

UNIVERSITY OF CALICUT
B.Sc. DEGREE PROGRAMME

SYLLABUS
COMPLEMENTARY COURSE: ZOOLOGY

B.Sc. ZOOLOGY COMPLEMENTARY COURSE

INTRODUCTION

Board of Studies in Zoology (U.G.) of University of Calicut reviewed the existing Zoology complementary courses and decided to revise and update the B.Sc. Zoology Complementary syllabus. The Board recommended that the revised syllabus may be implemented for the B.Sc. Degree Programme of the University of Calicut, which offers Zoology as one of the Complementary subjects, **with effect from 2019 admission.**

Accordingly, course content, scheme of instruction, evaluation, credits, marks and duration of examinations of B.Sc. Zoology Complementary Courses are modified. Course outcomes are also introduced for each complementary course. The course structure includes both theory and practical components to be dealt with during the first four semesters of the programme. Accordingly there will be four complementary theory courses, one each in the first four semesters of the B. Sc. Programme and the theory examinations will be conducted at the end of the respective semester. There is only one practical course and its examination will be conducted at the end of the fourth semester. The practical course is designed in such a way that they support the theory course in first four semesters and also impart the basic skills on techniques expected of a zoology student. Attempts have been made to update the syllabus by incorporating the recent trends in various branches of Zoology, conforming to the workload prescribed by the University.

COMPLEMENTARY COURSE: SCHEME OF INSTRUCTION

Zoology is one of the Complementary courses of the B.Sc. Degree Programme. It is to be taught during the first four semesters of the programme. Course title, scheme of instruction and evaluation, distribution of credits and marks and other details of B.Sc. Zoology Complementary Course is shown in Table 1. The syllabus includes Theory as well as Practical components.

Theory

The total number of theory complementary courses is four [ZOL1C01T, ZOL2C02T, ZOL3C03T and ZOL4C04T], one in each semester. All the four courses have a credit of 2 each with a total of 8 credits.

Practical

The practical related to theory courses, (I*A, I*B, I*C and I*D) are to be conducted in the four semesters. External university practical examinations will be held only at the end of the 4th semester [ZOL4C05P; 4 credits]. **Record:** A candidate who appears for the practical examination must submit an authentic record of work done by him/her. Hand-drawn sketches of whole animals/ mountings/ sections/dissections are compulsory. The record should contain the scientific name, phylum and class (for vertebrates order also) of the specimens with notes on identifying features and zoological importance, if any.

Table 1

B.Sc. ZOOLOGY (COMPLEMENTARY) PROGRAMME

Structure of complementary course

Course code, Title, Instructional hours, Credits, Marks and Duration of Examinations in four semesters

**Total Credit: 12 (External 80% and Internal 20%)
(2019 Admission onwards)**

Semesters	Complementary Course	Code	Course title	Instructional hours/ week	Instructional hours in a semester	Credits	External Marks	Internal marks	Total marks	Duration of Exam (hrs)
I	Theory I	ZOL1C01T	Animal Diversity and Wildlife Conservation	2	36	2	60	15	75	2
	Practical I*A	--	Practical related to theory course ZOL1C01T	2	36	*			--	
II	Theory II	ZOL2C02T	Economic Zoology	2	36	2	60	15	75	2
	Practical I*B	--	Practical related to the theory course ZOL2C02T	2	36	*			--	
III	Theory III	ZOL3C03T	Physiology and Ethology	3	54	2	60	15	75	2
	Practical I*C	--	Practical related to theory course ZOL3C03T	2	36	*			--	
IV	Theory IV	ZOL4C04T	Genetics and Immunology	3	54	2	60	15	75	2
	Practical I*D	--	Practical related to theory course ZOL1C01T & ZOL4C04T	2	36	*			--	
	Practical I*A+ I*B+ I*C+ I*D	ZOL4C05P	Zoology Complementary Practical (Practical I*A, I*B, I*C & I*D)	--	144	4	80	20	100	4
	TOTAL					12	320	80	400	

Total credits for the B.Sc. Zoology Complementary Programme = 12 credits

Scheme of evaluation: External 80 % + Internal 20 %

- * Practical examinations for 1st, 2nd, 3rd and 4th semesters will be held at the end of 4th semester.
- Theory examinations are of 2 hours duration
- Practical examination is of 4 hrs duration.
- A panel of two examiners (one internal and one external) will evaluate the University practical examination at the end of semester IV.

COMPLEMENTARY COURSE: SCHEME OF EVALUATION

Zoology Complementary courses comprise 4 theory courses (one each in first 4 semesters (Total 8 credits) and 1 practical course (4 credits) at the end of fourth semester. Total credits for the complementary course is 12.

THEORY: EVALUATION SCHEME

The scheme of evaluation for complementary course contains two parts: *viz.*, internal evaluation (20% marks) and external evaluation (80% marks).

1. INTERNAL EVALUATION

The internal evaluation will be a continuous process. It will be done by the faculty members of the department of Zoology of the institution where the candidate is pursuing the study. The internal assessment shall be based on a transparent system involving student's attendance, performance in class tests, assignments and seminars in respect of theory examinations. The colleges shall send the marks obtained for internal examination to the university. Internal evaluation carries 20% (15 marks) of the total marks (75). The distribution of marks shall be as follows.

