



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

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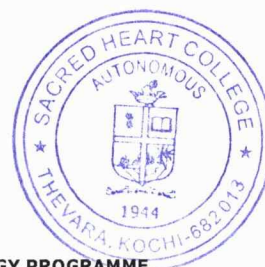
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**Report of the Board of Studies**



B.Sc. ZOOLOGY PROGRAMME

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**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, 1<sup>st</sup> 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, 1<sup>st</sup> semester Core course)**
4. Two digits to indicate the course number of that semester. ie., **ZY1B01 (Zoology, 1<sup>st</sup> 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., **ZY1B01U (Zoology, 1<sup>st</sup> 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/ZY5D02U/ZY5D03U)
ZYC	Zoology Complementary Zoology (ZY1C01U/ZY2C02U/ZY3C03U/ZY4C04U)
ZYC (P)	Zoology Complementary Zoology Practical ♦Model I♦ (ZY1C01U [P]/ZY2C02U [P]/ZY3C03U [P]/ZY4C04U [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 6 <sup>th</sup> 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 6<sup>th</sup> 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 3<sup>rd</sup> 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 5<sup>th</sup> semester and 18 hours in 6<sup>th</sup> 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	-
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**\*Attendance & Laboratory Involvement \*\***

<u>Attendance *</u>	<u>Laboratory Involvement **</u>
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:**

- The examination has duration of 3 hours
- Each question paper has four parts A, B, C & D.
- 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
- 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.
- 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.
- 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.

- Correct formula with correct substitution and answer : **A**
- 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)

Total Credits 20

**Semester I**

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	1 <sup>st</sup> Complementary Course Chemistry I/Biochemistry I	2	2
7	1 <sup>st</sup> Complementary Course Chemistry Practicals I	2	1
8	2 <sup>nd</sup> Complementary Course Botany I	2	2
9	2 <sup>nd</sup> 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	1 <sup>st</sup> Complementary Course Chemistry II/Biochemistry II	2	2
7	1 <sup>st</sup> Complementary Course Practicals II	2	1
8	2 <sup>nd</sup> Complementary Course Botany II	2	2
9	2 <sup>nd</sup> 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	1 <sup>st</sup> Complementary Course III Chemistry III/Biochemistry III	3	3
6	1 <sup>st</sup> Complementary Course III Practicals III	2	1
7	2 <sup>nd</sup> Complementary Course III Botany III	3	3
8	2 <sup>nd</sup> 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	1 <sup>st</sup> Complementary Course IV Chemistry IV/Biochemistry IV	3	3
6	1 <sup>st</sup> Complementary Course IV Chem. Practicals.	2	1
7	2 <sup>nd</sup> Complementary Course IV Botany IV	3	3
8	2 <sup>nd</sup> 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 6 <sup>th</sup> 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
	Total	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	16	8
Field Study and Group activity	1	
Sixth semester	16	8
Project work ( in 6 <sup>th</sup> 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	ZY6B09U[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 (6<sup>th</sup> 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 )	18	1	1
		Visit to research institutes (6th Semester) Study tour/Field study , Group activity (5th Semester)	18	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

v <sup>th</sup> 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	Animal Diversity ♦ Non-Chordata (Practical) - Animal Diversity ♦ Non-Chordata	36	2	2
	ZY1C01U [P]	Chordata	36	2	1
Semester 2	ZY2C02U	Animal Diversity ♦Chordata	36	2	2
	ZY2C02U [P]	(Practical) - Animal Diversity ♦Chordata	36	2	1
Semester 3	ZY3C03U	Human Physiology and Immunology (Practical) - Human Physiology and Immunology	54	3	3
	ZY3C03U [P]		36	2	1
Semester 4	ZY4C04U	Applied Zoology (Aquaculture, Sericulture, Vermiculture and Apiculture )	54	3	3
	ZY4C04U [P]	(Practical) - Applied Zoology	36	2	1

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

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

SEMESTER	CODE	COURSE	HRS	Weightage ratio		CREDITS
				INTE-RNAL	EXTE-RNAL	
1 I	ZY1B01U	General Methodology and Perspectives in Science	3	1	3	2
1 II	ZY2B02U	Biodiversity and Modern Systematics	3	1	3	2
1 III	ZY3B03U	Animal diversity -Non Chordata	3	1	3	3
1 IV	ZY4B04U	Animal Diversity Chordata	3	1	3	3
1 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
1 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				

CTIVES OLOGY RE DICE IED			3	1	3	3
	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
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	Session (1)	Biology			
ZY6B10U [P]	3Hrs	Genetics & Biotechnology	1	3	1
ZY6B11U [P]	Day 2 Session(2)	Microbiology and Immunology	1	3	1
ZY6B12U [P]	3Hrs	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
				<b>Total</b>	<b>13</b>

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

**SCHEME OF PRACTICAL CORE COURSES**

(External exam)

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

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

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

		or LCD, in 7 Minutes)
		Viva Voce-4
<b>Total</b>	<b>8</b>	<b>25</b>

**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 Publishers, 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 Publishers, 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, Polarization microscopy, Video microscopy.

(b) Electron - Scanning (SEM), Transmission (TEM) and STEM

Micrometry ♦ Stage and Eyepiece micrometers

Camera Lucida

Instrumentation

- pH Meter

Separation Techniques

- Centrifuge

- Chromatography

- Electrophoresis

Analytical techniques

- Colorimeter

- Spectrophotometer

- X-ray crystallography

#### **Core readings**

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 Publishers, 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*, 5<sup>th</sup> 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, 2<sup>nd</sup> 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, IL Marie, 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. Experimental 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 ♦ calibration and measurement of microscopic objects ♦ low power
3. Camera Lucida (draw a few diagrams using Camera Lucida)
4. Paper chromatography (demonstration only)
5. Instrumentation ♦ demonstration (write notes on principle, equipment and its use)
  - pH Meter
  - Colorimeter/ Spectrophotometer
  - Centrifuge
  - Electrophoresis
6. Scientific drawing (representatives from any five taxa)
7. Insect Preservation techniques (Group Activity)

**SEMESTER II****ZY2B02U Core Course 2****BIODIVERSITY AND MODERN SYSTEMATICS**

**36 hrs**  
**Credits 2**

**Objectives:**

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

**Pre requisite:**

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

**PART I: BIODIVERSITY****(26 Hrs )****Module I ♦ Introduction to Biodiversity****(2 hrs)**

- Definition
- Historical perspective
- Concepts ♦
  - Nature ♦ environment ♦ biodiversity
- Scope and importance

**Core Readings**

- 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 ♦ 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. Norton & 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 ♦ 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. Norton & 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 -

Quadrat

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. Norton & 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.berkeley.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. Quadrature 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

54 hrs. Credits 3

#### Objectives

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

#### MODULE I

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

Classification ♦ Keys and Principles.

Nomenclature (Uninomial, 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**

Dhama P.S. and Dhama 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 phasmodia. Eg. Enterobius, Ascaris

Class Aphasmodia. Eg. Trichinella

**General Topic-**

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

**Phylum Annelida (2 hrs)**

Classification upto classes.

Class I - Archannelida. Eg. Polygordius

Class II ♦ Polychaeta. Eg. Chaetopterus

Class III - 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. Scutigera

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

Class VI- Cephalopoda Eg. Sepia

**General Topic-**

Pearl formation and culture

**Phylum Echinodermata**

**(4 hrs)**

Classification upto classes

Class I- Asterozoa Eg. Astropecten

Class II- Ophiurozoa Eg. Ophiothrix

Class III- Echinozoa Eg. Echinus

Class IV- Holothurozoa Eg. Holothuria

Class V ♦ Crinozoa 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. 2001 Invertebrate 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, Agarwal 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 7<sup>th</sup> 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
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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: Acipenser

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. II.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<sup>th</sup> & 1<sup>st</sup> 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-Balbani 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<sub>1</sub>, S, G<sub>2</sub> 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 molecules (neuro- transmitters, hormones, growth factors, cytokines, vitamin A and D derivatives)

Role of cyclic AMP

**Core Readings**

Karp. G., 1996 *Cell and Molecular 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 6

**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 3<sup>rd</sup> 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 8<sup>th</sup> edition Prentice Hall, Chapter 7 pgs 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  
Aflatoxin  
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., Pandey S.N. 2009 *Essential 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, New York (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](http://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](http://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, Evaluation and Ecology*, S. Chand & Company New Delhi (Module 1-5)

## PART II ♦ ZOOGEOGRAPHY AND ETHOLOGY (24 hrs)

### Module VI ♦ Zoogeography: Introduction (5 hrs)

Origin of oceans and continents  
Plate tectonics ♦ 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 Zoogeography*. 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 3<sup>rd</sup> 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, New York  
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](http://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](http://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* 3<sup>rd</sup> 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, 27<sup>th</sup> Ed, Mc Graw Hill



**Module -2 METABOLISM****9 hrs**

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

**Core Readings**Harper ♦s Illustrated Biochemistry, 27<sup>th</sup> Ed, Mc Graw Hill**Module 3- ENZYMES****4 hrs**

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

**Core Readings**Harper ♦s Illustrated Biochemistry, 27<sup>th</sup> Ed, Mc Graw Hill**Module 4 ANTIOXIDANTS****1 hr**

Antioxidants and functions

**Core Readings**Harper ♦s Illustrated Biochemistry, 27<sup>th</sup> 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 &amp; 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 ♦ Schafer ♦s method & Drinker ♦s method, respiratory disorders ♦ 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 ♦CIRCULATION****4 hrs**

Cerebral circulation, blood brain barrier and cerebrospinal fluid, haemodynamic principles, formation and fate of blood cells, blood clotting mechanism ♦ 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 ♦EXCRETION****4 hrs**

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

**Core Readings**

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

Zoological Society of Kerala, Study material 2002. *Biochemistry, Physiology and Developmental Biology* Published by Zoological Society of Kerala**Module 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 ♦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 ♦s disease, epilepsy, Alzheimer ♦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 StallSchna.

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, 5<sup>th</sup> ed. Prentice Hall, Upper Saddle River, NJ. Martin, C.R. Endocrine Physiology, Oxford University Press

Norris, D.O. 1997. Vertebrate Endocrinology, 3<sup>rd</sup> 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, 27<sup>th</sup> 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**

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

Majumdar N. N - Vertebrate embryology

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

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

**Module II** **18 hrs**

**Cleavage**

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

**Blastulation**

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

**Fate maps**

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

**Gastrulation**

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

**Cell differentiation and gene action**

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

**Core Readings**

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

Majumdar N. N - Vertebrate 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 constrictor experiments, Organizer and embryonic induction. In vitro 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

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

Majumdar N. N - Vertebrate embryology

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

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

#### Module IV

8 hrs

#### Teratology / Dysmorphology.

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

#### Developmental defects

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

#### Congenital abnormalities (birth defects)

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

#### Causes of malformation. (brief accounts.)

Genetic disorders (single gene defects)

Chromosome aberration, aneuploidy (numerical abnormalities).

Structural abnormalities (deletion, insertion and re-arrangements)

Chromosomal mosaicisms

Environmental factors. (external factors)

Chemicals, drugs, hormones and vitamins.

