

MAHARAJA'S COLLEGE, ERNAKULAM
[A GOVERNMENT AUTONOMOUS COLLEGE]
REGULATIONS FOR UNDER GRADUATE PROGRAMMES UNDER
CHOICE BASED CREDIT SYSTEM- 2016 ADMISSION ONWARDS

1. TITLE

1.1. These regulations shall be called "Regulations for Under Graduate Programmes under Choice Based Credit System, 2016" of Maharaja's College, Ernakulam [Autonomous].

2. SCOPE

2.1 Applicable to all Under Graduate Programmes conducted by Maharaja's College Ernakulam [Autonomous] with effect from 2016-17 admissions.

2.2 The provisions herein supercede all the existing regulations for undergraduate programmes to the extent herein prescribed.

3. DEFINITIONS

3.1. '*Academic Week*' is a unit of five working days in which distribution of work is organized from day1 today5, with five contact hours of one hour duration on each day. A sequence of 18 such academic weeks constitutes a semester.

3.2. '*College Co-ordinator*' is a teacher nominated by the College Council to co-ordinate the continuous evaluation undertaken by various departments within the college. He/she shall be nominated to the college level monitoring committee.

3.3. '*Common Course I*' means a course that comes under the category of courses for English and '*Common Course II*' means additional language, a selection of both is compulsory for all students undergoing undergraduate programmes. '*Common Course II*' is exempted in the cases of B.A Economics (Honours), B.Sc. Physics(Instrumentation) and B.Sc. Environmental Chemistry and Water Management programmes.

3.4. '*Complementary Course*' means a course which would enrich the study of core courses.

3.5. '*Core Course*' means a course in the subject of specialization within a degree programme.

3.6. '*Course*' means a complete unit of learning which will be taught and evaluated within a semester.

- 3.7. **'Credit'** is the numerical value assigned to a course according to the relative importance of the content of the syllabus of the programme.
- 3.8. **'Department'** means any teaching department in a college.
- 3.9. **'Department Co-ordinator'** is a teacher nominated by a Department Council to co-ordinate the continuous evaluation undertaken in that department.
- 3.10. **'Department Council'** means the body of all teachers of a department in a college.
- 3.11. **'Faculty Advisor'** means a teacher from the parent department nominated by the Department Council, who will advise the student in the choice of his/her courses and other academic matters.
- 3.12. **Grace Marks** shall be awarded to candidates as per the M.G.University orders issued from time to time in recognition of meritorious achievements in NCC/NSS/Sports/ Arts and Cultural Activities.
- 3.13. **'Grade'** means a letter symbol (e.g., S, A, B, C, etc.), which indicates the broad level of performance of a student in a course/ semester/programme.
- 3.14. **'Credit Point (CP)'** of a course is the value obtained by multiplying the grade point (GP) by the Credit (C) of the course $CP = GP \times C$.
- 3.15. **'Cumulative Grade Point Average (CGPA)'** is the value obtained by dividing the sum of credit points in all the courses taken by the student for the entire programme by the total number of credits and shall be rounded off to two decimal places.
- 3.16. **'Choice based Course'** means a course other than in the subject of specialization which can be opted by a student/department in a degree programme.
- 3.17. **'Parent Department'** means the department which offers core courses within a degree programme.
- 3.18. **'Programme'** means a three year programme of study with examinations spread over six semesters, according to the regulations of the respective programme, the successful completion of which would lead to the award of a degree.
- 3.19. **'Semester'** means a term consisting of a minimum of **450** contact hours distributed over **90** working days, inclusive of examination days, within **18** five-day academic weeks.

4. ELIGIBILITY FOR ADMISSION, AND RESERVATION OF SEATS

4.1 Eligibility and Norms for admission and reservation of seats for various Degree Programmes shall be according to the rules framed by the Mahatma Gandhi University/State Government from time to time.

5. DURATION

5.1 The duration of U.G. programmes shall be **6 semesters** (the semesters defined under 3.19 above).

5.2 The duration of odd semesters shall be from **June to October** and that of even semesters from **November to March**. There shall be one week *semester break after odd semesters and two months vacation during April and May in every academic year*.

5.3 A student may be permitted to complete the Programme, on valid reasons, within a period of 8 continuous semesters from the date of commencement of the first semester of the programme.

6. REGISTRATION

6.1 The strength of students for each course shall remain as per existing regulations.

6.2 Each student shall register for the courses in the prescribed registration form in consultation with the Faculty Advisor within two weeks from the commencement of each semester. Faculty Advisor shall permit registration on the basis of the preferences of the student and availability of seats.

6.3 The number of courses/credits that a student can take in a semester is governed by the provisions in these regulations pertaining to the minimum and maximum number of credits permitted.

6.4 Those students who possess the required minimum attendance and progress during a semester and could not register for the semester examination are permitted to apply for Notional Registration to the examinations concerned enabling them to get promoted to the next class.

7. SCHEME AND SYLLABUS

7.1. The U.G. programmes shall include (a) Common courses I & II, (b) Core courses, (c) Complementary Courses, (d) Choice Based Course I & II. Complementary Courses are exempted in the case of B.Com and B.A Economics (Honours) programmes.

7.2. Credit Transfer and Accumulation system can be adopted in the programme. Transfer of Credit consists of acknowledging, recognizing and accepting credits by an institution for programmes or courses completed at another institution. The Credit Transfer Scheme shall allow students pursuing a programme in one College to continue their education in another College without break.

The College shall allow credit transfer, subject to the approval of the concerned Board of Studies and Academic Council.

8. PROGRAMME STRUCTURE

The structure of UG Programmes is as follows:

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the programme	120
c	Minimum credits required from common courses	38*
d	Minimum credit required from common courses in B.Com.	24
e	Minimum credit required from common courses in B.A. Economics(Honours), B.Sc. Instrumentation and B.Sc. Environmental Chemistry	8
f	Minimum credits required from Core + Complementary + Vocational courses including Project	74*
g	Minimum credits required from Choice Based Course I & II	8
h	Minimum attendance required	75%

*except in the case of Language Restricted Programmes [LRPs] including B. Com.,B.A Economics (Honours), B.Sc. Instrumentation and B.Sc. Environment Chemistry.

9. EXAMINATIONS.

The evaluation of each course shall contain two parts:

- (i) In-Semester Assessment (ISA)
- (ii) End-Semester Assessment (ESA)

The in-semester to end semester, assessment ratio shall be 1:4, for both courses with or without practical. There shall be a maximum of 80 marks for end semester assessment and maximum of **20** marks for in-semester assessment. For all courses (theory & practical), grades are given on a 10- point scale based on the total percentage of marks (**ISA+ESA**) as given below:

Percentage of Marks	Grade	Grade Point(GP)
95 and above	S Outstanding	10
85 to below 95	A ⁺ Excellent	9
75 to below 85	A Very Good	8
65 to below 75	A ⁻ Good	7
55 to below 65	B ⁺ Above average	6
50 to below 55	B Average	5
40 to below 50	C Pass	4
Below 40	F Fail	0
	Ab Absent	0

10. CREDIT POINT(CP), SEMESTER GRADE POINT AVERAGE (SGPA) & CUMULATIVE GRADE POINT AVERAGE (CGPA)

Credit Point (CP) of a course is calculated using the formula

$$CP = C \times GP, \text{ where } C = \text{Credit}; GP = \text{Grade point}$$

Semester Grade Point Average (SGPA) of a Semester is calculated using the formula

$$SGPA = TCP/TC, \text{ where } TCP = \text{Total Credit Point of that Semester}$$

$$TC = \text{Total Credit of that Semester}$$

Cumulative Grade Point Average (CGPA) of a Programme is calculated using the formula

$$CGPA = \frac{\sum(TCP \times TC)}{\sum TC}$$

CGPA shall be rounded off to two decimal places

Grades for the different semesters and overall programme are given based on the corresponding CPA as shown below:

GPA	Grade
Equal to 9.5 and above	S Outstanding
Equal to 8.5 and below 9.5	A ⁺ Excellent
Equal to 7.5 and below 8.5	A Very Good
Equal to 6.5 and below 7.5	A ⁻ Good
Equal to 5.5 and below 6.5	B ⁺ Above average
Equal to 5.0 and below 5.5	B Average
Equal to 4.0 and below 5.0	C Pass
Below 4.0	F Failure

Note: A separate minimum of 30% marks each for in-semester and end semester (for both theory and practical) and aggregate minimum of 40% are required to pass for a course. For the

successful completion of a semester, a student should pass all courses and score a minimum **SGPA** of 4.0. However, a student is permitted to move to the next semester irrespective of his/her **SGPA**. To pass in a programme, a separate minimum of Grade **C** is required for all the individual courses. If a candidate secures **F** Grade for any one of the courses offered in a Semester/Programme only **F** grade will be awarded for that Semester/Programme until he/she improves this to **C** grade or above within the permitted period. Candidate secures **C** grade (**CGPA**) and above shall be eligible for higher studies.

11. MARKS DISTRIBUTION FOR END SEMESTER EXAMINATION AND IN-SEMESTER EVALUATION

The end semester examination of all semesters shall be conducted by the college at the end of each semester. All theories, practicals and project(s) are treated as individual papers and marks should be in the 80(external)/20 (internal) pattern. In-semester evaluation is to be done through continuous assessment. Marks distribution for end semester and in-semester assessments and the components for in-semester evaluation with their marks are shown below:

Components of the in-semester evaluation and their marks are as below.

11.1 For all courses without practical

- a) **Marks of End Semester Examination : 80**
- b) **Marks of In Semester Evaluation : 20**

All the three components of the in-semester assessment are mandatory.

Components of In-Semester Evaluation	Marks
Attendance	5
Assignment /Seminar/Viva	5
2 Test papers*	10
Total	20

*marks of test papers shall be the average

11.2 For all courses with practical

- a) **Marks of theory -End Semester Examination : 80**
- b) **Marks of theory – In Semester Evaluation : 20**

Components of Theory–In Semester Evaluation	Marks
Attendance	5
Assignment/Seminar/Viva	5
2 Test papers*	10
Total	20

*marks of test papers shall be the average

c) Marks of Practical –End semester Examination: 80

(Practicals shall be conducted in even semesters for all programmes except commerce. For Commerce, in semester evaluation shall be conducted separately for odd and even semesters).

d) Marks of Practical- In Semester Evaluation: 20

Components of Practical-In Semester evaluation	Marks
Attendance	4
Record*	10
Viva / Working Model Projects	6
Total	20

*Marks awarded for Record should be related to number of experiments recorded.

11.3 Project Evaluation: (Maximum marks100)

Components of Project-Evaluation	Marks
In-semester Evaluation*	20
Dissertation (End semester)	50
Viva-Voce (End semester)	30
Total	100

*Components of Internal Evaluation	Marks
Relevance and Contents	5
Analysis and Presentation	5
Pre-submission Presentation and Viva	10
Total	20

12. Attendance Evaluation

1) For all courses without practical

% of attendance	Marks
90 and above	5
85 – 89	4
80-84	3
76-79	2
75	1

(Decimals are to be rounded to the next higher whole number)

2) **For all courses with practical**

% of Attendance	Marks for theory	% of Attendance	Marks for practical
90 and above	5	90 and above	4
85--89	4	85—89	3
80--84	3	80—84	2
76-79	2	75—79	1
75	1		

(Decimals are to be rounded to the next higher whole number)

13. In-Semester Assessment

The evaluation of all components is to be published in the department and is to be acknowledged by the candidates. All documents of in-semester assessments are to be kept in the department for two years and shall be made available for verification by the college authorities.

13.1 Grievance Redressal Mechanism for In-Semester Assessment

In-Semester assessment shall not be used as a tool for personal or other type of vengeance. A student has every right to know, how the teacher arrived at the marks. In order to address the grievance of students, a two-level Grievance Redressal mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1:Department Level: The department cell chaired by the Head; with Dept. coordinator and teacher in-charge,as members.

Level 2: College level: A committee with the Principal as Chairman, Dept. Coordinator, HOD of concerned Department and a senior teacher nominated by the College council as members.

13.2 The college council shall nominate a senior teacher as coordinator of in-semester evaluations. This coordinator shall make arrangements for giving awareness of the in-semester evaluation components to students immediately after commencement of I semester

13.3 The in-semester evaluation report in the prescribed format should reach the Controller of Examinations before the 4th week of October and March in every academic year.

14. End Semester Examination

The end semester examination of all semesters shall be conducted by the College at the end of each semester.

- 14.1** Students having a minimum of 75% average attendance for all the courses only can register for the examination. Condonation of shortage of attendance to a maximum of 10 days or 50 hours in a semester, subject to a maximum of 2 times during the whole period of the programme, may be granted by the subcommittee of the College Council on valid grounds. This condonation shall not be counted for in-semester assessment.

Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on production of participation/attendance certificates, within one week, from competent authorities and endorsed by the Head of the institution. This is limited to a maximum of 10 days per semester and this benefit shall be considered for in-semester assessment also.

Those students who are not eligible to attend the end semester examination due to shortage of attendance, even with condonation, shall repeat the course along with the next batch upon the recommendation of the Head of the Department and the College Council.