Table 2. Criteria for Internal Evaluation of Complementary course [15 marks]

Sl. No.	Criteria	Marks
1	Test paper (1)	6
2	Assignment	3
3	Seminar	3
4	Classroom Participation (CRP) (Attendance)	3
Total Marks		15

Table 2.1. Pattern of Test paper [30 Marks]

Duration	Pattern	Total number of questions	Number of questions can be answered	Marks for each question	Ceiling of Marks
1 Hour	Short answer	6	6	2	10
	Paragraph	3	3	5	10
	Essay	2	1	10	10
Total marks					30

Table 2.a. Split up of internal marks for Test Paper [40%]

Sl. No.	Range of Marks in test paper	Out of 6 [Maximum internal marks 15]
1	85 to 100%	6
2	65 to below 85%	5
3	55 to below 65%	4
4	45 to below 55%	3
5	35 to below 45%	2
6	Below 35%	1

Table 2.b. Criteria for Internal Evaluation of Assignment [20%]

Sl. No.	Criteria	Out of 3
1	Submission in time	1
2	Content	2
3	Total Marks	3

Table 2.c. Criteria for Internal Evaluation of Seminar [20%]

Sl. No.	Criteria	Out of 3
1	Excellent	3
1	Good	2
2	Average	1
3	*Total Marks	3

**Based on way of presentation, content, answer to questions etc.*

Table 2.d. Split up of internal marks for Attendance [20%]

Sl. No.	Range of CRP (Attendance)	Out of 3
1	85 and above	3
2	75 to below 85%	2
3	50 to below 75%	1
4	below 50%	0

2. EXTERNAL EVALUATION

External evaluation carries 80% (60 marks) of the total marks (75). University theory examination will be conducted at the end of each semester. The pattern of question papers for external examination is as given below. The students can answer all the questions in Sections A & B. But there shall be ceiling (maximum marks that can be scored) in each section.

Table 3. Pattern of Question Paper for Complementary course [Theory]

Duration	Pattern	Total number of questions	Number of questions can be answered	Marks for Each question	Ceiling of Marks
2 Hours	Section A: Short answer	12	12	2	20
	Section B: Paragraph	7	7	5	30
	Section C: Essay	2	1	10	10
Total Marks					60

PRACTICAL [COMPLEMENTARY]: EVALUATION SCHEME

Practical corresponding to each complementary course will be conducted during the corresponding semesters. Internal evaluation of complementary Practical course will be conducted at 4th semester (End semester). Internal evaluation carries 20% [20 marks] of the total marks (100) in each practical. The colleges shall send only the marks obtained for internal examination to the university. External evaluation carries 80% [80 marks] of the total marks (100).

1. INTERNAL EVALUATION

Table 4. Criteria of Evaluation for Complementary Practical [20 marks]

Sl. No.	Criteria	Marks
1	Attendance	4
2	Lab involvement, Performance & punctuality	4
3	Class test (1 No.)	8
4	Record	4
Total Marks		20

Table 4.a. Attendance

Sl. No.	Attendance (%)	Marks
1	85 and above	4
2	75 to below 85%	2
3	50 to below 75%	1
4	below 50%	0

Table 4.b. Lab involvement, Performance & Punctuality

Sl. No.	Criteria	Marks
1	Excellent	4
2	Very Good	3
3	Good	2
4	Average	1
5	Below Average	0

Table 4.c. Class Test [One]

Sl. No.	Criteria	Marks
1	85 to 100%	8
2	65 to below 85%	6
3	55 to below 65%	4
4	45 to below 55%	3
5	35 to below 45%	2
6	Below 35%	1

Table 4.d. Record

Sl. No.	Criteria	Marks
1	Punctuality in submission	1
2	Contents	2
3	Scientific accuracy and neatness	1
Total Marks		4

2. EXTERNAL EVALUATION

Practical corresponding to each complementary course will be conducted during the corresponding semesters. A combined University practical examination related to the first four complementary theory courses (Practical I*A, I*B, I*C and I*D) will be held at the end of fourth semester. External evaluation carries 80% of (80 marks) the total marks (100 marks). External evaluation will be done by a team consisting of **one internal examiner and one external examiner**. Practical examination is of **4 hours** duration.

Any candidate, who turns up for a practical examination, must submit a certified and bonafide record / report of work done by him/ her duly attested by the Teacher- in- charge and the Head of the Department at the time of practical examinations.

Table 5. Scheme of question paper for Complementary Practical

Question Nos.	Nature of questions	Total no. of questions	Marks for each question	Marks	Duration
I : Q 1-6	Spotters: from various sections of courses: Identification/ sketches/ descriptions/ reasons /importance/ significance/ from Non chordata, Chordata, Histology, Osteology, Economic zoology etc.	6	3	18	4 hours
II: Q 7	Minor expt.: from various courses - results/explanation/ sketches etc.	1 (as per choice)	9	9	
III: Q 8	Minor expt.: from various sections – (Non chordata/ Chordata/ physiology/ Immunology etc.) results/ explanation/ sketches etc.	1 (as per choice)	12	12	
IV: Q 9	Major expt: from Non chordata/ Chordata/Physiology, Immunology etc.	1 (as per choice)	22	22	
	Viva-voce			#3	
V:Record	-	-	-	16	
	Total Marks			80	

Viva voce – Examiner may ask questions based on the principles/methodology/concepts of the experiments performed during the practical examinations.