Multifactorial and idiopathic disorders

#### Core Readings

Dutta 2007 Obstetrics, Church Livingstone 17 Ed

Harrison, Harrison's Book of Internal Medicine Church Livingstone 17<sup>th</sup> Ed.

#### Selected Further Readings

Balinsky 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 Obstetrics, Church Livingstone 17 Ed

Gibbs (2006). Practical guide to developmental biology.

Gilbert S. F - Developmental biology

Harrison, Harrison's Book of Internal Medicine Church Livingstone 17<sup>th</sup> Ed.

Jain P. C - Elements of developmental biology.

John Rigo Fundamental Genetics Cambridge University Press. 2009

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

Majumdar N. N - Vertebrate 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 Verlag 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](http://www.Wikipedia.com). (Module IV)

[www.medpedia.com](http://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.

**Part I GENETICS**

34 hrs

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

2 hrs

**Core Readings**

	Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology Chapter 1 &2.	
odule ♦II	<p><b>Interaction of genes:</b> Allelic and non Allelic. Allelic- incomplete dominance, Co-dominance Non allelic interactions, ♦ complementary, supplementary, epistasis ♦ dominant (feather colour in fowl) and recessive (coat colour in mice) Polygenes (Skin colour inheritance in man) pleiotropism, modifying genes, lethal genes (Brief account with one example each) Multiple alleles (eg) Coat Colour in rabbits. Man ABO blood group Rh factor, Blood group and its inheritance (Genetic problems related to this topic are included in practicals)</p> <p><b>Core Readings</b> Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology Chapter 3 &amp;4.</p>	5 hrs
odule-III	<p>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.</p> <p><b>Core Readings</b> Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology Chapter 5</p>	3hrs
odule IV	<p>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</p> <p><b>Core Readings</b> Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology Chapter 6</p>	3hrs
odule V	<p>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</p> <p><b>Core Readings</b> Zoological Society of Kerala Study material 2002. Cell Biology Genetics and Biotechnology Gardner E.J. &amp; Snustand D.P 1984. <i>Principles of Genetics</i> (John Wiley &amp; Sons ) New York</p>	5 hrs
odule VI	<p>Extra nuclear inheritance (Cytoplasmic inheritance Characteristics: Organella DNA ( Mitochondrial and plastid DNA) Kappa particles in paramecium.</p> <p><b>Core Readings</b> Vijayakumaran Nair 2006, <i>Genetics and Molecular Biology</i>. Continental Publications, Trivandrum.</p>	2hrs
odule VII	<p><b>Bacterial genetics;</b> Bacterial genome Recombination in Bacteria ♦ Bacterial transformation. Transduction, conjugation F mediated sex ductioin. Resistance transfer factor (RTF) Mechanism of drug resistance in bacteria Transposable genetic elements in bacteria, basic components and mechanisms of transposition in bacteria.</p> <p><b>Core Readings</b> Panicker S. Abraham G and Francis G. 2008. <i>Microbiology and Immunology</i> Published by Zoological Society of Kerala Chapter 10</p>	5hrs

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

odule VIII	<p><b>Human Genetics:</b> 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 Cri du chat syndrome) Sex chromosomal anomalies (Klinefelter's syndrome, and Turner's syndrome) Single gene disorders Gene mutation and disorders (Brief mention) Autosomal single gene disorders (Sickle cell anaemia, brachydactyly; inborn errors of metabolism such as phenylketonuria, 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 choriovillous sampling - Ultrasound scanning and Fetoscopy. Genetic counselling, Eugenics and Euthenics.</p> <p><b>Core Readings</b>            Stern C. 1973. Principles of Human Genetics (W.H. Freeman and Co.)            Veer Bala Rastogi &amp; 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 &amp; IBH Publications.</p>	9hrs
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## Part II BIOTECHNOLOGY

odule IX	<p>Definition and scope of Biotechnology</p> <p><b>Core Readings</b>            Sudha Gangal- Principles &amp; Practice of Animal Tissue Culture. University Press. Pp- 128-135</p>	20hrs 1 hr
odule X	<p><b>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 <i>in situ</i> Hybridization (FISH), Colony hybridization, DNA fingerprinting and its applications. RFLP- Applications Gene libraries, - Human DNA library, Construction of genomic library and cDNA library. Stem cell cultures, Therapeutic cloning, human ES cell cultures, Human EG cell cultures and Human EC cell cultures, Potential uses of stem cells.</b></p> <p><b>Core Readings</b>            Sobti &amp; Sharma 2008 <i>Essentials of Modern Biology</i> 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 &amp; Walker 2008 <i>Biochemistry and Molecular Biology</i> 6<sup>th</sup> edition, Cambridge University Press. Chapter -5</p>	5hrs
odule XI	<p>Genetic engineering and recombinant DNA technology            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</p> <p><b>Core Readings</b>            John Ringo 2009 <i>Fundamental Genetics</i> Cambridge University Press, Chapter 29.            Sobti &amp; Sharma 2008 <i>Essentials of Modern Biology</i> 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</p>	6 hrs

Wilson & Walker 2008 *Biochemistry and Molecular Biology* 6<sup>th</sup> edition,  
 Cambridge 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 Society 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 & Bjorn 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, actinomycetes and mycoplasma

**Core Readings**

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

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

Kanika Sharema. Manual of Microbiology tools techniques 2<sup>nd</sup> 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 Immunology, Study Material Series published by Zoological Society of Kerala Chapter 5 p. 107-137	
	Anthananarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.	
	Kanika Sharema. Manual of Microbiology tools techniques 2 <sup>nd</sup> Ed. Anes 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	5 hrs
	<b>Core Readings</b>	
	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	
	Anthananarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.	
	Kanika Sharema. Manual of Microbiology tools techniques 2 <sup>nd</sup> Ed. Anes student Editions 2009	
odule 4	Bacterial Growth, Effect of various factors on bacterial growth. Eg ( <i>E. coli</i> ) Modes of cell division. New cell formation, Nutritional requirements. Bacterial growth curve	2 hrs
	<b>Core Readings</b>	
	Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 3	
	Anthananarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.	
	Kanika Sharema. Manual of Microbiology tools techniques 2 <sup>nd</sup> Ed. Anes student Editions 2009	
odule 5	Microbial Metabolism	2 hrs
	Energy Production by Anaerobic processes Glycolysis, Pentose phosphate pathway, Fermentation, Energy production by Aerobic processes i.e. TCA Cycle , Glyoxylate cycle	
	<b>Core Readings</b>	
	Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 4	
	Anthananarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.	
	Kanika Sharema. Manual of Microbiology tools techniques 2 <sup>nd</sup> Ed. Anes student Editions 2009	
odule 6	Viruses -Structure of Viruses Human, Animal, Plant and Bacterial Viruses. Replication of viruses, cultivation of animal and plant viruses. Viral assay	3 hrs
	<b>Core Readings</b>	
	Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Chapter 2	
	Anthananarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd.	
	Kanika Sharema. Manual of Microbiology tools techniques 2 <sup>nd</sup> Ed. Anes student Editions 2009	
odule 7	<b>Infections</b>	2 hr
	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	
	<b>Core Readings</b>	
	Anthananarayan R & C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd	
	Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, 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 2 <sup>nd</sup> Ed. Anes student Editions 2009	

odule 8	<p>Diseases caused by different pathogens, epidemiology, symptomology, 7 hrs diagnosis and treatment Bacterial: Mycobacterium (<i>M. tuberculosis</i>, <i>M. leprae</i>). (TB and leprosy) <i>Salmonella</i> (Typhoid) Clostridium (Tetanus and Botulism) Spirochete disease (Leptospirosis, Syphilis) Viral : Herpes virus (Chicken pox) HIV ♦ AIDS virus, Poliovirus (Polio) Fungal: Tinea or ringworm (Dermatophytoses,) <i>Candida albicans</i> (Candidiasis) <b>Core Readings</b> 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 &amp; C.K. Jayaram Panicker. Textbook of Microbiology (2008) Orient Longman Private Ltd. Kanika Sharema. Manual of Microbiology tools techniques 2<sup>nd</sup> Ed. Ane♦ student Editions 2009</p>	
<b>ART II IMMUNOLOGY</b>		27 hrs
odule 9	<p>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 <b>Core Readings</b> 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 <i>Essentials of Immunology ELBS</i></p>	
odule 10	<p>Antigens and Antibodies 5hrs Types of Antigens, haptens, antigenic determinants. Basic structure of immunoglobulins. Different classes of immunoglobulins and functions <b>Core Readings</b> 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 <i>Essentials of Immunology ELBS</i></p>	
odule 11	<p>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 <b>Core Readings</b> Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Ivan Roitt, 2002 <i>Essentials of Immunology ELBS</i></p>	
odule 12	<p>Immune Response system 6 hrs Primary and secondary lymphoid organs. Cells of the immune system ♦ Leucocytes, Lymphocytes T &amp; B cells, Macrophages, Plasma cells, Memory cells, MHC Antibody synthesis, primary and secondary responses, Monoclonal antibodies ♦ Hybridoma technology , uses, Polyclonal antibodies. <b>Core Readings</b> 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 <i>Essentials of Immunology ELBS</i></p>	
odule 13	<p>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 <b>Core Readings</b> Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala Ivan Roitt, 2002 <i>Essentials of Immunology ELBS</i></p>	
odule 14	<p>Vaccines 3 hrs Brief history of vaccination, principles of vaccines, major types of vaccines</p>	

(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, Mauds Harney Siraj Misbah and Next Snowden: 2006 *Essentials of Clinical Immunology* Fifth Ed. Blackwell Publishing Company,
- Heritage, J ., E.G.V. Evas & 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* 2<sup>nd</sup> 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 5<sup>th</sup> 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* 2<sup>nd</sup> 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 GENSNIIP**

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

**Module 6 Future Prospects: 2 hrs.**

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

**Core Readings**

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

**Part III BIostatistics Total- 18 hrs.**

**Module 7. Sample & Sampling techniques 2 hrs**

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

**Core Readings**

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**

Campbell, 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 2<sup>nd</sup> .Ed. Springer International ed.*

Jin Xiang 2008 *Essential Bioinformatics 1<sup>st</sup> Ed. Cambridge University Press.*

Khan and Khanum, 1990 *Fundamentals of biostatistics*

Neil C.Jones and Pavel A.Pevzner. 2004 *An 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 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 GENSNIIP.
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.  
 Ratandeeep 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.  
 Ratandeeep 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 tourism. 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**

	<b>PART ♦ I NUTRITION AND COMMUNITY HEALTH</b>	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	10 hrs
	<b>Core Readings</b> 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	
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	10 hrs
	<b>Core Readings</b> K Park, (2008) Park♦s Text Book of Preventive and Social Mediine 18 <sup>th</sup> Edition. Banarasidass Bhenot Publication Tom Sanders and Peter Emery. (2004) Molecular basis of human nutrition: Taylor & Francis Publishers Ane Book	
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.	10 hrs
	<b>Core Readings</b> 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	
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 Bartlett. Human Genetics a modern Synthesis. Published by Boston. P 39, 266-270

**ART II COMMUNITY HEALTH AND SANITATION**

36 hrs

odule V 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). 5<sup>th</sup> edition. Tata McGraw Publishing Company Ltd.  
Monica Cheesbrough, Laboratory Manual for Tropical Counties Vol.II LBS.

odule VI 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). 5<sup>th</sup> 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 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 Bartlett. Human Genetics 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** ♦ *Leptocoris 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 management.

