

B.Sc ZOOLOGY

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DEFINITIONS

'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.

'Academic Week' is a unit of five working days in which distribution of work is organized from Monday to Friday, with five contact hours of one hour duration on each day.

'Programme' means a three year programme of study and 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.

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

'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.

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

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

'Open course' means a course outside the field of his/her specialization, which can be opted by a student.

'Credit' is the numerical value assigned to a course according to the relative importance of the content of the syllabus of the programme.

'Parent Department' means the department which offers core courses within a degree programme.

'Grade' means a letter symbol (A, B, C, etc.), which indicates the broad level of performance of a student in a course/ semester/programme.

'Grade point' (GP) is the numerical indicator of the percentage of marks awarded to a student in a course.

Words and expressions used and not defined in this regulation shall have the same meaning assigned to them in the Act and Statutes.

COURSE STRUCTURE OF BSc ZOOLOGY PROGRAMME

The U.G.programme in Zoology includes

- (a) **Common Courses**
- (b) **Core Courses**
- (c) **Complementary Courses**
- (d) **Open Course**
- (e) **Investigatory Project**

No course shall carry more than 4 credits.

Student shall have the option to choose Open courses offered by any other Department.

Programme Duration	6 Semesters
Total Credits required for successful completion of the programme	120
Minimum credits required from common courses	38
Minimum credits required from Core courses + Complementary + Project	79
Minimum credits required from Open course	3
Minimum attendance required	75%

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 evaluation and maximum of **20** marks for in-semester evaluation. For all courses (theory & practical), grades are given on a 07-point scale based on the total percentage of marks. (**ISA+ESA**) as given below

Percentage of Marks	Grade	Grade Point
90 and above	A+ - Outstanding	10
80-89	A - Excellent	9
70-79	B - Very Good	8
60-69	C - Good	7
50-59	D - Satisfactory	6
40-49	E - Adequate	5
Below 40	F - Failure	4

Note: Decimal are to be rounded to the next whole number

CREDIT POINT AND CREDIT POINT AVERAGE

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

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

Credit Point Average (CPA) of a Semester/Programme is calculated using the formula

$$CPA = TCP/TC, \text{ where } TCP = \text{Total Credit Point}; TC = \text{Total Credit}$$

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

CPA	Grade
Above 9	A+ - Outstanding
Above 8, but below or equal to 9	A - Excellent
Above 7, but below or equal to 8	B - Very Good
Above 6, but below or equal to 7	C – Good
Above 5, but below or equal to 6	D – Satisfactory
Above 4, but below or equal to 5	E – Adequate
4 or below	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 for a pass for a course. For a pass in a programme, a separate minimum of Grade **E** 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 **E** grade or above within the permitted period. Candidate who secures **E** grade and above will be eligible for higher studies.

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. In-semester evaluation is to be done by 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.

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.

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Components of In- semester Evaluation	<i>Marks</i>
Attendance	5
Assignment /Seminar/Viva	5
Test paper(s) (1 or 2) (1x10=10; 2x5=10)	10
Total	20

2) For all courses with practical

a) Marks of theory –End-semester Examination: 60

b) Marks of theory –In-semester Evaluation: 10

Components of Theory: In-semester Evaluation	Marks
Attendance	3
Assignment/Seminar/Viva	2
Test paper(s) (1 or 2)	5
Total	10

a) Marks of Practical: End-semester Examination: 20

b) Marks of Practical: In-semester Evaluation: 10

Components of Practical: In-semester evaluation	Marks
Attendance	2
Record	5
Lab involvement	3
Total	10

PROJECT EVALUATION

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

ASSIGNMENTS

Assignments are to be done from 1st to 4th Semesters. At least one assignment should be done in each semester.

SEMINAR/VIVA

A student shall present seminar for each course in the 5th semester.

Student shall appear for a Viva-voce examination for each course in the 6th semester.

ATTENDANCE EVALUATION

1) For all courses without practical

Percentage 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	3	90 and above	4
80--89	2	85--89	3
75--79	1	80--84	2
		75--79	1

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

IN-SEMESTER ASSESSMENT - TEST PAPERS

At least one in-semester test-paper is to be attended in each semester for each course. The evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of in-semester assessments are to be kept in the college for two years. The responsibility of evaluating the in-semester assessment is vested on the teacher(s), who teach the course.

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 without practical

	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
	10	10	1	10
	12	8	2	16
	9	6	4	24
	4	2	15	30
TOTAL	35	26	x	80

Pattern of questions for end-semester examination for theory papers with practical

	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
	8	8	1	8
	10	6	2	12
	6	4	4	16
	4	2	12	24
TOTAL	28	20	x	60

INVESTIGATORY PROJECT, FIELD COURSE, FIELD VISIT, STUDY TOUR & VISIT TO RESEARCH INSTITUTES

Investigatory Project

Each student is expected to complete one investigatory project during the programme and the project dissertation shall be submitted for evaluation at the end of 6th semester. The projects are to be identified during the 4th semester of the programme with the help of the supervising teacher. Project presentation and viva- voce will be conducted along with the 6th semester practical examinations.

Wildlife Biology Field Course

A Wildlife field course with duration of not less than 3 days should be conducted during the 6th semester of the programme. The field course is meant as a practical adjunct to the Wildlife Biology theory course offered during Semester 6 and the students are expected to attain a firsthand knowledge on various aspects of Wildlife Biology, its conservation and management.

Field visit to biodiversity rich area

Field visit to a biodiversity rich area should be conducted during the 1st semester. The visit is intended to study the biodiversity and conservation status of the area and forms a part of the practical course during Semester 1. Each student is required to prepare a report of the visit which will be evaluated during the practical examination at the end of the semester.

Study Tour & Visit to Research Institutes

Study tour and visit to research institutes should be conducted preferably during the 5th semester. During the study tour, students are expected to visit different habitats, zoos, aquaria and other places of zoological importance. They must also visit research institutes to familiarize themselves with the process of research in biological sciences.

PROGRAMME OBJECTIVES

The B.Sc. Zoology programme is designed to:

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

PROGRAMME OUTCOMES

The graduate of this programme should be able to

1. Develop respect for nature
2. Explain the importance of biodiversity
3. Identify and list out common animals
4. Understand the basic principles of evolution and adaptations in animals
5. Appreciate the influence of environment on the life of organisms
6. Explain various physiological & biochemical processes in our bodies
7. Understand the basic genetic mechanisms in organisms
8. Identify potential risk factors to health of human beings
9. Use tools of information technology for the study of biology
10. Develop the skills to pursue advanced studies in biology

B.Sc. DEGREE IN ZOOLOGY PROGRAMME
COURSE STRUCTURE
SCHEME OF INSTRUCTIONAL HOURS AND CREDITS
(TOTAL CREDITS 120)
Semester I

Code	Course Title	Hrs/	Credits
CEN101	Common Course I: English – 1	5	4
CEN102	Common Course I: English – 2	4	3
	Common Course II: Second Language – 1	4	4
BZO101	Core Course 1: Fundamentals of Biodiversity and Biosystematics	2	2
BZO1P01	Core Course - 1 Practical: Fundamentals of Biodiversity and	2	1
DCH101	Complementary Course I: Chemistry I	2	2
DCH1P01	Complementary Course I: Chemistry Practicals I	2	1
DB0101	Complementary Course II: Botany I	2	2
DB01P01	Complementary Course II: Botany Practicals I	2	1
	Total	25 hrs	20

Semester 2

Code	Course Title	Hrs/	Credits
CEN203	Common Course I: English - 3	5	4
CEN204	Common Course I: English – 4	4	3
	Common Course II: Second Language -2	4	4
BZO202	Core Course 2: Evolutionary Biology and Zoogeography	2	2
BZO2P02	Core Course 2 - Practical: Evolutionary Biology and	2	1
DCH202	Complementary Course I: Chemistry -2	2	2
DCH2P02	Complementary Course I: Chemistry Practicals - 2	2	1
DBO202	Complementary Course II: Botany - 2	2	2
DBO20P2	Complementary Course II: Botany Practicals -2	2	1
	Total	25 hrs	20

Semester 3

Code	Course Title	Hrs/	Credits
CEN304	Common Course I: English - 5	5	4
	Common Course II: Second Language – 3	5	4
BZ303	Core Course 3: Animal Diversity - Non Chordata	3	3
BZO3P03	Core Course 3 - Practical: Animal Diversity - Non Chordata	2	1
DCH303	Complementary Course I: Chemistry - 3	3	3
	Complementary Course I: Chemistry Practicals - 3	2	1
DBO303	Complementary Course II: Botany - 3	3	3
DBO3P03	Complementary Course II: Botany Practicals - 3	2	1
	Total	25 hrs	20

Semester 4

Code	Course Title	Hrs/	Credits
CEN406	Common Course I: English- 6	5	4
	Common Course II: Second language – 4	5	4
BZO404	Core Course 4: Animal Diversity – Chordata	3	3
BZO4P04	Core Course 4 - Practical: Animal Diversity - Chordata	2	1
DCH404	Complementary Course I: Chemistry - 4	3	3
DCH4P02	Complementary Course I: Chemistry Practicals - 4	2	1
DBO404	Complementary Course II: Botany - 4	3	3
DBO4P04	Complementary Course II: Botany Practicals - 4	2	1
	Total	25 hrs	20

Semester 5

No	Course Title	Hrs/	Credits
BZO505	Core Course 5: Research Methodology, Instrumentation &	3	3
BZO506	Core Course 6: Cell Biology and Molecular Biology	3	3
BZO507	Core Course 7: Perspectives in Ecology	3	3
BZO508	Core Course 8: Biochemistry and Physiology	4	3
	Core Course Practicals (Core 5, 6, 7 & 8)	8	4
OZO501	Open Course (for other streams): Human Health and Genetics	4	3
BZO5FV	Field Visit, Study Tour & Visit to Research Institutes		1
	Total	25 hrs	20

Semester 6

No	Course Title	Hrs/	Credits
BZO609	Core Course 9: Genetics, Biotechnology and Bioinformatics	4	3
BZO610	Core Course 10: Microbiology and Immunology	3	3
BZO611	Core Course 11: Endocrinology, Reproductive Biology and	3	3
BZO612	Core Course 12: Developmental Biology	3	3
BZO613	Core Course 13: Wild life Biology, Conservation and		
	Core Course Practicals (9, 10, 11 & 12)	8	4
BZO6PJ	Investigatory Project & Wildlife Biology Field Course		1
		25 hrs	20

SEMESTER I
Core Course 1
FUNDAMENTALS OF BIODIVERSITY AND BIOSYSTEMATICS

36 hrs - 2 Credits

PART I – BIODIVERSITY (24 hrs)

Module I - Introduction to Biodiversity

(12 hrs)

Biodiversity and its significance; Biodiversity as a natural resource
Levels of biodiversity - species, domesticated, genetic, alpha, beta, gamma.
Biodiversity distribution - tropical, temperate and polar
Biological hot spots- significance, global, Indian
Western ghats - ecological, social, cultural and economic aspects
Values of biodiversity; Threats to biodiversity; Role of invasive species

Module II - Conservation & Management of Biodiversity

(8 hrs)

Need for biodiversity conservation; Global measures; 3Rs in biodiversity
Importance of wetlands; Types of wetlands; Significance of mangroves; Importance of Kuttanad biodiversity
Endemic species and their conservation; Red Data Book and its significance; Conservation methods: Ex- situ, In-situ

