

FULL SYLLABUS WITH COURSE OUTCOME, Dept. of ZOOLOGY, Ramananda centenary college, Purulia.

Course Code	Course Title	Course Type	Course outcomes
BZOCCHC101	Non-chordates I: Protista to Pseudocoelomates	CC-1	<ol style="list-style-type: none"> 1. Development of clear concept on different invertebrate forms and their physiology. 2. Describing general taxonomic rules of non-chordate classification. 3. Classifying Protista up to phylum using examples from parasitic adaptation.
BZOCCHC102	Perspectives in Ecology	CC-2	<ol style="list-style-type: none"> 1. Learning the basic biological principles and processes to understand ecology and environment and their proper functioning. 2. Understanding distribution of fauna in different realms and their mutual interaction. 3. Studying interaction between biotic and abiotic factors. Conducting a local excursion to obtain and record various data and their subsequent analysis to holistically understand Ecology in silico. 4. Developing idea on numerous protected zones in wildlife, different conservation strategies and WPA
BZOCCHC201	Non-Chordates II: Coelomates	CC-3	Correlating the theoretical knowledge with practical curricula to develop a holistic idea on Invertebrate Zoology
BZOCCHC202	Cell Biology	CC-4	<ol style="list-style-type: none"> 1. Identification & knowledge gathering on cellular & subcellular levels of organisation. 2. Correlating the theoretical knowledge with practical curricula to develop a holistic idea on cell biology.
BZOCCHC301	Diversity of Chordata	CC-5	<ol style="list-style-type: none"> 1. Development of clear concept on different vertebrate forms and their physiology. 2. Describing general taxonomic rules of chordate classification.
BZOCCHC302	Animal Physiology: Controlling & Coordinating Systems	CC-6	<ol style="list-style-type: none"> 1. Learning principles and concepts of basic physiological processes to relate the various levels of organization and interaction amongst them to ensure proper functionality of an individual. 2. Developing physiological and biochemical understanding through scientific enquiry into the nature of mechanical, physical, and biochemical functions of humans, their organs, and the cells of which they are composed. 3. Understanding interactions and interdependence of physiological and biochemical processes.
BZOCCHC303	Fundamentals of Biochemistry	CC-7	<ol style="list-style-type: none"> 1. Learning the practical knowledges to analyse different biochemical samples and assess the presence of macro and/or micro molecules therein. 2. Development of bio-chemical background in various life sustaining processes.

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BZOOCCHC401	Comparative Anatomy of Vertebrates	CC-8	<ol style="list-style-type: none"> 1. 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. 2. Comparative anatomy is an important tool that helps determine evolutionary relationships between organisms.
BZOOCCHC402	Animal Physiology: Life Sustaining Systems	CC-9	<ol style="list-style-type: none"> 1. Learning principles and concepts of basic physiological processes to relate the various levels of organization and interaction amongst them to ensure proper functionality of an individual. 2. Determine if an animal has sustained an injury. Understand the physical capabilities or limitations of particular species.
BZOOCCHC403	Immunology	CC-10	<ol style="list-style-type: none"> 1. Learning the fundamental basis of how organisms react to biological foreign agents. 2. Understanding different types of immunity. 3. Studying interactions of antigens, antibodies, complements and other immune components. 4. Understanding of immune mechanisms in disease control, vaccination, process of immune interactions. 5. Understanding the basis and mechanism of various parasite mediated and Physiological diseases.
BZOOCCHC501	Molecular Biology	CC-11	<ol style="list-style-type: none"> 1. Developing knowledge of underlying molecular mechanisms of various genetic and cellular phenomena. 2. Structure and function of macromolecules, the importance of proteins to all living organisms, and molecular genetics.
BZOOCCHC502	Principles of Genetics	CC-12	<ol style="list-style-type: none"> 1. This course focuses on transmission and molecular genetics. Topics include chromosome structure and replication, genetic linkage and mapping, regulation of gene expression in prokaryotes and eukaryotes, epigenetics, genetic mutation, genetics of cancer, and the principles of genetic engineering. 2. Gathering knowledge on different genetic mechanisms.
BZOOCCHC601	Developmental Biology	CC-13	<ol style="list-style-type: none"> 1. Aims to understand how an organism develops—how a single cell becomes an organized grouping of cells that is then programmed at specific times to become specialized for certain tasks. 2. Development of clear concept on different vertebrate forms and their physiology. 3. Gathering knowledge on different developmental processes & genetic mechanisms 4. Correlating the theoretical knowledge with practical curricula to develop a holistic idea on Vertebrate Zoology by considering their skeletal systems.
BZOOCCHC602	Evolutionary Biology	CC-14	<ol style="list-style-type: none"> 1. Evolutionary biology seeks to explain the diversity of life: the variety of organisms

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			<p>and their characteristics, and their changes over time.</p> <p>2. Learning the theoretical skills to taxonomic assessment of different animals correlating their evolutionary background as well as behavioral pattern.</p> <p>3. Gaining knowledge regarding the various theories of evolution, evolutionary process such as variation, speciation, natural selection, origin of primates and man.</p> <p>4. Learning basic principles of animal taxonomy, systematic, classification, speciation etc.</p>
BZOOSEHT305	Aquarium Fish Keeping	SEC-1	<p>1.The main emphasis in ornamental plant breeding is to improve variety traits, novel colour, form, size, number of flowers, flower vase life, repeat blooming, disease resistance, nutrient uptake capacity and growth habit.</p> <p>2. Increase in the income of the Ornapreneurs and fish farmers through different activities in this sector. To create employment opportunity to the rural & urban population. To augment ornamental fisheries traders & export earnings.</p>
BZOOSEHT405	Sericulture	SEC-2	<p>1. Gain skill with hands on training on mulberry cultivation and carry forward to field, 3. Gain skill with hands on training on silkworm egg production and support grainage activity, 4. Acquire knowledge and develop skill in silkworm rearing and support silkworm farming.</p> <p>2. It is used in clothing, upholsteries, surgical sutures, beddings, parachutes, etc. Sericulture is the cultivation of silkworms for harvesting silk. This article will look closer at the impact of sericulture on economy, environment, and society.</p> <p>3. Sericulture provides gainful employment, economic development and improvement in the quality of life to the people in rural area and therefore it plays an important role in anti poverty programme and prevents migration of rural people to urban area in search of employment.</p>
BZOODSHC1	Animal Biotechnology	DSE-1	<p>1. The objective of this course is to familiarize the techniques involved animal biotechnology. The course aims to provide theory and practical sessions of biotechnology as part of Professionalization.</p> <p>2. There is a wide array of scope for veterinary biotechnologists in numerous sectors such as research institutes, defense organizations, biotechnology companies, food-processing plants. Apart from research, they can opt for a teaching profession in different universities.</p>
BZOODSHC2	Fish and Fisheries	DSE-2	<p>1. A student studying Fisheries resource management is also taught biology, anatomy, taxonomy, physiology along with a fisheries environment which includes oceanography,</p>

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			<p>limnology, ecology, biodiversity.</p> <p>2. The management of fisheries, the protection of species, and the preservation of the aquatic environment all depend on an in-depth study of fish variety, distribution, habitat requirements, and life cycles.</p> <p>3. It is a multidisciplinary subject that encompasses the biological study of breeding, habits and life of different species of fish.</p>
BZOODSHC3	Wild Life Conservation and Management	DSE-3	<p>1. Students will be able to identify species, characteristics, habitat requirements and life cycles of birds, fish and/or mammalian wildlife species. Students will be able to apply knowledge to solve problems related to wildlife conservation and management.</p> <p>2. Natural resources are components of the environment that are vital to humans somehow. The term conservation of natural resources refers to the sustainable use and management of natural resources such as animals, water, air, and earth deposits.</p> <p>3. Learning the basic biological principles and processes to understand ecology and environment and their proper functioning.</p> <p>4. Understanding distribution of fauna in different realms and their mutual interaction.</p> <p>5. Studying interaction between biotic and abiotic factors.</p> <p>6. Developing idea on numerous protected zones in wildlife, different conservation.</p>
BZOODSHC4	Parasitology	DSE-4	<p>1. Developing idea on parasites and parasitic diseases, including the distribution, biochemistry, physiology, molecular biology, ecology, evolution and clinical aspects of parasites, including the host response to these agents.</p> <p>2. Identify, describe and contrast unicellular parasites and parasitic worms. Describe specific human and non-human parasitic diseases. Prepare and observe live parasitic specimens and test students' own seropositivity for a particular parasitic infection.</p>
BZOODSHC5	Animal Behaviour and Chronobiology	DSE-5	<p>1. The objective of this course is to gain insight into animal behavior, we are in a stronger position to understand vexing conservation problems, such as how to save endangered species, assess environmental quality, design nature preserves, and evaluate the importance of human-related threats to survival in otherwise fit animals.</p>
BZOODSHC6	Bio statistics and Bio informatics	DSE-6	<p>1. Learning the theoretical skills to establish any biological phenomena by statistically assessing the experimental data.</p> <p>2. The objective of this course is to data analysis and statistical reasoning applied practically to medicine and public health. It is a fundamental discipline at the core of modern health data science, and underpins most key public health research disciplines such as epidemiology and health services research.</p>