**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 vermiculture, **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 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.

Dhooira 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.  
 NPCB 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. Upadhyay, 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&M University 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 Gurukul., 2007. *Forest Landscapes of the Southern Western Ghats, India Biodiversity, 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<sup>S</sup>  
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 UNFCCC 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, New York  
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.*Another Unique Species:Patterns in Human Evolutionary 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.  
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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.; 3<sup>rd</sup> 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](http://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.sdnip.nic.in>  
<http://www.teriin.org>  
[www.grist.org](http://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

Module I Human normal chromosome complement. Genetic disorders in man. Chromosomal anomalies. Eg. Down Syndrome and Cri du 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.

9 hrs

Module II 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.

9 hrs

**ART ◆ II NUTRITION AND COMMUNITY HEALTH**

18 hrs

Module -III 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

5 hrs

Module IV	<p>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</p> <p><b>Core Readings</b>          K Park, (2008) Park's Text Book of Preventive and Social Medicine 18<sup>th</sup> Edition. Banarasidas Bhanot Publication          Tom Sanders and Peter Emery. (2004) Molecular basis of human nutrition: Taylor &amp; Francis Publishers Ane Book</p>	5 hrs
Module V	<p>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 disorders - Prevention and Management.</p> <p><b>Core Readings</b>          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 &amp; Francis Publishers Ane Book</p>	5 hrs
Module VI	<p>Life Skills Education</p> <p>Physical activity, emotional adjustment and well being, Yoga, Meditation and Relaxation, Psychoneuroimmunology</p> <p><b>Core Readings</b>          Edlen Gordon Janes and Bartlett. Human Genetics a modern Synthesis. Published by Boston. P 39, 266-270</p>	3 hrs
<b>PART III COMMUNITY HEALTH AND SANITATION</b>		36 hrs
Module VII	<p>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, <b>water purification techniques.</b>  <b>Vermi composting a method of solid waste management</b></p> <p><b>Core Readings</b>          Pelczar M.J. Jr. E.C.S. Chane &amp; N.R. Krieg, Microbiology (Concept &amp; Applications). 5<sup>th</sup> edition. Tata McGraw Publishing Company Ltd.          Monica Cheesbrough, Laboratory Manual for Tropical Counties Vol.II LBS.</p>	12 hrs
Module VIII	<p>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)</p> <p><b>Core Readings</b>          Pelczar M.J. Jr. E.C.S. Chane &amp; N.R. Krieg, Microbiology (Concept &amp; Applications). 5<sup>th</sup> edition. Tata McGraw Publishing Company Ltd.          Panicker S, Franis G And Abraham g. (2008) Microbiology &amp; Immunology. Zoological Society Study Material Series. Published by Zoological Society of Kerala.</p>	12 hrs
Module IX	<p>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 &amp; cancer (e) HIV, AIDS ♦ causes &amp; preventive measures</p> <p><b>Core Readings</b>          Zoological Society of Kerala Study Material Series 2002 ♦ Cell biology Genetics &amp; Biotechnology published by Zoological Society of Kerala.          K Park, (2008) Park's Text Book of Preventive and Social</p>	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 Bartlett. Human Genetics 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****ZYSD03U 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, koi, 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 vermiculture.. 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 Dagainawala - General Microbiology
4. Stanier - Microbial World
5. Prescott,Harley,and Klein - 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 &amp; Paul P I (2007)

Protista &amp; 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. Tricoplax 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 &amp; Paul P I (2007)

Protista &amp; 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 &amp; Paul P I (2007)

Protista &amp; Animal Diversity Academica Publications.

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

**Module 5**

Phylum - Platyhelminthes

2 hrs

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 &amp; Paul P I (2007)

Protista &amp; 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. Phasmdia - Wuchereria
2. Aphasmdia ♦ 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. Arachnida ♦ Spider
  3. Pycnogonida ♦ Nymphon

Subphylum Mandibulata

- Class 1. Crustacea ♦ Daphnia
2. Chilopoda - Centepede
  3. Symphyla - Scutigereilla
  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).  
 Ekambaranatha 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. Ananthkrishnan, 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. Petromyzon

Class 2 Ostracodermi 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 &amp; Publishers Pvt. Ltd.

Young J.Z. 1981. The life of Vertebrates (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 &amp; Publishers Pvt. Ltd.

Young J.Z. 1981. The life of Vertebrates (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. Ichthyophis

**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 &amp; Publishers Pvt. Ltd.

Young J.Z. 1981. The life of Vertebrates (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. Ichthyosaurus

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, Kweralthile 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<sub>2</sub> and CO<sub>2</sub> 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 nephron, composition of urine ♦ normal and abnormal constituents, urine formation (ultra filtration , selective reabsorption, tubular secretion and counter current mechanism); Hormonal control of renal function, Kidney disorders ♦ 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, myelinated and non myelinated nerve fibres;  
Nerve impulse ♦ initiation and propagation of nerve impulse, All or none law, Saltatory conduction, Synaptic transmission, Neurotransmitters, Brain waves, Electroencephalogram, Neural disorders ♦ Parkinson's disease, Epilepsy, Alzheimer's syndrome, Dyslexia.

#### Core Readings

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<sub>2</sub> 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 7 Endocrinology

5 hrs

Endocrine glands and their hormones, mode of action (in brief) , Hypothalamus, Pituitary , Thyroid, Parathyroid, Thymus , Islets of Langerhans, 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 5<sup>th</sup> 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, 17<sup>th</sup> 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 Action of Salivary amylase on Starch (Demonstration Only)
- 4 Estimation of Haemoglobin (Demonstration only)
- 5 Identification of human blood groups, A, AB, B and O, Rh factor
- 6 Instruments (Principle & use) Sphygmomanometer, Stethoscope,  
Measurement of blood pressure using Sphygmomanometer (demonstration)

#### SEMESTER IV

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

ZY4C04U - APPLIED ZOOLOGY (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 stiffing 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. & Lafy, 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

I. 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

54 hrs. Credits 2

#### Objectives

1. To study the scientific classification of invertebrate fauna.
2. To learn the physiological and anatomical peculiarities of some invertebrate phyla through type study.
3. To learn the 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 (Uninomial, 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 Phasmodia Eg. Enterobius, Ascaris

Class Aphasmodia Eg. Trichinella

### General Topic-

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

#### Phylum Annelida (2 hrs)

Classification upto classes.

Class I- Archannelida Eg. Polygordius

Class II ♦ Polychaeta Eg. Chaetopterus

Class III- 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. Scutigera

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

Class VI- Cephalopoda Eg. Sepia

### General Topic-

[Pearl formation and culture](#)

**Phylum Echinodermata****(4 hrs)**

Classification upto classes

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

**General Topics**

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

**Minor Phyla****( 2 hrs)**

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

**Phylum Hemichordata****(1 hr)**

Eg. Balanoglossus

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

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

**Selected Further Readings**

Anderson D.T. 2001 Invertebrate 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 &amp; 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, Agarwal 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 7<sup>th</sup> 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**

<b>Sub class I: Archeornithes</b>	Eg: Archaeopteryx (Affinities)
<b>Sub class II: Neornithes</b>	
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: Procvavia
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<sup>th</sup> 7 1<sup>st</sup> 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

**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<sub>2</sub> and CO<sub>2</sub> 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 nephron, composition of urine ◆ normal and abnormal constituents, urine formation (ultra filtration , selective reabsorption, tubular secretion and counter current mechanism); Hormonal control of renal function, Kidney disorders ◆ 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, myelinated and non myelinated nerve fibres; Nerve impulse ◆ initiation and propagation of nerve impulse, All or none law, Saltatory conduction, Synaptic transmission, Neurotransmitters, Brian waves, Electroencephalogram, Neural disorders ◆ Parkinson's disease, Epilepsy, Alzheimer'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<sub>2</sub> 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&amp;B cells,

Macrophages, Plasma cells , Memory cells, MHC, Antibody synthesis,

Monoclonal antibodies, Hybridoma technology

Immune disorders ♦ hypersensitivity, Auto immunity &amp; 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**

Anthananarayan R &amp; 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 5<sup>th</sup> 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, 17<sup>th</sup> Ed. Banarasidass Bhenot Publications

Prosser and Brown, Comparative Animal Physiology

Sebastian Prof. M.M., Animal Physiology

William S Hoar, Animal Physiology.

**ZY3CV03U[P] - HUMAN PHYSIOLOGY AND IMMUNOLOGY**

2Hrs/Week

36Hrs

Credit 1

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

**SEMESTER IV****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, Hyderabad)  
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  
PREPARATIONBIOLOGICAL 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) Practical	2 2	2 1
3	Core 2: Preparation Of Biological Specimens: Plants Practical	2 2	2 1
4	Core 3: Preparation Of Biological Specimens: Animals Practical	2 2	2 1
5	Practical Trauning OJT 54 Hrs		1
6	Complementary-1:◆Biochemistry-1◆(From Board Of Studies ◆ Biochemistry) Practical	2 2	2 1
7	Complementary- 2:◆Zoology -1◆ (From Board Of Studies- Zoology) Practical	2 2	2 1
	<b>Total</b>	<b>25</b>	<b>20</b>

## SEMESTER II

		Hrs/Week	Credit
1	◆Common Course In English◆ (From Board Ofstudies ◆ English)	5	4
2	Core 4: General Biological Techniques Practical	2 2	2 1
3	Core 5: Preparation Of Permanent Slides Practical	2 2	2 1
4	Core 6: Clinical Chemistry And Clinical Microbiology Practical	2 2	2 1
	Practical Training OJT 54 Hrs		1
5	Complementary-1:◆Biochemistry-2◆(From Board Of Studies ◆ Biochemistry) Practical	2 2	2 1
6	Complementary- 2:◆Zoology -2◆ (From Board Of Studie- Zoology) Practical	2 2	2 1
	<b>Total</b>	<b>25</b>	<b>20</b>

## SEMESTER III

		Hrs/Week	Credit
1	Core 7: Physiology With Clinical Correlation-1 Practical	3 2	3 1
2	Core 8: Physiology With Clinical Correlation- 2 Practical	3 2	3 1
3	Core 9: General Laboratory Techniques And Electronics Practical	3 2	3 1
4	Complementary-1:◆Biochemistry-3◆(From Board Of Studies ◆ Biochemistry) Practical	3 2	3 1
5	Complementary- 2:◆Zoology -3◆ (From Board Of Studies Zoology) Practical	3 2	3 1
	<b>Total</b>	<b>25</b>	<b>20</b>

**SEMESTER IV**

		<b>Hrs/Week</b>	<b>Credit</b>
<b>1</b>	Core 10: Teaching Laboratory Techniques, And Water, Soil And Air Analysis Practical	3 2	3 1
<b>2</b>	Core 11: Tissue Culture And Gene Manipulation Practical	3 2	3 1
<b>3</b>	Core 12: Production And Marketing Of Biological Specimens Practical	3 2	3 1
<b>4</b>	Complementary-1: ♦Biochemistry-4♦(From Board Of Studies ♦ Biochemistry) Practical	3 2	3 1
<b>5</b>	Complementary- 2: ♦Zoology -4♦ (From Board Of Studies - Zoology) Practical	3 2	3 1
	<b>Total</b>	<b>25</b>	<b>20</b>