- 14.2** All students are to do a project. This project can be done individually or as a group of 3 students. The projects are to be identified during the 4th semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners appointed by the College.

- 14.3** Those candidates who have not appeared/failed in the end semester examinations of 5th and 6th Semester shall be eligible to appear for special supplementary examination by paying separate fees. For reappearance/ improvement, the students can appear along with the next batch.

- 14.4** A student who registers his/her name for the end semester examination will be eligible for promotion to the next semester.

- 14.5** A student who has completed the entire curriculum requirement, but could not register for the Semester examination can register notionally, for getting eligibility for promotion to the next semester.

14.6 A candidate who has not secured minimum marks/credits in in-semester examinations can re-do the same subsequently with the next batch.

14.7 All programmes and courses shall have unique alphanumeric code.

15. PATTERN OF QUESTIONS

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.

Pattern of questions for end semester examination for theory paper

	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
	10	8	1	8
	8	6	2	12
	8	6	5	30
	4*	2	15	30
TOTAL	30	22	x	80

*questions in bunches of two

16. There shall be 2 level monitoring committees for the successful conduct of the scheme. They are:

1. Department Level Monitoring Committee (DLMC), comprising HOD and two teachers nominated as members by the Department Council.

2. College Level Monitoring Committee (CLMC), comprising Principal, Controller of Examinations, Academic Coordinator, Department Co-ordinator and A.O/Superintendent as members.

17. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Principal shall, for a period of one year from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any programme with such modifications as may be necessary.

SEMESTER I**ZOO1COR01 Core Course I****ANIMAL DIVERSITY - INVERTEBRATA PART -I**

36 Hr

Credit 2

Objectives

- To study the scientific classification of invertebrate fauna.
- To learn the physiological and anatomical features of some invertebrate phyla through type study.
- To stimulate the curiosity in living things around them.
- To learn the evolutionary significance of various invertebrate fauna

Module I

(4 Hrs)

Diversity of life forms – An Overview

Efforts of classification	– Two-kingdom and Five-kingdom classification (Mention <i>Cavaller-smith's Eight-kingdom classification also</i>)
Nomenclature	-Uninomial, Binomial & Trinomial
Symmetry	– Asymmetry, Spherical, Radial, Biradial and Bilateral
Coelom	– Acoelomates, Pseudocoelomates and Eucoelomates Schizocoelom, Enterocoelom, Protostomia and Deuterostomia

Kingdom Protista

(10Hrs)

Type: - Paramecium

Salient features and classification upto Phyla.

*(Mention the names of phyla of animal-like, plant-like and fungus-like protists)***Animal-like protists***Salient features of animal-like protists with notes, on the examples cited.*

1. Phylum Rhizopoda : Amoeba
2. Phylum Actinopoda : Actinophrys

- | | |
|------------------------------|----------------|
| 3. Phylum Foraminifera: | Elphidium |
| 4. Phylum Ciliophora : | Paramecium |
| 5. Phylum Opalinata: | Opalina |
| 6. Phylum Kinetoplasta : | Trypanosoma |
| 7. Phylum Metamonada : | Giardia |
| 8. Phylum Choanoflagellata : | Proterospongia |
| 9. Phylum Parabasilia : | Trychonympha |
| 10. Phylum Sporozoa : | Plasmodium |

Plant-like protists

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

- | | |
|------------------------------|-------------|
| 11. Phylum Euglenophyta : | Euglena |
| 12. Phylum Cryptophyta : | Cryptomonas |
| 13. Phylum Bacillariophyta : | Diatoms |
| 14. Phylum Chlorophyta : | Volvox |
| 15. Phylum Rhodophyta : | Red Algae |
| 16. Phylum Dinoflagellata : | Noctiluca |

Fungus-like protists

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

- | | |
|----------------------------|--------------|
| 16. Phylum Myxomycophyta : | slime moulds |
| 17. Phylum Microsporidia : | Nosema |

General topics: (1) Parasitic Protists (Entamoeba ,Leishmania, Trypanosoma)

(2) Lifecycle of Plasmodium

(Mention different species of Plasmodium: *P.vivax*, *P.malariae*, *P.falciparum*,

P.knowlesi, and *P.ordi*)

Module II

Kingdom Animalia

Outline classification of Kingdom Animalia

(1Hr)

Three sub kingdoms – **Mesozoa, Parazoa and Eumetazoa**

Sub kingdom **Mesozoa** E.g. Rhopalura.

(3Hrs)

Sub kingdom **Parazoa**

Phylum Porifera

Salient features and classification upto classes

Class I – Calcarea E.g. Sycon.

Class II – Hexactinellida E.g. Euplectella.

Class III – Demospongia E.g. Cliona.

General topics

1. Reproduction in Sponges

2. Canal system in Sponges.

Sub kingdom **Eumetazoa**

Phylum Coelenterata

5Hrs

Salient features and classification upto classes

Type: Obelia

Class I- Hydrozoa Eg. Physalia.

Class II- Scyphozoa Eg. Rhizostoma.

Class III- Anthozoa Eg. Fungia

General topics

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

2. Polymorphism in Coelenterates.

MODULE III

Phylum Ctenophora

1 Hr

Salient features

E.g. Pleurobrachia

Phylum Platyhelminthes

4Hrs

Salient features and classification upto classes

Class I- Turbellaria E.g. Dugesia.

Class II- Trematoda E.g. Fasciola

Class III- Cestoda E.g. Taenia solium

General topics

1. Life history of *Fasciola hepatica*.
2. Platyhelminth parasites (*Schistosoma*, *Taenia solium*, *Echinococcus*).

Superphylum : Aschelminthes

Phylum Nematoda

4Hrs

Salient features and classification upto classes

Class- Phasmodia E.g. Enterobius, Ascaris

Class -Aphasmodia E.g. Trichinella

General topic

Pathogenic nematodes. (*Wuchereria bancrofti*, *Brugia malayi*, *Ancylostoma duodenale*, *Enterobius vermicularis*, *Ascaris lumbricoides*)

Phylum Annelida

2Hours

Salient features and classification upto classes

Class I- Archannelida E.g. Polygordius

Class II- Polychaeta E.g. Nearthes

Class III- Oligochaeta E.g. Pheretima

Class IV- Hirudinomorpha E.g. Hirudinaria

Phylum Onychophora

2 Hrs

Distribution, peculiarities and affinities

E.g. Peripatus

References:-

Anderson D.T 2001, Invertebrate zoology 2nd edition Oxford university press

Barnes,R.D (1987) Invertebrate Zoology ,Vth Edition ,W.B SAUNDERS Newyork

Thomas A. P. (Editor) 2009. , Invertebrata , Greenleaf Publications, Kottayam.

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, Invertebrates Part I and Part

II. S. Viswanathan Printers and Publishers Pvt. Ltd.

Parker & Haswell, Text book of zoology-Invertebrate ,volume 1, 7th edition

Zoological Society of Kerala Study material. Animal Diversity 2002.

SEMESTER I ZOO1P01 PRACTICAL**ANIMAL DIVERSITY- INVERTEBRATA PART -I****36 Hours****Credit 1****Scientific Drawing:-**

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

Anatomy:-**Study of sections. (Any two)**

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

Dissections/Virtual Dissection

1. Earthworm - Alimentary canal upto 26th segment
2. Earthworm - Nervous system

Mounting:-

1. Nereis - Parapodia
2. Earthworm - Setae
3. Earthworm – Spermatheca

Identification:-General identification- The students are expected to identify the animals by their generic names and 20% of these by their specific names. Protista , Porifera, Coelenterata, Platyhelminthes, Annelida (15 specimens)

SEMESTER II**ZOO2COR02-Core Course II****ANIMAL DIVERSITY - INVERTEBRATA PART II**

36 Hrs

Credits 2

Objectives:

- To study the scientific classification of invertebrate fauna.
- To learn the physiological and anatomical features of some invertebrate phyla through type study.
- To stimulate the curiosity in living things around them.
- To learn the evolutionary significance of various invertebrate fauna

Module I**Phylum Arthropoda****11 Hrs**

Salient features and Classification upto classes

Type :- Penaeus

1. Subphylum: Trilobitomorpha

Class – Trilobita (*Mention salient features*)

2. Subphylum: Mandibulata

Class I –	Crustacea	E.g. Sacculina
Class II –	Chilopoda	E.g. Scolopendra (Centipede)
Class III –	Symphyla	E.g. Scutigera
Class IV –	Diplopoda	E.g. Julus (Millipede)
Class V –	Insecta	E.g. Periplaneta (Cockroach)
Class VI –	Paupoda	E.g. Pauropus

3. Subphylum

Chelicerata

Class I –	Merostomata	E.g. Limulus
Class II –	Arachnida	E.g. Scorpion

General topics

1. Vectorial arthropods -Mosquitoes, Sand flies, Flea, Ticks

2. Larval forms of Penaeus

Module II**4hrs****Phylum Mollusca**

Salient features and Classification upto classes

Class I Monoplacophora	E.g. Neopilina
Class II Amphineura	E.g. Chiton
Class III Gastropoda	E.g. Pila
Class IV Scaphopoda	E.g. Dentalium
Class V Pelecypoda	E.g. Pinctada
Class VI Cephalopoda	E.g. Sepia

General topics

Pearl formation and culture

Phylum Echinodermata**6Hrs**

Salient features and Classification upto classes

Class I	Asteroidea	E.g. Astropecten
Class II	Ophiuroidea	E.g. Ophiothrix
Class III	Echinoidea	E.g. Echinus
Class IV	Holothuroidea	E.g. Holothuria
Class V	Crinoidea	E.g. Antedon

General topics

Water vascular system

Larval forms of echinoderms

Minor phyla**2Hrs**

Salient features

1. Chaetognatha E.g. Sagitta
2. Sipunculida E.g. Sipunculus

3. Rotifera E.g. Brachionus (Examples in brief)

Phylum Hemichordata

Salient features

1Hr

Eg. Balanoglossus (brief)

Module III

12Hrs

Phylum Chordata

Salient features and classification

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

Sub Phylum: Urochordata

Salient features

Class I Larvacea E.g. Oikopleura

Class II Ascidiacea E.g. Ascidia (Mention retrogressive metamorphosis)

Class III Thaliacea E.g. Doliolum

Sub phylum: Cephalochordata

Salient features

E.g. **Amphioxus- Type**

References :

Barnes, R.D (1982) Invertebrate Zoology ,Vth Edition

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Ekabaranatha Ayyar M. 2000. A Manual of Zoology. Volume 2. S. Viswanathan Printers & Publishers. Pvt. Ltd.

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.

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

SEMESTER II**ZOO2P02 PRACTICAL****ANIMAL DIVERSITY- INVERTEBRATA PART II****36 hrs.****Credit 1**

Scientific Drawing:- Make scientific drawings of 5 locally available invertebrate specimens belonging to different phyla (Arthropoda to Hemichordata)

Anatomy: - Study of sections.

1. Amphioxus - T.S through pharynx and T.S through intestine

Dissections /Virtual dissection

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

Mounting:-

1. Prawn -Appendages
2. Honey bee/plant bug/Mosquito (any two) -Mouth parts
3. Cockroach -Salivary glands

Identification:-General identification- The students are expected to identify the following animals by their generic names and 20% of these by their specific names. (Arthropoda, Mollusca Echinodermata, Hemichordata and Protochodata) (15 specimens)

Taxonomic identification with key:- Identification of insects up to the level of order. (5 Specimens) Odonata, Coleoptera, Diptera Hymenoptera, Lepidoptera.

SEMESTER III

ZOO3COR03 CORE COURSE III
ANIMAL DIVERSITY – VERTEBRATA

54 Hrs

Credits 3

Objectives:

- To make the student observe the diversity in chordates and their systematic position.
- To appreciate the diversity of life forms
- To inculcate the a sense of scientific enquiry on biodiversity related topics

Module I**10Hrs****Sub phylum: Vertebrata****Division 1** - Agnatha

Class I Ostracodermi Eg: Cephalaspis

Class II Cyclostomata Eg: Petromyzon

Division 2_ Gnathostomata**Super Class** : Pisces

Salient features and classification

Class: Chondrichthyes

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

Class: Osteichthyes

Sub Class – Choanichthyes

Order1- Crossopterigii Eg: Latimeria

Order 2: Dipnoi Eg: Lepidosiren

Sub Class – Actinopterigii

Super Order 1- Chondrostei Eg: Acipencer

Super Order 2- Holostei Eg- Amia

Super order 3- Teleostei Eg: Sardine

General topics

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

Module II**10 hrs**

Super Class Tetrapoda

Class : **Amphibia**

Salient features and classification

Type - Frog (*Euphlyctis hexadactylus*)

Order I Anura Eg: Hyla (Haplobatrachus tigrinis)

Order II Urodela Eg: Amblystoma (Mention axolotl larva and neoteny -
paedomorphosis)

Order III Apoda Eg: Ichthyophis.