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			3. Bioinformatics combines computer programming, big data, and biology to help scientists understand and identify patterns in biological data. It is particularly useful in studying genomes and DNA sequencing, as it allows scientists to organize large amounts of data.
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Course Code	Course Title	Course Type	Allotted
BZOOCCHC101	Non-chordates I: Protista to Pseudocoelomates	CC-1	R.M
BZOOCCHC102	Perspectives in Ecology	CC-2	M.KS.
BZOOCCHC201	Non-Chordates II: Coelomates	CC-3	R.M
BZOOCCHC202	Cell Biology	CC-4	M.KS.
BZOOCCHC301	Diversity of Chordata	CC-5	R.M
BZOOCCHC302	Animal Physiology: Controlling & Coordinating Systems	CC-6	M.KS.
BZOOCCHC303	Fundamentals of Biochemistry	CC-7	M.KS.
BZOOCCHC401	Comparative Anatomy of Vertebrates	CC-8	R.M
BZOOCCHC402	Animal Physiology: Life Sustaining Systems	CC-9	M.KS.
BZOOCCHC403	Immunology	CC-10	M.KS.
BZOOCCHC501	Molecular Biology	CC-11	M.KS.
BZOOCCHC502	Principles of Genetics	CC-12	M.KS.
BZOOCCHC601	Developmental Biology	CC-13	M.KS.
BZOOCCHC602	Evolutionary Biology	CC-14	R.M
BZOOSEHT305	Aquarium Fish Keeping	SEC-1	M.KS.
BZOOSEHT405	Sericulture	SEC-2	R.M
BZOODSHC1	Animal Biotechnology	DSE-1	M.KS.
BZOODSHC2	Fish and Fisheries	DSE-2	M.KS.
BZOODSHC3	Wild Life Conservation and Management	DSE-3	R.M
BZOODSHC4	Parasitology	DSE-4	R.M
BZOODSHC5	Animal Behaviour and Chronobiology	DSE-5	R.M
BZOODSHC6	Bio statistics and Bio informatics	DSE-6	M.KS.

M.KS.: Dr. MANAB KUMAR SAHA,

R.M: Mr. RAMANATH MAHATO



SIDHO-KANHO-BIRSHA UNIVERSITY

Purulia, West Bengal, India

CURRICULUM

Under Choice Based Credit System (w.e.f session 2017-2018)

**BACHELOR OF SCIENCE(BSC)
HONOURS
IN
ZOOLOGY**

BACHELOR OF SCIENCE(BSC) HONOURS IN ZOOLOGY

NOTE: ** refers the **Course Code** of the selected course from the pool of choices

First Semester				
Course Code	Course Title	Course Type	(L-P-Tu)	Credit
BZOOCCHC101	1.1 Core T1 – Non-chordates I: Protista to Pseudocoelomates	CC-1	4-2-0	6
BZOOCCHC102	Core T2 – Perspectives in Ecology	CC-2	4-2-0	6
**103	One from pool of Generic Electives	GE-1		6
BAECCEST104	Environmental Studies	AECC-1	2-2-0	4
Total				22
Second Semester				
Course Code	Course Title	Course Type	(L-P-Tu)	Credit
BZOOCCHC201	Non-Chordates II: Coelomates	CC-3	4-2-0	6
BZOOCCHC202	Cell Biology	CC-4	4-2-0	6
**203	One from pool of Generic Electives	GE-2		6
**204	One from pool of AECC-MIL (ENGLISH / MIL)	AECC-2	2-0-0	2
Total				20
Third Semester				
Course Code	Course Title	Course Type	(L-P-Tu)	Credit
BZOOCCHC301	Diversity of Chordata	CC-5	4-2-0	6
BZOOCCHC302	Animal Physiology: Controlling & Coordinating Systems	CC-6	4-2-0	6
BZOOCCHC303	Fundamentals of Biochemistry	CC-7	4-2-0	6
**304	One from pool of Generic Electives	GE-3		6
BZOOSEHT305	Aquarium Fish Keeping	SEC-1	2-0-0	2
Total				26
Fourth Semester				
Course Code	Course Title	Course Type	(L-P-Tu)	Credit
BZOOCCHC401	Comparative Anatomy of Vertebrates	CC-8	4-2-0	6
BZOOCCHC402	Animal Physiology: Life Sustaining Systems	CC-9	4-2-0	6

BZOOCCHC403	Immunology	CC-10	4-2-0	6
**404	One from pool of Generic Electives	GE-4		6
BZOOSEHT405	Sericulture	SEC-2	2-0-0	2
Total				26
Fifth Semester				
Course Code	Course Title	Course Type	(L-P-Tu)	Credit
BZOOCCHC501	Molecular Biology	CC-11	4-2-0	6
BZOOCCHC502	Principles of Genetics	CC-12	4-2-0	6
**503	One from pool of Discipline Specific Electives	DSE-1		6
**504	One from pool of Discipline Specific Electives	DSE-2		6
Total				24
Sixth Semester				
Course Code	Course Title	Course Type	(L-P-Tu)	Credit
BZOOCCHC601	Developmental Biology	CC-13	4-2-0	6
BZOOCCHC602	Evolutionary Biology	CC-14	4-2-0	6
**603	One from pool of Discipline Specific Electives	DSE-3		6
**604	One from pool of Discipline Specific Electives	DSE-4		6
Total				24



SIDHO-KANHO-BIRSHA UNIVERSITY
Curriculum

BACHELOR OF SCIENCE(BSC) HONOURS IN ZOOLOGY (Continued)

List of Discipline Specific Electives

Available in Semester	DSE Ref Code	DSE Course Code (**)	Course Title	(L-P-Tu)	Credit
V	BZOODSHC1	BZOODSHC	Animal Biotechnology	4-2-0	6

V	BZOODSHC2	BZOODSHC	Fish and Fisheries	4-2-0	6
V	BZOODSHC3	BZOODSHC	Wild Life Conservation and Management	4-2-0	6
VI	BZOODSHC4	BZOODSHC	Parasitology	4-2-0	6
VI	BZOODSHC5	BZOODSHC	Animal Behaviour and Chronobiology	4-2-0	6
VI	BZOODSHC6	BZOODSHC	Bio statistics and Bio informatics	4-2-0	6



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Curriculum

BACHELOR OF SCIENCE(BSC) HONOURS IN ZOOLOGY (Continued)

List of AECC-MIL Courses

AECC-MIL Course Code (**)	Course Title	Offered By Department	(L-P- Tu)	Credit
BAECCLT	English Communication	ENGLISH	2-0-0	2
BAECCLBT	BANGLA BHASAR BHASIK SANGJOG বাংলা ভাষার ভাষিক যোগ সংযোগ	BENGALI	2-0-0	2
BAECCLHT	Hindi bhasa aur sampreshan AECC (MIL) : हिन्दी भाषा और सम्प्रेषण	HINDI	2-0-0	2

BACHELOR OF SCIENCE(BSC) HONOURS IN ZOOLOGY
SIDHO-KANHO-BIRSHA UNIVERSITY SYLLABUS AND CURRICULUM OF UG CBCS (w.e.f. 2017-2018)

Title:

1.1 Core T1 – Non-chordates I: Protista to Pseudocoelomates

Syllabus:**1.1 Core T1 – Non-chordates I: Protista to Pseudocoelomates****Non-Chordates I: Protists to Pseudocoelomates****4 Credits****Unit 1: Basics of Animal Classification**

1. Definitions: Classification, Systematics and Taxonomy; Taxonomic Hierarchy, Taxonomic types
2. Codes of Zoological Nomenclature; Principle of priority; Synonymy and Homonymy; Six kingdom concept of classification (Carl Woese)

Unit 2: Protista and Metazoa

1. Protozoa
 1. General characteristics and Classification up to phylum (according to Levine et. al., 1981) Locomotion in *Euglena*, *Paramecium* and *Amoeba*; Conjugation in *Paramecium*.
 2. Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica*
2. Metazoa
 1. Evolution of symmetry and segmentation of Metazoa

Unit 3: Porifera

General characteristics and Classification up to classes; Canal system and spicules in sponges

Unit 4: Cnidaria

1. General characteristics and Classification up to classes
2. Metagenesis in *Obelia*
3. Polymorphism in Cnidaria
4. Corals and coral reef diversity, function & conservation

Unit 5: Ctenophora

General characteristics

Unit 6: Platyhelminthes

1. General characteristics and Classification up to classes
2. Life cycle and pathogenicity and control measures of *Fasciola hepatica* and *Taenia solium*

Unit 7: Nematoda

1. General characteristics and Classification up to classes
2. Life cycle, and pathogenicity and control measures of *Ascaris lumbricoides* and *Wuchereria bancrofti*
3. Parasitic adaptations in helminthes

Classification for metazoans to be followed from: Rupert and Barnes, 1994, 6th Edition.