Module III - Biodiversity Estimation

(4 hrs)

Biodiversity aspects: species richness, abundance, evenness
Biodiversity indices: Shannon- Weiner index, Simpson index, Pilou's index
Sampling techniques: Quadrature, Transect
Remote sensing

PART II - BIOSYSTEMATICS (12 hrs)

Module IV - Introduction to Biosystematics

(4 hrs)

Importance of systematics; Animal classification-hierarchy; ICZN code; Nomenclature: Linnaean, Trinomial
Morphological, numerical and phylogenetic systems of classification; DNA bar-coding

Module V - Animal collection and preservation techniques

(8 hrs)

Collection and preservation techniques
Taxidermy - definition and methods, (reptiles, birds and mammals)

References:

- Andrew S. Pullin 2002. *Conservation Biology*. Cambridge University Press, Cambridge, UK.
Anne E. Magurran 2004. *Measuring Biological Diversity*. Blackwell Publishing, MA, USA.
Chapman J.L. & M. J. Reiss 2006 *Ecology, Principles and Applications*. Sec Edition Cambridge University Press.
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Forman, R.T and M. Gordaon. 1986. *Landscape Ecology*. John Wiley & Sons, NY, USA.
Kapoor, V.C. 1998. *Theory and Practice of Animal Taxonomy*. Oxford and IBH Pub.Co, New Delhi

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

SEMESTER I
Core Course 1- Practical
FUNDAMENTALS OF BIODIVERSITY AND BIOSYSTEMATICS

36 hrs - 1 Credit

1. Sampling
2. Quadrate study
3. Transect study
4. Species area curve
5. Identification of Biodiversity hot spots using Google Earth
6. Identification using keys (4 specimens each)
 - Insect
 - Fish
 - Snake
7. Taxa identification techniques
 - Bird body parts
 - Butterfly/ dragonfly body parts and venation
8. Simple identification of any 20 local animals representing different taxa
 - Common name and scientific name
9. Field study:
 - Visit a biodiversity rich area and submit a report on the biodiversity and conservation efforts there. (*Individual report should be submitted by each student.*)

SEMESTER II
Core Course 2
EVOLUTIONARY BIOLOGY AND ZOOGEOGRAPHY

36 hrs - 2 Credits

PART I – EVOLUTIONARY BIOLOGY (27 hrs)

Module I – Origin and History of life (3 hrs)

Introduction, Chemical evolution, Miller-Urey experiment, Haldane and Oparin theory
 Geological time scale, Mass extinction

Module II – Theories of organic evolution (5 hrs)

Lamarckism- principles, examples and criticism
 Darwinism- Natural selection theory, examples and criticism
 Modern Synthetic theory (Neo Darwinism)
 Neutral theory of molecular evolution

Module III – Evidences for evolution (5 hrs)

Evidences from morphology and anatomy, Physiology and biochemistry, Embryology,
 Palaeontology

Types of fossils, Dating of fossils

Module IV – Patterns of evolution (4 hrs)

Adaptive radiation, convergent evolution and parallel evolution
 Microevolution, Macroevolution and Mega evolution
 Gradualism, case study of horse evolution; Punctuated equilibrium, case study of foraminiferans

Module V – Population genetics and evolution (5 hrs)

Genetic basis of variation, Hardy Weinberg equilibrium, Change in gene frequencies, Factors affecting gene frequencies

Module VI – Species and speciation (5 hrs)

Species concept – Morphological, biological, evolutionary and phylogenetic Speciation – types and mechanism; Isolating mechanisms

PART II – ZOOGEOGRAPHY (9 hrs)

Module VII – Zoogeographical Realms (5hrs)

Origin of continents- Plate tectonics/ continental drift
 Zoogeographical realms; Biogeography of India
 Insular fauna: Continental Island- Madagascar; Oceanic Island- Galapagos

Module VIII – Animal Distribution (4 hrs)

Kinds of animal distribution
 Factors and means of animal distribution
 Barriers in animal distribution

References:

Evolutionary Biology

- 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.
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- Goodwin,B. 1996. *How the Leopard Changed its Spots: The Evolution of Complexity*. Simon &Schuster, NY,USA.
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- Strickberger, M.W.2000. *Evolution*. Jones and Bartlett, Boston.
- Verma P.S. and Agarwal V.K 2007 *Cell biology, Genetics, Molecular Biology, Evolution and Ecology*, S. Chand & Company New Delhi

Zoogeography

- A.R. Wallace, 1962. The geographical distribution of animals. Hafner Publ. Co.
- Alfred Russel Wallace, 1876. The Geographical Distribution of Animals, With a Study of the Relations of Living and Extinct Faunas as Elucidating the Past Changes of the Earth's Surface. (New York: Harper and Brothers, 1876).
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- Frank Evers Beddard, 2008. A Text-Book of Zoogeography. Published by BiblioBazaar, LLC, 2008. 192 pages.
- Joachim Illies, 1974. Introduction to Zoogeography. Macmillan (January 1974).
- John C. Briggs, 1974. Marine Zoogeography (Population Biology).
- John R. Merrick, 2006. Evolution and Biogeography of Australasian Vertebrates. 942 pages. Publisher: Ausci (January 2006)
- L F De Beaufort, 1951. Zoogeography of the Land & Inland Waters.
- Miklos D. F Udvardy, 1969. Dynamic zoogeography: With special reference to land animals. 445 pages. Van Nostrand Reinhold (1969).
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- S K Tiwari, Faunal Regions of the World. Vedams eBooks (P) Ltd (India). Shivkumar Tiwari, 1985. Readings in Indian Zoogeography (vol.1). Today & Tomorrow Printers & Publishers.
- S. K. Tiwari, 2006. Fundamentals of World Zoogeography. Vedams eBooks (P) Ltd (India). 384 pages. (Sarup & Sons, Ansari Rd. Daryaganj, Delhi).
- S.K. Tiwari, 1985. Zoogeography of India And South East Asia. International Book Dist. Dehra Dun.
- S.K. Tiwari, Zoogeography of Indian Amphibians. Today & Tomorrow Printers and Publishers.
- Wilma George, 1962. Animal geography. Heinemann Edu. Books Ltd. 142 pages.

SEMESTER II
Core Course 2 - Practical
EVOLUTIONARY BIOLOGY AND ZOOGEOGRAPHY

36 hrs - 1 Credit

1. Identification of Zoogeographical realms using Google Earth
2. Study of endemic species of each realm
3. Study of evolution of animals using Virtual lab
4. Study of Homology / Analogy
5. Study of connecting links
6. Study of living fossils
7. Study of Geological time scale
8. Study of vestigial organs
9. Calculation of gene/ allele frequency using Hardy- Weinberg equilibrium
10. Identification of Drosophila mutants

SEMESTER III
Core Course 3
ANIMAL DIVERSITY- NON CHORDATA

54 hrs - 3 Credits

Module I - Introduction to invertebrates

(2 hrs)

Outlines of classification

Phylogeny- cell number, embryology and body symmetry, developmental pattern

Module II - Kingdom Protista

(7 hrs)

General characteristics and outline classification

Type: Paramecium

Life history of parasitic protozoan –Plasmodium

A brief description of Entamoeba, Trypanosoma, Leishmania.

Module III - Kingdom Animalia

(1 hr)

Outline classification; Mesozoa and Metazoa

Phylum Mesozoa - Rhopalura

Module IV – Subkingdom Metazoa

(2 hrs)

Levels of animal organization; Body layers; Symmetry; Coelom; Metamerism

Germ layers; Protostomes and Deuterostomes; Cephalisation

Body plan of animals- Blind sac and Tube within tube

Module V – Phylum Porifera & Placozoa

(2 hrs)

Phylum Porifera: General characteristics; Outline classification; Canal system in Sponges

Class Calcarea - Leucosolenia

Class Desmospongia - Spongilla

Class Hexactinellida – Euplectella

Phylum Placozoa - *Trypanoxylon adherens*

Module VI – Phylum Coelenterata

(3 hrs)

General characteristics; Outline classification

Class Hydrozoa – Hydra, Obelia

Class Scyphozoa - Aurelia

Class Anthozoa - Sea Anemone

Polymorphism in Coelenterates; Coral reefs with reference to Indian ocean; Threats and conservation of coral reefs

Module VII – Phylum Ctenophora

(1 hr)

Major characteristics (Mention the affinities of Ctenophores)

Pleurobrachia

Module VIII - Phylum Platyhelminthes

(5 hrs)

General characteristics; Outline classification

Class Turbellaria - Bipalium

Class Digenea(Trematoda) - Fasciola and its life cycle

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Class Aspidogaster - Aspidogaster
 Class Monogenea - Entobdella
 Class Cestoda - Tape worm

Module IX – Phylum Aschelminthes (4 hrs)

General characteristics; Outline classification

Class Nematoda - Ascaris
 Class Nematomorpha - Gordius
 Class Gastrotrichia - Chaetonotus
 Class Kinorhyncha - Echinoderes

Brief study of Parasitic nematodes -Enterobius, Blood fluke, Hook worm, Filarial worm

Module X – Phylum Annelida (4 hrs)

General characteristics; Outline classification

Class Polychaeta - Nereis
 Class Archiannelida - Polygordis
 Class Oligochaeta - Earth worm
 Class Hirudinea – Hirudinaria, Haemadipsa

Vermicomposting; Economically important earthworm species

Module XI - Phylum Arthropoda (13 hrs)

General characteristics; Outline classification

Type: Penaeus

Subphylum Trilobitomorpha

Class Trilobita (Extinct)

Subphylum Chelicerata

Class Merostoma – Limulus

Class Arachnida – Spider

Class Pycnogonida – Nymphon

Subphylum Mandibulata

Class Crustacea – Daphnia

Class Chilopoda - Centepede

Class Symphyla - Scutigereilla

Class Diplopoda - Millipede

Class Pauropoda - Pauropus

Class Insecta – Butterfly

Beneficial Insects: Honey bee, Lac insect, Silk insect

Vectors and vector borne diseases: Dengue, JE, Chickungunya

Insect pests of agricultural importance – Paddy, Coconut

Pests of Fruits and Vegetables(Brief mention only)

Prawn and Lobster fisheries

Module XII - Phylum Mollusca (4 hrs)

General characteristics; Outline classification

Class Monoplacophora - Neopilina

Class Amphineura - Chiton

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Class Scaphopoda - Dentalium
 Class Gastropoda - Pila
 Class Bivalvia - Lamellidens
 Class Cephalopoda - Loligo
 Pearl culture and Mussel culture

Module XIII – Phylum Echinodermata (3 hrs)

General characteristics; Outline classification

Class Asterozoa – Asteropecten
 Class Ophiurozoa - Ophiothrix
 Class Echinozoa – Echinus
 Class Holothurozoa – Cucumaria
 Class Crinozoa – Antedon

Water vascular system in Echinoderms

Module XIV - Phylum Hemichordata (1 hr)

General characteristics –Balanoglossus

Module XV - Minor Phyla (2 hrs)

Sipunculida; Chaetognatha; Rotifera; Onychophora, Acantocephala

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SEMESTER III
Core Course 3 - Practical
ANIMAL DIVERSITY- NON CHORDATA