FIRST SEMESTER B.Sc. ZOOLOGY COMPLEMENTARY COURSE

Theory Course- I

ANIMAL DIVERSITY AND WILDLIFE CONSERVATION

Code: ZOL1C01T

[36 hrs] [2 hours/week] [3 credits]

COURSE OUTCOMES [COs]

COs	Course Outcome Statements
CO1	Describe the general characters of protists and salient features of phylum – Rhizopoda, Ciliophora, Dinoflagellata and Apicomplexa (2 hrs)
CO2	Enumerate the salient features and examples of Phylum – Porifera, Coelenterata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Onychophora, Mollusca and Echinodermata, and the structural organization of <i>Peneaus</i> sp. (14 hrs)
CO3	Describe the characteristic features and classification of phylum Chordata with examples and, structural organization of <i>Oryctolagus cuniculus</i> (14 hrs)
CO4	Explain levels of biodiversity, threats to biodiversity, biodiversity hotspots, importance and strategies for conservation of wildlife and sustainable development (6 hrs)

Question paper pattern for external examination

[Module: 1 Short answer 2x2=4marks

Module: 2 Short answer 3x2 = 6marks, Paragraph 3x5=15 marks; Essay 1x10=10 marks

Module: 3 Short answer 3x2= 6 marks; Paragraph 3x5=15 marks; Essay 1x10=10 marks

Module: 4 Short answer 4x2=8 marks, Paragraph 1x5=5marks]

Section A: PROTISTA

MODULE 1. Kingdom Protista (2 hrs)

General characters.

Salient features of protozoans.

Phylum Dinoflagellata: e.g. Noctiluca

Phylum Ciliophora: e.g. Vorticella

Phylum Rhizopoda: e. g. Amoeba

Phylum Apicomplexa: e.g. Plasmodium (exclude life cycle)

[Short answers]

Section B: Animal Diversity

MODULE 2: Animal diversity-Part I Nonchordata (14 hrs)

Salient features of phyla, classification down to classes

(8 hrs)

Phylum Porifera: e.g. *Leucosolenia*

Phylum Coelenterata: e.g. *Obelia*, *Aurelia*, *Sea anemone*

Phylum Platyhelminthes: e.g: *Fasciola*, *Schistosoma*

Phylum Aschelminthes: e.g. *Ascaris*, *Enterobius*

Phylum Annelida: e.g: *Arenicola*, *Hirudinaria*, *Megascolex*

Phylum Arthropoda: e.g: *Limulus*, *Sacculina*, *Eupagurus*,

Phylum Onychophora: e.g: *Peripatus*

Phylum Mollusca: e.g. *Perna*, *Teredo*, *Sepia*, *Pinctada*

Phylum Echinodermata: e.g. *Asterias*, *Holothuria*, *Sea urchin*

Type: *Peneaus* sp. (Exclude details of larval stages)

(6 hrs)

[Short answers/Paragraphs/Essays]

MODULE 3. Animal diversity-Part II Chordata (14 hrs)

Phylum Chordata: Salient features, Mention classes **(6 hrs)**

Sub phylum Urochordata e.g. *Ascidia*

Subphylum Cephalochordata e.g. *Branchiostoma*

Subphylum Vertebrata:

Div I. Agnatha e.g. *Petromyzon, Myxine*

Div II: Gnathostomata

Super class: Pisces

Class: Chondrichthyes: e.g. *Narcine*

Class: Osteichthyes: e.g. *Echeneis, Hippocampus, Heteropneustes, Scomberomorus, Pomfret*

Super class: Tetrapoda

Class Amphibia: e.g. *Ichthyophis, Salamandra, Rhacophorus, Duttaphrynus*, Mention - *Nasikabatrachus sahyadrensis*

Class Reptilia: e.g. *Chamaeleo, Chelone, Naja, Bungarus, Daboia*

Class Aves e.g. *Columba*

Class Mammalia e.g. *Pteropus*

Type: *Oryctolagus cuniculus* **(8 hrs)**

External features, skeletal system, digestive system, respiratory system, circulatory system, sense organs and nervous system. [Exclude skin, skull bones, arterial system, venous system, lymphatic system, autonomous nervous system and endocrine system].

[Short answers/Paragraphs/Essays]

Section C: Conservation Biology

MODULE 4. Conservation Biology (6 hrs)

- I. Biodiversity, Levels of biodiversity (brief), significance and uses of biodiversity, threats to biodiversity- (fragmentation, invasive species, over exploitation, poaching, climate change), extinction of species, concept of threatened species.
- II Biodiversity hot spots, brief notes on hot spots that include Indian region (Western Ghats and Sri Lanka, Indo Burma, Himalayas and Sundaland); endemism.
- III Wild life management and conservation- Importance of wild life, strategies of conservation (*Ex situ* and *In situ*), mention Protection Acts- The Wildlife Protection Act, 1972.
- IV Sustainable development (concept)
- V. Red Data Book, IUCN, WWF (Brief account)

[Short answers/Paragraphs]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Project Tiger
2. Project Elephant

3. Operation Rhino

4. Ramsar sites

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SECOND SEMESTER B.Sc. ZOOLOGY COMPLEMENTARY COURSE

Theory Course- II

ECONOMIC ZOOLOGY

Code: ZOL2C02T

[36 hrs] [2 hours/week] [3 credits]

COURSE OUTCOMES [COs]

COs	Course Outcome Statements
CO1	Explain parasitism and the major protist, cestode, trematode and nematode parasites of man and major insect vectors of human diseases and their control (11 hrs)
CO2	Understand major beneficial and harmful insects, damages caused to host plants and their control measures (14 hrs)
CO3	Understand pisciculture, prawn, mussel and pearl culture (11 hrs)

Question paper pattern for external examination

[Module 1 Short answer 4x2=8 marks, Paragraph 3x5=15 marks

Module 2 Short answer 5x2 = 10 marks, Paragraph 2x5=10 marks; Essay 1x10=10 marks

Module 3 Short answer 3x2=6 marks; Paragraph 2x5=10 marks; Essay 1x10=10 marks]

MODULE 1: Parasitism in relation to man (11 hrs)

Introduction, classification of parasites and hosts (2 hrs)

Obligatory, facultative, external, internal, hyperparasites. Definitive, intermediate, carrier and reserve hosts. Infection and infestation - Mention Hyper infection and Auto infection. Modes of infection - Inoculative, contaminative, direct and retroinfection, zoonotic diseases

Human Parasites (5 hrs)

Parasitic Protists – *Plasmodium vivax*, *Entamoeba histolytica*

Cestodes – *Taenia solium*, mention *T. saginata* and *Echinococcus granulosus*

Trematodes (Flukes) – *Schistosoma haematobium*

Nematodes – *Ancylostoma duodenale*, *Wuchereria bancrofti* and *Enterobius vermicularis*

Vectors of human diseases (4 hrs)

Insect vectors of human diseases and their control. *Anophales*, *Culex*, *Aedes*, *Xenopsylla*, *Cimex*, *Pediculus* and *Pthirus* (Diseases like malaria, filariasis, yellow fever, typhus fever, dengue, plague, chikungunya, kala azar).

