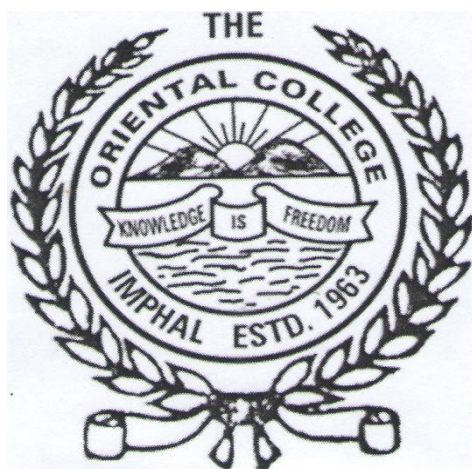


B.Sc. (H) ZOOLOGY

**THREE YEAR FULL TIME PROGRAMME
(Six - Semester Course)**

**Under
CHOICE BASED CREDIT SYSTEM**



COURSE CONTENTS

(A draft for implementing from 2020-21 Session)

**Department of Zoology
Oriental College (Autonomous)
Takyel, Imphal**

AFFILIATED TO MANIPUR UNIVERSITY, CANCHIPUR

Preamble:

Zoology is one of the major subjects of Basic Sciences and deals with all aspects of animal biology. It includes an interesting range of highly diverse topics. A zoology student needs to gain understanding of many areas of the subject to keep pace with advancements in Life Sciences.

This under-graduate degree program has been designed by the Board of Studies in Zoology of Oriental College (Autonomous) with a substantial component of what is needed from zoologists as a skilled career and what zoologists need to pursue for post-graduation and further academic studies. It follows the guidelines laid down by the University Grants Commission, New Delhi. This newly designed curriculum is a perfect blend of the classical aspects in Zoology and the advanced and more specialized areas.

This degree offers Discipline Specific Core Courses [CC] in Animal Systematics, Animal Ecology, Animal Cell biology, Animal cell Biotechnology Applied Zoology, Histology, Biological Chemistry, Genetics, Developmental Biology, Parasitology, Medical & Forensic Zoology, Animal Physiology, Molecular Biology, Entomology, Techniques in Biology and Evolutionary Biology.

In addition to the Core Courses, Ability Enhancement Compulsory Courses [AECC] have been added in the second year i.e. Semester III and Semester IV of the undergraduate course. In the third year i.e. Semester V and Semester VI, Discipline specific Elective Courses [DSEC] and Skill Enhancement Courses [SEC] have been offered. The students, therefore, have an opportunity to take courses in Environment Awareness, Aquarium Management, Poultry Management and Environmental Impact Assessment. In Semester VI the students also have a course dedicated to Project work.

The syllabus has been framed in such a way that the student gains each year, a broader perspective of the subject as he progresses towards completion of the degree program. Field trips, Educational visits and the Project work have been included for the student to experience the applications of the theory learnt in the classroom.

After completion of the program, it is expected that students will understand and appreciate: animal diversity, few applications of Zoology, the structure, functions and life processes at cellular, tissue, organ and system level, significance of evolution, and basic concepts of human health. The students would also gain an insight into laboratory and field work through the practical course, field work and the project.

While presenting this new syllabus to the teachers and students of B. Sc. Zoology, I am extremely happy to state that efforts have been made to seek inputs of all the stake holders to make it more relevant.

The new course that will be effective from the academic year 2020- 2021 and will follow the Choice Based Credit System in a Semester mode. It has been primed keeping in view the distinctive requirements of B. Sc. Zoology students. The contents have been drawn-up to accommodate the widening prospects of the discipline of Life Sciences. This program has been introduced with 132 credits for the subject group while 08 credits to earn from any of the groups offering a range of curricular, cocurricular and extracurricular activities and another 08 credits to ability enhancement.

OUTCOME OF THE COURSE

The students of B. Sc. Students should be able to acquire the following knowledge.

1. This newly designed curriculum of B.Sc. Zoology will allow students to acquire the skill in handling scientific instruments planning and performing in the laboratory and exercising critical judgement, independent thinking and problem solving skills.
2. At **first year of under-graduation** the topics related to the fundamentals of zoology, including exposure to diversity in animal groups and industries based on the zoological areas are covered. The practical course is aimed at to equip the students with skills required for animal identification, morphological, anatomical, technical description, classification and also applications of zoology in the various industries.
3. At **second year under-graduation**: The level of the theory and practical courses shall be one step ahead of the first year B.Sc. courses based on the content of first year shall be introduced.
4. At **third year under-graduation**: Theory and practical courses in each semester shall deal with the further detailed studies of the various disciplines of the Zoology subject and other branches of Zoology such as Genetics, Animal Physiology, Molecular Biology, Biochemistry, Microtechnique, Non-chordate and Chordate, Developmental Biology, Histology, Cell Biology, Biodiversity, Public health and hygiene, Pathology, Entomology, Biotechnology, etc. The students will also learn about use of various technical skills in the biological sciences to be helpful during research in the Zoology subject.

COURSE STRUCTURE FOR HONOURS STUDENTS

Course Type →	Core Course (14)	Discipline Specific Elective DSE (4)	Generic Elective GE (4)	Skill Enhancement Course SEC (2)	Ability Enhancement Course AECC (2)
Credits →	14 x 6 = 84	4 x 6 = 24	4 x 6 = 24	2 x 4 = 8	2 x 4 = 8
Semesters ↓	Paper	Paper	Paper	Paper	Paper
1	ZOO-HC 1016		ZOO-HG 1016		GEN/MAN-AE 1014
	ZOO -HC 1026				
2	ZOO -HC 2016		ZOO-HG 2016		EVS-AE 2014
	ZOO -HC 2026				
3	ZOO -HC 3016		ZOO-HG3016 /ZOOHG3026	ZOO-SE 3014/ ZOO-SE 3024	
	ZOO -HC 3026				
	ZOO -HC 3036				
4	ZOO -HC 4016		ZOO-HG4016 /ZOOHG4026	ZOO-SE 4014/ ZOO-SE 4014	
	ZOO -HC 4026				
	ZOO -HC 4036				
5	ZOO -HC 5016	ZOO-HE 5016 ZOO-HE 5026/ ZOO-HE 5036/ ZOO-HE 5046/ ZOO-HE 5056			
	ZOO -HC 5026				
6	ZOO -HC 6016	ZOO-HE 6016 ZOO-HE 6026/ ZOO-HE 6036/ ZOO-HE 6046/ ZOO -HE 6056			
	ZOO -HC 6026				
Total: 14X6=84 credits, 4X6=24 credits, 4X6=24 credits, 2X4=8 credits, 2X4=8 credits, 26 papers and 148 credits.					

Honours Core course (14 papers of 6 credits each) **Course code: HC**

AECC — Ability enhancement compulsory course (2 papers of 4 credits each)

Course code: AE

SEC — Skill enhancement course (2 papers of 4 credits each) **Course code: SE**

DSE — Discipline specific elective course (4 papers of 6 credits each) **Course code: HE**

GE — Generic elective course (4 papers of 6 credits each) **Course code: HG**

Note: A student opting Zoology as Honours course may take Generic Elective Papers from any other disciplines available in the college other than Zoology.