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

**SEMESTER V**

		<b>Hrs/Week</b>	<b>Credit</b>
<b>1</b>	Core 13 : Cell Biology And Molecular Biology (From Board Of Studies- Zoology) Practical	3 2	3 1
<b>2</b>	Core 14: Environmental Biology, Toxicology And Disaster Management (From Board Of Studies - Zoology) Practical	3 2	3 1
<b>3</b>	Core 15: Radiological, Biochemical And Advanced Instrumentation Techniques Practical	3 2	3 1
<b>4</b>	Core 16: <b>Entrepreneurship Development And Marketing</b> Practical	<b>4</b> <b>2</b>	<b>3</b> <b>1</b>
<b>5</b>	<b>Open Course:</b> Human Genetics, Nutrition, Community Health And Sanitation ♦ /Food Microbiology (From Board Of Studies - Zoology)	4	4
	<b>Total</b>	<b>25</b>	<b>20</b>

**SEMESTER VI**

		<b>Hrs/Week</b>	<b>Credit</b>
<b>1</b>	Core 17: Genetics And Biotechnology (From Board Of Studies - Zoology) Practical	3 2	3 1
<b>2</b>	Core 18: Reproductive And Developmental Biology (From Board Of Studies - Zoology) Practical	3 2	3 1
<b>3</b>	Core 19: Microbiology And Immunology (From Board Of Studies - Zoology) Practical	3 2	3 1
<b>4</b>	Core 20: General Informatics, Bioinformatics And Biostatistics (From Board Of Studies ♦ Zoology) Practical	4 2	3 1
<b>5</b>	Core Choice-Based: Nutrition, Community Health And Sanitation/ Ecotourism (From Board Of Studies - Zoology)	4	3
<b>6</b>	OJT Training BT & SP		1
	<b>Total</b>	<b>25</b>	<b>20</b>

**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* 2<sup>nd</sup> Ed. Cambridge Low Price Edition, Cambridge University Press
3. Campbell, N.A., and Reece J.B. 2005. *Biology* . 7<sup>th</sup> (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* 2<sup>nd</sup> Ed. Cambridge Low Price Edition, Cambridge University Press
3. Campbell, N.A., and Reece, J.B. 2005. *Biology* . 7<sup>th</sup> (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* 3<sup>rd</sup> Ed. Mc Graw Hill
6. Miller, S.A., and Harley J.P. 2005. *Zoology*. 6<sup>th</sup> 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* 2<sup>nd</sup> Ed. Cambridge Low Price Edition, Cambridge University Press
3. Campbell, N.A., and Reece, J.B. 2005. *Biology* . 7<sup>th</sup> (International) Edition. Pearson- Benjamin-Cummings
4. Talaro, K.P., and Talaro, A. 2002. *Foundations in Microbiology* 4<sup>th</sup> 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* 3<sup>rd</sup> 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* 3<sup>rd</sup> Ed. The Benjamin/Cummings Publishing Co
3. Talaro ,K.P., and Talaro, A. 2002. *Foundations in Microbiology* 4<sup>th</sup> 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* 11<sup>th</sup> 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* 4<sup>th</sup> 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* 11<sup>th</sup> ed. John Wiley & Sons, Inc.
2. Thibodeau, G.A., and Patton, K.T. 2007. *Anthon's Textbook of Anatomy and Physiology*. 18<sup>th</sup> ed. Mosby
3. Seeley, R.R., Stephens, T.D., and Tate, P. 2006. *Anatomy and Physiology* 7<sup>th</sup> ed. McGraw Hill International Edition
4. Fox, S.I. 2006. *Human Physiology* 9<sup>th</sup> 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<sub>2</sub> 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* 11<sup>th</sup> Ed. John Wiley & Sons, Inc.
5. Thibodeau, G.A., and Patton, K.T. 2007. *Anthony's Textbook of Anatomy and Physiology*. 18<sup>th</sup> ed. Mosby
6. Seeley, R.R., Stephens, T.D., and Tate, P. 2006. *Anatomy and Physiology* 7<sup>th</sup> ed. McGraw Hill International Edition
7. Fox, S.I. 2006. *Human Physiology* 9<sup>th</sup> 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* 2<sup>nd</sup> ed. Cambridge University Press
2. Jones, M., Jones, Geoff, G. and Acaster D. 1999. *Chemistry* 2<sup>nd</sup> ed. Cambridge University Press
3. Blei, I and Odian, G. 2006. *General, Organic and Biochemistry- Connecting Chemistry to your Life* 2<sup>nd</sup> 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* 6<sup>th</sup> 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 [quadrant, 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 &amp; 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 Mechanical 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* 2<sup>nd</sup> ed. Cambridge University Press
2. Jones, M., Jones, Geoff, G. and Acaster D. 1999. *Chemistry* 2<sup>nd</sup> ed. Cambridge University Press
3. Blei, I and Odian, G. 2006. *General, Organic and Biochemistry- Connecting Chemistry to your Life* 2<sup>nd</sup> Ed. W.H. Freeman and Company
4. Kotz, J.C., and Treichel, P 1999. *Chemistry and Chemical Reactivity* 4<sup>th</sup> 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* 5<sup>th</sup> 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 &amp; 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 Mechanical 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**  
**ZF3V06U SPOILAGE OF FOOD, METHODS OF FOOD**  
**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 AND MYCOLOGY**  
**ZM3V06U**  
**Practical VI : MEDICAL ENTOMOLOGY AND MYCOLOGY**  
**ZM3V06U (P)**

**COURSE VII : MEDICAL BACTERIOLOGY AND VIROLOGY**  
**ZM4V07U**  
**Practical VII : MEDICAL BACTERIOLOGY AND VIROLOGY**  
**ZM4V07U (P)**  
**COURSE VIII : MEDICAL MICROBIOLOGY**  
**ZM4V08U**  
**Practical VIII : MEDICAL MICROBIOLOGY**

**ZM4V08U (P)**

### RESTRUCTURED CURRICULUM FOR B.SC. (MODEL II VOCATIONAL) DEGREE IN ZOOLOGY PROGRAMME

#### COURSE STRUCTURE

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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
	<b>Total</b>	<b>25</b>	<b>19</b>

#### 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 I Microbiology (F/M) Practical 2 Capture Fishery and Biology of Fishes (A) / General Methodology, Environmental and Agricultural Microbiology (F/M)	2 2	2 1
6	On The Job Training ( 2 Weeks )		2
7	Complementary Course ♦ 2 Practical	3 2	2 1
	<b>Total</b>	<b>25</b>	<b>21</b>

**SEMESTER 1II**

Sl. No.	Course Title	Hrs/Week	Credit
1	Common Course English ♦ 3	5	4
2	Core Course - 3 Animal Diversity Non-Chordata Practical 3 - Animal Diversity Non-Chordata	3 2	3 1
3	Vocational Course ♦ 5 Fisheries Environment (A)/Dairy Microbiology (F)/ Parasitology (M) Practical 3 Fisheries Environment (A)/Dairy Microbiology (F)/ Parasitology (M)	2 3	2 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) 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)	2 3	2 2
5	Complementary Course ♦ 3 Practical	3 2	3 1
	<b>Total</b>	<b>25</b>	<b>20</b>

**SEMESTER 1V**

Sl. No.	Course Title	Hrs/Week	Credit

1	Common Course English ♦ 4	5	4
2	Core Course - 4 Animal Diversity Chordata Practical 4 - Animal Diversity Chordata	3 2	3 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 Practical	3 2	3 1
	<b>Total</b>	<b>25</b>	<b>20</b>

**SEMESTER V**

Sl. No.	Course Title	Hrs/Week	Credit
1	Core Course - 5 Cell Biology and Molecular Biology Practical 5 - Cell Biology and Molecular Biology	3 2	3 1
	Group activity and Field Study (Practical Hr 1) Report to be submitted in VI <sup>th</sup> 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 Practical 7 Evolution, Zoogeography and Ethology	3 2	3 1
4	Core Course ♦ 8 Biochemistry, Human Physiology and Endocrinology Practical 8 Biochemistry, Human Physiology and Endocrinology	3 2	3 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
	<b>Total</b>	<b>25</b>	<b>20</b>

**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 Course 11 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 Ecotourism/ Nutrition, Community Health and Sanitation/ Applied Entomology, Management of Ornamental fish breeding/ Vermiculture and Beekeeping	4	3
6	Project Practical ♦ Field Study and Group Activity (as in Core) (1 hour)	1	1
	<b>Total</b>	<b>25</b>	<b>20</b>

**Model 2 Programmes in Zoology and Core Courses**

Instructional Hours, Credit, Total Instructional Hours, University Examination, Weightage Internal and External Evaluation of Core Courses will follow the same pattern as in Model 1 Zoology Programme.

For Vocational Courses also University Examination will be conducted at the end of each Semester both for Theory and Practical . Duration of examination is 3 hrs and Internal External weightage ratio is 1:3

**C. SCHEME OF EXAMINATION COMPLEMENTARY SUBJECT**

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 ♦ Scope and importance. Significance of aquaculture compared to other agricultural systems and commercial fisheries.

**Core Readings**

1. Aquaculture ♦ Principles and Practices  
T.V.R.Pillay  
Fishing News Books
2. Open sea Mariculture  
Hanson and Goodwin

**Module 2 (3 hrs)**

Types of aquaculture ♦ Freshwater brackish water and Mari culture. Shell fish culture, Finfish culture, Monoculture, Polyculture.

**Core Readings**

1. Aquaculture ♦ Principles and Practices  
T.V.R.Pillay  
Fishing News Books
2. Handbook of Fisheries and Aquaculture  
Indian Council of Agricultural Research.

**Module 3 (3 hrs)**

Integrated farming ♦ The concept of recycling of organic waste for maximum production. Rice cum fish culture. Culture practices and economics of duck cum fish, poultry cum fish and pig cum fish culture.

**Core Readings**

1. Aquaculture ♦ Principles and Practices  
T.V.R.Pillay  
Fishing News Books
2. Handbook of Fisheries and Aquaculture  
Indian Council of Agricultural Research.

**Additional Reading**

3. Coastal Aquaculture in India  
R.Santhanam, N.Ramanathan and B. Jegadeesan  
CBS Publishers & distributors, New Delhi. 1990.

**Module 4 (7 hrs)**

Site selection procedures ♦ study of topography of pond site. Soil quality parameters ♦ physical, soil type, porosity, percolation, shear strength rate of compaction etc. Chemical ♦ salinity, pH, nutrients, toxic gases etc. Water quality parameters-Chemical salinity, pH, dissolved oxygen, pollution,. Physical ♦ suspended solids, availability. Biological parameters-presence of juveniles/seedlings, predators/ competitors, introduction to plankton, nekton and important groups.