36 hrs - 1 Credit

Scientific Drawing:-

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

Anatomy:-

Study of sections

1. Hydra.
2. Ascaris (male or female)
3. Fasciola
4. Earthworm (TS through intestine)

Study of nervous system in Prawn

Study of digestive system in Cockroach

Identification of common mosquitoes(4 genuses)

Mounting:-

1. Mouth parts – House fly and Honey Bee
2. Prawn appendages.

Identification:-

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

SEMESTER IV
Core Course 4
ANIMAL DIVERSITY – CHORDATA

54 hrs - Credits 3

Module I - Introduction to Phylum Chordata

(1 hr)

General characteristics

(Classification up to order – Sub Phylum, Super class, Class, Sub class, Order)

Module II - Sub phylum Urochordata

(3 hrs)

Class I : Larvacea - Oikopleura

Class II: Ascidiacea - Ascidia (Mention Retrogressive Metamorphosis)

Class III: Thaliacea - Doliolum

Module III - Sub phylum Cephalochordata

(1 hr)

Amphioxus

Module IV - Division Agnatha

(2 hrs)

Class I: Ostracodermi - Cephalaspis

Class II: Cyclostomata - Petromyzon, Myxine

Module V - Division Gnathostomata

(12 hrs)

Super class Pisces

Class I: Chondrichthyes

Sub class Elasmobranchi - Narcine

Sub class Holocephali - Chimaera

Class II: Osteichthyes

Sub class Choanichthyes

Order I: Crossopterygii - Latimeria

Order II: Dipnoi - Lepidosiren

Sub class Actinopterygii

Super order 1. Chondrostei - Acipenser

Super order 2. Holostei - Amia

Super order 3. Teleostei – Sardine

Accessory respiratory organs in fish; Scales in fishes; Common culture fishes of Kerala (traditional and recent trends)

Fresh water fishes of Kerala (Brief mention only)

Module VI - Super class Tetrapoda

(4 hrs)

Class: Amphibia

Order I: Anura - Euphlyctis

Order II: Urodela - Amblystoma (Axolotl larva and neoteny)

Order III: Apoda - Ichthyophis

Frogs and toads of Kerala (Brief mention only)

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Module VII – Class Reptilia

(4 hrs)

Sub class I: Anapsida

Order Chelonia - Chelone

Sub class II: Parapsida - Ichthyosaurus

Sub class III: Diapsida

Order I Rhynchocephalia - Sphenodon

Order II Squamata - Chamaleon

Sub class IV: Synapsida - Cynognathus

Identification of poisonous and non poisonous snakes; Snakes of Kerala

Module VIII - Class Aves

(6 hrs)

Sub class I: Archaeornithes - Archaeopteryx (Affinities)

Sub class II: Neornithes

Super order I: Palaeognathae - Struthio

Super order II: Neognathae - Brahminy kite

Flight adaptations in birds; Migration in Birds;

Birds of Kerala(Brief mention only)

Module IX - Class Mammalia

(20 hrs)

Type: *Homo sapiens*

Sub class I: Prototheria - Echidna

Sub class II: Metatheria - Macropus

Sub class III: Eutheria

Order 1. Insectivora - Talpa

Order 2. Dermoptera - Galeopithecus

Order 3. Chiroptera - Pteropus

Order 4. Primates - Loris

Order 5. Carnivora - Panthera

Order 6. Edentata - Armadillo

Order 7. Pholibota - Manis

Order 8. Proboscidea - Elephas

Order 9. Hydracoidea - Procvia

Order 10. Sirenia - Dugong

Order 11. Perissodactyla - Zebra

Order 12. Artiodactyla - Cameleus

Order 13. Lagomorpha - Oryctolagus

Order 14. Rodentia - Porcupine

Order 15. Tubulidentata - Orycteropus

Order 16. Cetacea - Delphinus

Dentition in Mammals; Aquatic Mammals

Mammals of Kerala (Brief mention only)

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SEMESTER IV
Core Course 4 - Practical
ANIMAL DIVERSITY - CHORDATA

36hrs - 1 Credit

1. Morphology

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

Mounting of placoid scales/cycloid/ctenoid scales

2. Study of Human Anatomy using Virtual lab

1. Viscera

2. Digestive System

3. Heart

4. Respiratory System

5. Excretory System

6. Brain

7. Reproductive System – Male & Female

3. Study of sections

Human skin, Cartilage, Bone

4. Osteology

Human vertebrae (Typical, Atlas, Axis, Lumbar)

Pectoral and pelvic girdles of Man

5. Dentition in Mammals (Dog, Rabbit, Man)

6. Study of feathers

7. Identification:-

General identification of poisonous snakes (Cobra, Viper, Krait)

Non poisonous (Rat snake, Natrix, Python)

Identify animals by their scientific names: Protochordata-1, Pisces-4, Amphibia-3,

Reptilia- 4, Aves-1, Mammalia-2.

8. Taxonomic identification with key:-

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

ii) Identification of snakes up to family.

SEMESTER V

Core Course 5

RESEARCH METHODOLOGY, INSTRUMENTATION AND BIOSTATISTICS

54 Hrs - 3 Credits

PART I - RESEARCH METHODOLOGY (26 hrs)

Module I - Introduction

(5 hrs)

Basic concepts of research: Meaning, Objectives
Types of Research: Descriptive/Analytical, Applied/Fundamental, Quantitative/Qualitative, Conceptual/Empirical

Module II - Research Design

(4 hrs)

Basic principles; Meaning, need and features of good design; Types of research designs

Module III – Research Documentation & Presentation

(5 hrs)

Scientific documentation and communication; Research report writing (Thesis and dissertations, Research articles, Oral communications); Bibliography formats; Plagiarism
Presentation techniques: Assignment, Seminar, Debate, Workshop, Colloquium, Conference

Module IV – Measurements

(8 hrs)

Units of measurements; Calculations and related conversions of measurement units
Metric system- length; surface; weight; Square measures; Cubic measures; Volumetric; Circular or angular measure
Concentration - percent volume; ppt; ppm
Chemical – Molarity, Normality
Temperature- Celsius, centigrade, Fahrenheit

Module V - Bioethics

(4 hrs)

Introduction; Animal rights and animal laws in India; Animal use in research and education; Laboratory animal use, care and welfare; Animal protection initiatives; Animal Welfare Board of India
Working with Humans: harm, risk, and benefits; Consent

PART II - INSTRUMENTATION

Module VI - Research Tools

(14 hrs)

Light microscopy – Simple and Compound, Phase Contrast Microscope, Electron Microscope: SEM and TEM, pH Meter, Centrifuge, Electrophoresis, Colorimeter, Chromatography
Computer simulation of biological systems

PART III – BIOSTATISTICS (14 hrs)

Module VII - Sample & Sampling techniques

(6 hrs)

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

Module VIII - Measures of Central Tendency

(2 hrs)

Mean, Median, Mode (Direct method only)

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Module IX- Measures of dispersion

(6 hrs)

Range; Quartile Deviation; Mean Deviation; Standard Deviation; Standard error (Merits & demerits)

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SEMESTER V

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Core Course 5 – Practical

RESEARCH METHODOLOGY, INSTRUMENTATION AND BIostatISTICS

36 hrs - 1 Credit

1. Magnification and focusing of objects using light microscopes
2. Phase contrast microscopy
3. Micrometry – calibration and measurement of microscopic objects
4. Camera Lucida (draw a few diagrams using Camera Lucida)
5. Paper chromatography
6. Instrumentation
 - Determination of pH using pH meter
 - Separation of colloids using centrifuge
 - Principle and applications colorimeter
 - Principle and applications of Electrophoresis
7. Graphical representation of data using MS Excel
 - Line diagram
 - Bar diagram
 - Pie diagram

SEMESTER V
Core Course 6
CELL BIOLOGY AND MOLECULAR BIOLOGY

54 Hrs - 3 Credits

PART I - CELL BIOLOGY (27 hrs)

Module I - Introduction

(2 hrs)

Cell theory

Eukaryote, Prokaryote; Mycoplasma; Virus; Viroid; Prion

Module II - Cell membrane & Permeability

(6 hrs)

Molecular models of cell membrane: Sandwich model; Unit membrane model; Fluid mosaic model

Modifications of plasma membrane: Microvilli; Tight junction; Gap junction; Desmosomes

Cell permeability – Diffusion; Osmosis; Passive transport; Active transport

Cell coat and Cell recognition

Module III - Ultra structure of Cytoplasm

(6 hrs)

Cytoskeleton: Microtubules; Microfilaments; Intermediate Filaments

Endoplasmic reticulum - Structure and functions

Ribosomes (Prokaryotic and Eukaryotic)

Golgi complex - Structure and functions

Lysosomes - Polymorphism; GERL concept; functions

Mitochondria - Structure and functions; Symbiont hypothesis

Module IV- Nucleus

(6 hrs)

Structure and functions of interphase nucleus

Nuclear membrane; Pore complex

Structure and functions of nucleolus

Chromosome 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, Meiosis and Amitosis

Module VI – Cancer & Ageing

(4 hrs)

Types of tumors-benign and malignant

Types of cancers-Carcinoma, Sarcoma, Lymphoma, Leukemia

Causes of cancer- Physical, Chemical and Biological

Properties of cancer cells

Brief account on Ageing, Theories of Ageing

PART II - MOLECULAR BIOLOGY (27 hrs)

Module VII - Nature of Genetic Material

(9 hrs)

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Discovery of DNA as genetic material – Griffith’s transformation experiments; Hershey Chase experiment of Bacteriophage infection
Structure and 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; Pseudo genes; Overlapping genes; Transposons

Module VIII - Gene Expression

(12 hrs)

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

Module IX - Gene Regulation

(6 hrs)

Prokaryotic: Operon concept - Lac operon and Tryptophan operon; Catabolite repression (Glucose effect).
Brief account of Eukaryotic gene regulation

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SEMESTER V
Core Course 6 – Practical
CELL BIOLOGY AND MOLECULAR BIOLOGY

36 hrs - 1 Credit

1. Study of tissues using permanent slides of epithelial tissues(Squamous, Cuboidal, Columnar), striated muscle, smooth muscle, neuron, cartilage and bone.
2. Isolation, staining and mounting of striated muscle fibre.
3. Squash preparation of onion root tip and identification of mitotic stages.
4. Mounting of polytene chromosome (Drosophila/Chironomus).
5. Identification of meiotic stages using permanent slides.
6. Preparation of human blood smear and identification of blood cells.
7. Study of tonicity using RBC.
8. Comparative study of prokaryotic and eukaryotic cells.
9. Identification of cell organelles.
10. Models (DNA, DNA replication, RNA – Different types)

SEMESTER V
Core Course 7
PERSPECTIVES IN ECOLOGY

54 hrs - 3 Credits
(2 hrs)

Module I - Introduction

Relevance of ecological studies. Autecology and synecology.

Module II - Ecosystem

(12 hrs)

Components and classification

Habitat ecology: Fresh water habitat types; Lentic and lotic.

Marine habitat: Intertidal zone, Rocky shore, Muddy shore, Sandy shore; Coral reefs; Open sea;

Pelagic realm; Benthic realm

Wetland and Mangroves; Estuarine ecosystem; Ramsar sites in Kerala

Terrestrial biomes

Food chain; Detritus and grazing food chains

Energy flow through the ecosystem, Ecological pyramids and ecological efficiencies.