[Short answers/Paragraphs]

MODULE 2. Useful Insects, Insect Pests and their control (14 hrs)

Insect Pests (9 hrs)

Definition of Pests, Kinds of Pests, Causes of pest outbreak.

Nature of damage to host plants and control measures of the following pests. (Exclude structure and Life history of Pests).

- Spodoptera* sp. (rice swarming caterpillar)
- Leptocorisa* sp. (rice bug)
- Rhynchophorus* sp. (red palm weevil)
- Opisina* sp. (Black headed caterpillar, mention biological control)
- Aceria* sp. (Coconut mite)
- Helopeltis* sp. (tea bug)
- Cosmopolites* sp. (Banana rhizome weevil)
- Bactrocera* sp. (Fruit fly)

- i) *Batocera* sp. (mango stem borer)
- j) *Sitophilus* sp. (rice weevil)

Insect control (2 hrs)

Basic principles of chemical control and biological control. Integrated Pest Management (IPM) (Brief notes).

Useful Insects (3 hrs)

Apiculture, Sericulture & Lac culture: Economic importance. Predatory insects, insect parasitoids.

[Short answers/Paragraphs/Essays]

MODULE 3. Aquaculture and Fishery Biology (11 hrs)

Brief Introduction mentioning its scope in Kerala. (1 hr)

Pisciculture (5 hrs)

Egg collection and hatching, induced spawning. Nursery ponds, manuring, feeding and harvesting, Ornamental fish farming (brief account). Mention common species. Fish utilization

Prawn culture. (2 hrs)

Breeding and spawning of prawns, seed collection and culture, types of prawn farms, mention common species.

Mussel farming (2 hrs)

Seed collection, artificial collection of seeds, induced spawning, rearing of larvae, farming methods and harvesting.

Pearl Culture (1 hr)

Preparation of nuclei, preparation of host and graft tissue, implantation and nursing.

[Short answers/Paragraphs/Essays]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. *Callosobruchus chinensis* (Pulse beetle).
2. *Eomenacanthus stramineus* (Chicken louse).
3. *Hippobosca maculata* (house fly).
4. *Tabanus striatus* (horse fly).
5. *Pediculus humanus* (head louse)

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THIRD SEMESTER B.Sc. ZOOLOGY COMPLEMENTARY COURSE

Theory Course- III

PHYSIOLOGY AND ETHOLOGY

Code: ZOL3C03T

[54 hrs] [3 hours/week] [2 credits]

COURSE OUTCOMES [COs]

COs	Course Outcome Statements
CO1	Describe the structure of plasma membrane and the various trans-membrane transport mechanisms (3 hrs)
CO2	Enumerate the constituents of normal diet and the mechanism of digestion and absorption of carbohydrates, proteins and lipids and the regulation of gastrointestinal function (4 hrs)
CO3	Explain the mechanism of transport of respiratory gases, control of respiration, respiratory problems and artificial ventilation (6 hrs)
CO4	Explain the structure and working of human heart and mechanism of regulation of heart beat; constituents of human blood and blood transfusion and cardiovascular problems (7 hrs)
CO5	Illustrate the structure of human kidney, the mechanism of urine formation, hormonal control of kidney function and kidney disorders; osmoregulation and urea cycle (6 hrs)
CO6	Enumerate the structure of myofibrils and myofilaments; muscle contractile and regulatory proteins and mechanism of muscle contraction (7 hrs)
CO7	Explain different types of nerve cells and glial cells, maintenance of resting membrane potential, generation and propagation of action potential and synaptic transmission (7 hrs)
CO8	Describe innate behavior, learned behavior, patterns of behavior and factors that affect behavior (8 hrs)
CO9	Enumerate biological rhythms, communication in animals and social organization in mammals (6 hrs)

Question paper pattern for external examination

[Module 1-7 Short answer 9x2=18 marks, Paragraph 6x5=30 marks, Essay 1x10=10 marks
Module 8-9 Short answer 3x2 = 6 marks, Paragraph 1x5=5 marks; Essay 1x10=10 marks]

Section A. PHYSIOLOGY (40 hrs)

MODULE 1. Trans-membrane transport mechanisms (3 hrs)

Structure of Plasma membrane. Fluid mosaic model. Trans-membrane transport - passive & active mechanisms, vesicular transport

[Short answers/Paragraphs]

MODULE 2. Nutrition (4 hrs)

Constituents of normal diet. Digestion of carbohydrates, proteins and lipids. Absorption of nutrients (brief account). Brief account on the neural and hormonal control of gastrointestinal function. BMR and obesity

[Short answers/Paragraphs]

MODULE 3. Respiration (6 hrs)

Gas exchange and transport. Respiratory pigment – haemoglobin – properties. Control of respiration – neural & chemical (brief account). Respiratory problems - hypoxia, asphyxia, CO poisoning. Respiratory problem of high altitudes. Physiological adaptive mechanisms of diving mammals. Artificial ventilation; heart lung machine.