Semester wise Course and Credit details

Sem.↓	Course	Course code	Title	Credits	Remarks
1	Core	ZOO-HC 1016	Non-chordates 1: Protista to Pseudocoelomates (Theo+Pract)	4+2=6	Compulsory
		ZOO-HC 1026	Principles of Ecology (Theo+Pract)	4+2=6	
	Generic Elective	ZOO-HG 1016	Animal Diversity (Theo+Pract)	4+2=6	It can choose from other disciplines other than Zoology available in the college
	Ability Enhancement	GEN -AE-1014/ MAN-AE 1014	General English/Manipuri (MIL)	3+1	Compulsory
2	Core	ZOO-HC 2016	Non-chordates II: Coelomates (Theo+Pract)	4+2=6	Compulsory
		ZOO-HC 2026	Cell Biology (Theo+Pract)	4+2=6	
	Generic Elective	ZOO-HG 2016	Animal cell Biotechnology	4+2=6	It can choose from other disciplines other than Zoology available in the college
	Ability Enhancement	EVS-AE 2014	Environmental Science	3+1	Compulsory
3	Core	ZOO-HC 3016	Diversity of Chordates (Theo+Pract)	4+2=6	Compulsory
		ZOO-HC 3026	Physiology: Controlling and Coordinating Systems (Theo+Pract)	4+2=6	
		ZOO-HC 3036	Fundamentals of Biochemistry (Theo+Pract)	4+2=6	
	Generic Elective	ZOO-HG 3016/	Aquatic Biology	4+2=6	It can choose from other disciplines other than Zoology available in the college
		ZOO-HG 3026	Human Physiology	4+2=6	
	Skill Enhancement	ZOO-SE 3014/	Apiculture	4	Compulsory (choose any one)
ZOO-SE 3024		Sericulture	4		
4	Core	ZOO-HC 4016	Comparative Anatomy of Vertebrates (Theo+Pract)	4+2=6	Compulsory
		ZOO-HC 4026	Physiology: Life Sustaining systems (Theo+Pract)	4+2=6	
		ZOO-HC 4036	Biochemistry of Metabolic processes (Theo+Pract)	4+2=6	

	Generic Elective	ZOO-HG 4016/	Environment and Public Health	4+2=6	It can choose from other disciplines other than Zoology available in the college
		ZOO-HG 4026	Food, Nutrition and Health	4+2=6	
	Skill Enhancement	ZOO-SE 4014/	Aquarium Fish keeping	3+1	Compulsory (choose any one)
		ZOO-SE 4024	Medical Diagnostics	3+1	
5	Core	ZOO-HC 5016	Molecular Biology (Theo+Pract)	4+2=6	Compulsory
		ZOO-HC 5026	Principles of Genetics (Theo+Pract)	4+2=6	
	Discipline Specific Elective	ZOO-HE 5016	Animal Behaviour and Chronology (Theo+Pract)	4+2=6	Compulsory (Choose any one)
		ZOO-HE 5026/	Animal Biotechnology (Theo+Pract)	4+2=6	
		ZOO-HE 5036/	Biology of Insecta (Theo+Pract)	4+2=6	
		ZOO-HE 5046/	Endocrinology (Theo+Pract)	4+2=6	
		ZOO-HE 5056	Fish & Fisheries (Theo+Pract)	4+2=6	
6	Core	ZOO-HC 6016	Developmental Biology (Theo+Pract)	4+2=6	Compulsory
		ZOO-HC 6026	Evolutionary Biology (Theo+Pract)	4+2=6	
	Discipline Specific Elective	ZOO-HE 6016	Immunology (Theo+Pract)	4+2=6	Compulsory (Choose any one)
		ZOO-HE 6026/	Parasitology (Theo+Pract)	4+2=6	
		ZOO-HE 6036/	Reproductive Biology (Theo+Pract)	4+2=6	
		ZOO-HE 6046/	Wild Life Conservation & Management (Theo+Pract)	4+2=6	
		ZOO-HE 6056	Computational Biology (Theo+Pract)	4+2=6	

CORE COURSE I:
Compulsory 14 papers of 6 credits each

ZOO-HC 1016: NON-CHORDATES I; PROTISTS TO PSEUDOCOELOMATES

Learning Objectives:

- To enable the students to develop an appreciation for the biodiversity of invertebrate species.
- To impart knowledge about co-existence of different forms of living organisms ranging from unicellular to multicellular animals.

Learning Outcome:

- On completion of the course the student should be able to know the general organization of Non-chordates as a group and know the taxonomy and characteristic features of the various Non-chordate phyla.
- The student should also understand the architecture and functions of a cell and its organelles.

THEORY (Credits 4 & 75 marks)

	marks
Unit 1: Protista, Parazoa and Metazoa	20
General characteristics and Classification up to classes Study of <i>Euglena</i> , <i>Amoeba</i> and <i>Paramecium</i> Life cycle and pathogenicity of <i>Plasmodium vivax</i> and <i>Entamoeba histolytica</i> Locomotion and Reproduction in Protista Evolution of symmetry and segmentation of Metazoa	
Unit 2: Porifera	10
General characteristics and Classification up to classes Canal system and spicules in sponges	
Unit 3: Cnidaria	15
General characteristics and Classification up to classes Metagenesis in <i>Obelia</i> Polymorphism in Cnidaria Corals and coral reefs	
Unit 4: Ctenophora	5
General characteristics and Evolutionary significance	
Unit 5: Platyhelminthes	10
General characteristics and Classification up to classes Life cycle and pathogenicity of <i>Fasciola hepatica</i> and <i>Taenia solium</i>	
Unit 6: Nematelminthes	15
General characteristics and Classification up to classes Life cycle, and pathogenicity of <i>Ascaris lumbricoides</i> and <i>Wuchereria bancrofti</i> Parasitic adaptations in helminthes	

**NON-CHORDATES I: PROTISTS TO PSEUDOCOELOMATES
PRACTICALS (Credits 2 & 25 marks)**

	marks
1. Study of whole mount of <i>Euglena</i> , <i>Amoeba</i> and <i>Paramecium</i> , Binary fission and Conjugation in <i>Paramecium</i>	4
2. Examination of pond water collected from different places for diversity in protista.	2
3. Study of <i>Sycon</i> (T.S. and L.S.), <i>Hyalonema</i> , <i>Euplectella</i> , <i>Spongilla</i>	4
4. Study of <i>Obelia</i> , <i>Physalia</i> , <i>Millepora</i> , <i>Aurelia</i> , <i>Tubipora</i> , <i>Corallium</i> , <i>Alcyonium</i> , <i>Gorgonia</i> , <i>Metridium</i> , <i>Pennatula</i> , <i>Fungia</i> , <i>Meandrina</i> , <i>Madrepora</i>	4
5. One specimen/slide of any ctenophore	2
6. Study of adult <i>Fasciola hepatica</i> , <i>Taenia solium</i> and their life cycles (Slides/micro-photographs). Study of adult <i>Ascaris lumbricoides</i> and its life stages (Slides/micro-photographs)	4
7. To submit a Project Report on any related topic on life cycles/coral/ coral reefs.	5

Note: Classification to be followed from -Ruppert and Barnes (2006) Invertebrate Zoology, 8th edition, Holt Saunders International Edition

SUGGESTED READINGS

- L.H. Hyman _The Invertebrates‘ Vol I, II and V. – M.C. Graw Hill Company Ltd.
- Kotpal, R.L. 1988 - 1992 Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata. Rastogi Publications, Meerut.
- E.L. Jordan and P.S. Verma _Invertebrate Zoology‘ S. Chand and Company.
- Parker, T.J. and Haswell _A text book of Zoology‘ by, W.A., Mac Millan Co. London.
- Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition
- . Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
- Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson

CORE COURSE II

ZOO-HC 1026: PRINCIPLES OF ECOLOGY

Objectives:

- To educate the students about the basic environmental phenomena like ecosystem, energy flow through the ecosystem and biogeochemical cycles.
- To enable the students, understand the adaptations of the animals to their environment

Learning Outcome:

- The learners will be able to identify and critically evaluate their own beliefs, values and actions in relation to professional and societal standards of ethics and its impact on ecosystem and biosphere due to the dynamics in population.
- To understand anticipate, analyse and evaluate natural resource issues and act on a lifestyle that conserves nature.
- The Learner understands and appreciates the diversity of ecosystems and applies beyond the syllabi to understand the local lifestyle and problems of the community.
- The learner will be able to link the intricacies of food chains, food webs and link it with human life for its betterment and for non-exploitation of the biotic and abiotic components.