Module III - Population Ecology

(5 hrs)

Characteristics of population, population growth curves, r and k selections

Population regulation by density dependent and density independent factors; Life tables, survivorship curves.

Module IV - Community Ecology

(8 hrs)

Habitat and niche concept

Compartmentation in communities: Trophic levels, guild structure and food webs.

Ecotone and edge effect, Keystone species and dominant species concept

Animal associations with reference to competition, predation. Predator-prey oscillation

Antibiosis, Protocooperation, Commensalism, Mutualism.

Module V - Biogeochemical Cycles

(3 hrs)

The Phosphorus Cycle, Nitrogen Cycle, Carbon Cycle, Sulphur Cycle.

Module VI - Resource Ecology

(6 hrs)

Natural resources and its sustainable management

Renewable and non-renewable energy resources; Mineral resources; hydropower; tidal power

Green building concept and green technology concept

Module VII - Environmental issues

(7 hrs)

Global Issues: Global warming and Climate change; Ozone depletion; Greenhouse effect; Acid rain; Nuclear accidents; Carbon trading carbon credit; Carbon sequestration; IPCC/UNFCC

Local issues: Sand mining; Wetland reclamation; Landscape changes; Deforestation; Threats to fresh water resources of Kerala; Tourism and its impact on environment

Module VII - Pollution

(6 hrs)

Air pollution; Water pollution; Land pollution; Sound Pollution; Pesticide pollution; Municipal solid waste management; e-waste and its management

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Module IX - Disaster Management

(5 hrs)

Introduction to hazards; Hazards classification; Types of hazards: natural and anthropogenic
 Disaster management- introduction; Earthquakes; Cyclone; Tsunami; Floods; Landslides;
 Droughts

References:

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SEMESTER V
Core Course 7 - Practical
PERSPECTIVES IN ECOLOGY

36 hrs - 1 Credit

1. Estimation of dissolved oxygen
2. Estimation of dissolved carbon dioxide
3. Collection and identification of freshwater/ marine plankton
4. Plankton count(Fresh water/ marine)
5. Extraction of soil organisms
6. Study of soil types
7. Identification of minerals and rocks
8. Transparency measurements using Secchi disc
9. Study of pond ecosystem and preparation of food web

SEMESTER V
Core Course 8
BIOCHEMISTRY AND PHYSIOLOGY

72 hrs - 3 Credits

PART I – BIOCHEMISTRY (18 Hrs)

Module I – General Biochemistry & Biomolecules

(5 hrs)

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

Module II - Metabolism

(9 hrs)

Carbohydrate metabolism- Glycolysis, glycogenolysis, gluconeogenesis, glycolysis –citric acid cycle, ATP synthesis, Hexose monophosphate shunt

Lipid metabolism- Biosynthesis and oxidation of fatty acids- Beta oxidation, Physiologically important compounds synthesized from cholesterol.

Protein metabolism- Deamination, transamination, transmethylation, decarboxylation, ornithine cycle and Uric acid synthesis

Module III – Enzymes

(4 hrs)

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

PART II – PHYSIOLOGY (54 Hrs)

Module IV - Nutrition

(7 hrs) Types of

nutrition; Major and minor nutrients; Importance of fiber in diet; Digestion and absorption of carbohydrates, proteins and lipids; Nervous and hormonal control of digestion; Special modes of digestion: ruminant and symbiotic

Balanced diet; Nutritional disorders: Overnutrition, malnutrition, undernutrition, Defects of modern food habits, Obesity, Anorexia, acidity and ulcers, flatulence.

Module V - Respiration

(8 hrs)

Respiration in animals: cutaneous, tracheal, branchial, pulmonary.

Exchange and transport of respiratory gases. Respiratory pigments in animals: hemoglobin(mention structure), myoglobin, hemocyanin, haemerythrin, chlorocruorin.

Exchange and transport of respiratory gases, Oxy-hemoglobin curve, Bohr effect, reverse Bohr effect and Haldane effect.

Respiratory disturbances and disorders: Dyspnoea, asthma, emphysema, Anoxia, hypoxia, cyanosis, hypocapnia, hypercapnia and asphyxia; Carbon monoxide poisoning

Respiratory adaptations to high altitudes, Physiological adaptations of deep sea animals, Physiological problems of deep sea diving.

Module VI – Circulation

(8 hrs)

Organs and mechanism of circulation- Types of heart

Cardiac cycle, Control and rhythmicity of the heart beat- Pacemakers, Pulse, Blood pressure and disorders, Neural and Hormonal control.

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Human Blood and its constituents, Buffer system in blood, Blood clotting mechanism: intrinsic and extrinsic pathways, clotting factors, disorders of blood clotting, anticoagulants, blood groups and transfusion.

Circulatory disorders- Myocardial infarction, angina pectoris, cardiac arrest, thrombus and embolus, arteriosclerosis and atherosclerosis.

Clinical analysis- Electrocardiogram (ECG), Erythrocyte sedimentation rate (ESR), Haematocrit, Total and differential blood cell count

Module VII – Excretion (7 hrs)

Patterns of nitrogen excretion in animals: ammonotelism, ureotelism, uricotelism.

Structure of nephron, formation of urine, counter current mechanism, water and salt balance, acid-base control and homeostasis; Hormonal control of kidney functions.

Composition of urine- normal and abnormal constituents, Diseases of the kidney- Kidney stones, Proteinuria, Nephrosis, Pyelonephritis.

Artificial kidney (haemodialysis), Peritoneal dialysis and Kidney transplantation.

Module VIII – Muscle Physiology (7 hrs)

Muscular movements, Types of muscles

Vertebrate skeletal muscle: Structure and function; Mechanism, Biochemistry and Energetics of muscle contraction

Neuromuscular junction

Electrophysiology of muscle, threshold and spike potentials, simple muscle twitch, whole muscle contraction, isotonic and isometric contraction, latent and refractory periods, summation, beneficial effect, tetanus, tonus, staircase phenomenon, fatigue, oxygen debt, rigor mortis.

Module IX – Neurophysiology (6 hrs)

Structure and types of neurons, Nerve fiber and impulse propagation, Synaptic transmission & properties of synapses, neurotransmitters, role of dopamine and serotonin. Neuroreceptors. Reflexes and types of reflexes.

Central nervous system, Peripheral nervous system and Autonomous Nervous System

Electroencephalogram (EEG)

Neural disorders- Parkinson's disease, Dementia, Alzheimer's disease, Dyslexia, Epilepsy, Schizophrenia.

Module X – Sensory Physiology (5 hrs)

Chemoreceptors: Gustatory receptors- taste buds, Olfactory receptors

Mechanoreceptors: statoreceptors

Phonoreceptors- Physiology of hearing

Touch receptors

Photoreceptors- Physiology of vision

Thermoreceptors

Module XI – Environmental Physiology (5 hrs)

Body Temperature and its Regulation, Poikilotherms, Homeotherms

Physiological adaptation to Cold; Shivering; Dormancy; Hibernation; Aestivation

Photoperiodism

Stress Physiology- Stress factors(internal & external), Stress adaptations

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SEMESTER V
Core Course 8 - Practical
BIOCHEMISTRY AND PHYSIOLOGY

36 hrs - 1Credit

BIOCHEMISTRY

- 1) Qualitative analysis of sugars – glucose, fructose, lactose, maltose, starch and glycogen
- 2) Qualitative analysis of lipids (Sudan III) and Cholesterol (Liebermann Burchard test)
- 3) Estimation of serum glucose by Biuret method (Colorimetric)
- 4) Determination of amylase activity in time intervals (starch-iodine test)

PHYSIOLOGY

- 1) Determination of haemoglobin content of blood
- 2) Total RBC count using Haemocytometer
- 3) Total WBC count using Haemocytometer
- 4) Estimation of PCV
- 5) Instruments: Sphygmomanometer and Stethoscope (principle and use)
- 6) Measurement of blood pressure using a sphygmomanometer

SEMESTER VI
Core Course 9
GENETICS, BIOTECHNOLOGY AND BIOINFORMATICS

72 Hrs - 3 credits

PART I - GENETICS (36 hrs)

Module I - Introduction

(2 hrs)

Gene and alleles, genotype and phenotype, homozygous and heterozygous, wild type and mutant alleles, Chromosome theory of heredity

Module II - Mendelism

(3hrs)

Mendel's laws, Dominant and recessive traits, test cross and back cross, reciprocal cross, Mendelian traits in man

Module III - Interaction of genes

(5 hrs)

Allelic: Incomplete dominance, Co-dominance

Non allelic interactions: Complementary, supplementary

Epistasis: Dominant (feather colour in fowl), Recessive (coat colour in mice)

Polygenes (Skin colour inheritance in man)

Pleiotropism; Modifying genes; Lethal genes (Brief account with one example each)

Multiple alleles (coat colour in rabbits, ABO blood group, Rh factor and its inheritance)

Module IV - Linkage and Recombination

(3hrs)

Morgan's work in Drosophila (Complete and incomplete linkage)

Arrangement of linked genes-cis and trans

Recombination

Cytological evidence of crossing over (Stern's Experiment)

Module V - Sex determination

(3hrs)

Sex chromosomes and autosomes

Chromosomal mechanism sex determination (XX-XO, XX-XY, ZW-ZZ)

Sex determination in man; Barr bodies and Lyon hypotheses (Dosage compensation); Role of Y chromosome

Sex determination in honey bees; Sex determination in Drosophila; Intersex; Gynandromorphs

Hormonal influence on sex determination; Sex reversal

Environmental influence; Genic balance theory; Hermaphroditism

Module VI - Sex linked inheritance

(1 hr)

Definition, Characteristics of sex linked inheritance (criss-cross inheritance)

Haemophilia and colour blindness

Pseudoautosomal genes (incompletely sex-linked genes)

Holandric genes; Sex limited and sex influenced traits in man

Module VII - Mutations

(5hrs)

Types of Mutations: Somatic and germinal; Induced and random

Chromosomal mutations - structural and numerical changes

Gene mutation (point mutation)

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Molecular basis of gene mutations: Transversions, Transitions, Frame shift
 Mutagens: Physical, Chemical, Biological

Module VIII - Extra nuclear inheritance (2hrs)

Kappa particles in Paramecium
 Maternal effect genes in snail

Module IX - Bacterial Genetics (4 hrs)

Bacterial genome
 Recombination in Bacteria
 Bacterial transformation; Transduction; Conjugation; F mediated sexduction

Module X - Human Genetics (8hrs)

Pedigree Analysis; Karyotyping- Normal human chromosome complement
 Aneuploidy and Non disjunction
 Genetic disorders in Man: Chromosomal anomalies- Autosomal: Down syndrome; Edward's syndrome; Cri-du-chat syndrome
 Sex chromosomal - Klinefelter's syndrome; Turners syndrome
 Single gene disorders (Brief mention): Sickle cell anaemia and Brachydactyly
 Inborn errors of metabolism: Phenylketonuria; Alkaptonuria; Albinism and Tyrosinosis
 Multifactorial disorders: Polygenic traits - Cleft lip and cleft palate.
 Prenatal Diagnosis: Amniocentesis; Choriovillus sampling; Ultrasound scanning; Fetoscopy;
 Genetic counselling
 Eugenics, Euphenics and Euthenics