1.1 Core P1 – Non-Chordates I Lab

Non-Chordates I: Protists to Pseudocoelomates

2 credits

List of Practical

Identification of Amoeba, Euglena, Entamoeba, Opalina, Paramecium, Plasmodium vivax and Plasmodium falciparum (from the prepared slides)

Identification of Sycon, Neptune's Cup, Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora

Identification and significance of adult Fasciola hepatica, Taenia solium and Ascaris lumbricoides

Staining/mounting of any protozoa/helminth from gut of cockroach

Reading References:

1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.

2. Invertebrates by Brusca&Brusca. Second edition, 2002.

Title:

Core T2 – Perspectives in Ecology

Syllabus:

Unit 1: Introduction to Ecology

History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of Physical factors, The Biosphere.

Unit 2: Population

Unitary and Modular populations Unique and group attributes of population: Demographic factors, life tables, fecundity tables, survivorship curves, dispersal and dispersion.

Geometric, 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.

Unit 3: Community

Community characteristics: species diversity, abundance, , dominance, richness, Vertical stratification, Ecotone and edge effect. Ecological succession with one example

Unit 4: Ecosystem

Types of ecosystem with an 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

Unit 5: Applied Ecology

Wildlife Conservation (in-situ and ex-situ conservation).Management strategies for tiger conservation; Wild life protection act (1972)

List of Practical

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided
2. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Wiener diversity index for the same community
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 CO₂
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary/Sea coast

Reading References:

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
 - ▶ Ecology: Theories & Application (2001). 4th Edition by Peter Stilling.
 - ▶ Ecology by Cain, Bowman & Hacker. 3rd edition. Sinauer associates
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Title: Fundamentals of Environmental Studies

Syllabus:

Unit 1: Basics of Environmental Studies (05 lectures)

Definition, Nature, Scope and Importance; Components of environment: Environmental education

Unit 2: Natural Resources: Renewable and Nonrenewable Resources (10 lectures)

Nature and natural resources their conservation and associated problems:

- Forest resources: Uses, types and importance, Joint Forest Management & Tribal population, Deforestation and its effects
- Water resources: Distribution of water on Earth; Use, over exploitation of surface and ground water; Dams: Benefits and problems; Flood and Drought
- Mineral resources: Mineral resources in India; Use and exploitation, Social impacts of mining
- Food resources: World food problems and food insecurities.
- Energy resources: Renewable and Nonrenewable energy sources; Use of alternate energy sources - Case studies
- Land resources: Land as a resource; Land degradation, landslides, soil erosion, desertification
- Use of resources for sustainable development

Unit 3: Ecology and Ecosystems (08 lectures)

Concept of ecology, Population ecology, Community ecology

- Concept of an ecosystem, different types of ecosystem
- Food chains, food webs and ecological succession
- Energy flow in the ecosystem and energy flow models

Unit 4: Biodiversity and its conservation (08 lectures)

- Biodiversity: Levels of biological diversity
- Values of biodiversity

- Hot-Spots of biodiversity, Mega-biodiversity countries
- Threat to biodiversity
- Threatened and endemic species of India
- Conservation of biodiversity (*In-situ* and *Ex-situ*)
- Ecosystem services: Ecological, Economical, Social, Ethical, Aesthetical and Informational values

Unit 5: Environmental Pollution and Management (08 lectures)

(a) Nature, Causes, Effects and Control measures of –

- (i) Air pollution (ii) Water pollution (iii) Soil pollution (iv) Noise pollution
v) Nuclear hazards

(b) Fireworks Pollution: Definition, Composition/Ingredients, effects, monitoring strategies

- Solid waste management: Causes, effects and disposal methods; Management of biomedical and municipal solid wastes
- Disaster management: Floods, Earthquake, Cyclone and Landslides

Unit 6: Environmental Policies and Practices (10 lectures)

- Constitutional Provisions for protecting environment- Articles 48(A), 51 A (g)
- Environmental Laws: The Environment (Protection) Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981; The Water (Prevention and Control of Pollution) Act 1974; Forest (Conservation) Act, 1980
- The wildlife Protection Act, 1972
- Climate change, Global warming, ENSO, Acid rain, Ozone layer depletion; Montreal and Kyoto Protocols

Unit 7: Human Communities and Environment (06 lectures)

- Human population growth; Impacts on environment
- Population explosion – Family Welfare Programme
- Environment and human health: Concept of health and disease; Common communicable and Non- communicable diseases; Public awareness
- Environment movements in India: Chipko Movements, Silent Valley Movement, Movements in Karnataka

Unit 8: Field Work Report/Project Report/Term paper (based on any one of the following topics and to be evaluated by internal teachers

only) (05 lectures)

- Environmental assets - River/Forest/Grassland/Hill/Mountain *etc.*
 - Environmental pollution - Urban/Rural/Industrial/Agricultural
 - Study of common Plants/Insect /Birds/Wild life *etc.*
 - Study of simple ecosystems: Pond/River/Hill slope *etc.*
 - Municipal solid waste management and handling.
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Title: Non-Chordates II: Coelomates

Syllabus:

Unit 1: Introduction

Evolution of coelom and metamerism

Unit 2: Annelida

General characteristics and Classification up to classes Excretion in Annelida through nephridia. Metamerism in Annelida.

Unit 3: Arthropoda

1. General characteristics and Classification up to classes. Vision in Insecta.
2. Respiration in Arthropoda (Gills in prawn and trachea in cockroach)
3. Metamorphosis in Lepidopteran Insects.
4. Social life in termite

Unit 4: Onychophora

General characteristics and Evolutionary significance

Unit 5: Mollusca

1. General characteristics and Classification up to classes
2. Nervous system and torsion in Gastropoda
3. Feeding and respiration in *Pila* sp

Unit 6: Echinodermata

1. General characteristics and Classification up to classes
2. Water-vascular system in Asteroidea
3. Larval forms in Echinodermata
4. Affinities with Chordates

Unit 7: Hemichordata

General characteristics of phylum Hemichordata. Relationship with non-chordates and chordates

Note: Classification to be followed from Rupert and Barnes, 1994, 6th Edition.

List of Practical

1. Study of following specimens:
 1. Annelids - *Aphrodite*, *Nereis*, *Heteronereis*, *Sabella*, *Serpula*, *Chaetopterus*, *Pheretima*, *Hirudinaria*
 1.
 1. Arthropods - *Limulus*, *Palamnaeus*, *Palaemon*, *Daphnia*, *Balanus*, *Sacculina*, *Cancer*, *Eupagurus*, *Scolopendra*, *Julus*, *Bombyx*, *Periplaneta*, termites and honey bees *Onychophora* - *Peripatus*
 2. Molluscs - *Chiton*, *Dentalium*, *Pila*, *Doris*, *Helix*, *Unio*, *Ostrea*, *Pinctada*, *Sepia*, *Octopus*, *Nautilus*
 1.
 1. Echinodermates - *Pentaceros/Asterias*, *Ophiura*, *Clypeaster*, *Echinus*, *Cucumaria*
1.
 1. *Antedon*
 2. Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm
 3. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm
 4. Mount of mouth parts and dissection of digestive system and nervous system of

*Periplaneta**

1. To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm)

Reading References:

1. and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition
- The Invertebrates: A New Synthesis, III Edition, Blackwell Science
-

Title: Cell Biology

Syllabus:

Unit 1: Overview of Cells

Basic structure of Prokaryotic and Eukaryotic cells, Viruses, Viroid, Prion and Mycoplasma

Unit 2: Plasma Membrane

1. Ultra structure and composition of Plasma membrane: Fluid mosaic model
2. Transport across membrane: Active and Passive transport, Facilitated transport
3. Cell junctions: Tight junctions, Gap junctions, Desmosomes

Unit 3: Cytoplasmic organelles I

1. Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes
2. Protein sorting and mechanisms of vesicular transport

Unit 4: Cytoplasmic organelles II

1. Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis
Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis
2. Peroxisomes: Structure and Functions

Unit 5: Nucleus

1. Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus
2. Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)

Unit 6: Cell Division

Type, structure and functions of cytoskeleton, Centrosome: Structure and Functions, Accessory proteins of microfilament & microtubule, Cell cycle and its regulation, Cancer (Concept of oncogenes and tumor suppressor genes with special reference to p53, Retinoblastoma and Ras and APC. Mitosis and Meiosis: Basic process and their significance

Unit 7: Cell Signaling

1. Cell signalling transduction pathways; Types of signaling molecules and receptors
2. GPCR and Role of second messenger (cAMP)
3. Extracellular matrix-Cell interactions
4. Apoptosis and Necrosis

List of Practical

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis.
3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
4. Preparation of permanent slide to demonstrate:
 1. DNA by Feulgen reaction/ By Ethidium Bromide
 2. Cell viability study by Trypan Blue staining

Reading References:

Lewin's Cells – 3rd Edition – Cassimeris/Lingappa/Plopper – Johns & Bartlett Publishers

► Biology of Cancer by Robert. A. Weinberg. 2nd edition.