**Core Readings**

1. Water quality in ponds for aquaculture.  
C.E.Boyd. 1990  
Agricultural experiment Station , Auburn University, Auburn, Alabama. 482 pages
2. Handbook on design, construction and Equipment in coastal aquaculture (Shrimp Farming).  
Anand.S. Upadhyay  
Allied publishers Ltd., Bombay

**Additional reading**

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 ♦ 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 Research
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

**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](http://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. McLearnay
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 Rosenbergi
5. MPEDA  
Hand book on Aquafarming  
Shrimp Hatchery
6. CMFRI Special Publication No. 21(1985),52 pages  
A guide to prawn Farming in Kerala.

**Module 7 (4 hrs)**

Culture of Mollusca- mussel, pearl oyster, edible oyster, clams.

**Core Readings**

1. Korringa P. 1976  
Farming Marine Organisms Low in the food Chain  
Elsevier Scientific Publishing Co.  
Amsterdam,Netherlands,264 pages.
2. Farming Bivalve Molluscs : Method for study & development  
DB Quayle and G.F. Newkirk  
World Aquaculture,Vol I.Published by the world Aquaculture Society in  
Association with The IDRC. 294 pages.
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 Prospects (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 Souvenir .Department of Fisheries,Government of Kerala & Matsyafed
3. Breeding of Aquarium Fishes .Herbert R. Axelrod Vol.I &II

**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 ♦Traditional and Mechanized ♦Fishing gear material: Properties of fishing gear appurtenances,floats,sinkers-description. Major fishing gears and their operation.Static gear ♦Gill nets,Long line and Fish traps,Mobile gear-Drag nets-Trawl,Seine nets-Pure seine,Shore seines.

**Core Readings**

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. 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. Publ. 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, otoliths and vertebrae. Estimation of growth by direct methods. Marking and tagging of fish for growth studies. Ova Diameter Frequency and Spawning Frequency. Determination of size at first maturity and spawning season.

**Core Readings**

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 meteorology- 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. Publ. No. 59 (1994). A handbook on Indian Sea cucumbers. 47 pages.
4. CMFRI Spl. Publ. 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. Garrett,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 Physiology 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 steroids in 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, Nandeesh.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 cholerae, 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 ENDOCRINOLOGY****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, Invertebrate 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.  
 Jhingran, 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 Jhingran, Cold water fisheries of India  
 Sandhu, G.S (1990); Research techniques in biological Sciences. Anmol Publishing hose, Delhi  
 Santosh kumar and Manju Tembhe, (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. 7<sup>th</sup> Edition, Orient Longman.  
 Microbiology, 5<sup>th</sup> 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. 7<sup>th</sup> Edition, Orient Longman.  
 Microbiology, 5<sup>th</sup> 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. 7<sup>th</sup> Edition, Orient Longman.

Microbiology, 5<sup>th</sup> 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. 7<sup>th</sup> Edition, Orient Longman.

Microbiology, 5<sup>th</sup> 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. 7<sup>th</sup> Edition, Orient Longman.

Microbiology, 5<sup>th</sup> 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, ribonucleoprotein, genetic recombination and its prospects, basics of recombinant RNA and recombinant DNA technology. (Brief account only)

#### Core Readings

Ananthanarayan & Panicker. Text book of Microbiology, 2006. 7<sup>th</sup> Edition, Orient Longman.

Microbiology, 5<sup>th</sup> Edition, M.J. Pelczar, E.C.S Chan & N.R. Kreig, 2002 Tata McGraw Hill Edition.

#### Selected Further Readings

Ananthanarayan & Panicker Text book of Microbiology, 7<sup>th</sup> Edition, Orient Longman.

Essentials of Microbiology by Purohit & Singh.

Fundamentals of microbiology, 5<sup>th</sup> Edition, Alcamo.

Fundamentals of microbiology, 6<sup>th</sup> Edition, Frobisher, W.B. Saunders Company.

General Microbiology ♦ Vol ♦II, Powar & Dagainawala, Himalaya Publishing House.

Manual of Microbiology, Tools and Techniques by Kanika Sharma.

Microbiology, 1<sup>st</sup> Edition, R.P. Singh, Kalyani Publishers.

Microbiology, 5<sup>th</sup> Edition, M.J. Pelczar, E.C.S Chan & N.R. Kreig, 2002 Tata McGraw Hill Edition.

Microbiology, 6<sup>th</sup> Edition, Prescott, Harley, Klein, International Edition.

### SEMESTER I

#### ZF1V02U COURSE II ♦ BIOINSTRUMENTATION

36 Hrs  
Credits 2

#### Module 1 (7 hrs)

Microscopy: - light microscopy, bright field, Dark field, phase contrast microscopy, fluorescence, transmission and scanning electron microscopy. Specimen preparation for light and electron microscopy.

#### Core Readings

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

Kanika Sharma, Manual of Microbiology, Tools and Techniques, 2<sup>nd</sup> 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, 8<sup>th</sup> Edition, McGraw Hill Publication.

Kanika Sharma, Manual of Microbiology, Tools and Techniques, 2<sup>nd</sup> Edition, Ane Books Pvt. Ltd.

Upadhyay, Upadhyay, Nath, Biophysical Chemistry Principles & techniques, 4th revised Edition 2007, Himalaya Publishing House.

#### Module 3

(15 hrs)

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Centrifugation ♦ Principle, instrumentation, methods and types of centrifugation, application biological science.

#### Core Readings

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

Kanika Sharma, Manual of Microbiology, Tools and Techniques, 2<sup>nd</sup> 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, 8<sup>th</sup> Edition, McGraw Hill Publication.

Kanika Sharma, Manual of Microbiology, Tools and Techniques, 2<sup>nd</sup> 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, 8<sup>th</sup> Edition, McGraw Hill Publication.

Harley Klein. Microbiology, 6<sup>th</sup> Edition by Prescott,

Kanika Sharma, Manual of Microbiology, Tools and Techniques, 2<sup>nd</sup> Edition, Ane Books Pvt. Ltd.

M.J. Pelczar, Microbiology, 5<sup>th</sup> Edition, E.C.S. Chan and N.R. Kreig, McGraw Hill Publications.

Rodney Boyer Modern experimental biochemistry, 3<sup>rd</sup> 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, 2<sup>nd</sup> Edition, Ane Books Pvt. Ltd.

Klittaker. 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, 2<sup>nd</sup> Edition, Ane Books Pvt. Ltd.

Klittaker. 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, 2<sup>nd</sup> Edition, Ane Books Pvt. Ltd.

Klittaker. Fermentation technology

**Module 4 (6 hrs)**

Introduction to tracer techniques: Fluorescent tracer, Isotope, ELISA.

**Core Readings**

Kanika Sharma, Manual of Microbiology, Tools and Techniques, 2<sup>nd</sup> Edition, Ane Books Pvt. Ltd.

Klittaker. Fermentation technology

**Selected Further Readings**

A.H. Patel. Industrial Microbiology

Jayaram Pamilees & Ananthanarayan, Microbiology, .

Kanika Sharma Manual of Microbiology, Tools & Techniques

Klittaker. 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: 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.

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 2<sup>nd</sup> 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 2<sup>nd</sup> 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 ♦ lahiar 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 2<sup>nd</sup> 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 2<sup>nd</sup> ed. New Age International publishers

**Selected Further Readings**

W.C. Frasier & Westhoff , Food Microbiology,

James M. Jay , Modern food microbiology, 4<sup>th</sup> ed.

Shakuntala N, Manay, M. Shadaksharaswamy, Food facts and Principles 2<sup>nd</sup> ed. New Age International publishers

Marion Bennion, Introductory foods, 10<sup>th</sup> edition,.

Winton and Winton , Milk and Milk Products

Norman N, Potter, Joseph H Hotchkis, Food Science, 5<sup>th</sup> ed.

Ahmed, M.,N., Food Science and Nutrition

Sivasankar B., Food Processing and Preservation

Subha Lakshmi and Sobha , A. Udipi, Food Processing and Preservation

Blank F.C., 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



**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 &amp; other condiments.

**Core Readings**

M.R. Adams, M.O. Moss, Food microbiology, New Age International (P) Ltd. Publishers

Prescott, Harleg, Klein, Microbiology, 7<sup>th</sup> 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, 7<sup>th</sup> 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, 7<sup>th</sup> 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, 7<sup>th</sup> 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 industrial microbiology , discovery of the microbial world, experiments of Pasteur, Era of discovery of antibiotics, the discovery of anaerobic life. Industrial fermentation, Submerged and solid fermentation, Fermentors fermenter design, Sterilization, process control.

**Core Readings**

A.H. Patel, Industrial microbiology, Mac Millan India Ltd.

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, lypophilization, 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, gibberllic acid, oxalic acid. Production of amino acids: lysine and glutamic acid, production of enzymes: proteases and amylases. Production of antibiotics: Penicillin, Streptomycin, Production of vitamins, Vitamin B12 & riboflavin, 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, 7<sup>th</sup> edition, Jones & Bartlett Publishers

Prescott, Harley & Klein Microbiology, 7<sup>th</sup> 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.
- 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****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) membrane filter system  
(c) Anaerobic sludge digester

**SEMESTER III****ZF3V05U(P) PRACTICAL-III DAIRY MICROBIOLOGY****54 hrs  
Credit 2**

1. Qualitative analysis of milk by standard plate count method
2. Quality testing of milk by rezazurin test
3. Methylene blue reduction test for microbial contamination of milk.
4. Litmus milk reaction
5. Detection of mastitis through milk test

**SEMESTER III****ZF3V06U(P) PRACTICAL- IV FOOD MICROBIOLOGY - MICROBIOLOGY OF SPOILAGE OF FOOD, METHODS OF FOOD PRESERVATION AND MICROBIOLOGICAL EXAMINATION OF FOOD****54hrs  
Credit 2**

1. Isolation of Lactobacilli and Staphylococcus from curd
2. Enumeration of bacterial from spoiled food.
3. Enumeration of fungi from spoiled food
4. Isolation and identification of bacteria from spoiled food samples (vegetables, meat, fish) Biochemical tests for microbes used for identification.  
Fermentation of carbohydrates IMV i C test , Urease catalase and oxidase test

**SEMESTER IV****ZF4V07U(P) PRACTICAL V ♦ FOOD MICROBIOLOGY - MICROBIOLOGY OF CEREALS , BEVERAGES , EGG, MEAT AND FERMENTED FOOD****54 hrs  
Credit 2**

1. Isolation and identification of fungi from spoiled food samples (vegetables, meat, fish)
2. Isolation of *Aspergillus flavus* from spoiled food
3. Inhibitory effect of low temperature on microbial growth

**SEMESTER IV****ZF4V08U(P) PRACTICAL VI ♦ INDUSTRIAL MICROBIOLOGY****54 hrs  
Credit 2**

1. Determination of fermentation by using yeast
2. Wine production
3. Cultivation of edible mushrooms
4. Isolation and maintenance of industrially important microbes from soil/environment (a) bacteria, (b) algae (c) bacteriophage (d) Fungi

**Selected Further Readings**

A.H.Patel Industrial Microbiology , Macmillan India.  
 A.H.Patel.Industrial Biotechnology  
 Ananthanarayan & Jayaram Panicker Text book of Microbiology.  
 H.A.Moddy Environment Microbiology  
 J.R.Norriz, D.J Road, A.K.Varma Methods in Microbiology ♦ Vol.XXIV by  
 K. R.Aneja Experiments in Microbiology, Plant pathology and Biotechnology by. New age international publishers.  
 Monica Cheesbrough, Medical Laboratory manual for Tropical Countries Microbiology ♦ Vol.I & II ELEBS.  
 R.C Dubey & D.K.Maheshwari A text book of microbiology, S.Chand & Company Ltd.  
 R.C.Dubey, D.K.Maheshwari, Practical microbiology, S.Chand & Company Ltd.  
 R.Cruickshank et al.Medical Microbiology  
 Swaroop, Pathak and Arora Laboratory Techniques in Biology  
 Welson and Goulding Tools and Techniques in Biology

**VOCATIONAL SUBJECT MEDICAL MICROBIOLOGY****SEMESTER I****ZM1V01U COURSE I ♦ GENERAL MICROBIOLOGY****36 Hrs  
Credits 2****Module 1 (7 hrs )**

The historical development of microbiology, classification of 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, 7<sup>th</sup> Edition, Orient Longman.  
 Microbiology, 5<sup>th</sup> 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, 7<sup>th</sup> Edition, Orient Longman.  
 Microbiology, 5<sup>th</sup> 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, 7<sup>th</sup> Edition, Orient Longman.  
 Microbiology, 5<sup>th</sup> 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, 7<sup>th</sup> Edition, Orient Longman.  
 Microbiology, 5<sup>th</sup> 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, 7<sup>th</sup> Edition, Orient Longman.  
 Microbiology, 5<sup>th</sup> 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, ribonucleoprotein, genetic recombination and its prospects, basics of recombinant RNA and recombinational DNA technology. (Brief account only)

**Core Readings**

Ananthanarayan & Paniker Text book of Microbiology, 7<sup>th</sup> Edition, Orient Longman.