PART II – BIOTECHNOLOGY (18 hrs)

Module XI - Tools and Techniques of Genetic Engineering (14 hrs)

Tools: Enzymes- Restriction enzymes and DNA ligases
 Vectors: Plasmids and Phage vectors
 Production of recombinant DNA(Briefly mention)
 Gene transfer: Virus mediated and DNA mediated
 PCR technique and DNA amplification
 Blotting Techniques: Southern Blotting; Northern Blotting; Western Blotting
 DNA hybridization: Fluorescence *in-situ* Hybridization (FISH), Colony hybridization
 DNA finger printing and its applications
 RFLP- markers and applications
 Gene libraries; Genomic and cDNA libraries
 Potential uses of stem cells

Module XII - Applications of Biotechnology (4 Hrs)

Tissue culture – Principle and uses
 Single cell protein (SCP)
 Biotechnology and Medicine: Therapeutic cloning; Gene therapy; Monoclonal antibodies; Humulin
 Antibiotics; DNA Vaccines
 Biotechnology in agriculture : Microbial insecticides; GMO

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Problems in Biotechnology: Hazards of genetic engineering; Ethical issues; Biowar

PART III - BIOINFORMATICS (18 hrs)

Module XIII – Biological Information Management

(9 hrs)

Introduction, DNA, RNA and Proteins as information molecules

Genome sequencing projects; Storing, accessing and annotating sequence data, role of databases and internet

Bioinformatics Databases - NCBI GenBank, PDB

Database searching

Module XIV - Sequence Analysis

(5 hrs)

Sequence alignment: Pair-wise alignment - BLAST, Multiple sequence alignment- CLUSTAL

Omega

Molecular Phylogenetics

Module XV – Structural Bioinformatics

(4 hrs)

Protein Structure prediction- Computer Aided Drug Discovery

Molecular Visualization Software – Rasmol

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SEMESTER VI
Core Course 9 - Practical
GENETICS, BIOTECHNOLOGY AND BIOINFORMATICS

36 hrs - 1 Credit

1. Genetic problems – (Problems from each type)
(a) Mono and Dihybrid cross (b) Back cross (c) Multiple alleles.
2. Study of barr body in human buccal epithelium.
3. Study through photographs of the Karyotype- Turner's Syndrome , Klinefelter's and Down's Syndrome.
4. Sex linked inheritance (color blindness, hyper trichosis, ichthyosis, hemophilia)
5. Autosomal disorders (sickle cell anemia, brachydactyly)
6. Sexing of *Drosophila melanogaster*
7. Isolation of genomic DNA
8. Downloading Nucleotide and Protein sequence files from databases
9. Downloading structure files and visualizing using Rasmol
10. Sequence Analysis using BLAST, CLUSTAL Omega

SEMESTER VI
Core Course 10
MICROBIOLOGY AND IMMUNOLOGY

54 hrs - 3 Credits

PART I - MICROBIOLOGY (27 hrs)

Module I - Introduction to Microbiology (2 hrs)

Scope of Microbiology; Outline classification of bacteria, fungi and viruses

Module II - Methods in Microbiology (8 hrs)

Methods of sterilization and disinfection: Physical; Chemical
Preparation of culture media: Selective media; Enrichment media; Enriched media; Differential media
Plating techniques and isolation of pure colonies; Aerobic and anaerobic cultivation
Culture preservation techniques: Refrigeration, Deep freezing, Freezing under liquid nitrogen; Lyophilization

Module III - Basic Bacteriology (4 hrs)

Morphology and fine structure of bacteria; Flagella, Pili, Capsule, Cell wall and its composition; Cytoplasmic membrane; Protoplast; Spheroplast; Nuclear material, Cell inclusions, Bacterial spores

Module IV - Basic Virology (4 hrs)

Viruses -Structure of Viruses; Human, Animal, Plant and Bacterial Viruses; Replication of viruses – Lytic and lysogenic cycle

Module V- Microbial Infections (3 hrs)

Primary and secondary infections; Cross infection; Nosocomial infection; Endogenous and exogenous infections
Epidemic, endemic and pandemic; Modes of transmission of diseases: by food, water, air and vectors

Module VI - Microbial Diseases (6 hrs)

A brief study of the following microbial diseases:-
Bacterial: Tuberculosis & Typhoid
Viral :Swine Flu, Bird Flu, Dengue, Chikungunya
Fungal: Dermatophytoses & Candidiasis

PART II - IMMUNOLOGY (27 hrs)

Module VII - Introduction to Immunology (4 hrs)

Types of immunity; Acquired immunity- passive & active
Innate immunity - Mechanism of innate immunity, Barriers
Phagocytosis; Inflammation

Module VIII - Antigens and Antibodies (6 hrs)

Types of antigens; haptens; antigenic determinants
Basic structure of immunoglobulins

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Different classes of immunoglobulins and functions
 Complement system, biological effects of complement

Module IX - Antigen-antibody reactions

(5 hrs)

Precipitation test; Agglutination Test

Clinical applications of antigen - antibody reaction: Widal test; VDRL; ELISA; Complement fixation test; Coombs test

Module X - Immune Response system

(5 hrs)

Primary and secondary lymphoid organs

Cells and tissues of the immune system

Primary and secondary responses

Monoclonal antibodies; Hybridoma technology

Module XI – Immunopathology

(7 hrs)

Hypersensitivity - types of hypersensitivity reactions

Autoimmunity - causes; Graves disease; Hashimoto thyroiditis; Pernicious anemia

Immunodeficiency- primary and secondary

Transplantation immunology; Graft rejection

Major Histocompatibility complex; Human leukocyte antigen system

Immunohaematology, Immunology of blood transfusion, Erythroblastosis foetalis

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Microbiology

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SEMESTER VI
Core Course 10 - Practical
MICROBIOLOGY AND IMMUNOLOGY

36 hrs - 1 Credit

1. Instruments –Autoclave, Hot air oven, Laminar Air Flow, Bacteriological incubator –
Working and use in Microbiology lab.
2. Cleaning and sterilization of glassware
3. Preparation of solid and liquid media for microbial cultures. (Ingredients, pH and method of preparation) (Demonstration)
 - (a) Solid media (1) Nutrient agar (2) Mac Conkey's agar
 - (b) Liquid Media (1) Nutrient broth (2) Peptone water.
 - (c) Semi solid agar
 - (d) Firm agar
4. Culture methods
 - (a) Streak plate technique
 - (d) Pour plate culture
 - (e) Liquid culture
5. Examination of microbes in living condition
Hanging drop method for demonstrating motility of bacteria.
6. Gram staining – preparation, procedure, identification of Gram + ve and Gram –ve bacteria.
7. Determination of ABO blood groups and Rh factor (Antigen –antibody Reaction)

SEMESTER VI
Core Course 11
ENDOCRINOLOGY, REPRODUCTIVE BIOLOGY AND ETHOLOGY
54 Hrs – 3 credits

PART I - ENDOCRINOLOGY (20 hrs)

Module I – General Principles

(6 hrs)

Hormones as messengers; classification and types of hormones
Mechanism of hormone action, Concept of hormone receptors, Hormonal control of homeostasis.

Module II – Endocrine Glands

(14 hrs)

Secretion, regulation, functions and disorders of hormones of Hypothalamus, Hypophysis, Pineal, Thyroid, Parathyroid, Thymus, Islets of Langerhans, Adrenal, Gonads, Placenta
Gastro intestinal hormones

Part II - REPRODUCTIVE BIOLOGY (16 hrs)

Module III - Reproductive Organs and Gametogenesis

(8 hrs)

Human reproductive organs; Ultra structure of testes and ovary
Spermatogenesis and oogenesis; Structure of human sperm and egg; Hormonal control of gametogenesis

Module IV - Sexual cycle

(8 hrs)

Estrus cycle (non-primate) and menstrual cycle (primate cycle); Hormonal control of menstrual cycle
Puberty; Menarche; Menstrual cycle; Pregnancy; Parturition; Lactation; Menopause and associated physiological changes

Part III - ETHOLOGY (18 hrs)

Module V - Introduction

(1 hr)

Scope and branches of Ethology

Module VI – Learning & Motivation

(5 hrs)

Instinct; Taxes; Kineses
Types of learning with examples; latent learning; Lorenz experiments; Pavlov's experiments in classical conditioning; short and long term memory
Types of motivation

Module VII - Communication

(4 hrs)

Origin and evolution of communication system
Types of communication with examples-electrical, chemical, olfactory, auditory, visual, echolocation, pheromonal communication in social insects and primates

Module VIII - Orientation and navigation

(5hrs)

Definition; significance of migration; Migration in fishes, birds and wild animals
Types of migration; Navigational cues

Module IX - Biological rhythm

(3hrs)

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Types of biological rhythms with specific examples: circadian, circannual, lunar, tidal;
 Biological clock

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Reproductive Biology

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SEMESTER VI
Core Course 11- Practical
ENDOCRINOLOGY, REPRODUCTIVE BIOLOGY AND ETHOLOGY

36 hrs - 1 Credit

1. Study of permanent histological slides of endocrine glands.
 - T.S. of Pituitary gland
 - T.S. of Thyroid gland
 - T.S. of Adrenal Gland
 - T.S. of Islets of Langerhans
 - T.S. of Testis
 - T.S. of Ovaries
2. Study of pituitary gland of fishes
3. Study of male and female reproductive system of a teleost fish
4. Pheromone traps
5. Skinner box/T Maze
6. Identification of behaviour showing pictures
7. Experiment to demonstrate phototaxis using *Drosophila*/House fly

SEMESTER VI
Core Course 12
DEVELOPMENTAL BIOLOGY

54 Hrs – 3 Credits

Module I - Early History

(1 hr)

Preformation, Epigenesis, Biogenetic law
Comparative embryology; Evolutionary embryology

Module II - Classification of Eggs

(5 hrs)

Classification of eggs based on the amount, distribution and position of yolk; Mosaic and regulative, Cleidoic and non cleidoic egg
Influence of yolk on development
Egg polarity; Egg symmetry

Module III - Fertilization and Zygote formation

(5 hrs)

Attraction of sperm and the egg; Binding of spermatozoa- fertilization tube formation; Cortical reactions; Activation of the egg; Amphimixis; Significance of fertilization
Parthenogenesis: Natural parthenogenesis; Arrhenotoky; Thelytoky; Obligatory and Facultative; Artificial Parthenogenesis; Significance of parthenogenesis

Module IV - Cleavage

(3 hrs)

Planes of cleavage - Meridional, vertical, equatorial and latitudinal
Types - Holoblastic and Meroblastic
Patterns - radial, bilateral and spiral
Determinate and indeterminate
Cleavage laws
Factors affecting cleavage

Module V - Cell lineage

(1hr)

Significance; Method of cell lineage with an example

Module VI - Morulation and Blastulation

(4 hrs)

Formation of morula; Blastula formation, Types of blastula; Factors affecting blastulation

Module VII - Fate maps

(4 hrs)

Concept of fate maps; Significance of fate map; Construction of fate maps; Natural and artificial fate maps
Vital staining, carbon particle, Radioactive labeling, Histochemical, Cytological and genetical
Fate maps of frog and chick

Module VIII - Gastrulation

(5 hrs)

Events of gastrulation
Morphogenetic cell movements: Epiboly and Emboly (invagination, involution, delamination, infiltration convergence, divergence, ingression, constriction, extension and concrescence).