► 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.

► 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.

Title: Diversity of Chordata

Syllabus:

Unit 1: Introduction to Chordates

General characteristics and outline classification of Phylum Chordata

Unit 2: Protochordata

General characteristics and classification of sub-phylum Urochordata and Cephalochordata up to Classes. Retrogressive metamorphosis in *Ascidia*. Chordate Features and Feeding in *Branchiostoma*

Unit 3: Origin of Chordata

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

Unit 4: Agnatha

General characteristics and classification of cyclostomes up to order

Unit 5: Pisces

1. General characteristics and classification of Chondrichthyes and Osteichthyes up to Subclasses
2. Accessory respiratory organ, migration and parental care in fishes
3. Swim bladder in fishes.

Unit 6: Amphibia

1. General characteristics and classification up to living Orders.

2. Metamorphosis and parental care in Amphibia

Unit 7: Reptilia

1. General characteristics and classification up to living Orders
1. Poison apparatus and Biting mechanism in Snake

Unit 8: Aves

1. General characteristics and classification up to Sub-Classes
2. Exoskeleton and migration in Birds
3. Principles and aerodynamics of flight

Unit 9: Mammals

1. General characters and classification up to living orders
2. Affinities of Prototheria
3. Exoskeleton derivatives of mammals
4. Adaptive radiation in mammals with reference to locomotor appendages
5. Echolocation in Chiropterans and Cetaceans

Unit 10: Zoogeography

Zoogeographical realms, Plate tectonic and Continental drift theory, distribution of birds and mammals in different realms

Note: Classifications for Protochordata, Agnatha, Reptilia, Aves and Mammalia to be followed from Young (1981), for Pisces to be followed from Nelson (1994), for Amphibia to be followed from Duellman and Trueb (1986).

List of Practical

1. Protochordata

Balanoglossus, Herdmania, Branchiostoma

1. Agnatha

Petromyzon, Myxine

1. Fishes

Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeineis, Anguilla, Hippocampus, Tetradon/ Diodon, Anabas, Flat fish

1. Amphibia

Necturus, Bufo, Hyla, Alytes, Axolotl, Tylotriton

1. Reptilia

Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus. Key for Identification of poisonous and non-poisonous snakes

1. Mammalia: Bat (Insectivorous and Frugivorous), *Funambulus*
2. Pecten from Fowl head
3. Dissection of brain and pituitary of Tilapia
4. Power point presentation on study of any two animals from two different classes by students (may be included if dissections not given permission)

Title: Animal Physiology: Controlling & Coordinating Systems

Syllabus:

Unit 1: Tissues

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

Unit 2: Bone and Cartilage

Structure and types of bones and cartilages, Ossification

Unit 3: Nervous System

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

Unit 4: Muscular system

Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle fibre

Unit 5: Reproductive System

Histology of testis and ovary (mammalian), Physiology of Reproduction (mammalian)

Unit 6: Endocrine System

1. Histology and function of pituitary, thyroid, pancreas and adrenal
2. Classification of hormones; Mechanism of Hormone action
3. Signal transduction pathways for Steroidal and Non steroidal hormones
4. Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system

5. Placental hormones

List of Practical

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

Reading References:

Reference Books

- ▶ Histology: A Text and Atlas. Sixth Edition. Ross & Pawlina. Lippincott Williams & Wilkins.
 - ▶ Eckert Animal Physiology by David Randall and Warren Burggren. 4th edition. W.H. Freeman.
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Title: Fundamentals of Biochemistry

Syllabus:

Unit 1: Carbohydrates

1. Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides; Derivatives of Monosaccharides
2. Carbohydrate metabolism: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis

Unit 2: Lipids

1. Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Sphingolipid, Glycolipids, Steroids, Eicosanoids and terpenoids.
2. Lipid metabolism: β -oxidation of fatty acids; Fatty acid biosynthesis

Unit 3: Proteins

1. Amino acids

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

1. Proteins

Bonds stabilizing protein structure; Levels of organization

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

Unit 4: Nucleic Acids

1. Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids
2. Types of DNA and RNA, Complementarity of DNA, Hypo- Hyperchromaticity of DNA
3. Basic concept of nucleotide metabolism

Unit 5: Enzymes

Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Derivation of Michaelis-Menten equation, Lineweaver-Burk plot; Factors affecting rate of enzyme-catalyzed reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Strategy of enzyme action- Catalytic and Regulatory (Basic concept with one example each)

Unit 6: Oxidative Phosphorylation

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

List of Practical

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.
2. Quantitative estimation of Lowry Method
3. Demonstration of proteins separation by SDS-PAGE.
4. To study the enzymatic activity of Trypsin and Amylase.

5. Preparation of Normal. Molar and Standard solutions, Phosphate Buffers, Serial dilutions

Reading References:

Reference Books

- ▶ 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.
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Title: Aquarium Fish Keeping

Syllabus:

Unit 1: Introduction to Aquarium Fish Keeping

The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes

Unit 2: Biology of Aquarium Fishes

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 and Butterfly fish

Unit 3: Food and feeding of Aquarium fishes

Use of live fish feed organisms. Preparation and composition of formulated fish feeds, Aquarium fish as larval predator

Unit 4: Fish Transportation

Live fish transport - Fish handling, packing and forwarding techniques.

Unit 5: Maintenance of Aquarium

General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry

Title: Comparative Anatomy of Vertebrates

Syllabus:

Unit 1: Integumentary System

Structure, function and derivatives of integument in amphibian, birds and mammals

Unit 2: Skeletal System

Overview of axial and appendicular skeleton; Jaw suspension; Visceral arches.

Unit 3: Digestive System

Comparative anatomy of stomach; dentition in mammals

Unit 4: Respiratory System

Respiratory organs in fish, amphibian, birds and mammals

Unit 5: Circulatory System

General plan of circulation, Comparative account of heart and aortic arches

Unit 6: Urinogenital System

Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri

Unit 7: Nervous System

Comparative account of brain, Cranial nerves in mammals

Unit 8: Sense Organs

Classification of receptors, Brief account of auditory receptors in vertebrate

List of Practical

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
2. Study of disarticulated skeleton of Toad, Pigeon and Guineapig
3. Demonstration of Carapace and plastron of turtle
4. Identification of mammalian skulls: One herbivorous (Guineapig) and one carnivorous (Dog) animal
5. Dissection of Tilapia: Digestive system, Brain, pituitary, urinogenital system

Reading References:

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

Saxena, R.K. & Saxena, S.C. (2008) : Comparative Anatomy of Vertebrates, Viva Books Pvt.

Title: Animal Physiology: Life Sustaining Systems

Syllabus:

Unit 1: Physiology of Digestion

Structural organisation and functions of Gastrointestinal tract and Associated glands; Mechanical and chemical digestion of food, absorption of Carbohydrates, Lipids, Proteins and Nucleic Acids; Digestive enzymes

Unit 2: Physiology of Respiration

Mechanism of Respiration, Respiratory volumes and capacities, transport of Oxygen and Carbon dioxide in blood, Dissociation curves and the factors influencing it, respiratory pigments; Carbon monoxide poisoning

Unit 3: Physiology of Circulation

1. Components of Blood and their functions; Structure and functions of haemoglobin
 2. Haemostasis; Blood clotting system, Fibrinolytic system
 3. Haemopoiesis; Basic steps and its regulation
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1. Blood groups; ABO and Rh factor

Unit 4: Physiology of Heart

1. Structure of mammalian heart, Coronary Circulation, Structure and working of conducting myocardial fibres, Origin and conduction of cardiac impulses
2. Cardiac Cycle and cardiac output
3. Blood pressure and its regulation

Unit 5: Thermoregulation & Osmoregulation

1. Physiological classification based on thermal biology.
2. Thermal biology of endotherms
3. Osmoregulation in aquatic vertebrates
4. Extrarenal osmoregulatory organs in vertebrates

Unit 6: Renal Physiology

Structure of Kidney and its functional unit, Mechanism of urine formation, Regulation of acid-base balance

List of Practical

1. Enumeration of red blood cells and white blood cells using haemocytometer
2. Estimation of haemoglobin using Sahli's haemoglobinometer
3. Preparation of haemin and haemochromogen crystals
4. Recording of blood pressure using a sphygmomanometer

Reading References:

Reference Books

► 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,
 - ▶ Eckert Animal Physiology: Mechanisms and adaptations Randall, Burggren and French Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills
 - 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
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Title: Immunology

Syllabus:

Unit 1: Overview of Immune System

Basic concepts of health and diseases, Historical perspective of Immunology, Cells and organs of the Immune system

Unit 2: Innate and Adaptive Immunity

Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral).

Unit 3: Antigens

Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes

Unit 4: Immunoglobulins

Structure and functions of different classes of immunoglobulins, Antigen- antibody interactions, Immunoassays (ELISA and RIA), Hybridoma technology, Monoclonal antibody production

Unit 5: Major Histocompatibility Complex

Structure and functions of MHC molecules.