General Topics

Climate change and threat to amphibians in Kerala

Parental care in amphibians

Module III**6Hrs****Class : Reptilia**

Salient features and classification

Sub Class I : Anapsida

Order : Chelonia

Eg: Chelone

Sub Class II : Parapsida

Eg: Ichthyosaurus

Sub Class III : Diapsida

Order : Rhynchocephalia

Eg : Sphenodon

Order : Squamata

Eg : Chamaleon

Order : Crocodilia

E.g. Crocodylus

Sub Class IV : Synapsida

Eg: Cynognathus

General topic

Identification of poisonous and non- poisonous snakes of Kerala

Snake venom, poison apparatus, and biting mechanism of snakes

Sphenodon -characters and affinities

Module IV

10 Hrs

Class Aves

Salient features and classification

Type: Pigeon (Columba livia)

Sub Class I : Archeornithes E.g. Archeopteryx

Sub Class II : Neornithes

Super Order I

Palaeognathae

Eg: Struthio

Super Order I

Neognathae

Eg: Pavo cristatus

General topics

1. Migrations in birds

2. Flight adaptations in birds.

3. Birds of Kerala (brief account)

Module V

18Hrs

Class : Mammalia

Salient features and classification

Type : Rabbit

Sub Class I : Prototheria

Eg: Echidna

Sub Class II: Theria

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

General topics

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

Core readings

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Jordan E L and .P.S. Verma, 2002 Chordate Zoology S. Chand and Co. New Delhi.

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New Delhi.

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Thomas A P (Editor) 2010 Chordata.

SEMESTER III**ZOO3P03 CORE PRACTICAL****ANIMAL DIVERSITY VERTEBRATA****36hrs****Credit 1****1. Morphology: Scientific Drawing**

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

2. Dissections/Virtual Dissection

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

1. Frog Viscera

2. Frog Digestive System

3. Frog Arterial System

4. Frog 9th & 1st Spinal nerve

5. Frog Sciatic Plexus

6. Frog Brain/Shark 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

Amphioxus T. S. through intestine

5. Identification:-

General identification-

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

(Pisces-5, 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 IV**ZOO4COR04 CORE COURSE IV****BIODIVERSITY AND MODERN SYSTEMATICS****54 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

UNIT I: BIODIVERSITY**Module I****(3 hrs)****Introduction** -Definition,

Alpha, Beta, and Gamma diversity

-Scope and importance of biodiversity

Levels of biodiversity

-Genetic, Species, Ecosystem

- biodiversity on earth- Tropical, temperate and polar

Module II

Values of biodiversity (2 hrs)

Direct use value, Indirect use value, Non use value, Ecosystem services

Module III**Threats to biodiversity** (5 hrs)

Types of threats

Habitat loss, man- wildlife conflict (with case studies)

Invasive species, Pollution

Anthropogenic activities

Climate change

Module IV**Biodiversity conservation and management** (14 hrs)

Conservation strategies

In situ, ex situ

National parks, Sanctuaries and Biosphere reserves

International efforts

WWF, CITES

Convention on Biological Diversity (CBD)

IUCN-Mention status, Red and Green Data Book,

WCMC, UNEP

Conservation strategies in India, MoEF

Legal measures

Wild life Protection Act, 1972

The Environment Protection Act, 1986

Forest (Conservation) Act 1980, 1988

Biodiversity Act 2002

Biodiversity rule 2004

National biodiversity action plan

Peoples participation, Peoples biodiversity register (PBR)

Local initiatives

(Chipko movement, Narmada Bachao Andolan, Silent Valley)

Module V

Animal Collection techniques

(4 hrs)

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

Preservation techniques - Curation, Taxidermy

Rearing techniques

Laboratory and field.

Module VI**(5 hrs)****Biodiversity estimation****Tools and techniques**

Sampling techniques – Quadrate, Line transect

Measurements - Density, Abundance, Frequency

Biodiversity indices -Concepts

Shannon-Weiner, Simpson

Module VII**Bioethics****(7Hrs)**

Introduction

Animal rights and animal laws in India.

Prevention of cruelty to animals Act 1960

Concept of 3 R - (**R**efine- to minimize suffering, **R**educe -to minimize animals, **R**eplace – modern tools and alternate means)

Animal use in research and education.

Laboratory animal use, care and welfare

Animal protection initiatives-Animal Welfare Board, CPCSEA

Working with Humans -harm, risk, and benefits, Consent.

Human Rights Act-1995, 1998.

UNIT II MODERN TAXONOMY (14 hrs)**Module VIII****Taxonomical Principles (9 hrs)**

Brief history

Concepts and definition

Importance of classification

Approaches of taxonomy

Molecular taxonomy

Phylogeny and Taxonomy

Tree of Life, bar coding of life

Zoological nomenclature

International Code of Zoological Nomenclature (ICZN)- Rules

Module IX**Tools and techniques (5 hrs)**

Identification Keys

Dichotomous keys (Single access key)

Polytomous key

Multi access key

Advantages and disadvantages

References:

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

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

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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.

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

SEMESTER IV**ZOO4P04 CORE PRACTICAL****BIODIVERSITY AND MODERN SYSTEMATICS**

36 Hrs

Credit 1

1. Quadrature study
2. Transect study
3. Sampling
4. Species area curve
5. Identification using keys- Fish, Snake
6. Taxa, identification techniques
 - Bird body parts
 - Butterfly/ dragonfly body parts and venation
7. Identification of any 20 local fauna representing different taxa
8. Field study (compulsory)
 - Visit to two important areas of biodiversity
 - Report on local biodiversity conservation efforts
 - Eg. Sacred grooves, medicinal plant garden
 - Watch birds in their natural habitat and prepare a field note
 - (Report should be submitted by each student)

SEMESTER V**ZOO5COR05 CORE COURSE V
METHODS AND APPROACHES IN BIOLOGY**

54 hrs

Credit 3

Objectives

- To develop proper scientific mind, understand some basic concept of research in biology and its methodologies
- To gain an understanding of tools and techniques used for data collection in biology
- Student will learn how to choose and apply statistical tools to data sources, when and how statistical tools can be used to analyze data and to gain experience in using computer technology in the application of statistical procedures.
- To gain a theoretical as well as hands on experience with common bioinformatics tools and databases.

UNIT 1 RESEARCH METHODOLOGY**6 hrs****Module 1**

- Research- Types of Research based on Purpose- Basic and Applied Research
- Process of Research-Steps
- Research Communication
- Research report writing (Structure of a scientific paper)
- Project proposal writing
- Seminar, debate, workshop, colloquium, Conference Brief description and major differences
- Ethical issues in Biological research, Plagiarism
- Role of IPR in Research and Development

UNIT 2 TOOLS & TECHNIQUES IN BIOLOGY**12 hrs****Module 2**

- Microscopes –Light microscopes ,dark- field, fluorescent, Phase-contrast, Electron microscopes-TEM and SEM, STEM ,Video microscopy

- Colorimeter, Spectrophotometer, pH meter, Chromatography, Electrophoresis, Centrifuge, Camera Lucida, Micrometry

Units of Measurements-concentrations- percent volume; ppt; ppm Chemical – molarity, normality

UNIT 3 BIOSTATISTICS

18 Hrs

Module 3

- Collection of data, Classification of data-Samples and Population
- Data presentation –tables, Diagram (Bar diagram, Pie diagram, pictogram) graphs(line graphs, Histogram, frequency curve, frequency polygon)
- Measures of central tendency- Mean, Median, Mode, (merits & demerits)
- Measures of Dispersion- Mean deviation, Standard deviation, Range, Standard error(merits & demerits)
- Correlation –Definition, Types of correlation
- Statistical tests-Basic concepts, test of significance, procedure for testing hypothesis.t test, chi square, ANOVA(Basic concepts only)
- Statistical inference-Probability distribution(Binomial, Poisson distribution, Normal distribution) -brief description only
- Statistical packages- SPSS

UNIT 4 BIOINFORMATICS

18 hrs

Module 4

(6 Hrs)

- Definition, Basic concepts in Bioinformatics, importance and role of bioinformatics in life sciences
- Contrast between Bioinformatics and computational biology
- Bioinformatics databases-Nucleotide sequence databases- NCBI- GENBANK. DDBJ,EMBL-ENA
- Protein databases- structure and sequence databases- PDB, SWISSPROT

Module 5

(8 Hrs)

- FASTA sequence file formats
- Scoring matrices- PAM& BLOSUM- Brief account
- The BLAST search engine- Important features
- Multiple sequence alignment
- Molecular Phylogeny

Module 6

(4 Hrs)

- Molecular visualization software- RASMOL
- ORF Finding Tool
- Single Nucleotide Polymorphism

References

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.

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Ruxton, G.D. and Colegrave, N. 2006. Experimental design for the life sciences. Oxford University Press. Chapters 1-6.

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Claverie & Notredame, Bioinformatics - A Beginners Guide, Wiley-Dreamtech India Pvt Ltd, 2003

Dan E. Krane and Michael L. Raymer, Fundamental Concepts of Bio-informatics, Pearson Education.

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

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

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

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

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

SEMESTER V

ZOO5PO5 PRACTICAL V

Methods and Approaches in Biology

36 hrs

Credit 1

1. Micrometry- Calibration and measurement of microscopic objects
2. Make illustration using Camera lucida- Mention scale used
3. Paper Chromatography (Demonstration only)
4. Graphical representation of biological data using Histograms, Line graphs and Pie diagrams
5. Find arithmetic mean, median, mode and range of a given data
6. Standard deviation of a biological data
7. Apply appropriate statistical test to solve the problem (Instructor can choose problems involving, t-test/ chi square/ANOVA) using statistical packages in EXCEL/ MINITAB etc
8. Download a specified sequence from NCBI and search it with BLAST and report result with comments.
9. Download any simple molecular structure and visualize it using RASMOL and comment on it
10. Download 2 sample genome sequences and find SNPs in it.

SEMESTER V

ZOO5CORE06 CORE COURSE VI

CELL BIOLOGY AND MOLECULAR BIOLOGY

54 Hrs

Credits

Objectives:

1. To emphasize the central role of Cell biology and Molecular biology, being the rapidly 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.(General statement)

UNIT 1 - CELL BIOLOGY**29 Hrs****Module I Introduction to cell and molecular biology****(2 hrs)**

Cell theory, Prokaryotic and Eukaryotic cells, Actinomycetes, Mycoplasmas, Viruses, Virions and Viroids, Prions.

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

Module III Ultrastructure of Cytoplasm (7 hrs)

Organization and functions of the following

Cytoskeleton - Microtubules, microfilaments, intermediate filaments.

Centriole

Endoplasmic reticulum, Ribosomes (Prokaryotic and Eukaryotic) Golgi complex ,
Lysosomes - Polymorphism - GERL concept,

Mitochondria-Endosymbiont hypothesis.

Module IV Nucleus (6 hrs)

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

Module V Cell Division (3 Hrs.)

Cell cycle - G₁, S, G₂ and M phases

Mitosis and Meiosis

Module VI Cell Communication (5Hrs.)

Cell signalling ,types of signalling - Signalling molecules (neuro- transmitters,
hormones, growth factors, cytokines, vitamin A and D derivatives) Role of cyclic
AMP ,Aging, Apoptosis and cancer biology(Brief account only)

PART II - MOLECULAR BIOLOGY 25Hrs.

Module VII Nature of Genetic Materials (9 Hrs)

Discovery of DNA as genetic material – Griffith's transformation experiments.

Hershey Chase Experiment of Bacteriophage infection, Chemical Structure of

DNA, Watson-Crick Model, Chargaff's rule, types of DNA & RNA. DNA replication. Modern concept of gene (Cistron, muton, recon, viral genes). Prokaryotic genome, Eukaryotic genome, Brief account of the following-- Split genes (introns and exons), Junk genes, Pseudogenes, Overlapping genes, Transposons

Module VIII Gene Expression

(10 hrs)

Central Dogma of Molecular Biology, One gene-one enzyme hypothesis, One gene-one polypeptide hypothesis. Characteristics of genetic code, Transcription (Prokaryotic and eukaryotic), Reverse transcription, post transcriptional modifications, Translation, Post translational modifications.

Module IX Gene regulations

(6 hrs)

Prokaryotic gene regulation (inducible, repressible systems), Operon concept -Lac operon and Tryptophan operon. Brief account of Eukaryotic gene regulation, Catabolite repression (Glucose effect).

References :

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SEMESTER V**ZOO5P06 PRACTICAL VI****CELL BIOLOGY AND MOLECULAR BIOLOGY**

36 hrs

Credit 1

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

SEMESTER V**ZOO5CORE07 CORE COURSE VII****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

UNIT I: ENVIRONMENTAL BIOLOGY**45 hrs****Module 1. Introduction****(2 hrs)**

- History, development-Major land marks in the history of Environmental Science in chronological Order -Stockholm conferences, Earth Summit and Climatic Change Conferences etc

Module 2. Ecology and Ecosystems**(16 hrs)**

- Ecology Concept and branches,
- Abiotic and biotic components (Brief description only)
- Terrestrial ecosystem Forest,-Types, distribution and adaptation
 - Desert- Types ,distribution and adaptation
 - Grassland – Types, distribution and adaptation
 - Tundra-Types and Adaptations
- Freshwater ecosystem - Physico chemical nature (Brief description only)

- Types: Lentic , Lotic , Ground water
- Marine ecosystem: Physico chemical nature (Brief description only)
 - Intertidal zone , Rocky shore, Muddy shore, Sandy shore ,Open sea-
Pelagic realm, Benthic realm
 - Coral reef and its conservation
 - Wetland and mangroves, Estuaries

Module 3 Environmental Issues

(8 hrs)

- Causes and effects of land degradation with special reference to Kerala
- Degradation/loss of freshwater resources, wetlands/paddy fields in Kerala
- Convention on wetlands (Ramsar, 1971)
- Ramsar sites in Kerala threats and conservation aspects
- Coastal regulation Zone –Implications to Kerala
- Impact of tourism on Environment

(Students are expected to visit places of biological importance listed above)

Module 4. Municipal Waste & Management

(5 hrs)

- Types of waste –Solid, sewage ,medical and e-waste
- Degradable and Non degradable
- Plastic pollution-Problems and management
- Medical waste: Sources, types and management strategies
- E-waste -sources, Toxic ingredients, Effects on environment and human health &
Management strategies.