[Short answers/Paragraphs/Essays]

MODULE 4. Body fluids and circulation (7 hrs)

Constituents of human blood. Agglutination, coagulation of blood and haemostasis
Haemolysis. Blood transfusion (short notes). Brief account on the structure and
working of human heart. Pacemaker and conducting system of heart. Cardiac cycle
and regulation of heart beat. Blood pressure and pulse. Cardiovascular problems
(brief account) - arteriosclerosis and atherosclerosis, myocardial infarction,
hypertension and thrombosis.

[Short answers/Paragraphs/Essays]

MODULE 5. Osmoregulation and Excretion (6 hrs)

Osmoconformers and osmoregulators. Water retention and conservation in desert
animals. Urea cycle. Ammonotelism, ureotelism and uricotelism. Hormonal control
of kidney function. Kidney disorders, renal hypertension, nephritis and renal
failure. Dialysis and kidney transplantation (short notes)

[Short answers/Paragraphs/Essays]

MODULE 6. Muscle Physiology (7 hrs)

EM structure of myofibrils and myofilament. Muscle - contractile proteins and
major regulatory proteins. Chemistry and mechanism of muscle contraction.
Energy for muscle contraction. Muscle twitch and muscle tetanus, isometric and
isotonic contraction. All-or-none law and summation of stimuli. Muscle fatigue and
rigor mortis.

[Short answers/Paragraphs/Essays]

MODULE 7. Nerve physiology (7 hrs)

Mention different types of nerve cells and glial cells. Maintenance of resting
membrane potential; generation and propagation of action potential. Threshold
stimulus, all or none response. Synapse, types of synapses, synaptic transmission
and neurotransmitters.

[Short answers/Paragraphs/Essays]

Section B. ETHOLOGY (14 hrs)

MODULE 8. Behaviour (8 hrs)

Innate behaviour

Orientation, taxes and kinesis, simple reflexes and instincts, drive and motivation

Learned behaviour

Habituation, conditioned reflex, trial and error learning, latent learning, imprinting,
insight learning

Patterns of behaviour

Habitat selection, sexual selection, co-operation, territoriality, aggression,
courtship and agonistic behaviour.

Proximate factors

Neurological basis of behaviour, mention hormonal, biochemical, environmental
and genetic factors that influence behaviour.

[Short answers/Paragraphs/Essays]

MODULE 9: Biological clocks/rhythms (6 hrs)

Photoperiod, circadian rhythm, migration, navigation and homing instinct,
diapause, hibernation and aestivation. Communication in animals. Social
organization in mammals – Elephant as example

[Short answers/Paragraphs/Essays]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Role of enzymes in digestion of Carbohydrates, proteins and lipids.
2. Absorption of carbohydrates, proteins, and lipids.
3. Problems of Alcoholism
4. Common renal problems - Renal hypertension, nephritis, renal failure, edema, acidosis, uremia, haematuria and calculi.
5. Minamata disease

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- Reena Mather (2016) *Animal Behaviour*, ISBN-13-9789350780480, Rosthogi Pub.

FOURTH SEMESTER B.Sc. ZOOLOGY COMPLEMENTARY COURSE

Theory Course- IV

GENETICS AND IMMUNOLOGY

Code: ZOL4C04T

[54 hrs] [3 hours/week] [2 credits]

COURSE OUTCOMES [COs]

COs	Course Outcome statements
CO1	Describe human karyotype , chromosomal anomalies and polygenic inheritance (6 hrs)
CO2	Explain the mechanisms of sex determination (4 hrs)
CO3	Enumerate the concept of genes, gene expression, genetic code, transcription and translation (8 hrs)
CO4	Illustrate the mechanism of recombinant DNA technology and its practical applications (13 hrs)
CO5	Explain the types of cancer, causes of transformation and characteristics of transformed cells (5 hrs)
CO6	Identify the cells and organs of immune system, antigens and antibodies (7 hrs)
CO7	Enumerate antigen-antibody interaction, generation of B-cell and T-cell response and major immunotechniques (7 hrs)
CO8	Explain primary and secondary immunodeficiency diseases, autoimmune diseases, vaccination and vaccines (4 hrs)

Question paper pattern for external examination

[Module 1-5 Short answer 8x2=16 marks, Paragraph 5x5=25 marks, Essay 1x10=10 marks
Module 6-8 Short answer 4x4= 8 marks, Paragraph 2x5=10 marks; Essay 1x10=10 marks]

Section A: GENETICS (36 hrs)

MODULE 1. Human Genetics (6 hrs)

Normal human karyotype: Classification and grouping of human chromosomes (Patau's & Denver schemes). Chromosomal anomalies and disorders (short note only). Autosomal anomalies: Phenyl ketonuria & Sickle cell anemia. X-linked – Haemophilia and Colour blindness. Y-linked – Y-Chromosome infertility. Polygenic inheritance - Cleft palate or Cleft lip and diabetes mellitus. Prenatal diagnosis. Genetic counselling. Eugenics, Euthenics and Euphenics.

[Short answers/Paragraphs/Essays]

MODULE 2. Genetic Control of Sex (4 hrs)

Autosomes and sex chromosomes: Mention Barr body and its significance. Chromosomal mechanism of sex determination: genic balance theory. Control of sex; hormonal influence of sex determination; sex mosaics; gynandromorphism

[Short answers/Paragraphs]

MODULE 3. Genes and gene expression (8 hrs)

Modern concept of genes, split genes, pseudogenes, overlapping genes and transposons. Gene expression. Genetic code, transcription and translation (brief account)

[Short answers/Paragraphs/Essays]

MODULE 4. Genetic Engineering (13 hrs)

Brief account of recombinant DNA technology – role of enzymes (restriction endonucleases, exonucleases, DNA polymerase, DNA ligase, reverse transcriptase, alkaline phosphatase, polynucleotide kinase and terminal transferase). Cloning vectors – plasmid vectors (mention pBR322), phage vectors, cosmids, viruses and YAC vector. Construction of recombinant DNA (preparation of vector DNA and donor DNA, joining of vector and donor DNAs, introduction of recombinant DNA into the host cell and selection of transformants). Methods of gene transfer. Practical applications, advantages and potential hazards.