THEORY (Credits 4 & 75 marks)

	marks
Unit 1: Introduction to Ecology	10
History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors	
Unit 2: Population	25
Unitary and Modular populations Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion Exponential and logistic growth, equation and patterns, r and K strategies Population regulation - density-dependent and independent factors Population interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical responses	
Unit 3: Community	15
Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one example Theories pertaining to climax community	
Unit 4: Ecosystem	20
Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies Nutrient and biogeochemical cycle with one example of Nitrogen cycle Human modified ecosystem	
Unit 5: Applied Ecology	5
Ecology in Wildlife Conservation and Management	

PRINCIPLES OF ECOLOGY

PRACTICALS (Credits 2 & 25 marks)

- | | marks |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided | 4 |
| 2. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community | 6 |
| 3. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO ₂ | 10 |
| 4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary | 5 |

SUGGESTED READINGS

- M.P.Arora, 'Ecology' Himalaya Publishing company.
- P.D.Sharma, 'Environmental Biology'.
- P.R.Trivedi and Gurdeep Raj. 'Environmental Ecology'
- Veer Bala Rastogi, '-Ecology and Animal Distribution'
- P.K. Gupta, '-Text Book of Ecology and Environment'
- Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
- Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
- Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
- Robert Leo Smith Ecology and field biology Harper and Row publisher
- Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Pres

CORE COURSE III

ZOO-HC 2016: NON-CHORDATES II:

COELOMATES Objectives:

- To understand the Animal diversity around us.
- To understand the underlying principles of classification of animals and its terminology
- To enable the students to understand the difference in their morphology and general anatomy and to classify and study their general characters as well as functional anatomy.
- To enable the students to understand the dominance of Arthropods and their association with human welfare in a number of ways.
- To impart in depth knowledge to students about the different modes of living and structural modification acquired to suit varied living conditions.

Learning outcomes for the course:

- The student will be able to understand classify and identify the diversity of animals.
- The student understands the importance of classification of animals and classifies them effectively using the six levels of classification.
- The student knows his role in nature as a protector, preserver and promoter of life which he has achieved by learning, observing and understanding life.

THEORY (Credits 4 & 75 marks)

	marks
Unit 1: Introduction to Coelomates	5
Evolution of coelom and metamerism	
Unit 2: Annelida	10
General characteristics and Classification up to classes Excretion in Annelida	
Unit 3: Arthropoda	15
General characteristics and Classification up to classes Vision and Respiration in Arthropoda Metamorphosis in Insects Social life in bees and termites	
Unit 4: Onychophora	5
General characteristics and Evolutionary significance	
Unit 5: Mollusca	15
General characteristics and Classification up to classes Respiration in Mollusca Torsion and detorsion in Gastropoda Pearl formation in bivalves Evolutionary significance of trochophore larva	
Unit 6: Echinodermata	15
General characteristics and Classification up to classes Water-vascular system in Asteroidea Larval forms in Echinodermata Affinities with Chordates	
Unit 7: Minor Phyla	10
Distinguishing characters and examples of Nemertinea, Rotifera, Acanthocephala, Sipunculida and Phoronida.	

NON-CHORDATES II: COELOMATES

PRACTICAL (Credits 2 & 25 marks)

	marks
1. Study of following specimens: Annelids - Aphrodite, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria Arthropods - Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta, termites and honey bees Onychophora - Peripatus Molluscs - Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus Echinodermates - Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumaria and Antedon	9
2. Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm	4
3. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm	2
4. Mount of mouth parts and dissection of digestive system and nervous system of Periplaneta	5
5. To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm)	5

Note: Classification to be followed from —Ruppert and Barnes (2006) Invertebrate Zoology, 8th edition, Holt Saunders International Edition

SUGGESTED READINGS

- L.H. Hyman _The Invertebrates‘ Vol I, II and V. – M.C. Graw Hill Company Ltd.
- Kotpal, R.L. 1988 - 1992 Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata. Rastogi Publications, Meerut.
- E.L. Jordan and P.S. Verma _Invertebrate Zoology‘ S. Chand and Company.
- Parker, T.J. and Haswell _A text book of Zoology‘ by, W.A., Mac Millan Co. London.
- Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition
- Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
- Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson

CORE COURSE IV

ZOO-HC 2026:CELLBIOLOGY

Objectives:

- Cell Biology deals with the detailed study of a cell including cell structure, cell composition, cell organelles and the interaction of cells with other cells and the larger environment in which they exist.

Learning outcomes for Cell Biology

- The learner will understand the importance of cell as a structural and functional unit of life.
- The learner understands and compares between the prokaryotic and eukaryotic system and extrapolates the life to the aspect of development.
- The dynamism of bio membranes indicates the dynamism of life. Its working mechanism and precision are responsible for our performance in life.
- The cellular mechanisms and its functioning depends on endo-membranes and structures. They are best studied with microscopy.

THEORY (Credits 4 & 75 marks)

	marks
Unit 1: Overview of Cells	10
Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions	
Unit 2: Plasma Membrane	12
Various models of plasma membrane structure Transport across membranes: Active and Passive transport, Facilitated transport Cell junctions: Tight junctions, Desmosomes, Gap junctions	
Unit 3: Endomembrane System	12
Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes	
Unit 4: Mitochondria and Peroxisomes	12
Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis Peroxisomes	
Unit 5: Cytoskeleton	8
Structure and Functions: Microtubules, Microfilaments and Intermediate filaments	
Unit 6: Nucleus	10
Structure Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)	
Unit 7: Cell Division	6
Mitosis, Meiosis, Cell cycle and its regulation	
Unit 8: Cell Signaling	5
GPCR and Role of second messenger (cAMP)	

CELL BIOLOGY

PRACTICAL (Credits 2 & 25 marks)

	marks
1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis	6
2. Study of various stages of meiosis.	4
3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.	6
4. .Preparation of permanent slide to demonstrate:	9
i) DNA by Feulgen reaction	
ii) DNA and RNA by MGP	
iii) Mucopolysaccharides by PAS reaction	
iv) Proteins by Mercurbromophenol blue/Fast Green	

SUGGESTED READINGS

- Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.

GENERIC ELECTIVE COURSES

ZOO-HG1016:ANIMAL DIVERSITY

Objectives:

- To enable the students to develop an appreciation for the biodiversity of invertebrate and vertebrates.
- To impart knowledge about co-existence of different forms of living organisms ranging from unicellular to multicellular animals.
- To understand the terminology needed in classification.
- To classify invertebrates and to be able to understand the possible group of the invertebrate observed in nature to understand our role as a caretaker and promoter of life.

Learning outcomes:

- The student will be able to understand classify and identify the diversity of animals.
- The student understands the importance of classification of animals and classifies them effectively using the six levels of classification.
- The student knows his role in nature as a protector, preserver and promoter of life which he has achieved by learning, observing and understanding life.

THEORY (Credits 4 & 75 marks)	marks
Unit 1. Protista	5
General characters of Protozoa; Life cycle of Plasmodium	
Unit 2. Porifera	5
General characters and canal system in Porifera	
Unit 3. Radiata	5
General characters of Cnidarians and polymorphism	
Unit 4. Aceolomates	5
General characters of Platyhelminthes; Life cycle of Taenia solium	
Unit 5. Pseudocoelomates	5
General characters of Nemathehelminthes; Parasitic adaptations	
Unit 6. Coelomate Protostomes	5
General characters of Annelida ; Metamerism.	
Unit 7. Arthropoda	5
General characters. Social life in insects.	
Unit 8. Mollusca	5
General characters of mollusca; Pearl Formation	
Unit 9. Coelomate Deuterostomes	5
General characters of Echinodermata, Water Vascular system in Starfish.	
Unit 10. Protochordata	5
Salient features	

Unit 11. Pisces	5
Osmoregulation, Migration of Fishes	
Unit 12. Amphibia	5
General characters, Adaptations for terrestrial life, Parental care in Amphibia.	
Unit 13. Amniotes;	5
Origin of reptiles. Terrestrial adaptations in reptiles.	
Unit 14. Aves:	5
The origin of birds; Flight adaptations	
Unit 15. Mammalia	5
Early evolution of mammals; Primates; Dentition in mammals.	