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Module IX - Tubulation	(1 hr)
Neurogenesis and neural crest cells; Notogenesis; Mesogenesis	
Module X – Germ Layers	(2 hrs)
Concept of germ layers and their derivatives	
Module XI - Stem Cells	(2 hrs)
Properties and type of stem cells Totipotency, Pluripotency, Unipotency of embryonic cells	
Module XII - Early embryology of Frog	(5 hrs)
Gametes, fertilization, cleavage, blastulation, fate map, gastrulation, notogenesis, neurulation, development of nervous system and eye	
Module XIII - Embryology of Chick	(6 hrs)
Brief account of 18 hour chick embryo and 24 hour chick embryo. Extra embryonic membranes in chick.	
Module XIV- Mammalian Development	(7 hrs)
Blastocyst; Implantation Foetal membranes and placenta; Placenta in mammals; Functions of placenta Classification of placenta based on nature of contact, mode of implantation and histological intimacy of foetal and maternal tissue Contraception & birth control; MTP Infertility- Causes of infertility-male and female; IVF, test tube babies, GIFT & ZIFT; Embryo transfer technology	
Module XV - Experimental Embryology	(3 hrs)
Spemann's constriction and transplantation experiments Organizer and embryonic induction	

References:

- B.I 1981 An Introduction to Embryology, W.B. Saunders and Co.
 Berril, N.J and Kars G. 1986. Developmental biology, Mc Graw Hills
 Berry A. K - An introduction to embryology.
 Dutta 2007 Obstrestics, Chuch Livingston 17 Ed
 Gibbs (2006). Practical guide to developmental biology.
 Gilbert S. F - Developmental biology
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 John Rigo Fundamental Genetics Cambridge University Press. 2009
 Julio Collado Vides & Relf Hofestadt Gene Regulation and Metabolism Post genomic
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 Majumdar N. N - Vetebrate embryology
 Melissa A – Gibbs, A practical Guide to Developmental Biology, Oxford university press (Int. student edition) 2006

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Vijayakumarn Nair K. and P. V George. A manual of developmental biology, Continental publications, Trivandrum.
Werne A Muller. Dev. Biology, Springer Verlay New York 2008
Arora M.P. Embryology. Himalaya Publishing House (Module I, Module II, Module III)
Suresh.C. Goel. *Principles of Animal Developmental Biology*. Himalaya Publishing House.
Arumugam. N. *Text Book of Embryology*. Saras Publication. (module I, Module II, Module III)
Sastry & Shukal. *Developmental biology*. Rastogi publications (Module I, Module II, Module III)

SEMESTER VI
Core Course 12 - Practical
DEVELOPMENTAL BIOLOGY

36 hrs - 1 Credit

1. Study of egg types
2. Embryological studies- Blastula (frog, chick)
3. Amniocentesis
4. Study of mammalian sperm and ovum
5. Study of placenta- rabbit and man
6. Study of 18 hour & 24 hour chick embryo slides
7. Egg candling
8. Mounting of chick embryo (36- 48 hr)

SEMESTER VI
Core Course 13
WILDLIFE BIOLOGY, CONSERVATION & MANAGEMENT

72 hrs – 3 Credits

Module I - Introduction to Wildlife Biology

(2 hrs)

Definition of Wildlife, its scope and importance

Values of Wildlife: ecological, scientific, economic, cultural, ethical and aesthetic values

Module II - Wildlife Habitats

(12 hrs)

Importance of forest; Roles of invertebrate fauna in forest ecosystem; Forest types in India; Extent of forest in India

Susceptibility of forest to damages, nature of damage, cause, preventive and protective measures; Forest fires: harmful and beneficial effects; control measure against fires

Important National Parks, Wildlife Sanctuaries and protected areas in India and their prominent fauna

Module III - Sociobiology of Wild Animals

(8 hrs)

Competition; Scent marking; Social spacing; Aggression; Territory; Migration and migration corridors

Dominance: determinants, intergroup, interspecies

Social insects; Social behaviour of Ungulates, Wild dogs, Primates and Elephants

Module IV - Diversity & Distribution of Indian Wildlife

(12 hrs)

Important Indian wild fauna and their distribution: Asiatic Lion, Indian Tiger, Indian one horned Rhinoceros, Indian Elephant, Gaur, Lion-tailed Macaque, Dhole, Red Panda, Sloth Bear, Indian Wild Ass, Nilgiri Tahr, Malabar Giant Squirrel, Great Indian Bustard, Hornbill, Gangetic Dolphin.

Module V - Wildlife Monitoring

(12 hrs)

Capturing and marking techniques: entrapping, darting, tagging and banding

Population enumeration: line transect, capture – recapture, pellet count, pug mark & PIP, scat analysis, call track count, radio telemetry

Field studies and photography: Still and video photography, aerial photography, types of photographic equipments, camera traps, use and care of photographic equipments; Field requirements: equipments, field clothing-use of hides

Module VI - Major threats to Wildlife

(12 hrs)

Human interaction; Habitat destruction; Human-wildlife conflicts; Tourism; Fragmentation; Degradation; Exotic species introduction; Feral animals; Overexploitation

IUCN Red List criterion and categories: indeterminate, rare, vulnerable, endangered, critically endangered and extinct, their status in India- especially in Western Ghats

Prevention of Wildlife poaching and trade

Diseases of wildlife: microbial, parasitic, pathogenic and their control, Foot and mouth disease.

Module VII - Wildlife Conservation and Management

(14 hrs)

Zonation and management of wildlife habitat: cores, buffers and corridors; Habitat utilization pattern

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Analysis of wildlife management problems in plantations and exploited forests; Conservation induced displacement and rehabilitation of human settlements

In-situ conservation: Establishment of protected areas, Biosphere reserves, Critical wildlife habitats (CWH)

Ex-situ conservation: Captive breeding and repopulation programme, Role of Zoos, Parks, Oceanarium; Gene banks and germplasm conservation; Regional, national and global conservation efforts

National and international conventions – CITES, TRAFFIC

Laws in wildlife conservation; Wildlife (Protection) Act – 1972

Brief study of Project Tiger, Project Elephant, Gir Lion Sanctuary Project, Crocodile Breeding Projects, Project Hangul

Governmental and Non Governmental Organizations in Wildlife conservation, management and research: MoEF, WII, WWF, WCS, BNHS.

References:

Aaron, N.M (1973) Wildlife ecology, W.H. Freeman Co. San Francisco, U.S.A.

Ali, Salim,(1997) The Book of Indian Birds, Oxford University Press, Mumbai

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Apte, Deepak, The Book of Indian Shells. Oxford University Press, Mumbai.

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- Tiwari, S.K., Zoogeography of India and Asia. CBS Publisher and Distributors, New Delhi.
- Usher MB, Wildlife Conservation and Evaluation, Chapman & Hall, London
- .

**OPEN COURSE FOR OTHER STREAMS
SEMESTER V
HUMAN HEALTH & GENETICS**

72 hrs - Credits 3

PART I HUMAN HEALTH (58 hrs)

Module I – Introduction

(2 hrs)

Definition and meaning of health; Dimensions and determinants of health

Module II - Food & Nutrition

(4 hrs)

Importance of nutrition; Macro and micro nutrients: Carbohydrates, Proteins, Lipids, Water, Minerals, Vitamins

Meal pattern; Balanced diet; BMR; Malnutrition

Module III - Health & Exercise

(3 hrs)

BMI; Diet and Exercise; Physical activity and health benefits; Effect of exercise on body systems

Module IV- Life style diseases

(4 hrs)

Obesity: causes and preventing measures

Diabetes: causes and management

Cardiovascular disorders: prevention and management

Cancer: different types, causes of cancer, carcinogens, diet & cancer

Module V - Food borne diseases and their prevention

(5 hrs)

Food Safety: General principles of hygiene

Important food borne illness: Staphylococcal food poisoning, Botulism, Salmonellosis, Shigellosis, Amoebiasis

Module VI - Water quality & Water borne diseases

(5 hrs)

Water quality parameters; Water purification techniques; Waste water management

Pathogenic microorganisms transmitted by water; Cholera and Typhoid; Prevention of water borne diseases

Module VII - Common infectious diseases

(5 hrs)

Tuberculosis; Hepatitis; Swine flu (H1N1); Bird flu (H5N1); Chikungunya; Dengue fever; Leptospirosis; Role of vectors in spread of diseases

Module VIII - Immunity & Vaccination

(2 hrs)

Basic concepts of immunology; Immunity to infection; Vaccination

Module IX - Replacement & Restoration therapies

(2hrs)

Organ transplantation; Cell replacement therapy; Gene therapy

Module X –Reproductive Health & Infertility

(7 hrs)

Pre-natal diagnosis:- Amniocentesis, Chorionic Villus Sampling, Ultra sound scanning, Fetoscopy; Genetic counseling

Umbilical cord banking

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Causes of human infertility; ICSI, IVF & test tube babies
STDs, HIV, AIDS – causes & preventive measures

Module XI - Mental Health & Disorders

(6 hrs)

Concept of mental health; Emotional adjustment and well being; Yoga; Meditation and Relaxation

Anxiety disorders; Bipolar disorder; Depression; Schizophrenia; Treatments for mental disorders

Module XII - Drug Abuse

(4 hrs)

Tobacco use, Tobacco related illnesses and tobacco control; Alcoholism; Drug and substance abuse; Abuse related illnesses and their control

Addiction; De-addiction

Module XIII - Old age and associated problems

(5 hrs)

Biology of ageing; Health problems of the elderly: Osteoporosis; Arthritis; Hypertension; Alzheimer's disease; Parkinson's disease

Module XIV - Safety & First Aid

(4 hrs)

Accident prevention; Health and Safety in daily life; Health and Safety at work; First aid and emergency care; Common injuries and their management

PART II HUMAN GENETICS (14 hrs)

Module XV- Genetic Disorders

(7 hrs)

Human normal chromosome complement; Chromosomal anomalies- Down Syndrome and Cri-du-chat syndrome; Sex chromosomal anomalies – Klinefelter's Syndrome and Turner's Syndrome

Single gene mutation disorders- Sickle cell anaemia

Polygenic – Cleft lip and palate

Sex linked inheritance – Haemophilia and Colour blindness

Module XVI – Genetics in Daily life

(7 hrs)

Human blood groups and their inheritance pattern; Rh factor

Blood transfusion – Universal Donor, Universal recipient

DNA finger printing and applications – Probing for criminals, method to resolve paternity and maternity disputes

Human genome project – a brief account

Eugenics and Euthenics; Genetically Modified Organisms

References:

Arora, D.R. and Arora, B. 2008. *Text Book of Microbiology*. CBS Publishers and Distributors, New Delhi

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

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

Guyton, A.C. 1996. *Text Book of Medical physiology*. Prism Books Pvt.Ltd.Bangalore

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Das, H.K. 2007. *Text book of Biotechnology*. Wiley India Pvt. Ltd. New Delhi
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Hannigan, B. M., Moore, C. B. T. and Quinn, D. G. 2010. *Immunology*. Viva Books, New Delhi
Monica Cheesbrough, *Laboratory Manual for Tropical Countries Vol.II* LBS.
Norman Bezzaant *HELP First Aid for everyday emergencies*. Jaico Publishing House, Bombay, Delhi
Pelczar M.J. Jr. E.C.S. Chane & N.R. Krieg, *Microbiology (Concept & Applications)*
Rai. B.C. *Health Education and Hygiene*. Published by Prakashan Kendra, Luckno