[Short answers/Paragraphs/Essays]

MODULE 5. Cytogenetics of Cancer (5 hrs)

Types of cancer: brief account of sarcomas, carcinomas, melanomas, leukemia, lymphomas and blastomas. Characteristics of cancer cells: uncontrolled multiplication, loss of contact inhibition, metastasis, reduced cellular adhesion, metaplasia, invasiveness, growth factor secretion, cell surface alterations, alterations in transcriptome and proteome and protease secretion. Origin of Cancer: Carcinogens, oncogenic viruses, polygenic basis, hereditary predisposition to cancer

[Short answers/Paragraphs]

Section B: IMMUNOLOGY (18 hrs)

(Brief account of the following topics)

MODULE 6. Cells and organs of immune system, antigens and antibodies (7 hrs)

Cells and organs of immune system

Innate and adaptive immunity. Cells of immune system- B cell, T cell, NK cell and Antigen Presenting Cells (dendritic cells, macrophage cells). Organs of the immune system- Primary lymphoid Organs (Thymus, Bone Marrow), Secondary lymphoid Organs (Spleen, lymph node, MALT)

Antigens

Antigenicity, Immunogenicity and Haptens. Factors influencing immunogenicity. Mention human immunoglobulin gene families – λ and κ light chain families and heavy chain family and major histocompatibility complex (MHC) group of genes.

Antibodies

Structure, different classes and Function. Monoclonal antibodies-Hybridoma technology and applications.

[Short answers/Paragraphs/Essays]

MODULE 7. Antigen-Antibody interaction & Generation of B-cell and T-cell response (7 hrs)

Antigen - antibody interaction

Strength of Antigen-Antibody interaction. Cross reactivity, Precipitation reactions, and Agglutination reactions. Immunotechniques – Detection of biomolecules using ELISA, RIA, and Western blot. Southern blot, Northern blot and DNA Fingerprinting (Brief)

Generation of B cell and T-cell response:

Humoral and cell-mediated response. Properties of B-cell and T-cell- epitopes. Activation and differentiation of B and T cells. Cytokines- brief

[Short answers/Paragraphs]

MODULE 8. Immunodeficiency diseases, vaccines & vaccination (4 hrs)

Immunodeficiency diseases

Primary (Bruton's disease, Di-George syndrome & SCID). Secondary types: AIDS- Mention Acute, Chronic and Crisis phase, Window period. Autoimmune disease- Mention Hashimoto's thyroiditis, Grave's disease, Myasthenia gravis and Systemic Lupus Erythematosus.

Vaccines and Vaccination

Principle of vaccination; mention Attenuated vaccines, Inactivated vaccines, Toxoid vaccines and DNA vaccines.

[Short answers/Paragraphs/Essays]

Topics for Assignments/Seminars

(Topics allotted for assignments/ seminars should be considered for internal assessments only, and can be subdivided among students)

1. Human genome
2. DNA tumor viruses
3. Human genome project
4. Structure of immunoglobulins and T-cell receptors

REFERENCES

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- Eldon John Gardner, Michael J. Simmons and Peter Snustad (1991) *Principles of Genetics*, 8th Edn, ISBN-10: 0471533971, Wiley, 714 pages
- Gangane, S.D (2012) *Human Genetics*, 2nd Edition, ISBN-10: 8131230228, Elsevier, 312 pages
- Ivan Roitt (1994): *Essential Immunology*, 8th Edition, ISBN-10: 0632033134, Blackwell Science, 456 pages
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- Jogchand, S.N.(2016) *Gene Biotechnology*, ISBN-978-93-5262-087-6, Himalaya Publishing House, 447 pages
- John Playfair and Gregory Bancroft (2014) *Infection and Immunity*, 4th Edition, ISBN: 9780199609505, OUP., 400 pages
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- Twyman R M. (2001) *Instant notes in Developmental Biology*, Viva Books, 421 pages

**B.Sc. ZOOLOGY COMPLEMENTARY COURSE
PRACTICAL**

Code: ZOL4C05P

[Practical I*A+I*B+I*C+I*D] [4 Credits]

COURSE OUTCOMES [COs]

COs	Course Outcome statement
CO1	Identify the salient features of the phylum; taxonomic position, habit, habitat, adaptations/importance of selected protists, non-chordates and chordates (36 hrs)
CO2	Describe major human parasites and economically important insects, molluscs and fishes (36 hrs)
CO3	Perform detection of human blood groups and prepare human blood smear as per laboratory standards; mounting of specialized organs of selected non-chordates and chordates, and demonstrate the presence of biomolecules in samples by standard laboratory protocols (36 hrs)
CO4	Illustrate the normal and selected abnormal human karyotypes and mode of inheritance of selected human genetic disorders and perform the dissection of earthworm and sardine to demonstrate the alimentary canal and <i>Penaeus</i> to demonstrate the nervous system (36 hrs)