ANIMAL DIVERSITY

PRACTICAL (Credits 2 & 25 marks)

- Study of following specimens:

Non Chordates: Euglena, Noctiluca, Paramecium, Sycon, , Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus, , Hermitcrab, Daphnia, Millipede, Centipede, Beetle, Chiton, Dentalium, Octopus, Asterias, and Antedon.

Chordates: Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Ichthyophis/Uraeotyphlus, Salamander, Rhacophorus Draco, Uromastix, Naja, Viper, model of Archaeopteryx, any three common birds-(Crow, duck, Owl), Squirrel and Bat.

9
- Study of following Permanent Slides: Cross section of Sycon, Sea anemone and Ascaris(male and female). T. S. of Earthworm passing through pharynx, gizzard, and typhlosolar intestine. Bipinnaria and Pluteus larva.

4
- Temporary mounts of Septal & pharyngeal nephridia of earthworm. Unstained mounts of Placoid, cycloid and ctenoid scales.

4
- Dissections of Digestive and nervous system of Cockroach. Urinogenital system of Rat

8

SUGGESTED BOOKS

- Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA.
- Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole
- Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.
- Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi.
- Raven, P. H. and Johnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill Publications. New Delhi.

ZOO-HG 2016: ANIMAL CELL BIOTECHNOLOGY

Learning objectives

- Identification and characterization of animal breeds,
- Developing DNA - based diagnostics and genetically engineered vaccines for animals,
- Studying animal genomics and its varied applications
- Developing embryo - transfer technology, cloning, transgenic animals
- DNA forensics, molecular diagnostics, cloning, stem cell research and bio - processing technologies are other important areas of animal biotechnology.

Learning outcomes:

- Be able to describe the structure of animal genes and genomes.
- Be able to describe basic principles and techniques in genetic manipulation and genetic engineering.
- Be able to describe gene transfer technologies for animals and animal cell lines.
- Be able to describe techniques and problems both technical and ethical in animal cloning.
- Be able to describe the contribution 'functional genomics' is making and is likely to make in animal biotechnology now and in the future.

THEORY (Credits 4 & 25 marks)

	marks
UNIT 1: Introduction	5
Concept and Scope of Biotechnology	
UNIT2:Techniques in Gene manipulation	20
Outline process of genetic engineering and recombinant DNA technology, Isolation of genes, Concept of restriction and modification: Restriction endonucleases, DNA modifying enzymes Cloning Vectors: Plasmids, Phage vectors, Cosmids, Phagemids, BAC, YAC, HAC. Shuttle and Expression Vectors. Construction of Genomic libraries and cDNA libraries Transformation techniques: microbial, plants and animals: Cloning in mammalian cells, Integration of DNA into mammalian genome- Electroporation and Calcium Phosphate Precipitation method.	
UNIT 3: Animal cell Culture	15
Basic techniques in animal cell culture and organ culture, Primary Culture and Cell lines, Culture media- Natural and Synthetic, Stem cells, Cryopreservation of cultures. Agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, DNA sequencing: Sanger method, Polymerase chain reaction, DNA Fingerprinting and DNA microarrays.	
UNIT 4: Fermentation	10
Different types of Fermentation: Submerged & Solid state; batch, Fed batch &Continuous; Stirred tank, Air Lift, Fixed Bed and Fluidized. Downstream Processing: Filtration, centrifugation, extraction, chromatography, spray drying and lyophilization.	
UNIT 5: Transgenic Animal Technology	10
Production of transgenic animals: nuclear transplantation, Retroviral method, DNA microinjection method, Dolly and Polly.	

UNIT 6: Application in Health

10

Development of recombinant Vaccines, Hybridoma technology, Gene Therapy. Production of recombinant Proteins: Insulin and growth hormones.

UNIT 7: Bio safety

5

Physical and Biological containment.

ANIMAL CELL BIOTECHNOLOGY

PRACTICAL (Credits 2 & 25 marks)

	marks
1. Packing and sterilization of glass and plastic wares for cell culture.	3
2. Preparation of culture media.	3
3. Preparation of genomic DNA from E. coli/animals/ human.	3
4. Plasmid DNA isolation (pUC 18/19) and DNA quantitation using agarose gel electrophoresis (by using lambda DNA as standard).	5
5. Restriction digestion of lambda (λ) DNA using EcoR1 and Hind III.	3
6. Preparation of competent cells and Transformation of E. coli with plasmid DNA using CaCl ₂ , Selection of transformants on X-gal and IPTG (Optional).	5
7. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting, PCR, DNA Microarrays	3

SUGGESTED READINGS

- Animal Cells Culture and Media, D.C. Darling and S.J. Morgan, 1994. BIOS Scientific Publishers Limited.
- Methods in Cell Biology, Volume 57, Jennie P. Mathur and David Barnes, 1998. Animal Cell Culture Methods Academic Press.
- P.K. Gupta: Biotechnology and Genomics, Rastogi publishers (2003).
- B.D. Singh: Biotechnology, Kalyani publishers, 1998 (Reprint 2001).
- T.A. Brown: Gene cloning and DNA analysis: An Introduction, Blackwell Science (2001).
- Bernard R. Click & Jack J. Pasternak: Molecular Biotechnology, ASM Press, Washington (1998).
- Methods in Gene Biotechnology, W. Wu, M.J. Welsh, P.B. Kaufman & H.H. Zhang, 1997, CRC Press, New York
- Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA

CORE COURSE V

ZOO-HC 3016: DIVERSITY OF CHORDATA

Learning objectives:

- To understand what the chordates are.
- To make students to identify the diversification of species of chordate world.
- To understand the level of organization in chordate subphylum with evolutionary relationship among them.
- to make the students understand the basic characters, advancements and adaptations of different types of vertebrates.
- To understand different behaviours and adaptations in higher vertebrates
- To understand affinities among different groups of higher vertebrates.

Learning outcomes

- On completion of the course the student should be able to identify and classify the Chordates
- Student should be able to describe unique characters of protochordates and other vertebrates.
- To understand the diversity and ecological role of different groups of chordates.
- Student should be able to recognize life functions of chordates.
- Understand the physiological and anatomical peculiarities through type study and also the ecological role of different groups of chordates.

THEORY (Credits 4 & 75 marks)

Unit 1: Introduction to Chordates

3

General characteristics and outline classification

Unit 2: Protochordata

8

General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata

Unit 3: Origin of Chordata

5

Dipleurula concept and the Echinoderm theory of origin of chordates. Advanced features of vertebrates over Protochordata

Unit 4: Agnatha

3

General characteristics and classification of cyclostomes upto classes.

Unit 5: Pisces

8

General characteristics of Chondrichthyes and Osteichthyes, classification up to order. Migration, Osmoregulation and Parental care in fishes

Unit 6: Amphibia	6
Origin of Tetrapoda (Evolution of terrestrial ectotherms); General characteristics and classification up to order; Parental care in Amphibians	
Unit 7: Reptilia	8
General characteristics and classification up to order; Affinities of <i>Sphenodon</i> ; Poison apparatus and Biting mechanism in snakes	
Unit 8: Aves	12
General characteristics and classification up to order. <i>Archaeopteryx</i> -- a connecting link; Principles and aerodynamics of flight, Flight adaptations and Migration in birds	
Unit 9: Mammals	10
General characters and classification up to order; Affinities of Prototheria; Adaptive radiation with reference to locomotory appendages	
Unit 10: Zoogeography	12
Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, distribution of vertebrates in different realms.	

DIVERSITY OF CHORDATA

PRACTICALS (Credits 2 & 25 marks)

1. **Protochordata:** *Balanoglossus*, *Herdmania*, *Branchiostoma*, Colonial Urochordata. Sections of *Balanoglossus* through proboscis and branchiogenital regions, Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions, Permanent slide of *Herdmania* spicules found in the test. 5
2. **Agnatha:** *Petromyzon*, *Myxine* 2
3. **Fishes:** *Scoliodon*, *Sphyrna*, *Pristis*, *Torpedo*, *Chimaera*, *Mystus*, *Heteropneustes*, *Labeo*, *Exocoetus*, *Echeneis*, *Anguilla*, *Hippocampus*, *Tetrodon/ Diodon*, *Anabas*, 2
4. **Amphibia:** *Ichthyophis/Ureotyphlus*, *Necturus*, *Bufo*, *Hyla*, *Alytes*, *Salamandra*. 2
5. **Reptilia:** *Chelone*, *Trionyx*, *Hemidactylus*, *Varanus*, *Uromastix*, *Chamaeleon*, *Ophiosaurus*, *Draco*, *Bungarus*, *Vipera*, *Naja*, *Hydrophis*, *Zamenis*, *Crocodylus*, Key for Identification of poisonous and non-poisonous snakes 4
6. **Aves:** Study of six common birds from different orders. Types of beaks and claws 4
7. **Mammalia:** *Sorex*, *Bat* (Insectivorous and Frugivorous), *Funambulus*, *Slow Loris*, Duck-billed platypus, *Echidna*.
Mount of weberian ossicles of *Mystus* / *Carp*, pecten from Fowl head Dissection of Fowl head (Dissections and mounts subject to permission) 6

Power point presentation on study of any two animals from two different classes by students (may be included if dissections not given permission)

Demonstration of dissection of fowl head with the help of flow charts, slides or videos.

Classification from Young, J. Z. (2004) to be followed

SUGGESTED READINGS

- Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
- Pough H. Vertebrate life, VIII Edition, Pearson International.
- Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub Co.
- Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.

CORE COURSE VI

ZOO-HC 3026

ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

Learning Objective:

- To enable the students, know about all the physiological processes controlling the human body.
- To make the students understand the functions of hormones and their mechanism of action.
- To explain the role of nerve cells (neuron) in the transmission of nerve impulses.
- To analyze the role of some of the endocrine glands in regulating our growth and behaviour.

Learning Outcome:

- On completion of the course the student should be able to know mechanism of body functions and the basic knowledge of chemistry of biomolecules.
- Students can enlist various sensory receptors in human body and describe the structure and functioning of the sense organs—eye, ear, nose, tongue and skin.
- Students can identify properties of hormones and mention their nature and manner of functioning.
- state the effects of over functioning (hyperactivity) and hypoactivity (under functioning) of pituitary and thyroid.

THEORY (Credits 4 & 75 marks)

Unit 1: Tissues

8

Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue

Unit 2: Bone and Cartilage

8

Structure and types of bones and cartilages, Ossification, bone growth and resorption.

Unit 3: Nervous System

15

Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and Neuromuscular junction; Reflex action and its types - reflex arc; Physiology of hearing and vision.

Unit 4: Muscle

12

Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus.

Unit 5: Reproductive System

12

Histology of testis and ovary; Physiology of male and female reproduction; Puberty, Methods of contraception in male and female

Unit 6: Endocrine System

20

Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them and their mechanism of action; Classification of hormones; Regulation of their secretion; steroidal and non-steroidal hormones; Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system; Placental hormones

ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS

PRACTICALS (Credits 2 & 25 marks)

1. Recording of simple muscle twitch with electrical stimulation (or Virtual) 5
2. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex) 4
3. Study of permanent slides of Mammalian skin, Squamous epithelium, Striated muscle fibres and nerve cells, Cartilage, Bone, Spinal cord, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid 8
4. Microtomy: Preparation of permanent slide of any five vertebrate tissues 8

(*Subject to UGC guidelines)

SUGGESTED BOOKS

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hecourt Asia PTE Ltd. /W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons
- Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.

CORE COURSE VII

ZOO-HC 3036

FUNDAMENTALS OF BIOCHEMISTRY

Learning objectives:

- Ability to understand basic principles of chemistry to biological systems and molecular biology.
- To acquaint the students with the structure, chemical properties and biological significance of macromolecules of physiological importance.

Learning outcomes:

- Understand the principles of various fields of chemistry and biology (organic chemistry, analytical chemistry, biochemistry, genetics, metabolism, and molecular biology).
- Apply modern instrumentation theory and practice to biochemical problems.
- On completion of the course the student should be able to know mechanism of body functions and the basic knowledge of chemistry of biomolecule.

THEORY (Credits 4 & 75 marks)

Unit 1: Carbohydrates

10

Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates

Unit 2: Lipids

10

Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Triacylglycerols, Phospholipids, Glycolipids, Steroids

Unit 3: Proteins

20

Amino acids: Structure, Classification and General properties of α -amino acids; Physiological importance of essential and non-essential α -amino acids

Proteins: Bonds stabilizing protein structure; Levels of organization in proteins; Denaturation; Introduction to simple and conjugate proteins

Immunoglobulins: Basic Structure, Classes and Function, Antigenic Determinants.

Unit 4: Nucleic Acids

15

Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids Cot Curves: Base pairing, Denaturation and Renaturation of DNA Types of DNA and RNA, Complementarity of DNA, Hypochromicity of DNA denaturation.

Unit 5: Enzymes

20

Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of K_m and V_{max} , Lineweaver-Burk plot; Multi-substrate reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action.

FUNDAMENTALS OF BIOCHEMISTRY

PRACTICAL (Credits 2 & 25 marks)

- | | |
|----------------------------------------------------------------------------------|---|
| 1. Qualitative tests of functional groups in carbohydrates, proteins and lipids. | 8 |
| 2. Paper chromatography of amino acids. | 5 |
| 3. Action of salivary amylase under optimum conditions. | 4 |
| 4. Effect of pH, temperature and inhibitors on the action of salivary amylase. | 4 |
| 5. Demonstration of proteins separation by SDS-PAGE. | 4 |

SUGGESTED READING

- Cox, M.M and Nelson, D.L. (2008). *Lehninger's Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.
- Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). *Harper's Illustrated Biochemistry*, XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.
- Hames, B.D. and Hooper, N.M. (2000). *Instant Notes in Biochemistry*, II• Edition, BIOS Scientific Publishers Ltd., U.K.
- Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2008). *Molecular Biology of the Gene*, VI Edition, Cold Spring Harbor Lab. Press, Pearson Pub.

CORE COURSE VIII

ZOO-HC 4016

COMPARATIVE ANATOMY OF VERTEBRATES

Learning Objectives:

- Study relationships between the structural and functional anatomy of the different vertebrate groups and their environment are examined.
- The comparative study of the body structures of different species of animals in order to understand the adaptive changes they have undergone in the course of evolution from common ancestors.
- To understand the compare of homologous structures of different species specially forelimbs.

Learning Outcomes:

- On completion of the course the student should be able to know the general plan and functioning of different components of the systems in the body.
- The students should be able to understand the characteristics of vertebrates and what makes both chordates and vertebrates unique among animals.
- They can also understand of the evolutionary history of vertebrates and the evolutionary relationships among different groups of vertebrates.
- It also assists in classifying the organisms based on similar characteristics of their anatomical structures.
- Homologies of the forelimb among vertebrates give the evidence for evolution.

THEORY (Credits 4 & 75 marks)

Unit 1: Integumentary System	7
Structure, functions and derivatives of integument	
Unit 2: Skeletal System	10
Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches	
Unit 3: Digestive System	10
Alimentary canal and associated glands, dentition	
Unit 4: Respiratory System	10
Skin, gills, lungs and air sacs; Accessory respiratory organs	

Unit 5: Circulatory System	10
General plan of circulation, evolution of heart and aortic arches	
Unit 6: Urinogenital System	10
Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri	
Unit 7: Nervous System	10
Comparative account of brain	
Autonomic nervous system, Spinal cord, Cranial nerves in mammals.	
Unit 8: Sense Organs	8
Classification of receptors Brief account of visual and auditory receptors in man.	

COMPARATIVE ANATOMY OF VERTEBRATES

PRACTICAL (Credits 2 & 25 marks)

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------|---|
| 1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs | 2 |
| 2. Disarticulated skeleton of Frog, Varanus, Fowl, Rabbit | 4 |
| 3. Carapace and plastron of turtle /tortoise | 2 |
| 4. Mammalian skulls: One herbivorous and one carnivorous animal | 4 |
| 5. Dissection of rat to study arterial and urinogenital system(subject to permission) | 4 |
| 6. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted) | 4 |
| 7. Project on skeletal modifications in vertebrates (may be included if dissection not permitted) | 5 |

SUGGESTED READINGS

- Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education
- Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies
- Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons
- Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House

CORE COURSE IX

ZOO-HC 4026

ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

Learning Objective:

- The study of animal physiology is closely linked with anatomy, physical and chemical laws that constrain living as well as nonliving systems.
- To understand the proper animal physiology and evaluating underlying biological processes, behavioural states and animal response to different biological, and environmental stimuli.
- It will provide a thorough understanding of normal body function, enabling more effective treatment of abnormal or disease states.

Learning Outcome:

- On completion of the course the student should be able to know mechanism of body functions and the basic knowledge of chemistry of biomolecules.
- This course provides the study of life sustaining in mammals, principally human.
- It investigates the biological processes that occur for animal life to exist. These processes can be studied at various levels of organization from membranes through to organelles, cells, organs, organ systems, and to the whole animal.

THEORY (Credits 4 & 75 marks)

Unit 1: Physiology of Digestion

16

Structure and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Hormonal control of secretion of enzymes in Gastrointestinal tract.

Unit 2: Physiology of Respiration

16

Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Respiratory pigments, Dissociation curves and the factors influencing it; Carbon monoxide poisoning; Control of respiration

Unit 3: Renal Physiology

10

Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance.

Unit 4: Blood

15

Components of blood and their functions; Structure and functions of haemoglobin Haemostasis: Blood clotting system, Kallikrein-Kininogen system, Complement system & Fibrinolytic system, Haemopoiesis Blood groups: Rh factor, ABO and MN.

Unit 5: Physiology of Heart

18

Structure of mammalian heart; Coronary circulation; Structure and working of conducting myocardial fibers. Origin and conduction of cardiac impulses Cardiac cycle; Cardiac output and its regulation, Frank-Starling Law of the heart, nervous and chemical regulation of heart rate. Electrocardiogram, Blood pressure and its regulation.

ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

PRACTICALS (Credits 2 & 25 marks)

1. Determination of ABO Blood group	2
2. Enumeration of red blood cells and white blood cells using haemocytometer	4
3. Estimation of haemoglobin using Sahli's haemoglobinometer	4
4. Preparation of haemin and haemochromogen crystals	4
5. Recording of frog's heart beat under in situ and perfused conditions	4
6. Recording of blood pressure using a sphygmomanometer	4
7. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney	3

(*Subject to UGC guidelines)

SUGGESTED READINGS

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Harcourt Asia PTE Ltd. W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons,
- Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.
- Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills

CORE COURSE X

ZOO-HC 4036

BIOCHEMISTRY OF METABOLIC PROCESSES

Learning Objective:

- To describe, in quantitative terms, the chemical changes catalyzed by the component enzymes of the route in mammalian body.
- To describe the various intracellular controls that govern the rate at which the pathway functions.
- To understand the various biomolecules in body and the functions of biomolecules in body secretion.
- To understand the structural chemistry of proteins, carbohydrates, fats.

Learning Outcome:

- The student should be able to understand intricacies of Biochemistry and Its role in metabolic processes.
- Students are able to understand the physiology at cellular and system levels.
- Students are able to describe the role and functions of different biomolecules.
- Biochemical studies have yielded such benefits as treatments for many metabolic diseases, antibiotics to combat bacteria and methods to boost industrial and agricultural productivity.
- Students are able to understand how mammalian body get nutrition from different biomolecule.

THEORY (Credits 4 & 75 marks)

Unit 1: Overview of Metabolism **18**

Catabolism vs Anabolism, Stages of catabolism, Compartmentalization of metabolic pathways, Shuttle systems and membrane transporters; ATP as "Energy Currency of cell"; coupled reactions; Use of reducing equivalents and cofactors; Intermediary metabolism and regulatory mechanisms

Unit 2: Carbohydrate Metabolism **15**

Sequence of reactions and regulation of glycolysis, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis

Unit 3: Lipid Metabolism **14**

β -oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis.

Unit 4: Protein Metabolism **14**

Catabolism of amino acids: Transamination, Deamination, Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids

Unit 5: Oxidative Phosphorylation **14**

Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System

BIOCHEMISTRY OF METABOLIC PROCESS

PRACTICALS (Credits 2 & 25 marks)

1. Estimation of total protein in given solutions by Lowry's method. 5
2. Detection of serum glutamic-oxaloacetic transaminase (SGOT) and Serum Glutamic Pyruvic Transaminase (SGPT) or Glucose screening tests (GST) and Glutathione (GSH) in serum/ tissue 5
3. To study the enzymatic activity of Trypsin and Lipase. 5
4. Study of biological oxidation (SDH) [any mammal] 5
5. To perform the Acid and Alkaline phosphatase assay from serum / tissue. 5

SUGGESTED READINGS

- Cox, M.M and Nelson, D.L. (2008). Lehninger Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York.
- Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw-Hill Companies Inc.
- Jain, J. L., Sunjay Jain, and Jain Nitin (2016) Fundamentals of biochemistry, S. Chand and Company limited, New Delhi.
- Hames, B.D. and Hooper, N.M. (2000). Instant Notes in Biochemistry, II Edition, BIOS Scientific Publishers Ltd., U.K.

ZOO-HG 3016
HUMAN PHYSIOLOGY

Learning objectives:

- The primary objective of the human Physiology course is to ensure that students understand how the body works.
- State the functions of each organ system of the body.
- Explain the mechanisms by which each function relates the anatomy and histology of each organ system.

Learning outcomes:

- At the end of the course students should have an enhanced knowledge and appreciation of mammalian physiology.
- understand the functions of important physiological systems including the cardio-respiratory, renal, reproductive and metabolic systems.
- understand how these separate systems interact to yield integrated physiological responses to challenges such as exercise, fasting and ascent to high altitude & how they can sometimes fail.

THEORY (Credits 4 & 75 marks)

Unit 1: Digestion and Absorption of Food **12**

Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins; Nervous and hormonal control of digestion (*in brief*)

Unit 2: Functioning of Excitable Tissue (Nerve and Muscle) **13**

Structure of neuron, Propagation of nerve impulse (myelinated and non-myelinated nerve fibre); Structure of skeletal muscle, Mechanism of muscle contraction (Sliding filament theory), Neuromuscular junction

Unit 3: Respiratory Physiology **10**

Ventilation, External and internal Respiration, Transport of oxygen and carbon dioxide in blood, Factors affecting transport of gases.

Unit 4: Renal Physiology **10**

Functional anatomy of kidney, Mechanism and regulation of urine formation,

Unit 5: Cardiovascular Physiology **10**

Structure of heart, Coordination of heartbeat, Cardiac cycle, ECG

Unit 6: Endocrine and Reproductive Physiology **20**

Structure and function of endocrine glands (pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, and testes), Brief account of spermatogenesis and oogenesis, Menstrual cycle.

HUMAN PHYSIOLOGY

PRACTICAL (Credits 2 & 25 marks)

- | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 1. Preparation of temporary mounts: Neurons and Blood film. | 5 |
| 2. Preparation of haemin and haemochromogen crystals. | 5 |
| 3. Estimation of haemoglobin using Sahli's haemoglobinometer. | 5 |
| 4. Examination of permanent histological sections of mammalian oesophagus, stomach, duodenum, rectum, lung, kidney, thyroid, pancreas, adrenal, testis, ovary. | 10 |

SUGGESTED READINGS

- Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*, XII Edition, John Wiley and Sons, Inc.
- Widmaier, E.P., Raff, H. and Strang, K.T. (2008). *Vander's Human Physiology*, XI Edition, McGraw Hill. □
- Guyton, A.C. and Hall, J.E. (2011). *Textbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company. □
- Marieb, E. (1998). *Human Anatomy and Physiology*, IV Edition, Addison-Wesley.
- Kesar, S. and Vashisht, N. (2007). *Experimental Physiology*, Heritage Publishers.
- Prakash, G. (2012). *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Company Ltd.

ZOO-HG 3026
AQUATIC BIOLOGY

Learning objectives:

- To understand aquatic biomass, lake as an Ecosystem.
- Students can identify relation among physico–chemical characteristics as well as nutrient cycles in lakes.
- To make the students understand marine life.
- To understand causes of pollution in aquatic resources.

Learning outcomes:

- knowledge of ecological, organism, cellular and molecular diversity of marine beings.
- carry out physio-chemical analysis of freshwater and are able to monitor water quality.
- are able to apply techniques for the environmental recovery of aquatic ecosystems.
- To understand causes of pollution from different angles of environment and quality of water.

THEORY (Credits 4 & 75 marks)

UNIT 1: Aquatic Biomes **18**

Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.

UNIT 2: Freshwater Biology Lakes: **25**

Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico–chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes-Nitrogen, Sulphur and Phosphorous. Streams: Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes.

UNIT 3: Marine Biology **14**

Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.

UNIT 4: Management of Aquatic Resources **18**

Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment- BOD and COD.

AQUATIC BIOLOGY

PRACTICAL (Credits 2 & 25 marks)

1. Determine the area of a lake using graphimetric and gravimetric method. 4
2. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem. 4
3. Determine the amount of Turbidity/transparency, Dissolved Oxygen, Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake/ water body. 8
4. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance. 4
5. A Project Report on a visit to a Sewage treatment plant/Marine bioreserve/Fisheries Institutes. 5

SUGGESTED READINGS

- Anathakrishnan : Bioresources Ecology 3rd Edition
- Goldman : Limnology, 2nd Edition
- Odum and Barrett : Fundamentals of Ecology, 5th Edition
- Pawlowski: Physicochemical Methods for Water and Wastewater Treatment, 1st Edition
- Wetzel : Limnology, 3rd edition
- Trivedi and Goyal : Chemical and biological methods for water pollution studies
- Welch : Limnology Vols. I-II

ZOO-HG 4016

ENVIRONMENT AND PUBLIC HEALTH

Learning objectives:

- Promote healthier environments to improve health.
- focuses on reducing people's exposure to harmful pollutants in air, water, soil, food, and materials in homes and workplaces.
- Environmental pollutants can cause health problems like respiratory diseases, heart disease, and some types of cancer.
- to develop waste management to the environment and its associated problems which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively towards solutions of current problems.

Learning outcomes:

- After studying this course, students should be able to define and use or recognize definitions and applications of each of the terms in disaster management.
- Students create an idea about the causes and effects of green house.
- Students have an idea about the control of pollution.

THEORY (Credits 4 & 75 marks)

UNIT 1: Introduction

18

Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment, dose Response Evaluation, exposure Assessment.

UNIT 2: Climate Change

12

Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health

Unit 3: Pollution

10

Air, water, noise pollution sources and effects, Pollution control

Unit 4: Waste Management Technologies

25

Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants, Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath.

Unit 5: Diseases

10

Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid.

ENVIRONMENT AND PUBLIC HEALTH

PRACTICAL (Credits 2 & 25 marks)

1. To determine the pH of the given soil and water samples from different locations. 6
2. To determine the Free Cl of the given soil and water sample from different locations. 6
3. To determine the Free SO₄ of the given soil and water sample from different locations. 6
4. To determine the Free NO₃ of the given soil and water sample from different locations. 7

SUGGESTED BOOKS

- Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
- Kolluru Rao, Bartell Steven, Pitblado R and Stricoff “Risk Assessment and Management Handbook”, McGraw Hill Inc., New York, 1996.
- Kofi Asante Duah “Risk Assessment in Environmental management”, John Wiley and sons, Singapore, 1998.
- Kasperson, J.X. and Kasperson, R.E. and Kasperson, R.E., Global Environmental Risks, V.N. University Press, New York, 2003.
- Joseph F Louvar and B Diane Louver Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey 1997.

ZOO-HG 4026

FOOD, NUTRITION AND HEALTH

Learning Objective:

- To know the basic concepts of food, nutrients and its impact on health.
- Students will be able to interpret and apply nutrition concepts to evaluate and improve the nutritional health of communities.
- Students will be able to identify and apply food principles to food and nutrition systems
- Students will be able to integrate knowledge and skills in food and nutrition with professional issues affecting the nutrition and/or dietetics fields.
- To understand food and water borne infections, food spoilage and their preventive measures.

Learning Outcome:

- On completion of the course the student should be able to know the concept of balanced diet, special nutritional requirements in various age groups and the diet related disorders in humans.
- Apply biological, biochemical and physiologic scientific principles to nutrition practice.
- Summarize health promotion and disease prevention theories and guidelines and explain the role of food in promotion of a healthy lifestyle.

THEORY (Credits 4 & 75 marks)

Unit 1: Basic concept of food and nutrition

15

Food Components and food-nutrients Concept of a balanced diet, nutrient needs and dietary pattern for various groups adults, pregnant and nursing mothers, infants, school children, adolescents and elderly

Unit 2: Nutritional Biochemistry:

20

Carbohydrates, Lipids, Proteins- Definition, Classification, their dietary source and role Vitamins- Fat-soluble and Water-soluble vitamins- their dietary source and importance Minerals- Iron, calcium, phosphorus, iodine, selenium and zinc: their biological functions

Unit 3: Health

20

Introduction to health- Definition and concept of health Major nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkor and marasmus), Vitamin A deficiency disorders, Iron deficiency disorders, Iodine deficiency disorders- their causes, symptoms, treatment, prevention and government programmes, if any.

Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary and lifestyle modifications Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome (AIDS) - their causes, treatment and prevention Common ailments- cold, cough, and fevers, their causes and treatment

Unit 4: Food hygiene:

20

Potable water- sources and methods of purification at domestic level Food and Water borne infections: Bacterial infection: Cholera, typhoid fever, dysentery; Viral infection: Hepatitis, Poliomyelitis, Protozoan infection: amoebiasis, giardiasis; Parasitic infection: taeniasis and ascariasis their transmission, causative agent, sources of infection, symptoms and prevention Brief account of food spoilage: Causes of food spoilage and their preventive measures

FOOD, NUTRITION AND HEALTH

PRACTICAL (Credits 2 & 25 marks)

1. To detect adulteration in (a) Ghee (b) Sugars (c) Tea leaves and (d) Turmeric 3
2. Estimation of Lactose in milk 3
3. Ascorbic acid estimation in food by titrimetry 3
4. Estimation of Calcium in foods by titrimetry 3
5. Study of the stored grain pests from slides / photograph (*Sitophilus oryzae*, *Trogoderma granarium*, *Callosobruchus chinensis* and *Tribolium castaneum*): their identification, habitat and food sources, damage caused and control. Preparation of temporary mounts of the above stored grain pests. 8
6. Project- Undertake computer aided diet analysis and nutrition counseling for different age groups. 5

OR

Identify nutrient rich sources of foods (fruits and vegetables), their seasonal availability and price

OR

Study of nutrition labeling on selected foods

SUGGESTED BOOKS

- Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2007; New Age International Publishers
- Srilakshmi B. Nutrition Science; 2002; New Age International (P) Ltd.
- Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International (P) Ltd.
- Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO.
- Bamji MS, Rao NP, and Reddy V. Text Book of Human Nutrition; 2009; Oxford & IBH Publishing Co. Pvt Ltd.
- Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill.
- Lakra P, Singh MD. Textbook of Nutrition and Health; First Ed; 2008; Academic Excellence.
- Manay MS, Shadaksharaswamy. Food-Facts and Principles; 1998; New Age International (P) Ltd.
- Gibney et al. Public Health Nutrition; 2004; Blackwell Publishing

**SKILL ENHANCEMENT COURSES
ZOO-SE 3014**

APICULTURE

Learning Objectives:

- To understand the knowledge of biology of bees and bee culture.
- To improve the standard of beekeeping amongst amateur beekeepers.
- To understand the disease found in bees and preventive measures.
- Give the knowledge of Bee Keeping, Modern Methods in employing artificial

Learning outcome:

- After completing this programme, students will be able to Understand bee biology and behaviour, types of bees and Life cycle.
- Have an idea of beekeeping systems and beekeeping equipments, installation of hives tools.
- Bees plays an important in pollination of many flowering plants.
- Honey produced by apiculture which is a delicious and highly nutritious food.