**COMPLEMENTARY ZOOLOGY COURSES
 FOR
 BSc BOTANY PROGRAMME**

**SEMESTER I
 Complementary course 1
 ANIMAL DIVERSITY – NON CHORDATA**

**36hrs – 2 Credits
(1 hr)**

Module I- Introduction

General Introduction; five kingdom classification

Module II - Kingdom Protista

Salient features

Pathogenic Protista – Plasmodium, Entamoeba, Leishmania

(3 hrs)

Module III – Subkingdom Mesozoa & Parazoa

Phylum Mesozoa- Rhopalura

Parazoa: Phylum Porifera – Leucosolenia

Phylum Placozoa – *Trypanoxys adherens*

(2 hrs)

Module IV - Phylum Coelenterata

Salient features, Classification up to classes

Class Hydrozoa – Physalia

Class Scyphozoa – Aurelia

Class Anthozoa – Adamsia

Corals and coral reefs; Polymorphism in Coelenterata

(4 hrs)

Module V - Phylum - Platyhelminthes

Salient features, classification up to classes

Class Turbellaria – Planaria

Class Trematoda – Fasciola

Class Cestoda – *Taenia solium*

(2 hrs)

Module VIII – Phylum Aschelminthes

General characteristics; Outline classification

Class Nematoda - Ascaris

Class Nematomorpha - Gordius

Class Gastrotrichia - Chaetonotus

Class Kinorhyncha - Echinoderes

Brief study of Parasitic nematodes -Enterobius, Hook worm, Pin worm

(4 hrs)

Module VI - Phylum Annelida

Salient features, classification up to classes

Class Polychaeta - Nereis

Class Archannelida - Polygordius

Class Oligochaeta – Earthworm – Pheretima

(2 hrs)

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Class Hirudinomorpha – Hirudinaria

Module VIII - Phylum Arthropoda

(10 hrs)

Salient features, classification up to classes

Subphylum Trilobitomorpha

Class Trilobita (Extinct)

Subphylum Chelicerata

Class Merostoma – Limulus

Class Arachnida – Spider

Class Pycnogonida – Nymphon

Subphylum Mandibulata

Class Crustacea – Daphnia

Class Chilopoda - Centepede

Class Symphyla - Scutigereilla

Class Diplopoda - Millipede

Class Pauropoda - Pauropus

Class Insecta – Butterfly

(Detailed account of examples are not necessary)

Larval forms of Crustacea

Insect pests

1. Pests of coconut – *Oryctes rhinoceros*, *Rhynchophorus ferrugineus*, *Nephantis serinopa*, Eriophid mite

2. Pests of paddy – *Leptocorisa acuta*, *Spodoptera mauritius*

3. Pests of stored grains - *Trogoderma granarium*, *Tribolium castaneum*, *Sitophilus oryzae*

Insect vectors and vector borne diseases- Mosquito, Rat flea, House fly, Sand fly, Glossinia

Phylum Onychophora – Peripatus (Mention its affinities)

Module XI - Phylum Mollusca

(3 hrs)

General characteristics; Outline classification

Class Monoplacophora - Neopilina

Class Amphineura - Chiton

Class Scaphopoda - Dentalium

Class Gastropoda - Pila

Class Bivalvia - Lamellidens

Class Cephalopoda -Loligo

Module X - Phylum Echinodermata

(4 hrs)

Salient features, classification up to classes

Class 1. Asteroidea – Astropecten

2. Ophiuroidea - Ophiothrix

3. Echinoidea – Echinus

4. Holothuroidea – Cucumaria

5. Crinoidea – Antedon

Water vascular system in Echinodermata

Module XI - Phylum Hemichordata

(1 hr)

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Salient features; Balanoglossus

References:

- Barnes, R.D. 1987. Invertebrate Zoology (W.B. Saunders, New York).
- Barrington, E.J.W., 1967. Invertebrate Structure and function (ELBS and Nelson , London).
- Dhami, P.S. and Dhami, J.K. 1979. Invertebrate Zoology (R. Chand and Co. New Delhi).
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- Groove, A.J. and Newell, G.E. 1974. Animal Biology – Indian Reprint (University Book Stall, New Delhi).
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- Marshall, A.J. and Williams, W.D. 1972. Text Book of Zoology Vol. Invertebrates (ELBS and Macmillan, London).
- Mayer, E. 1980. Principles of Systematic Zoology (Tata McGraw Hill Publishing Co., New Delhi.)
- Nair, K.K. Ananthakrishnan, T.N. David, B.V. 1976. General and Applied Entomology (T.M.H. New Delhi).

SEMESTER I
Complementary course 1 - Practical
ANIMAL DIVERSITY – NON CHORDATA

36 hrs - 1 Credit

Scientific Drawing:-

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

Anatomy:-

Study of sections

1. Hydra.
2. Ascaris (male or female)
3. Fasciola
4. Earthworm (TS through intestine)

Study of nervous system in Prawn

Study of digestive system in Cockroach

Identification of common mosquitoes(4 genus)

Mounting:-

Mouth parts – House fly and Honey bee.

Prawn appendages.

Identification:-

General identification- The students are expected to identify the following Phylum –wise number of animals by their scientific names: Protista -2, Porifera-1, Coelenterata-2, Platyhelminthes-1, Annelida-2, Arthropoda-3, Mollusca- 2, Echinodermata-2

SEMESTER II
Complementary course 2
ANIMAL DIVERSITY – CHORDATA

36hrs – 2 Credits
(10 hrs)

Module I - Phylum Chordata

General characters of the Phylum Chordata; Classification up to classes

Sub phylum I Urochordata: General characters

Class 1 Larvacea - Oikopleura

Class 2. Ascidiacea - Ascidia

Class 3. Thaliacea - Salpa

Retrogressive metamorphosis

Subphylum II Cephalochordata: General characters - Brachiostoma

Subphylum III Vertebrata: General characters

Division I Agnatha: General characters

Class 1 Cyclostomata - Petromyzon

Class 2 Ostracodermi – Cephalaspis

Division II Gnathostomata: General characters

Super class Pisces and Super class Tetrapoda

Module II – Super class Pisces

(7 hrs)

General characters

Class 1. Chondrichthyes - Narcine

Class 2. Osteichthyes - Sardine, Latimeria

Lung fishes; Accessory respiratory organs in fishes; Migration in fishes; Scales in fishes

Module III - Super Class Tetrapoda

(4 hrs)

General characters

Class : Amphibia General characters

Order I Urodela - Amblystoma

II Anura - Bufo

III Apoda - Ichthyophis

Parental care in Amphibians

Module IV - Class Reptilia

(5 hrs)

General characters

Sub class I: Anapsida - Chelone

Sub class II Diapsida - Chameleon

Subclass III Parapsida - Ichthyosaurus

Poisonous and non-poisonous snakes of India

Module V - Class Aves

(5 hrs)

General characters

Sub class I: Archaeornithes - Archaeopteryx

Sub class II. Neornithes - Pigeon

Flight adaptations of birds; Migration in birds; Flightless birds

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Module VI - Class Mammalia

(5 hrs)

General characters

- Sub class I Prototheria - Echidna
- Sub Class II Metatheria - Macropus
- Sub class III Eutheria - Elephas

Aquatic mammals, Dentition in mammals

References:

- Deoras, P.J. 1981. Snakes of India (National Book Trust of India.)
- Ekamberanatha Ayyar M. (1990) A Manual of Zoology, Volume I. Vertebrate Part I and Part II S. Viswanathan Printers & Publishers Pvt. Ltd.
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SEMESTER II
Complementary course 2 - Practical
ANIMAL DIVERSITY – CHORDATA

36hrs – 2 Credits

Morphology

Scientific Drawing- Make scientific drawing of 5 locally available vertebrate specimens belonging to different classes
Mounting of placoid scales/cycloid/ctenoid scales
Study of feathers

Study of sections

Amphioxus T. S. through pharynx/T.S. through intestine

Osteology

Frog vertebrae
Pectoral and pelvic girdles of Frog
Dentition in Mammals (Dog, Rabbit, Man)

Identification:-

General identification of poisonous snakes(Cobra, Viper, Krait) non poisonous(Rat snake, Natrix, Python)

General identification-

Identify all the animals by their scientific names: Protochordata-1, Pisces-4, Amphibia-3, Reptilia- 4, Aves-1, Mammalia-2.

Taxonomic identification with key:-

Identification of fishes up to the level of order.

SEMESTER III
Complementary course 3
HUMAN PHYSIOLOGY AND IMMUNOLOGY

54 hrs - 3 Credits

Part I HUMAN PHYSIOLOGY (36 hrs)

Module I – Nutrition

(4 hrs)

Digestive organs and associated glands in man, Balanced diet, Recommended Dietary Allowance (RDA, Importance of fiber in diet, Malnutrition disorders, Vitamin deficiencies, Mineral deficiencies (Iron, Calcium and Iodine)

Module II - Respiration

(4 hrs)

Respiratory organs in man: exchange and transport of respiratory gases Respiratory pigments: hemoglobin (mention structure), myoglobin
Respiratory disorders – Dyspnoea, Hypoxia, Asphyxia, Hypo and Hypercapnia, CO poisoning, smoking and its physiological effects

Module III - Circulation

(6 hrs)

Structure of human heart
Blood – Composition and function, Brief account of mechanism of blood clotting, Blood groups and transfusion
Haemophilia, Cerebral and pulmonary thrombosis, Cerebral haemorrhage
Blood pressure, ECG
Cardiovascular disorders – Arteriosclerosis, Myocardial infarction, Angiogram and Angioplasty

Module IV – Excretion

(6 hrs)

Structure of human nephron, Composition of urine – normal and abnormal constituents
Urine formation (ultra filtration, selective reabsorption, tubular secretion and counter current mechanism), Hormonal control of renal function
Kidney disorders – myelonephritis, glomerular nephritis, nephrotic syndrome; Dialysis

Module V - Neurophysiology

(6 hrs)

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

Module VI - Muscle Physiology

(4 hrs)

Striated, Non striated and Cardiac muscle, Ultra structure of striated muscle fibre, Mechanism of muscle contraction, Threshold and spike potential, simple muscle twitch, Fatigue, Rigor mortis

Module VII - Endocrinology

(6 hrs)

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

Part II – IMMUNOLOGY (18 hrs)

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Module VIII - Introduction to immunology

(3 hrs)

Types of immunity: Innate, Acquired, Passive and Active

Mechanism of innate immunity (Barriers, phagocytosis, inflammation) Complement System, biological effects of complements

Module IX - Antigens and antibodies

(5 hrs)

Types of antigens; Haptens; Antigenic determinants.

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

Module X - Antigen antibody reactions

(5 hrs)

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

Module XI - Immunity

(5 hrs)

Brief accounts of the following:

Immune response system

Primary and secondary lymphoid organs

Cells of Immune system – Leucocytes, lymphocytes, T&B cells, Macrophages, Plasma cells,

Memory cells, MHC, Antibody synthesis, Monoclonal antibodies, Hybridoma technology

Immune disorders – Hypersensitivity, Auto immunity & Immunodeficiency; AIDS

Vaccines - Major types of vaccines (BCG, DPT, Polio vaccine and TAB vaccines); Recent trends in vaccine preparation.