Module 5.Man and Environment

(5 hrs)

- Natural resources- Introduction (concept)
- Energy resources- Conventional, Non conventional

- Energy crisis and energy conservation measures

Module 5. Global environmental changes (9 hrs)

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

PART II. DISASTER MANAGEMENT AND TOXICOLOGY 9 hrs

Module 6. Disaster Management (5 hrs)

- Definition, Classification : Natural, Anthropogenic, Hybrid
- Earthquake, Landslide, Flood, Drought, Cyclone, Tsunami
- Mitigation measures

Module 7. Toxicology (4 hrs)

- Definition, History of toxicology, Classification - occurrence/ source
- Toxicants of biological origin & Non biological Origin- Aflatoxin, Botulinum toxin
Heavy metal toxicants , Food additives

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.

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SEMESTER V**ZOO5P07 PRACTICAL VII****ENVIRONMENTAL BIOLOGY, TOXICOLOGY & DISASTER MANAGEMENT**

36 hrs

Credit 1

1. Estimation of dissolved oxygen
2. Estimation of dissolved carbon dioxide
3. Estimation of Soil Organic Carbon(Demonstration only)
4. Determination of pH using pH paper /digital pH meter
5. Plankton count
6. Identification of freshwater/ marine plankton
7. Extraction of soil organisms(Demonstration only)
8. Identification of minerals and rocks
9. Sechi disc, Plankton Net
10. Study of Food Web
11. Compulsory Field Study report on one Terrestrial/Marine/Fresh Water ecosystem

SEMESTER V**ZOO5COR08 CORE COURSE VIII****BIOCHEMISTRY, HUMAN PHYSIOLOGY AND ENDOCRINOLOGY****54 hrs****Credits 3****UNIT I. BIOCHEMISTRY****(18 hrs)****Module1 General biochemistry, Bioelements and Biomolecules 4 hrs**

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

Module -2 Metabolism**10 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

Module 3- Enzymes**4 hrs**

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

UNIT II. HUMANPHYSIOLOGY**25Hrs****Module 4- Nutrition****3 hrs .**

Food adulteration, Defects of modern food habits, Dietary fibres, Antioxidants and functions, BMI, nutrition during pregnancy, breast feeding, anorexia, acidity and ulcers, fasting and its significance, malfunctions of gastro intestinal tract, Vitamins—source and deficiency disorders

Module 5 -Respiration**5 hrs**

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

Module 6 Circulation**4 hrs**

Cerebral circulation, blood brain barrier and cerebrospinal fluid, haemodynamic principles, formation and fate of blood cells, Haemostasis, blood clotting mechanism , intrinsic and extrinsic pathways, clotting factors, Anticoagulants, blood transfusion (safety and security problems),stroke, haemolysis, jaundice, thrombosis, ESR.

Module 7 Excretion**4 hrs**

Urine formation, 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.

Module 8 -Muscle physiology **3 hrs**

Ultrastructure of Skeletal muscle, 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.

Module 9 Neurophysiology**4 hrs**

Nerve impulse transmission, Regeneration of fibres and role of 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.

Module 10-Sports physiology**2hrs**

Muscular, Respiratory and cardiovascular changes during exercise, dope test, drug abuse. Significance of exercise in body fitness.

UNIT III ENDOCRINOLOGY**11 hrs****Module 11****5 hrs**

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

Module 12**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. Endocrine Disruption-Thyroid and Sex hormones.

Core readings**Human Physiology**

Best and Taylor: Physiological basis of Medical practice

Chakrabarti, Ghosh&: Human Physiology, the New Book StallSchana.

Chatterjee C.C.: Human Physiology, Vol I & II Medical Allied Agency

Eckert & Randall : Animal Physiology, Mechanism and Adaptations , CBS publishers, New Delhi.

Ganong W F : Review of Medical Physiology, McGraw 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

SaradaSubramanyam& K. Madhavankutty : Textbook of human physiology, S. Chand & Co Ltd, New Delhi.

Endocrinology

Barrington, E.J.W. General and Comparative Endocrinology, Oxford, Clarendon Press.

Bentley, P.J.Comparative Vertebrate Endocrinology, Cambridge University Press.

David O. Norris Vertebrate Endocrinology 3th Edition,

Gorbman ,A *et. al.* Comparative endocrinology, John Wiley & Sons.

Hadley, M.E. 2000. Endocrinology, 5th ed. Prentice Hall, Upper Saddle River, NJ. Martin, C.R.

Endocrine Physiology, Oxford University Press

Norris, D.O. 1997. Vertebrate Endocrinology, 3rd ed. Academic Press, Sand Diego, CA.

Williams, R.H. Textbook of Endocrinology, W.B. Saunders

Biochemistry

Ackerman E, Biophysical Science, Prentice Hall Inc.

Awapara J, Introduction to Biological chemistry, Prentice-Hall of India

Cohn E E and Stumpf P K, outlines of Biochemistry, Wiley Eastern

Foster, R.L. Nature of Enzymology

Garett and Grisham.Biochemistry.

Harper's Illustrated Biochemistry, 27th Ed, McGraw Hill

Lehninger, Biochemistry ,Kalyani Publications

Lodishet. al. Molecular Cell Biology

RangnathaRao 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

SEMESTER V**ZOO5PO8 PRACTICAL VIII****BIOCHEMISTRY, HUMAN PHYSIOLOGY AND ENDOCRINOLOGY****36 hrs.****Credit 1****PHYSIOLOGY**

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

ENDOCRINOLOGY

1. Cockroach: Corpora cardiaca & Corpora allata (Demonstration)
2. Human hormonal disorders (Diagrams and photographs)

BIOCHEMISTRY

1. Qualitative analysis of protein, glucose, starch and lipid
2. Effect of Salivary Amylase on starch.

SEMESTER V**CHOICE BASEED CORE COURSE I****ZOO5CRE01 APLIED ZOOLOGY PART-1****72 hours****4 credits****UNIT 1 AQUACULTURE AND FISHERIES SCIENCE****46 hrs**

Module1. Aquaculture: Introduction, scope in India and Kerala, Export potential, Different types of cultures. **(3 hrs)**

Module 2. Mariculture Prawn culture: Important culture varieties, Pokkali culture, breeding spawning, control breeding, induced maturation, eye stalk ablation, culture methods, freezing, curing and canning.

Mussel culture: *Pernaindica*, *Pernaviridis*, Seed collection, artificial seed production, induced spawning, rearing, raft culture, harvesting. **(8 hrs)**

Module 3. Pisciculture and Fisheries Egg collection, induced spawning, construction, preparation and maintenance of ponds, manuring, feeding and harvesting, cryo preservation of fish germplasm, semen bank and preservation media. **(6 hrs)**

Biology and culture of Indian major carps :*Catlacatla*, *Labeorohita*, *Cirrhinamrigala*. **(3hrs)**

Biology and culture of Exotic carps:Eg: *Hypophthalmichthysmolitris* – (Silver carp). **(2hrs)**

Inland fishes and fisheries:eg: *Channa*, *Clarius* - Rivers, Paddy fields, Utilisation of sewage in fish culture. **(3 hr)**

General account and fishery aspect of sardine, shark, tuna. **(3 hrs)**

Plankton and Fishery production:Zooplankton and Phytoplankton – Vertical migration – Plankton and Productivity. **(2 hrs)**

Fishing Gears: Gill net / drift gill net, purse-seines, harpoon, Chinese dip nets, echo sounders, sonar, remote sensing. **(5hrs)**

Fish Spoilage and Preservation: Biochemical changes, spoilage, use of ice, freezing, canning, dehydration, salting, and smoking. **(4 hrs)**

Fish utilisation: Nutritive value, bye products, liver oil, body oil, fish meal, fish flour, Isin glass, glue, skin, fin soup, lime, chitin, chitosan. **(3 hrs)**

Diseases and parasites of Fish: Fungal infection – by – *Saproleginia* – Bacterial – Fin & tail rot disease, Dropsy. **(3 hrs)**

Mud banks of Kerala coast **(1 hr)**

UNIT II ORNAMENTAL FISH CULTURE AND AQUARIUM MANAGEMENT

26Hrs

Module 4 Concept and Scope of Ornamental Fish Culture. Common fresh water ornamental fishes –indigenous and exotic species .Common marine ornamentals- fishes, crustaceans, molluscs, echinoderms etc. Sexual dimorphism in ornamental fishes. Live bearers and egg layers. **(10hrs)**

Module 5 Breeding of ornamental fishes :General conditions for breeding-pH, temperature, sex ratio etc. Brood- stock management; selection of brooders, maintenance and management. Breeding of gold fish, Koei, Tetra, Barb, Fighter, Gourami and live bearers. Induced breeding in ornamental fishes. Colour enhancement techniques in fishes. **(10 hrs)**

Module 6 Aquarium management Concept and significance, Setting up of a fresh water aquarium, Fish feed- natural and artificial, Common diseases of aquarium fishes and their management. **(6hrs)**

General topics

Role of physical and chemical factors in aquaculture.

Fish weed organism: Sea weed culture. eg: *Grassilaria*, *Sargassum*.

Dairy products, manufacture and nutritive value.

Core readings

Banerji, G.C. : A text book of Animal husbandry, 1998. Oxford & IBH.

Banerji, G.C. Poultry, Oxford & IBH.

P.R. Venkitaraman: Economic Zoology.

V. Sudheeran: Economic Zoology.

Kurian C.V., Sebastian C.V: Prawn and Prawn fisheries in India, Hindustan Publication Corporation of India.

Alikunhi, K.R: Fish culture in India, KAV, ICAR.

Pillai, T.P: Aquaculture, Principles and Practices of fishing.

ICAR: Handbook of Animal Husbandry, 1990/97, ICAR, PUSA, N.D.

SEMESTER V**CHOICE BASED CORE COURSE II****ZOO5CRE01 WILDLIFE BIOLOGY****72 Hrs****4 Credits****Objective**

To make the students equipped with the knowledge of wildlife resources of India having emphasis to the principles and applications of various wildlife management techniques

Module I**7 hrs**

Wildlife Resources of India with special reference to Kerala: Definition of wildlife, Brief account of mammals, birds, herpetofauna, fishes, invertebrates of Kerala, IUCN status (brief account)

Module II**10 hrs**

Evaluation of Wildlife habitat: Define habitat – Forest habitat types (mangroves, moist deciduous, dry deciduous, semi evergreen, evergreen, shola forests)

Module III**20 hrs**

Population Estimation: Basic concepts and applications - Direct count (block count, transect methods, Point counts, visual encounter survey, waterhole survey). Indirect count (Call count, track and signs, pellet count, pugmark, camera trap, DNA finger printing and aerial photography).

Module IV**15 hrs**

Human-Wildlife Conflicts: Basic concepts, reason for conflicts, Identification of damages caused by wild animals and control measures. Case studies – Elephant, gaur, wild boar, monkey, tiger and leopard, Translocation of Wild animals – Principles, Methods and application. Human wildlife co existence, traditional knowledge in wildlife conservation

Wildlife management: Threats and conservation issues (poaching, habitat loss, habitat fragmentation and habitat degradation, roadside kills, alien species, pollution, other anthropogenic activities, endemism etc.). Wildlife (Protection) Act, 1972 – IUCN – CITES – NBA – IBA – Project Tiger – Project Elephant – Project Crocodile

Module V

20 hrs

Wildlife Conservation: Definition, In-situ and ex-situ conservation, formation, management and administration. Case studies (Silent Valley National Park, Chinnar Wildlife sanctuary, Periyar Tiger Reserve, Salim Ali Bird sanctuary, Thattekkad, Trivadrum Zoo, Arignagar Anna Zoological Park, Chennai).

Field visit and Report writing on any two destinations are taken for external evaluation during the practical examinations in the VIth Semester.