**FIRST SEMESTER COMPLEMENTARY COURSE [PRACTICAL I *A]
[36 hrs] [2 hrs/week]**

A. Animal Diversity

- Phylum Dinoflagellata : *Noctiluca*
 Ciliophora : *Vorticella*
 Porifera : *Leucosolenia*
 Coelenterata : *Obelia, Physalia, Rhizostoma* (Any 2).
 Platyhelminthes : *Fasciola*
 Aschelminthes : *Ascaris*
 Annelida : *Chaetopterus / Arenicola, Hirudinaria*.
 Arthropoda : *Eupagarus, Belostoma, Limulus, Sacculina* (Any 3).
 Onychophora : *Peripatus*
 Mollusca : *Chiton, Sepia/ Loligo, Octopus* (Any 2)
 Echinodermata : *Asterias, Holothuria*.
- Chordata
- Prochordates : *Ascidia/ Branchiostoma*.
 Cyclostomata : *Petromyzon*.
 Superclass: Pisces : *Narcine, Echeneis, Hippocampus, Heteropneustes, Anguilla, Pomfret* (Any 3)
 Class Amphibia : *Ichthyophis, Axolotl larva, Rhacophorus* (Any 2)
 Class Reptilia : *Chamaeleo, Daboia, Bungarus*
 Class Aves : *Columba*
 Class Mammalia : *Pteropus* or any other Bat.

B. Histology: Study of the T.S. of *Hydra*, *Ascaris*, Earth worm (through typhlosolic region).

C. Osteology: Dentition (Rabbit), Pectoral and Pelvic girdles, typical vertebra

REFERENCES

- Jordan E. L. and P S Verma (2013) *Chordate Zoology*, 14th Edition, ISBN-10: 8121916399, S. Chand Publishres, 1076 pages
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- Ghose K. C. and B. Manna (2007) *Practical Zoology*, ISBN-8173811822, New Central Book Agency 481 pages
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SECOND SEMESTER COMPLEMENTARY COURSE [PRACTICAL I *B]

[36 hrs] [2 hrs/week]

Study of the following items

Parasites

Entamoeba, *Plasmodium*, *Schistosoma*, *Taenia*, *Ancylostoma*, *Enterobius*, *Wuchereria*, *Hirudinaria*, *Cimex* (Any 5).

Insect pests

Spodoptera, *Leptocorisa*, *Oryctes*, *Rhynchophorus*, *Opisina*; *Batocera*, Termite, *Sitophilus* (Any 5).

Useful insects

Apis (worker), *Bombyx* female (any one)

Ornamental fishes

Poecilia reticulata (guppy), *Poecilia sphenops* (Black molly), *Carassius auratus* (Gold fish), *Puntius denisonii*, *Pterophyllum scalare* (Angel fish), *Colisa* sp. (Gaurami), *Betta* sp. (Fighting fish), *Danio malabaricus* (Giant Danio) (Any three)

Culture fishes

Catla catla (*Catla*), *Labeo rohita* (*Rohu*), *Cirrhinus mrigala* (*Mrigal*), *Ctenopharyngodon idellus* (*Grass Carp*) (Any three)

Economically important items

Perna, *Pinctada*, *Teredo*, *Loligo*, *Penaeus*, *Scoliodon*, *Sardinella*, *Rastrelliger*, *Cybium* (Any 5).

REFERENCES

- Dhaliwal G.S., Ram Singh and Chhillar B.S. (2014) *Elements of Agricultural Entomology*, ISBN-10: 8127226300, Kalyani Publishers
- John O Donel Alexander (1984) *Arthropods and Human Skin*, ISBN 978-1-4471-1356-0, Springer.
- 'Living Jewels': A hand book on freshwater ornamental fish, The Marine Products Export Development Authority, Ministry of Commerce & Industry, Govt. of India.
- "Commercial Fin Fishes and Shell Fishes of India", The Marine Products Export Development Authority, Ministry of Commerce & Industry, Govt. of India.

**THIRD SEMESTER COMPLEMENTARY COURSE [PRACTICAL I *C]
[36 hrs] [2 hrs/week]**

Section A: Physiology

1. Blood smear preparation and study of RBC and different types of WBCs.
2. Human blood grouping – ABO and Rh systems.
3. Detection of monosaccharides, polysaccharides, proteins & lipids.

Section B: Mounting

1. Earth worm: Setae in situ (minor), Spermatheca (minor)
2. *Penaeus*: Appendages (minor)
3. Cockroach: Salivary apparatus (major).
4. Honeybee: Mouth parts (minor).
5. Shark: Placoid scales (minor).

REFERENCES

- Jayasurya; N.C. Nair; N. Soundara Pandian; N. Arumugam; S. Leelavathy and T. Murugan: *Saras Practical Zoology Vol.1: Invertebrata*; ISBN : 9789382459231, Saras Publication, 424 pages
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- William Lutterschmidt and Deborah Lutterschmidt (2008) *Laboratory Excercises in Human Physiology*, 2nd Edition, ISBN-10: 0077229738, Mc Graw Hill, 256 pages

**FOURTH SEMESTER COMPLEMENTARY COURSE [PRACTICAL I *D]
[36 hrs] [2 hrs/week]**

Section A: Dissections

Earthworm: Alimentary canal upto 25th segment (minor)
Penaeus: Nervous system (major)
Sardinella: Alimentary canal (major)

Section B: Genetics

Study of the following (use slides/ models / charts / photographs)

1. Study of sex linked inheritance (haemophilia, sickle cell anaemia, color blindness)
2. Study of normal human karyotype (male and female) and abnormal karyotypes – Down's syndrome, Klinefelter's syndrome, Turners syndrome, Edwards syndrome (Any two)