Structure of T cell Receptor and its signalling, T cell development & selection

Unit 6: Cytokines

Types, properties and functions of cytokines.

Unit 7: Complement System

Components and pathways of complement activation.

Unit 8: Hypersensitivity

Gell and Coombs' classification and brief description of various types of hypersensitivities.

Unit 9: Immunology of diseases

Dengue and Tuberculosis, Leprosy

Unit 10: Vaccines

Various types of vaccines. Active & passive immunization (Artificial and natural).

List of Practical

1. Demonstration of lymphoid organs.
2. Histological study of spleen, thymus and lymph nodes through slides/ photographs
3. Preparation of stained blood film to study various types of blood cells.
4. ABO blood group determination.
5. Demonstration of ELISA

The experiments can be performed depending upon usage of animals in UG courses.

Reading References:

Reference Books

- ▶ Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.
 - Abbas, K. Abul and Lichtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication.
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Title: Sericulture

Syllabus:

Unit 1: Introduction

1. Sericulture: Definition, history and present status; Silk route
2. Types of silkworms, Distribution and Races
3. Exotic and indigenous races
4. Mulberry and non-mulberry Sericulture

Unit 2: Biology of Silkworm

1. Life cycle of *Bombyx mori*
2. Structure of silk gland and secretion of silk

Unit 3: Rearing of Silkworms

1. Selection of mulberry variety and establishment of mulberry garden
2. Rearing house and rearing appliances.
3. Disinfectants: Formalin, bleaching powder, RKO
4. Silkworm rearing technology: Early age and Late age rearing
5. Types of mountages
6. Spinning, harvesting and storage of cocoons

Unit 4: Pests and Diseases

1. Pests of silkworm: Uzi fly, dermestid beetles and vertebrates
2. Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial
3. Control and prevention of pests and diseases

Unit 5: Entrepreneurship in Sericulture

1. Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture
2. Visit to various sericulture centres.

Title: Molecular Biology

Syllabus:

Unit 1: Nucleic Acids

Salient features of DNA and RNA Watson and Crick Model of DNA

Unit 2: DNA Replication

Mechanism of DNA Replication in Prokaryotes, Semi-conservative, bidirectional and discontinuous Replication, RNA priming, Replication of telomeres

Unit 3: Transcription

Mechanism of Transcription in prokaryotes and eukaryotes, Transcription factors, Difference between prokaryotic and eukaryotic transcription.

Unit 4: Translation

Mechanism of protein synthesis in prokaryotes, Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation

Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA

Capping and Poly A tail formation in mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA

Unit 6: Gene Regulation

Regulation of Transcription in prokaryotes: *lac* operon and *trp* operon; Regulation of Transcription in eukaryotes: Activators, enhancers, silencer, repressors, miRNA mediated gene silencing, Genetic imprinting

Unit 7: DNA Repair Mechanisms

Types of DNA repair mechanisms, RecBCD model in prokaryotes, nucleotide and base excision repair, SOS repair

Unit 8: Molecular Techniques

PCR, Western and Southern blot, Northern Blot, Sanger DNA sequencing

List of Practical

1. Demonstration of polytene and lampbrush chromosome from photograph
2. Isolation and quantification of genomic DNA using spectrophotometer (A260 measurement)
3. Agarose gel electrophoresis for DNA

Reading References:

Reference Books

- ▶ Molecular Cell Biology by Harvey Lodish. 7th Edition. W.H. Freeman.
 - ▶ Molecular Biology Of The Gene by Watson. 7th Edition. Pearson.
 - ▶ iGenetics: A Molecular Approach by Peter. J. Russell. 3rd edition. Pearson Benjamin Cummings.
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Title: Principles of Genetics

Syllabus:

Unit 1: Mendelian Genetics and its Extension

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

Unit 2: Linkage, Crossing Over and Chromosomal Mapping

Linkage and Crossing Over, molecular basis of crossing over, Measuring Recombination frequency and linkage intensity using three factor crosses, Interference and coincidence

Unit 3: Mutations

Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one suitable example of each), Non-disjunction and variation in chromosome number; Molecular basis of mutations in relation to UV light and chemical mutagens

Unit 4: Sex Determination

1. Mechanisms of sex determination in *Drosophila*
2. Sex determination in mammals
3. Dosage compensation in *Drosophila* & Human

Unit 5: Extra-chromosomal Inheritance

1. Criteria for extra chromosomal inheritance, Antibiotic resistance in *Chlamydomonas*,
2. Kappa particle in *Paramecium*
3. Shell spiralling in snail

Unit 6: Recombination in Bacteria and Viruses

Conjugation, Transformation, Transduction, Complementation test in Bacteriophage

Unit 7: Transposable Genetic Elements

Transposons in bacteria, Ac-Ds elements in maize and P elements in *Drosophila*, LINE, SINE, Alu elements in humans

List of Practical

1. Chi-square analyses
2. Linkage maps based on conjugation
3. Identification of chromosomal aberration in *Drosophila* and man from photograph
4. Pedigree analysis of some human inherited traits

Reading References:

Reference Books

- ▶ Developmental biology by Scott.F.Gilbert, 9th edition.

- ▶ 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.
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Title: Developmental Biology

Syllabus:

Unit 1: Introduction

Basic concepts: Phases of Development, Cell cell interaction, Differentiation and growth, Differential gene expression

Unit 2: Early Embryonic Development

Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and 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)

Unit 4: Post Embryonic Development

Development of brain and Eye in Vertebrate

Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each)

Unit 5: Implications of Developmental Biology

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

List of Practical

1. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
2. Study of the developmental stages and life cycle of Drosophila from stock culture
3. Study of different sections of placenta (photomicrograph/ slides)
4. Project report on Drosophila culture/chick embryo development

Reading References:

Reference Books

- ▶ Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
 - ▶ Slack JMW , Essential Developmental Biology
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Title: Evolutionary Biology

Syllabus:

Unit 1

Life's Beginnings: Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Evolution of eukaryotes

Unit 2

Historical review of Evolutionary concepts, Lamarckism, Darwinism and Neo Darwinism

Unit 3

1. Geological time scale, Fossil records of Hominids (from *Australopithecus* to *Homo sapiens*), evolution of horse
2. Neutral theory of molecular evolution, Molecular clock

Unit 4

Sources of variations: Heritable variations and their role in evolution

Unit 5

1. Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to biallelic Population); Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, types of selection, selection coefficient, mode of selection heterozygous superiority).
2. Genetic Drift mechanism (founder's effect, bottleneck phenomenon)
3. Role of Migration and Mutation in changing allele frequencies.

Unit 6

Species concept, Isolating mechanisms, modes of speciation
Adaptive radiation/macroevolution (exemplified by Galapagos finches)

Unit 7

Extinctions, Back ground and mass extinctions (causes and effects), detailed example of K-T extinction

Unit 8

1. Origin and Evolution of Man, Unique Hominin characteristics contrasted with primate characteristic
2. Molecular analysis of human origin

Unit 9

Phylogenetic trees, Construction & interpretation of Phylogenetic tree using parsimony, Convergent & Divergent evolution.

List of Practical

1. Study of fossils from models/ pictures
2. Study of homology and analogy from suitable specimens
3. Study and verification of Hardy-Weinberg Law by chi square analysis

4. Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.

Reading References:

Reference Books

- ▶ Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.
 - ▶ Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
 - ▶ Genetics: A Molecular Approach. 3rd edition. Peter.J.Russell.
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BACHELOR OF SCIENCE(BSC) HONOURS IN ZOOLOGY (Continued)

List of Discipline Specific Electives

Title: Animal Biotechnology

Syllabus:

Unit 1: Introduction

Concept and scope of Biotechnology. Organization of prokaryotic and eukaryotic genome, Concept of genomics

Unit 2: Molecular Techniques in Gene manipulation

1. Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics).Restriction enzymes: Nomenclature, detailed study of Type II. Transformation techniques: Calcium chloride method and electroporation. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization
2. Southern, Northern and Western blotting
3. DNA sequencing: Sanger method
4. Polymerase Chain Reaction, DNA Finger Printing and DNA micro array

Unit 3: Genetically Modified Organisms

1. Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection.
2. Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock out mice.

Unit 4: Culture Techniques and Applications

Animal cell culture, Expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia)

List of Practical

1. Genomic DNA isolation from E. coli/Blood genomic
2. Plasmid DNA isolation (pUC 18/19) from E. coli

3. Restriction digestion of plasmid DNA.
4. Construction of circular and linear restriction map from the data provided.
5. Calculation of transformation efficiency from the data provided.
6. To study following techniques through photographs
 1. Southern Blotting
 2. Northern Blotting
 3. Western Blotting
 4. DNA Sequencing (Sanger's Method)
 5. PCR
 6. DNA fingerprinting
7. Project report on animal cell culture

Reading References:

- Brown, T.A. (1998). Molecular Biology Labfax II: Gene Cloning and DNA Analysis. II Edition, Academic Press, California, USA.
- ▶ Glick, B.R. and Pasternak, J.J. (2009). Molecular Biotechnology - Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA.
 - ▶ Weaver. Molecular Biology of Gene. 5th edition.