Core readings

- Saharia, V.B. 1982 Wildlife in India, Nataraj Publishers, Dehra Dun
- Seshadri, B.1986 India's Wildlife reserves , Sterling Pub'rs Pvt. Ltd., New Delhi
- Giles, R.H. Jr. (Ed) 1984. Wildlife Management Techniques 3rd edition. The wildlife Society, Washington. D.C. Nataraj Publishers, Dehradun. India
- Dasmann, RF. 1964, Wildlife Biology. John and Wiley and sons Newyork. Pp231.
- Robinson, Wl. and Eric, G. Bolen, 1984. Wildlife Ecology and Management Mac Millan Publishing Co, Ny. Pp 478.
- Menon, V. 2003. A Field Guide to Indian Mammals. Dorling Kindersley (India) Pvt. Limited
- Thomas, A.P. (Ed) 2013. Biodiversity Scope and Challenges. Green leaf Publications, Kottayam
- Sharma P.D. 2001. Ecology and Environment. Rastogi Pulications, Meerut
- Daniel, J.C. 2002. The Book of Indian Reptiles and Amphibians, Oxford University Press, Mumbai
- Daniels, R.J. R. 2002. Freshwater Fishes of peninsular India. Universities press (India) Private Ltd. Hyderabad
- Tripheron, C.A. and Johnson, N.F. 2005. Borrer and Delong's Introduction to the Study of Insects. Brooks/Cole Ceanage Learning Ltd.

Vilaniam, J. V. Antony Palakkal, Sunny Luke, 2012, Introduction to Kerala Studies.
International Institute for Scientific and Academic Collaboration, Inc, New Jersey USA

SEMESTER V

CHOIE BASED CORE COURSE III

ZOO5CRE01 VECTOR AND VECTOR BORNE DISEASES

72 Hrs

4 Credits

Objectives

Module I

4 Hrs

Brief introduction: of Carrier and Vectors (mechanical and biological vector), Reservoirs, Host-vector relationship, Vectorial capacity, Adaptations as vectors, Host Specificity

Module II

22 Hrs

Study of Vector Borne disease: Mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis. Sand fly-borne diseases – Visceral Leishmaniasis, Leishmaniasis, Phlebotomus fever. House fly as important mechanical vector, Myiasis. Flea-borne diseases – Plague, Typhus fever. Louse-borne diseases –Relapsing fever, Trench fever, Vagabond's disease, Phthiriasis.

Module III

20 hrs

Introduction to Vector control: Aims, objectives, goals, importance and advantages, History and background, recent trends, alternatives to the use of insecticides (chemical & microbial), vector control at individual or at community or at both levels. Selection of appropriate control measures - Self protection measures, types of vector control - selective, integrated and comprehensive vector control.

Module IV

6 hrs

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

Module V**20 hrs**

Control of mosquitoes and flies: (Black flies, Sand flies, Biting midges, Tabanids, Stable flies)
 Selection of suitable site specific control measures, Personal protection measures, zooprophyllaxis, Insecticide treated fabrics, Long lasting insecticide treated mosquito nets (LLINs), Insecticide spraying (larviciding - indoor residual spraying - space spraying).
 Alternatives - biological control, environmental management including source reduction.

Tsetse fly-Prevention and control (Traps and insecticide impregnated screens - Insecticide spraying ground and aerial).

References:

Bates M (1949) Natural History of mosquitoes The Macmillan Co.

Chapman, R.F. (1998). The Insects: Structure and Function. IV Edition, Cambridge University Press, UK.

De Barjac. 1990. Bacterial control of mosquitoes & black flies: biochemistry, genetics & applications of *Bacillus thuringiensis israelensis* & *Bacillus sphaericus*.

Gordon RM, Lavoipierre MMJ (1962) Entomology for students of Medicine. Blackwell Scientific Publ.

Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK.

Kettle DS (1984) Medical and veterinary entomology CAB international.

Laird, M. 1988. The natural history of larval mosquito habitats. Academic Press Ltd., New York.

Lacey, L. A. and Undeen, A.H. 1986. Microbial Control of Black Flies and Mosquitoes. Annual Review of Entomology, 31: 265-296.

Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell.

Marquardt, W.C. 2005. Biology of disease vectors (2nd Edition). Doody Enterprises, Inc. USA.

Pedigo L.P. (2002). Entomology and Pest Management. Prentice Hall Publication.

Potts, W.H. Glossinidae (tsetse flies). 1973. In: Smith, K.G.V. (ed.): Insects and other Arthropods of Medical Importance. British Museum (Natural History), London.

Richard and Davies Imm's general Text book of Entomology, Vol I & II. Chapman and Hall

Roy DN and Brown AWA (1970) Entomology (Medical & veterinary) Bangalore printing and Publishing co.

Rozendaal, J. A. 1997. Vector Control. Methods for use by individuals and communities. World Health Organisation, Geneva.

Rao, T. R. 1984. The Anophelines of India. Malaria Research Centre, ICMR, New Delhi.

Service M. W. 1996. Medical Entomology for students. Chapman & Hall, London

Speight, M.R., Hunter, M.D. & Watt, A.D. 1999. Ecology of Insects- Concepts and Applications. Blackwell Science Ltd., London.

Wall, R., Shearer, D. 2001. Veterinary ectoparasites: biology, pathology and control. Blackwell Science.

Wall, R., Shearer, D. 1997. Adult flies (Diptera). In: Wall, R., Shearer, D. (eds.): Veterinary Entomology. Chapman & Hall, London.

Ward, J.V. 1992. Aquatic Insect Ecology. John Wiley & Sons, Inc., USA.

Williams, D.D. & Feltmate, B.W. 1992. Aquatic Insects. C.A.B. International

SEMESTER VI

**ZOO6COR09 CORE COURSE IX
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.

Module1**Introduction****10 hrs**

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 and symmetry of egg.

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) Classification and Significance

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

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

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). Embryology of frog, Gametes, fertilization, cleavage, blastulation, fate map, gastrulation, notogenesis, neurulation, development of nervous system and sense organs (Eye only), Metamorphosis (brief account only)

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.

Human development

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

Nature of contact.

Mode of implantation.

Histological intimacy of foetal and maternal tissue.

Functions of placenta.

Experimental embryology.

Spemann's constriction experiments, Organizer and embryonic induction. In vitro fertilization (test tube baby) Prenatal diagnostic Techniques, 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, ICSI, GIFT, & ZIFT (Intra fallopian transfer gamete/zygote)

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).

Causes of malformation. (brief accounts.)

Genetic factors

Environmental factors. (external factors)

Chemicals, drugs, hormones and vitamins.

Multifactorial and idiopathic disorders

References:

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

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

Dutta 2007 Obstetrics, Church Livingstone 17 Ed

Harrison, Harrison's Book of Internal Medicine Church Livingstone 17th Ed.

Selected Further Readings

Berril, N.J and Kars G. 1986. Developmental biology, McGraw 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 17th Ed.

Jain P. C - Elements of developmental biology.

John Rigo Fundamental Genetics Cambridge University Press. 2009

Julio Collado Vides & Relf Hofstad 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 (International 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, SpringerVerlay New York 2008

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

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

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

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

Web Resources: www.Wikipedia.com. (Module IV), www.medpedia.com. (Module IV)

SEMESTER VI

ZOO6P09 PRACTICAL IX

REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY

36 hrs

Credit 1

Practical

Model/Chart/ Slide may be used

1. Embryological studies- Blastula, gastrula (frog, chick)
2. Embryo transfer, cloning
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-
8. Reproductive system of Cockroach/fish
9. Calculation of gonadosomatic index Cockroach/fish

SEMESTER VI

ZOO6COR10 CORE COURSE X
GENETICS AND BIOTECHNOLOGY

54 hrs

Credits 3

Objectives of the Course

1. To make students understand and appreciate the mode of inheritance.
2. To introduce the development and applications of biotechnology
3. To critically evaluate the application of the principles of Genetics And Biotechnology

UNIT I GENETICS

36hrs

Module I Mendel's Experiments, Monohybrid cross, dihybrid cross, test cross, backcross, reciprocal cross Principles of inheritance. Chromosome theory of heredity. 3 hrs

Module II Interaction of genes: (Brief account with one example each)

Allelic interactions - 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, lethal genes

Multiple allelism (eg) Coat Colour in rabbits. ABO Blood group and its inheritance in man 6hrs

Module-III

Linkage and recombination, 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 Elementary knowledge of mapping principles.

3hrs

Module IV

Sex determination: Chromosome theory of sex determination (sex chromosomes and autosomes) chromosomal mechanism (XX-XO, XX-XY, ZW-ZZ) Barr bodies ,Dosage compensation & Lyon hypothesis : Sex determination in man- role of Y chromosome. Sex determination in honey bees. Genic balance theory. *Drosophila*- intersex, gynandromorphs sex mosaics, Hermaphroditism Freemartin. Hormonal Influence on sex determination. Environmental influence on sex determination.

4hrs

Module V

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

4hrs

Module VI

Extra nuclear inheritance (Cytoplasmic inheritance Characteristics: Organellar DNA Mitochondrial and plastid DNA) Kappa particles in paramecium, Epigenetics –brief accounts.

2hrs

Module VII

Bacterial genetics; Bacterial genome Recombination in Bacteria. Bacterial transformation. Transduction, conjugation F mediated sexduction. Resistance transfer factor (RTF) Mechanism of drug resistance in bacteria Transposable genetic elements in bacteria, basic components and mechanisms of transposition in bacteria. 5hrs

Module VIII Human Genetics:

Karyotyping- Normal human chromosome complement. Pedigree Analysis Aneuploidy and Non disjunction. Genetic disorders in Man Chromosomal anomalies Autosomal (eg. Down syndrome, Edward's syndrome and Cridu chat syndrome) Sex chromosomal anomalies (Kline felters syndrome, and Turners syndrome) Single gene disorders- Autosomal single gene disorders (Sickle cell anaemia, brachydactyly; inborn errors of metabolism such as phenyl ketonuria, alkaptonuria,Albinism). Sex linked 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. Genetic counselling, Eugenics and Euthenics. 9hrs

UNIT II BIOTECHNOLOGY

18hrs

Module IX

Definition and scope of Biotechnology

Basic aspects of 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 5hr

Module X

Techniques in gene cloning : Biotechnology techniques-Southern Blotting, Northern Blotting and Western Blotting, PCR technique and DNA amplification, DNA hybridization, Fluorescence in situ Hybridization (FISH), Colony hybridization, DNA finger printing and its applications. RFLP- Applications: Gene libraries ,Human Genome Project-.

Stem cells cultures, human ES cell cultures, Human EG cell cultures and Human EC cell cultures, Potential uses of stem cells. 6hrs

Module XI

Practical Applications of Biotechnology

Tissue culture- Principle and uses Technology of mammalian and plant cell culture. Single cell protein (SCP) , 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 4hrs

Module XII Potential Hazards of Biotechnology

Advantages and hazards of genetic engineering Problems of biologically active biotechnology products.Problems of biotechnological inventions: Patent protection Trade secrets Plant breeders rights. Biowar and biopiracy 3 hrs

References

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

Gardner E.J. & Snustand D.P 1984. Principles of Genetics (John Wiley & Sons) New York

Vijayakumaran Nair 2006, Genetics and Molecular Biology. Continental Publications, Trivandrum

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

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

Stern C. 1973. Principles of Human Genetics (W.H. Freeman and Co.)

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

Verma P.S. and Agarwal V.K. 1988 Genetics (S. Chand and Co. New Delhi)

Winchester A.M. 1966. Genetics (Oxford & IBH Publications

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

Sobti & Sharma 2008 Essentials of Modern Biology Anes Student Edition Chapter 2 p. 89

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

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

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

Sobti & Sharma 2008 Essentials of Modern Biology Anes Student Edition Chapter 2 p. 89

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

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Press. Chapter -5

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

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

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

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

Selected Further Readings

Bala Subramanian D., C.F & Bryle & K. Dharmarajan J. Green Kunthala Jayaraman, Concept in Biotechnology. University Press 2007

Benjamin Lewin 2004 Gene VIII Oxford University Press

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

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

Colin Ratledge & Bijorn Kristiansen, Basic Biotechnology 3 rd ed. Cambridge University (2008)

De Robertis E.D. and De. Robertis E.M. 1987 cell & Molecular Biology (Lea & Febya / Info-Med)

Desmand S.T. Nicholi An introduction to Genetic Engineering Cambridge Sec, Ed. 2007.

Frank H, Stephenson Calculation for Molecular Biology and Biotechnology . Academic press 2006

Gardner E.J. and Snustand D.P. 1984. Principles of Genetcis (John Wiley & Sons New York.)

Gerhard Fuchs. Biotechnology & in Corporative Perspective. Study in global Competition series, Ane Book 2003

Jan Vijay Aging of the Genome The dual role of DNA in life and Deaths. Oxford university Press 2008

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

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

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

Powar. C.B. 1983. Cell biology (Himalaya Publishing company)

Prave D. Faustu and Sitting W and Subasten D.A (Eds) 1987 Fundamentals of Biotechnology (VCH publishers. Germany)

R.C. Sobte and Suparna. S. Pachauri. Essentials of Biotechnology Ane Book Pvt. Ltd. 2009

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

Sinnat Dunn & Dobzhansky 1959. Principles of Genetics (T.M.H. New Delhi)

Stern C. 1973. Principles of Human Genetics (W.H. Freeman and Co.)

Strickberger W.M. 1990. Genetics (Mac Millan Publishing Co.)