REFERENCES

- Jayasurya; N.C. Nair; N. Soundara Pandian; N. Arumugam; S. Leelavathy and T. Murugan: *Saras Practical Zoology Vol.1: Invertebrata*; ISBN : 9789382459231, Saras Publication, 424 pages
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MODEL QUESTION PAPER
FIRST SEMESTER B.Sc. DEGREE EXAMINATION
(CBCSS -UG)
Zoology: Complementary course
ZOL1C01 - **ANIMAL DIVERSITY AND WILDLIFE CONSERVATION**

Time: Two Hours

Maximum: 60 Marks

Section A

I. Short answer questions. Each question carries 2 marks.

1. Describe the salient features of phylum Dinoflagellata with a suitable example.
2. Comment on *Plasmodium vivax* as a human pathogen.
3. What is gemmule?
4. Explain mutualism with respect to sea anemone.
5. Write a note on biodiversity hotspots.
6. What is Red Data book?
7. Write a short account on pearl formation.
8. Explain the adaptations of *Echeneis*.
9. Write a note on strategies for conservation.
10. Explain the adaptations of *Rhacophorus*.
11. What is neurotoxic venom? Give an example
12. Explain sustainable development.

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Write a note on the evolutionary significance of *Peripatus*.
14. Explain metagenesis with respect to *Obelia*
15. Write a note on the parasitic adaptations of *Fasciola*.
16. Explain the structure of typical vertebra of Rabbit with labeled diagram.
17. Describe the salient features of subphylum Urochordata with a suitable example.
18. Write a note on the adaptations of *Pteropus*.
19. Describe the various threats to biodiversity.

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any one question.

20. Explain the salient features and classification of phylum Annelida down to classes with example from each class.
21. With a neat labelled diagram, describe structure of heart of *Oryctolagus*.

(1x10 = 10 marks)

MODEL QUESTION PAPER
SECOND SEMESTER B.Sc. DEGREE EXAMINATION
(CBCSS –UG)
Zoology: Complementary course
ZOL2C02 – **ECONOMIC ZOOLOGY**

Time: Two Hours

Maximum: 60 Marks

Section A

I. Short answer questions. Each question carries 2 marks.

1. What is ancylostomiasis?
2. Differentiate between infection and infestation
3. What are zoonotic diseases?
4. What is bladder worm?
5. Discuss the damages caused and control measures of coconut mite.
6. What is induced spawning? Mention its application.
7. Discuss the damages caused by *Spodoptera* sp.
8. What are the different types of prawn farms?
9. Explain the control measures of *Cosmopolites* sp.
10. What are insect parasitoids?
11. Comment on *Sitophilus* sp.
12. Name the common cultivable prawn species.

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Discuss mosquitoes as vectors of human diseases.
14. Write a note on *Wuchereria bancrofti*.
15. Comment on *Plasmodium vivax* as a human pathogen.
16. Write a short note on integrated pest management.
17. Give an outline classification of pests and the causes of pest outbreak.
18. Write a short account on pearl culture.
19. Comment on common cultivable ornamental fishes.

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any one question.

20. Explain the various insect pest management strategies.
21. Describe the various steps in pisciculture.

(1x10 = 10 marks)

MODEL QUESTION PAPER
THIRD SEMESTER B.Sc. DEGREE EXAMINATION
(CBCSS -UG)
Zoology: Complementary course
ZOL3C03 - **PHYSIOLOGY & ETHOLOGY**

Time: Two Hours

Maximum: 60 Marks

Section A

I. Short answer questions. Each question carries 2 marks.

1. What is circadian rhythm.
2. Write a note on social organization in elephants.
3. Differentiate between hibernation and aestivation.
4. Explain the mechanism of absorption of nutrients.
5. What is BMR? Mention the factors affecting it.
6. Differentiate between arteriosclerosis and atherosclerosis.
7. Write a note on respiratory problems of high altitudes.
8. Explain cardiac cycle.
9. What is summation of stimuli?
10. Differentiate between osmoconformers and osmoregulators.
11. Write a note on hormonal control of kidney function.
12. Explain all or none law.

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Explain briefly the mechanism of muscle contraction.
14. Write a short account on the structure of the human heart.
15. Describe urea cycle.
16. Explain the neural and chemical control of respiration.
17. Briefly explain the digestion of carbohydrates, proteins and lipids.
18. Describe the fluid mosaic model of plasma membrane.
19. Give an account on communication behavior in animals.

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any one question.

20. Describe the mechanism of nerve impulse transmission.
21. Explain the different kinds of behavior.

(1x10 = 10 marks)

MODEL QUESTION PAPER
FOURTH SEMESTER B.Sc. DEGREE EXAMINATION
(CBCSS -UG)
Zoology: Complementary course
ZOL4C04 – **GENETICS AND IMMUNOLOGY**

Time: Two Hours

Maximum: 60 Marks

Section A

I. Short answer questions. Each question carries 2 marks.

1. Write a note on cytokines.
2. What are haptens?
3. Mention the various cells of the immune system.
4. What is adaptive immunity?
5. Write a note on viral origin of cancer.
6. What are cosmids?
7. Comment on pseudogenes.
8. Explain the practical applications of genetic engineering.
9. What are transposons?
10. Explain genic balance theory.
11. Comment on gynandromorphism.
12. Explain polygenic inheritance

(Ceiling: 20 marks)

Section B

II. Paragraph questions. Each question carries 5 marks

13. Explain the Patau's scheme of classification of human chromosomes.
14. Describe the features of genetic code.
15. Write a note on various gene transfer methods.
16. Write a note on the process of transcription.
17. Describe the structure of immunoglobulin.
18. Explain the characteristics of cancer cells.
19. Write a note on ELISA

(Ceiling: 30 marks)

Section C

III. Essay questions. Answer any one question.

20. Explain the steps in the construction of recombinant DNA.
21. Write an essay on immunodeficiency diseases.

(1x10 = 10 marks)