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

### Selected Further Readings

Ananthanarayan & Paniker Text book of Microbiology, 7<sup>th</sup> Edition, Orient Longman.  
 Essentials of Microbiology by Purohit & Singh.  
 Fundamentals of microbiology, 5<sup>th</sup> Edition, Alcamo.  
 Fundamentals of microbiology, 6<sup>th</sup> Edition, Frobisher, W.B. Saunders Company.  
 General Microbiology ♦ Vol ♦II, Powar & Dagainawala, Himalaya Publishing House.  
 Manual of Microbiology, Tools and Techniques by Kanika Sharma.  
 Microbiology, 1<sup>st</sup> Edition, R.P. Singh, Kalyani Publishers.  
 Microbiology, 5<sup>th</sup> Edition, M.J. Pelczar, E.C.S Chan & N.R. Kreig, Tata McGraw Hill Edition.  
 Microbiology, 6<sup>th</sup> 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, 8<sup>th</sup> Edition, McGraw Hill Publication.  
 Kanika Sharma, Manual of Microbiology, Tools and Techniques, 2<sup>nd</sup> 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, 8<sup>th</sup> Edition, McGraw Hill Publication.  
 Kanika Sharma, Manual of Microbiology, Tools and Techniques, 2<sup>nd</sup> 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, 8<sup>th</sup> Edition, McGraw Hill Publication.  
 Kanika Sharma, Manual of Microbiology, Tools and Techniques, 2<sup>nd</sup> 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, 8<sup>th</sup> Edition, McGraw Hill Publication.  
 Kanika Sharma, Manual of Microbiology, Tools and Techniques, 2<sup>nd</sup> Edition, Ane Books Pvt. Ltd.

#### Selected Further Readings

Beacker & Deamer The World of cell.  
 Benson, Microbiological application laboratory manual in general microbiology, 8<sup>th</sup> Edition, McGraw Hill Publication.  
 Harley Klein. Microbiology, 6<sup>th</sup> Edition by Prescott,  
 Kanika Sharma, Manual of Microbiology, Tools and Techniques, 2<sup>nd</sup> Edition, Ane Books Pvt. Ltd.  
 M.J. Pelczar, Microbiology, 5<sup>th</sup> Edition, E.C.S. Chan and N.R. Kreig, McGraw Hill Publications.  
 Rodney Boyer Modern experimental biochemistry, 3<sup>rd</sup> Edition, Pearson education.  
 Upadhyay, Upadhyay, Nath, Biophysical Chemistry Principles & techniques, 4th revised Edition 2007, Himalaya Publishing House.

## SEMESTER II

### ZM2V03U COURSE III: GENERAL METHODOLOGY

**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  
Klittaker. Fermentation technology  
Swaroop Pathal & Arora Laboratory in Biology  
Welson & Goulding Tools & Techniques in Biology

**SEMESTER II****ZM2V04U COURSE IV ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY****MODULE 1 10Hrs**

Microorganisms in soil. Factors influencing soil micro flora, biological interrelationship of microorganisms: mutualism, synergism (protocooperation) commensalism, 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.

**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, parasitism, 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: Diphyllbothrium, sparganum, Taenia, Echinococcus Hymnoleps, Schistosoma, Fasciola, Fasciolosis, colonorchis, paragonimus (b) Nematelminthes: 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 protozoology 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 Vectors - 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, Aedes and Mansonia. Mosquito control: various methods mosquito borne diseases and their control.  
Phlebotomus (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 Vectors - 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 Vectors - Borend diseases by Dr. A.P. Pandya  
Text Book of Microbiology, Sixth edition, R. Ananthanarayan and C.K. J. Paniker

**MODULE IV****10 hrs**

Superficial mycoses: General characters, disease and etiological agents of *Tinea versicolor*, *Black piedra*, *White piedra*, *Tinea nigra* subcutaneous: General characters, disease and etiological agents of Sporotrichosis, Chromoblastomycosis, Maduromycosis, Systemic mycoses.

**Core Readings**

Medical Entomology including Epidemiology of Vectors - 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 Vectors - 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 Vectors - 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 1 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, 3<sup>rd</sup> 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, symptomatology, diagnosis and treatment of Tuberculosis, Syphilis Actinomycosis, Rickettsial diseases, chlamydial infections , Mycoplasmal diseases.

**Core Readings**

Gabriel Virella, B.I. Microbiology and Infectious diseases, 3<sup>rd</sup> 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, 3<sup>rd</sup> 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. 16<sup>th</sup> edition, Churchill Livingstone Publications  
Gabriel Virella, B.I. Microbiology and Infectious diseases, 3<sup>rd</sup> ed. Waery Publications  
Monica Cheesbrough, Medical Laboratory Manual for Tropical Countries , 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**

- Ananthanarayan R. and C.K.J. Paniker Text book of Microbiology , Sixth edition, , Orient Longman Publishers.  
Chakraborty P., A textbook of Microbiology, 1<sup>st</sup> edition, , New Central Book Agency (P) Ltd.

**Module 2 10 hrs**

Respiratory tract infections: infections of the upper and lower respiratory tract

**Core Readings**

- Ananthanarayan R. and C.K.J. Paniker Text book of Microbiology , Sixth edition, , Orient Longman Publishers.  
Chakraborty P., A textbook of Microbiology, 1<sup>st</sup> 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**

- Ananthanarayan R. and C.K.J. Paniker Text book of Microbiology , Sixth edition, , Orient Longman Publishers.  
Chakraborty P., A textbook of Microbiology, 1<sup>st</sup> 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.

Chakraborty P., A textbook of Microbiology, 1<sup>st</sup> 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.

Chakraborty P., A textbook of Microbiology, 1<sup>st</sup> 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.

Chakraborty P., A textbook of Microbiology, 1<sup>st</sup> edition, , New Central Book Agency (P) Ltd.Gabriel Virella, B.I. Microbiology and Infectious diseases , 3<sup>rd</sup> edition , Waverly PublicationsShanson. D.C. Microbiology in Clinical Practice, 3<sup>rd</sup> 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.
- 4 Demonstration of selective and differential media
- 5 Isolation of pure colonies (a) streak plate method (b) pour plate method (c) subculturing (picking off) technique (d) Broth cultures.
- 6 Calibration of an ocular micrometer for different objectives of a microscope. Measurement of microorganisms by the use of an ocular micrometer.
- 7 Bacterial Staining Method (a) Simple Staining (b) Gram's staining (c) Acid-fast staining (d) capsule staining (e) flagella staining (f) spore staining (g) Negative staining Indian ink preparation.
- 8 Examination of microbes in Living condition (a) wet mount (b) Hanging drop method for demonstrating motility of bacteria
- 9 Instrumentation and working principle (a) pH meter (b) colorimeter (c) Laminar air flow Bench (d) Autoclave (e) Hot air oven (f) Colony counter.

**SEMESTER II****ZM2V04U(P) - PRACTICAL II GENERAL METHODOLOGY ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY****36 hrs  
Credit 1**

1. Introduction to chromatographic techniques.

2. Paper chromatographic separation of aminoacids.
3. pH measurement of culture media.
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) membrane filter system  
(c) Anaerobic sludge digester

**SEMESTER III****ZM3V05U(P) PARASITOLOGY****54 hrs****Credit 2**

1. Introduction to parasitology - Collection and processing of clinical specimens for parasites.
2. Examination of faeces for parasites.
3. Examination of blood for parasites.
- a) Preparation of thick smear
- b) Preparation of thin smear
4. Identification of Protozoan and Helminthic parasites

**SEMESTER III****ZM3V06U(P) PRACTICAL-IV MEDICAL ENTOMOLOGY AND MYCOLOGY****54 hrs  
Credit 2**

1. Identification of Vectors of clinical importance
  - a. Mosquito
  - b. Fleas
  - c. Ticks and Mites
  - d. Louse
  - e. Bed bug
2. Introduction and general principles for the lab diagnosis of fungal infections. Collection of samples
3. Slide culture method for cultivation of fungus
4. Study of morphology of fungi  
Fungal staining, lactophenol cotton blue mounting
5. Identification of fungal pathogens
  - a) Aspergillus b) Penicillium c) Rhizopus d) Mucor

**SEMESTER IV****ZM4V07U(P) PRACTICAL-V MEDICAL BACTERIOLOGY AND VIROLOGY****54 hrs  
Credit 2**

1. Biochemical tests for the identification of microbes
  - a. Fermentation of carbohydrates
  - b. IMViC test
  - c. Urease test
  - d. Catalase test
  - e. Oxidase test

2. Antibiotic sensitivity test
3. Carbohydrate utilization test for the identification of *E. coli*, *Salmonella*, *Shigella* 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.Norri, 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 CURRICULUM 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

<b>Fundamentals of Microbiology</b>							
<b>Practical</b>	2	1		36			
<b>Core I Industrial Microbiology Course II IMZ 1 B 02 U Biostatistics &amp; Bioinstrumentation</b>	3	3	3	54	3	1	3
<b>Core II Zoology CourseI ZY 1 B 01 U General Methodology &amp; Perspectives in Science</b>	2	2	3	36	3	1	3
<b>Practical ( Zoology Board syllabus)</b>	2	1		36			
<b>Complementary I Biochemistry CourseI Elementary Biochemistry I [Biochemistry Board syllabus]</b>	2	2	3	36	3	1	3
<b>Practical</b>	2	1		36			

<b>Complementary II Computer Science Course I Computer Fundamentals and Office Automatioon (Computer Science Board Syllabus)</b>	2	2	3	36	3	1	3
<b>Practical</b>	2	1		36			
<b>TOTAL</b>	<b>25 Hrs</b>	<b>20 Credit</b>	<b>20 Credit</b>				