Sudha Gangal Biotechnology Principles And & practice of Animal Tissue culture, Universities Press 2007

Susantha Gosnalibke Merged Evolution (Long term implication of Biotechnology and Information Technology) Gordon & Breech Pub. 2005

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

Verma P.S. and Agarwal V.K. 1988 Genetics (S. Chand and Co. New Delhi)

Winchester A.M. 1966. Genetics (Oxford & IBH Publications.

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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

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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

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Winchester A.M. 1966. Genetics (Oxford & IBH Publications

SEMESTER VI

ZOO6P10 PRACTICAL X
GENETICS AND BIOTECHNOLOGY

36 hrs

Credit 1

1. Genetic problems – (Problems from each type)

Steps in solving genetic problems

(a) Mono and Dihybrid ratio (b) Back cross (c) Multiple alleles.

2. Study using photographs of the Karyotype- Turner's Syndrome , Klinefelter's and

Down's Syndrome (Any human genetic disorders)

4. Study of the karyotype and idiogram from the given

photograph of somatic metaphase chromosome-(Human)

5. Pedigree chart construction

6. Sexing of *Drosophila melanogaster*

7. Study of Polymerase Chain Reaction (Demonstration)

8. Western blotting of proteins from SDS-polyacrylamide gel

(Demonstration)

9. Southern blotting of DNA fragments from agarose gel

(Demonstration)

10. Northern Blotting of RNA molecules (Demonstration)

(Students are expected to visit the near by research institution / Biotechnology departments/ research centre, and see the demonstration of practicals 7, 8,9 and 10 ,or using virtual lab , if they do not have such facility in their institution)

SEMESTER VI

ZOO6COR11 CORE COURSE XI
MICROBIOLOGY AND IMMUNOLOGY

54 hrs

Credits 3

UNIT I MICROBIOLOGY

28 hrs

Module I	Introduction and Scope of Microbiology Outline classification of bacteria, fungi, viruses, actinomycetes and mycoplasma	1 hr
Module II	Methods in Microbiology 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. Staining- Gram's staining and Acid fast staining.	6 hrs
Module III	Morphology and fine structure of bacteria, size, shape and arrangements. Flagella, Pili, Capsule, cell wall and its composition, Cytoplasmic membrane, protoplast, spheroplast, nuclear material , cell inclusions, Bacterial spores	5 hrs
Module IV	Bacterial Growth, Effect of various factors on bacterial growth. Eg (<i>E. coli</i>) Modes of cell division.Nutritional requirements.Bacterial growth curve,Enumeration of bacteria	2 hrs

Module V	Antimicrobial Drugs	4hrs
	Mode of action of antimicrobial drugs Inhibition of cell wall synthesis, inhibition of protein synthesis, injury to the plasma membrane, inhibition of nucleic acid synthesis and inhibition of synthesis of essential metabolites.	
Module VI	Viruses -Structure of Viruses Human, Animal, Plant and Bacterial Viruses. Replication of viruses, cultivation of animal and plant viruses. Viral assay	3 hrs
Module VII	Infections Types, Primary and secondary infections. Cross infection , nosocomial infection Infection, endogenous and exogenous infections, different sources of infections, contagious diseases (Epidemic, endemic and pandemic) modes of transmission of diseases (by food, water, air, vectors, and carriers. Mention different types of carriers, healthy carriers, convalescent carriers, temporary and chronic carriers, contact carriers, paradoxical carriers , bacteraemia, Septicaemia	2 hr
Module VIII	Diseases caused by different pathogens, epidemiology, symptomology, diagnosis and treatment Bacterial: Mycobacterium (<i>M. tuberculosis</i> , <i>M leprae</i>) (TB and leprosy) <i>Salmonella</i> (Typhoid) <i>Clostridium</i> (Tetanus and Botulism Spirochete disease (Leptospirosis, Syphilis) Viral : Herpes virus (Chicken pox) Influenza, Chickunguniya Dengue and Zika virus. Fungal: <i>Tinea</i> or ring worm (Dermatophytoses,) <i>Candida albicans</i> (Candidiasis)	7 hrs
UNIT 11 IMMUNOLOGY		26 hrs
Module IX	Introduction to immunology Types of immunity, innate immunity, acquired, passive, active Mechanism of innate immunity (eg. Barriers, Phagocytosis, inflammation. Complement	3 hrs

system, biological effects of complements

Module X	Antigens and Antibodies Types of Antigens, haptens, antigenic determinants. Basic structure of immunoglobulins. Different classes of immunoglobulins and functions	5hrs
Module XI	Antigen-antibody reactions, Precipitation test, Agglutination Test, Clinical applications of antigen antibody reaction : Eg: Widal , VDRL , ELISA test Complement fixation test, Coombs test	5 hrs
Module XII	Immune Response system Primary and secondary lymphoid organs. Cells of the immune system Leucocytes, Lymphocytes T & B cells, Macrophages, Plasma cells, Memory cells, MHC Antibody synthesis, primary and secondary responses, Monoclonal antibodies Hybridoma technology , uses, Polyclonal antibodies.	6 hrs
Module XIII	Immunopathology- immune disorders (Hypersensitivity, autoimmunity and immunodeficiency) Different types of hypersensitivity reactions - Type I, Type II, Type III) Autoimmunity, Autoimmune diseases (Rheumatoid arthritis, Addison's disease and SLE -brief account) Transplantation Immunity- Graft rejection, major histocompatibility, Human leukocyte antigen system - (HLA) immuno -suppression. Tumour immunity-Immune responses in malignancy, Immunotherapy Immunodeficiency- AIDS	5hrs
Module XIV	Vaccines Brief history of vaccination, principles of vaccines, major types of vaccines (BCG, DPT, Polio vaccine and TAB vaccines) DNA vaccines, toxoides, adjuvants. Recent trends in vaccine preparation	2 hrs

Core readings:

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

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

Park K., Park's Text Book of Preventive and Social Medicine 2002, 17^t Ed. BanarasidassBhenot Publications

Tortora (p584-586) Gerard J. Tortora , Berdell R. Funke Christine L. Microbiology :An introduction

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 .

Ivan Roitt, 2002 *Essentials of Immunology ELBS*

Selected Further Readings

Anthanarayan R & C.K. JayaramPanicker. 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, MasedHarneySirajMisbah 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, 17^t Ed. Banarasidass Bhenot Publications

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

- Keith Wilson and John Walker, 2009, Principles and Techniques of Biochemistry and Molecular Biology Sixth Ed. Cambridge University Press
- Mangi, E.M.T El. C.F.A Bryca, A.L Demain, A.K. Allman Fermentation Microbiology & Biotechnology Sec. Ed. Taylor Framics London New York 2006
- Michael J. PelczarECS,Chan& Noel. R. Kreig, Microbiology, Tata McGraw Hill 5th ed. 1996.
- Monica Cheesbrough: Laboratory Manual for Tropical Countries. Vol.II Microbiology, ELBS Cambridge Ed. 1986.
- Panicker, S. Francis G., and Abraham G.K. 2008 , Microbiology and Immunology, Study Material Series published by Zoological Society of Kerala.
- PrakeshArora M. Anes Illustrated Dictionary of Immunology, Ane Book India. 2002
- Prescott. Microbiology 2nd edition

SEMESTER VI

ZOO6P11 PRACTICAL XI
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 Cfu /ml in well water sample (demonstration).
6. Examination of microbes in living condition
 - (a) Wet mount
 - (b) Hanging drop method for demonstrating motility of bacteria.
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 cotton blue 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

ZOO6COR12 COURSE XII

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

PART I EVOLUTION

30 hrs

Module I Origin of life

(5 hrs)

Introduction, Origin of universe

Theories of origin of life (Brief account only)

Chemical evolution- Miller-Urey experiment, Haldane and Oparin theory

Evidences of evolution

Homologous organ .analogous organ, Fossil & Fossilization.

Module II Theories of organic evolution (6 hrs)

Lamarckism

Critical analysis of Lamarck's propositions

Weisman's germplasm theory

Darwinism- Critical analysis of Darwinism

Mutation theory-

Modern Synthetic theory

Neutral theory of molecular evolution

Module III Population genetics and evolution (6 hrs)

Hardy Weinberg equilibrium, Factors affecting genetic Equilibrium

Genetic drift -Bottle neck, Founder principle, mutation and evolution.

Module IV Evolution above species level (9 hrs)

Adaptive radiation, Microevolution, Macroevolution, Evolution of horse & man

Mega evolution, Gradualism vs Punctuated equilibrium

Isolation and Isolating Mechanism,

Natural selection types and examples

Speciation -Types

Module V Geological time scale (4 hrs)

Geological Time scale

Geological dating with radioactive elements

Mass extinction

PART II ZOOGEOGRAPHY AND ETHOLOGY **24 hrs**

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

Origin of oceans and continents

Plate tectonics, continental drift

Zoogeographical realms; Wallace's line, Weber's line, 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

Module VIII Ethology **(1 hr)**

Definition

History and scope of ethology

Module IX Patterns of Behaviour **(8 hrs)**

Innate behaviour : Reflex , instinct Taxes,Kinesis

Learned Behavior –Types-Sensitization, Habituation ,Conditioned reflex, Trial & Error learning ,Latent ,Imprinting ,Insight

Biorhythms: Circadian, Seasonal rythms.

Migration Navigation &Homing instinct

Module X Socioethology

(5 hrs)

Social groups in insects and primates

Dominance & Hierarchies

Human pheromones

Natural selection and behaviour

Core readings :

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.)

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

Goodwin,B. 1996. *How the Leopard Changed its Spots: The Evolution of Complexity*. Simon
&Schuster, NY,USA. (Module 4 & 5)

Jerry A.Coyne and H.Allen Orr.2004. *Speciation*. Sinauer Associates (Module 4)

- Rob Desalle and Ian Tattersall 2008. *Human Origins: What Bones and Genomes Tell Us about Ourselves*. Texas A&M University Press, USA. (Module 3 & 4)
- Sean B. Carroll and David M. Kingsley .2005 *Evolution: Constant Change and Common Threads*. Holiday Lectures on Science. Webcast or DVD available at www.hhmi.org/biointeractive/evolution. (Module 3 & 4)
- Strickberger, M.W.2000. *Evolution*. Jones and Bartlett, Boston. (Module 1-5)
- Verma P.S. and Agarwal V.K 2007 *Cell biology, Genetics, Molecular Biology, Evaluation and Ecology*, S. Chand & Company New Delhi (Moldule 1-5)
- Andrews. M.I and Joy, K.P. 2003. *Environmental biology, evolution, ethology and Zoogeography*. St.Marys 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)
- Bonner, J.T. 1980. *The Evolution of Culture in Animals*. Princeton University Press..NJ,USA.
(Module 10)
- David McFarland. 1999. *Animal Behaviour*. Pearson Education Ltd . Essex, England. (Module 8 and 9)
- Dawkins, M.S. 1995.*Unravelling Animal Behaviour*. Harlow:Longman. (Module 8, 9 and 10)
- Dunbar,R. 1988. *Primate Social Systems*.Croom Helm,London. (Module 10 & 11)
- Manning Aubrey and Marian Stamp Dawkins 1998. *An Introduction to Animal Behaviour*.Cambridge University Press,UK. (Module 8, 9 & 10)
- Paul W. Sherman and John Alcock.,2001 Exploring Animal Behaviour- Readings from American Scientist 3rd Edn. Sinauer Associates Inc. MA,USA. (Module 10 & 11)
- Wilson, E.O. 1975. Sociobiology. Harvard University Press, Cambridge, Mass. USA. (Module 9)
- Zoological Society of Kerala Study material. 2002. *Environmental Biology and Ethology*
Published by Zoological Society of Kerala (Module 6, 7, 8 & 9)

Selected Further Readings

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

- Goodwin,B. 1996. *How the Leopard Changed its Spots: The Evolution of Complexity*. Simon &Schuster, NY,USA.
- Jerry A.Coyne and H.Allen Orr.2004. *Speciation*. Sinauer Associates
- Rob Desalle and Ian Tattersall 2008.*Human Origins: What Bones and Genomes Tell Us about Ourselves*. Texas A&M University Press, USA.
- Sean B. Carroll and David M. Kingsley .2005 *Evolution: Constant Change and Common Threads*. Holiday Lectures on Science. Webcast or DVD available at www.hhmi.org/biointeractive/evolution.
- Strickberger, M.W.2000. *Evolution*. Jones and Bartlett, Boston.
- Bonner, J.T. 1980. *The Evolution of Culture in Animals*. Princeton University Press.NJ, USA.
- David McFarland. 1999. *Animal Behaviour*. Pearson Education Ltd. Essex, England.
- Dawkins, M.S. 1995.*Unravelling Animal Behaviour*. Harlow: Longman.
- Dunbar, R. 1988. *Primate Social Systems*.Croom Helm, London.
- Manning Aubrey and Marian Stamp Dawkins 1998. *An Introduction to Animal Behaviour*.Cambridge University Press,UK.
- Paul W. Sherman and John Alcock.,2001 *Exploring Animal Behaviour- Readings from American Scientist* 3rd Edn. Sinauer Associates Inc. MA,USA.
- Wilson, E.O. 1975. *Sociobiology*. Harvard University Press, Cambridge, Mass. USA.