References:

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Ashim K. Chakravarthy. 1998. *Immunology*. Tata McGraw-Hill, New Delhi.
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David Male,Jonathan Brostoff, David Roth and Ivan Roitt. 2006. *Immunology*. Mosby, Edinburgh,UK
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SEMESTER III
Complementary course 3- Practical
HUMAN PHYSIOLOGY AND IMMUNOLOGY

36Hrs- 1 Credit

- 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
- 4 Estimation of Haemoglobin
- 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

SEMESTER IV
Complementary course 4
APPLIED ZOOLOGY

54 hrs - 3 Credits

Module I – Introduction to Aquaculture

(4 hrs)

Advantages and salient features of aquaculture; Types of aquaculture
Biotic and abiotic factors of water; Importance of algae in aquaculture

Module II – Pisciculture

(14 hrs)

Construction and maintenance of culture pond
Common cultivable fishes of Kerala; Economic importance and morphology of culturable species: Catla, Rohu, Mrigal, Etroplus & Tilapia.
Carp culture
Composite fish culture; Integrated Fish Culture
Induced breeding in fishes
Important Fish Diseases; Fish preservation and processing

Module III - Aquarium management

(3 hrs)

Setting up of an Aquarium; Types of filtration
Styles in Aquarium setting
Common species of Aquarium fishes; Aquarium plants

Module IV - Prawn culture, Mussel culture & Pearl culture

(3 hrs)

Prawn culture: *Penaeus indicus*, *Macrobrachium rosenbergii*
Mussel culture: *Perna viridis*, *Perna indicus*
Pearl culture: *Pinctada fucata*

Module V - Sericulture

(12 hrs)

Four species of silkworms, Life history of silkworms
Silkworm Rearing Techniques; Mounting of worms; Harvesting and stifling of cocoons
Diseases and Pests of silkworms
Silkworm diseases; Preventive and control measures

Module VI - Vermiculture

(6 hrs)

Species of Earthworms suitable for vermiculture
Reproduction and life cycle of earth worms
Physical and Chemical effects of Vermiculture
Vermicomposting: Site Selection, Cement pit; Soil pit; Preparation of pit; Maintenance and Monitoring of pit

Module VII - Apiculture

(12 hrs)

Species of Honey bees
Organization of honeybee colony
Bee keeping methods and equipments
Apiary management and maintenance

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Stingless bee keeping (Meliponiculture)
Bee pasturage, Pollination by honey bees
Byproducts of honey bees and their uses
Diseases and pests of honey bees, control measures.

References:

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Singh, V.P.P. and Ramachandran, V., 1985 Freshwater Fish Culture (ICAR, New Delhi)
Sudheeran, M.S. & John P.C., 1989 Economic Zoology (Prathibha Publ., Kottayam)
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SEMESTER IV
Complementary course 4 - Practical
APPLIED ZOOLOGY

36 hrs - 1credit

1. General Identification, Economic importance, Morphology, scientific names and common names of the following
 - a. Economic importance and morphology of culturable species
(Catla, Rohu, Grass carp, Common carp, Etroplus, Tilapia)
Penaeus indicus/*P.monodon*,
Perna viridis/*P.indicus*
Pinctada fucata
 - b. Aquarium equipments- Power head, power filter, canister, aerators
 - c. Two species of earthworms used in Vermiculture
 - d. Two species of honey bees
 - e. Silkworm. Cocoon/Adult
2. Castes of bees
3. Bee keeping equipments
4. Beeswax, Honey, Silk, Vermicompost (Identification-Uses)
5. Chandrika /Natrika used in sericulture
6. Fish diseases (any 2diagrams/specimens)
7. Fish Parasite (any one)

**CORE ZOOLOGY COURSES
FOR
BSc INDUSTRIAL MICROBIOLOGY & ZOOLOGY PROGRAMME**

Core Courses 1 to 12 of BSc Industrial Microbiology & Zoology Programme are the same as that of BSc Zoology Programme except Core Courses 5 and 8. Syllabus for Core Courses 5 and 8 are given below.

**Core Course 5
RESEARCH METHODOLOGY AND BIOSTATISTICS**

36 Hrs - 2 Credits

PART I - RESEARCH METHODOLOGY (24 hrs)

Module I - Introduction

(4 hrs)

Basic concepts of research: Meaning, Objectives

Types of Research: Descriptive/Analytical, Applied/Fundamental, Quantitative/Qualitative, Conceptual/Empirical

Module II - Research Design

(4 hrs)

Basic principles; Meaning, need and features of good design; Types of research designs

Module III – Research Documentation & Presentation

(4 hrs)

Scientific documentation and communication; Research report writing (Thesis and dissertations, Research articles, Oral communications); Bibliography formats; Plagiarism

Presentation techniques: Assignment, Seminar, Debate, Workshop, Colloquium, Conference

Module IV – Measurements

(8 hrs)

Units of measurements; Calculations and related conversions of measurement units

Metric system- length; surface; weight; Square measures; Cubic measures; Volumetric; Circular or angular measure

Concentration - percent volume; ppt; ppm

Chemical – Molarity, Normality

Temperature- Celsius, centigrade, Fahrenheit

Module V - Bioethics

(4 hrs)

Introduction; Animal rights and animal laws in India; Animal use in research and education; Laboratory animal use, care and welfare; Animal protection initiatives; Animal Welfare Board of India

Working with Humans: harm, risk, and benefits; Consent.

PART II – BIOSTATISTICS (12 hrs)

Module VI - Sample & Sampling techniques

(5 hrs)

Collection of data; Classification of data; Frequency distribution tables

Graphical representation: - Bar diagrams, Histogram, Pie diagram and Frequency curves

Module VII - Measures of Central Tendency

(2 hrs)

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Mean, Median, Mode (Direct method only)

Module VIII - Measures of dispersion

(5 hrs)

Range; Quartile Deviation; Mean Deviation; Standard Deviation; Standard error (Merits & demerits)

References:

Research Methodology

- Anderson, J, Durston, B.H. and Poole, M. 1992. Thesis and assignment writing. Wiley Eastern Ltd.
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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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- Bailey, N.T.J. 1994. *Statistical Methods in Biology* (3rd edn). Cambridge University Press.
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Core Course 8
ANIMAL PHYSIOLOGY

54 hrs - 3 Credits

Module I - Nutrition (9hrs) Types of nutrition; Major and minor nutrients; Importance of fiber in diet; Digestive organs and associated glands in man; Digestion and absorption of carbohydrates, proteins and lipids; Nervous and hormonal control of digestion; Special modes of digestion: ruminant and symbiotic Balanced diet; Nutritional disorders: Overnutrition, malnutrition, undernutrition, Defects of modern food habits, Obesity, Anorexia, acidity and ulcers, flatulence.

Module II - Respiration (9 hrs)
Respiration in animals: cutaneous, tracheal, branchial, pulmonary.
Respiratory organs in man: exchange and transport of respiratory gases. Respiratory pigments in animals: hemoglobin(mention structure), myoglobin, hemocyanin, haemerythrin, chlorocruorin.
Exchange and transport of respiratory gases, Oxy-hemoglobin curve, Bohr effect, reverse Bohr effect and Haldane effect.
Respiratory disturbances and disorders: Dyspnoea, asthma, emphysema, Anoxia, hypoxia, cyanosis, hypocapnia, hypercapnia and asphyxia; Carbon monoxide poisoning
Respiratory adaptations to high altitudes, Physiological problems of deep sea diving.

Module III – Circulation (9 hrs)
Organs and mechanism of circulation- Types of heart, Structure of human heart
Cardiac cycle, Control and rhythmicity of the heart beat- Pacemakers, Pulse, Blood pressure and disorders, Neural and Hormonal control.
Human Blood and its constituents, Buffer system in blood, Blood clotting mechanism: intrinsic and extrinsic pathways, clotting factors, disorders of blood clotting, anticoagulants, blood groups and transfusion.
Circulatory disorders- Myocardial infarction, angina pectoris, cardiac arrest, thrombus and embolus, arteriosclerosis and atherosclerosis.
Clinical analysis- Electrocardiogram (ECG), Erythrocyte sedimentation rate (ESR), Haematocrit, Total and differential blood cell count

Module IV – Excretion (7 hrs)
Patterns of nitrogen excretion in animals: ammonotelism, ureotelism, uricotelism.
Structure of human kidney, nephron, formation of urine, counter current mechanism, water and salt balance, acid-base control and homeostasis; Hormonal control of kidney functions.
Composition of urine- normal and abnormal constituents, Diseases of the kidney- Kidney stones, Proteinuria, Nephrosis, Pyelonephritis.
Artificial kidney (haemodialysis), Peritoneal dialysis and Kidney transplantation.

Module V – Muscle Physiology (7 hrs)
Muscular movements, Types of muscles
Vertebrate skeletal muscle: Structure and function; Mechanism, Biochemistry and Energetics of muscle contraction

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Neuromuscular junction

Electrophysiology of muscle, threshold and spike potentials, simple muscle twitch, whole muscle contraction, isotonic and isometric contraction, latent and refractory periods, summation, beneficial effect, tetanus, tonus, staircase phenomenon, fatigue, oxygen debt, rigor mortis.

Module VI –Neurophysiology (6 hrs)

Structure and types of neurons, Nerve fiber and impulse propagation, Synaptic transmission & properties of synapses, neurotransmitters, role of dopamine and serotonin. Neuroreceptors. Reflexes and types of reflexes.

Structure of human brain, Peripheral and Central nervous system

Electroencephalogram (EEG)

Neural disorders- Parkinson's disease, Dementia, Alzheimer's disease, Dyslexia, Epilepsy, Schizophrenia.

Module VII – Sensory Physiology (4 hrs)

Chemoreceptors: Gustatory receptors- taste buds, Olfactory receptors

Mechanoreceptors: statoreceptors, phonoreceptors- human ear and its physiology

Touch receptors

Photoreceptors- Human eye and its physiology

Thermoreceptors

Module VIII – Environmental Physiology (2 hrs)

Body Temperature and its Regulation, Poikilotherms, Homeotherms

Physiological adaptation to cold, Shivering, Dormancy, Hibernation, Aestivation, Photoperiodism.

References:

Bentley, P.J. 1998. *Comparative Vertebrate Endocrinology* (3rd edn). Cambridge University Press

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CORE COURSE 8 - PRACTICAL ANIMAL PHYSIOLOGY

36 hrs – 1 Credit

- 1) Preparation of Human blood smear & identification of leucocytes
- 2) Determination of haemoglobin content of blood
- 3) Total RBC count using Haemocytometer
- 4) Total WBC count using Haemocytometer
- 5) Differential count of WBC
- 6) Estimation of PCV
- 7) Identification of human blood groups, A, AB, B and O, Rh factor
- 8) Effect of different anti-coagulants on blood clotting time
- 9) Salivary amylase activity on starch
- 10) Abnormal constituents of Urine- Sugar, Ketone bodies, Albumin
- 11) Instruments (Principle & use)– Sphygmomanometer , Stethoscope
- 12) Measurement of blood pressure using a sphygmomanometer