## SEMESTER II

Course Title	No of hours/ Week	Number of Credits	Total Credits	Total Hrs/ Sem	Univ. Exam Hrs	IA	EA
<b>Common Course in English II Critical Thinking, Academic writing &amp; Presentation. [Board of studies English]</b>	5	4	4	90	3	1	3
<b>Core I Industrial Microbiology CourseIII IMZ 2 B 03U Microbial physiology</b>	4	2	3	72	3	1	3
<b>Practical</b>	4	1		72			
<b>Core II Zoology CourseII ZY 2 B 02 U Biodiversity &amp; Modern Systematics</b>	2	2	3	36	3	1	3
<b>Practical</b>	2	1		36			
<b>Complementary I Biochemistry CourseII Elementary Biochemistry II [Biochemistry Board syllabus]</b>	2	2	3	36	3	1	3
<b>Practical</b>	2	1		36			
<b>Complementary II Computer Science Course II Programming with C Language (Computer Science Board Syllabus)</b>	2	4	7	36	3	1	3
<b>Practical</b>	2	3		36			
<b>TOTAL</b>	<b>25 Hrs</b>	<b>20 Credit</b>	<b>20 Credit</b>				

## SEMESTER III

Course Title	No of hours/ Week	Number of Credits	Total Credits	Total Hrs/ Sem	Univ. Exam Hrs	IA	EA
<b>Core I Industrial Microbiology Course IV IMZ 3 B 04 U Medical Microbiology and Virology</b>	2	2	2	36	3	1	3
<b>Core I Industrial Microbiology</b>							

<b>CourseV</b> <b>IMZ 3 B 05U</b> <b>Molecular Biology and Microbial Biotechnology</b>	2	2	3	36	3	1	3
<b>Practical</b>	2	1		36			
<b>Core I Industrial Microbiology</b> <b>CourseVI</b> <b>IMZ 3 B 06U</b> <b>Basics of Industrial Microbiology</b>	3	3	4	54	3	1	3
<b>Practical</b>	2	1		36			
<b>Core II Zoology CourseIII ZY 3 B 03 U</b> <b>Animal Diversity ♦ Non chordata</b> ( Zoology Board syllabus)	3	3	4	54	3	1	3
<b>Practical</b>	2	1		36			
<b>Complementary I Biochemistry</b> <b>CourseIII</b> <b>Enzymology &amp; Metabolism-(1)</b> [Biochemistry Board syllabus]	3	3	4	54	3	1	3
<b>Practical</b>	2	1		36			
<b>Complementary II Computer Science Course III</b> <b>Web technology and Programming</b> (Computer Science Board Syllabus)	2	3	3	36	3	1	3
<b>Practical</b>	2	0		36			
<b>TOTAL</b>	<b>25 Hrs</b>	<b>20 Credit</b>	<b>20 Credit</b>				

## SEMESTER IV

LO	Course Title	No of hours/ Week	Number of Credits	Total Credits	Total Hrs/ Sem	Univ. Exam Hrs	IA	EA
	<b>Core I Industrial Microbiology Course VII</b> <b>IMZ 4 B 07U Fermentation Technology</b>	3	2	3	54	3	1	3
	<b>Practical</b>	2	1		36			
	<b>Core I Industrial Microbiology Course VIII</b> <b>IMZ 4B 08U Agricultural Microbiology &amp; Biofertilizers</b>	3	2	3	54	3	1	3
	<b>Practical</b>	2	1		36			
	<b>Project Core I</b> <b>Enterprenurship Development Programme and OJT 1 week</b>	1	Credit to be given in VI sem		18			
	<b>Core II Zoology CourseIV</b> <b>ZY 4 B 04 U</b> <b>Animal Diversity- Chordata</b>	3	3	4	54	3	1	3
	<b>Practical</b>	2	1		36	2		
	<b>Complementary I Biochemistry CourseIV</b> <b>Biochemistry Metabolism (2)</b> [Biochemistry Board syllabus]	3	3	4	54	3	1	3
	<b>Practical</b>	2	1		36			
	<b>Complementary II Computer Science Course IV</b> <b>Visual Programming Techniques</b>	2	3	6	36	3	1	3
	<b>Software lab IV</b> <b>Practical</b>	2	3		36			
	<b>TOTAL</b>	<b>25 Hrs</b>	<b>20 Credit</b>	<b>20 Credit</b>				

## SEMESTER V

LO	Course Title	No of hours/	Number of Credits	Total Credits	Total Hrs/	Univ. Exam	IA	EA
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	Week			Sem	Hrs		
Open course ZY5D04U Food Microbiology/ Any open course offered 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	3	3	4	54	3	1	3
Practical	2	1		36			
Core II Zoology CourseVI ZY 5 B 06 U Environmental Biology, Toxicology & Disaster Management	3	3	4	54	3	1	3
Practical	2	1		36			
Core II Zoology CourseVII ZY 5 B 07 U Evolution, Zoo geography & Ethology	3	3	4	54	3	1	3
Practical	2	1		36			
Core II Zoology CourseVIII ZY 5 B 08 U Biochemistry, Human physiology &Endocrinology	3	3	4	54	3	1	3
Practical	2	1		36			
<b>TOTAL</b>	<b>25 Hrs</b>	<b>20 Credit</b>	<b>20 Credit</b>				

## SEMESTER VI

LO	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	2	2	3	36	3	1	3
	Practical	2	1		36			
	Core I project Enterpreneurship Developmetn programme & OJT 1 week	1	1	1	18		1	3
	Core II Zoology CourseIX ZY 6 B 09 U Reproductive & Developmental Biology	3	3	4	54	3	1	3
	Practical	2	1		36			
	Core II Zoology CourseX ZY 6 B10U Genetics &Biotechnology	3	3	4	36	3	1	3
	Practical	2	1		36			
	Core II Zoology CourseXI(a) ZY 6 B 11(a) U Immunology ( Zoology Core syllabus modified)	2	2	3	36	3	1	3
	Practical	2	1		36			
	Core II Zoology Course 12 ZY6B12 U General Informatics, Bioinformatics and Biostatistics	3	3	4	54	3	1	3
	Practical	2	1		36			
	Core II Zoology Project work and field visit Group activity	1	1	1	18		1	3



<b>TOTAL</b>	<b>25 Hrs</b>	<b>20 Credit</b>	<b>20 Credit</b>				
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**TOTAL CREDITS ♦ 120****150 Hrs**

SEME-STER	Common Course	Complementary		Core I	Core II	OPEN COURSE
	ENGLISH	BIO-CHEMISTRY	COMPU-TER SCIENCE	INDUS-TRIAL MICRO-BIOLOGY	ZOOLOGY	
<b>I</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>7</b>	<b>3</b>	
<b>II</b>	<b>4</b>	<b>3</b>	<b>7</b>	<b>3</b>	<b>3</b>	
<b>III</b>		<b>4</b>	<b>3</b>	<b>9</b>	<b>4</b>	
<b>IV</b>		<b>4</b>	<b>6</b>	<b>6</b>	<b>4</b>	
<b>V</b>					<b>16</b>	<b>4</b>
<b>VI</b>				<b>4</b>	<b>16</b>	
<b>TOTAL</b>	<b>8</b>	<b>14</b>	<b>19</b>	<b>29</b>	<b>46</b>	<b>4</b>

**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 Computer 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
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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
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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:**

- The examination has duration of 3 hours
- Each question paper has four parts A, B, C & D.
- 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
- 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.
- 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.
- 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	<b>4</b>	
Part-A	Major practical	a) 4+ b) 4 =	<b>8</b>
Part-B	Minor practical	a) 2+ b) 1 =	<b>3</b>

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**  
**Weightage**

(Credit 1)

	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
<b>Total</b>	<b>8</b>	<b>25</b>

**Double Core ♦ Industrial Microbiology and Zoology**

- Double Core programme is exempted from Core choice Board Courses (Electives) that is designed for Model I and Model II (Vith Semester) However they have open courses in Vth Semester as other Model I and Model II programmes.
- Syllabus for Core II Zoology follows the same pattern of Instructional Hrs, University exams credits, Practicals , IA and EA as in Model I Zoology Programme.
- Course I to XII (1-12) are the same as that of Zoology Core Model I except Course XI (11)
- Course XI is ZY6B11 (a) U Immunology as given in scheme.
- The Syllabus of ZY6B11 (a) U Theory and ZYB 11 (a) U(P) Practical is given below

**SYLLABUS FOR**  
**B.Sc ZOOLOGY CORE**

(Course I to course XII are the same as that of Zoology Core Model I except Course XI. Course XI is given below )

**Y 6 B 11(a)U - IMMUNOLOGY**

36 hrs  
Credit 2  
5 hrs

Module 1 Introduction to immunology

Types of immunity, innate immunity, acquired , passive , active Mechanism of innate immunity (eg. Barriers, Phagocytosis, inflammation).

#### Core Readings

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

odule 2 Antigens and Antibodies 8hrs

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*

odule 3 Antigen-antibody reactions, Precipitation test, Agglutination Test, Clinical 7 hrs

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*

odule 4 Immune Response system 8 hrs

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

#### Core Readings

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 5 Immunopathology- immune disorders 5hrs

(Hypersensitivity, autoimmunity and immunodeficiency)

Different types of hypersensitivity reactions -

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

(Eg. Arthus reaction, Serum sickness)

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

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

Immunodeficiency, AIDS

#### Core Readings

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

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

odule 6 Vaccines 3 hrs

Brief history of vaccination, principles of vaccines, major types of vaccines (BCG, DPT, Polio vaccine and TAB vaccines) DNA vaccines, toxoides, adjuvants. Recent trends in vaccine preparation

#### Core Readings

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

Anthananarayan 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, Mased Harney Siraj Misbah and Next Snowden: 2006 Essentials of Clinical Immunology Fifth Ed. Blackwell Publishing Company,

Heritage, J ., E.G.V. Evas & 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 2<sup>nd</sup> Ed. Ane ♦s student Editions 2009

**ZY 6 B 11(a)U (P) PRACTICAL IMMUNOLOGY****36 hrs  
Credit 1**

1. Antibiotic sensitivity test.
- 2 Determination of ABO blood groups and Rh factor (Antigen ♦ antibody Reaction)
3. Study through photographs/ illustration, the primary immune (Bone marrow and thymus) and secondary immune (spleen and lymph nodes) organs in Rat/Man.
4. ELISA
5. RIA
6. WIDAL Test

**SYLLABUS FOR CORE I****INDUSTRIAL MICROBIOLOGY****SEMESTER I****IM Z 1 B 01 U - FUNDAMENTALS OF MICROBIOLOGY****54Hrs****Credit 3****Module 1.** The historical development and scope of Microbiology - 5 hrs**Module 2.** Diversity of Microbial world- Principle of Classification- Outline classification of Bacteria according to Bergy ♦s manual(including Cyanobacteria), Fungi, Viruses, Actinomycetes and Mycoplasma . Two types of cellular organization ♦ Prokaryotic & Eukaryotic -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, enrichment media and differential media plating techniques- Techniques and isolation of pure colonies. Culture preservation techniques (Refrigeration, Freezing and liquid nitrogen and lyophilization). Methods of staining ♦ simple stain, differential stain (Gram stain, acid fast stain), Structural stain (spore staining, flagellar staining, capsule staining). Measurement of microbial size and number.

