and Wrignt - Pesticide Microbiology
3. R.S. Malhotra - Plant Pathology
4. Carr and Whitton - Biology of Cyanobacteria
5. J.R. Norria D.J. Road, A.K. Verma - Methods in Microbiology, Vol. XXIV

SEMESTER V

OPEN COURSE

(Studetns can follow any open course offered by the institution)

ZY5D04U - FOOD MICROBIOLOGY

72 hrs

Credit 4

Module1. Food as a substrate for micro organisms, micro-organisms important in food microbiology- moulds, yeasts and bacteria; brief account of each group; general characteristics and importance; Principles of food preservation – asepsis – removal of micro organisms, anaerobic conditions – high and low temperatures – drying, chemical preservatives – food additives. 15Hrs

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

Module 3. Dairy Microbiology - Bacteriological examination of milk. Preservation of milk – pasteurization , different methods and advantages, sterilization, dehydration, Bacteriological standards and grading of milk, Fermented dairy products- Cheese ,Buttermilk, lassie, cheese, cream, condensed and dry milk products, yoghurt; , low lactose milk, Kefis and Kumiss 10 Hrs

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

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

MODULE 6 (Activity Oriented Study) **18 hrs**

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

5. Methylene blue Reductase test for milk

Report writing

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

Core Readings

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

SEMESTER VI

IM Z 6 B0 9 U MICROBIAL WASTE MANAGEMENT
54 Hours
Credit 3

Module 1. Solid waste disposal; sanitary landfills, composting; Role of microorganisms in composting – worm composting - biomethanation.

14 Hrs

Module 2. Treatment of liquid waste; Microbiology of municipal sewage; sewage treatment – primary secondary and tertiary treatments; disinfections; industrial effluents – paper mill, leather industries fertilizer industries and Beveries – Microbial and chemical characteristics, BOD,COD, microbes as indicators of waste water, pollution treatments processes, septic tank municipal treatment processes, mechanical treatment and biological treatment, trickling filters, inhoff tank, activated sludge process, oxidation ponds, anaerobic sludge digestion rotating disc.

20 Hrs

Module 3. Biodegradation of environmental pollutants; Hospital waste management, Bioremediation, application of bioremediation of hazardous wastes, dyes, oil ,pesticides; Bio sorption; Microbial deterioration of paints, biodegradation of wool, leather, plastics.

20 hrs.

IM Z 6B 09 U (P) PRACTICAL - MICROBIAL WASTE MANAGEMENT

36 hrs

Credit 1

1. Bacterial examination of water by MPN technique and IMVIC test
2. Estimation of BOD and COD from water, soil and sewage

Readings

1. Pelzer, Reid and Chan - Microbiology
2. Gandy and Gandy - Microbiology for Environmental Scientists and Engineers
3. Rodolfs, Willem - Industrial Waste: Their disposal and Treatment
4. Standard Methods for Water Analysis.

REPORT OF BOARD OF STUDIES

Members

1. **Dr. Susan Panicker (Chairperson)**

   Reader and HOD, Dept of Zoology, Baselius College, Kottayam

2 **Mr. T.G. Ramachandran Pillai,** D.B. College, Pampa, Parumala

3 **Mr. Baby Augustine,** St. Thomas College, Pala

4 **Mr. George K. Thomas,** St. George College, Aruvithura

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6 **Mr. Sunny Jose,** St. Xavier's College, Vaikom

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8 **Dr. John Joseph,** S.H. College, Thevara

9 **Mr. Thomas M. Paimpalil,** St. Stephen's College, Uzhavoor

10 **Mrs. Syamala M.V.**, Maharajas College, Ernakulam

11 **Dr. Jyothis Mathew**, School of Biosciences, Mahatma Gandhi University

Brief Report

The members of the Board of Studies met several times and worked out the format for the proposed restructuring of the undergraduate programme in Zoology in Choice Based, Credit and Semester System and introduction of Grading in Valuation as per the guidelines envisaged by the University. The chairperson and members met experts in various disciplines of the subject, and attended workshops conducted by the experts form KSHEC.

The five-day workshop was conducted by the University in continuation of the Board of Studies chairperson's meeting on 8-5-09 FN and Board of Studies members meeting on 8-5-09 AN. The workshop was conducted on 14-5-09, 15-5-09, 20, 21, and 22 May 2009 at School of Environmental Studies, Mahatma Gandhi University, P.D. Hills, Kottayam. 61 teachers attended the workshop. The Hon. Vice Chancellor Dr. Rajan Gurukkal inaugurated the workshop . Hon. ProVice-Chancellor Dr. Rajan Varghese presided over the meeting , Prof. K. Mathew, Prof. Chandra Shekharan and Prof. Sadasivan Nair Members Syndicate gave the guidelines for the workshop. The resource persons participated in the workshop (July 24, 25and 31) were Dr. Achuth Sankar Nair, Dr. K.G. Padmakumar, Dr. Jose Joseph, Dr. Isaac P. Abraham, Rev. Dr. K.M. George , Dr. Francis Xavier, Dr. Susan Panicker, Prof. K. Mathew, Dr. Punnen Kurian, Dr. Thomas Philip, Dr. Gigi K.Joseph (May 14, 15, 20, 21, 22) Dr. A.P. Thomas, Dr. N.J. Rao, Dr. Jyothis Mathew, Dr. Aloysius M. Sebastian, Dr. Punnen Kurian, Dr. Nelson P.Abraham, Dr. Shaju Thomas, Dr. Alice K. Thomas Dr. Shirly Annie Oommen , Mrs. Gladys Francis, Dr. Reethamma O.V. Mrs. Antonio Roseline, Mr. T.K. Mukundan, Dr. K.J. Benny, Mr. Jose Abraham , Mrs. Bina Jacob , Dr. Sampath Kumar, Dr. Susan Thomas, Miss. Tigi Paul , Mr. Madhusudhanan, and Miss Usha P. Hariharan . Dr. Jyothis Mathew, Dr. T. Thomas Philip Issac P. Thomas and Mr. Jojo Joseph gave expert advice in the formulation of syllabus for Microbiology, Immunology, Bioinformatics and Biological Techniques and Specimen preparation. The teams constituted under the leadership of Members of Board of Studies, discussed in detail the syllabi and presented the courses and suggestions emerged form these group discussions and presentations helped to restructure the programme as envisaged by the Kerala State Higher Education Council and Mahatma Gandhi University. The participants contributed actively to the cause and appreciated the University in restructuring the undergraduate syllabi in Choice Based Course, Credit, and Semester System and introduction of grading pattern in valuation. The Chairperson Dr. Susan Panicker is thankful to the authorities of the Kerala Higher Education Council and Mahatma Gandhi University, the members of Board of Studies, Prof. Jacob Kurian Onattu, Principal Baselius College, Kottayam, Dr. A.P. Thomas, Director School of Environmental Sciences and the faculty and resources participants for their wholehearted cooperation and help throughout the venture. Thanks are due to Lars Computers MG University, Ms. Chippi Sarah Kuriakose and Rahul Ramesh, Baselius College, Kottayam.