THEORY (Credits 4 & 100 marks)

Unit 1: Biology of Bees	20
History, Classification, Types of Honey Bees, morphological structure, Social Organization of Bee Colony, caste system and Biology of Honey Bees.	
Unit 2: Rearing of Bees	20
Bee rearing (Indigenous and Modern) Methods, Beehives – Newton and Langstroth Bee Pasturage, Selection of Bee Species for Apiculture, Bee Keeping Equipments, Methods of Extraction of Honey (Indigenous and Modern).	
Unit 3: Diseases and Enemies	12
Bee Diseases and Enemies Control and Preventive measures.	
Unit 4: Bee Economy	12
Products of Apiculture Industry, Economic importance of Honey, Bee wax, Propolis, Pollen etc.	
Unit 5: Entrepreneurship in Apiculture	16
Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens	
Unit 6: Visit to a Apiculture industry / Bee rearing site and Submission of Project report.	20

SUGGESTED READINGS

- Prost, P. J. (1962). *Apiculture*. Oxford and IBH, New Delhi.
- Bisht D.S., *Apiculture*, ICAR Publication.
- Singh S., *Beekeeping in India*, Indian council of Agricultural Research, NewDelhi.

**ZOO-SE 3024
AQUARIUM FISH KEEPING**

Learning objective:

- To know the technique of rearing /maintaining fishes in an aquarium.
- To understand socio-economy and diversity of fishes and to analyze the impact of the aquarium fish trade on social and natural.
- Have an idea of aquarium fishes, their types, sexes, etc.
- Knowledge of preparation and composition of formulated fish feeds.

Learning outcome:

- On completion of the course the students should be able to Identify fresh water and marine ornamental fishes both indigenous and exotic.
- The students should be able to know the biology of aquarium fishes, their nutritional requirements and care.
- Can identify the equipment and requirements for setting up an aquarium.
- Maintaining good water quality is the single most important thing that an aquarium owner can do to ensure the health of their fish.
- Fishes are known to attract financial benefits and wealth.

THEORY (Credits 4 & 100 marks)

Unit1: Introduction to Aquarium Fish Keeping	12
The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes.	
Unit 2: Biology of Aquarium Fishes	25
Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish, Butterfly fish Shark and Tiger shark. Aquarium fishes of Manipur.	
Unit 3: Food and feeding of Aquarium fishes	15
Use of live fish feed organisms. Preparation and composition of formulated fish feeds, Different types of fish feeds.	
Unit 4: Fish Transportation	14
Live fish transport - Fish handling, packing and forwarding techniques.	
Unit 5: Maintenance of Aquarium	14
General Aquarium maintenance, budget for setting up an Aquarium Fish Farm as a Cottage Industry.	
Unit 6: Visit to a Aquarium cottage industry and Submission of Project report.	20

SUGGESTED READINGS:

- Encyclopedia of Aquarium and Pond Fish, 1 October 2019 by David Alderton
- The Complete Aquarium Guide, 3 November 2005 by Thierry Maite-Allain
- Eyewitness Handbook: Aquarium Fish, Flexibound – Import, 7 October 1993
by Dick Mills
- Aquarium Fish: A Definitive Guide to Identifying and Keeping Freshwater and Marine
Fishes Paperback – Illustrated, 1 May 2020
- by Gina Sandford

**ZOO-SE 4014
SERICULTURE**

Learning objectives:

- It also involves giving students a thorough knowledge about the cultivation of mulberry, maintenance of the farm, seed technology, silkworm rearing and silk reeling.
- Train the students in identifying the diseases and pests of the mulberry plant.
- Students get to learn about the quality of various things like leaf, seed cocoon, commercial cocoon and fibre so that they can get maximum return when actually practiced.
- This course gives us employment and job opportunities in the public, private and government sector.

Learning outcomes:

- After completion of the course the students will be able to understand: Morphology of silkworm and its anatomical features like silk gland and secretion of silk.
- Scientific way of silkworm rearing technology of young and late age silkworm for raising assured cocoon crops.
- Must have an idea of characteristics of microbial organisms that causes diseases to silkworm. Control and prevention of pests and diseases.

THEORY (Credits 4 & 100 marks)

Unit 1: Introduction	15
Sericulture: Definition, history and present status; Silk route Types of silkworms, Distribution and Races - Exotic and indigenous races, Mulberry and non-mulberry Sericulture	
Unit 2: Biology of Silkworm	12
Life cycle of Mulberry and Tasar Silkworm, Structure of silk gland and secretion of silk	
Unit 3: Rearing of Silkworms	20
Selection of mulberry variety and establishment of mulberry garden, Rearing house and rearing appliances Disinfectants: Formalin, bleaching powder, Resham Keet Oushadh (RKO), Silkworm rearing technology: Early age and Late age rearing, Description of types of mountages, Spinning, harvesting and storage of cocoons. Post cocoon processing – Stifling and reeling.	

Unit 4: Pests and Diseases **18**

Pests of silkworm: Uzi fly, dermestid beetles and vertebrates

Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial

Control and prevention of pests and diseases

Unit 5: Entrepreneurship in Sericulture **15**

Prospects of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture. Economic importance of silk.

Unit 6: Visit to various sericulture centres and Submission of Project report. **20**

SUGGESTED READINGS

- Manual on Sericulture; Food and Agriculture Organisation, Rome 1976
- Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
- Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn. & Pub. Govt. Press, Bangalore
- Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.
- Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan 1972.
- Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.
- Silkworm Rearing; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome 1988.
- A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989.
- Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986.

**ZOO-SE 4024
MEDICAL DIAGNOSTICS**

Learning objectives:

- Diagnosis is the process of finding out if a patient has a specific disease.
- Students will be able to understand that diagnostic tests are essential at every step.
- It is necessary both for non-infectious diseases and infectious diseases.

Learning outcomes:

- After completion of the course the students know different types of blood tests.
- Have idea about different types of non-infectious diseases and infectious diseases with their causes.
- Also where medical imaging is necessary.

THEORY (Credits 4 & 100 marks)

Unit 1: Introduction to Medical Diagnostics and its Importance	8
Unit 2: Diagnostics Methods Used for Analysis of Blood	20
Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.)	
Unit 3: Diagnostic Methods Used for Urine Analysis	10
Urine Analysis: Physical and chemical characteristics; Abnormal constituents.	
Unit 4: Non-infectious Diseases	15
Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/Kit	
Unit 5: Infectious Diseases	12
Causes, types, symptoms, diagnosis and prevention of Tuberculosis, Hepatitis and AIDS.	
Unit 6: Tumours	15
Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, Positron Emission Tomography (PET), Magnetic resonance Imaging (MRI) and Computed Tomography (CT) Scan (using photographs).	
Unit 7: Visit to Pathological Laboratory and Submission of Project	20

SUGGESTED READINGS

- Park, K. (2007), *Preventive and Social Medicine*, B.B. Publishers
- Godkar P.B. and Godkar D.P. *Textbook of Medical Laboratory Technology*, II Edition, Bhalani Publishing House
- Cheesbrough M., *A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses*
- Guyton A.C. and Hall J.E. *Textbook of Medical Physiology*, Saunders
- Robbins and Cortan, *Pathologic Basis of Disease*, VIII Edition, Saunders
- Prakash, G. (2012), *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Co. Ltd.