- 12 hrs

**IM Z 1 B 01 U (P) PRACTICAL - FUNDAMENTALS OF MICROBIOLOGY****36 hrs  
Credit 1**

1. Preparation of Media-(Liquid media, Solid media, Semisolid media)
2. Cleaning and Sterilization of glassware
3. Maintenance of culture room
4. Isolation methods
  - Serial dilution
  - Spread Plate
  - Streak Plate , Pour Plate methods , Stab culture method , Lawn Culture.
5. Staining techniques
  - Simple staining
  - Differential staining ♦ Gram staining, Acid fast staining
  - Capsule staining, Flagella staining, Spore staining, Negative Staining-Indian ink Preparation
6. Lacto phenol cotton blue mounting of fungi
7. Haemocytometry

8. Motility of Bacteria  
- Hanging drop method ,Wet mount

**Core Readings**

1. Y K Parsher - Modern microbiology
2. Y K Parsher - Microbiology
3. S N Prasad - Applied microbiology
4. S. S Purohit - Microbiology, fundamentals and application 6<sup>th</sup> 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****INSTRUMENTATION**

**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  
hrs

**8**

**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, Krebs cycle & its significance, fermentation, pentose phosphate pathway, oxidative and substrate level phosphorylation, gluconeogenesis

**8 hrs**

**Module 5.** Nitrogen metabolism: Nitrogen fixation in symbiotic and free living system, Photosynthetic and non-photosynthetic systems, oxygen regulation of nitrogen fixation, nitrification, denitrification and ammonifying bacteria, pathway of nitrate assimilation in photosynthetic and non-photosynthetic

systems, transamination and deamination reactions, Carbon cycle

18 hrs

**Module 6.** Introduction to Antibiotics:-Classification of Antibiotics Antibiotic Sensitivity test (Qualitative and Quantitative) Examples- Structure & mode of action (Penicillin Chloramphenicol.)

10 hrs

**IM Z 2 B 03U (P) PRACTICAL - MICROBIAL PHYSIOLOGY 54 hrs**

**Credit 1**

1. Effect of pH on the growth of bacteria on solid media
2. Effect of salt on the growth of Microorganisms
3. Effect of antibiotics on bacterial growth by paper disc method
4. Biochemical Tests
  - Triple sugar iron agar test
  - IMVIC tests
  - Starch hydrolysis
  - Gelatine liquefaction
  - Catalase test
  - Urease test
5. Determination of growth phase of *E. coli* by measurement of O.D.

**CORE READINGS**

1. Moat and Foster - Microbial physiology
2. Pelzar Reid and Chan - Microbiology
3. Comprehensive Biotechnology - Vol I, II, III,IV
4. Prescott ♦ Microbiology
5. Ananthanarayan and Jayaram Panicker -Text book of Microbiology
6. Jaquelyin G Black - Microbiology
7. DR. N.Kannan - Laboratory manual of General Microbiology

**SEMESTER III**

**IM Z 3 B 04 U MEDICAL MICROBIOLOGY AND VIROLOGY**

**36 Hrs**

**Credit-2**

**Module 1.** Normal microbial flora of Human body, A systematic study of *Staphylococcus aureus*, Streptococci (*Str. pyogenes* and *Str. Pneumonia*) , *Bacillus anthracis*, *Escherichia coli*, *Klebsiella pneumoniae*, *Shigella*, *Pseudomonas aeruginosa*, *Vibrio cholerae*.  
10hrs

**Module2.** Urinary tract infections, Genital tract infections, Sexually transmitted disease, and Nosocomial infections  
5 hrs

**Module 3.** Diseases caused by different pathogens; epidemiology, symptomatology, diagnosis and treatment of Tuberculosis, Syphilis, Actinomycosis.  
6 hrs

**Module 4.** Respiratory tract infections: infections of the upper and lower respiratory tract

5 hrs

**Module 5.** Viral diseases: Herpes virus, Orthomyxovirus (influenza) , Paramyxoviruses, (mumps, measles ) Rubella, Hepatitis, Rhabdo viruses, AIDS Viruses , Polio, Arboviruses, Oncogenic viruses

10hrs

Module 6. Activity 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 Countries, 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

- |                  |  |        |
|------------------|--|--------|
| <b>Module 1.</b> | 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 |
| <b>Module 2.</b> | Structural Organization of genomes in prokaryotes  | 3 hrs  |
| <b>Module 3.</b> | Mutation: Molecular mechanism of mutation, forward and reverse mutation, transition, transversion, and chemical induced mutations  | 5 Hrs  |
| <b>Module 4.</b> | Genetic recombination in bacteria: Transformation, transduction and conjugation. Use of transformation, transduction and conjugation in genetic mapping, preparation of genetic maps.  | 6 Hrs  |
| <b>Module 5.</b> | 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 $\beta$ Lactam antibiotics ( Penicillin and its relatives ) Amino glycosides and tetracyclines  | 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. Ananthanarayanan 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 Cheesbrough - 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 ♦ lyophilization 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: Surface, Submerged and Continuous fermentation 7 hrs

**IM Z 3 B 06 U (P) Practical - BASICS OF INDUSTRIAL MICROBIOLOGY**

36 hrs

Credit 1

1. Study of alcoholic fermentation of fruit juice by yeast
2. Production of citric acid by *Aspergillus niger*
3. Estimation of citric acid

**CORE READINGS**

1. R. A. Atlas, McMillan - Microbiology, Fundamentals and Application
2. Pelzar, Reid and Chew - Microbiology
3. A H Patel - Industrial Microbiology, Macmillan India
4. Casida - Industrial Microbiology
5. Whittaker - Fermentation Technology
6. P F Stanbury - Principles of Fermentation Technology

**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**

- Module 1. Soil Microorganisms: biological interrelationship of microorganisms: mutualism, synergism (protocooperation) commensalisms, Amensalism, Parasitism, Predation .Interaction between plants and microorganism ♦ microorganisms of rhizosphere, rhizoplane, phylloplane and mycorrhiza. 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. 15 Hrs
- Downy mildew of grapes
  - Tikka disease of groundnut
  - Citrus canker
  - Bacterial leaf blight of rice
  - Mycoplasmal diseases ♦ sandal spik
  - Grassy shoot disease of sugar cane
  - Viral disease ♦ TMV
- 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 Rhizoplane and Phylloplane micro organisms
5. Study of plant pathogens

## REFERENCES

1. Martin - Soil Microbiology
2. Hill and Wright - 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**

(Students can follow any open course offered by the institution)

**ZY5D04U - FOOD MICROBIOLOGY****72 hrs****Credit 4**

- Module 1.** Food as a substrate for micro organisms, micro-organisms important in food microbiology- moulds, yeasts and bacteria; brief account of each group; general characteristics and importance; Principles of food preservation ♦ asepsis ♦ removal of micro organisms, anaerobic conditions ♦ high and low temperatures ♦ drying, chemical preservatives ♦ food additives. 15Hrs
- Module 2.** General principles underlying food spoilage and contamination; canned food ♦ sugar products; vegetables, fruits, meat and meat products, milk and milk products, fish, sea food ♦ spoilages. 12 Hrs
- Module 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 Dagainawala - General Microbiology
4. Stanier - Microbial World
5. Prescott, Harley, and Klein - 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 - bimethanation.

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

Credit 1

36 hrs

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

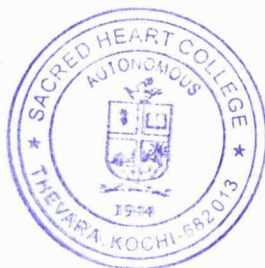
### Members

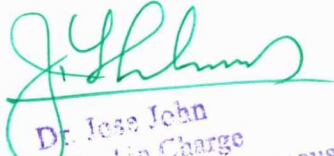
1. **Dr. Susan Panicker (Chairperson)**  
Reader and HOD, Dept of Zoology, Baselius College, Kottayam
2. **Mr. T.G. Ramachandran Pillai**, D.B. College, Pampa, Parumala
3. **Mr. Baby Augustine**, St. Thomas College, Pala
4. **Mr. George K. Thomas**, St. George College, Aruvithura
5. **Dr. Abraham Samuel K.**, C.M.S. College, Kottayam
6. **Mr. Sunny Jose**, St. Xavier's College, Vaikom
7. **Mrs. K.V. Zeena**, Maharajas College, Ernakulam
8. **Dr. John Joseph**, S.H. College, Thevara
9. **Mr. Thomas M. Paimpalil**, St. Stephen's College, Uzhavoor
10. **Mrs. Syamala M.V.**, Maharajas College, Ernakulam
11. **Dr. Jyothis Mathew**, School of Biosciences, Mahatma Gandhi University

**Brief Report**

The members of the Board of Studies met several times and worked out the format for the proposed restructuring of the undergraduate programme in Zoology in Choice Based, Credit and Semester System and introduction of Grading in Valuation as per the guidelines envisaged by the University. The chairperson and members met experts in various disciplines of the subject, and attended workshops conducted by the experts from KSHEC.

The five-day workshop was conducted by the University in continuation of the Board of Studies chairperson's meeting on 8-5-09 FN and Board of Studies members meeting on 8-5-09 AN. The workshop was conducted on 14-5-09, 15-5-09, 20, 21, and 22 May 2009 at School of Environmental Studies, Mahatma Gandhi University, P.D. Hills, Kottayam. 61 teachers attended the workshop. The Hon. Vice Chancellor Dr. Rajan Gurukkal inaugurated the workshop. Hon. ProVice-Chancellor Dr. Rajan Varghese presided over the meeting, Prof. K. Mathew, Prof. Chandra Shekharan and Prof. Sadasivan Nair Members Syndicate gave the guidelines for the workshop. The resource persons participated in the workshop (July 24, 25 and 31) 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. Shirley Annie Oommen, Mrs. Gladys Francis, Dr. Reethamma O.V. Mrs. Antonio Roseline, Mr. T.K. Mukundan, Dr. K.J. Benny, Mr. Jose Abraham, Mrs. Bina Jacob, Dr. Sampath Kumar, Dr. Susan Thomas, Miss. Tigi Paul, Mr. Madhusudhanan, and Miss Usha P. Hariharan. Dr. Jyothis Mathew, Dr. T. Thomas Philip, Issac P. Thomas and Mr. Jojo Joseph gave expert advice in the formulation of syllabus for Microbiology, Immunology, Bioinformatics and Biological Techniques and Specimen preparation. The teams constituted under the leadership of Members of Board of Studies, discussed in detail the syllabi and presented the courses and suggestions emerged from these group discussions and presentations helped to restructure the programme as envisaged by the Kerala State Higher Education Council and Mahatma Gandhi University. The participants contributed actively to the cause and appreciated the University in restructuring the undergraduate syllabi in Choice Based Course, Credit, and Semester System and introduction of grading pattern in valuation. The Chairperson Dr. Susan Panicker is thankful to the authorities of the Kerala Higher Education Council and Mahatma Gandhi University, the members of Board of Studies, Prof. Jacob Kurian Onattu, Principal 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.



  
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