

**NOWGONG COLLEGE
(AUTONOMOUS)**



**UG SYLLABUS
(AS PER NEP-2020)
DEPARTMENT OF ZOOLOGY
(MAJOR+ MINOR+ SEC)**

CERTIFICATE/DIPLOMA/DEGREE COURSE IN ZOOLOGY

SYLLABUS FOR UG PROGRAMME IN ALL DISCIPLINES

Course and Credit Structure

Semester	Major(Maj)	Minor (Min)	Inter-Disciplinary (Multi)	AEC	SEC	VAC	Summer Internship	Research Project/ Dissertation	Total
I	ZOOL-MAJ-1014	ZOOL-MIN-1014		ASSA/HIND/BE NG-AEC-1012	ZOOL-SEC- 1014	UNIN-VAC- 1012 ENST-VAC- 1012	-----	-----	22
II	ZOOL-MAJ-2014	ZOOL-MIN-2014		ASSA/HIND/BE NG-AEC-2012	ZOOL-SEC- 2014	DITS-VAC- 2012 YOGA-VAC- 2012	-----	-----	22
Certificate after 1year (TotalCredit=44)									
III	ZOOL-MAJ-3014 ZOOL-MAJ-3024	ZOOL-MIN-3014		ENGL-AEC- 3012	XXXX-SEC- 3014	-----	-----	-----	22
IV	ZOOL-MAJ-4014 ZOOL-MAJ-4024 ZOOL-MAJ-4034 ZOOL-MAJ-4044	ZOOL-MIN-4014	-----	ENGL-AEC- 4012	-----	-----	-----	-----	22

N.B.:1. 4credit papers=100marks (60T+20IA+20P)

2. 2credit papers=50marks (30T+10IA+10P)&AEC:50marks (40T+10IA)

Question pattern:

For 100 marks papers [1marks x7(no options), 2 marks x4(no options, 5 marks x3(5 options), 10 marks x3(5 options)]

For 50 marks papers [1marks x4(no options), 2 marks x3(no options, 5 marks x2(4 options), 10 marks x1(2 options)]

ForAEC50marks papers [1marks x4(no options), 2 marks x3(no options, 5 marks x2(4 options),10 marks x2(4 options)]

- Major=Discipline Specific Core
- Minor=Discipline Specific Elective

DetailsofCoursesintheProgrammeofDepartmentofZoology,NowgongCollege(Autonomous)

Major Course (MAJ) papers

- ZOOL-MAJ-1014-Non-Chordates (Theory+Practical)
- ZOOL-MAJ-2014 - Chordates (Theory+ Practical)
- ZOOL-MAJ-3014-Principles of Ecology (Theory+Practical)
- ZOOL-MAJ-3024 - Animal cell structure and organelles (Theory+ Practical)
- ZOOL -MAJ-4014 - Comparative anatomy of vertebrates (Theory +Practical)
- ZOOL-MAJ-4024 – Theories and Principle of Genetics (Theory+ Practical)
- ZOOL -MAJ-4034- Animal Physiology (Theory+ practical)
- ZOOL-MAJ-4044-Developmental biology (Theory+Practical)

Minor Papers (MIN) to be offered to other Departments/Disciplines

- ZOOL-MIN-1014-Non-Chordates (Theory+Practical)
- ZOOL-MIN-2014 - Chordates (Theory+ Practical)
- ZOOL-MIN-3014-Principles of Ecology (Theory+Practical)
- ZOOL-MIN-4014 - Comparative anatomy of vertebrates (Theory +Practical)

Skill Enhancement Course (SEC)

- ZOOL-SEC-1014-Ornamental fish & fisheries (Theory+Practical/Presentation)
- ZOOL-SEC-2014 - Non-mulberry sericulture (Theory+ Practical/Presentation)

SEMESTER: I
CODE: ZOOL-MAJ-1014
NON-CHORDATES
PAPERCREDIT-4(3T+1P)

Total No. of Lectures: 45L+15P

Total marks=100;T60+P20+IA20(T+P)

Objectives:

The course would provide an insight to the learner about the existence of different life forms on the Earth and appreciate the diversity of animal life. It will help the student to understand the features of Kingdom Animalia and systematic organization of the animals based on their evolutionary relationships, structural and functional affinities along with basic concept of taxonomy. The course will also make the students aware about the characteristic morphological and anatomical features of diverse animals;

Learning Outcome:

Upon completion of the course, students should be able to:

- Learn about the importance of systematic, taxonomy, nomenclature, biological classification, and structural organization of invertebrate animals.
- The diversity of non-chordates living in varied habit and habitats.
- Understand evolutionary history and relationships of different non-chordates through functional and structural affinities.
- Critically analyze the organization, complexity, and characteristic features of non-chordates making them familiarize with the morphology and anatomy of representatives of various animal phyla.