Primrose & Twyman. Principles of Gene Manipulation and Genomics. 7th edition.

Title: Fish and Fisheries

Syllabus:

Unit 1: Introduction and Classification

1. General description of fish
2. Feeding habit, habitat and manner of reproduction
3. Classification of fish (up to Subclasses)

Unit 2: Morphology and Physiology

Types of fins and their modifications; Locomotion in fish; Hydrodynamics; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy; Osmoregulation in Elasmobranchs; Reproductive strategies (special reference to Indian fish); Electric organ, Bioluminescence

Unit 3: Fisheries

Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations

Unit 4: Aquaculture

Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products

Unit 5: Fish in research

Transgenic fish, Sex reversal

Note: Classification to be followed from: Nelson (2004)

List of Practical

1. Morphometric and meristic characters of fishes
2. Study of *Petromyzon*, *Myxine*, *Pristis*, *Chimaera*, *Exocoetus*, *Hippocampus*, *Gambusia*, *Labeo*, *Heteropneustes*, *Anabas*
3. Study of different types of scales (through permanent slides/ photographs).
4. Study of crafts and gears used in Fisheries
5. Water quality criteria for Aquaculture: Assessment of pH, Conductivity, Turbidity, Alkalinity, Salinity
6. Study of air breathing organs in *Channa*, *Heteropneustes*, *Anabas* and *Clarias*
7. Project Report on a visit to any fish farm/ pisciculture unit.

Reading References:

Q Bone and R Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.

▶ D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK von der Emde, R.J. Mogdans and B.G. Kapoor. The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands

▶ C.B.L. Srivastava, Fish Biology, Narendra Publishing House

▶ J.R. Norman, A history of Fishes, Hill and Wang Publishers

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

Title: Wild Life Conservation and Management

Syllabus:

Unit 1: Introduction to Wild Life

Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.

Unit 2: Evaluation and management of wild life

Habitat analysis, Physical parameters: Topography, Geology, Soil and water Biological Parameters: food, cover, forage, browse and cover estimation Standard evaluation procedures: remote sensing and GIS.

Unit 3: Management of habitats

Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity Restoration of degraded habitats

Unit 4: Population estimation

Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores; Pug marks and census method.

Unit 5: Aims and objectives of wildlife conservation

Wildlife conservation in India – through ages; different approaches of wildlife conservation; modes of conservation; in-situ conservation and ex-situ conservation: necessity for wildlife conservation

Unit 6: Management planning of wild life in protected areas

Estimation of carrying capacity; Eco tourism / wild life tourism in forests; Concept of climax persistence; Ecology of perturbation.

Unit 7: Man and Wildlife

Causes and consequences of human-wildlife conflicts; mitigation of conflict – an overview; Management of excess population

Unit 8: Protected areas

National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.

List of Practical

1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers, etc.
4. Demonstration of different field techniques for flora and fauna
5. PCQ, ten tree method, Circular, Square & rectangular plots, Parker's 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
6. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)

Reading References:

Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.

► Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). People and Wildlife, Conflict or Co-existence? Cambridge University.

► Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5th edition. The Wildlife Society, Allen Press.

► Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences

► Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing.

Title: Parasitology

Syllabus:

Unit 1: Introduction to Parasitology

Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship

Unit 2: Parasitic Protists

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani*

Unit 3: Parasitic Platyhelminthes

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Schistosoma haematobium*, *Taenia sajinata*

Unit 4: Parasitic Nematodes

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti* and *Trichinella spiralis*, *Brugia malayi*; Nematode plant interaction; Gall formation

Unit 5: Parasitic Arthropods

Biology, importance and control of ticks (Soft tick *Ornithodoros*, Hard tick *Ixodes*), mites (*Sarcoptes*), Lice (*Pediculus*), Flea (*Xenopsylla*) and Bug (*Cimex*)

Unit 5: Parasite Vertebrates

Brief account of Cookicutter Shark, Hood Mocking bird, Vampire bat

List of Practicals

1. Study of life stages of *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani*

through permanent slides/micro photographs

1. Study of adult and life stages of *Schistosoma haematobium*, *Taenia sajinata* through permanent slides/micro photographs
2. Study of adult and life stages of *Ancylostoma duodenale*, *Brugia malayi* and *Trichinella spiralis* through permanent slides/micro photographs
3. Immunopathology of Malaria and Filariasis
4. Study of plant parasitic root knot nematode, Meloidogyne from the soil sample
5. Study of *Pediculus humanus*, *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides/ photographs
6. Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]
7. Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a by-product]

Submission of a brief report on parasitic vertebrates

Reading References:

Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors

E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea & Febiger

Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group

Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi

Rattan Lal Ichhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi

Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers

K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS

Title: Animal Behaviour and Chronobiology

Syllabus:

Unit 1: Introduction to Animal Behaviour

Origin and history of Ethology, Brief profiles of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen Proximate and ultimate causes of behaviour, Methods and recording of a behaviour

Unit 2: Patterns of Behaviour

Stereotyped Behaviours (Orientation, Reflexes); Individual Behavioural patterns; Instinct vs. Learnt Behaviour; Associative learning, classical and operant conditioning, Habituation, Imprinting.

Unit 3: Social and Sexual Behaviour

Social Behaviour: Concept of Society; Communication and the senses

Altruism; Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance.

Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Parental care in fish and amphibian, Parent-offspring conflict.

Unit 4: Introduction to Chronobiology

Historical developments in chronobiology; Biological oscillation: the concept of Average, amplitude, phase and period Adaptive significance of biological clocks

Unit 5: Biological Rhythm

Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms; Concept of synchronization and masking; Photic and non-photic zeitgebers; Circannual rhythms; Photoperiod and regulation of seasonal reproduction of vertebrates; Role of melatonin.

List of Practical

1. To study nests and nesting habits of the birds and social insects.
2. To study the behavioural responses of wood lice to dry and humid conditions.
3. To study geotaxis behaviour in earthworm.
4. To study the phototaxis behaviour in insect larvae.
5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.
6. Study and actogram construction of locomotor activity of suitable animal models.
7. Study of circadian functions in humans (daily eating, sleep and temperature patterns).

Reading References:

Animal Behaviour by Drickamar.

- ▶ John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
 - ▶ Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
 - ▶ Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
 - Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.)R.D. Lewis. (3rdEd) 2002 Baren and Noble Inc. New York, USA
 - ▶ Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.
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Title: Bio statistics and Bio informatics

Syllabus:

Unit 1: Concept of data and distribution

1. Definition of data.
2. Concept of qualitative, quantitative, discrete, continuous, nominal, ordinal, interval and ratio data.
3. Types of distribution: Normal, skewed, uniform, symmetric bimodal, non-symmetric bimodal, spread, spread with outlier.
4. Basic concept and types of Kurtosis.

Unit 2: Probability and its use in Biological Sciences

1. General concept of probability.
2. The sum rule and the product rule.
3. Usage of probability in Biological Sciences (Genetics mainly).

Unit 3: Analytical Methods

1. Correlation.
2. Regression.
3. t Test.

Unit 4: Bioinformatics

1. Basic concept of Bioinformatics: Goals, scope, application and limitations.
2. Biological databases: Primary, secondary, and specialised databases.
3. Pitfalls of biological databases.

List of practical:

1. Calculation of mean, median, mode, standard deviation, and standard error.
2. Construction of bar diagrams and pie diagrams using computer.
3. Submission of a project report on field generated data with application of at least one statistical tool (i.e. correlation, regression, t Test, mean, median, mode, standard deviation, and standard error)

Reading references:

1. Essential Bioinformatics by JinXiong, 1st Edition, 2006, Cambridge University press
 2. Genetics: Analysis and Principles by Robert Brooker, 4th Edition, 2012, McGraw Hill
 3. Biostatistics: A guide to design, analysis and discovery by Ronald Forthofer Eun Lee Mike Hernandez, 2nd Edition, 2006, Academic Press (Elsevier)
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SIDHO-KANHO-BIRSHA UNIVERSITY

Purulia, West Bengal, India

CURRICULUM

Under Choice Based Credit System (w.e.f session 2017-2018)

**BACHELOR OF SCIENCE(BSC)
PROGRAM COURSE
WITH
ZOOLOGY**

NOTE: ** refers the **Course Code** of the selected course from the pool of choices

First Semester				
Course Code	Course Title	Course Type	(L-P-Tu)	Credit
BZOCCRC101	Non-Chordates I: Protists to Pseudocoelomates	CC-1 (Discipline A)	4-2-0	6
102	Discipline B	CC-1 (Discipline B)		6
103	Discipline C	CC-1 (Discipline C)		6
**104	One from pool of AECC-MIL (ENGLISH / MIL)	AECC-1	2-0-0	2
Total				20

Second Semester				
Course Code	Course Title	Course Type	(L-P-Tu)	Credit
BZOCCRC201	Non-Chordates II: Coelomates	CC-2 (Discipline A)	4-2-0	6
202	Discipline B	CC-2 (Discipline B)		6
203	Discipline C	CC-2 (Discipline C)		6
BAECCEST204	Environmental Studies	AECC-2	2-2-0	4
Total				22