SEMESTER VI**CHOICE BASED CORE COURSE-II****ELECTIVE II****ZOO6CRE02 APPLIED ZOOLOGY PART -II**

72 hrs

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

UNIT I. APPLIED ENTOMOLOGY**18 hrs****Module I Pests of common crops of Kerala (Paddy and Coconut)**

Morphology, damages caused and control measures.

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

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

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

Insect pest management**8hrs**

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

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

Autocidal control (sterile male technique)

IPM – Integrated Pest Management.

Module II – APICULTURE

18 hrs

Bee Keeping -Definition, Uses of bees. Sp.of bees cultured, organization of honey bee colony, Social life and adaptation of honey bees. Communication among honey bees. bee keeping methods (modern method only) and equipments, management and maintenance of an apiary-growth period, dividing the colony, uniting two colonies, replacing old queen with new queen, honey flow period, dearth periodswarming management, monsoon management. Enemies of bees. Bee diseases. Bee pasturage. Honey and wax composition. Testing the quality of honey. Extraction of wax Uses of honey and wax. Apitherapy. Royal jelly , propolis. Agencies supporting apiculture.

Module III Sericulture

5hrs

History and Scope of sericulture

Silk Producing insects – *Bombyx mori* (Life Cycle)*Antheraea paphia*

Sericulture Practices-Extraction of silk

Types of Silks

Diseases and management

UNIT 2 Poultry Science

6hrs

Module IV Introduction and Scope

- (a) Egg production, cable bird production, nutritive value, bye products.
 - (b) Different breeds – Exotic – 3 examples. Indigenous – 2 examples
 - (c) Poultry rearing : Selection of eggs, hatching, incubation, brooding, sexing, vaccination.
- Poultry housing: Free range system, Semi-intensive system (deep litter system and

individual cage system).

Equipments for feeding: Nutrients for starting, growing, laying hen.

Common poultry feeds, food rations, and feed formulation.

Common diseases of poultry (Ranikket, Pullorum, Fowl pox).

UNIT 3 Animal husbandry

(6 hrs)

Module V- Introductin: history, origin, domestication.

Breeds of cattle:

Milk type : Sindhi, Gir

Draft breed: Nagori&Kangayam

Duel purpose: Ongole, Haryana

Exotic breed : Jersey, Holstein – Friesian

Native breeds: Conservation programmes, Vechur cow.

Feeding: Common cattle feeds, fodder

Common diseases : Anthrax, Foot & Mouth disease. Parasites.

Meat hygiene: Slaughter and clean meat production – Zoonotic diseases.

Module VI Dairy Science (4 hrs)

Role of dairy development in rural economy employment opportunities, white revolution.

Dairy processes: Staining, Filtration, Cooling, Chilling, Clarification, Pasteurisation,

Freezing, Recombined milk, Soft curd milk, Skimmed and toned milk.

Artificial milk, Milk – adulteration.

Field visit and report writing

7 hrs

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

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.

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

Selected Further Readings

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

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

Ananthakrishnan T.N.Dimensions of Molecular Entomology. University

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

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

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

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

Farm made aquafeeds FAO fisheries technical paper, 343.

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

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

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

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

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

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

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

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

Sukla. Upadhay, Economic Zoology

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

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

Banerji, G.C.: A text book of Animal husbandry, 1998. Oxford & IBH.

Banerji, G.C. Poultry, Oxford & IBH.

P.R. Venkitaraman: Economic Zoology.

V. Sudheeran: Economic Zoology.

SEMESTER VI**CHOICE BASED CORE COURSE-II****ELECTIVE II****ZOO6CRE02 PISCICULTURE**

72 Hrs

3 Credits**Objectives****Module I****7 hrs**

Introduction to Aquarium and Ornamental fishes: Major families of and freshwater ornamental aquarium fishes. Aquarium setting and Maintenance. Types of Aquarium. Size, capacity and shape of Aquarium tanks. Aquarium plants–types and functions. Aquarium accessories- Aerators, Thermostat.etc

Filtration of water- Mechanical, Chemical and Biological filtration. Protein skimmers. Setting up of a biological filter. Maintenance of aquarium - Feed management and compatibility of fishes.

Module II**10 hrs**

Nutritional requirement of Aquarium fishes: Different types of feed – Natural and Artificial. Feeding methods. Preparation of artificial feeds. Live feeds and their culture - Microalgae, Daphnia, Moina, Earthworm, Mosquito larvae, Chironomous larvae, Artemia, Infusoria, Tubifex. Nutritional diseases. Aquarium fish diseases and their management. Bacterial, Viral, Fungal, protozoan and other parasitic diseases of aquarium fishes. Preventive measures, disease symptoms and treatment of fish diseases.

Module III**20 hrs**

Breeding of ornamental fishes. Factors controlling reproduction: Oviparity and viviparity in fishes. Induced breeding. Reproductive guilds in fishes- Nest building and parental care. Breeding of goldfishes, angelfish, gouramies, tetras. Breeding of live bearers- Guppy.

Module IV**15 hrs**

Marine ornamental fishes: Major marine ornamental fish resources of India. Methods of collection and transportation. Use of anaesthetics. Setting up and management of marine fish aquariums. Breeding marine ornamental fishes- Clown fish, Damsel fish and sea horses.

Module V**20 hrs**

Criteria for the selection of culturable species of edible fishes: Major Culturable species of edible fishes in India. Culture of Carps, Tilapias, Mulletts, Pearl spot and air breathing fishes. Layout of ponds- Nursery, rearing and stocking ponds. Pond preparation – manuring, liming, fertilizing, eradication of weeds, pests and predators. Water quality parameters affecting pond fish culture. Harvesting.

References

- 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.
- 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.
- MPEDA A handbook on Aquafarming- Ornamental fishes, MPEDA Kochin.
- Handbook of Tropical Aquarium Fishes, McGraw-Hill, 1955.
- Saltwater Aquarium Fishes, TFH Publications, 1987. Herbert .R. Axelrod.
- Aquarium Fishes of the World, TFH Publications, 1998. Herbert.R.Axelrod.
- Dr. Axelrod's Atlas of Freshwater Aquarium Fishes, TFH Publications, 2004. Herbert .R. Axelrod.
- Marine Ornamental Fish culture. Package of Practices. CMFRI Special publication.101.
- Marine Ornamental Fishes. CMFRI. CMFRI Technology Information Series.3.
- Encyclopedia of Aquarium and pond fishes. David Alderton. DK Books.

SEMESTER VI**CHOICE BASED CORE COURSE-II****ELECTIVE II****ZOO6CRE02 MANAGEMENT OF LIFE STYLE DISEASES****72 hrs****Credit 3****Objectives**

1. To understand the relevance, significance and implications of life style disorders.
2. To understand the various types and causes of life style disorders.
3. To understand the ways in which life style disorders can be identified, managed and prevented.

Module I**7 hrs**

Introduction and Definition of the life style diseases: Problem- leading cause of death and developed countries, upward trend in most countries. Reason - increase in life expectancy, changes in life style, changing patterns.

Understanding of health: basis of all health care; Narrow view - machine break down - repair, holistic concept- promotion and protection of health.

Determinants of health: Biological, Behavioural and Socio cultural, Environmental and socioeconomic responsibility: Individual, community, state.

Module II**10 hrs**

Life style: Diffuse concept, Reflections- social values, attitudes, activities. Life style learnt through social interaction with parents, peer group friends and siblings etc. and through school and mass media.

Health requirements: Healthy life style, health problems associated with life style changes.

Statistics of life style diseases: Mounting figures of lifestyle disorders.

Module III**20 hrs**

Common life style diseases: Atherosclerosis, Alzheimers disease, Cancer, Asthma, Liver cirrohosis, Type 2 Diabetes, Chronic obstructive Pulmonary disease, Heart disease, Chronic renal failure, Stroke, Osteoporosis, Depression, Occupational lifestyle diseases.

Modern lifestyle disorders: Sleeping habits, Junk food, anxiety, food poisoning, Acidity.

Module IV**15 hrs**

Causes of Lifestyle diseases: Bad diet options, poor life style choices - Drug abuse, tobacco smoking, and alcohol drinking, Lack of adequate exercise, wrong body posture - Disturbed biological clock, environmental conditions, occupational life style diseases.

Module V**20 hrs**

Prevention: Controllable factors - habits, practices or behaviors like smoking, eating habits, exercise, amount of sleep.

Uncontrollable factors: age, gender, heredity and race.

Healthy diet: disease prevention through diet and nutrition, avoiding foods that are high in fats, salt and refined products;

Moderate exercise: right postures of sitting & standing, relaxation and cutting down of stress.

Economic and productivity impact of life styles diseases:

Core readings:

Biochemistry with clinical correlation – Thomas M Delvin

Elen Gorden Janes and Barttlet.Human genetics a modern synthesis.Published by Boston P266 - 270

Fahey,tomas D, Insel,Paul M AND Rothwalt 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.

M.Kumar,R.Kumar. Guide to Prevention of Lifestyle Diseases. Deep and Deep Publications.

P. Sing.MD.Textbook of Nutritional Health;First Ed:2008; Academic excellence.

Yojana,October 2012 ,p 46-48

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

<https://.google.com/books/books.../Guide to Prevention of lifestyle diseases.>

https://en.Wikipedia.org/wiki/Lifestyle_disease .

[www.ncbi.nlm.nih.gov/NCBI/literature/Pub Med Central \(pmc\)](http://www.ncbi.nlm.nih.gov/NCBI/literature/Pub_Med_Central_pmc)

[www.thehealthsite.com/topics/lifestyle diseases -diseases-conditions.](http://www.thehealthsite.com/topics/lifestyle_diseases_diseases_conditions)

www.ncbi.nlm.nih.gov/NCBI/Literature/Bookshelf

Semester I**COMPLEMENTARY COURSE BOTANY-I****BOT1CMP01 ANIMAL DIVERSITY – NON CHORDATA****36 hrs****Credit 2****Objectives**

1. To acquire knowledge on the taxonomic status of the various nonchordate animals.
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 General Introduction to Non Chordata**7hrs**

Five Kingdom classifications

Kingdom Protista

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 Choanoflagellata | : Proterospongia |
| 11. Phylum Ciliophora | : Paramecium |
| 12. Phylum Sporozoa | : Plasmodium |
| 13. Phylum Microsporidia | : Nosema |

Module II**7 hrs**

Kingdom: Animalia (Salient features, Classification up to classes)

1 hr

Sub Kingdom: Mesozoa – eg: Rhopalura (mention 5 salient features)

Sub Kingdom : Parazoa

Phylum : Porifera .**2 hr**

Class: Calcarea. E.:Sycon; Class:Hexactinella. Eg : Euplectella; Class: Desmospongia. Eg: Cliona.

Sub Kingdom : Eumetazoa

Phylum : Coelenterata**3hrs**

Class 1. Hydrozoa – Physalia

Class 2. Scyphozoa – Rhizostoma

Class 3. Anthozoa – Adamsia

General topic: Corals and Coral Reefs

Phylum Ctenophora Eg.Pleurobrachia**1hr.****Module III****6hrs****Phylum - Platyhelminthes**

Class 1 :Turbellaria – Dugesia.

Class 2 :Trematoda – Fasciola

Class 3 :Cestoda – Taenia solium

Phylum- Nematoda

Class 1 Phasmodia - *Wuchereria*

Class 2: Aphasmodia – *Enterobius*

General Topic: Human Parasitic nematods : *Ascaris, Ancylostoma, Trichuris,*

Phylum- Annelida

Class 1 : Polychaeta - *Neanthes*

Class 2 : Oligochaeta – Earthworm – *Pheretima*

Class 3 : Hirudinomorpha – *Hirudinaria*

General topic: Parasitic adaptations of leech.

Module IV**8hrs****Phylum – Arthropoda****Type - Prawn – *Penaeus***

Classification up to class:

Class 1: Merostoma (eg: *Limulus*)

Class 2: Arachnida (eg: Spider)

Class 3: Pycnogonida (eg: *Nymphon*)

Class 4: Crustacea (eg: *Daphnia*)

Class 5: Chilopoda (eg: *Centipede*)

Class 6: Symphyla (eg: *Scutigera*)

Class 7: Diplopoda (eg: Millipede)

Class 8: Pauropoda (eg: *Pauropus*)

Class 9: Insecta (eg: butterfly)

(Detailed account of examples are not necessary)

Insect pests

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

Module: V

8 hrs

Phylum – Mollusca (Salient features and classification up to classes)

4hrs

Class 1. Aplousobranchia – Neomenia

Class 2. Monoplacophora – Neopalina

Class 3. Bivalvia – Perna

Class 4. Polyplacophora – Chiton

Class 5. Gastropoda – Pila

Class 6. Cephalopoda – Sepia

Class 7. Scaphopoda – Dentalium

Phylum – Echinodermata

3hrs

Class 1. Asterozoa – Astropecten

Class 2. Ophiurozoa - Ophiothrix

Class 3. Echinoidea – Echinus

Class 4. Holothuroidea – Cucumaria

Class 5. Crinoidea – Antedon

Phylum – Hemichordata

1hr.

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.

Barnes, Robert D. 1981. Invertebrate Zoology. Saunders College Publ. 1089 pages.

Jordan, E.L. & Verma, P.S. 2000: Invertebrate Zoology. S. Chand & Co. 857 pages.

Anderson, Donald Thomas. 2006: Invertebrate Zoology. Oxford Univ. Press. 476 pp

Semester I

COMPLEMENTARY COURSE BOTANY-I

PRACTICAL I

BOT1CP01 ANIMAL DIVERSITY – NON CHORDATA

36 hrs

Credit 1

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

Field Work: Collection and identification of pests of crop plants & stored products

Semester II**COMPLEMENTARY COURSE BOTANY-II****BOT2CMP02- ANIMAL DIVERSITY – CHORDATA**

36 hrs

Credit 2

Objectives

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

Module I**8hrs.****Phylum Chordata** - General characters, Classification upto classes**Sub phylum I Urochordata**

Class 1. Larvacea eg . Oikopleura

Class 2. Ascidiacea eg. Ascidia

Class 3. Thaliacea eg. Salpa

Subphylum II Cephalochordata

Eg. Brachiostoma (Amphioxus) Mention the significance and affinities.

Subphylum III Vertebrata**Division I Agnatha**

Class Cyclostomata eg. Petreromyzon

Division 2 Gnathostomata

Super class 1. Pisces

Super class 2. Tetrapoda

Module II.

4hrs

Super class Pisces

Class 1. Chondrichthyes . Eg:.,Scoliodon ,Narcine

Class 2: Osteichthyes. Sardine, Mackerel, Mullet, Clarius etc

General Topic: Accessory respiratory organs in fishes

Module III

14 hrs

Super Class Tetrapoda

Class : Amphibia

10hrs

Type : *Euphlyctis hexadactylus*

Order I. Urodela eg. Amblystoma (Mention Axolotl larva and Neoteny)

Order II. Anura eg. *Duttaphrynus melanostictus*

Order III . Apoda eg. *Ichthyophis*

Class : Reptilia

4hrs

Sub class I: Anapsida Eg. Chelone, Crocodiles.

Sub class II Diapsida Eg. Chameleon, Calotes

Subclass III Parapsida Eg. Ichthyosaurus

Subclass IV Synapsida Eg. Cynognathus .

General Topic: Identification of Poisonous and non-poisonous snakes of Kerala

Module IV

4hrs

Class Aves- General characters (Mention common names and scientific names of examples).

Sub class I : Archaeornithes Eg: Archaeopteryx (Significance).

Sub class II. Neornithes Eg: Struthio, Kiwi, emu. Pigeon, Peacock, Crow, koel.

General Topic: Flight adaptations of birds.

Module V

Class – Mammalia

6 hrs

Sub class I Prototheria eg. Echidna

Sub Class II Metatheria eg. Macropus

Sub class III Eutheria eg. Elephas, Pteropus, Armadillo, Porcupine , Dugong, Oryctolagus , Dolphin.

General Topic: Aquatic mammals and their adaptations.

Core readings:

J.Z. Young, 2006: The life of vertebrates. (The Oxford University Press, New Delhi). 646 pages. Reprinted.

M. Ekambaranatha Ayyar, 1973: A manual of zoology. Part II. (S. Viswanathan Pvt. Ltd., Madras).

E.L. Jordan & P.S. Verma, 1998 :Chordate zoology. (S. Chand & Co.). 1092 pages.

Gurdarshan Singh & H. Bhaskar, 2002: Advanced Chordate Zoology. Campus Books, 6 Vols., 1573 pp.,

SEMESTER II**COMPLEMENTARY COURSE BOTANY-II****PRACTICAL II****BOT2CP02 - ANIMAL DIVERSITY – CHORDATA****36 hrs****Credit 1**

1. Morphology – **Scientific drawing:** 5 specimens of chordates
2. **Simple identification:** 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:** Placoid scales of shark, ctenoid and cycloid scales .
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**COMPLEMENTARY COURSE BOTANY-III****BOT3CMP03 - HUMAN PHYSIOLOGY AND IMMUNOLOGY****54 hrs****Credit .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.

UNIT I HUMAN PHYSIOLOGY**36 hrs****Module I**

Nutrition: Outline classification of food components: (Carbohydrates, Lipids, Proteins, Vitamines, Minerals and trace elements), Malnutrition disorders, Vitamin deficiencies, and mineral deficiencies (Iron, Calcium and Iodine) **3hrs**

Respiration: Transport of O₂ and CO₂ in blood, respiratory disorders – Dyspnoea, Hypoxia, Asphyxia, Hypo and Hypercapnia, CO poisoning, smoking and its physiological effects. **5hrs**

Circulation: 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 infarction, Angiogram and Angioplasty. **7hrs**

Module II

Excretion: 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 **6hrs**

Neurophysiology: 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, Schizophrenia. **6hrs**

Module III

Muscle Physiology: Striated, Non striated and Cardiac muscle, Ultra structure of striated muscle fibre, Mechanism of muscle contraction, Threshold and spike potential, Fatigue, O₂ debt, Rigor mortis. **4hrs**

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

UNIT II IMMUNOLOGY

18hrs

Module IV

Introduction to immunology. Types of immunity, innate immunity , acquired, passive and active. Mechanism of innate immunity (eg. Barriers , phagocytosis , inflammation) **3hrs**

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

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

ModuleV 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 (Brief account only)

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

Vaccines: Major types of vaccines (BCG, DPT, Polio vaccine and TAB vaccines). Recent trends in vaccine preparation. Mention two vaccine preparing centres in India. **5hrs**

Core readings:

Guyton : Text Book of Medical Physiology Saunders

Sarada Subramanyam & K. Madhavankutty : Textbook of human physiology, S. Chand & Co
Joshi : Nutrition and Dietetics , Tata Mc. Graw HillLtd, New Delhi.

Ganong W F : Review of Medical Physiology, Mc Graw Hill, New Delhi.

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

Ivan Roitt: Essentials of Immunology ELBS.

SEMESTER III**COMPLEMENTARY COURSE BOTANY-III****PRACTICAL III****BOT3CP03 HUMAN PHYSIOLOGY AND IMMUNOLOGY****36hrs****Credit 1**

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

SEMESTER IV**COMPLEMENTARY COURSE BOTANY-IV****BOT4CMP04 -APPLIED ZOOLOGY (AQUACULTURE,
SERICULTURE, VERMICULTURE AND APICULTURE)****54 hrs****Credit 3****OBJECTIVES**

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

Module I**18hrs**

Aquaculture : Traditional methods of aquaculture, Advantages and salient features of aquaculture, Types of aquaculture, Biotic and abiotic factors of water, Importance of Alga in aquaculture, Common Cultivable fishes of Kerala 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.

Module II

Prawn culture, Mussel culture, Pearl culture

6hrs**Module III****12hrs**

Sericulture : Four species of silkworms, Life history of silkworms, Silkworm Rearing Techniques. Mounting of worms. Harvesting and stiffling of cocoons. Diseases and Pests of silkworms, Silkworm diseases. Preventive and control measures. Mention 2 sericulture institutes.

Module IV**6 hrs.**

Vermiculture : 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.

ModuleIV

12hrs

Apiculture: 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:

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

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

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

Menon, K.N., 1970: Malsyakrishi (State Institute of language, Trivandrum)Singh, S., 1962 Bee keeping in India (ICAR, New Delhi)

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

Bhosh, C.C., 1949: Silk Production and Weaving in India (CSIR), New Delhi) Director. Zoological Survey of India, 1994, earthworms Resources and Vermiculture

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

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

COMPLEMENTARY COURSE BOTANY-IV**PRACTICAL IV****BOT4CP04- APPLIED, ZOOLOGY****(AQUACULTURE, SERICULTURE VERMICULTURE, APICULTURE)**

36 hrs

Credit 1

1. General Identification, Economic importance, Morphology, scientific names and common names of the following
 - . Economic important and morphology of culturable fishes (Catla, Rohu, Grass carp, Common carp, Silver carp, Etroplus, Tilapia)
 - Two species of earthworms used in Vermiculture
 - Two species of honey bees
 - Silkworm. Cocoon/Adult
2. Fish Parasites (Any one). Castes of bees
3. Bee keeping equipments Beehive, Smoker, honey extractor
4. Beeswax, Honey, Silk, Vermicompost (Identification-Uses)
5. Chandrika /Natrika used in sericulture
6. Fish diseases (Any two diagrams /specimens).

BOARD OF STUDIES OF ZOOLOGY

MEMBERS:

1. Internal:

Dr.Rema.L.P (Chair Person)	- Associate Professor
Smt. Zeena.K.V	- Assistant Professor
Smt.Shyla.M.H	- Assistant Professor
Dr.Sunish.K.S	- Assistant Professor
Smt. Anitha Abraham	- Assistant Professor
Sri.P.A.Janish	- Assistant Professor
Dr.Prakasan.K	- Assistant Professor

2. External Experts

Dr.K.S.Jameela Beevi:	Principal (Rtd) ,KKTM Govt. College, Pullut .
Prof.E.Kunhikrishnan:	Head of the Dept. of Zoology (Rtd), University College, Thiruvananthapuram.

3. Industry Expert

Prof. Sivarajan

4. Alumni

Dr.A.Gopalakrishnan: Director, Central Marine Fisheries Research Institute, Kochi.

5. University Nominee

Dr.Jose.D.Kaippally: Head of the Dept. of Zoology, S.B.College, Changanasserry.

REPORT OF BOARD OF STUDIES

The faculty members of the Department of Zoology met several times discussed and worked out the format for the proposed restructuring of undergraduate and post graduate programmes in Zoology as a part of implementing academic autonomy. The first formal preparatory session was organized in the departmental library on 26.5.2015. In addition to the then faculty members of the department, the external experts of the Board of Studies were also attended in the discussion and formed a frame work for the undergraduate and post graduate syllabi.

The Workshops on Curriculum Restructuring as the part of implementing academic autonomy were conducted in three phases. The first phase was conducted on 8.10.2015 & 9.10.2015 and the second and third phase were conducted on 24th and 25th of October 2015 and 9th December 2015 respectively. All sessions were witnessed by enthusiastic participation of the members which helped the department in shaping an excellent curriculum.

The first phase of the workshop was inaugurated by Prof.Ramakantan.N., Principal in charge for the day. In the welcome address, Dr.Reman.L.P. emphasized the importance of designing a curriculum which can cater to the aspiration of students and equip them to face the future challenges. Dr.Prakasan.K., Coordinator of the programme explained the schedule of sessions and arrangements made for the smooth conduct of the workshop.

All the thirty five participants were grouped into five and each group included one or two member from the Department to note down and consolidate the suggestions. Smt. Sandhya Krishnan and Dr.Reman.L.P were the members from department for Group I, Smt. Zeena.K.V and Smt.Shyla.M.H. for Group II, Dr.Prakasan.K for Group III, Smt.Anitha Abraham and Sri.P.A.Janish for Group IV and Dr.K.S.Sunish for Group V. In the first phase, discussions were conducted regarding the structure of the curriculum in a holistic way. Changes in the course structure and semester patterns were thoroughly discussed. The members unanimously opined to design a syllabus to provide thorough knowledge about various animal sciences, make students aware of applications of Zoology in various industries, to equip the students with laboratory skills and field based studies, to make the students aware about conservation and sustainable use of biodiversity and also to facilitate students for a successful career in Zoology. They also suggested a change in the semester wise course pattern and suggested the inclusion of Nonchordata and Chordata courses in the initial semesters of study. Prof.E. Kunhikrishnan made valuable suggestions on Environmental Science, Evolution and Ethology. The suggestions of Prof.P. Radhakrishnan, Dr.Shaju Thomas, Dr.K.S.Jameela Beevi and Dr.John Joseph among many others were commendable and gave a critical analysis of the present curriculum. They contributed valuable inputs to make the syllabi more meaningful to the students.

The second phase conducted on 24.10.2015 and 25.10.2015 focused on finalizing the undergraduate syllabus as per the suggestions and recommendations made in the first phase. A comparative evaluation of the PG syllabi of various universities were also conducted and a frame work for designing new post graduate curriculum were also made accordingly. A one day work shop was later conducted on 9.12.2015 to discuss and design the post graduate syllabus. All thirty five members were actively involved in the discussion till the end of the programme. We use this occasion to thankfully acknowledge the valuable contributions made by Prof.E.R. Chandran, Dr.P.K.Sumodan, Dr.Thejass, Dr,Binitha .R.N., Dr.Selven, Dr.Anu Anto, Prof.Gladys Francis, Prof.P. Radhakrishnan, Dr.Shaju Thomas, Dr.K.S.Jameela Beevi and Dr.John Joseph. Newer trends in Biological sciences were introduced to cater the employability of post graduate students and the syllabus is complying with that of UGC. Experiments involving animals are replaced with those using softwares. The sessions were concluded in high spirit of scientific temper and academic excellence.

Meeting of the BoS held at the Computer Laboratory on 21.12.2015 discussed the draft copy of restructured syllabi for B.Sc. and M.Sc. for 2016 admission onwards and approved for presenting to the Academic Council.