COURSE CONTENT:THEORY: 45Lectures=45Hours

CREDITS-3

UNIT1:

Protista, Parazoa, and Metazoa: General characteristics and Classification up to classes, Study of Euglena, Amoeba, and Paramecium, Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica*. Locomotion and Reproduction in Protista Evolution of symmetry and segmentation of Metazoa

UNIT2:

Porifera: General characteristics and Classification upto classes. Canal system in sponges.

Cnidaria: General characteristics and Classification up to classes, Metagenesis in Obelia, Polymorphism in Cnidaria, Corals, and coral reefs, General characteristics of Ctenophora and its evolutionary significance.

UNIT3:

Helminthes: General characteristics and Classification of Platyhelminthes and nemathelminthes up to classes, Parasitic adaptations in helminthes.

Annelida:General characteristics and Classification upto classes, Coelomoducts, and Nephridia in Annelids.

Arthropoda: General characteristics and Classification up to classes, Metamorphosis in Insects.

UNIT4:

Mollusca: General characteristics and Classification upto classes. Respiration in Mollusca, Torsion, and detorsion in Gastropoda, Pearl formation in bivalves.

Echinodermata: General characteristics and Classification upto classes. Affinities of Echinodermata with Chordates.

COURSECONTENT:PRACTICAL 15Lectures= 15Hours

CREDIT:1

Study of whole mount of *Euglena*, *Amoeba*, and *Paramecium*, binary fission and conjugation in *Paramecium*.

Study of *Sycon* (T.S.andL.S.), *Hyalonema* , *Euplectella*, *Spongilla*.

Study of *Obelia*, *Physalia*, *Millepora*, *Aurelia*, *Tubipora*, *Corallium*, *Alcyonium*, *Gorgonia*, *Metridium*, *Pennatula*, *Fungia*, *Meandrina*, *Madrepora*, *Beroe*.

Study of adult *Fasciola hepatica*, *Taenia solium* and *Ascaris lumbricoides*.

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, Cucumari and Antedon.*

Mount of mouth parts and dissection of digestive system and nervous system of *Periplaneta*.

Note: Classification to be followed from “Ruppert and Barnes(2006) *Invertebrate Zoology*, 8th edition, Holt Saunders International Edition” and Young, J. Z. (2004)

SUGGESTED READINGS

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.

SEMESTER: 2
CODE:ZOOL-MAJ-2014
CHORDATES
PAPERCREDIT-4(3T+1P)

Total No. of Lectures: 45L + 15P

Total marks=100;T60+P20+IA20(T+P)

Objectives:

The course would provide an insight to the learner about the existence of different life forms on the Earth, and appreciate the diversity of animal life. It will help the student to understand the features of Kingdom Animalia and systematic organisation of the animals based on their evolutionary relationships, structural and functional affinities. The course will also make the students aware about the characteristic morphological and anatomical features of diverse animals;

Learning Outcome:

Upon completion of the course, students should be able to:

- Learn about the importance of systematic and structural organization of animals.
- Appreciate the diversity of chordates living in varied habit and habitats.
- Understand evolutionary history and relationships of different chordates through functional and structural affinities.
- Critically analyse the organization, complexity and characteristic features of chordates making them familiarize with the morphology and anatomy of representatives of various animal phyla.

COURSE CONTENT: THEORY: 45Lectures=45Hours

CREDITS-3

UNIT 1:

Chordata: General characteristics and outline classification of Chordata, Dipleurula concept of origin of chordate, General characteristics and classification of Protochordata. (Hemichordata, Urochordata and Cephalochordata); Retrogressive metamorphosis in Urochordata, Affinities of Hemichordata.

UNIT2:

Agnatha: General characteristics and classification of cyclostomes upto class.

Pisces: General characteristics of Chondrichthyes and Osteichthyes, classification upto order, Migration, Parental care in fishes.

UNIT3:

Amphibia: Origin of Tetrapoda, General characteristics and classification upto order; Parental care in Amphibians.

Reptilia: General characteristics and classification upto order; Affinities of Sphenodon; Poison apparatus and biting mechanism in snakes.

UNIT4:

Aves: General characteristics and classification upto order, Archaeopteryx-a connecting link; flight mechanism, Perching mechanism, flight adaptations and air sacs in birds.

Mammals: General characters and classification upto order; Affinities of Prototheria.

COURSE CONTENT: PRACTICAL 15Lectures=15Hours

CREDIT -1

Study of following specimens:

Protochordata: *Balanoglossus, Herdmania, Branchiostoma*, Colonial Urochordata
Sections of *Balanoglossus, Amphioxus*.

Agnatha: *Petromyzon, Myxine*.

Fishes: *Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetradon, Anabas, Flatfish*.

Dissection: Mount of weberian ossicles of *fish*.

Amphibia: *Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra*.

Reptilia: *Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus*.

Aves: Study of six common birds from different orders.

Mammalia: *Sorex*, Bat(Insectivorous and Frugivorous), *Funambulus, Loris, Herpestes, Erinaceous*.

Note: Classification to be followed from “Ruppert and Barnes(2006)*Invertebrate Zoology*, 8th edition, Holt Saunders International Edition” and Young, J. Z. (2004)

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.

SEMESTER: 3
CODE: ZOOL-MAJ-3014
PRINCIPLES OF ECOLOGY
PAPER CREDIT – 4 (3T+1P)

Total No. of Lectures:45L+ 15P

Total marks=100;T60 + P20+ IA20(T+P)

Objectives:

The primary aim of the syllabus is to sensitize the students about the paramount role and importance of nature. The study of Ecology imparts us the knowledge about the judicious use of existing ecological resources for sustainable development. The hands-on experiences of laboratory will also enable students to understand the ecosystem and ecology in a better way.

Learning Outcome:

Upon completion of the course, students should be able to:

- Demonstrate an understanding of key concepts in ecology with emphasis on historical perspective, role of physical factors and concept of limiting factors.
- Comprehend the population characteristics, dynamics, growth models and interactions. Understand the community characteristics, ecosystem development and climax theories.
- Know about the types of ecosystems, food chains, food webs, energy models, and ecological efficiencies.

COURSE CONTENT: THEORY 45 Lectures=45 Hours

CREDITS: 3

Unit 1:

Introduction to Ecology: History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical Factors

Unit 2:

Population: 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. Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical Responses

Unit 3:

Community: 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: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

COURSE CONTENT:PRACTICAL 15Lectures=15Hours

CREDIT:1

Calculation of Mean, Median, Mode, Standard deviation and Standard Error.

Graphical representation of data-Line diagram, Bar diagram and Pie diagram.

Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.

Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon- Weiner diversity index for the same community.

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).

Report on a visit to National Park/Biodiversity Park/Wildlife sanctuary

SUGGESTED READINGS:

Colinvaux,P.A.(1993).Ecology.II Edition.Wiley,JohnandSons,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 andRow publisher.

Ricklefs,R.E.,(2000).Ecology.Vth Edition.ChironPres.

SEMESTER: 3
CODE: ZOOL-MAJ-3024
ANIMAL CELL STRUCTURE AND ORGANELLES
PAPER CREDIT – 4 (3T+1P)

Total No. of Lectures:45L+15P

Total marks=100; T60+P20+IA20(T+P)

Objectives: The objective of the course is to help the students to learn and develop an understanding of a cell as a basic unit of life. This course is designed to enable them to understand the functions of cellular organelles and how a cell carries out and regulates cellular functions.

Learning Outcome: Upon completion of the course, students should be able to:

- Understand fundamental principles of cell biology.
- Explain structure and functions of cell organelles involved in diverse cellular processes.
- Have an insight in functioning of cell organelles
- Appreciate how cells grow, divide, survive, die and regulate these important processes.
- Learn the advances made in the field of cell biology and their applications.

COURSE CONTENT: THEORY 45 Lectures=45 Hours

CREDITS: 3

Unit: 1:

Overview of Cells: Cell theories, Concept of Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions.

Plasma Membrane: Various models of plasma membrane structure, Transport across membranes: Active and Passive transport, Facilitated transport Cell junctions: Tight junctions, Desmosomes, Gap junctions

Unit: 2:

Endomembrane System: Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes

Cytoskeleton: Structure and Functions: Microtubules, Microfilaments and intermediate filaments

Unit: 3:

Mitochondria and Peroxisomes: Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial respiratory Chain, Chemi-osmotic hypothesis, Peroxisomes

Unit 4:

Nucleus: Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus

Chromatin: Euchromatin and heterochromatin and packaging (nucleosome)

Cell Division: Mitosis, Meiosis, Cell cycle

COURSE CONTENT: PRACTICAL 15 Lectures=15 Hours

CREDITS:1

Preparation of temporary stained slide of onion root tip/tadpole larva/ lizard tail to study various stages of mitosis.

Study of various stages of meiosis.

Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.

Preparation of permanent slide to demonstrate:

- a. DNA by Feulgen reaction
- b. Mucopolysaccharides by PAS reaction
- c. Proteins by Mercuribromophenol blue/Fast Green

Cell viability assay.

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, Lewis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London.

SEMESTER: 4
CODE:ZOOL-MAJ-4014
COMPARATIVE ANATOMY OF VERTEBRATES
PAPER CREDIT – 4 (3T+1P)

Total No. of Lectures: 45L+15P

Total marks=100; T60+P20+IA20(T+P)

Objectives:

A study of vertebrate structure, function and evolution. Relationships between the structural and functional adaptations of the different vertebrate groups and their environment.

Learning Outcome: After completing the syllabus the students will have:

- An understanding of the characteristics of vertebrates which makes both chordates and vertebrates unique among animals.
- An understanding of the evolutionary history of vertebrates and the evolutionary relationships among different groups of vertebrates.
- Learn to compare and contrast the many physiological, ecological, adaptations of the different groups of vertebrates, the external anatomy, skeletal features, and internal organ systems of the different groups of vertebrates.
- Learn to observe and discuss field and laboratory techniques used in the study of vertebrates.

COURSECONTENT: THEORY45Lectures=45Hours

CREDITS-3

Unit 1:

Integumentary System: Structure, functions and derivatives of integument.

Skeletal System: Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches

Unit 2:

Digestive System: Alimentary canal and associated glands, dentition.

Respiratory System: Skin, gills, lungs and air sacs; Accessory respiratory organs.

Unit 3:

Circulatory System: General plan of circulation, evolution of heart and aortic arches

Urinogenital System: Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri.

Unit 4:

Nervous System: Classification of receptors, Brief account of visual and auditory receptors in man

Sense Organs: Comparative account of brain: Autonomic nervous system, Spinal cord, Cranial nerves in mammals

COURSECONTENT: PRACTICAL 15Lectures=15Hours

CREDIT:1

Study of placoid, cycloid and ctenoid scales through permanent slides/photographs.

Disarticulated skeleton of Frog, Fowl, Rabbit.

Carapace and plastron of turtle/tortoise.

Mammalian skulls: One herbivorous and one carnivorous animal.

Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted).

Project on skeletal modifications invertebrates (may be included if dissection not permitted).

SUGGESTED READING

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.

SEMESTER:4
CODE: ZOOL-MAJ-4024
THEORIES AND PRINCIPLE OF GENETICS
PAPER CREDIT- 4(3T+1P)

Total No. of Lectures:45L+15P

Total marks=100; T60+P20+IA20(T+P)

Objectives:

Completion of this subject is expected to enhance a student's ability to understand the fundamental principles of genetics and to describe the experiments used to establish them.

Learning Outcome: Upon successful completion of the course students will

- Have in depth knowledge on classical to molecular genetics

COURSE CONTENT: THEORY 45Lectures=45Hours

CREDITS: 3

Unit1:

Principles of inheritance, Incomplete dominance and co- dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex- influenced and sex-limited characters of inheritance.

Linkage and crossing over, Molecular mechanisms of crossing over, Recombination frequency as a measure of linkage intensity.

Unit2:

Chromosomal mechanisms of sex determination in *Drosophila* and Man

Criteria for extra-chromosomal inheritance, Antibiotic resistance in *Chlamydomonas*, Mitochondrial mutations in *Saccharomyces*, Infective heredity in *Paramecium* and Maternal effects

Unit3:

Types of gene mutations, Types of chromosomal aberrations, Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method, attached X method.

Unit4:

Conjugation, Transformation, Transduction, Complementation test in Bacteriophage.

Transposons in bacteria, Ac-Ds element in maize and P elements in *Drosophila*, Transposons in humans.

COURSE CONTENT: PRACTICAL 15 Lectures = 15 Hours

CREDITS: 1

Culture of *Drosophila*.

To study the Mendelian laws and gene interactions.

Chi-square analyses using seeds/beads/*Drosophila*.

Linkage maps based on data from conjugation, transformation and transduction.

Linkage maps based on data from *Drosophila* crosses.

Study of human karyotype by buccal epithelial cells (normal and abnormal).

Pedigree analysis of some human inherited traits/mammalian inherited traits.

SUGGESTED READINGS

Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India.

Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc
Klug, W.S., Cummings, M.R., Spencer, C.A. (2012).

Concepts of Genetics. X Edition. Benjamin Cummings
Russell, P.J. (2009). *Genetics - A Molecular Approach*. III Edition. Benjamin Cummings.

Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co.

Fletcher H. and Hickey I. (2015). *Genetics*. IV Edition. GS, Taylor and Francis Group, New York and London.

SEMESTER: 4
CODE:ZOOL-MAJ-4034
ANIMAL PHYSIOLOGY
PAPERCREDIT– 4(3T+1P)

Total No. of Lectures: 45L+15P

Total marks=100; T60+P20+IA20(T+P)

Objectives:

To develop basic concept and Knowledge among undergraduate students about the structure and functioning of different systems in body. This course gives in depth instructions in the organization, structures and functions of different organ systems in the body and will be able to know how these different systems interrelate to maintain homeostasis.

Learning Outcomes: After completing the syllabus the students will be able to

- Comprehend some of the vital processes like circulation of blood and its coagulation processes, digestion, excretion.
- Analyze the role of the respiratory systems, endocrine glands in body

COURSECONTENT:THEORY45Lectures=45Hours

CREDITS-3

Unit 1:

Physiology of Digestion: Structural organization 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 Gastro intestinal tract.

Unit 2:

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

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

Unit 4:

Physiology of Heart: Structure of mammalian heart; Coronary circulation; Structure and workingofconductingmyocardialfibers.Originandconductionofcardiacimpulses.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

COURSECONTENT: PRACTICAL15Lectures=15Hours

CREDIT:1

Determination of ABO Blood group.

Enumeration of red blood cells and white blood cells using haemocytometer.

Estimation of haemoglobin using Sahli's haemoglobinometer.

Preparation of haemin crystals.

Recording of blood pressure using a sphygmomanometer.

Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney.

SUGGESTED READINGS:

Guyton,A.C.&Hall,J.E.(2006).TextbookofMedicalPhysiology.XIEdition.HercourtAsia PTE Ltd. W.B. Saunders Company.

Tortora,G.J.&Grabowski,S.(2006).PrinciplesofAnatomy&Physiology.XIEditionJohn Wiley & sons.

Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. &Wilkins.

Sebulingam,KandSebulingam,P.(2012).EssentialsofMedicalPhysiology.XI.Edition. JaypeeBrothersmedicalPublishers(P)LTD.

SEMESTER: 4
CODE:ZOOL-MAJ-4044
DEVELOPMENTAL BIOLOGY
PAPER CREDIT – 4 (3T+1P)

Total No. of Lectures:45L+15P

Total marks=100; T60 +P20+IA20(T+P)

Objectives:

To provide the undergraduate students an in-depth knowledge on the embryonic and post embryonic developmental processes. It will also explain the basic principles and concepts underlying the developmental processes at the cellular and molecular level. It will give the knowledge about different types of eggs, cleavage patterns and various morphogenetic movements during gastrulation leading to formation of germ layers and their fate

Learning outcome:

On completion of the course, students should be able to:

- Understand the events that lead to formation of a multicellular organism from a single fertilized egg, the zygote.
- acquire basic knowledge of the cellular processes of development and the molecular mechanisms underlying these.
- Describe the general patterns and sequential developmental stages during embryogenesis; and understand how the developmental processes lead to establishment of body plan of multicellular organisms.
- Discuss the general mechanisms involved in morphogenesis and to explain how different cells and tissues interact in a coordinated way to form various tissues and organs. • Understand about the evolutionary development of various animals.
- Learn the importance of latest techniques like stem cell therapy, in vitro fertilization and amniocentesis etc. to be applied for human welfare.
- Develop the skill to raise and maintain culture of model system; Drosophila in the laboratory.

COURSECONTENT:THEORY45Lectures=45Hours

CREDITS-3

Unit 1:

Introduction: Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division

Unit 2:

Early embryonic development: Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to

polysemy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques);earlydevelopmentoffrogandchickuptogastrulation;Embryonicinductionand organizers

Unit 3:

Late embryonic development: Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta).

Post embryonic development: Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration; Ageing: Concepts and Theories.

Unit 4:

Implications of developmental biology: Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Amniocentesis.

COURSECONTENT:PRACTICAL15Lectures=15Hours

CREDIT:1

Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages).

Study of whole mounts of developmental stages of chick/duck.

Study of permanent slides:chick/duck, of different developmental stages. Primitives streak(13 and18hours),21,24,28,33,36,48,72, and96 hours of incubation(Hamilton and Hamburger stages).

Study of the developmental stages and life cycle of *Drosophila* from stockculture.

Study of different sections of placenta (photo micrograph/slides).

Project report on *Drosophila* culture/chick embryo development.

SUGGESTEDREADINGS:

Gilbert, S.F.(2010).Developmental Biology, IX Edition, Sinauer Associates, Inc.,Publishers, Sunderland, Massachusetts, USA.

Balinsky B.I.and Fabian B.C.(1981).An Introduction to Embryology,V Edition, International Thompson Computer Press.

Carlson, R. F. Patten's Foundations of Embryology Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers.

Lewis Wolpert(2002).Principles of Development. II Edition, Oxford University Press.

Veer Bala Rastogi(2016).Chordate Embryology. II Edition, Kedar Nath Ram Nath Publishers.

DEPARTMENT OF ZOOLOGY
(Minor Course)
of
Undergraduate Programme

SEMESTER: 1
CODE: ZOOLOGICAL-MIN-1014
BIOSYSTEMATICS & NON-CHORDATES
PAPER CREDIT-4 (3T+1P)

Total No. of Lectures: 45L + 15P

Total marks=100; T60+P20+IA20(T+P)

Objectives:

The course would provide an insight to the learner about the existence of different life forms on the Earth, and appreciate the diversity of animal life. It will help the student to understand the features of Kingdom Animalia and systematic organization of the animals based on their evolutionary relationships, structural and functional affinities along with basic concept of taxonomy. The course will also make the students aware about the characteristic morphological and anatomical features of diverse animals;

Learning Outcome:

Upon completion of the course, students should be able to:

- Learn about the importance of systematics, taxonomy, nomenclature, biological classification and structural organization of animals.
- Appreciate the diversity of non-chordates living in varied habit and habitats.
- Understand evolutionary history and relationships of different non-chordates through functional and structural affinities.
- Critically analyze the organization, complexity and characteristic features of non-chordates making them familiarize with the morphology and anatomy of representatives of various animal phyla.

COURSE CONTENT: THEORY 45Lectures=45Hours

CREDITS:3

UNIT 1:

Definition, basic concept and importance of Systematics and Taxonomy, Newer trends in taxonomy,

International Code of Zoological Nomenclature (ICZN), Taxonomic procedures-taxonomic collections, preservation, method of identification, taxonomic keys- different types of keys.

UNIT2:

Protista, Parazoa and Metazoa: General characteristics and Classification upto classes, Locomotion and Reproduction in Protista.

Porifera: General characteristics and Classification upto classes. Canal system in sponges.

Cnidaria: General characteristics and Classification up to classes, General characteristics of Ctenophora and its evolutionary significance.

UNIT3:

Helminthes: General characteristics and Classification of platyhelminthes and nemathelminthes up to classes, Parasitic adaptations in helminthes.

Annelida: General characteristics and Classification upto classes, Coelomoducts and Nephridia in Annelids

Arthropoda: General characteristics and Classification up to classes, Metamorphosis in Insects,

UNIT4:

Mollusca: General characteristics and Classification upto classes Respiration in Mollusca, Torsion and detorsion in Gastropoda, Pearl formation in bivalves.

Echinodermata: General characteristics and Classification upto classes. Affinities of Echinodermata with Chordates.

COURSECONTENT: PRACTICAL15Lectures=15Hours

CREDIT:1

Study of whole mount of *Euglena*, *Amoeba* and *Paramecium*, binary fission and conjugation in *Paramecium*.

Study of *Sycon*(T.S.andL.S.),*Hyalonema*,*Euplectella*, *Spongilla*.

Study of *Obelia*, *Physalia*, *Millepora*, *Aurelia*, *Tubipora*, *Corallium*, *Alcyonium*, *Gorgonia*, *Metridium*, *Pennatula*, *Fungia*, *Meandrina*,*Madrepora*, *Beroe*.

Study of adult *Fasciola hepatica*, *Taenia solium* and *Ascaris lumbricoides*.

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*.

Mount of mouth parts and dissection of digestive system and nervous system of *Periplaneta*.

Note: Classification to be followed from “Ruppert and Barnes(2006) *Invertebrate Zoology*, 8th edition, Holt Saunders International Edition” and Young, J. Z. (2004)

SUGGESTED READINGS

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.

SEMESTER: 2
CODE: ZOOLOGY-MIN-2014
CHORDATES
PAPER CREDIT-4(3T+1P)

Total No. of Lectures: 45L + 15P

Total marks=100;T60+P20+IA20(T+P)

Objectives:

The course would provide an insight to the learner about the existence of different life forms on the Earth, and appreciate the diversity of animal life. It will help the student to understand the features of Kingdom Animalia and systematic organisation of the animals based on their evolutionary relationships, structural and functional affinities. The course will also make the students aware about the characteristic morphological and anatomical features of diverse animals;

Learning Outcome:

Upon completion of the course, students should be able to:

- Learn about the importance of systematic and structural organization of animals.
- Appreciate the diversity of chordates living in varied habit and habitats.
- Understand evolutionary history and relationships of different chordates through functional and structural affinities.
- Critically analyse the organization, complexity and characteristic features of chordates making them familiarize with the morphology and anatomy of representatives of various animal phyla.

COURSE CONTENT: THEORY: 45 Lectures=45 Hours

CREDITS-3

UNIT 1:

Chordata: General characteristics and outline classification of Chordata, Dipleurula concept of origin of chordate, General characteristics and classification of Protochordata. (Hemichordata, Urochordata and Cephalochordata); Retrogressive metamorphosis in Urochordata, Affinities of Hemichordata.

UNIT 2:

Agnatha: General characteristics and classification of cyclostomes upto class.

Pisces: General characteristics of Chondrichthyes and Osteichthyes, classification upto order, Migration, Parental care in fishes.

UNIT3:

Amphibia: Origin of Tetrapoda, General characteristics and classification upto order; Parental care in Amphibians.

Reptilia: General characteristics and classification upto order; Affinities of Sphenodon; Poison apparatus and biting mechanism in snakes.

UNIT4:

Aves: General characteristics and classification upto order, Archaeopteryx-a connecting link; flight mechanism, Perching mechanism, flight adaptations and air sacs in birds.

Mammals: General characters and classification upto order; Affinities of Prototheria.

COURSE CONTENT: PRACTICAL 15Lectures=15Hours

CREDIT -1

Study of following specimens:

Protochordata: *Balanoglossus, Herdmania, Branchiostoma*, Colonial Urochordata
Sections of *Balanoglossus, Amphioxus*.

Agnatha: *Petromyzon, Myxine*.

Fishes: *Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetradon, Anabas, Flatfish*.

Dissection: Mount of weberian ossicles of *fish*.

Amphibia: *Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra*.

Reptilia: *Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus*.

Aves: Study of six common birds from different orders.

Mammalia: *Sorex, Bat (Insectivorous and Frugivorous), Funambulus, Loris, Herpestes, Erinaceous*.

Note: Classification to be followed from “Ruppert and Barnes (2006)*Invertebrate Zoology*, 8th edition, Holt Saunders International Edition” and Young, J. Z. (2004)

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.

SEMESTER: 3
CODE: ZOOL-MIN-3014
PRINCIPLES OF ECOLOGY
PAPER CREDIT – 4 (3T+1P)

Total No. of Lectures: 45L+ 15P

Total marks=100;T60 + P20+ IA20(T+P)

Objectives:

The primary aim of the syllabus is to sensitize the students about the paramount role and importance of nature. The study of Ecology imparts us the knowledge about the judicious use of existing ecological resources for sustainable development. The hands-on experiences of laboratory will also enable students to understand the ecosystem and ecology in a better way.

Learning Outcome:

Upon completion of the course, students should be able to:

- Demonstrate an understanding of key concepts in ecology with emphasis on historical perspective, role of physical factors and concept of limiting factors.
- Comprehend the population characteristics, dynamics, growth models and interactions. Understand the community characteristics, ecosystem development and climax theories.
- Know about the types of ecosystems, food chains, food webs, energy models, and ecological efficiencies.

COURSE CONTENT: THEORY 45 Lectures=45 Hours

CREDITS: 3

Unit 1:

Introduction to Ecology: History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical Factors

Unit 2:

Population: 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. Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical Responses

Unit 3:

Community: 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: 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

COURSE CONTENT: PRACTICAL 15Lectures=15Hours

CREDIT:1

Calculation of Mean, Median, Mode, Standard deviation and Standard Error.

Graphical representation of data-Line diagram, Bar diagram and Pie diagram.

Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.

Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon- Weiner diversity index for the same community.

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).

Report on a visit to National Park/Biodiversity Park/Wildlife sanctuary

SUGGESTED READINGS:

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.VthEdition. ChironPres.

SEMESTER-4
PAPERCODE: ZOOL-MIN-4014
COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF
VERTEBRATES
PAPERCREDIT: 04(3T+1P)

Total No. of Lectures: 45L+15P

Total marks=100; T60+P20+IA20(T+P)

Objectives:

A study of vertebrate structure, function and evolution. Relationships between the structural and functional adaptations of the different vertebrate groups and their environment.

Learning Outcome: After completing the syllabus the students will have:

- An understanding of the characteristics of vertebrates which makes both chordates and vertebrates unique among animals.
- An understanding of the evolutionary history of vertebrates and the evolutionary relationships among different groups of vertebrates.
- Learn to compare and contrast the many physiological, ecological, adaptations of the different groups of vertebrates, the external anatomy, skeletal features, and internal organ systems of the different groups of vertebrates.
- Learn to observe and discuss field and laboratory techniques used in the study of vertebrates.

COURSECONTENT: THEORY45Lectures=45Hours

CREDITS-3

Unit 1:

Integumentary System: Structure, functions and derivatives of integument.

Skeletal System: Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches

Unit 2:

Digestive System: Alimentary canal and associated glands, dentition.

Respiratory System: Skin, gills, lungs and air sacs; Accessory respiratory organs.

Unit 3:

Circulatory System: General plan of circulation, evolution of heart and aortic arches

Urinogenital System: Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri.

Unit 4:

Nervous System: Classification of receptors, Brief account of visual and auditory receptors in man

Sense Organs: Comparative account of brain: Autonomic nervous system, Spinal cord, Cranial nerves in mammals

COURSE CONTENT: PRACTICAL 15 Lectures=15 Hours

CREDIT:1

Study of placoid, cycloid and ctenoid scales through permanent slides/photographs.

Disarticulated skeleton of Frog, Fowl, Rabbit.

Carapace and plastron of turtle/tortoise.

Mammalian skulls: One herbivorous and one carnivorous animal.

Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted).

Project on skeletal modifications invertebrates (may be included if dissection not permitted).

SUGGESTED READING

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.

DEPARTMENT OF ZOOLOGY
(Skill Enhancement Course)
of
Undergraduate Programme

SKILL ENHANCEMENT COURSE -1
PAPER CODE: ZOOL-SEC-1014
(ORNAMENTAL FISH & FISHERIES)
Paper Credit:4 (3T+1P)

Total No. of Lectures: 45L + 15P

Total marks=100;T60+P20+IA20(T+P)

Objectives:

1. To make students learn about the potential of ornamental fish industry
2. To explore taxonomy, management and biology of ornamental fishes

Learning outcome: Students will be able to-

1. Identify ornamental fishes of the region and setup and maintain aquarium
2. Prepare food and culture of ornamental fishes
3. Explore business opportunities with ornamental fishes from Assam

COURSE CONTENTS: THEORY 45Lectures=45Hours

CREDIT:3

UNIT 1:

Ornamental Fish Diversity of North East India.

Aquarium plant diversity in the wetland of Assam.

Construction and management of Home Aquarium.

UNIT2:

Natural feed of Ornamental Fish.

Strategies for maintenance of natural colour of Ornamental Fish.

UNIT3:

Natural Breeding of Tricogaster species.

Health management of Ornamental Fish.

Feed formulation of Ornamental Fish.

UNIT4:

Development of Biological filtration in Aquarium.

Pure culture of planktons.

Ornamental fish culture and entrepreneurship development.

COURSE CONTENTS: PRACTICAL 15 Lectures = 15 Hours

CREDIT: 1

Identification of Ornamental Fish.

Culture of Indigenous ornamental fish in Aquarium.

Estimation of Physico-chemical characteristics of Aquarium water.

Biological filter for removal of Ammonia from Aquarium.

Culture of Planktons.

Culture of Tubifex.

SUGGESTED READINGS:

Handbook of Fisheries and Aquaculture, ICAR, New Delhi.

Ornamental Aquarium Fish of India by Kishori Tekriwal, Andrew Arunava Rao, John Dawes, Kingdom Books.

A Textbook of Fish Biology and Fisheries, S.S. Khanna and H.R. Singh, Narendra Publishing House.

Fish and Fisheries of India, V.G. Jhingran, Hindustanpub. Corp.

A Handbook of Fish Biology and Indian Fisheries, R.P. Parihaar, Central Publishing House.

SKILL ENHANCEMENT COURSE-2

PAPER CODE: ZOOL-SEC-2014

NON-MULBERRY SERICULTURE

Paper Credit:4 (3T+1P)

Total No. of Lectures: 45L+15P

Total marks=100; T60+P20+IA20(T+P)

Objectives:

1. Learning history and present status of Mulberry and Non-Mulberry Sericulture, varieties of silk.
2. Learning biology, life history, food plants and rearing of non-mulberry silkworms.
3. Acquainting pests and diseases of silkworm.
4. Learning non-mulberry silk products and Entrepreneurship development.

Learning outcome:

Students will learn about:

1. Non-mulberry silkworm diversity and rearing.
2. Non-mulberry silkworm food plants cultivation.
3. Management of Pests and diseases of non-mulberry silkworm.
4. Various process involved in non-mulberry silk production.

COURSE CONTENTS: THEORY 45 Lectures=45 Hours

CREDIT:3

UNIT 1:

Introduction: Sericulture, Definition, history and present status of Mulberry and Non-Mulberry Sericulture; Silk route, Varieties of Silk; Types and distribution of non-mulberry or wild or vanyasericigenous insects in N-E India.

Biology of Non-mulberry Silkworm: Life cycle of silkworm: Eri and Muga. Structure of silk gland and Nature of Silk

UNIT2:

Rearing of Silkworms (Eri and Muga Silkworm): Food plants of Eri and Muga Silkworm; **Rearing Operation:** Rearing house/Site and rearing appliances. **Disinfectants:** Formalin, bleaching powder. **Rearing technology:** Early age and Late age rearing Environmental conditions in rearing-Temperature, Humidity, Light and Air Types of mountages. Harvesting and storage of cocoons Spinning and Reeling of silk.

UNIT3:

Pests and Diseases: Pests of eri and muga silkworm, Pathogenesis of eri and muga silkworm diseases: Protozoan, viral, fungal and bacterial; Prevention and control measures of pests and diseases.

UNIT4:

Entrepreneurship in Non-Mulberry Sericulture: Varieties of Non-Mulberry Silk products and economics in India, Prospects of Non-Mulberry Sericulture in India: Non-Mulberry Sericulture industry in different states, employment generation and potential.

COURSE CONTENTS: PRACTICAL 15 Lectures = 15 Hours

CREDIT: 1

Identification of larval and adult stages of different varieties of silkworms.

Study the life history of silkworms (Eri and Muga).

Study the primary and secondary food plants of silkworm (Eri & Muga).

Study the different diseases of silkworm through permanent slide/model/photographs
Study the pest, predator and parasitoids of silkworm.

Study the silk gland of silkworm through model/photographs (Dissection of the silk gland of eri and mulberry silkworm if specimens are available).

Visit to Govt./Private sericulture farm and preparation of report.

SUGGESTED READINGS:

Jolly, M.S., S.K. Sen, T.N. Sonwalker and G.K. Prasad 1979. Non-Mulberry Sericulture. in: Manual of Sericulture, Rome, FAO, 4 (29).

Chowdhury, S.N. 1981. Muga Silk Industry. Directorate of Sericulture, Govt. of Assam, Guwahati 781005, Assam.

Chowdhury, S.N. 1982. Eri Silk Industry. Directorate of Sericulture, Govt. of Assam, Guwahati 781005, Assam.

Chowdhury, S.N. 1992. Silk and Sericulture. Directorate of Sericulture and Weaving, Govt. of Assam, Guwahati-781005, Assam.

Chutia, B. C., Rajkhowa, R. and Goswami, B. 2020. Non-Mulberry Sericulture, Assam Book Depot (p) Ltd. Assam.