Third Semester				
Course Code	Course Title	Course Type	(L-P-Tu)	Credit
BZOCCRC301	Diversity of Chordata	CC-3 (Discipline A)	4-2-0	6
302	Discipline B	CC-3 (Discipline B)		6
303	Discipline C	CC-3 (Discipline C)		6
BZOOSERT304	Aquarium Fish Keeping	SEC-1 (Discipline A)	2-0-0	2
Total				20

Fourth Semester				
Course Code	Course Title	Course Type	(L-P-Tu)	Credit
BZOCCRC401	Comparative Anatomy of Vertebrates	CC-4 (Discipline A)	4-2-0	6
402	Discipline B	CC-4 (Discipline B)		6
403	Discipline C	CC-4 (Discipline C)		6
BZOOSERT404	Sericulture	SEC-2 (Discipline A)	2-0-0	2
Total				20

Fifth Semester				
Course Code	Course Title	Course Type	(L-P-Tu)	Credit
**501	One from pool of Discipline Specific Electives of Zoology	DSE-1 (Discipline A)		6
**502	One from pool of Discipline Specific Electives of Discipline B	DSE-1 (Discipline B)		6
**503	One from pool of Discipline Specific Electives of Discipline C	DSE-1 (Discipline C)		6
BZOOSERT504	Medical Diagnostic Techniques	SEC-3 (Discipline A)	2-0-0	2
Total				20

Sixth Semester				
Course Code	Course Title	Course Type	(L-P-Tu)	Credit
**601	One from pool of Discipline Specific Electives of Zoology	DSE-2 (Discipline A)		6
**602	One from pool of Discipline Specific Electives of Discipline B	DSE-2 (Discipline B)		6
**603	One from pool of Discipline Specific Electives of Discipline C	DSE-2 (Discipline C)		6
BZOOSERT604	Apiculture	SEC-4 (Discipline A)	2-0-0	2
Total				20

DSE Ref Code	DSE Course Code (**)	Course Title	Offered By Department	(L-P-Tu)	Credit
BZOODSRC1	BZOODSRC	Wild Life Conservation and Management	Zoology	4-2-0	6
BZOODSRC2	BZOODSRC	Fish and Fisheries	Zoology	4-2-0	6

GE Reference Code	GE Course Code (**)	Course Title	Offered By Department	(L-P-Tu)	Credit
BSNSGERT1	BSNSGERT	Basic Sanskrit प्राथमिकसंस्कृतम्	SANSKRIT	5-0-1	6
BHISGERT2	BHISGERT	Colonialism and Developments in the Environment: India	HISTORY	5-0-1	6
BENGGERT3	BENGGERT	Selections from English Prose and Poems	ENGLISH	5-0-1	6
BMUCGERT4	BMUCGERT	Preliminary knowledge of Music in practical field	MUSIC	5-0-1	6
BBNGGERT5	BBNGGERT	PRAK-ADHUNIK BANGLA SAHITYER NIRBACHITA PATH প্রাক-আধুনিক বাংলা সাহিত্যের নির্বাচিত পাঠ	BENGALI	5-0-1	6
BBOTGERC6	BBOTGERC	Plant Ecology and Taxonomy	BOTANY	4-2-0	6
BCEMGERC7	BCEMGERC	Atomic Structure, Chemical Periodicity, Acids And Bases, Redox Reactions, General Organic Chemistry & Aliphatic Hydrocarbons	CHEMISTRY	4-2-0	6
BEDCGERT8	BEDCGERT	Philosophical and Sociological Foundations of Education	EDUCATION	5-0-1	6
BECOGERT9	BECOGERT	Introductory Microeconomics	ECONOMICS	5-0-1	6
BMTMGERT10	BMTMGERT	Basics of Higher Mathematics	MATHEMATICS	5-0-1	6
BPHIGERT11	BPHIGERT	Ethics in the Public Domain	PHILOSOPHY	5-0-1	6
BPHSGERC12	BPHSGERC	Mechanics	PHYSICS	4-2-0	6
BPLSGERT13	BPLSGERT	Gandhi and Contemporary World I	POLITICAL SCIENCE	5-0-1	6
BGEOGERT14	BGEOGERT	GE 1 – Climate Change: Vulnerability and Adaptation	GEOGRAPHY	5-0-1	6
BSNTGERT15	BSNTGERT	Introduction of Santali Language Santali Parsi Reyak Uprum	SANTALI	5-0-1	6
BSOCGERT16	BSOCGERT	Indian Society: Images and Realities	SOCIOLOGY	5-0-1	6
BZOOGERC17	BZOOGERC	Animal Diversity	ZOOLOGY	4-2-0	6
BSTSGERT18	BSTSGERT	Probability and Statistics	STATISTICS	5-0-1	6
BHINGERT19	BHINGERT	Kala aur sahitya GEC-1 : कला और साहित्य	HINDI	5-0-1	6
BCOSGERC20	BCOSGERC	Computer Fundamentals	COMPUTER SCIENCE	4-2-0	6
BANTGERC21	BANTGERC	Health Science/Env. Science + Practical	ANTHROPOLOGY	4-2-0	6
BGELGERC22	BGELGERC	Essentials of Geology	GEOLOGY	4-2-0	6
BNUTGERT23	BNUTGERT	Nutritional Physiology and Nutrition and Human Life Cycle	NUTRITION	5-0-1	6
BMCBGERC24	BMCBGERC	INDUSTRIAL AND FOOD MICROBIOLOGY	MICROBIOLOGY	4-2-0	6
BPEDGERT25	BPEDGERT	Yoga Science	PHYSICAL EDUCATION	5-0-1	6
BENVGERT26	BENVGERT	Environment and Society	ENVIRONMENTAL SCIENCE	5-0-1	6

LCC-MIL Reference Code	LCC-MIL Course Code (**)	Course Title	Offered By Department	(L-P-Tu)	Credit
BBNGCCLT 103	BBNGCCLT	KABITA কবিতা	BENGALI	2-0-0	6
BBNGCCLT 303	BBNGCCLT	GALPO গল্প	BENGALI	2-0-0	6
BHINCCLT 103	BHINCCLT	Hindi vyakaran aur sampreshan CC-3(MIL): हिन्दी व्याकरण और सम्प्रेषण	HINDI	2-0-0	6
BHINCCLT 303	BHINCCLT	Hindi bhasha aur sampreshan CC-9(MIL) : हिन्दी भाषा और सम्प्रेषण	HINDI	2-0-0	6

AECC-MIL Course Code (**)	Course Title	Offered By Department	(L-P-Tu)	Credit
BAECCLT	EnglishCommunication	ENGLISH	2-0-0	2
BAECCLBT	BANGLA BHASAR BHASIK SANGJOG বাংলা ভাষার ভাষিক যোগ সংযোগ	BENGALI	2-0-0	2
BAECCLHT	Hindi bhasa aur sampreshan AECC (MIL) : हिन्दी भाषा और सम्प्रेषण	HINDI	2-0-0	2

Non-Chordates I: Protists to Pseudocoelomates

Unit 1: Basics of Animal Classification:

1. Definitions: Classification, Systematics and Taxonomy; Taxonomic Hierarchy, Taxonomic types
2. Codes of Zoological Nomenclature; Principle of priority; Synonymy and Homonymy; Six kingdom concept of classification (Carl Woese)

Unit 2: Protista and Metazoa

1. Protozoa:
 1. General characteristics and Classification up to phylum (according to Levine et. al., 1981) Locomotion in *Euglena*, *Paramecium* and *Amoeba*; Conjugation in *Paramecium*.
 2. Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica*
2. Metazoa:
 1. Evolution of symmetry and segmentation of Metazoa

Unit 3: Porifera

General characteristics and Classification up to classes; Canal system and spicules in sponges

Unit 4: Cnidaria

1. General characteristics and Classification up to classes
2. Metagenesis in *Obelia*
3. Polymorphism in Cnidaria
4. Corals and coral reef diversity, function & conservation

Unit 5: Ctenophora

General characteristics

Unit 6: Platyhelminthes

1. General characteristics and Classification up to classes
2. Life cycle and pathogenicity and control measures of *Fasciola hepatica* and *Taenia solium*

Unit 7: Nematoda

1. General characteristics and Classification up to classes
2. Life cycle, and pathogenicity and control measures of *Ascaris lumbricoides* and *Wuchereria bancrofti*
3. Parasitic adaptations in helminthes
4. Classification for metazoans to be followed from: Rupert and Barnes, 1994, 6th Edition.

List of Practical:

Identification of *Amoeba*, *Euglena*, *Entamoeba*, *Opalina*, *Paramecium*, *Plasmodium vivax* and *Plasmodium falciparum* (from the prepared slides)

1. Identification of *Sycon*, Neptune's Cup, *Obelia*, *Physalia*, *Millepora*, *Aurelia*, *Tubipora*, *Corallium*, *Alcyonium*, *Gorgonia*, *Metridium*, *Pennatulula*, *Fungia*, *Meandrina*, *Madrepora*
2. Identification and significance of adult *Fasciola hepatica*, *Taenia solium* and *Ascaris lumbricoides*
3. Staining/mounting of any protozoa/helminth from gut of cockroach

Title: Non-Chordates II: Coelomates

Syllabus: Unit 1: Introduction:

Evolution of coelom and metamerism

Unit 2: Annelida

General characteristics and Classification up to classes Excretion in Annelida through nephridia. Metamerism in Annelida.

Unit 3: Arthropoda

1. General characteristics and Classification up to classes. Vision in Insecta.
2. Respiration in Arthropoda (Gills in prawn and trachea in cockroach)
3. Metamorphosis in Lepidopteran Insects.
4. Social life in termite

Unit 4: Onychophora

General characteristics and Evolutionary significance

Unit 5: Mollusca

1. General characteristics and Classification up to classes
2. Nervous system and torsion in Gastropoda
3. Feeding and respiration in *Pila* sp

Unit 6: Echinodermata

1. General characteristics and Classification up to classes
2. Water-vascular system in Asterozoa
3. Larval forms in Echinodermata
4. Affinities with Chordates

Unit 7: Hemichordata

General characteristics of phylum Hemichordata. Relationship with non-chordates and chordates
Note: Classification to be followed from Rupert and Barnes, 1994, 6th Edition

List of Practical:

Study of following specimens:

1. **Annelids** - *Aphrodite*, *Nereis*, *Heteronereis*, *Sabella*, *Serpula*, *Chaetopterus*, *Pheretima*, *Hirudinaria*
2. **Arthropods** - *Limulus*, *Palaemon*, *Daphnia*, *Balanus*, *Sacculina*, *Cancer*, *Eupagurus*, *Scolopendra*, *Julus*, *Bombyx*, *Periplaneta*, termites and honey bees *Onychophora* – *Peripatus*
3. **Molluscs** - *Chiton*, *Dentalium*, *Pila*, *Doris*, *Helix*, *Unio*, *Ostrea*, *Pinctada*, *Sepia*, *Octopus*, *Nautilus*
4. **Echinoderms** - *Pentaceros/Asterias*, *Ophiura*, *Clypeaster*, *Echinus*, *Cucumaria* and *Antedon*

1. Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm
2. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm
3. Mount of mouth parts and dissection of digestive system and nervous system of *Periplaneta**

1. To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm)

Diversity of Chordata

Unit 1: Introduction to Chordates:

General characteristics and outline classification of Phylum Chordata

Unit 2: Protochordata

General characteristics and classification of sub-phylum Urochordata and Cephalochordata up to Classes. Retrogressive metamorphosis in *Ascidia*. Chordate Features and Feeding in *Branchiostoma*

Unit 3: Origin of Chordata

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

Unit 4: Agnatha

General characteristics and classification of cyclostomes up to order

Unit 5: Pisces

1. General characteristics and classification of Chondrichthyes and Osteichthyes up to Subclasses
2. Accessory respiratory organ, migration and parental care in fishes
3. Swim bladder in fishes. Classification up to Sub-Classes

Unit 6: Amphibia

1. General characteristics and classification up to living Orders.
2. Metamorphosis and parental care in Amphibia

Unit 7: Reptilia

1. General characteristics and classification up to living Orders.
2. Poison apparatus and Biting mechanism in Snake

Unit 8: Aves

1. General characteristics and classification up to Sub-Classes
2. Exoskeleton and migration in Birds
3. Principles and aerodynamics of flight

Unit 9: Mammals

1. General characters and classification up to living orders
2. Affinities of Prototheria
3. Exoskeleton derivatives of mammals
4. Adaptive radiation in mammals with reference to locomotor appendages
5. Echolocation in Chiropterans and Cetaceans

Unit 10: Zoogeography

Zoogeographical realms, Plate tectonic and Continental drift theory, distribution of birds and mammals in different realms

Note: Classifications for Protochordata, Agnatha, Reptilia, Aves and Mammalia to be followed from Young (1981), for Pisces to be followed from Nelson (1994), for Amphibia to be followed from Duellman and Trueb (1986).

List of Practical

Protochordata: *Balanoglossus*, *Herdmania*, *Branchiostoma*

Agnatha: *Petromyzon*, *Myxine*

Fishes: *Scoliodon*, *Sphyrna*, *Pristis*, *Torpedo*, *Chimaera*, *Mystus*, *Heteropneustes*, *Labeo*, *Exocoetus*, *Echeneis*, *Anguilla*, *Hippocampus*, *Tetrodon/ Diodon*, *Anabas*, Flat fish

Amphibia: *Necturus*, *Bufo*, *Hyla*, *Alytes*, *Axolotl*, *Tylototriton*

Reptilia: *Chelone*, *Trionyx*, *Hemidactylus*, *Varanus*, *Uromastix*, *Chamaeleon*, *Ophiosaurus*, *Draco*, *Bungarus*, *Vipera*, *Naja*, *Hydrophis*, *Zamenis*, *Crocodylus*. Key for Identification of poisonous and non-poisonous snakes

1. Mammalia: Bat (Insectivorous and Frugivorous), *Funambulus*
2. Pecten from Fowl head
3. Dissection of brain and pituitary of Tilapia
4. Power point presentation on study of any two animals from two different classes by students (may be included if dissections not given permission)

Title: Aquarium Fish Keeping

Unit 1: Introduction to Aquarium Fish Keeping

The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes

Unit 2: Biology of Aquarium Fishes

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 and Butterfly fish

Unit 3: Food and feeding of Aquarium fishes

Use of live fish feed organisms. Preparation and composition of formulated fish feeds, Aquarium fish as larval predator

Unit 4: Fish Transportation

Live fish transport - Fish handling, packing and forwarding techniques.

Unit 5: Maintenance of Aquarium

General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry

Title: Comparative Anatomy of Vertebrates

Unit 1: Integumentary System

Structure, function and derivatives of integument in amphibian, birds and mammals

Unit 2: Skeletal System

Overview of axial and appendicular skeleton; Jaw suspension; Visceral arches.

Unit 3: Digestive System

Comparative anatomy of stomach; dentition in mammals

Unit 4: Respiratory System

Respiratory organs in fish, amphibian, birds and mammals

Unit 5: Circulatory System

General plan of circulation, Comparative account of heart and aortic arches

Unit 6: Urinogenital System

Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri

Unit 7: Nervous System

Comparative account of brain, Cranial nerves in mammals

Unit 8: Sense Organs

1. Classification of receptors, Brief account of auditory receptors in vertebrate
2. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
3. Study of disarticulated skeleton of Toad, Pigeon and Guineapig
4. Demonstration of Carapace and plastron of turtle
5. Identification of mammalian skulls: One herbivorous (Guineapig) and one carnivorous (Dog) animal
6. Dissection of Tilapia: Digestive system, Brain, Pituitary, Urinogenital system

List of Practical

Title: Sericulture

Unit 1: Introduction

1. Sericulture: Definition, history and present status; Silk route
2. Types of silkworms, Distribution and Races
3. Exotic and indigenous races
4. Mulberry and non-mulberry Sericulture

Unit 2: Biology of Silkworm

1. Life cycle of *Bombyx mori*
2. Structure of silk gland and secretion of silk

Unit 3: Rearing of Silkworms

1. Selection of mulberry variety and establishment of mulberry garden
2. Rearing house and rearing appliances.
3. Disinfectants: Formalin, bleaching powder, RKO
4. Silkworm rearing technology: Early age and Late age rearing
5. Types of mountages
6. Spinning, harvesting and storage of cocoons

Unit 4: Pests and Diseases

1. Pests of silkworm: Uzi fly, dermestid beetles and vertebrates
2. Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial
3. Control and prevention of pests and diseases

Unit 5: Entrepreneurship in Sericulture

1. Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture
2. Visit to various sericulture centres.

Title: Medical Diagnostic Techniques

Unit 1: Introduction to Medical Diagnostics and its Importance

Unit 2: Diagnostics Methods Used for Analysis of Blood

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

Urine Analysis: Physical characteristics; Abnormal constituents

Unit 4: Non-infectious Diseases

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

Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis, Malarial parasite (Microscope based and ELISA based)

Unit 6: Clinical Biochemistry: LFT, Lipid profiling

Unit 7: Clinical Microbiology: Antibiotic Sensitivity Test

Unit 8: Tumours

Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs).

Title: Apiculture

Unit 1: Biology of Bees:

1. History, Classification and Biology of Honey Bees
2. Social Organization of Bee Colony

Unit 2: Rearing of Bees

1. Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth
2. Bee Pasturage
3. Selection of Bee Species for Apiculture
4. Bee Keeping Equipment
5. Methods of Extraction of Honey (Indigenous and Modern)

Unit 3: Diseases and Enemies

1. Bee Diseases and Enemies
2. Control and Preventive measures

Unit 4: Bee Economy

Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc

Unit 5: Entrepreneurship in Apiculture

Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens